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της Ευρωπαϊκής Ένωσης στην Κύπρο

Water Development Department

FINAL REPORT

REVISION OF THE DROUGHT MANAGEMENT PLAN

10 / 2016

"PROVISION OF CONSULTANCY SERVICES FOR THE DRAFTING OF THE 2ND RIVER BASIN MANAGEMENT PLAN OF CYPRUS FOR THE IMPLEMENTATION OF DIRECTIVE 2000/60/EC AND THE DRAFTING OF THE FLOOD RISK MANAGEMENT PLAN FOR THE IMPLEMENTATION OF DIRECTIVE 2007/60/EC"

WDD 10/2014

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ABBREVIATIONS

EC	European Commission
WWTP	Wastewater Treatment Plant
SWB	Surface Water Bodies
GD	Guidance Document
RB	River Basin
WFD	Water Framework Directive
RBD	River Basin District
GIS	Geographic Information System
MP	Management Plans
WDD	Water Development Department
GWB	Groundwater Body
EC	European Commission
EEA	European Environment Agency
RWR	Renewable Water Resources
SPI	Standardized Precipitation Index
TWA	Total Water Abstraction
WEI	Water Exploitation Index
WISE	Water Information System for Europe

1. NON-TECHNICAL SUMMARY

The objective of this Issue was to revise the Drought Management Plan of the 1st RBMP adopted by the Republic of Cyprus in 2011. Several of the conclusions and analyses of the 1st Drought Management Plan have been transferred verbatim to this 2nd Drought Management Plan as it was not considered appropriate to change them. Where possible, the text indicates the source of the items listed in the revised Management Plan as the 1st RBMP. The revision concerned the following:

1. Processing and Review of the Drought Indices and Prolonged Drought Indices per Hydrologic Region of Cyprus that leads to the Exception process under Article 6.4 of the WFD.
2. Overview of historical periods during which the impact of drought in the hydrological regions did not allow the achievement of the environmental objectives of Article 4 of the WFD and identification and recording of bodies of water for which it may not be possible to achieve the objectives set.
3. Overview, processing and revision of the Drought Management Plans for specific areas of Cyprus that are directly associated with large and organised water works.
4. Determination of the Water Scarcity Index in Cyprus, as represented by the Water Exploitation Index (WEI+), not only for Cyprus overall, but also per Hydrologic Region and per river basin. In general, it is shown that Cyprus exerts strong pressure on renewable water resources while there are two hydrologic regions in which there is no considerable pressure on water resources.
5. Determination of the vulnerability of Cyprus to drought and water scarcity, taking account of social, economic and environmental factors. The analysis of vulnerability is broken down into water supply, irrigation and the environment.

Summarising the results of this issue:

Drought Indices:

Regarding the Drought Indices, the items described in the 1st RBMP were maintained, as the indices were considered sufficient. A system of six indicators was developed:

- The **Precipitation Index SPI-12** is the main tool for the diagnosis and monitoring of drought intensity.
- The **Hydrologic Year Runoff Index** for the runoff of one or more hydrological years allows the control of the conclusions of the SPI index.
- The dam **Storage Index** for the Southern Conveyor and Paphos projects has a direct management significance, since it is related to the abstractions policy.
- The **Wet Period Runoff Index** contributes to the early detection of drought.

- The **Monthly Regime Index** of average daily flow of rivers is only used during drought and contributes to the early detection of increased pressures on the riverine ecosystems.

For the detection of increased pressures on the groundwater bodies, the index proposed depends on the monitoring of the level in selected locations per water body, and the comparison of change between decision making dates (usually in January). Given that the groundwater bodies must recover quantitatively and qualitatively, any indication of reversal of the recovery trend (level reduction or/and quality aggravation) should be detected promptly and immediate action should follow regarding the volumes to be pumped. This practice must be revised once the groundwater bodies recover.

These indexes, included in the operational program on drought management, are connected to each other on the basis of specific trigger levels and through specific numerical values of the corresponding parameters. Therefore, based on the Drought Management Plan, when the level of preparedness reaches a certain level, the corresponding process is activated as foreseen in the action plan.

Prolonged Drought Indices:

In reference to the provisions of the Framework Directive 2000/60, “prolonged drought” was defined as an event so infrequent and with such a magnitude that it is not possible to retain all measures for protection of water bodies, as these are prescribed in the Management Plan.

Thus, the classification of a drought period as “prolonged”, leading to the application of Paragraph 4 of Article 6 of Directive 2000/60 on temporary degradation of water bodies, arises from the application of three meteorological and hydrological indicators, namely:

- The **SPI - 12 index** and more specifically the drought magnitude e that is the outcome of the intensity and the duration of the drought (see Paragraph 6.2.1).
- The **Hydrologic Year Runoff Index** (see Paragraph 6.2.2).
- The **Water Bodies Downgrading Index** (see 6.3.6).

The first two indices in parallel are used for the determination and the announcement of the Prolonged Drought in each of the Hydrologic Regions of Cyprus and the alert state of the infrastructure needed for the measurement of the mean daily discharges for each hydrometric station that is designated the evaluation of the Monthly Runoff Index. If this happens, then the measurement infrastructure should be set in high alert so that if the median value of the mean daily discharges of the specified month is less that the 5% of the whole set of daily discharges of the timeseries for the station, and the Exemption for the temporary downgrading of Article 4.6 is declared.

In the context of the Prolonged Drought, for each hydrometric station that is designated for the control of the Monthly Runoff Index (or Index of Degradation Riverine Ecosystem), the periods of the stress in river systems designated as HIGH were determined. Accordingly, the monitoring and characterization system for water bodies in the context of Directive 2000/06 was suggested to be used for diagnosing the downgrading of water bodies.

Review of the Application of the 1st Drought Management Plan for the South Conveyor Project:

From the data analysis that took place it was proven that during the year with Exceptional Drought (2013-14) at the area of the South Conveyor, there was a temporal deviation and not application of the Management Plan for the following reasons:

1. The high level of storage during the previous year. On 1st April of the year 2013, the storage was equal to approximately 142 hm^3, a value very close to the total storage of the dams of the Southern Conveyor.
2. The desalination operation was not as expected (according to the 1st Drought Plan) because due to the cost of the desalination and to the Economic Program of the Republic of Cyprus it was not possible for the desalination plants to operate at their maximum potential. Therefore, as desalinations did not provide the expected results (based on the 1st RBMP) abstractions from the dams were much greater than those specified.

In summary, the proposals for drought management in the South Conveyor project are:

1. Faithful implementation of the annual programme of abstraction of water from Southern Conveyor dams combined with the volume of desalination even when the economic conditions do not allow for the full operation of desalination under the terms of the 1st RBMP. It was not considered necessary to change the abstraction program in relation to the storage of the 1st RBMP, so this is an integral part of this 2nd Drought Management Plan. With the full operation of the desalination, almost complete coverage of the needs in water is provided.
2. The abstraction programme of the 1st RBMP shall be followed both in times of drought and (if possible) in normal conditions or in high aquifer conditions as abstraction, as abstraction management allows storage of sufficient volume in the reservoirs to face the periods of droughts that are bound to occur in the future.
3. Increased participation of recycled water in irrigation is required as well as increased water storage, because there is no coincidence in time with respect to the periods calling for a maximisation of irrigation consumption. The study of the Tersefanou dam as regards the storage of the outflows from the Wastewater Treatment Plant (WWTP) of Larnaca is a very important step in this direction following the recycled water quantities of the WWTP of Limassol stored in the Polemidia reservoir. Moreover, underground aquifers should be found to receive volumes of recycled water to be used for irrigation at a later time (the aquifer in the area of Akrotiri could be used for this purpose). Increasing the use of recycled water for irrigation will accordingly reduce abstractions from underground aquifers in the area of the Southern Conveyor, which, in this region, are in poor condition in quantitative and qualitative terms.

Review of the Application of the 1st Drought Management Plan for the Paphos Project and Proposal of Measures:

During the dry hydrological year 2013-14, annual abstractions from the Paphos Project dams were similar to those given in the 1st RBMP and the system is classified as “sufficient”. Thus, it seams that although there were zero abstractions from the desalination of Paphos, abstractions from the dams faithfully followed the 1st Drought Management Plan. In general, it appears that the full operation of the desalination plant and the recycled water system fully covers (or marginally does not cover) demand for water supply, even in times of drought, while shortages in irrigation are due only to the insufficiency of the three reservoirs, while the needs of permanent crops are covered using recycled water.

The Abstractions Programme was modified for the Paphos Project dams, given the storage on the 1st April, due to the fact that, once constructed, the Paphos desalination plant shall have a reduced capacity (nominal capacity of 15,000 m^3/d instead of 30,000 m^3/d with respect to the references in the 1st RBMP).

Review of the Application of the 1st Drought Management Plan for the Chrysochou Project and Proposal of Measures:

In the wider Chrysochou area, the overall balance is positive but there is a significant contribution of abstractions from the water bodies of Chrysochou and Androlikou. Abstractions from the Chrysochou Project during the drought period are very close to normal values, therefore the impact of drought in the Chrysochou area is small.

The analysis conducted leads to the following conclusions:

1. In wet hydrological years, the quantity of water stored in the Evretou dam should be maximised, as the storage capacity of the project is now large and therefore the storage of larger quantities of water in the Evretou dam creates security reserves for impending periods of drought.
2. Given the proximity to the groundwater bodies of **Androlikou (CY_14)** and **Letymbou-Giolou (CY_12),** the possibility of covering part of the water supply needs using these groundwater bodies could be explored. Moreover, a significant reserve can be secured from the **Lefkara-Pachna GWB (CY_18)** located in the western margin of the study area, where significant spring flows from Kefalovriso is observed. An investigation is however required both as regards the quality status of the water sources and a cost - benefit analysis for the construction of a pipeline to the urban centres of the region.
3. Due to increased consumption of water, the use of recycled water for irrigation should be investigated, as farmland generally coincides with urban or tourist areas.

Review of the Application of the 1st Drought Management Plan for the Troodos area and Proposal of Measures:

Demand is met by spring flows, using wells and water reservoir projects (Projects of Pitsilia, Xyliatos). Most springs are used for water supply, while some are also used for irrigation. Water wells in the WDD database surpass the figure of 380 and are located mainly in the east. In any case, irrigation is several times larger than water supply, by one order of magnitude. It is therefore understood that in case of drought, it is sufficient to restrict irrigation to cover water supply demand, provided that the quality of water permits such a use.

Review of the Application of the 1st Drought Management Plan for the Pissouri area and Proposal of Measures:

Demand in the water supply of Pissouri area is projected to be fully covered by the recharge dam of Souskiou in the bed of Dhiarizos river, once and if it is built. Irrigation demand shall be covered by the boreholes in the Cha-potami riverbed, as it has bee done up to now.

Review of the Application of the 1st Drought Management Plan for the Western Mesaoria area and Proposal of Measures:

By the end of 2015, the WDD Planning Service shall have completed the feasibility study of the Vassilikos Conveyor to supply Nicosia with desalinated water (from Vassilikos desalination), to ensure water supply from an alternative source to the Tersefanou conveyor, while also supplying 28 Communities in Western Mesaoria, thereby ensuring the provision of adequate and good quality water to these communities that only used boreholes with qualitative and quantitative issues for water supply until now. As regards irrigation, because the study of groundwater body CY_17 has shown it to be one of the most problematic areas to date, it is considered that the use of underground sources should be limited, by restructuring crops.

Water Scarcity Index:

The Water Exploitation Index (WEI), including its amendment WEI+, is used by the European Environment Agency to provide an overview of water scarcity at the European level and has been defined by the European Union as the main water scarcity index within the WFD. It is defined as the ratio (%) of the total annual water abstraction with respect to the average interannual availability of water resources. The WEI+ index refers only to fresh water reserves and the pressures on the annual renewable reserves and does not include other quantities of water involved in the water balance outside of the hydrological cycle, i.e. it does not include neither desalinations nor, or course, recycled water, which emerges from desalination through the treatment of urban wastewater.

The WEI+ Index presents the pressure on water resources for Hydrologic Regions under the control of the Republic of Cyprus. The total WEI+ index is equal to 73.1%, leading to the familiar conclusion that Cyprus's water resources are under significant pressure, even with a lenient 60% limit. The highest values of WEI+ appear in Hydrologic Regions 6, 7 and 9 (Nicosia, Kokkinohoria and Limassol areas) and they even above 100%, meaning that the permanent reserves are being pumped. It is known that in the Kokkinohoria region, permanent reserves are being pumped, although the region significantly draws its water from the Southern Conveyor project. The lowest values appear in Regions 2 & 3, where, except from the Evretou dam (Region 2), there is no other significant water reservoir and water exploitation project.

Vulnerability Assessment:

The vulnerability of water resources in drought and water scarcity was approached based on a methodology that calculates vulnerability MOD per water use. These uses are (a) water supply that includes tourism and stock farming, (b) irrigation that includes stock farming and (c) the environment.

Finally, vulnerability per water use in cases of drought and water scarcity is calculated, by connecting the use with four factors in total: (a) vulnerability of the water resource in drought, (b) the priority of the use (water supply, environment and irrigation), (c) the amount of water required to meet the needs (water supply in urban areas, irrigation in major irrigated surfaces) and (d) water supply projects. For example, areas that are supplied by the larger system of the Southern Conveyor comprising desalination will have much less vulnerability with respect to an area irrigated by a surface water source (e.g a dam), as during periods of prolonged drought it is very likely (statistically certain) that seasonal plantations will not be irrigated.

Vulnerability ratings are assigned based on the above methodology: VERY LOW, LOW, MEDIUM, HIGH and VERY HIGH; they are represented on a map using the polygons of the administrative boundaries of the Municipalities and Communities of Cyprus with regard to water supply as basic shape file geographic information. In irrigation, the above shape file is compared to the file with the GWP surfaces that are supplied with water, as it is highly likely that within the administrative boundaries of the settlement there is a portion thereof supplied with water from a GWP and another portion irrigated thanks to boreholes.

To assess the vulnerability to drought and water scarcity with respect to the environment, we used the percentage of HS located within the network of Natura Protected Areas that are significantly correlated with the availability of water resources, as these areas are biodiversity cores, in which, during such conditions, biodiversity is threatened and vulnerability increases. The definition of vulnerability is performed per river basin, by recording the length of the hydrographic network within the Natura protected areas and related to water.

Based on the above methodology, vulnerability is reported in water, supply, irrigation and the environment and it is presented on the map based on vulnerability classes in the relevant colour palette.

2. EXECUTIVE SUMMARY

The objectives of the herein 2nd Drought Management Plan is the revision of the 1st one that was approved by the Republic of Cyprus in 2011. A certain number of the analyses and outcomes of the 1st Drought Management Plan are accepted and incorporated as used in this management plan. In this text, when feasible, wherever possible the source of information of the 1sr Drought Management Plan is stated. The revision of the Drought Management Plan is referred to the following:

1. Analyses and Review of the Drought Indices and the Prolonged Drought Indices for every Hydrologic Region that leads to the process of the Exemption of the Article 4.6 of the WFD.
2. Review of the historical periods for every Hydrologic Region where the impact of the drought phenomena was against the satisfaction of the environmental targets of the Article 4 of WFD and the determination and record of the hydrologic systems that will not suffice the determinated targets.
3. Review, analyses and revision of the Drought Management Plans that are referring to the Governmental Hydraulic Systems (such as the South Conveyor Project and the Paphos Project).
4. Determination of the Water Scarcity Index for the Republic of Cyprus as resembled by the Water Exploitation Index (WEI+), not only for the whole of Cyprus under control of the Republic of Cyprus, but also for every Hydrologic Region and for every main subcatchment. In general, it is estimated that in Cyprus there is a significant stress on the sustainable water resources but in two Hydrologic Regions (Regions 2 and 3) there is only stress (not significant) on the water resources.
5. Determination of the vulnerability on drought and water scarcity taking under consideration social, economic and environmental factors. The vulnerability analysis is subject to the water supply, irrigation and the environment.

Summarizing the herein Drought Management Plan as follows:

Drought Indices:

Concerning the Drought Indices we preserve the mentioned of the 1st WRMP, as the referring indices were evaluated as effective and sufficient. A system with 6 indices were developed:

- The **Meteorological Index Standardized Precipitation Index (SPI -12)** that is used as a standard tool fot the diagnosis and monitoring of the drought intensity.
- The **Hydrologic Year Runoff Index** for the runoff from 1 to 5 hydrologic years. It is used for the control and evaluation of the outcome of the SPI index.
- The **Storage Index** of the reservoirs of the SCP project and the Paphos Project that has and immediate management significance because is it dependent on the abstraction policy.

- The **Wet Period Runoff Index** during the wet period and it is dedicated as an alert system for the drought designation.
- The **Monthly Runoff Index** of the mean daily discharge is used only during drought periods and is used to evaluate environmental increased stress in riverine systems.
- For the diagnosis of the increased stress on groundwater systems a simple index for the level monitoring of designated points for every water body, the period of decision making (usually during January) regarding the allocation to different uses. Because the groundwater bodies have to be recovered both in quantity and quality, every sign of stop of the recovery phase (level drawdown or quality degradation), should be checked on time and an immediate response regarding the abstracted volumes.

The above described indices are the internal part of the Operational Drought Mitigation Procedure, which are interdependent according to certain levels of application and then the accordingly operation procedure is activated. Therefore, according to the Drought Management Plan, when a certain readiness level is reached then the activation of the relative process is taking place according to the table of relative actions.

Prolonged Drought Indices:

In accordance with the obligation of the WFD the Prolonged Drought as a natural event that is too rare that leads to the application of the Paragraph 4 of Article 6 of the WFD for the temporary degradation of the water bodies is referring to the application of three meteorological and hydrological indices, that are the following:

- **SPI-12** Index and more specifically the drought magnitude that is the outcome of the intensity and the duration of the drought (Paragraph 6.2.1.)
- The **Hydrologic Year Runoff Index (ARI).**
- The **Monthly Runoff Index (MRI)** that is designated as the Index of Ecosystems Degradation.

The first two indices in parallel are used for the determination and the announcement of the Prolonged Drought in each of the Hydrologic Regions of Cyprus and the alert state of the processes and infrastructure that are needed for the measurement of the mean daily discharges for each hydrometric station that is designated the evaluation of the Monthly Runoff Index. If this happens, then the measurement infrastructure should be set in high alert so that if the median value of the mean daily discharges of the specified month is less that the 5% of the whole set of daily discharges of the timeseries for the specified month, then the Exemption for the temporary degradation is declared.

In the context of the Prolonged Drought it was determined in each measurement station that is designated for the control of the Monthly Runoff Index (or Index of Degradation Riverine Ecosystem) the periods of the stress in river systems is designated as HIGH. Accrodingly a monitoring system for the characterization of water bodies in the WFD context is prepared.

Review of the Application of the 1st Drought Management Plan for the SCP:

From the data analyses that took place it was proved that during the hydrologic year (2013-14) with Exemptional Drought at the area of the SCP there was a temporal deviation and not application of the 1st Drought Management Plan for the following reasons:

1. The high level of storage during the previous hydrologic year. In 1st of April 2013 the storage is equal to 124 hm^3, value that is very close to the total storativity of the SCP reservoirs.
2. The desalination operation was deviated the designated value according to the 1st Drought Management Plan because of the fiscal cost of the desalination and the Economic Program of the Republic of Cyprus it was not possible for the desalination plants to operate according to the maximum degree.

Synoptically, the proposals relative to the drought management at the area of the SCP are the following:

1. Strict application of the annual abstraction program for the SCP dams in conjunction with the desalination volumes even if fiscal conditions do not allow the complete operation of the desalination plants according to the Drought Management Plan. With the complete operation of the desalination plants it is feasible that the whole of the water supply demand will be met by desalination.
2. The abstraction program of the Drought Management Plan must be kept not only during drought periods but also during normal or even wet periods where abstraction management allows for the preservation of a least storage volume in the reservoirs of the SCP and Paphos Project accordingly, for the management of future prolonged droughts that will be very likely to be experienced in the future.
3. The increase of the percentage of the participation of the recycled water in irrigation supply is needed in combination with the increase of the storage of the recycled water because generally there is time lapse between recycled water production and irrigation application. The design study of the Tersefanou Dam for the storage of the Larnaka WWTP recycled water along with some other storage facilities elsewhere. Accordingly, the excess effluents from Lemessos WWTP are stored in Polemidia Reservoir. Moreover, groundwater aquifers that will be subjected to recharge of the WWTP effluents should be carefully examined and determined so as to be used later for irrigation (Akrotiri aquifer is seems to be feasible to be used for such a purpose). The increase of the recycled water consumption will accordingly decrease groundwater abstractions from the SCP area aquifers that are in not good status in terms of water quantity.

Review of the Application of the 1st Drought Management Plan for the Paphos Project and Proposed Program of Measures:

During the dry hydrologic year 2013-14 the annual abstractions from the Paphos project dams are in accordance with the corresponding obligation according to the 1st Management Plan and the system is characterized as "sufficient". Therefore, it seems that even if the desalination volumes are zero the abstraction form Paphos Dams are according the 1st WRMP. Generally, with the assumption of the full operation of the Paphos desalination plant and the recycled water the water supply demand will completely satisfied even during drought periods and the deficits in irrigation are due to the dams' failure and a big proportion of permanent plantations are covered by the recycled water.

For the Paphos project, there was e revision of the Abstraction Program with respect on the storage on the 1st of April because the Paphos Desalination Plant (whenever it is going to be constructed and operated) will have less capacity than initially planned (nominal capacity of 15 000 m^3/d in contrast to 30 000 m^3/d according to initial plans.

Review of the Application of the 1st Drought Management Plan for the Chrysochous Project

In the wider Chrysochous area the water budget seems to be positive, but there is a significant contribution from the nearby groundwater systems of Chrysochous and Androlikou. The abstraction rates from the Chrysochous area dams during drought periods are very near to the normal values, therefore the effects of drought in the Chrysochous area is small.

From the analysis that had taken place the following conclusions can be made:

1. During wet periods the maximization of the storage of Evretou Dam must be attempted because the storage capacity of the reservoir is very significant and therefore excess storage in Evretou reservoir can act as a strategic storage in front od possible forthcoming dry periods.
2. Because of the proximity of the groundwater systems Androlikou (CY_14) and Letymbou-Yiolou (CY_12) the possibility of the abstraction certain water volumes for the full coverage of the water supply needs during drought periods. Additionally, a strategic groundwater storage can be reached for the groundwater system Lefkara-Pachna (CY_18) that is situated on the western margin of the area where the Kephalobrysso Spring is situated.
3. Because of the increased water consumption in water supply and tourism the possibility of the use of recycled waster from the Polis WWTP (whenever is going to be constructed) should be explored.

Review of the Application of the 1st Drought Management Plan for the Troodos area

The demand coverage is met by springs, wells and a number of storage works (Pitsilia Project, Xyliatos Project). The majority of the springs is used to water supply and some of them in irrigation. The water supply wells according to recorded data are more than 380 and are situated mainly on the eastern part. In every case, irrigation is more than an order of magnitude than water supply. It is easily understood that during a drought period the water supply demand is going to be fully covered as long as minor decrease in irrigation abstractions is going to be made.

Review of the Application of the 1st Drought Management Plan for the Pissouri area

The water supply demand of the Pissouri area is going to be covered by the construction of Souskious groundwater recharge dam at Diarizos R., whenever this is going to be constructed. The irrigation demand is going to be met as nowadays from groundwater pumping at Cha-Potami area.

Review of the Application of the 1st Drought Management Plan for the Western Messaoria area

Until the end of the year 2015 the design study regarding the effectiveness of the Vassilikos Pipe of the Planning Section of the WDD is going to completed. This pipe will convey desalination water for the coverage of water supply for the 28 communities of the Western Messaoria Region. This pipe will ensure provision of clean water of good water in terms of quality and quantity at the area where nowadays is abstracting water from the groundwater aquifer which has a lot of problems. As long as the irrigation is concerned, because the groundwater system CY_17 is one of the most problematic areas in Cyprus regarding water abstractions.

Water Scarcity Index:

The Water Exploitation Index (WEI) along with its modification (WEI+) is used by the European Environment Agency for the water scarcity review and assessment in the WFD context. It is determined as the total water abstraction divided by the mean annual renewable availability of water resources. The WEI+ index is only referred to freshwater sources and the pressures that applied to the renewable water resources. In this context, the WEI+ index does not incorporate desalination volumes and the use of recycled water that is produced by the use of desalination water volumes.

From the application of the WEI+ index in Cyprus pressures applied to the renewable water resources for the Hydrologic Regions that are under fill control of the Cyprus' Government. The total WEI+ value is equal to 73.1% that leads to the easily understood statement that the pressure regime to the Cyprus' water resources is characterized as "significant", even with the more relaxed threshold value of 60%. The highest WEI+ values are experienced in the Hydrologic Regions 6, 7 and 9 (Nicosia, Kokkinochoria and Lemessos Areas) where WEI+ are more than 100%, that means that even permanent groundwater sources are abstracted. It is well known that in Kokkinochoria Region there is a overpumping of the renewable groundwater sources even though that the area is generally irrigated by the SCP project. The least values are computed in Hyrologic Regions 2 and 3, where, except of Evretou Dam, there is no major project for water exploitation.

Vulnerability Assessment:

An attempt to assess water resources vulnerability against drought and water scarcity is made according to a methodology that determines vulnerability according to different water uses (i.e. water supply, irrigation, environment). The final outcome is the vulnerability to drought and water scarcity combining four different parameters: (a) vulnerability of the water source, (b) priority of the water use, (c) the magnitude of the water volumes to suffice the demands, and (d) water exploitation projects. For instance, the area that their water supply demands are originated from the wider SCP system that incorporates desalination water should have much less vulnerability from a corresponding irrigation area that is abstracting water from a surface water source (e.g. dam) because in case of prolonged drought it is very possible (practically certain) that the temporary plantations are not going to be sufficed with irrigation water.

According to the mentioned methodology, five different classes of vulnerability are ascribed to every area with different water usage: VERY MINOR, MINOR, MODERATE, SIGNIFICANT, VERY SIGNIFICANT and are mapped by different colours. The basic mapping information is the shape file of the administrative areas of Municipalities/Communities of Cyprus and the shape file with the polygons of the areas of the Governmental Water Supply and Irrigation Projects. Specifically, regarding irrigation there is an intersection between the previous shape file, as it is possible areas that belong to an administrative area to be simultaneously irrigated (in different parts) from a governmental project or groundwater pumping outside of the main irrigation project.

Regarding vulnerability in respect to the environment the percentage of the NATURA areas that are dependent on water resources availability, because during drought and in water scarcity situations the biodiversity of the Natura region is threatened. The ascription of certain vulnerability characterization is made for each main catchment by measuring the total length of the stream network or lake area that are inside the Natura area that is dependent to the availability of water resources.

According to the above mentioned methodology, three different vulnerability maps are produced, one for each water use.

3. INTRODUCTION

3.1 PURPOSE AND INDIVIDUAL OBJECTIVES OF THE STUDY

The contract for the project “Provision of Consultancy Services for the Drafting of the 2nd River Basin Management Plan of Cyprus for the Implementation of Directive 2000/60/EC and the Drafting of the Flood Risk Management Plan for the Implementation of Directive 2007/60/EC” was awarded by the Water Development Department (WDD) of the Ministry of Agriculture, Natural Resources and Environment following the open tender WDD 10/2014 to our Joint venture LDK Consultants Engineers & Planners S.A. and ECOS Consulting S.A. and was signed on 18.5.2015 in Cyprus.

The above contract is accompanied by:
- the General Conditions
- the Special Conditions, and
- the Terms of Reference (specifications).

The subject of the contract relates to:

1. The preparation of the 2nd River Basin Management Plan of Cyprus, taking particular account of:
   - the institutional framework of the EC,
   - the relevant guidance documents of the EC and state-of-the-art expertise,
   - the 1st Management Plan of 2011,
   - the comments of the EC on this, and the agreed Action Plan,
   - individual studies that have since been commissioned by the WDD and
   - the available relevant information collected by the Service,

   the required Programme of Measures and the related Strategic Environmental Assessment Study (SEAS).

2. The revision of the Drought and Water Scarcity Management Plan of Cyprus, taking particular account of:
   - the relevant guidance documents of the EC and state-of-the-art expertise
   - the Drought Management Plan accompanying the 1st River Basin Management Plan of 2011
   - the Amended Drought Management Plan of 2013, and
   - the available relevant information collected by the Service.

3. The preparation of the 1st Flood Risk Management Plan of Cyprus, taking particular account of:
   - the institutional framework of the EC
   - the relevant guidance documents of the EC and state-of-the-art expertise, and
   - individual studies that have since been commissioned by the WDD and
   - the available relevant information collected by the Service

   the required Programme of Measures and the related SEAS.

Both the Programme of Measures and the related SEAS will finally be compiled as a single text for the River Basin and Flood Risk Management Plan.

3.2 OBJECT AND PURPOSE OF THIS DELIVERABLE

The objective of this Issue was to revise the Drought Management Plan of the 1st RBMP adopted by the Republic of Cyprus in 2011. Several of the conclusions and analyses of the 1st Drought Management Plan have been transferred verbatim to this 2nd Drought Management Plan as it was not considered appropriate to change them. Where possible, the text indicates the source of the items listed in the revised Management Plan as the 1st RBMP. The revision concerned the following:

1. Processing and Review of the Drought Indices and Prolonged Drought Indices per Hydrologic Region of Cyprus that leads to the Exception process under Article 6.4 of the WFD.
2. Overview of historical periods during which the impact of drought and water scarcity in the hydrologic regions did not allow the achievement of the environmental objectives of Article 4 of the WFD and identification and recording of bodies of water for which it may not be possible to achieve the objectives set.
3. Overview, processing and revision of the Drought Management Plans for specific areas of Cyprus that are directly associated with large and organised water works.
4. Determination of the Water Scarcity Index in Cyprus, as represented by the Water Exploitation Index (WEI+), not only for Cyprus overall, but also per Hydrologic Region and per river basin. In general, it is shown that Cyprus exerts strong pressure on renewable water resources while there are two hydrologic regions in which there is no considerable pressure on water resources.
5. Determination of the vulnerability of Cyprus to drought and water scarcity, taking account of social, economic and environmental factors. The analysis of vulnerability is broken down into water supply, irrigation and the environment.

3.3 SUPERVISING COMMITTEE

The contract is monitored by a Steering Committee composed of the following members:

- Nicos Neokleous, Deputy Chief Water Officer, WDD, Chairman
- Panagiota Hadjigeorgiou, Senior Executive Engineer, WDD, Coordinator
- Gerald Dörflinger, Hydrologist, Hydrometry Service, WDD
- Kostas Aristeidou, Hydrologist, Hydrology and Hydrogeology Service, WDD
- Maria Filippou, Executive Engineer, EU Service, WDD
- Riana Daniel Makridi, Executive Engineer, Planning Service, WDD

- Christos Christofi, 1st Class Geological Officer, Geological Survey Department
- Giorgos Nikolaou, Agriculture Officer, Agriculture Department
- Neoklis Antoniou, Environmental Officer, Environmental Department
- Marilena Aplikioti, Fisheries and Marine Research Officer, Department of Fisheries and Marine Research
- Andreas Chatzipakkos, Assistant District Officer of Nicosia
- Stavros Giavris, Civil Engineer, Ministry of Interior.

3.4 PREVIOUS STUDIES, GUIDANCE DOCUMENTS AND RELATED RESEARCH PROJECTS

The following were taken into account:

1. From the 1st RBMP, Annex VII: Water Policy and Annex VIII: Drought Management Plan and the amended Drought Management Plan of the WDD of August 2013.
2. Proposal for the "Plan for the Adjustment of Cyprus to Climate Change", which was co-financed by the European Union (LIFE+) and by national resources and is a Deliverable of Action 5 of the programme CYPADAPT (LIFE10ENV/CY/000723), titled "Development of a national strategy for adaptation to adverse impacts of climate change in Cyprus".
3. DROUGHT MANAGEMENT PLAN REPORT, Technical Report - 2008 - 023, Including Agricultural, Drought Indicators and Climate Change Aspects, Water Scarcity and Droughts Expert Network, European Commission
4. COMMON IMPLEMENTATION STRATEGY, FOR THE WATER FRAMEWORK DIRECTIVE (2000/60/EC), Guidance document No. 24 RIVER BASIN MANAGEMENT IN A CHANGING CLIMATE. European Union.
5. COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL Addressing the challenge of water scarcity and droughts in the European Union, Brussels, 18.7.2007

The following were used regarding the WEI+ index:

1. Update on Water Scarcity and Droughts indicator development of Henriette Faergemann (DG ENV) (May 2012), which describes the method of calculation of WEI+ as agreed by the relevant WG and valid until today.

2. European Water Assets Accounts and updating the use of freshwater resources indicator (CSI 018) – Draft for consultation of data sources and technical application of the WEI+ formulas Report version 3.2 (2015).

3. The European Commission recently published the WFD Reporting Guidance 2016, which, in Section 9.4 provides further guidance for the Reporting of the WEI+ index; the most important requirement is that the WEI+ should be calculated for the last 5 years. The requirement to calculate the WEI+ index for the season or for the most unfavourable month is a valuable addition.

3.5 ACKNOWLEDGEMENTS

Many thanks for their contribution to the project by providing data, information and directions are due to the executives of the Water Development Department and the Steering Committee. In particular, the contribution of P. Hadjigeorgiou, M. Panaretou, K. Aristeidou and F. Rousi in providing data and information and in submitting comments was invaluable.

3.6 STUDY GROUP

The following scientists worked for the implementation hereof:

The following scientists worked for the implementation of this contract:

- Dr Panos Panagopoulos, Civil Engineer, NTUA, Ph. D.,
- Dr Katerina Triantafyllou, Civil Engineer, NTUA, Ph. D.,
- Tasos Varveris, Chemical Engineer - D.E.S.S. Environment,
- Efi-Flaska Panagopoulos, Environmentalist,
- Evangelia Papagianni, Civil Engineer, M.Sc. in Science & Technology of Water Resources,
- Eleni Avramidi, Environmental Engineer, GIS Analyst,
- Dr Andreas Efstratiadis, Civil Engineer, NTUA, Ph. D.,
- Dr Nikos Mamasis, Rural and Surveying Engineer NTUA, Ph.D.,
- Dr Xenophon Stavropoulos, Hydrogeologist,
- Dr Alkiviadis Oikonomou, Biologist Ph.D.,
- Dr Panagiotis Panagiotidis, Biologist Ph.D.,
- Efi Filandra, Economist MA
- Brian Cox,
- Graydon Jeal,
- Dr Georgios Papanikolaou, Agronomist, Ph.D.,
- Eveline De Vos,
- Nikos Markatos,
- Andreas Loukatos, Chemical Engineer - D.E.A. Environment,
- Dr Georgios Chatzinikolaou, Environmentalist-Biologist Ph.D.,
- Dr Nomiki Sympoura, Hydrobiologist-Oceanographer Ph.D.,
- Dr Calliope Papapavlou, Biologist-Ecologist M.Sc.,

- Vasilis Gerakaris, Hydrobiologist-Oceanographer M.Sc,
- Dr Spiros Christopoulos, Civil Engineer Ph.D.,
- Dimitris Zarris, Civil Engineer, M.Sc. Hydrology.

4. DEFINITIONS & REQUIREMENTS OF DIRECTIVE 2000/60/EC ON THE MANAGEMENT OF DROUGHTS AND WATER SCARCITY

4.1 BASIC CONCEPTS

Drought is an extreme meteo-climatic phenomenon, which may come unannounced and be of indefinite duration, being the result of the combined action of several parameters. The drought is not limited to specific areas, and is not only a problem for dry and desert areas. Instead, drought in areas characterised by significant amounts of rainfall causes many more problems than those in arid regions, as ecosystems in areas with dry climate are accustomed to survive with little moisture, whereas, in areas with wet climate, it is even possible for ecosystems to be destroyed if the amount of rainfall is significantly reduced.

According to the European Commission (18.07.2007) "Drought" means a temporary decrease in water availability due to causes such as precipitation deficiency, whereas "Water Scarcity" means a situation in which the demand for water exceeds - in sustainability conditions - the exploitable water resources. Drought, dryness, water scarcity and desertification are common and overlapping processes in Mediterranean countries and are often misinterpreted when used. To clarify these concepts the following definitions are given (MEDROPLAN 2006):

Drought: Natural casual (random) temporary condition of consistent reduction in precipitation and water availability with respect to normal values, spanning along a significant period of time and covering a wide region. It is caused by natural causes.

Aridity: Natural permanent climatic condition with very low average annual or seasonal precipitation compared to potential evapotranspiration. It is caused by natural causes.

Water Scarcity: Water scarcity occurs when the available water resources are not enough to meet the long-term water needs. It refers to a long-term imbalance between available water resources and demand in a region (or a water supply system) exceeding the service capacity of the natural system. Water scarcity results from the rapid increase in water demand and/or low available water resources, due to population growth, expansion of water consuming crops, etc.[1]. It is also caused by the lack of infrastructure in water management (dams, water transmission and distribution systems, etc.). In addition to the quantitative aspect, water scarcity may also arise from poor quality status of the available water resources, which, although being enough in terms of quantity, may however be

[1] The original text is attached [2] The same official text reads: [3] With an operation authorisation for 90% of the time

polluted by point or diffuse sources of pollution and are therefore not available for human consumption.

Desertification: The degradation of land in arid, semi-arid and other areas with a dry season. Desertification is caused primarily by over-exploitation and inappropriate land use interacting with climatic variance. Its causes are mainly anthropogenic, as highlighted the FAO definition (http://www.fao.org/docrep/v0265e/v0265e01.htm), which states: "Human activities are the main factors triggering desertification processes on vulnerable land. These activities are many and vary by country, society, land use strategies and the technologies applied. The impact of human society does not depend solely on its density".

Although theoretically drought can simply reinforce water shortage[2], the latter can be mitigated through the management of water supply and demand. It must be noted that poor water management may lead to water scarcity without prior drought events. The table below (Table 4-1) schematically shows the difference between drought and water scarcity.

Table 4-1: Table for defining and making the distinction between Drought - Water Scarcity

	Natural Causes	Human induced Causes
Temporal Situation	DROUGHT	WATER DEFICIT
Permanent Situation	ARIDITY	WATER SCARCITY DESERTIFICATION

The expected presence of freshwater in a region depends on the following factors (Mamasis and Koutsoyiannis, 2007):

- how it comes from the atmosphere by the process of precipitation (rain, snow), which depends on the climate status of the region;
- its movement in the soil and the subsoil (rivers and sources flow) and the storage possibility (soil moisture, natural and artificial lakes, and underground aquifers);
- the water required to cover local needs such as crop irrigation, human and animal water needs, hydropower, industrial operations, providing for the preservation of the natural environment, recreation and navigation on rivers and lakes.

Drought differs from other natural disasters in three main points:

- It affects many more people than any other natural disaster;
- It is a phenomenon that develops silently and is difficult to determine the beginning and end thereof, while its effects accumulate slowly over a long time and can persist for several years after its end;

[2] The same official text reads: [3] With an operation authorisation for 90% of the time

- Social effects are less visible (do not result in destruction of infrastructure) and extend to much larger geographical areas than other natural disasters (floods, earthquakes).

4.1.1 DEFINITIONS OF WATER SCARCITY AND DROUGHT

Drought is a recurring climate phenomenon featured by temporary water deficits compared to the normal flow, for a prolonged period of time - a season, a year or several years. The term is relative, since droughts differ in extent, duration and intensity (EU, MEDAWater, MEDROPLAN, 2006). It is a fact that so far no comprehensive and widely accepted definition of drought has been given. Drought is defined differently from region to region or even depending on the goal of each researcher. Perhaps the most general among the recommended definitions is that of Berman and Rodier (1985): “drought is reduced water availability during a particular area for a certain period of time”. Its characteristics also depend on other factors, such as high temperatures, strong winds and low relative humidity (Oladipo, 1985). Moreover, drought is dependent on the time of occurrence (e.g. whether the absence of rainfall occurs during the plant development stages) but also on the efficiency of precipitation (e.g. precipitation intensity, number of rain events). Thus, each drought event can be considered unique, having its own characteristics.

Finally, it is important to stress the difference between aridity and drought. The first case, also found in the literature as dryness, refers to a climatic feature, a steady state, exhibiting reduced precipitation, that is not enough to maintain vegetation (Wallen, 1967; Greek Meteorological Society, 1998) . On the contrary, drought relates to a transient climate state featured by significant reduction of precipitation in a region (Anagnostopoulou, 2003). It is noted that both phenomena are caused by natural causes, as opposed to water scarcity or desertification, human factors playing a key role in the creation thereof (EU, MEDAWater, MEDROPLAN, 2006).

Drought means a temporary decrease in water availability due to causes such as precipitation deficiency, whereas “water scarcity” means a situation in which the demand for water exceeds (in sustainability conditions) the exploitable water resources. Respectively, while “drought’ is a random, natural phenomenon, “scarcity” results exclusively from inefficient management of a region’s water resources in the mid-term. To date, at least 11% of the European population and 17% of the European territory have been affected by water scarcity. Recent trends show a significant extension of water scarcity across Europe.

Water scarcity occurs when there are insufficient water resources to meet long-term water demand. It refers to long-term changes of the water balance combining low availability of water resources with a level of water demand exceeding the capacity of the natural system. Problems caused by insufficient water resources often occur in areas with low rainfall but also in areas with high population density, intensive farming and/or industrial production. In addition to the quantitative issues, water scarcity may also occur due to the qualitative state of water resources, which would be sufficient in quantitative terms, but however can not be used because of their poor quality status.

Water scarcity and drought are different phenomena in principle, although one of them can be responsible for enhancing the consequences of the other. In some areas, the severity and frequency of droughts may lead to water scarcity conditions, while overexploitation of available water resources can worsen the effects of droughts. Therefore, caution is required between the two phenomena; especially in water catchments affected by water scarcity. It is obvious that the two terms are interrelated since the severity and frequency of droughts may lead to future water scarcity conditions due to overexploitation of the available water resources. The differences between these two terms is clear, although interaction is possible. For example, (a) drought causes economic damage only during summer (or late spring) where demands on irrigation water are maximised, (b) water scarcity sets an upper limit to the economic development of a region and the ecosystem's ecological potential, while drought only establishes hydrologic deficits with a given duration, and (c) drought may occur in areas with water scarcity conditions requiring very special risk management. Despite the debate on the definitions of the two terms, it finally seems that water scarcity is somewhere at the crossroads of hydrological phenomena (in the form of drought) and social phenomena in the form of water demand either directly or indirectly. It is also worth noting that water scarcity in water systems does not mean that there is not enough water for basic human needs (e.g. water supply), but for all other use including environmental conservation.

4.1.2 CATEGORIES OF DROUGHT

Drought can be seen as a physical hazard, characterized as such when it is a natural event that can have negative consequences on human societies and the environment, and drought is a natural hazard that can be enhanced by increased water demand. The causes for the occurrence of drought are complex since they depend not only on the atmosphere but also on the hydrological processes channelling moisture to the atmosphere. Once the dry hydrological conditions occur, negative interactions take place reducing the moisture in the upper soil layer, which in turn reduces evapotranspiration, which again reduces the moisture available in the atmosphere. The lower the relative humidity in the atmosphere, the smaller the chance of rainfall, as it is difficult to reach the water vapour condensation limits on an ordinary low barometric system over a specific region. Only weather systems that can be transferred outside this region can be rain-bearing and reverse the drought status.

Drought is evaluated as first among all natural hazards with criterion the number of people that may be adversely affected. Even being a natural hazard itself, it differs significantly from all other natural hazards.

First, the beginning and the end of a drought is difficult to determine, its negative effects grow slowly but steadily, often added up to a significant amount of time, and may be extended even after the drought. Therefore, drought can be classified as a "creeping phenomenon". Secondly, due to the fact that until now there has been no universally accepted definition for drought, it is difficult to point out and define a drought period, especially at its early stages. Thirdly, the negative consequences of drought are not structural (i.e. no damage to infrastructure, etc.) and generally extend over wide geographical areas in contrast to other natural hazards, such as floods or earthquakes. In this sense, during a drought period it is extremely difficult to quantify the negative effects, and the help available for reducing these consequences is difficult compared to other natural disasters. Bryant (1991) classified natural hazards based on their characteristics and their negative effects. Key risk characteristics used for their classification were their degree of destructiveness, the duration of the event, their geographic scope, the loss of human life, economic loss, social effects, long-term effects, their sudden appearance and the appearance of accompanying phenomena. As a result, drought was ranked first on the basis of several of the above features, leaving behind other natural disasters such as tropical cyclones, volcanic eruptions, earthquakes and floods.

The definitions of drought (depending on the standpoint of the party providing the definition) can generally be described as conceptual or operational. Conceptual definitions are limited to explaining drought as a long, dry season, as opposed to operational definitions, which strive to define the onset, severity and end of periods of drought. Generally, the operational definitions of drought can be used to analyse the incidence, severity and duration for a given period of restoring drought. Some of the most established definitions of drought are:

- The World Meteorological Organization (WMO) defines drought as a persistent and growing decline in precipitation.
- According to the UN Convention to Combat Drought & Desertification, drought means the naturally occurring phenomenon that exists when precipitation has been significantly below normal recorded levels, causing serious hydrological imbalances that adversely affect land resource production systems.
- The Food and Agriculture Organization (FAO) defines drought as the percentage of years when crops fail from the lack of soil moisture.
- The Encyclopedia of Weather and Climate (Schneider, 1996) defines drought as an extended period – a season, a year, or several years – of deficient rainfall relative to the statistical multi-year mean for a region.
- Gumbel (1963) defines drought as the minimum value of average daily flow during a hydrological year.
- Palmer (1965) defines drought as a significant deviation from the normal hydrologic conditions of an area.
- Finally, Linseley et al. (1959) define drought as a sustained period of time without significant rainfall.

The literature presents four main categories of drought: meteorological, agricultural, hydrological and socioeconomic.

- Meteorological-climatic drought is defined on the basis of the deviation of rainfall (total amount and number of rain days) in comparison to that expected, based on the climate of the region.
- Agricultural drought is defined in terms of the effects of meteorological drought on crops, namely the deficiency of soil moisture in meeting crop water requirements, in order to start or continue their development. The water requirements of crops depend on the prevailing weather conditions, the biological characteristics of each species, their stage of development

and the physical and biological properties of the soil. The main parameter investigated is the difference between precipitation and potential evapotranspiration.

- Hydrological drought is associated with the effects of reduced rainfall on surface and ground water runoff, manifested in the reduction of soil moisture, the supply of rivers and springs, the levels of lakes, reservoirs and groundwater reserves.
- Socioeconomic drought expresses the vulnerability of a society to water shortage. It connects all previous drought categories to the supply and demand of products related to the use of water (drinking water, agricultural products, hydroelectric power, etc.). Socioeconomic drought occurs when the demand for these goods is greater than their supply as a result of water shortage. It may also be caused through political processes, such as conflicts between countries and social groups for the use of water or the movement of large populations to arid areas.
- Operational drought relates to the impacts of the physical phenomenon on water supply systems and leads to water shortages with uncertain economic consequences. Both the reduction of water availability and its impacts depend, apart from the importance of the event, on the efficiency of the mitigation measures adopted for the water supply systems and social-economic systems (Iglesias et al., 2007).

The definitions given to drought that affects underground water supplies (groundwater droughts) are also important. When groundwater body systems are affected by drought, infiltration and consequently the groundwater level and the outflow of groundwater to watercourse beds are significantly reduced. Such droughts are called groundwater droughts and generally last for months or even years. It is difficult to determine the total quantity of available water for underground aquifers. Even if it is possible to determine this accurately, the negative effects of the reduction of underground storage will be felt even before the overall reduction of underground storage is identified. Therefore, groundwater drought is defined based on the decrease of the groundwater level.

Groundwater drought is obviously due to reduced rainfall, probably in combination with high values of potential evapotranspiration. Reduced rainfall causes a decrease in soil moisture and thus reduced infiltration. The negative effects of this type of drought are severe. The low piezometric heights of underground aquifers lead to a reduction of underground runoff that enhances surface runoff in the hydrographic network, lakes and in various wetlands. For shallow, overhanging aquifers, the elevation of groundwater due to the suction force will be reduced and therefore agricultural production - and mainly wetlands, which are significantly dependent on underground upwelling - will be adversely affected. The water level in wells will fall further and shallow wells will dry up.

4.1.3 STANDARD QUALIFIERS OF DROUGHT

The standard qualifiers of a drought are its intensity, duration, geographic extent and destructiveness (Mamassis and Koutsoyiannis, 2007). In particular:

- The intensity of drought refers mainly to the reduction of rainfall and the severity of the impact of this reduction. Overall, it can be determined by calculating various drought indices, which are calculated based on precipitation and runoff. Intensity relates to the deviation of precipitation and other variables associated with evaporation (temperature, wind, humidity) from the expected climatic values. Intensity can be quantified statistically by estimating the probability of the occurrence of the specific values of the variables.
- Duration is difficult to determine because there is uncertainty about the start and end points of the phenomenon. Drought progresses slowly and has cumulative effects, as the lack of rainfall may persist for months or even years, while its effects are still present after the start of precipitation, as the recharging of all water bodies (mainly groundwater) requires time. A drought episode may occur very shortly after the first drop or complete absence of precipitation, and may subsequently last for months or even years, despite the fact that insignificant rainfall may be recorded during this period. Generally, duration can be determined by calculating the drought magnitude or severity, which is also described in more detail in Chapter 6.2 of this report.
- The geographic extent of drought depends directly on the weather and climatic characteristics of each region and on the existing water transport projects. The case of bodies of water supplied with water from different geographical regions in which climatic conditions are different is particularly interesting. In these systems, the geographic extent of drought is a particularly important parameter, since it can affect only a part of the water resources.
- Destructiveness expresses the effect of the natural phenomenon on human activities. It depends on the intensity, duration and extent of the drought, the temporal distribution of rainfall, the management of water systems and the development of demand. Thus, rainfall in relation to the development stages of crops, the number of rain events and their intensity, the presence of artificial reservoirs and the possibility of reducing water needs are linked to the effectiveness of rain in covering human needs and consequently with the destructiveness of drought.

4.2 IMPACT OF DROUGHT AND WATER SCARCITY

The impact of drought and water scarcity is important and may be amplified depending on the appearance, intensity and duration of each event as regards drought. A special role in the final impact is played by the sensitivity of the affected ecosystem, economy and society, as well as by the relative soil moisture, the storage capacity of aquifers and the supply of surface waters. Obviously, droughts have more adverse effects when they occur in areas already suffering from shortages of available water resources for meeting their various water needs (ACTeon et al., 2012).

4.2.1 IMPACT OF DROUGHT

The assessment of the potential impacts of drought in different environmental and anthropogenic systems is of particular importance, as these impacts can be used to assess the risk of drought

(MEDROPLAN, Iglesias et al., 2007). After the start of a drought phenomenon, the first sector affected is agriculture because of its strong connection with soil moisture. If the reduced rainfall continues, it affects other sectors that depend on different water resources, such as surface water and groundwater. Conversely, the agricultural sector is the first to recover after the end of the drought as soil moisture is replenished quickly, while other sectors may take months, or even years, to recover, depending on the intensity of the phenomenon (Water Scarcity Drafting Group, 2006).

The effects of drought can be divided into direct and indirect (Wilhite et al., 2007). Examples of direct effects include a decrease in the water level and supply, the reduction of agricultural and forestry production, as well as negative effects on the ecosystem, flora and fauna. Indirect effects are a consequence of direct effects, such as the reduction of income, unemployment, a rise in the prices of agricultural and forestry products, migration, etc. (Water Scarcity Drafting Group, 2006). The effects of drought can also be categorised according to the wider area they affect, into economic, social and environmental. The drought management guidelines issued in the framework of the MEDA Water Programme/MEDROPLAN (Iglesias et al., 2007) include the following overview of main impacts by sector.

Financial impacts

- Decreased production in agriculture, forestry, fisheries, hydroelectric energy, tourism, industry, and financial activities that depend on these sectors.
- Unemployment and reduced income caused by production decrease.
- Economic damage due to reduced navigability of streams, rivers and canals, as well as a possible increase in transport costs.
- Damage to the tourism sector due to reduced water availability in water supply and/or water bodies.
- Pressure on financial institutions (more risks in lending, decrease of capitals etc.) and reduction of tax revenues for governments.
- Price increases in food, water, energy and other products due to the reduced availability and probably the increased transport costs.
- Income reduction for water firms due to reduced water delivery.
- Spending on emergency measures to improve resources and decrease demands (additional costs for water transport and removal, costs of advertising/campaigning to reduce water use, etc.).

Social impacts

- Damage to public health and safety, because of the impact on air and water quality or increased fires.
- Increased social inequality because of impacts on different socio-economic groups
- Conflict of interest between different water users.

- Changes in the political outlook.
- Inconveniences due to water rationing.
- Impact on lifestyle (unemployment, reduced saving capability, difficulty in personal care, reuse of water at home, street and car washing prohibition, worry about the future, decreased entertainment, loss of property).
- Inequality as regards the effects of drought and the distribution of mitigation measures.
- Abandonment of activities and migration (in extreme cases).

Environmental impacts

The quantification of environmental impacts is not easy, but the recent extensive sensitisation of the public about environmental issues has resulted in focusing attention and resources on this. Some of the environmental impacts are short-term and abate relatively quickly after the end of the drought, while others can persist for a long time or be permanent (Water Scarcity Drafting Group, 2006). Environmental impacts can be summarised in the following:

- Drop in water supply and the quality of surface and underground water (e.g. overexploitation and salination of groundwater, especially in coastal areas).
- Damage to ecosystems, wetlands and biodiversity, landscape deterioration and occurrence of diseases in plants (soil erosion, dust, reduced vegetation coverage, etc.).
- Increased fires.
- Lack of food and drinking water.
- Increase of salt concentration (in streams, underground layers, irrigated areas).
- Losses in natural and artificial lakes (fish, landscapes, etc.).
- Damage to the life in rivers and wetlands (flora, fauna).
- Damage to air quality (e.g. polluting dust).

4.2.2 IMPACT OF WATER SCARCITY

Financial impacts should normally include the different cost categories (environmental, social costs), which are however difficult to take into account in the overall financial impacts. The financial impacts felt by consumers, households and various productive sectors (tourism, industry, energy and agriculture) can be summarised as follows:

- Lack/Shortage in public water supply, with impacts in the relevant sectors, especially in tourism.
- Increase in the cost and price of water for domestic consumption.
- In the agricultural sector, reduction of crop yields, increased water pumping costs, reduction of competitiveness.

- Drop in energy production due to the increased water temperature, which limits its use for cooling and reduction of water available in reservoirs for hydroelectric power generation.
- Reduction in production in various water-consuming industries.
- Increased investment costs for infrastructure for alternative water sources (desalination, wells, re-use, water transport, etc.).

Social impacts

The assessment of the social impacts of water scarcity is not an easy task. An initial qualitative assessment of the potential impacts includes:

- Declining employment in the agricultural sector.
- Relocation of water-consuming industries.
- Public health and safety problems due to the increase in the price of water as a result of compensatory measures.

Environmental impacts

The over-exploitation of water resources can lead to multiple significant environmental impacts on surface and ground water, wetlands, coastal areas, soils and biodiversity. The most significant environmental impacts of water scarcity include:

- Reduction of water reserves in aquifers due to over-pumping to meet various needs for water (tourism, agriculture, etc.).
- Salination of coastal aquifers.
- Failure in the ecological flow of rivers.
- Negative impacts on wetlands and their ecosystems.
- Aggravation of problems related to water quality as a result of the increased concentration of pollutants (reduced dilution due to the reduction of available water in water bodies).
- Negative effects on biodiversity, with loss of flora and fauna due to reduced water availability and deterioration of water quality in surface water bodies.
- Negative impacts on soils due to increased erosion and risk of desertification.

4.3 IMPACT OF CLIMATE CHANGE

4.3.1 INTRODUCTION

The information on climate change, its magnitude and impacts come from the text Synthesis Report (SYR) of the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5), 2014. This paper presents an overview of existing knowledge on climatology and climate change, focusing on new data and the results of the previous Text (IPCC Fourth Assessment Report (AR4)), issued in 2007. The SYR is a synthesis of the new results of AR5, based on the contribution of Working Group I (The Physical Science Basis), Working Group II (Impacts, Adaptation and Vulnerability) and Working Group III (Mitigation of Climate Change), and two additional IPCC publications (Special Report on Renewable Energy Sources and Climate Change Mitigation and Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation).

The position of the IPCC on climate change is clear and bleak. The conclusion stated in the beginning of the text is presented verbatim below*... "Human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history. Recent climate changes have had widespread impacts on human and natural systems. Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, and sea level has risen"*. Regardless of the scenarios concerning climate change for the future and the efforts to reduce greenhouse gas emissions, it is believed that the climate will continue to change in the coming decades, affecting the economy, society and the natural environment in a number of ways.

Climate change in Cyprus, as recorded over the last decades, mainly concerns an increase of the mean annual temperature and a drop in the average annual rainfall. According to climatic forecasts, these trends, combined with extreme weather events, will continue to occur, causing knock-on negative effects. The impacts of climate change, which are already apparent around the world, vary from region to region, depending on climatic, geographical, social and economic conditions. These impacts are expected to be particularly severe for Cyprus and the rest of the island area in the sensitive Mediterranean basin. Through a series of decisions and legislations, the global community and Europe are adopting policies and actions based on two pillars. One pillar includes actions to reduce emissions of greenhouse gases and pollutants responsible for climate change, and to limiting the rise of the mean global temperature below 20^{o}C, by 2020. The second pillar involves adjustment actions to effectively tackle the unavoidable impacts of climate change, focusing on the development and implementation of national adjustment strategies.

In 2014, the Republic of Cyprus drew up the "Proposal for the Plan for the Adjustment of Cyprus to Climate Change", which was co-financed by the European Union (LIFE+) and by national resources and is a Deliverable of Action 5 of the programme CYPADAPT (LIFE10ENV/CY/000723), titled "Development of a national strategy for adaptation to adverse impacts of climate change in Cyprus". Significant parts of this report were transferred verbatim in this Drought Management Plan.

4.3.2 CLIMATE CHANGE AT A GLOBAL LEVEL

According to the findings of Working Group I of the Intergovernmental Panel on Climate Change - IPCC (2013), the warming of the climate system is unequivocal. Since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and oceans have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased.

It is extremely likely that human activity, which increases concentrations of greenhouse gases, has been the dominant cause of the warming and extreme weather events (floods, heat waves, severe droughts, etc.) observed on the planet since the mid-20th century. It is also highly likely that the continued emissions of greenhouse gases will cause further warming and changes in other components of the climate system.

Temperature increase - Changes in precipitation: Regarding the warming of the atmosphere, both over land and over the oceans, each of the last three decades has been successively warmer than any preceding decade since 1850 (Figure 4-1). In the northern hemisphere, 1983 - 2012 was the warmest period of the last 1400 years. The analysis of surface temperature data (land and oceans) for the period from 1880 to 2012 globally shows a warming of 0.85°C (Figure 4-2). Furthermore, the warming for the period 2003 - 2012 in relation to the period 1850 - 1900 reaches 0.78°C (IPCC, 2013). Regarding precipitation, the observations show that, mainly in mid-latitude regions of the Northern Hemisphere, precipitation has increased since 1901, while in other areas there are both positive and negative trends. Regarding extreme events, observations show that the number of cold days and nights has decreased while the number of hot days and nights has increased worldwide. In addition, the incidence of heat waves has increased in most parts of Europe, Asia and Australia. Moreover, the frequency and intensity of heavy rainfall causing floods has increased in North America and in Europe.

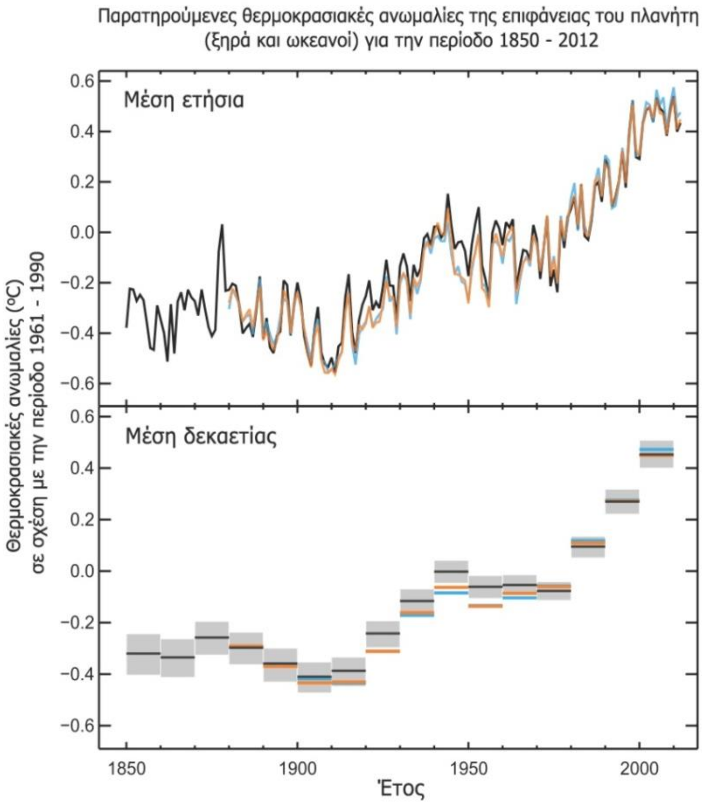

Figure 4-1: Observed temperature anomalies across the planet's surface (land and ocean) for the period 1850-2012. Average annual (above) and ten-year (below) anomalies.

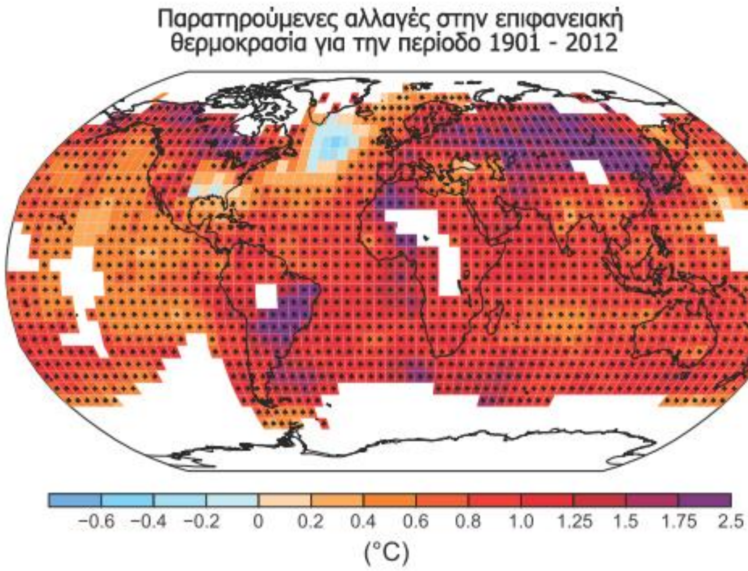

Figure 4-2: Observed changes in global surface temperature for the period 1901-2012.

Finally, the warming of the atmosphere on the surface of oceans has the effect of increasing their temperature (Figure 4-3). More specifically, the analysis of the observations shows that the upper 75 m of oceans warmed by 0.11 °C per decade over the period 1971 to 2010. However, warming is also observed in deeper ocean layers, as deep as 3000 metres and in some cases even deeper (IPCC, 2013).

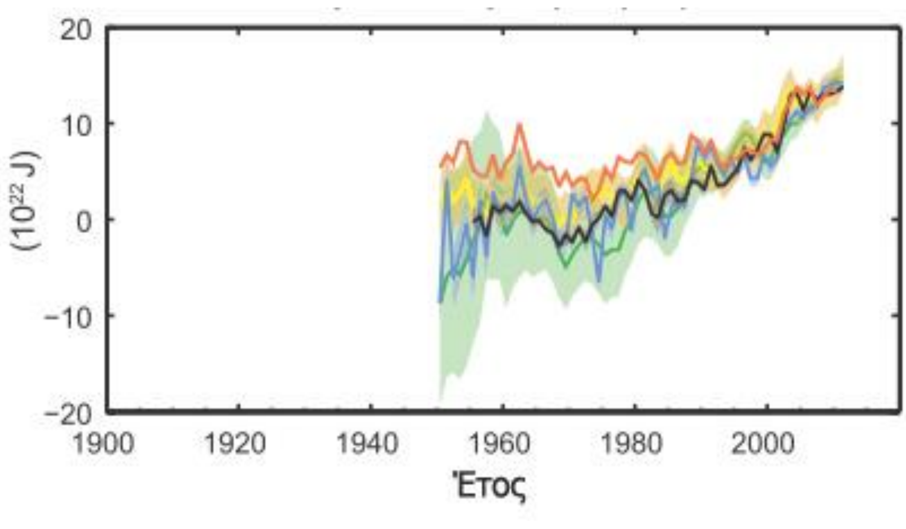

Figure 4-3: Heat content in the world's upper oceans (0-700 metres) for the period 2006-2010.

Melting of ice - snow: Over the last two decades, the Greenland and Antarctic ice sheets have been losing mass, glaciers have continued to shrink worldwide, and Arctic sea ice and the Northern Hemisphere snow cover (mainly during the spring) have continued to decrease in extent (Figure 4-4). More specifically, the average rate of ice loss from glaciers around the world over the period 1993 - 2009 was 275 Gt/yr, while the average annual rate of ice loss of Greenland over the period 2002 -

2011 was around 34 Gt/yr. Finally, the Arctic sea ice extent decreased over the period 1979 - 2012 with a rate of 3.5 to 4.1% per decade. During the summer, the respective sea ice loss rate is much higher and reaches 9.4 - 13.6% per decade.

Rise in sea level: Since the mid-19th century, the rate of sea level rise is estimated to be the largest of the last two millennia. During the period 1901 - 2010, the sea level has risen by 0.19 metres worldwide (Figure 4-5). This is mainly due to the melting of ice and glaciers and the thermal expansion of the oceans due to their warming.

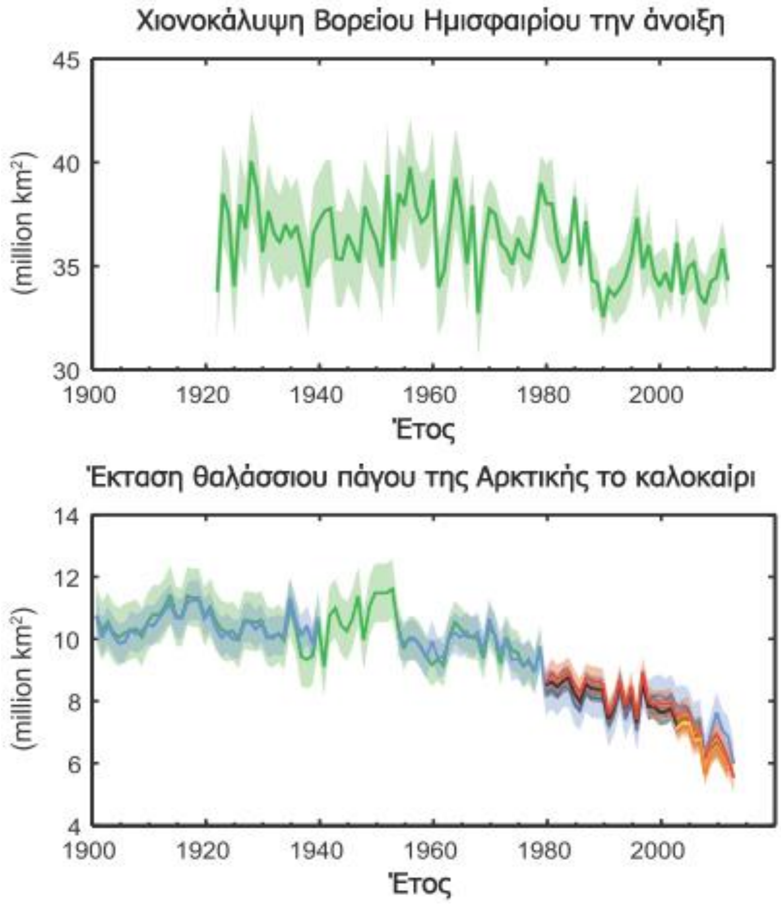

Figure 4-4: Extent of spring snow cover in the Northern Hemisphere (above), extent of Arctic sea ice in the summer (below).

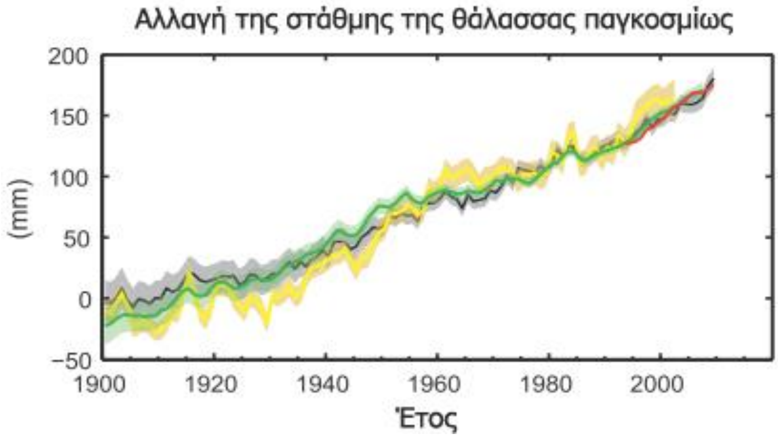

Figure 4-5: Change of sea levels in relation to the reference period 1900-1905.

4.3.3 CLIMATE CHANGE IN CYPRUS - TEMPERATURE

Cyprus is located in south-eastern Europe and owes its mild Mediterranean climate to the Mediterranean Sea surrounding it. The main characteristics of the Mediterranean climate of Cyprus are hot and dry summers and rainy but mild winters. Cyprus's relief of Cyprus significantly affects the climate. The Troodos mountain chain and, to a lesser extent, the Pentadaktylos mountain chain, play an important role in weather conditions in different regions of Cyprus and in the creation of local phenomena. Moreover, the presence of the sea surrounding the island creates local phenomena in the coastal areas. During the 20th century and early 21st century, Cyprus's climate, especially precipitation and temperature, presents significant fluctuations and trends. Similar fluctuations and trends in climate have been observed in the Eastern Mediterranean and the Middle East countries, which indicates a general change of climate in the region.

Analysis of the meteorological data of stations in Nicosia and Limassol for the periods 1892 – 2010 (Figure 4-6) and 1903 – 2010 (Figure 4-7) respectively, show an increase in the average temperature of the atmosphere by 1.4°C in Nicosia station and by 2.3°C Limassol station.

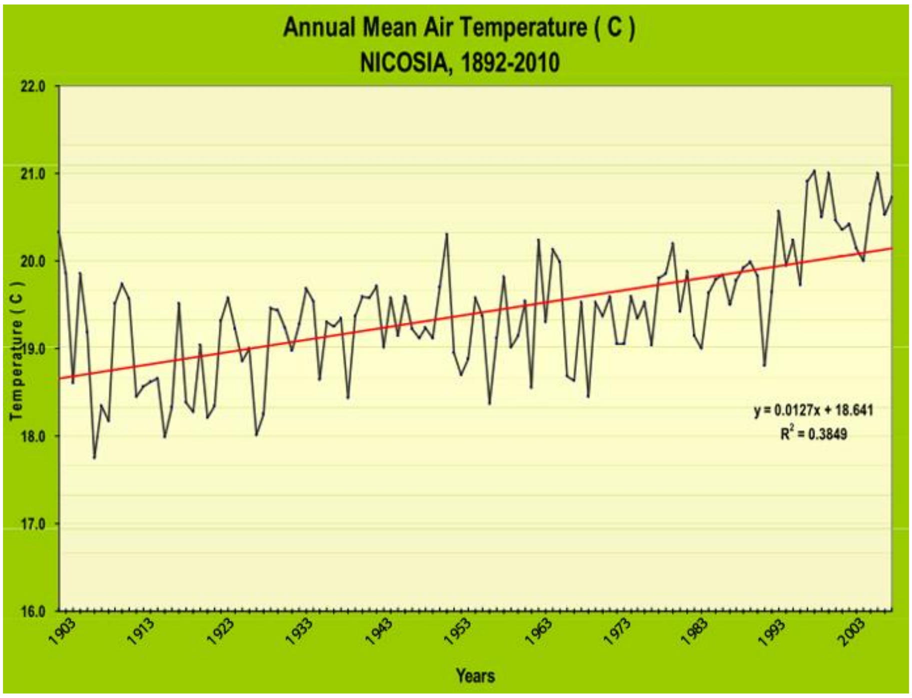

Figure 4-6: Average annual temperature in Nicosia for the period 1892-2010.

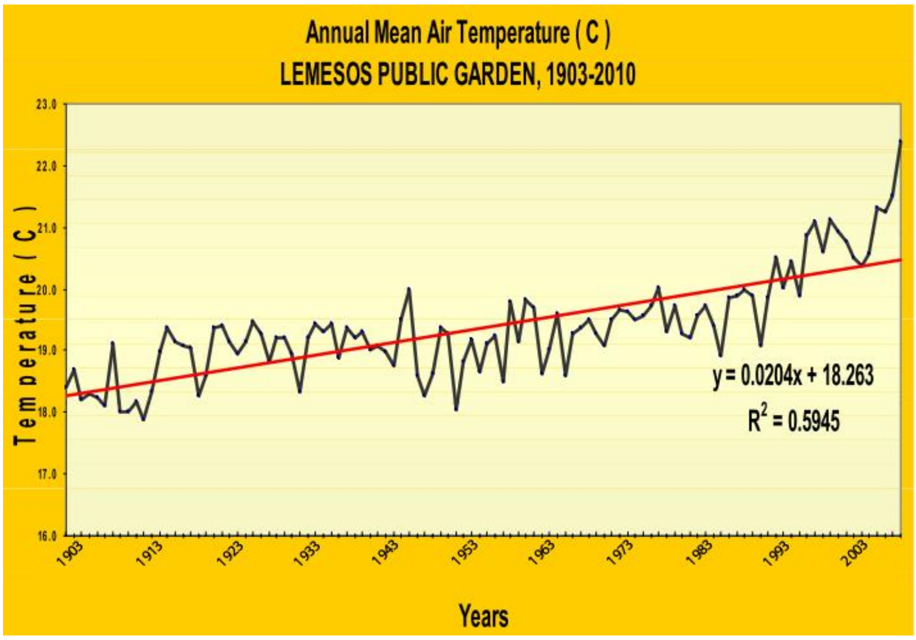

Figure 4-7: Average annual temperature in Limassol for the period 1903-2010.

Moreover, in terms of average annual maximum and minimum temperatures for the same periods, the Nicosia station data shows that both temperatures are on the rise (Figure 4-8). In addition, the relevant data from the Limassol station show that the average annual maximum temperature presents a slight decrease, while the average annual minimum temperature presents a significant increase, much greater than that in the Nicosia station (Figure 4-9).

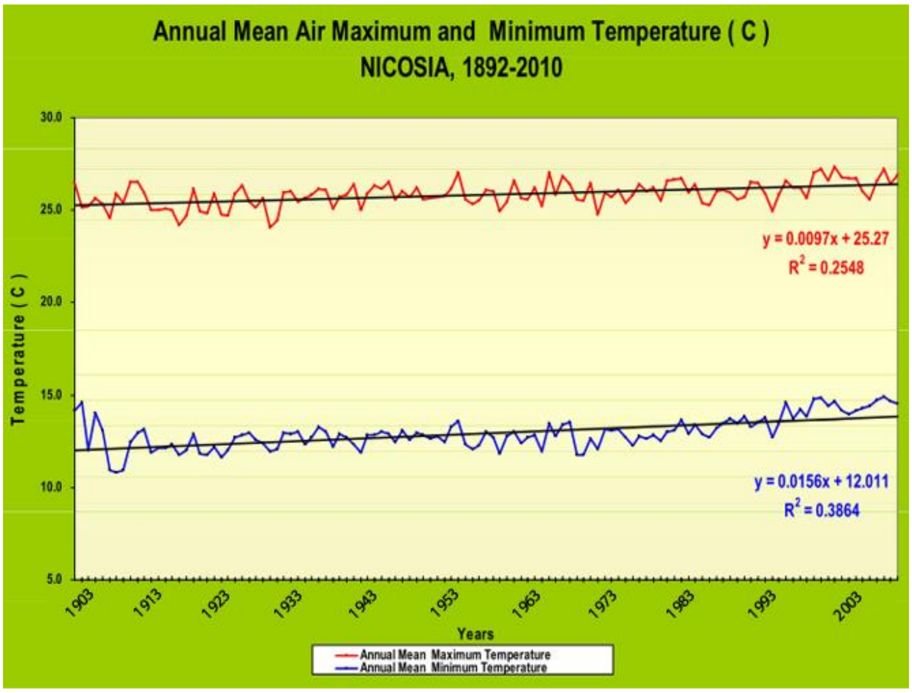

Figure 4-8: Average annual maximum (red line) and minimum (blue line) temperature in Nicosia for the period 1892 – 2010.

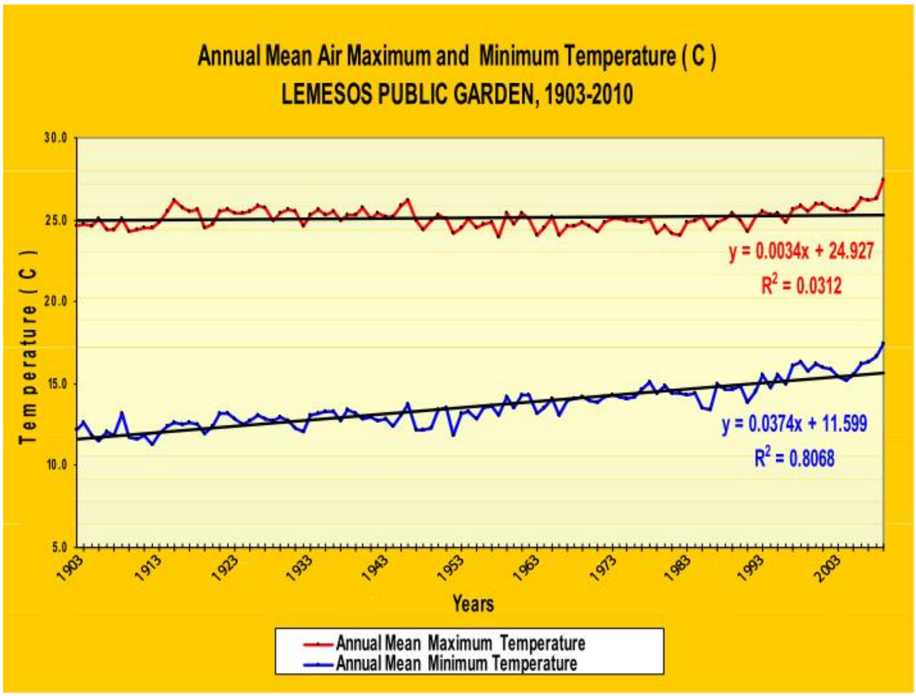

Figure 4-9: Average annual maximum (red line) and minimum (blue line) temperature in Limassol for the period 1903 – 2010.

Furthermore, according to observations from the Nicosia station, there is an increase of days with temperature equal to or higher to 40°C (Figure 4-10) and at the same time a significant reduction of days with temperature below or equal to 0°C (Figure 4-11).

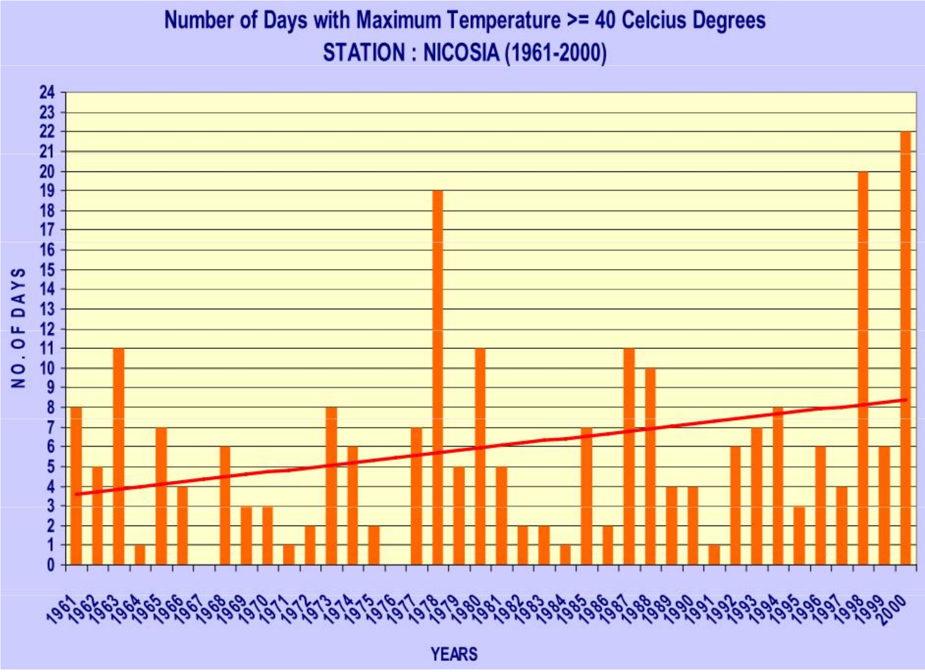

Figure 4-10: Number of days with maximum temperature above 40°C in Nicosia in the period 1961-2000.

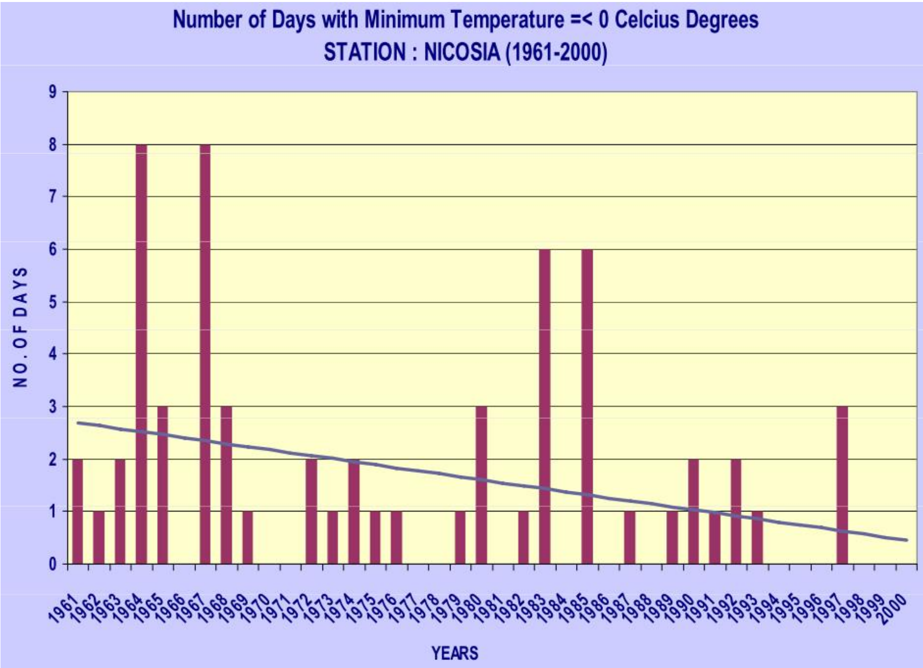

Figure 4-11: Number of days with minimum temperature below 0°C in Nicosia in the period 1961-2000.

4.3.4 CLIMATE CHANGE IN CYPRUS - RAINFALL

Data from the Meteorological Service of Cyprus show that annual rainfall in Cyprus, from the hydrological year 1916-1917 (for which there are annual data) to the year 2013-14 present a significant downward trend, which in several cases is statistically significant. This control is performed in a total of 50 stations for which there are data from the hydrological year 1916-1917 up to today.

Firstly, it should be noted that the quality of meteorological and rainfall data of Cyprus is obvious and that the extent of the measuring network of meteorological and hydrological parameters is well above sufficient. The rainfall stations that operate or operated until recently in Cyprus are about 150, while the hydrometric stations where flows are measured to date are more than 50 and are presented in Figure 4-12. Other than that, since monthly inflows are also measured on dam locations, an a very extensive over measurement system of meteorological and hydrological data is presented, allowing to analyse both climate change and the drought indices detailed below.

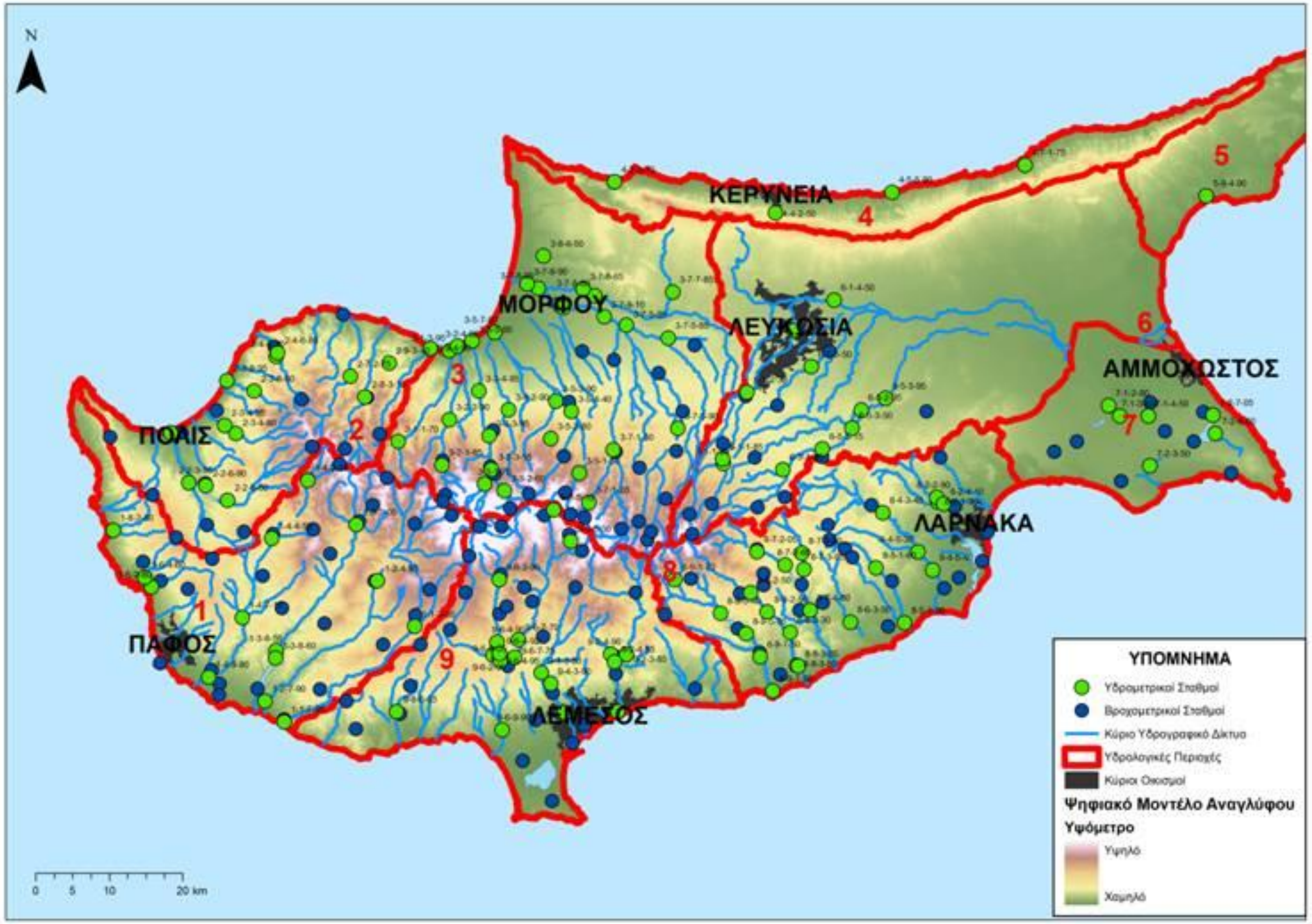

Figure 4-12: Map of Cyprus with pluviometric and hydrometric stations.

The project and assessment of surface water resources supply offered a comprehensive reassessment of rainfall values at the monthly level for the following reasons:

The last comprehensive assessment of rainfall throughout the Republic of Cyprus was performed in the 1st RBMP of Cyprus (Annex VII: Final Water Policy Report), updating the study of the United Nations' Food & Agricultural Organization (FAO) (Reassessment of the Island's Water Resources and Demand of Cyprus. Surface Water Resources, Ministry of Agriculture, Natural Resources and Environment - WDD – FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS (FAO), Frederic Rossel, 2002), where rainfall data related to the hydrological year 2007-2008 (compared to the year 2000 in the FAO study). The important work carried out in the 1st RBMP was a comprehensive review of the rainfall values, along with a homogenisation of data in order to have a common rainfall time sample for all stations, including exporting monthly rainfall per Hydrologic Region. In other words, until then, the average annual rainfall values related to a different time range for different stations; now, calculation of the average annual rainfall is attempted with common time frame for all stations. This time frame related to hydrological years from 1969-70 through 2007-08. This time frame almost coincides with the runoff measurements in the watercourses of the study area (1965) and is very close to the year 1971, which, pursuant to the FAO study (see above) has been recognised as the tipping point, when a significant (according to various statistical methods) and abrupt change of rainfall occurred. This study required a series of computational operations, the most important of which being sample extrapolation both backwards and forwards for those stations lacking complete time series for the time range of hydrological years 1969-70 through 2007-08. Completion of this study shall permit a superficial reduction of rainfall for the entire study area based on an updated and homogenised rainfall sample. Then, the monthly (and therefore annual) superficial and altitude-corrected rainfall for each Hydrologic Region were devised. The assessment of such data shows (from Figure 4-13 until Figure 4-19) that not only there is no downward trend in rainfall since 1969-70, but instead there is an upward trend (almost in all Hydrologic Regions), albeit not statistically significant. In this sense, the upward trend is not permanent and can easily turn into downward by adding a few years with reduced rainfall (compared to the average).

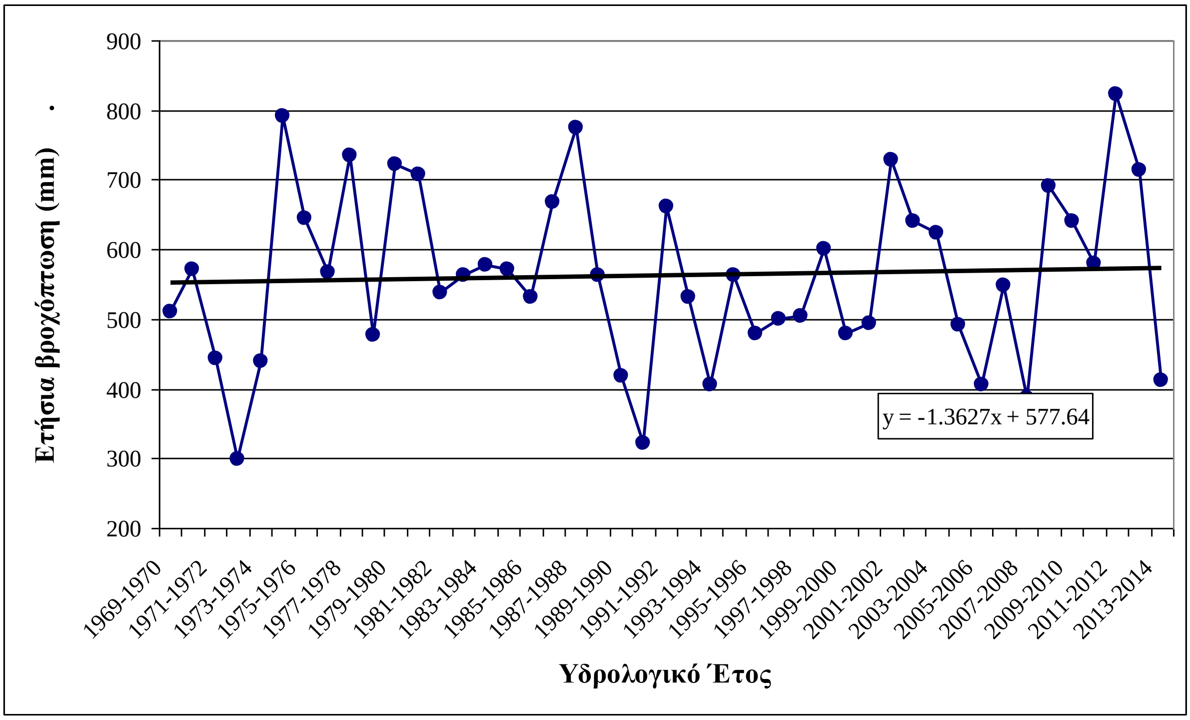

Figure 4-13: Annual Precipitation in Hydrologic Region 1.

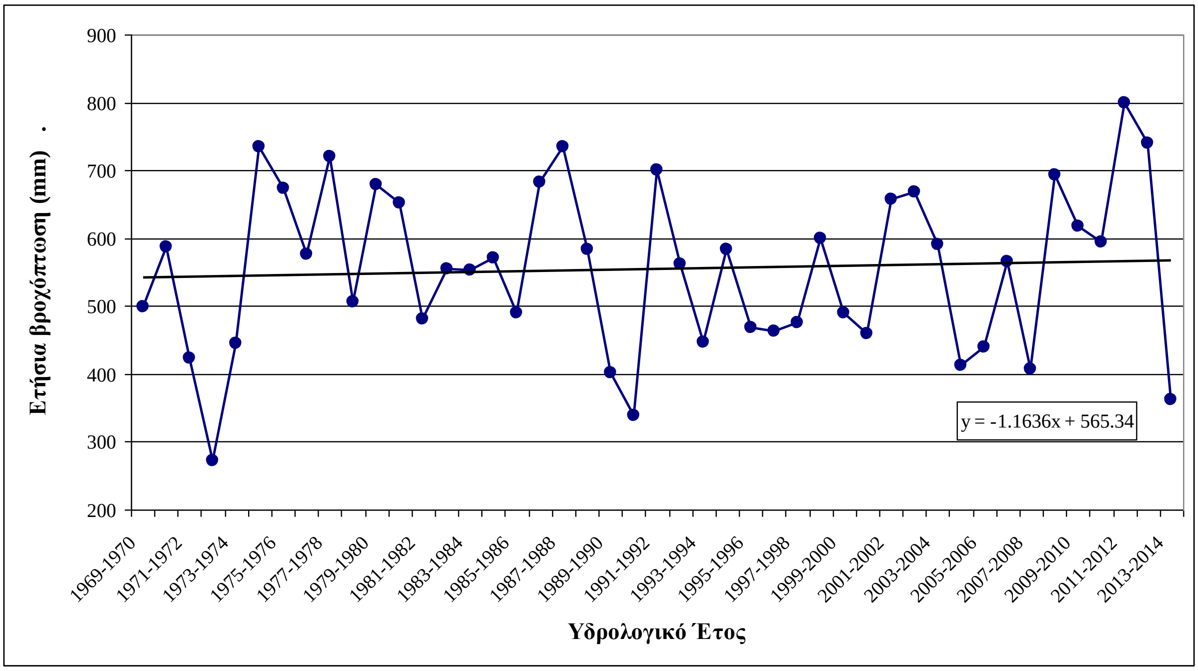

Figure 4-14: Annual Precipitation in Hydrologic Region 2.

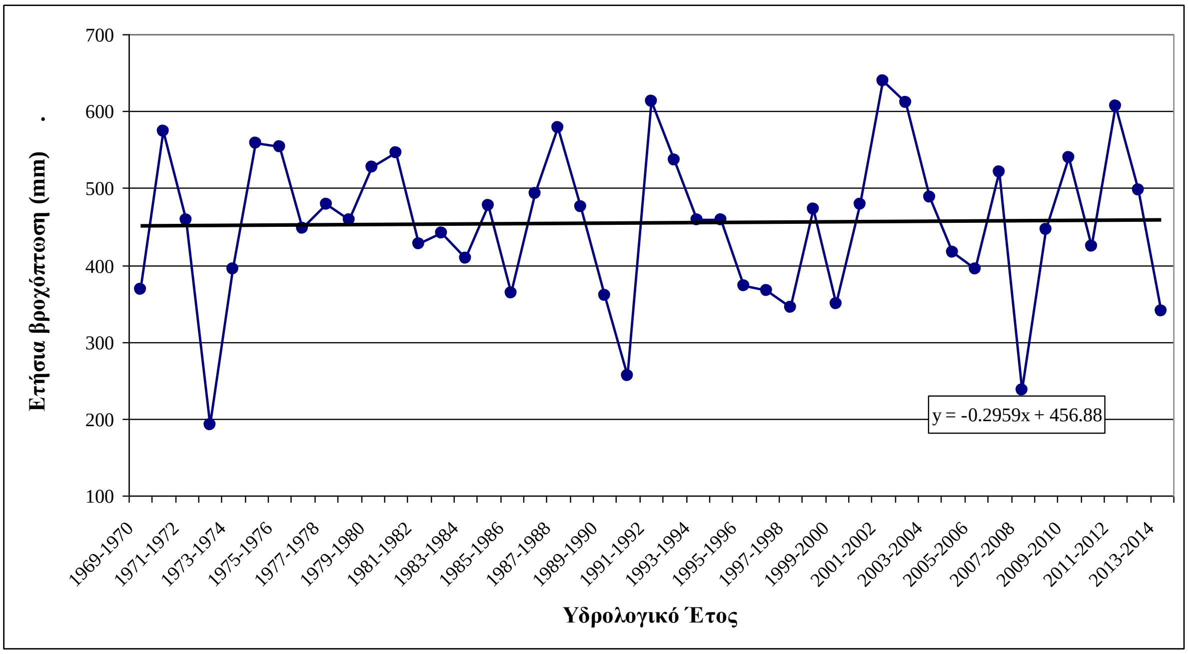

Figure 4-15: Annual Precipitation in Hydrologic Region 3.

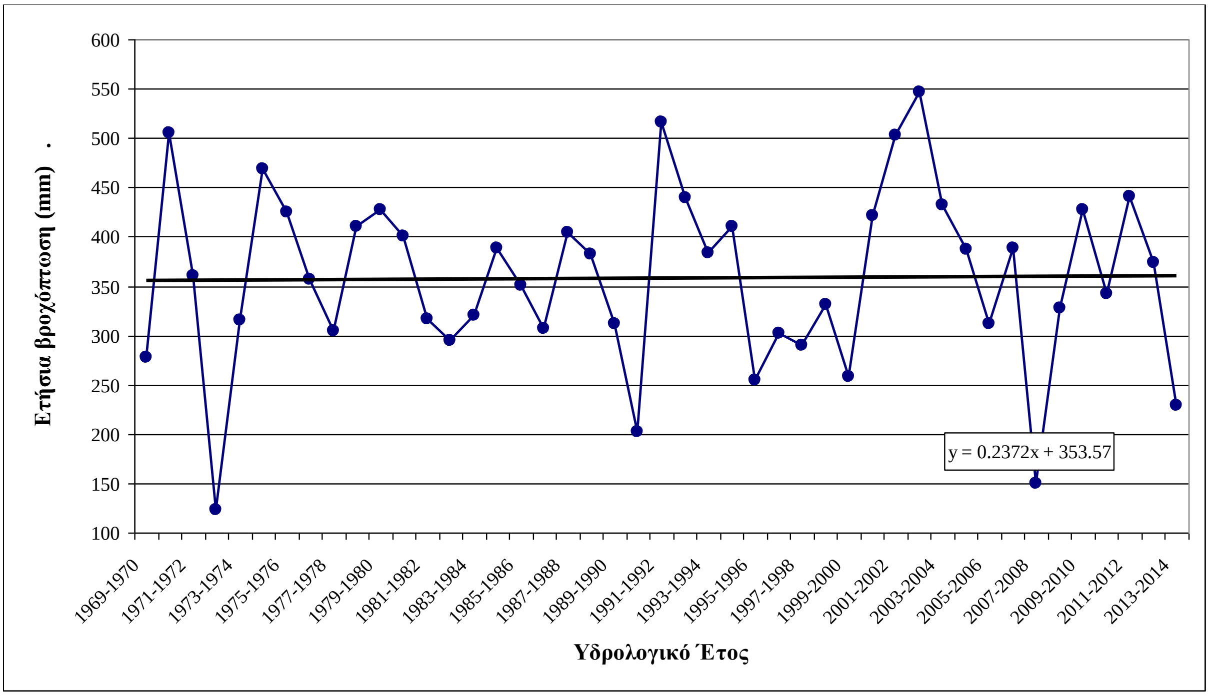

Figure 4-16: Annual Precipitation in Hydrologic Region 6.

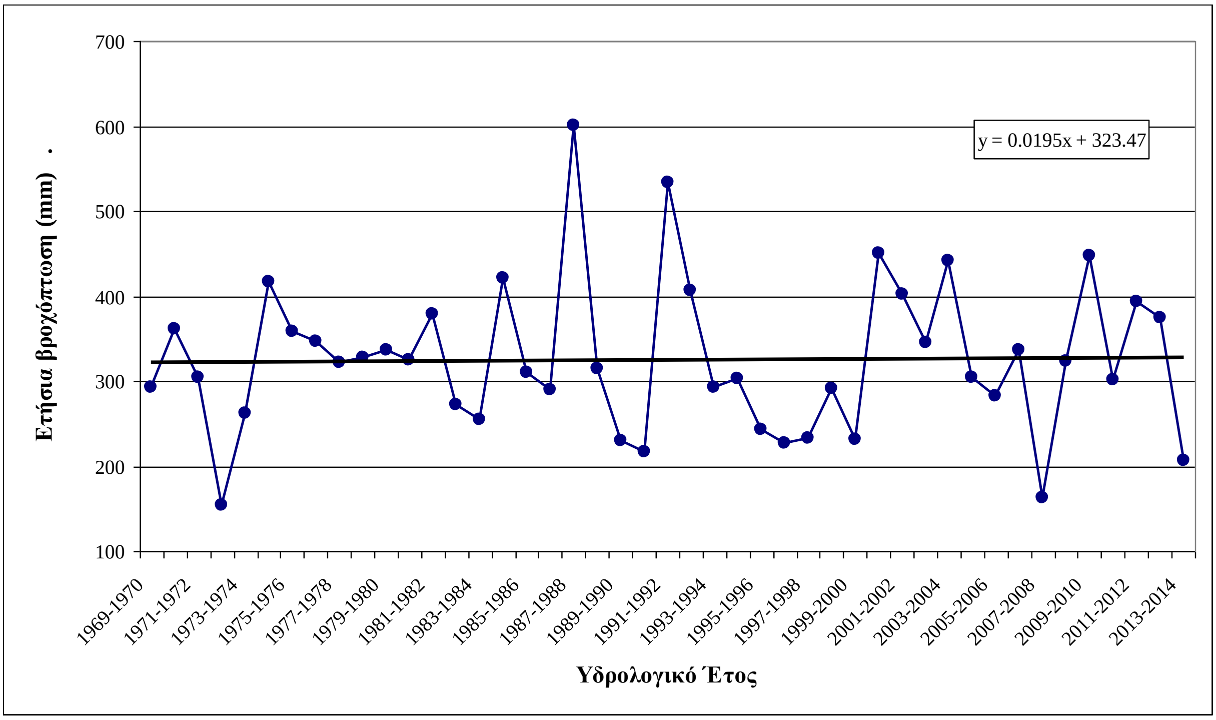

Figure 4-17: Annual Precipitation in Hydrologic Region 7.

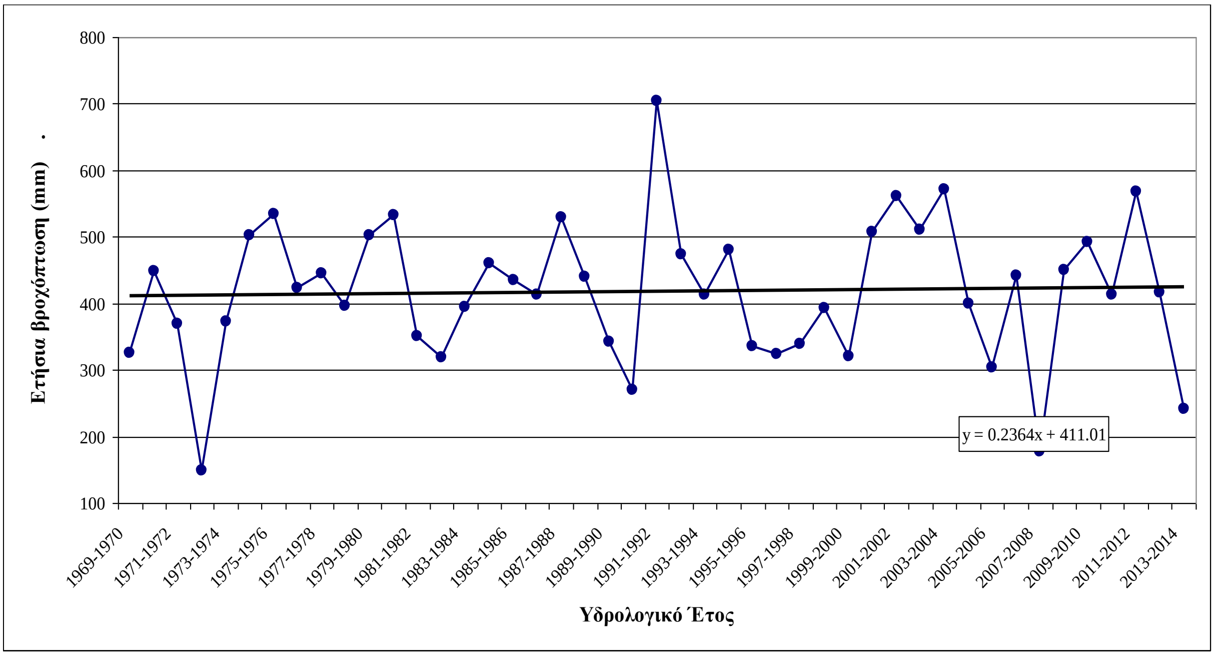

Figure 4-18: Annual Precipitation in Hydrologic Region 8.

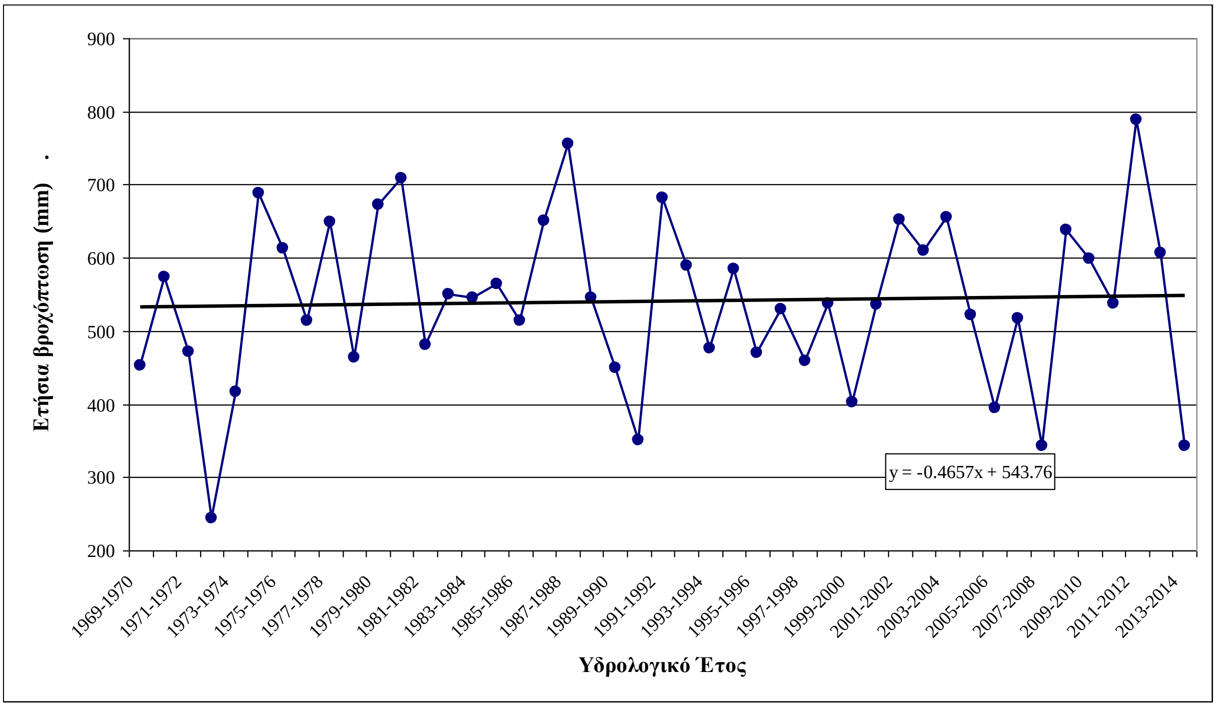

Figure 4-19: Annual Precipitation in Hydrologic Region 9.

The table below (Table 4-2) shows the average annual precipitation per hydrological region for the years from 1969-70 through 2013-14. Hydrologic Region 1 (Paphos Area) receives the most rainfall (average annual precipitation equal to about 563 mm), while Hydrologic Region 7 (Kokkinohoria Area) the least, with an average annual rainfall equal to 325.1 mm.

Table 4-2: Average annual rainfall in the hydrologic regions of Cyprus.

Hydrologic Region	Mean Elevation (m)	Surface Rainfall (without level adjustment) (mm)	Surface Rainfall (with level adjustment) (mm)
Hydrologic Region *1*	465.1	570.1	562.7
Hydrologic Region *2*	416.3	542.7	554.4
Hydrologic Region *3*	414.7	441.7	454.3
Hydrologic Region *6*	321.4	390.3	358.1
Hydrologic Region *7*	62.7	324.4	325.1
Hydrologic Region *8*	259.1	410.4	417.7
Hydrologic Region *9*	438.2	512.1	540.9

Then, the study is performed to confirm or reject Rossel's hypothesis, that around the year 1970 a sudden, abrupt and significant change in the regime of the annual rainfall was observed in Cyprus. To confirm or reject the hypothesis, two statistical tests were performed for rainfall stations having recorded raw data from the year 1916 to 1917 until today. The pluviometric stations are classified per Hydrologic Region and are presented in the table below (Table 4-3). Firstly, all pluviometric stations shown a downward trend for rainfall since the beginning of the sample. The first statistical operation tested whether the downward trends shown are significant with a (95%) confidence level.

Then, the tests showing that there is indeed a sudden change of rainfall before and after the year 1970 are two:

1. A test to verify whether the two annual rainfall samples (before and after 1970) belong or not to the same population, i.e. whether they have the same or similar statistical characteristics (or if the difference in the samples is statistically significant); and
2. Whether the variances of annual rainfall are statistically identical.

All three operations are performed using the Statistical Package XLSTAT in the Excel environment. The first test is based on the methodologies of Kolmogorov and Mann-Whitney. The second test is based on three methodologies: (a) the F-test, (b) the Bartlett test and (c) the Levene test. Testing whether the annual rains have a statistically significant downward trend means performing a Pearson correlation test with time series, taking the hydrologic year 1916-17 as 1 and the hydrologic year 2013-14 as 98.

The test results are presented in the table below (Table 4-3). In Column (1) “Statistically Significant Rainfall Downward Trend”, YES indicates a statistically significant downward trend and NO a downward trend that is not statistically significant.

In Column (2) which relates to whether the two rainfall belong or not to the same population, YES indicates that they do belong to the same statistical population and therefore, there are no statistically significant differences between the two samples. On the contrary, NO indicates that they do not belong to the same population and that there are substantial and statistically significant differences between the two samples.

The last column compares variances between the two samples to determine whether variance of annual rainfall varies around the mean. Substantial differences in the variances may indicate a significant change in weather conditions in Cyprus. YES indicates that there are no statistically significant differences in the two samples’ variances and NO indicates that the disparity in the variances is statistically significant. In other words, for Rossel's hypothesis to be true, columns (2) and (3) should indicate NO, while to reject it, they should state YES. There can be no conclusion if Columns (2) and (3) do not coincide, but Column (2) is considered more important.

Initial observation does not allow us to extract safe conclusions for a homogeneous behaviour of annual rainfall for the whole of Cyprus for the period of 98 years, but not even for a single Hydrologic Region. Therefore, in our opinion, any conclusions about whether there is a homogeneous downward trend in annual rainfall from the year 1916-17 would be mere assumptions, which we do not consider to be significant under Column (1) of the table below (Table 4-3).

Table 4-3: Table of statistical test results of annual rainfall in stations with data for 98 years (hyd. year 1916-17 to 2013-14).

Rainfall Station	Column (1) Statistical Significant Rainfall Decreasing Trend (YES/NO)	Column (2) Rainfall between 1916-1969 and 1970-2014 Statistically Identical (YES/NO)	Column (3) Statistical Equality of Rainfall Variances (YES/NO)
HYDROLOGIC REGION 1			
DROUSHEIA (FOR. ST.)	NO	YES	YES
KYKKOS (MONH))	YES	NO	NO
ANATOLIKO (MONH))	NO	YES	YES
PANO PANAYIA (FOR. ST.)	NO	YES	YES
AYIOS NEOFYTOS (MONH)	NO	NO	YES
PANO STROUMPI (POL. ST.)	NO	YES	YES
KALOKEDHARA	NO	NO	YES
HYDROLOGIC REGION 2			
KATW PYRGOS (POL. ST.)	NO	YES	YES
POLIS CHRYSOCHOUS (POL. ST.)	NO	YES	YES
STAVROS PSOKAS (FOR. ST.)	YES	NO	YES
YIALIA (FOR. ST.)	YES	YES	YES
HYDROLOGIC REGION 3			
KAPOURA (FOR. ST.)	YES	NO	YES
EVRYCHOU (POL. ST.)	YES	NO	YES
PLATANIA (FOR. ST.)	NO	YES	YES
PEDOULAS (POL. ST.)	NO	NO	YES
AYIOS EPIFANIOS	YES	NO	NO
KLIROY (POL. ST.)	YES	NO	NO
KOKKINOTPIMITHIA (POL. ST.)	NO	YES	YES
PALAICHORI	YES	NO	NO
PANAYIA GEFYRI (FOR. ST.)	YES	NO	NO
PERISTERWNA (POL. ST.)	NO	YES	YES
HYDROLOGIC REGION 6			
ATHALASSA	NO	YES	YES
KATO DEFTERA (POL. ST.)	YES	NO	NO
MACHAIRAS (MONH)	NO	NO	YES
ATHIENOU (POL. ST.)	NO	YES	YES
KIONIA (FOR. ST.)	NO	NO	NO
MANTRA KAMPIOU (FOR. ST.)	YES	NO	YES

PERA CHORIO (POL. ST.)	NO	YES	YES
NICOSIA	YES	NO	YES
HYDROLOGIC REGION 7			
DASAKI ACHNAS	NO	YES	YES
HYDROLOGIC REGION 8			
ALETHRIKO	YES	NO	YES
KORNOS (FOR. ST.)	NO	YES	YES
KALAVASSOS (PRIM. SCH.)	YES	NO	YES
ORA (PRIM. SCH.)	NO	YES	NO
KOFINOY (POL. ST.)	YES	YES	YES
PANO LEFKARA (POL. ST.)	NO	NO	YES
LARNACA	YES	NO	NO
HYDROLOGIC REGION 9			
AMIANTOS	NO	NO	YES
KOILANI (POL. ST.)	YES	NO	YES
PANW PLATRES (POL. ST.)	NO	YES	NO
SAITTAS (NURS.)	YES	NO	YES
TROODOS (PLATEIA)	NO	YES	YES
MONH (POL. ST.)	YES	NO	YES
AVDIMOU (POL. ST.)	NO	YES	YES
PISSOURI (POL. ST.)	YES	NO	YES
KALO CHORIO (POL. ST.)	NO	YES	NO
LIMASSOL	YES	NO	YES

Figure 4-20 shows the diagram of annual rainfall in Cyprus since 1901-02, as presented in the study “Proposal for the Plan for the Adjustment of Cyprus to Climate Change”. This shows that the average annual rainfall ranges from 559 mm (for the years 1901 to 1930) to 463 mm (for the years from 1971 to 2000).

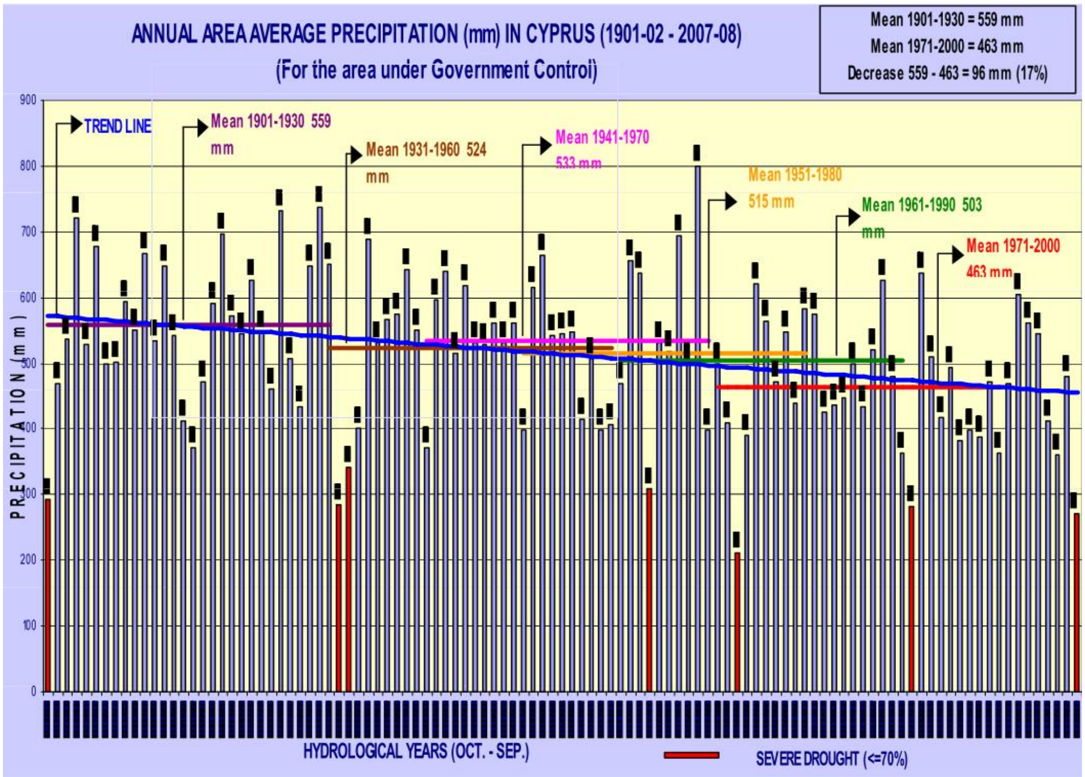

Figure 4-20: Average annual rainfall (mm) in Cyprus for the period 1901-2010.

Future forecasts: Contrary to the current data and conclusions, for future forecasts we adopt the "Proposal for the Plan for the Adjustment of Cyprus to Climate Change". On this basis, the calculation of expected changes, primarily in temperature, rainfall and extreme weather phenomena for the periods 2021 - 2050 and 2071 - 2100 in relation to the reference period 1961 - 1990, made with high spatial resolution simulations with regional climate models (RCMs), shows the already existing climate trends, i.e. warming, a decrease in rainfall and a worsening of extreme weather phenomena.

In the period 2021 - 2050, it is estimated that the increase of the annual maximum temperature will reach 1.3 - 1.9°C (Figure 4-21). In particular, the mountainous areas of Troodos show the largest increase of the maximum temperature, which reaches 1.9°C, while an increase of 1.6°C is expected in already polluted inland areas. In the western and southern regions, the expected maximum temperature increase is 1.4°C and 1.5°C respectively while in the eastern regions the expected increase is about 1.3°C. As for the period 2071 - 2100, an even greater increase of 3.0°C - 4.2°C is expected (Figure 4-22). In particular, the largest increase in the maximum temperature, of 4.2°C, is expected in mountain areas; however, in the inland area to the increase is significant, reaching 3.5°C. In the western, southern and eastern regions and the coasts, it is expected to rise by about 3.0°C.

Regarding precipitation, the results of climate model simulations show that for the period 2021 - 2050, the changes in the annual rainfall are not so important and the observed drops (approximately 10 - 20 mm per year) are confined to the mountainous areas of Troodos (Figure 4-23). The largest decreases in precipitation are expected in the period 2071 - 2100, for which the results show (Figure 4-24) that in the mountainous and western regions, mainly in the Akamas peninsula, the reduction will be around

100 - 130 mm per year while in the southern regions around 90 - 100 mm per year. In the eastern areas and inland, the decrease in precipitation is expected to be less than 50 mm per year.

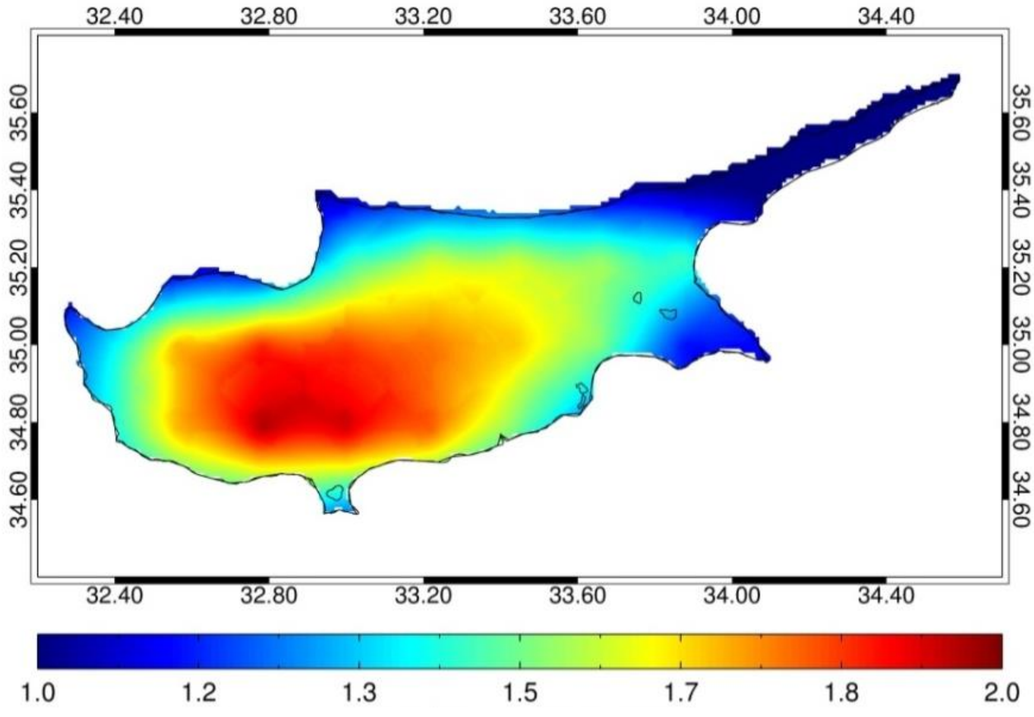

Figure 4-21: Changes in average annual maximum temperature in the period 2021-2050 compared with the period 1961-1990.

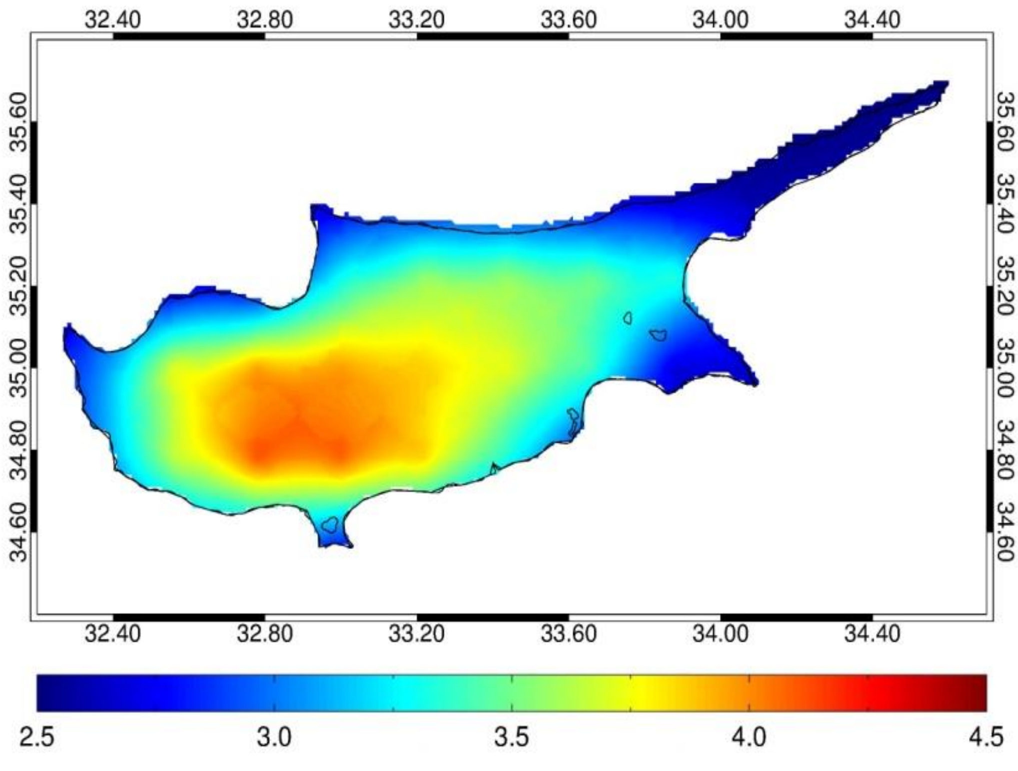

Figure 4-22: Changes in average annual maximum temperature in the period 2071-2100 compared with the period 1961-1990.

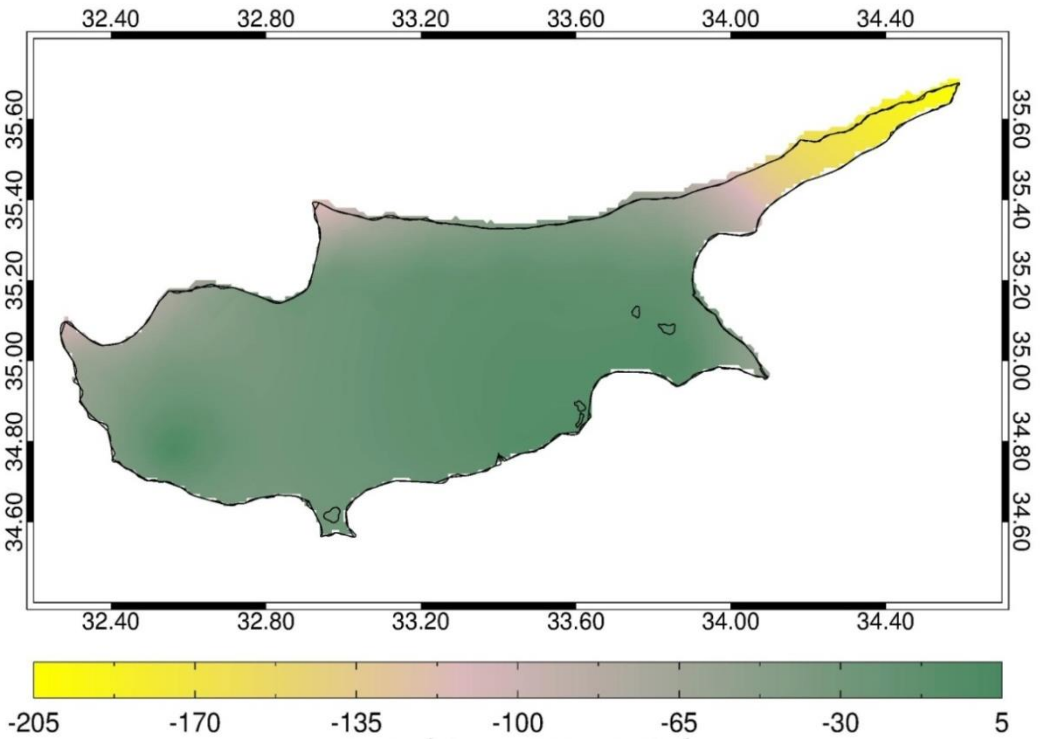

Figure 4-23: Changes in total annual rainfall in the period 2021-2050 compared with the reference period 1961-1990.

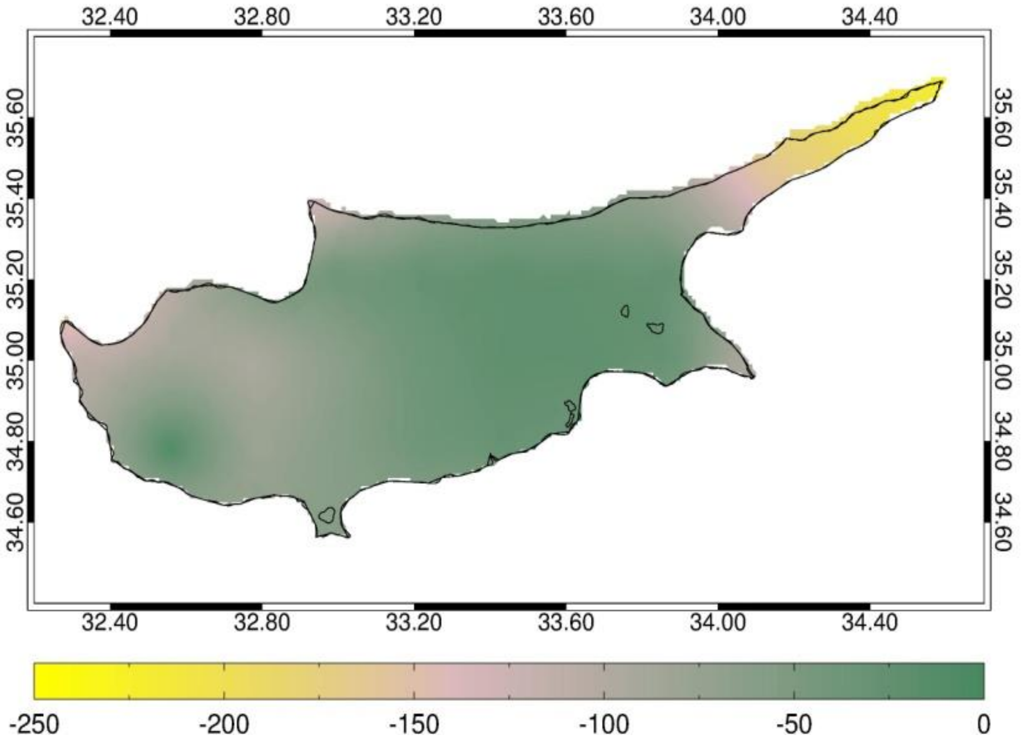

Figure 4-24: Changes in total annual rainfall in the period 2071-2100 compared with the reference period 1961-1990.

Regarding extreme heat waves, for the period 2021 - 2050, it is estimated that the annual number of very hot days (temperature over 35°C) is expected to increase to 34 days in inland regions, 30 in mountainous regions, 19 in southern regions and 17 in eastern regions (Figure 4-25). The western regions (Paphos) show the smallest increase in very hot days, of around 2-5 days. Greater changes in very hot days are expected for the period 2071 - 2100 (Figure 4-26). Throughout the study area, increases of 50-60 days are expected, with the exception of the Akamas peninsula and the region of Agia Napa, where the increase is around 5 days.

An increase is also expected in hot (or tropical) nights, where the minimum temperature is above 20°C. This parameter is closely linked to the health of the population, since a hot night after a very hot day can lead to a rise in people's discomfort. Regarding the period 2021 - 2050, the number of hot nights is expected to increase significantly in the mountainous and western regions, reaching 38 and 32 days respectively. In the rest of the area, the increase is expected to be between 25 to 30 days (Figure 4-27). For the period 2071 - 2100, the mountainous and western regions present the largest increase in hot nights (of 65-70 days) while in other areas the increase reaches 55 days (Figure 4-28).

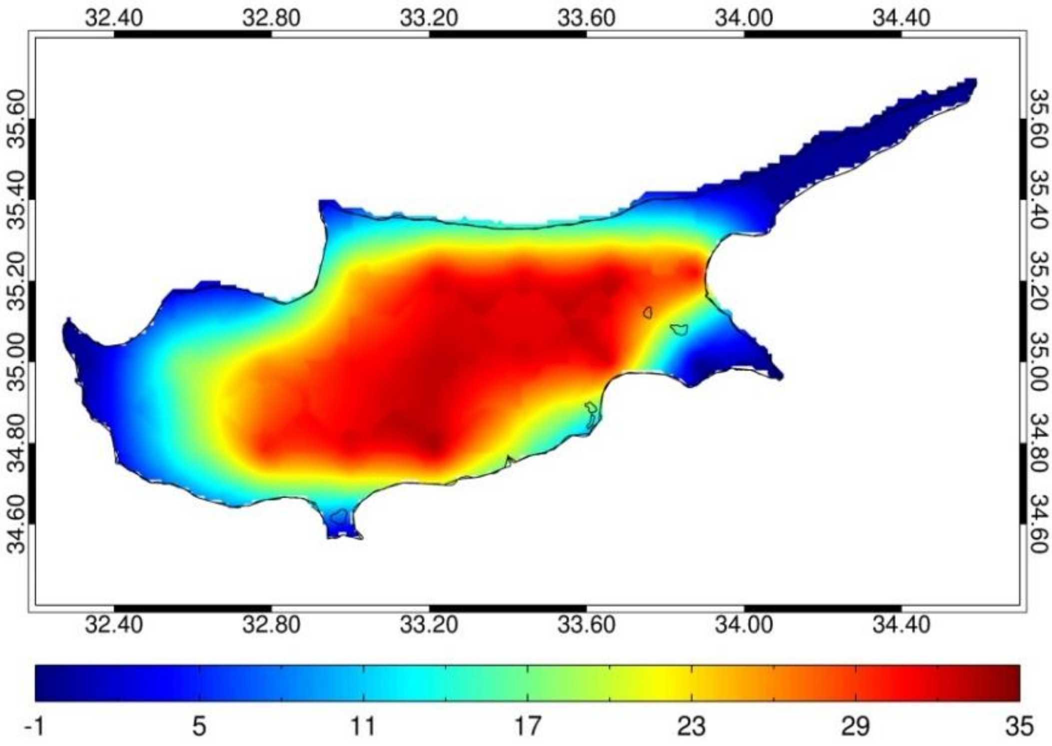

Figure 4-25: Changes in the number of heatwave days (maximum temperature > 35°C) in the period 2021-2050 compared with the reference period 1961-1990.

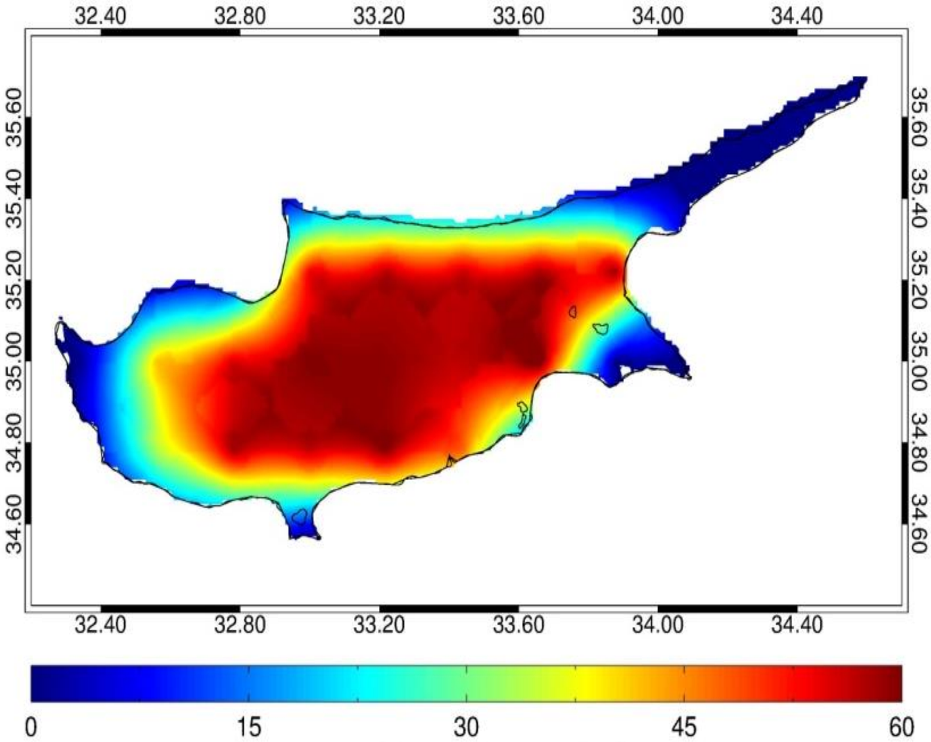

Figure 4-26: Changes in the number of heatwave days (maximum temperature > 35°C) in the period 2071-2100 compared with the reference period 1961-1990.

Finally, droughts in Cyprus are expected to become more frequent in both the near and distant future. According to the simulation results, for the period 2021 - 2050, an increase of dry days, i.e. those with rainfall of less than 0.5 mm, of around 4-6 days is expected in coastal areas and of 10 to 12 days in mountainous areas and inland areas (Figure 4-29). For the period 2071 - 2100, greater changes are expected in the number of dry days. More specifically, in the coastal zone from the region of Paphos to Larnaca, an increase of 10 days is expected, while in the rest of the region the increase ranges from 15-20 days (Figure 4-30).

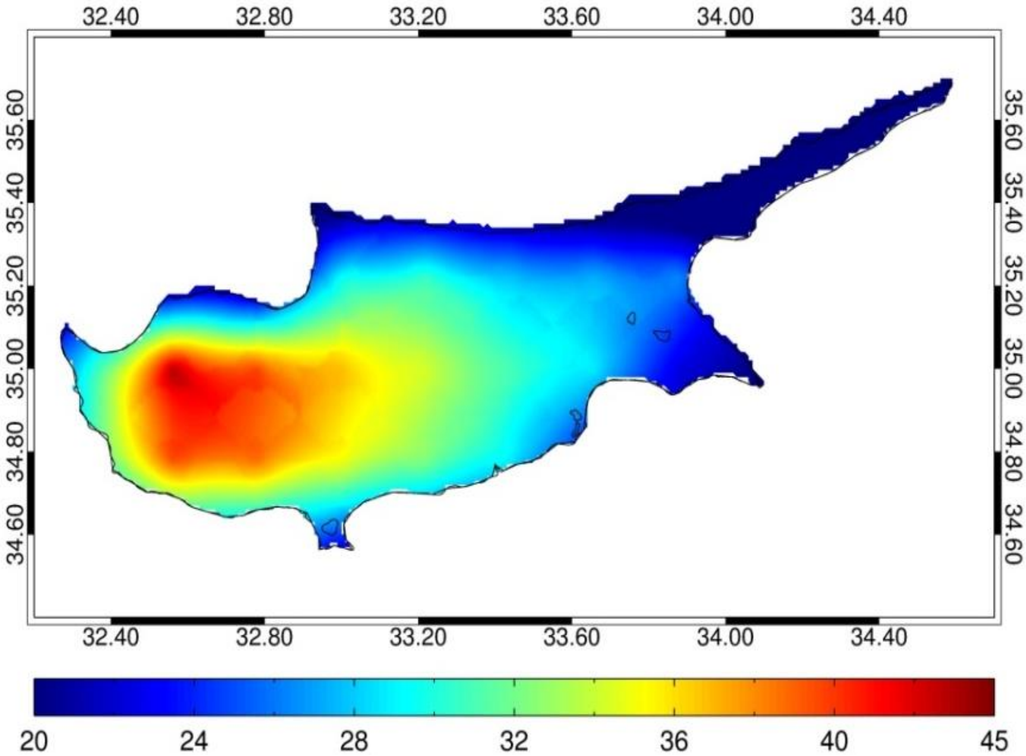

Figure 4-27: Changes in the number of tropical nights (maximum temperature > 20°C) in the period 2021-2050 compared with the reference period 1961-1990.

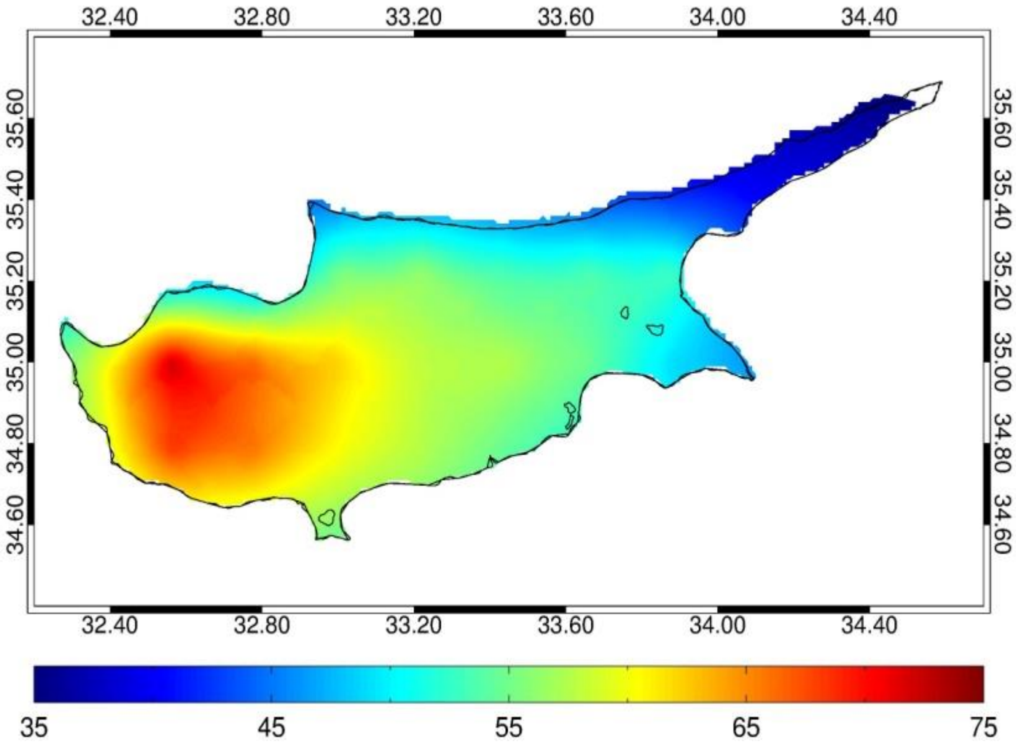

Figure 4-28: Changes in the number of tropical nights (maximum temperature > 20°C) in the period 2071-2100 compared with the reference period 1961-1990.

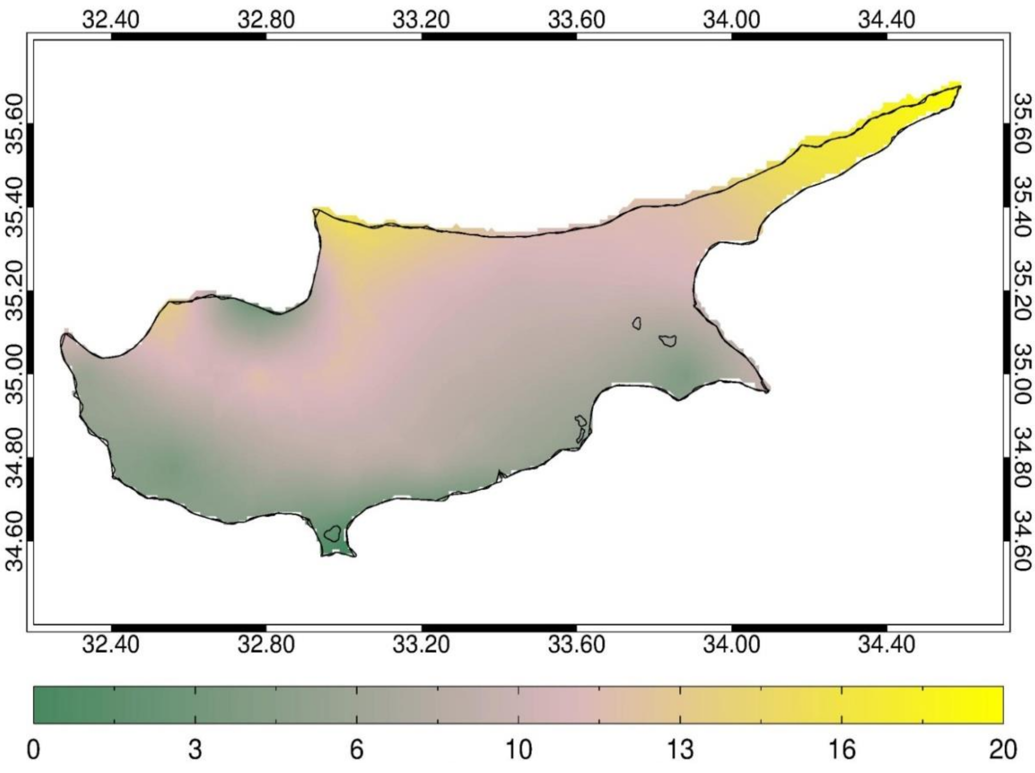

Figure 4-29: Changes in the number of dry days (rainfall < 0.5 mm) in the period 2021-2050 compared with the reference period 1961-1990.

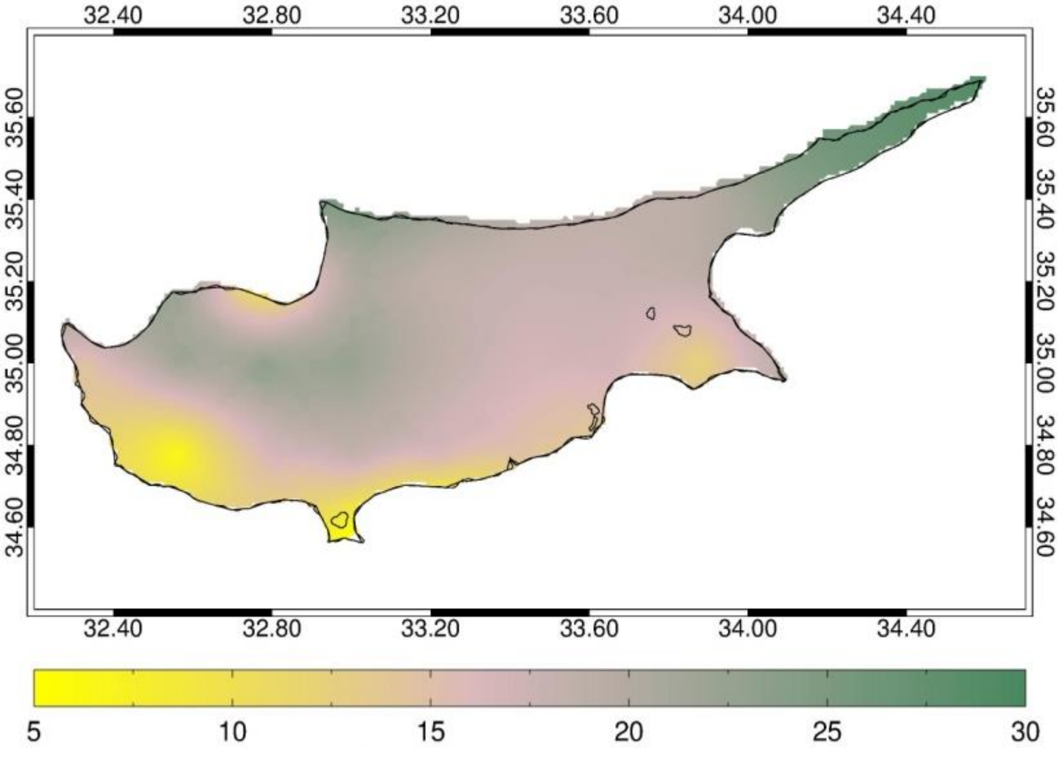

Figure 4-30: Changes in the number of dry days (rainfall < 0.5 mm) in the period 2071-2100 compared with the reference period 1961-1990.

The results of the changes in the above key climate parameters are summarised in the table below (Table 4-4).

Table 4-4: Pooled results of changes in key climate parameters for the periods 2021-2050 and 2071-2100, compared with the reference period 1961-1990.

	Western Areas		Southern Areas		Eastern Areas		Inland Areas		Mountainous Areas	
	2021 - 2050	2071 - 2100	2021 - 2050	2071 - 2100	2021 - 2050	2071 - 2100	2021 - 2050	2071 - 2100	2021 - 2050	2071 - 2100
Maximum Annual Temperature	1.4	3.0	1.5	3.0	1.3	3.0	1.6	3.5	1.9	4.2
Annual rainfall	0	100-130	0	90-100	0	<50	0	<50	10-20	100-130
Number of days with Extreme Heat	2-5	50-60*	19	50-60	17	50-60**	34	50-60	30	50 - 60
Days of Warm Nights	32	65	28	55	25	55	30	55	38	70
Number of Dry Days	4-6	10	4-6	10	4-6	10	10-12	15	10-12	20

* Except Akama Area where the increase is smaller, approximately 5 days.

** Except yhe wider area of Ayia Napa where the increase is smaller, approximately 5 days.

4.3.5 CLIMATE TRENDS

To test the performance of the various models used for future climate forecasts, the climate time series of observations from various weather stations in Cyprus were analysed, together with the corresponding time series provided by the climate models. There follows an indicative presentation of the time series of observations and the models for the average annual maximum temperature and mean annual precipitation for the weather station of Nicosia.

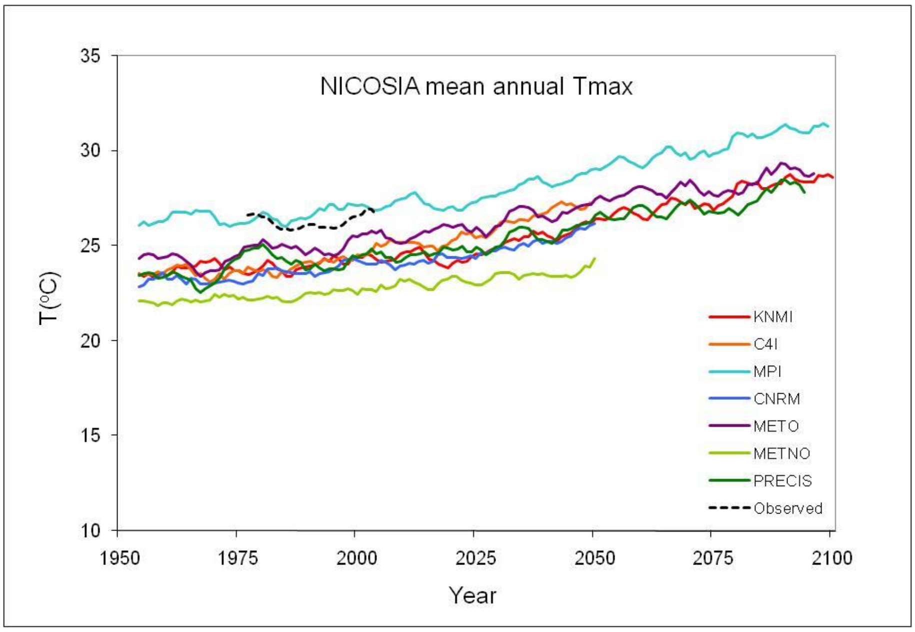

Figure 4-31: Time series of annual mean maximum temperature observations (black dashed line) and various regional climate models for the Nicosia station.

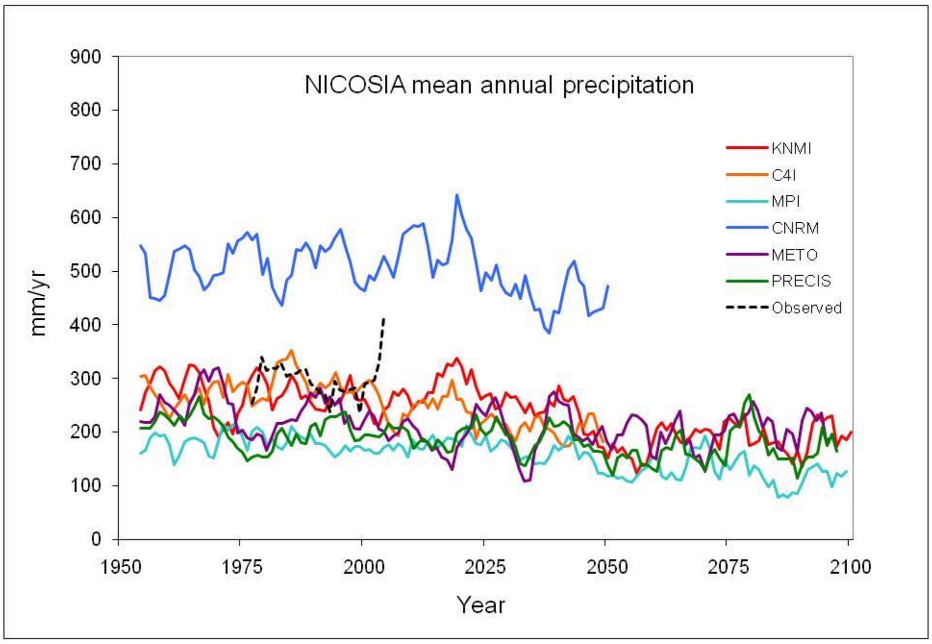

Figure 4-32: Time series of mean annual precipitation observations (black dashed line) and various regional climate models for the Nicosia station.

The analysis of the above time series shows that almost all models have a narrow spread, agreeing with the corresponding spread of the observations, which is a positive conclusion for assessing the capacity of the models to simulate the climate of the study area. Furthermore, the time series clearly show the trends in climate change in Cyprus, namely the continuing rise in temperature and the reduction in rainfall.

4.3.6 IMPACT OF CLIMATE CHANGE ON THE WATER RESOURCES OF CYPRUS

To determine the impact of climate change on the water resources of Cyprus, a descriptive correlation is first made between the observed and expected changes in Cyprus' climate with the impact each one of them can have. This recording is presented in summary in the following table (Table 4-5).

Table 4-5: Relationship between climate change and impacts in the field of water resources

Possible climate changes	Effects
Increase of air temperature	– Increase of water temperature. – Increase of evaporation and transpiration.
Increase of evapotranspiration	– Reduced runoff in the hydrographic network. – Lower aquifer recharge rates (lower groundwater) – Salination of aquifers due to reduction of infiltration.
Reduced rainfall and increased frequency of droughts	– Reduction of available runoff. – Increased water scarcity due to reduced availability of water resources in steady-state conditions. – Increased water pollution and quality deterioration due to the lower dilution of pollutants and consequent increase in their concentration (nitrogen, phosphorus, dissolved organic carbon, pathogens, pesticides, salts). – Lower aquifer recharge rates (lower groundwater) – Salination of coastal aquifers due to falling levels and saltwater intrusion.
Increased fluctuation in precipitation	– Increased deviation of annual runoff from the mean value and increase in the dam overflow periods and in periods with very little runoff.
Increase in heavy rainfall	– Increased incidence of floods. – Deterioration of the quality of surface water due to soil erosion in flood flows. – Lower aquifer recharge rates, particularly in mountainous areas, due to increased runoff.
Increase of surface water temperature	– Increased development of harmful algae and reduction of dissolved oxygen levels in water bodies, which can lead to eutrophication. – Prolonged thermal stratification in lakes, with reduction of the concentration of nutrients in the upper layers and extensive oxygen depletion in deeper layers. – Changes to mixing patterns and to capacity for self-cleaning. – Salination of water resources.
Rise in sea level	– Salination of coastal aquifers. – Contribution to the increased frequency of floods in coastal areas.

Additionally, the impact of climate change on the functioning and performance of works related to the utilisation of the water resources of Cyprus

Small scale exploitation projects (Weirs, small dams, etc.): In many cases, the mountainous areas of Cyprus rely on exploiting the main runoff of rivers, to cover their needs. Dependence on the main runoff will be particularly sensitive to climate change impacts due to the expected reduction of the main runoff in favour of flood runoff and the consequent increase in the number of streams and days without flow. Small dams with only short-term, seasonal storage will be similarly affected. For small dams, a additional effect will be the increase the sediment yield due to the increased soil erosion and the consequent reduction of their useful volume and therefore the increase in maintenance costs for these projects.

Large dams and reservoirs: Large dams with long-time storage are a very important element of the water resources system in Cyprus. Large dams are central to the water supply of the majority of the population and most of the irrigation. As interannual storage tanks, they are not sensitive to one year changes in flow regime. The main potential impacts on large dams will come from perennial droughts, increased sediment yield and increased water demand. Moreover, a prominent risk to be assessed arises from changes in the flood regime. However, in wet periods inflows in large dams are likely to increase due to changes in the rainfall regime, where more extreme rains with high and torrential runoff and less mild rains with little runoff and high infiltration will be observed. However, the long term average precipitation shall decrease.

Underground Aquifers: The majority of aquifers in Cyprus is currently experiencing an overexploitation regime. It is clear that the expected reduction in natural replenishment, as discussed above, shall further reverse the negative balance. Additional pressure due to climate change will occur in the coastal aquifers, stemming from the rising sea levels. This will lead to further penetration of the salt water front in the aquifer. For mountain communities, the risk of reducing and/or eliminating spring runoff should be assessed.

Desalination: Desalination plants have taken an important role in the water balance of Cyprus. The immediate climate change risks for desalination plants arise from rising sea levels and an increase in wave action. The risks arising from the need for increased production of desalinated water in the energy balance in Cyprus should be considered in particular.

Reuse of water: Increasing the reuse of water for irrigation if an important part of the water policy in Cyprus. No major impacts due to climate change are expected in this area. However, taking into account the impact on other areas, climate change will lead to the need for increased use of treated wastewater.

5. DESCRIPTION OF THE STUDY AREA

5.1 INTRODUCTION

Cyprus is an island country in the eastern Mediterranean, en EU member located east of Greece (270 km east from the coasts of Crete, Rhodes and Kastelorizo), south of Turkey (70 km from the Turkish coast) and west of Syria (110 km from the Syrian coast). In particular, Cyprus is located between the 34°33' and 35°42' N parallels and the 32°16' and 34°35' E meridians. It occupies an area of 9,254 ^{2} (of which 5,760 ^{2} are under the control of the Republic of Cyprus) and is the third largest Mediterranean island after Sicily and Sardinia. It has a maximum length of 225 km (distance between Cape Drepano and Cape Apostolos Andreas) and a width of 94 km (distance between Cape Kormakitis and Cape Gata). The total length of its coastline is 772 km.

Cyprus 's morphology is dominated by the following morphological units:

- Troodos mountain chain, located in the central-western part of the island, with the highest peak, Olympos, having an altitude of 1,951 m above sea level.
- Pentadaktylos mountain chain, which has a relatively small width and extends along the northern coast of the island with peaks up to 1,000 m in altitude.
- Mesaoria plain traversed by two rivers Pediaios and Gialia. Mesaoria plain is located between the mountain chains of Troodos and Pentadaktylos and has a generally low altitude.
- Coastal plains and valleys along the coast.

Cyprus has an intense Mediterranean climate with the typical seasonal variation strongly marked with respect to temperature, rainfall and the weather in general. Rainfall varies depending on latitude and altitude. In the eastern end of the island, in the Famagusta district, average annual rainfall is 320 mm and increases westward reaching in Paphos 540 to 550 mm. Annual rainfall also presents extremely high temporal, apart from the spatial, variability. On average, 80% to 85% of rainfall returns to the atmosphere as evapotranspiration, a rate that may reach 95% on drier years. This means that, in terms of annual contribution to water resources, rainfall variability is strengthened by increasing the rate of loss to the atmosphere, while rainfall decreases. As a result, on dry years, the water volumes added to the resources are sub-multiple with respect to average years.

In terms of surface runoff, the massif of Troodos is a determining factor, since it is the starting point of large and small rivers. All 25 important rivers and streams, in terms of runoff, spring from the mountains of Troodos. Total average runoff in Cyprus is of the order of 300 hm^3 annually. Part of this runoff is also part of the supply of groundwater. Hydrographically, Cyprus is subdivided into 9 hydrologic regions.

Out of 21 defined Groundwater Bodies (GWB), 20 are either delimited within the Troodos massif, or directly supplied by runoff coming from it. The GWB of Kokkinohoria (CY-1) in the Famagusta district, is an exception, as it is supplied to a lesser extent by river Gialia, which stems from the Troodos massif.

Natural supply of GWB in the area effectively controlled by the Government of the Republic of Cyprus amounts to approximately 220 hm^3 per year (period 2008-2013). Natural supply is supplemented by artificial recharge waters in the Germasogeia area with water from the homonymous dam and the Ezousa area through the respective recharging project, using treated water from the Paphos WWTP.

Figure 5-1: Map of the Republic of Cyprus with 9 hydrologic regions and the main hydrographic network

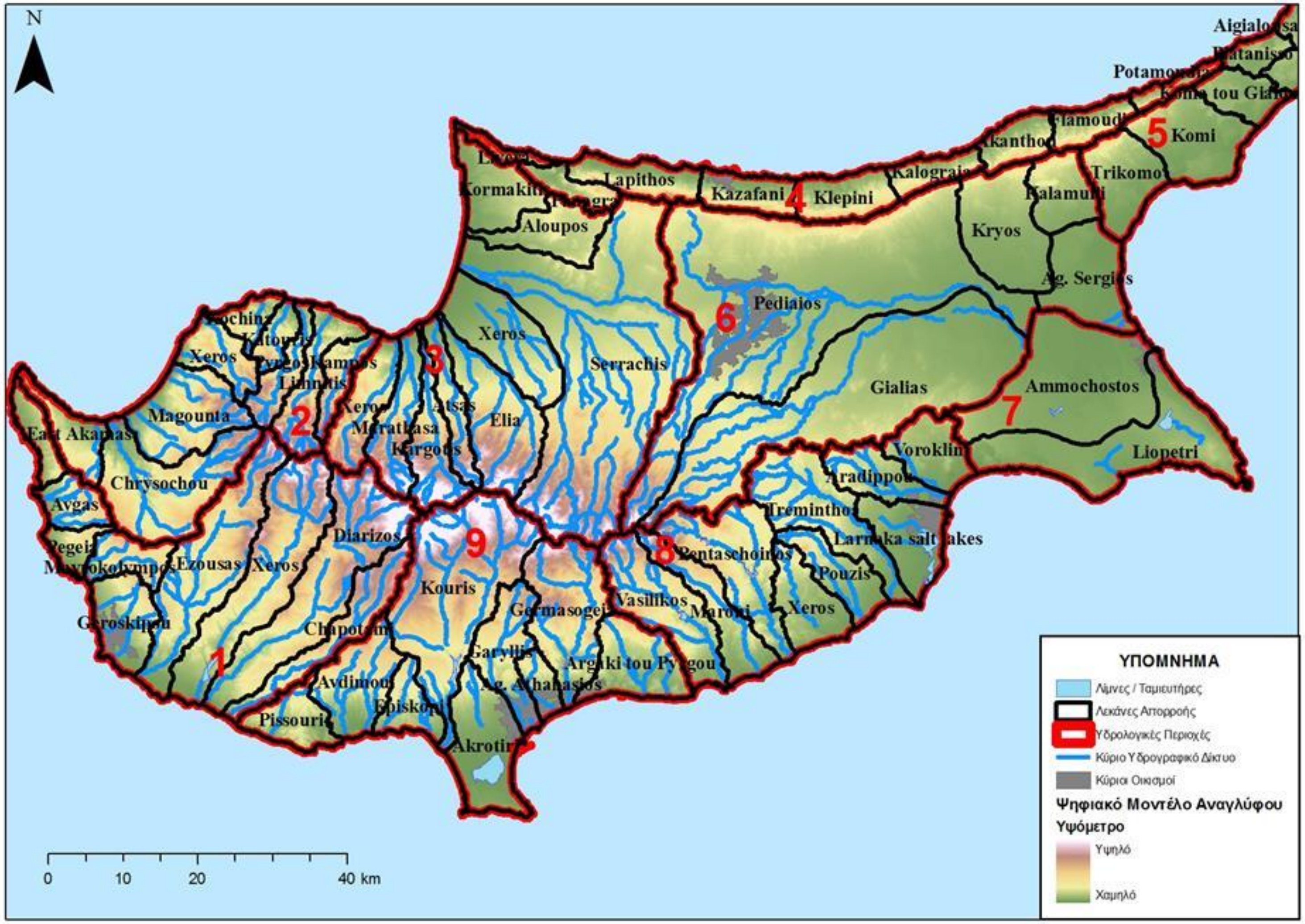

Figure 5-2: Map of the Republic of Cyprus with the main basins and the main hydrographic network

5.2 POPULATION AND DEVELOPMENT DATA OF THE REPUBLIC OF CYPRUS

Cyprus became an independent Republic on 16 August 60 and has a presidential system of government. Since 1974, about 37% of the territory of Cyprus has been under Turkish occupation. In these occupied areas the Government of Cyprus does not exercise effective control. For administrative reasons, Cyprus is divided into six (6) Districts. The administrative capital of each District is the namesake Municipality (Nicosia, Limassol, Larnaca, Paphos, Famagusta and Kyrenia). Each District is headed by a District Officer, who is the senior civil servant under the Ministry of Interior. The District Administration, in addition to their institutional role, according to the provisions of the 1999 Law on Communities, coordinate, guide and implement development projects in the communities.

Municipalities and Communities handle Local Administration Issues. The Municipalities (33) cover approximately 65% of the population, while Communities comprise the rest of the population. Besides Municipalities, the other type of first degree Local Authorities in Cyprus are the Community Councils and the Councils of Community Unions, with generally similar powers to those of Municipalities, but less independence. Community councils and Councils Community Unions amount to 353 in the free areas and represent about 35% of the population and 90% of the land area of Cyprus.

The total population recorded in free areas was 840,407 inhabitants, an increase of 21% since 2001. It has been estimated, based on the coverage check survey after the census, that a percentage of 1.93% was not recorded (they were absent, they were not declared, they did not respond, etc.), bringing the population to 856,960 on 1st October 2011, against 703,529 in 2001. This data per district show that the population in Paphos and Larnaca grew faster than in the other districts in the last decade.

The population of non-Cypriot nationals has increased significantly. Foreigners who have their habitual residence in Cyprus, meaning those who have been residing in Cyprus for at least one year, represent 20.3% of the recorded population, reaching 170,383, against 63,811 (9.4% of the total population) in 2001.

Table 5-1 : Population and Percentile population change, by district and in the whole of Cyprus, 1982-2011

Region	1982	Change 1982-1992	1992	Change 1992-2001	2001	Change 2001-2011	2011
Nicosia	210.684	16.2%	244 779	11.8%	273 642	19.5%	326 980
Famagusta	25.659	20.0%	30 798	22.5%	37 738	23.6%	46 629
Larnaca	84.496	18.6%	100 242	15.0%	115 268	24.2%	143 192
Limassol	145.614	19.2%	173 634	13.2%	196 553	19.7%	235 330
Paphos	45.645	15.2%	52 572	26.2%	66 364	33.0%	88 276

TOTAL	512.098	17.6%	602 025	14.5%	689 565	21.9%	840 407

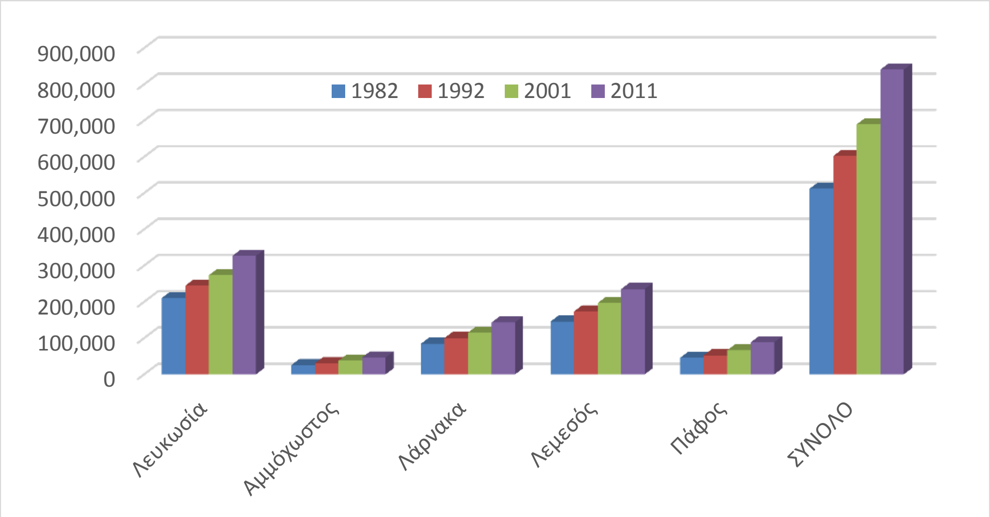

Figure 5-3: Population change, by district and in the whole of Cyprus, 1982-2011

In Cyprus, as in all European countries, the percentage of urban population is constantly increasing at the expense of people living in mountainous and less favoured areas. The percentage of population in urban areas was estimated at 67.4% compared to 68.7% in 2001 and 67.7% in 1992; therefore, a retention of population in rural areas was generally observed, although the residents continued decreasing in mountain villages.

The Cypriot economy is under a fiscal adjustment programme, covering the period 2013-2016. The period 2008-2013 is characterised by a decrease by 3.5 % of the Gross Domestic Product, a significant increase in the unemployment rate from 3.6% to 15.9% and by a Budget deficit of the General Government.

The **total** GDP of the country showed a decrease of 3.5%, from € 18.77 billion in 2008 to € 18.11 billion in 2013.

In 2013, the **Primary Sector** contributed to the GDP by a percentage (2.3%) slightly higher than in 2008 (2%)

The **Secondary Sector** shows a significant decrease (-44,1%) in its participation in the GDP from € 3.4 billion in 2008 to 1.9 billion in 2013. Its contribution to the total GDP of the country for 2013 is about 10.6%.

The **Tertiary Sector** is the dominant sector of economic activity in Cyprus, with a contribution to the GDP of 79.1 in 2013.

In general, the agriculture sector is an important pillar of the economy. Given the associated and resulting economic activities affected by the agricultural, forestry and food sector, and not only the financial activities of the primary sector (which contributes 2.3% to the country's GDP), it is estimated that the total contribution of agriculture to the economy of Cyprus is significant. The multiplier of the direct contribution to GDP has been estimated to approximately 4. This means that the reduction of the agricultural GDP by one unit can cause a four-fold equivalent reduction in the total GDP of the entire national economy. The agricultural sector as a whole has an important role in growth and employment and therefore in achieving the objectives of the Lisbon strategy. The fact that in the past two to three years, with the onset of the economic crisis, a shift of productive resources has been observed towards agriculture is indicative of the role to be played by the agricultural sector [SOURCE: MAAD&E, 2015].

5.3 INFRASTRUCTURE OF CYPRUS IN THE FIELD OF WATER RESOURCES

Water has always been a resource in shortage in Cyprus. During the Frankish period (1192-1571 AD) rainwater was stored and water was pumped from wells (laoumia). This continued in the Ottoman Empire (1571-1878 AD). Systematic management of water began during the British colonial rule (1878-1960), firstly focused on water supply and then irrigation. In 1896, the Department of Public Works was founded and its mission included the construction of hydraulic works. The period until the early 20th century was characterised by failed attempts to exploit surface water and groundwater resources. Then began an increasingly intensive use of groundwater.

In 1939, the Department of Water Supply and Development was created (and renamed in 1955 the Department of Water Development). In the 1940s and 1950s, the department was limited to performing small irrigation projects with bypass dams and small water reservoirs while thousands of boreholes were drilled. This resulted in overexploitation of groundwater resources that led to drops in the level and gradual salination in coastal areas. Thus, following independence, the Republic of Cyprus proceeded to systematically study and build many dams, such as the Pomos, Agia Marina, Argaka, Lefkara, Yermasoyia, Polemidia and Mavrokolympos dams. Water distribution networks were constructed at the same time.

The period after 1974 is characterised by the construction of large projects, such as the Paphos Irrigation Project, the Chrysochou Irrigation Project, the Vassilikos-Pentaschoinos Plan, the Pitsilia Rural Development Plan and finally, the Southern Conveyor Plan. At the same time, eater supply of cities and communities was strengthened and the water treatment plants of Choirokitia, Kornos, Limassol, Tersefanou and Asprokremmos were built. The gradual development of the water resources of the dams of Cyprus is shown in Figure 5-4.

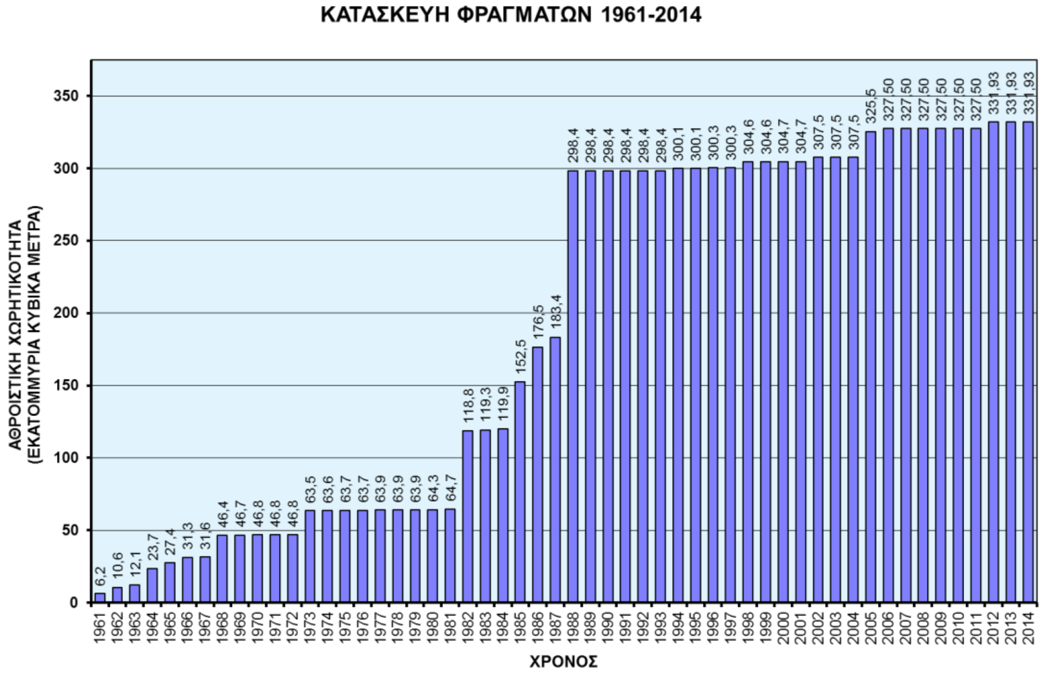

Figure 5-4: Evolution of the available storage capacity of Cyprus dams

The total list of Cyprus dams is presented in the table below (Table 5-2) showing that the total capacity of all dams of Cyprus amounts to 303 hm^3 of water, without this meaning that said amount is available. The following figure shows the location of the dams on the territory of Cyprus in relation to their storage capacity. It appears that the major reservoirs have been built in the southern foothills of Mount Troodos and belong to Hydrologic Regions 8 & 9. Cyprus now ranks first in Europe in terms of number and capacity of large dams in relation to its size, with a ratio of fifty large dams for every 10,000 ^{2}.

Table 5-2: Characteristics of the dams of Cyprus. (EFL: Earthfill, RFL: Rockfill, GRV: Gravity, ARC: Arch) - classified per year of construction

A/A	NAME	Construction Year	River	Type	Height (m)	Storage (hm^3.)	Irrigation	Water Supply	Mixed Use
1	Pera Pedi	1956	Kryos (Kouris)	GRV	22	0.055	√		
2	Pyrgos	1957	Katouris	GRV	22	0.285	√		
3	Trimiklini	1958	Kouris	GRV	33	0.340	√		
4	Prodromos	1962	Tank	EFL	10	0.122	√		
5	Athalassa	1962	Pediaios	EFL	18	0.791	√		
6	Argaka	1964	Makounta	RFL	41	0.990	√		
7	Kiti (Tremithos)	1964	Tremithos	EFL	22	1.614	√		
8	Agros	1964	Limnatis	EFL	26	0.099	√		
9	Polemidhia	1965	Garyllis	EFL	45	3.400	√		
10	Ayia Marina	1965	Xeros	RFL	33	0.298	√		
11	Kalopanayiotis	1968	Marathassas	EFL	40	0.363	√		
12	Mavrokolympos	1966	Mavrokolympos	EFL	45	2.180	√		
13	Pomos	1966	Livadi	RFL	38	0.860	√		
14	Germasogia	1968	Germasogia	EFL	49	13.50	√	√	√
15	Lefkara	1973	Pentasxinos	EFL/RFL	71	13.85	√	√	√
16	Palaichori – Kampi	1973	Serrachis	GRV	33	0.620	√		
17	Kyperounta #1	1974	Tank	EFL	7	0.050	√		
18	Arakapas	1975	Germasogia	GRV	23	0.129	√		
19	Lympia (New)	1977	Tremithos	GRV	12	0.220	√		
20	Ayioi Vavatsinias #1	1980	TANK.	EFL	17	0.055	√		
21	Eptagonia #1	1980	TANK.	EFL	16	0.092	√		
22	Chandria	1980	TANK.	EFL	35	0.070	√		
23	Melini #1	1980	TANK.	EFL	22	0.059	√		
24	pelendri	1980	TANK.	EFL	18	0.123	√		
25	Ayioi Vavatsinias	1981	Vassilikos	ARC	19	0.053	√		
26	Eptagonia # 3	1981	TANK.	EFL	12	0.065	√		
27	Akapnou - Eptagonia	1981	TANK.	EFL	9	0.132	√		
28	Katw Mylos	1981	TANK.	EFL	23	0.104	√		
29	Eptagonia # 2	1982	TANK.	EFL	8	0.127	√		

A/A	NAME	Construction Year	River	Type	Height (m)	Storage (hm^3.)	Irrigation	Water Supply	Mixed Use
30	Arakapas #1	1982	TANK.	EFL	12	0.192	√		
31	Asprokremmos	1982	Xeros R.	EFL	53	52.37	√	√	√
32	Xyliatos	1984	Lagoudera (Elia)	RFL	42	1.420	√		
33	Agridia	1983	TANK	EFL	18	0.059	√		
34	Kyperounta # 2	1983	TANK	EFL	27	0.273	√		
35	Lagoudera	1983	TANK	EFL	36	0.071	√		
36	Ora	1983	TANK	EFL	18	0.062	√		
37	Ayioi Vavatsinias # 2	1984	TANK	EFL	25	0.043	√		
38	Farmakas #1	1984	TANK	EFL	18	0.021	√		
39	Farmakas #2	1984	TANK	EFL	24	0.061	√		
40	Arakapas #2	1984	TANK	EFL	12	0.120	√		
41	Dierona	1984	TANK	EFL	24	0.159	√		
42	Xhirokitia	1984	TANK	EFL	16	0.205	√		
43	Esso Galata	1985	TANK	EFL	27	0.035	√		
44	Kalavassos	1985	Vassilikos	RFL	60	17.10	√	√	√
45	Dipotamos	1985	Pentasxoinos	RFL	60	15.50	√	√	√
46	Evretou	1986	Stavros tis Psokas	RFL	70	24.00	√		
47	Achna	1987	TANK	EFL	16	6.800	√		
48	Aradippou	1987	Parthenitis	GRV	14	0.090	√		
49	Kouris	1988	Kouris	EFL	110	115.0	√	√	√
50	Vyzakia	1994	TANK	EFL	37	1.690	√		
51	Odou #1	1996	TANK	EFL	33	0.032	√		
52	Odou #2	1996	TANK	EFL	34	0.053	√		
53	Meleni #2	1996	TANK	EFL	36	0.097	√		
54	Arminou	1998	Diarizos	EFL/RFL	45	4.30	√	√	√
55	Tsakistra	2000	Limnitis	GRV	23	0.10	√		
56	Tamassos	2002	Pediaios	EFL/RFL	34	2.80	√		

A/A	NAME	Construction Year	River	Type	Height (m)	Storage (hm^3.)	Irrigation	Water Supply	Mixed Use
57	Kanavious	2005	Ezousa	EFL/RFL	75	18.00	√	√	√
58	Akaki-Malounta	2007	Serrachis	EFL	38	2.00	√		
	TOTAL					303.31			

The Major Government Water Projects (GWP) managed by the Water Development Department (WDD) are:

- Southern Conveyor Project, including:
  - the Arminou dam (with the Dhiarizos and Cha-potami bypass), of a capacity of 4.3 hm^3, supplying the Kouris dam
  - the Kouris dam, of a capacity of 115 hm^3
  - the Yermasoyia-Polemidia Irrigation Project, including:
    - ✓ the Yermasoyia dam, of a capacity of 13.5 hm^3 and
    - ✓ the Polemidia dam, of a capacity of 3.5 hm^3
  - the Vassilikos-Pentaschoinos Irrigation Project, including:
    - ✓ the Kalavasos dam, of a capacity of 17.1 hm^3 and
    - ✓ the Dipotamos dam (with the Maroni bypass), of a capacity of 15.5 hm^3
    - ✓ the Lefkara dam, of a capacity of 13.85 hm^3, and
    - ✓ the off-stream Achna dam, of a capacity of 6.8 hm^3.
- Paphos Projects, including:
  - the Kannaviou dam, of a capacity of 18 hm^3, supplying also the Asprokremmos dam through a tunnel
  - the Asprokremmos dam, of a capacity of 52.37 hm^3, and
  - the Mavrokolympos dam, of a capacity of 2.18 hm^3.
- Chrysochou Projects, including:
  - the Evretou dam, of a capacity of 24 hm^3, supplying also the Argaka, Ag. Marina and Pomos dams
  - the Argaka dam, of a capacity of 0.990 hm^3
  - the Ag. Marina dam, of a capacity of 0.298 hm^3 and
  - the Pomos dam, of a capacity of 0.86 hm^3.

Figure 5-5: Map of the dams of Cyprus, showing their capacity.

- Nicosia District Projects:
  - the Pitsilas Irrigation Project, including:
    - ✓ the Xyliatos dam, of a capacity of 1.43 hm^3, supplying also the Vyzakia dam
    - ✓ the off-stream Vyzakia dam, of a capacity of 1.69 hm^3
  - the Kalopanagiotis dam and
  - the Lympia dam.

There are also other GWP, which are usually isolated small government projects which are not included in the Major GWP and mainly concern projects of irrigation water supply service, for which the water provider is the WDD, as the manager of such projects.

Of these:

- The Yermasoyia-Polemidia Irrigation Project, which as mentioned above is part of the Southern Conveyor, is used to irrigate 3,500 ha both directly and through recharge of groundwater (in this case the Yermasoyia dam). Note that the Polemidia dam is also supplied with recycled water (control for efficiency with overflows).
- The Vassilikos-Pentaschoinos Polemidia Irrigation Project, which as mentioned above is part of the Southern Conveyor, is used for:
  - water supply of Nicosia through the refineries of Kornos and Tersefanou (for the Kalavasos dam)
  - local irrigation of Vassilikos (801 ha), Pentaschoinos (422 ha) and Maroni (206 ha), i.e. a total of 1,420 ha
  - Irrigation through the Southern Conveyor, see below.

Note that the Kalavasos reservoir received water from the desalination plant of Vassilikos in 2014, as it the water supply conveyor to Nicosia has not been yet built.

Besides the above, the other reservoirs of the Southern Conveyor are used for:

- water supply of Limassol, Nicosia (through the Tersefanou and Kornos refineries), Larnaca and free Famagusta areas (through the Choirokoitia refinery)
- local irrigation, such as for the area of Akrotiri by the Kouris dam (1,680 ha) and for an area by the Lefkara dam
- irrigation through the Southern Conveyor, including:
  - Kokkinohoria irrigation (9,270 ha)
  - Athienou irrigation (451 ha)
  - Trouli-Avdelero irrigation (46 ha)
  - Kiti irrigation (1,206 ha)
  - Mazotou irrigation (609 ha)
  - Parekklisia irrigation (400 ha) and
  - Aradippou irrigation (250 ha)

i.e. a total of 13,512 ha.

The Paphos Project is used for:

- Water supply of the Paphos area (by the Kannaviou and Asprokremmos reservoirs) and
- Irrigation of 5,000 ha by the Asprokremmos, Mavrokolympos and Kannaviou reservoirs.

The Chrysochou project is used for irrigation of a 3,100 ha area.

The Pitsilia Irrigation Project, which as mentioned above is part of the Nicosia District projects, is used for:

- water supply through the recharge of the groundwater (from the Vyzakia dam)
- irrigation.
    - Besides the above, the other reservoirs of the Nicosia Project (Kalopanagiotis and Lympia) are used for irrigation.
- Groundwater bodies used for water supply are the following: Treminthos Bed (CY-03A), Mari-Kalo Horio (CY-06), Akrotiri (CY-09), Paramali-Avdimou (CY-10), Paphos (CY-11A), Letymbou-Giolou (CY-12), Androlikou (CY-14), Chrysochou-Gialia (CY-15A), Pyrgos (CY-16), Central & Western Mesaoria (CY-17), Lefkara-Pachna (CY-18), Troodos (CY-19) anδ several Small Aquifers of Local Importance (SALI).

Figure 5-6 shows the map of Groundwater Bodies (GWB) in Cyprus.

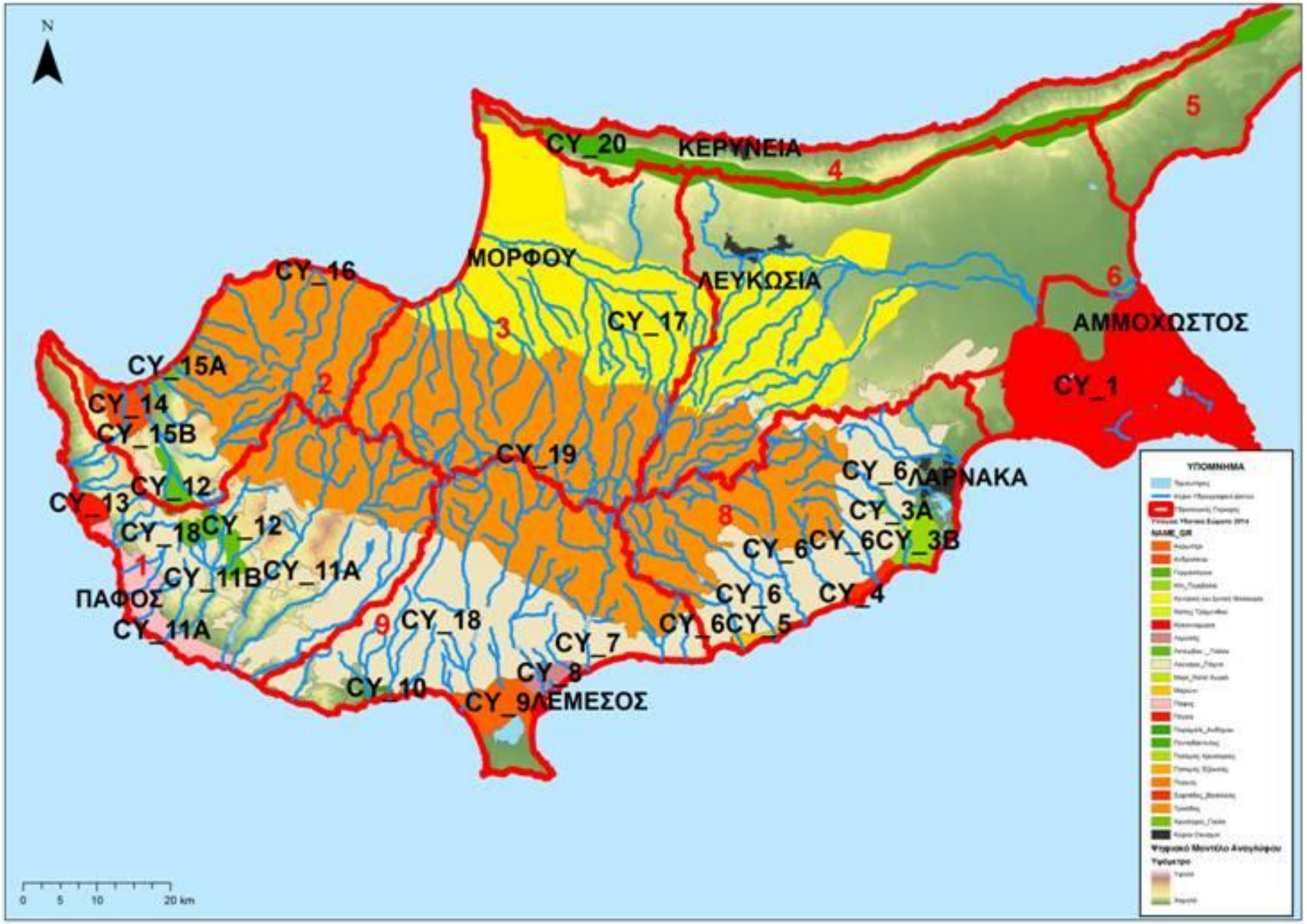

Figure 5-6: Hydrologic Regions and Distribution of Underground Water Bodies

Moreover, the following desalination plants are currently in operation:

- Larnaca, with a capacity of 62,000 m^3/day
- Dekelia , with a capacity of 60,000 m^3/day
- Episkopi (Limassol), with a capacity of 40,000 m^3/day, expandable to 60,000 m^3/day
- Vassilikos (since 2014), with a capacity of 60,000 m^3/day

with a total capacity of 222,000 m^3/day or ~ 73 hm^3/year[3].

Finally, tertiary treatment plants have been implemented in the following Wastewater Treatment Plants [WDD, 2015]:

- Limassol WWTP, with a capacity of 40,000 m^3/day
- Paphos WWTP, with a capacity of 19,500 m^3/day
- Agia Napa WWTP, with a capacity of 21,000 m^3/day
- Larnaca WWTP, with a capacity of 18,000 m^3/day
- Anthoupoli (Nicosia) WWTP, with a capacity of 13,000 m^3/day
- Vathia Gonia (WBL) WWTP, with a capacity of 22,000 m^3/day
- Vathia Gonia (WDD) WWTP, with a capacity of 2,200 m^3/day

with a total capacity of 135,700 m^3/day. The Desalination Plants and Wastewater Treatment Plants (WWTP) are presented in Figure 5-7.

According to available information, the regions that are irrigated with recycled water are Fasouri, Parekklisia, Pentakomo (SBLA), Agios Georgios Alamanou (SBLA), Larnaca (Dromolaxia), Greater Nicosia Area (Vathia Gonia WBL) and Parekklisia (SBLA).

Despite this significant growth of available water resources, due to both the growth in demand and the downward trend of rainfall, the available water amount is still not sufficient, leading to the need for restrictions on irrigation and water supply.

To address the situation, along with awareness campaigns to reduce consumption, an ambitius desalination plan was implemented to create desalination plants to enhance security in the supply of domestic water.

Finally, water recycling is gradually developed, following tertiary treatment of wastewater. Recycled water can be used for irrigation of all crops (excluding leafy vegetables, bulbs and tubers eaten raw) and to recharge Groundwater Bodies. Note that due to the content of the recycled water in nutrients, smaller quantities of plant fertilisers are required.

Total average annual water consumption for the period 2005-2007 is presented in the attached table [Economic Analysis, 2009, Report 2.1, Issue B].

Table 5-3 : Aggregate consumption results (in hm^3) per Water Service - 2005-2007 Average

[3] With an operation authorisation for 90% of the time

Service	INSIDE GWP	OUTSIDE GEP	TOTAL
Water Supply	69.8	11.22	79.90
Irrigation	38.24	105.01	143.25
Sewerage*	20.64		20.64
Reclaimed Water**	9.91		9.91

** This includes Mia Milia quantities, where 6.4 hm^3 (25,000 m^3 daily * 365 days * 70%) are processed*
*** Concerns consumed recycled water quantities*

The quantities of wasterwater sewage (and processing) and of recycled water supply have expanded in the past years with respect to those shown in the above table. Interestingly:

- the proportion of water supply from GWP is about 85% of the total water supply and
- the proportion of irrigation from GWP is about 30% of the total irrigation.

It becomes clear from the available consumption figures that the allocated amounts of water for the period 2010-2014 were:

1. Average annual total water supply: ~80 hm^3, of which:
   - from dams ~40.2 hm^3 or 68%
   - from government boreholes ~7.3 hm^3 or 12% and
   - from desalination ~32.5 hm^3 or 55%
2. Average annual total irrigation: ~58 hm^3, of which:
   - from dams 41.1 hm^3 or 71%
   - from government boreholes 5.1 hm^3 or 9% and
   - from recycling 11.6 hm^3 or 20%.

Based on the above:

- the total water supply demand is between 90 and 95 hm^3/year and
- the total irrigation demand is between 150 and 200 hm^3/year.

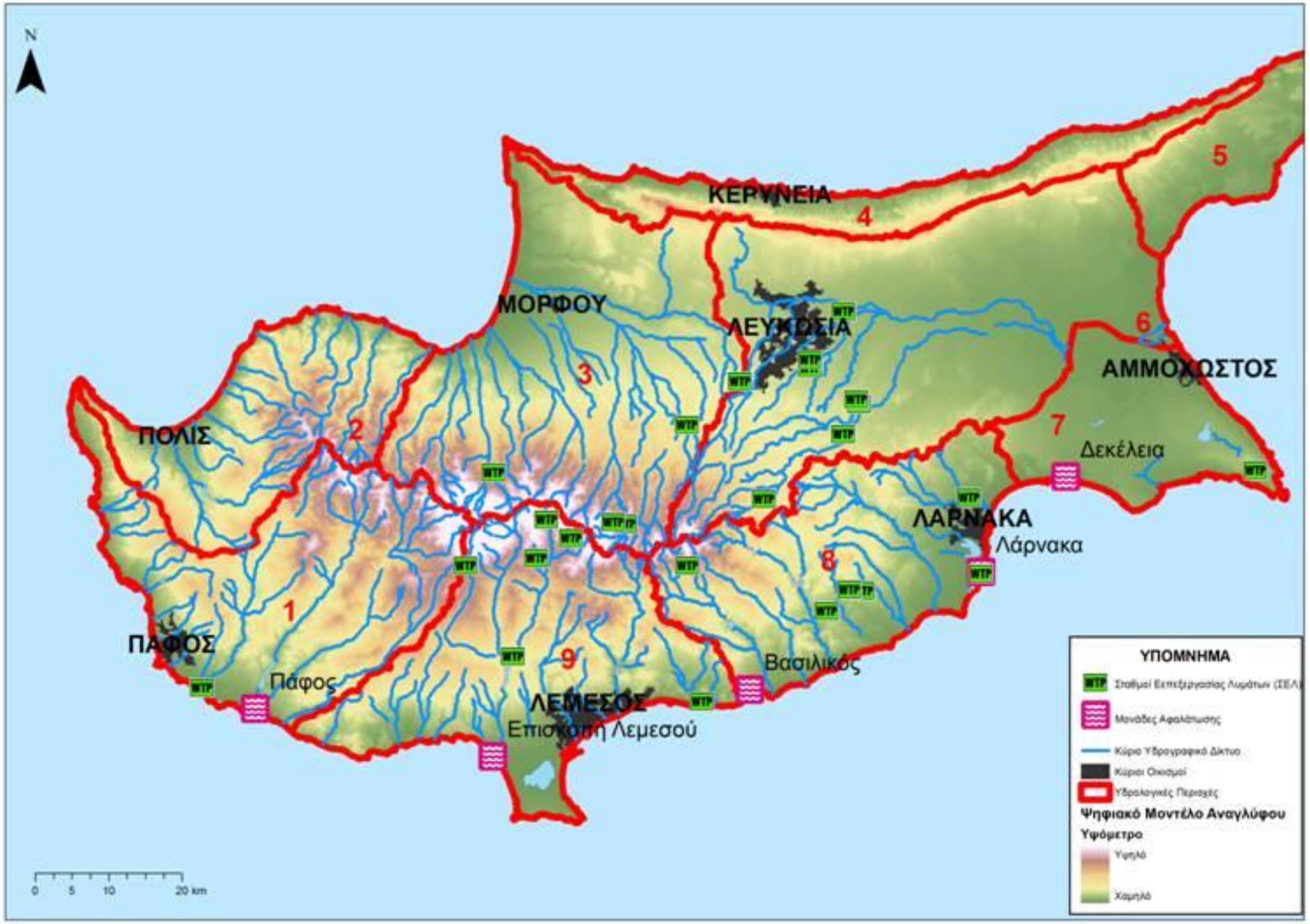

Figure 5-7: Map of Cyprus with desalination plants (the Paphos plant is out of operation) and Wastewater Treatment Plants (WWTP).

The distribution of water supply quantities for major uses [Economic Analysis, 2009, Report 2.1, Issue B] shows that agriculture is the sector that consumes the greatest amount of water in proportion to the other activities with a rate of 59.1%. It is followed by domestic use with 29.6%, tourism with 4.9% and industry and stock farming with 3% and 3.3% respectively, see Figure 5-8 [Economic Analysis, 2009, Report 2.1, Issue A].

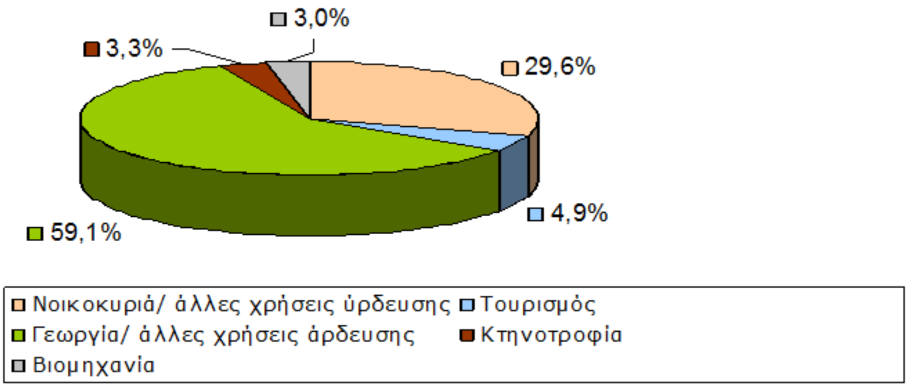

Figure 5-8: Main water uses by activity

Regarding the distribution of water supply per sector by the Water Supply Councils, domestic water use is significantly higher than other activities, see Figure 5-9 [Economic Analysis, 2009, Report 2.1, Issue A].

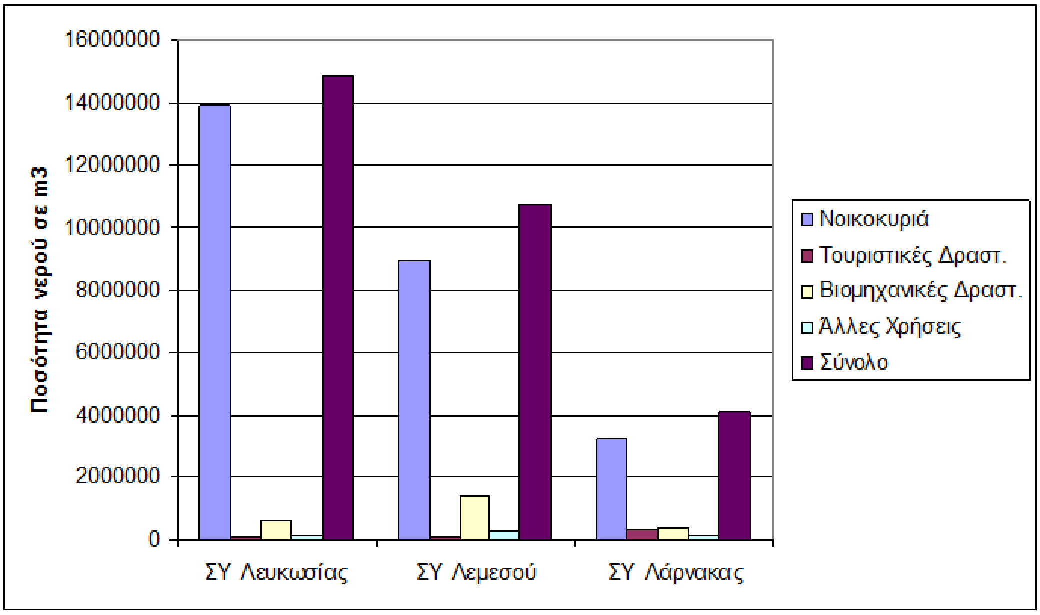

Figure 5-9: Water consumption of the Water Supply Service (Drinking Water Supply) by the Water Supply Councils per use

Figure 5-10 shows the total amount of water consumption in each Hydrologic Region outside of GWP and the corresponding amounts attributable to drinking water and irrigation water [Economic Analysis, 2009, Report 2.1, Issue B]. It is obvious that besides GWP, the largest percentage of water is used for irrigation, while water supply is a very small percentage of the total.

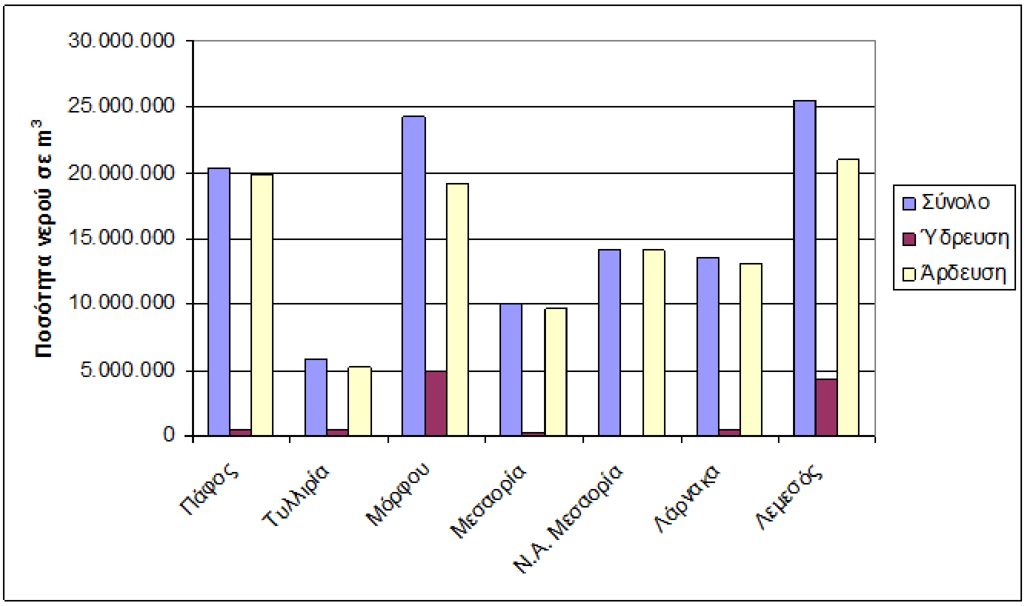

Figure 5-10: Quantity of water available from projects outside the GWP per use and overall

6. EVALUATION OF THE 1ST DROUGHT MANAGEMENT PLAN - CONNECTION WITH THE REVISED DROUGHT AND WATER SCARCITY MANAGEMENT PLAN

6.1 INTRODUCTION

This Chapter presents the evaluation of the 1st Drought Management Plan approved in 2011 for the intervening years that followed until now and proposed its revision in some points. These include: the arithmetic values of indices based on revised hydrological data; a small change of an index for Prolonged Drought and in the Paphos project, due to the reduced capacity of Paphos desalination, compared with original estimates. All flow timeseries used to determine indices related to river runoff and monthly inflows in the large dams of Cyprus are presented in ANNEX A.

6.2 DROUGHT INDICES

The 1st Drought Management Plan was drafted adopting a series of indices that provide information for the following purposes:

- Early detection of drought threat and of the start and end of the drought season.
- Intensity, duration and geographic scope of the drought.
- Pressure exerted on the wider natural environment.
- Pressure on rivers, lake and underground water bodies.
- Pressures on management and exploitation systems of water resources for water supply and irrigation.
- Pressure on non-irrigated agriculture.

Moreover, it was necessary to be able to directly compare the drought conditions among all regions of Cyprus and it was desirable to have, to a some extent, comparability with other countries' values in the Mediterranean and the EU. Finally, an index system based on processed measurements that are already performed under existing monitoring networks was desirable, meaning a system relying on the existing metering infrastructure of meteorological and hydrological parameters of the WDD in Cyprus.

The geographical segmentation to monitor the geographical scope of the drought phenomenon follows the known Hydrographic Regions of Cyprus (see Figure 5-1).

The main index to monitor the phenomenon is meteorological and specifically related to the surface rainfall in the Hydrologic Regions. The SPI method that enables direct comparison between different hydrologic regions and that has received widespread application internationally was chosen. The fundamental dynamics of the SPI index is that it can be calculated for all time scales and therefore SPI can be used to control short-term water resources, such as soil moisture, which is important for the agricultural production, and long-term water resources such as underground water reserves. The most recent EU text on the SPI index is: Faergemann Henriette, Update on Water Scarcity and Droughts Indicator Development (DG ENV) (May 2012)

As catchment basins in Cyprus are small, the contribution of snow is quite small and the rainfall rather concentrated in time, the meteorological index is suitable as a "guiding index" for drought. The choice of the special completion of rainfall in the entire basin ensures that all station measurements are taken into account. The SPI index is recalculated on rolling monthly basis. However, because of the particular climate of Cyprus with very rare rainfall during dry months and disperse rainfall in individual days during wet months, the reference period is always either 12 months or an integer multiple thereof, up to 60 months (e.g. the August 12-month index integrates all rainfall since the previous August). In case of a sudden change in drought conditions after a year with high rainfall, the 12-month SPI index may delay to detect the event. To ensure early detection of sudden changes, the following hydrological indices are defined and monitored.

To control the results of the SPI meteorological index, a **hydrological index of total runoff** (or **Hydrologic Year Index HYI**) for (1), two (2) etc. and up to five (5) hydrologic years is defined. The index is calculated for representative dams and hydrometric stations, one per Hydrologic Region (except for Hydrologic Region 7), that are carefully selected so that the upstream abstractions be (where possible) minimal, to ensure that runoff reduction conclusions relate exclusively to natural causes and not to any upstream abstractions. This index is complementary to the SPI with respect to runoff and it is useful to control for any significant differences in runoff due to the diversification of rainfall regime that is not detected by the SPI index. It is likely that the hydrological year index only calculated for 1 year does not reflect changes due to a slow and gradual change in precipitation. In such a case, changes in runoff shall be detected for an aggregation period of up to 5 years. Indeed, runoff in the hydrographic network is not only a result of surface runoff, but also of groundwater discharges in the hydrographic network, which is generally a slow process and requires a certain level so that the aquifer overflows into the hydrographic network.

For **early detection of an abrupt change in drought conditions** the **Wet Period Runoff Index (WPRI)** is defined and monitored. This index is calculated for a representative dam or hydrometric station for every Hydrologic Region (except for Hydrological Region 7) on a cumulative rolling basis from December to May of each hydrological year and is linked to the total runoff from October to the calculation month and to the deviation from the average runoff for the period.

To **assess pressure on river ecosystems** due to extremely low flow, the **Monthly Regime Index (MRI)** is defined and monitored, in relation to the median value of the calculation month's daily flow and the historical distribution of flow for the same month. The index is calculated for a representative hydrometric station for every Hydrologic Region (except for Hydrological Region 7), provided that there were no upstream abstractions and it is only monitored when the drought conditions are met. This index is particularly important as it determines the Exception of Article 4 of the WFD, as will be discussed below.

To **monitor pressure on the major storage projects (Southern Conveyor and Paphos projects),** an index defining the storage conditions is adopted, directly connected to the total stored volume in the dams of each project. At the end of the inflow period (1st April), this index, i.e. the storage in the dams of the Southern Conveyor and Paphos projects, is the basic tool for the suggested Water Policy ensuring the compatibility of the Drought Management Plan with the Water Policy. However, because this index is not meteorological or hydrological, but the result of a management policy and not directly of a physical abnormality, we suggest the index to be applied in the present Drought Management Plan only in conjunction with the Water Policy for Water Resources Management of Cyprus, considering that if storage in reservoirs is low then the area has entered a drought regime, even if this is not always the case. For instance, while the hydrological year 2013-14 was particularly dry, the available storage in the dams of the Southern Conveyor and Paphos projects was important because previous hydrological years experienced a high aquifer regime. This index will not be discussed further for the characterisation of drought.

To **monitor pressure on groundwater bodies** the monitoring and characterisation carried out under Directive 2000/60 shall be applied. Introducing new measurement positions is not considered appropriate (boreholes or springs).

The table below (Table 6-1) summarises the appropriate hydrological/meteorological index per monitored subject. Nevertheless, the most important thing to stress is that the selected dams/hydrometric stations to monitor drought conditions are points where upstream abstractions are minimal or even zero (for hydrometric stations) or dams whose adjustment capacity is very high compared to the abstractions. Especially for the SPI index, based on infrastructure developed during the 1st RBMP, the Meteorology Department of the WDD now calculates the SPI index internally for each hydrologic region and notifies the WDD a few months later. Based on the GD of the EU, the relevant SPI index to monitor dam storage and river runoff is the 12-month SPII (SPI-12).

All of the above indices use the reference time series, specified under the Amended Drought Management Plan by the WDD (August 2013) from the hydrological year 1970-1971 to 2009-2010. Preliminary reference prices will be reviewed every ten years and incorporated in the reference time series.

Table 6-1: Proposal for indices and Monitoring Subjects for Cyprus in the 1st RBMP

MONITORING SUBJECT	INDICES					
	SPI	Wet period runoff index	Hydrologic year runoff index	Monthly regime index	Dam storage index	Groundwater bodies' characterisation
Drought beginning and ending	✓	✓	✓			
Drought intensity	✓		✓			
Ensuring early diagnosis		✓			✓	
Pressure on the broader natural environment	✓					
Pressure on river ecosystems				✓		
Pressure on lake ecosystems			✓		✓	
Pressures on groundwater bodies	✓					✓
Pressure on water supply					[4]	✓
Pressure on irrigation	✓		✓		✓	✓
Pressure on non-irrigated agriculture (rainfed crops)	✓					
Dam abstraction planning					✓	

6.2.1 THE METEOROLOGICAL DROUGHT INDEX (SPI)

The Standardized Precipitation Index (SPI) is the most widely used statistical index and was coined by McKee et al. (1993). The index quantifies the meteorological drought on a monthly, seasonal or annual basis. A distribution function is fitted to the historical time series of rainfall and then the theoretical probability of rainfall value under examination is calculated. The SPI index is calculated as a normal distribution standard variable corresponding to the theoretical probability calculated. Regarding the selection of the distribution function, McKee et al. (1993) suggest the use of the gamma

[4] Secondary relevant index since the central water supply systems tend to be secured by desalination units.

distribution for samples longer than 30 years. Subsequent work of other researchers (e.g. Lana et al, 2001) used other distributions as well, such as the lognormal and Poisson distributions, which fitted best to the observed data. The index was selected by a committee of experts on drought and water scarcity. Thom (1966) argued that gamma distribution fits adequately on monthly rainfall data, as it is appropriate for describing variables with positive symmetry. The probability density function of the Gamma distribution is given by:

$$f(x) = \frac{x^{\alpha-1} e^{\frac{-x}{\beta}}}{\beta^{\alpha}\Gamma(\alpha)} \qquad (3.1)$$

where Γ(α) is the gamma function, set as:

$$\Gamma(\alpha) = \int_{0}^{\infty} x^{\kappa-1} e^{-x}\, dx$$

The gamma distribution is a two-parameter distribution defined for positive values of x (monthly rainfall) where α (> 0) is the shape parameter and β (<0) is the scale parameter. The parameter values are calculated based on mathematical relationships derived from the maximum likelihood method. The calculation of the SPI results from the conversion of the distribution function (cumulative form of the probability density function) at a value of equal probability of the standard normal distribution, i.e. with a mean of 0 and standard deviation of 1. Based on the value of SPI, drought intensity is characterised in the following table (Table 6-2).

Table 6-2: Drought classification and identification based on the SPI

SPI Intervals	Distribution Function, F_Z	Return Period (Years)	Drought Classification
$2.0 \leq SPI$	$0.977 \geq F_Z$	$44 \leq T$	Extremely Wet Season
$1.5 \leq SPI < 2.0$	$0.977 \geq F_Z > 0.933$	$15 \leq T < 44$	Very High Wet Season
$1.0 \leq SPI < 1.5$	$0.933 \geq F_Z > 0.841$	$6 \leq T < 15$	High Wet Season
$0.0 \leq SPI < 1.0$	$0.841 \geq F_Z > 0.500$	$2 \leq T < 6$	Normal Wet Season
$0.0 \geq SPI > -1.0$	$0.500 \geq F_Z > 0.159$	$2 \leq T < 6$	Mild Drought
$-1.0 \geq SPI > -1.5$	$0.159 \geq F_Z > 0.067$	$6 \leq T < 15$	Moderate Drought
$-1.5 \geq SPI > -2.0$	$0.067 \geq F_Z > 0.023$	$15 \leq T < 44$	Severe Drought
$-2.0 \geq SPI$	$0.023 \geq F_Z$	$44 \leq T$	Extreme Drought

The SPI index for each hydrologic region is calculated by the Department of Meteorology of the WDD on a rolling monthly basis for periods of 12, 24, 36, 47 and 60 months, with surface rainfall as a variable in the hydrologic region during the reference period.

Figure 6-1 shows the SPI-12 index for Hydrologic Region 1 and for the period of they hydrologic years 1970-71 to the year 2013-14, as supplied by the Department of Meteorology and based on the calculation methodology developed in the framework of the 1st RBMP of the Republic of Cyprus. Respectively, the following figures (from Figure 6-2 up to Figure 6-7) show the development of the SPI index for the other hydrologic regions under the control of the Republic of Cyprus.

This will serve to present the key elements of the index. According to the EU Text "Update on Water Scarcity and Droughts Indicator Development" of May 2012, the concentration number of rolling months to determine the meteorological drought depending on the purpose of "interpretation" of the SPI are:

- The SPI index with short concentration times (e.g. from SPA-1 to SPI-3), when indication is required for direct effects such as reduced soil moisture, snow coverage and runoff to water stream with a small basin and of small order pursuant to Strahler's classification.
- The SPI index for average concentration times (e.g. from SPI-1 to SPI-12) when indication is required for effects such as reduced runoff in main rivers or reservoir storage.
- The SPI index for long concentration times (e.g. from SPI-12 to SPI-48) when indication is required for effects such as reduced storage in large reservoirs and aquifers.

It is considered that to monitor storage in the territory of the Republic of Cyprus, the most appropriate index SPI is the one with a concentration time of 12 months (SPI-12).

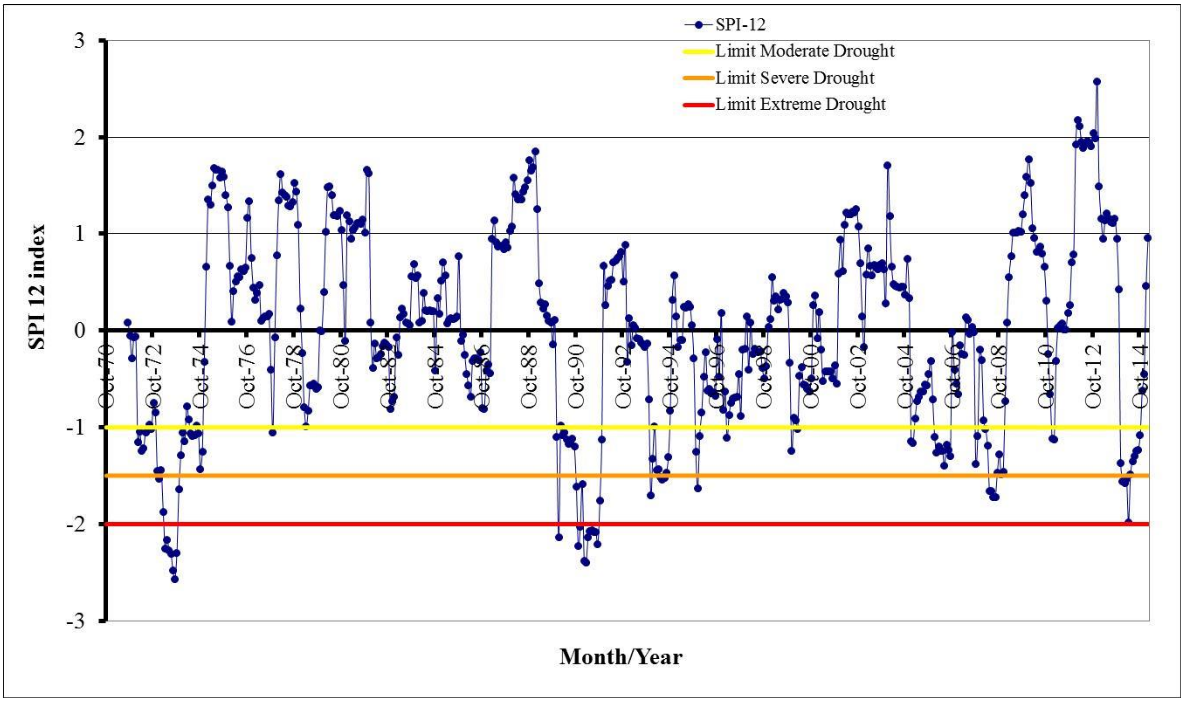

Figure 6-1: SPI index for 12 months in Hydrologic Region 1 (Hydrologic Period 1970-2014)

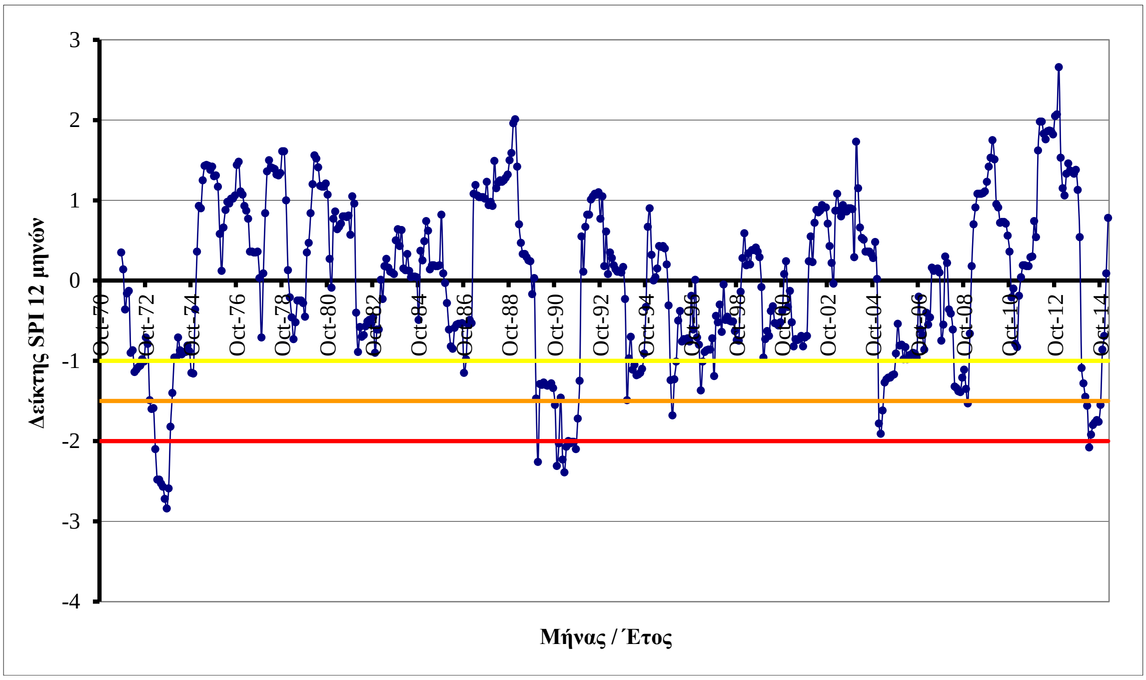

Figure 6-2: SPI index for 12 months in Hydrologic Region 2 (Hydrologic Period 1970-2014)

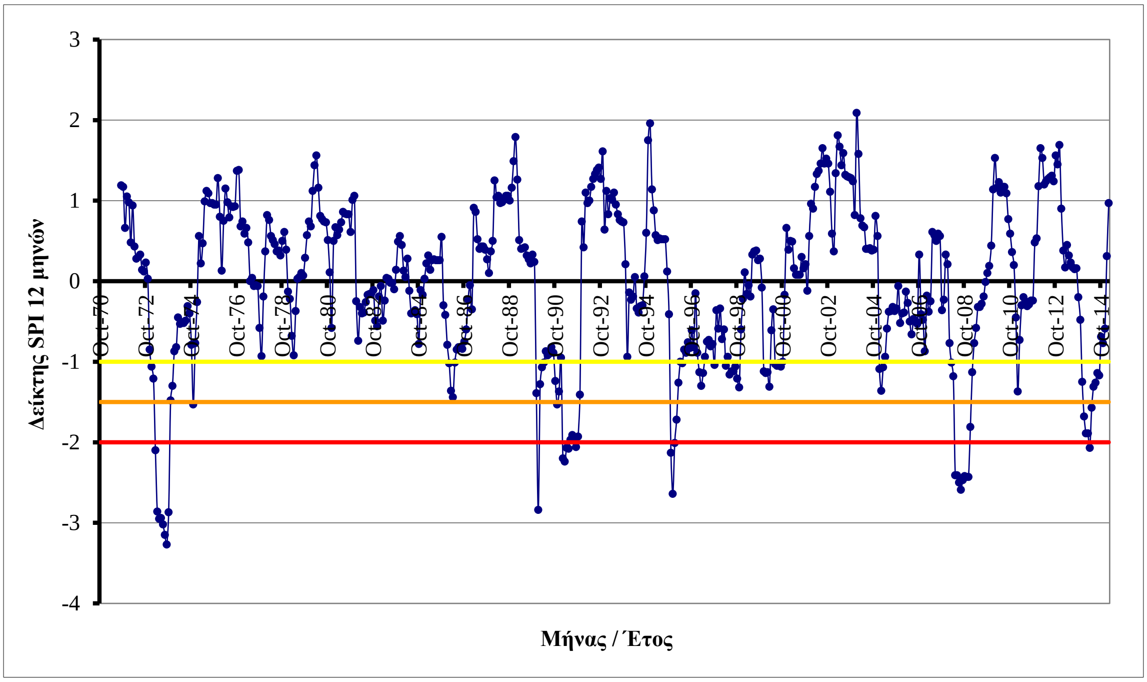

Figure 6-3: SPI index for 12 months in Hydrologic Region 3 (Hydrologic Period 1970-2014)

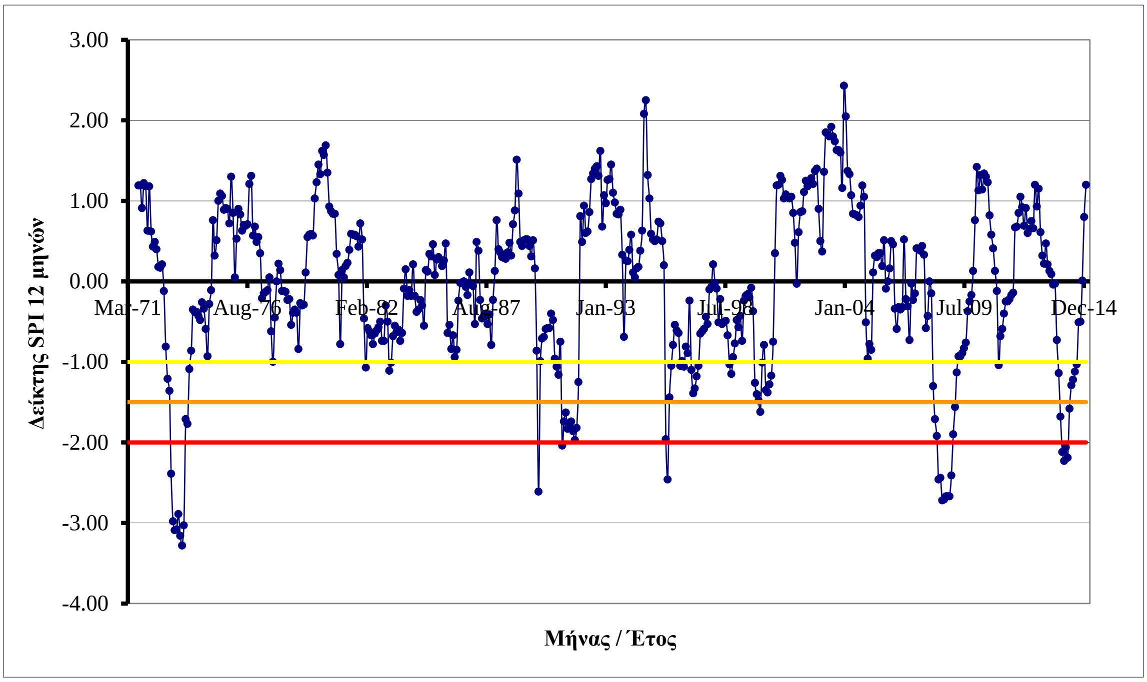

Figure 6-4: SPI index for 12 months in Hydrologic Region 6 (Hydrologic Period 1970-2014)

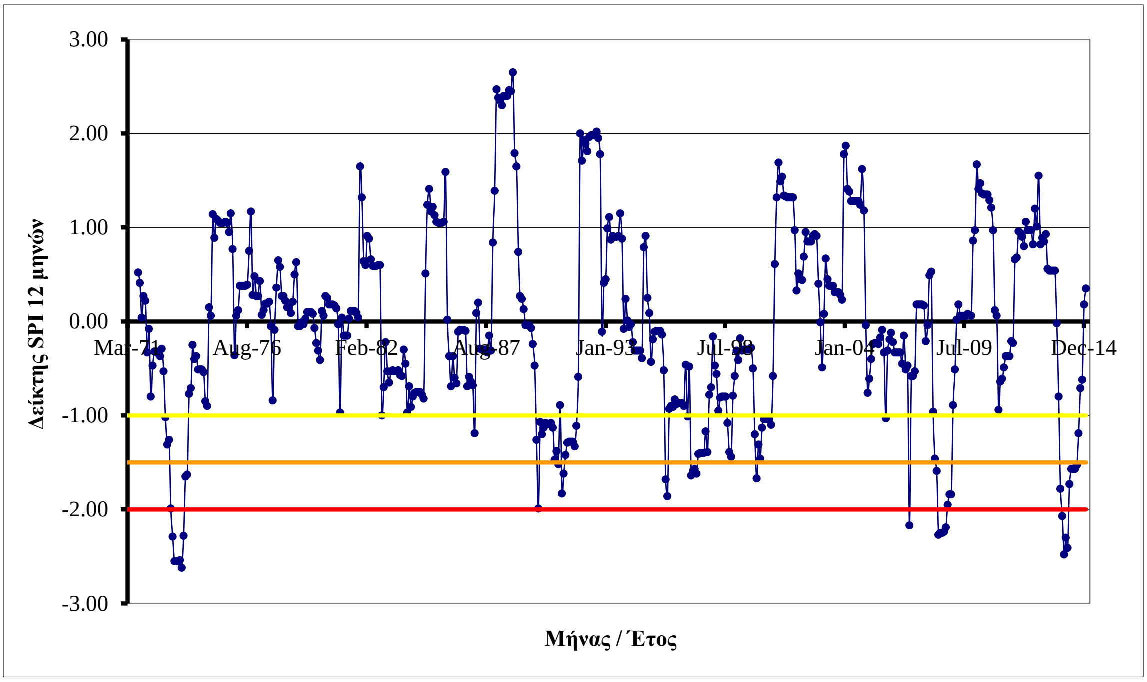

Figure 6-5: SPI index for 12 months in Hydrologic Region 7 (Hydrologic Period 1970-2014)

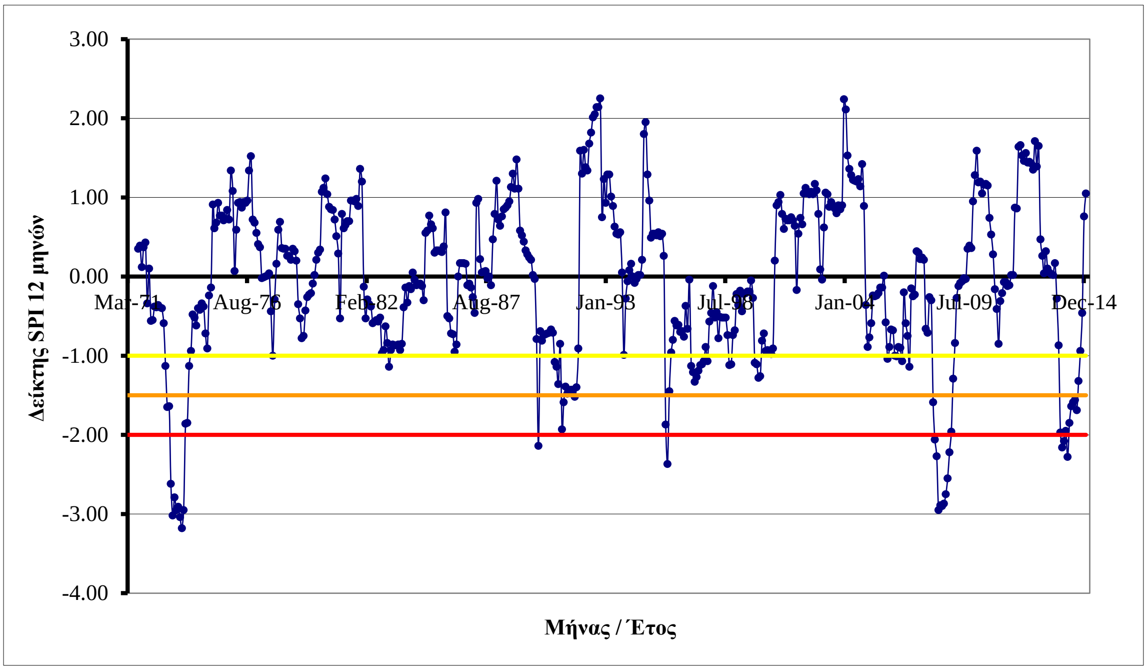

Figure 6-6: SPI index for 12 months in Hydrologic Region 8 (Hydrologic Period 1970-2014)

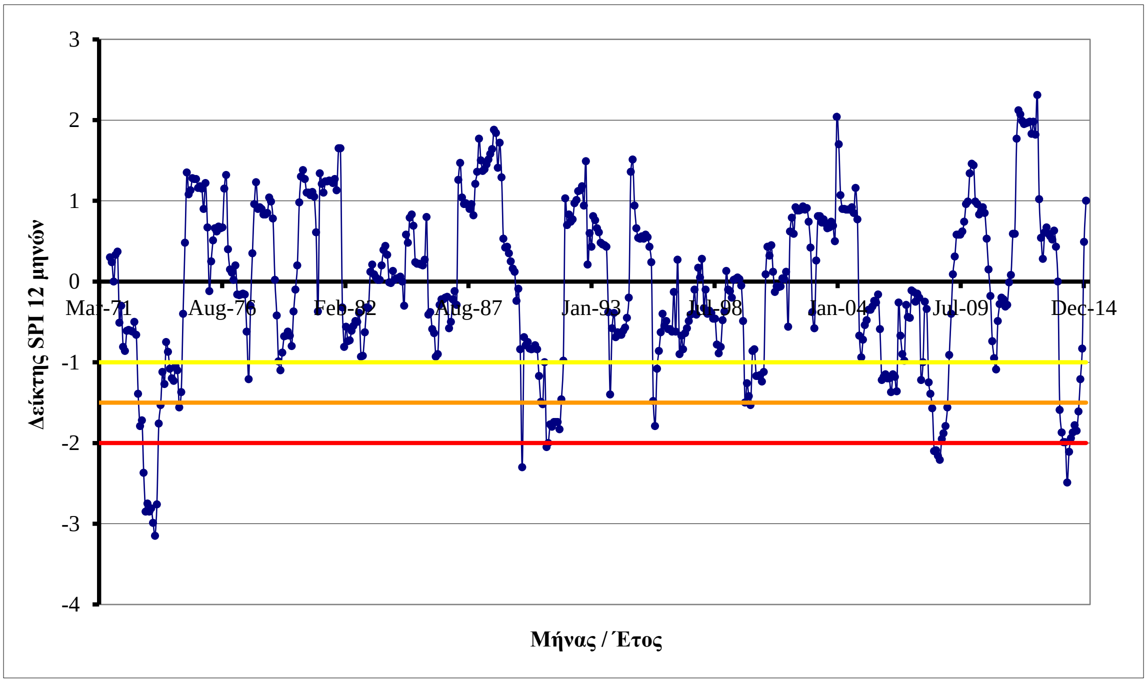

Figure 6-7: SPI index for 12 months in Hydrologic Region 9 (Hydrologic Period 1970-2014)

Pursuant to the SPI index definition, a drought period starts when the index becomes negative, provided it has reached the value of at least -1, without taking positive values in the meantime. The end is when the index takes back a positive value for the first time. Consequently, Mild drought periods (index value between 0 and -1) are considered as part of a drought event only if during the occurrence of the event the index takes values smaller than -1. In this case, the Moderate drought time is counted in the total duration and the total magnitude of the phenomenon, as described below. If the period ends without the index reaching a value less than -1, it is not characterised as a drought event, but merely as a period drier than average. This means that while drier than average periods obviously do not constitute an event of drought, to reverse the effects of a real event, the conditions have to become wetter than average. Therefore, while the index remains lower than 0 drought continues at the intensity given by the relevant Table ((Table 6-2). Even the period with "Mild drought" intensity is counted in the total magnitude of the event which, as explained below, is not only related to intensity, but to duration.

For example, the graph of Figure (Figure 6-1) shows two dry periods based on the 12-month index. The first period begins after the first quarter of the hydrological year 1989 and ends after the first quarter of 1991, reaching the intensity of extreme drought, with an index value below -2. The second period begins in the last quarter of the hydrological year 1992 and ends in the first quarter of 1994, while its intensity reaches the level of severe drought (-1 to -1.99), but not that of extreme drought.

The total cumulative Drought Magnitude (DM) is defined as the absolute value of the sum of all the individual monthly SPIi indices, where i is the corresponding month during the dry season:

$$DM = -\sum(SPIi)$$

This means that the Drought Magnitude takes into account both the drought intensity (i.e. the SPI index) and the persistence of the drought that is, its time duration, as highlighted in Figure 6-8 with respect to three different combinations of intensity and duration of the drought.

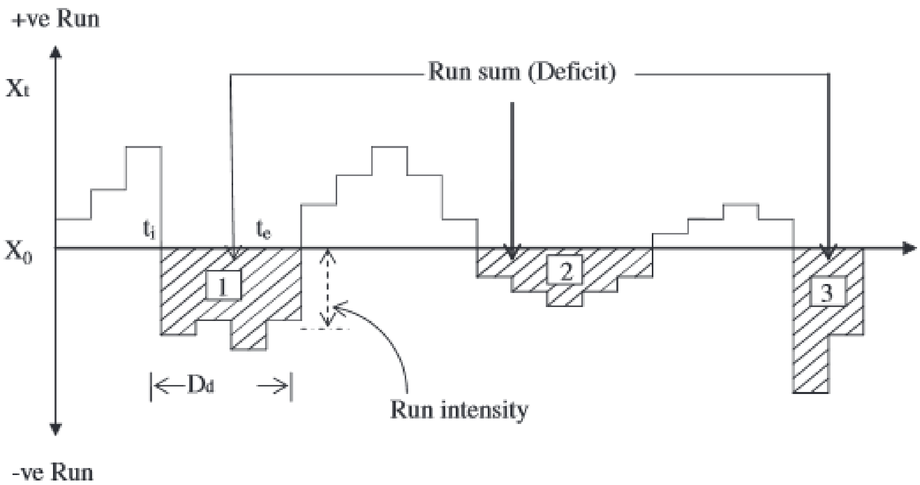

Figure 6-8: Schematic illustration of the magnitude of the drought

The following figures (from Figure 6-9 up to Figure 6-15) show the diagrams of drought events, depending on its magnitude. Each diagram includes the DM=30 line, which value is the limit beyond which the drought event is considered a "prolonged drought", as will be discussed in Section 6.3.

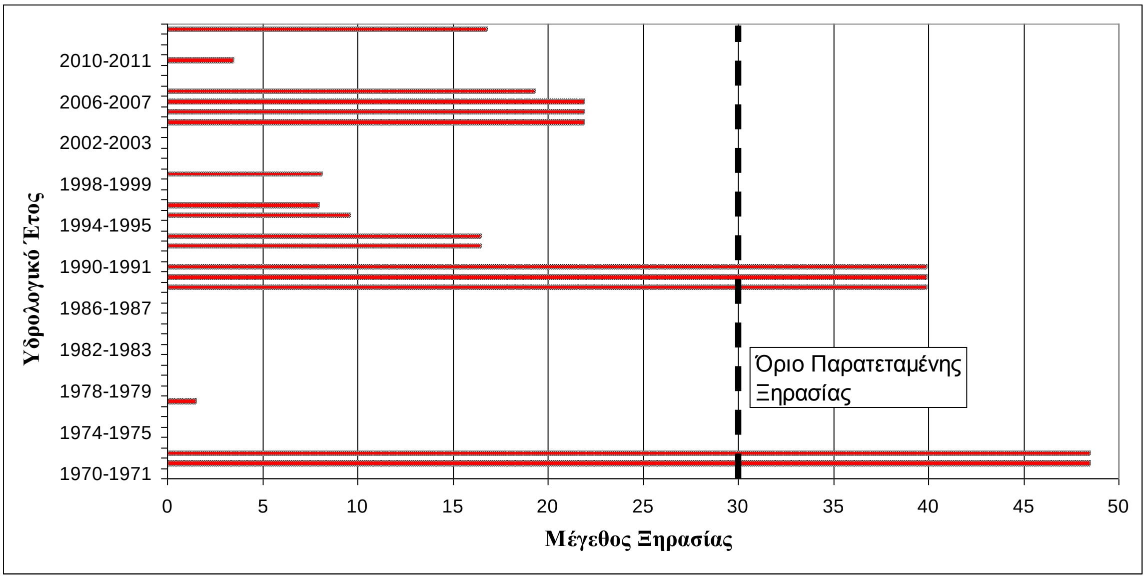

Figure 6-9: Drought magnitude diagram for drought periods in Hydrologic Region 1

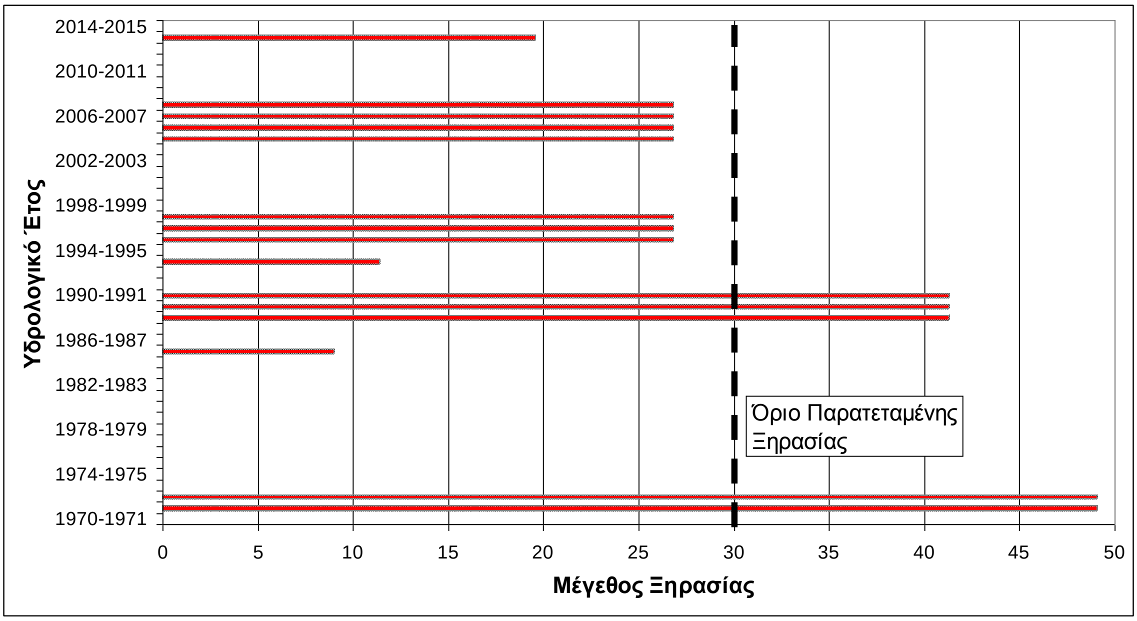

Figure 6-10: Drought magnitude diagram for drought periods in Hydrologic Region 2.

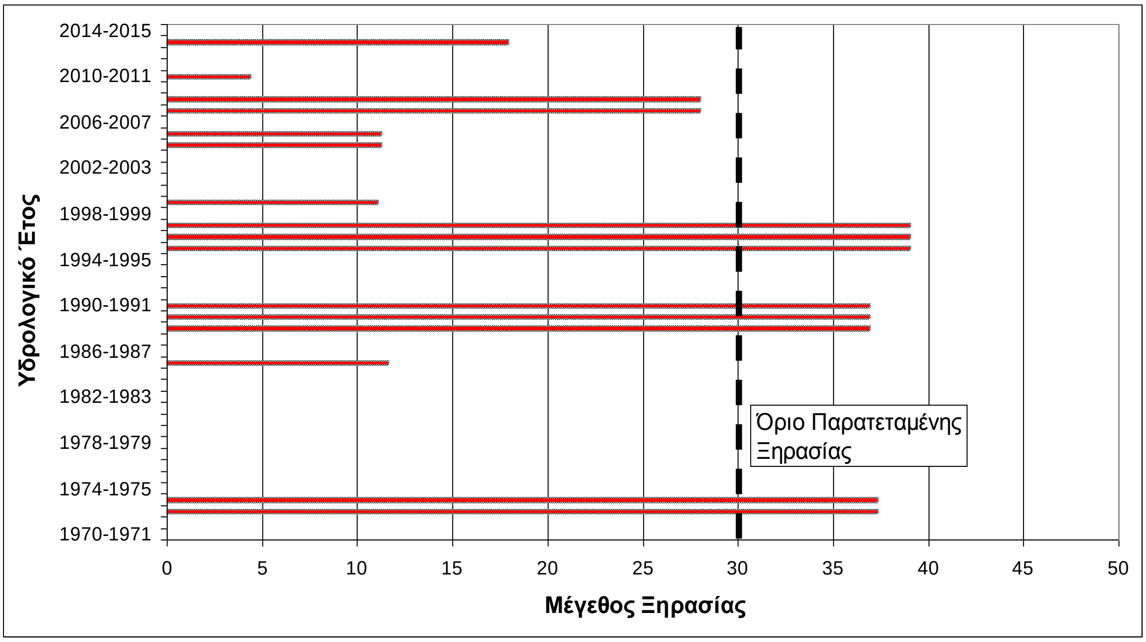

Figure 6-11: Drought magnitude diagram for drought periods in Hydrologic Region 3.

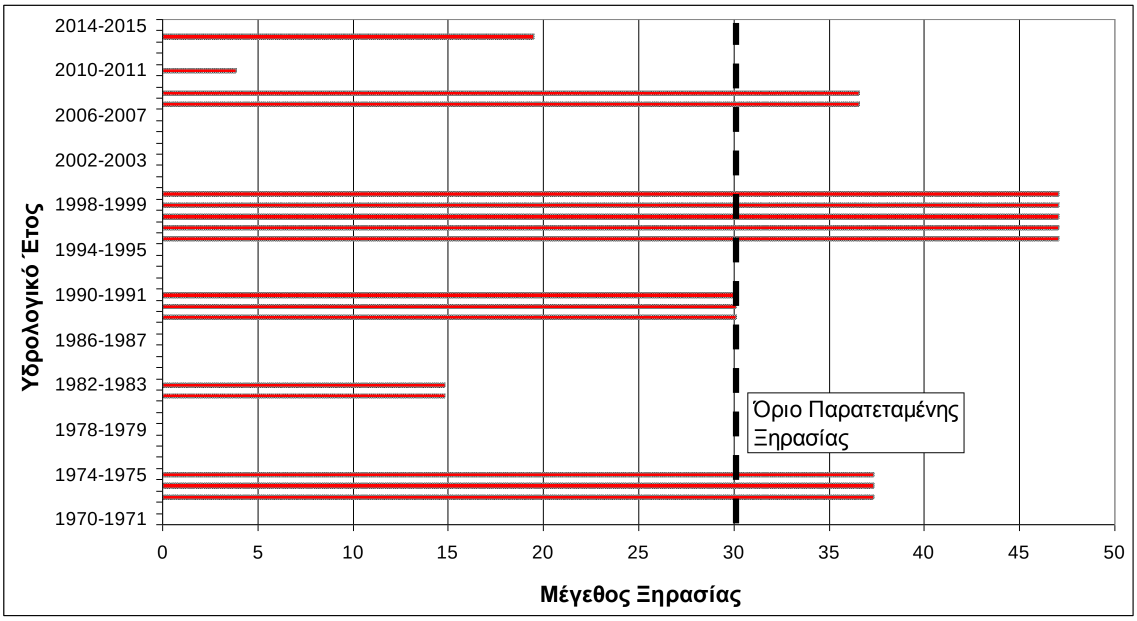

Figure 6-12: Drought magnitude diagram for drought periods in Hydrologic Region 6.

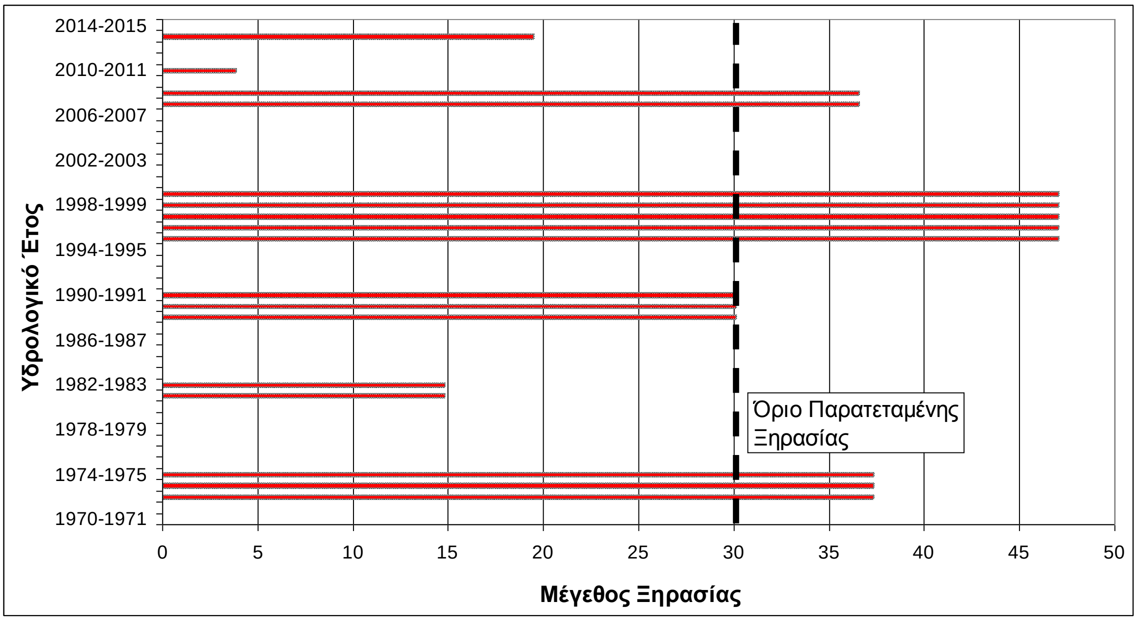

Figure 6-13: Drought magnitude diagram for drought periods in Hydrologic Region 7.

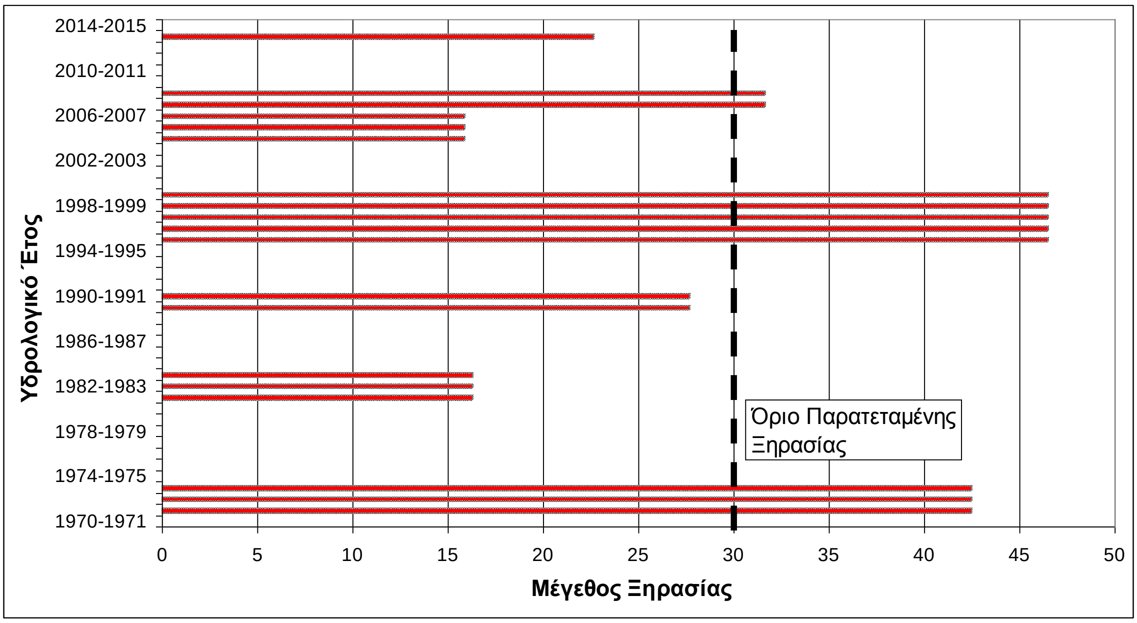

Figure 6-14: Drought magnitude diagram for drought periods in Hydrologic Region 8.

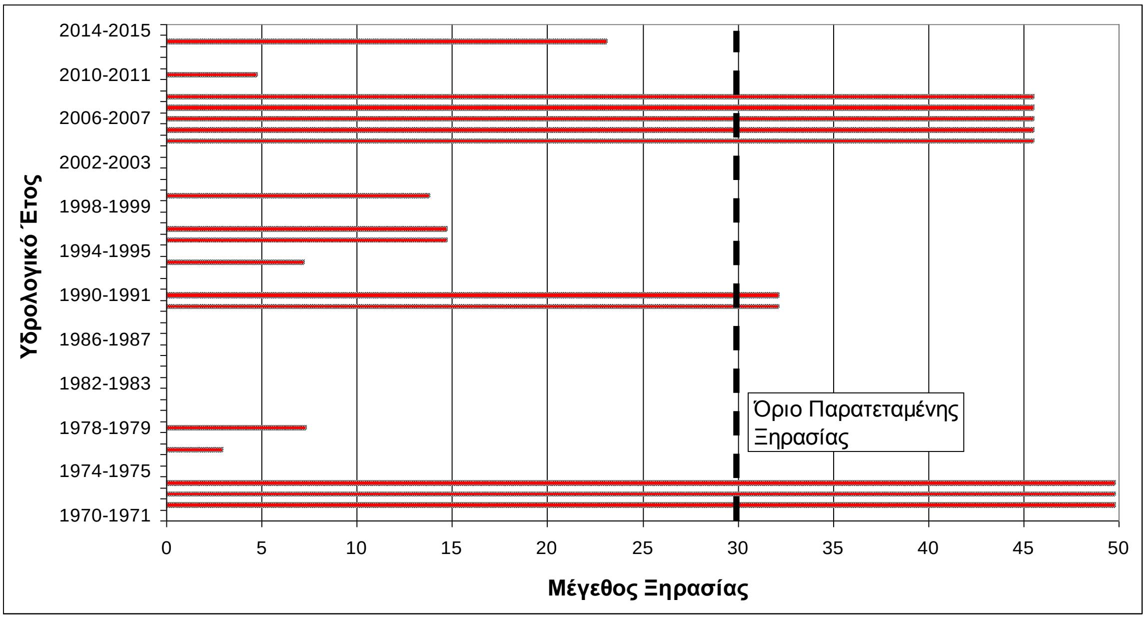

Figure 6-15: Drought magnitude diagram for drought periods in Hydrologic Region 8.

6.2.2 THE HYDROLOGICAL YEAR RUNOFF INDEX

This index operates as a complementary test of the meteorological SPI index and an operational index can also be used to identify drought. Given that this index directly depends on runoff values, it shall highlight possible shortcomings of the SPI index in predicting the impact on runoff that may arise from the hydrologic regime and not from the amount of rainfall per se. Although indices based on runoff are used by most EU countries, the small river basin size and the regime of Cyprus rivers are almost unique. In Cyprus, it is possible to extract reliable conclusions about the level of runoff for a period comprising the entire hydrological year or at least the entire wet season.

Regarding the runoff index of Cyprus, it is defined as the index of the sum of annual runoff, where *X*i is runoff of (1), two (2), three (3), four (4) or five (5) hydrological years and the limit value for the start, escalation and ending the drought is investigated. The index is calculated based on the inflows in dams given that it is immediately available within the existing dam monitoring programme by the WDD. Representative dams and hydrometric stations were chosen mainly based, to the extent possible, on those with minimal upstream storage and abstractions compared to the runoff at the dam location. The following dams and hydrometric stations were chosen for the hydrologic regions (Table 6-3):

Table 6-3: Proposed Dams and Hydrometric Stations per Hydrologic Region to calculate the Runoff Index

Region	Dam / Hydrometric Station	River
Hydrologic Region 1	Kannavious Dam	Ezousas
Hydrologic Region 2	Evretou Dam	Chrysochous
Hydrologic Region 3	r 3-7-1-50 (Peristeronas)	Serrachis
Hydrologic Region 6	r 6-1-1-80 (Ayios Onoufrios)	Pediaios
Hydrologic Region 7	-------------	-------------
Hydrologic Region 8	Kalavassos Dam	Vassilikos
Hydrologic Region 9	Kouris Dam	Kouris

Hydrologic region 7 does not comprise river bodies with a regime allowing such an analysis since their flow is sporadic.

For region 1, the most suitable dam in principle is that of Asprokremmos, but its position makes extremely likely the disruption of the inflow sample from upstream runoff. Between Kannaviou and Arminou dams, the former was chosen because the latter's large water transfer due to the diversion to Kouris, with respect to its storage capacity, was considered a potential source of errors.

Respectively, as an alternative hydrometric station to the Kannaviou dam, the station r1-4-4-50_Ezousas near Kannaviou was used, with a slight decrease of measurements, which resulted by taking into account both the basin ratio and the higher rainfall in the dam basin. In the long-term, we should aim at using the inflows to the dams directly. To accelerate the creation of an appropriate sample, after a few years of complete measurements at the dams (including overflows), the inflows on both dams and the measurements at stations should be compared. As part of the revision of the Drought Plan b they WDD (August 2013), we do not believe that there is reason for the change of the analysis positions of the Runoff Index per Hydrologic Region of Cyprus. Thus, Table 6-3 remains unchanged.

Nevertheless, some issues were noted with respect to the calculation of the inflow in the Kannaviou (Hydrologic Region 1) and Kalavassos (Hydrological Region 8) dams, in the 1st Management Plan in relation to the hydrological year 1987-88 and these flows were calculated again. For the Kouris and Evretou dams, the calculated inflows are approximately equal to those of the 1st MP, with some minor differences of no particular significance.

For the Kannaviou dam, the runoff of hydrometric station r1-4-4-50_Ezousas near Kannaviou were used, with a river basin equal to 80.56 km^2, while the Kannaviou dam basin (upstream of the hydrometric station) is equal to 56 km^2. Therefore, the reduction needed to bring the flows of the hydrometric station to the dam position should be done used a coefficient 0.69 (the ratio of the respective surfaces) to which the estimate from the change of surface rainfall from one position to another must be added. However, the variation of surface rainfall (elevation-corrected) is very small and the final reduction coefficient is equal to 0.70.

For the Kalavassos dam (for the hydrological years lacking estimates of reservoir balance by the corresponding WDD Service), hydrometric station r8-9-5-40_Vassilikos near Lageia, which is located immediately upstream of the Kalavassos dam was used. However, the data of said hydrometric station have been recorded since hydrological year 1983-84. The 1st RBMP complements the dam inflows for the previous years based on the recorded runoff of hydrometric station r8-9-7-50_Vassilikos Kalavassos, with a simple reduction of the surfaces, despite the fact that this hydrometric station is well downstream of the dam and several abstractions occur in the meantime, while for hydrological year 1972-73 the inflow has been recorded as zero. It is therefore appropriate to recalculate runoff at the Kalavassos dam by completing the data (based on organic correlation) of said station (r8-9-5-40_Vassilikos near Lageia) with data from hydrometric station r9-2-3-85_Germasogeia near Foinikaria, which was installed in the neighbouring basin of Yermasoyia and in particular at the eastern sub-basin of the dam immediately adjacent to the basin of Kalavassos dam. The monthly correlation coefficients are very significant (from 0.72 to 0.99), while the annual correlation coefficient is equal to 0.94. Once hydrometric station r8-9-5-40 is completed, then it is reduced to the position of the dam according to the ratio of their surfaces. The river basin of the dam is equal to 96.7 km^2, while the river basin of the hydrometric station is 86.6 km^2; hence, the reduction coefficient is equal to 1.12, without the need of reduction due to rainfall.

The inflows calculated for all the large dams of Cyprus are given in the relevant annex. To apply the common reference space with the Revised 1st Drought Plan (August 2013), the same reference period was maintained as follows:

- Hydrologic Region 1: Hydrometric station r1-4-4-50 and Kannaviou dam. Time series from 1/10/1970 to 30/9/2010.
- Hydrologic Region 2: Evretou Dam, time series from 1/10/1970 to 30/9/2010.
- Hydrologic Region 3: Hydrometric station r3-7-1-50. Time series from 1/10/1970 to 30/9/2010. For this hydrometric station, there are no data records for the hydrological years 1972-73 and 1973-74.
- Hydrologic Region 6: Hydrometric station r6-1-1-80. Time series from 01/01/1970 to 30/9/2010. For this hydrometric station, there are no data records for the hydrological years 1972-73 and 1973-74.
- Hydrologic Region 8: Kalavassos dam. The time series of hydrological year 1970-71 up to 1986-87 was used, as calculated herein. Data from hydrologic year 1987-88 to 2009-10 have been replaced with monthly inflows to the dam as compiled by the Irrigation Service of the WDD.
- Hydrologic Region 9: Kouris Dam. The time series of hydrological year 1970-71 up to 1986-87 was used, as calculated herein. Monthly inflows to the dam from 1984-85 to 2009-10 were used, as compiled by the Irrigation Service of the WDD.

In the case of the Revised 1st Drought Management Plan of Cyprus, the reference time series to calculate drought indexes has been generally set as between the hydrological years 1970-1971 and 2009-2010. Preliminary reference prices will be reviewed every ten years and incorporated in the reference time series. Based on the available time series, the index values for time series of periods of one (1) to five (5) years were calculated. For instance, over a period of 2 years, the value corresponding to the hydrological year 1980-1981 will be equal to the sum of the runoff of hydrological years 1979-80 and 1980-81. To extract the significance of the value of the integration level, it was correlated, for each period, with the scarcity of the corresponding phenomenon within the available time series. Scarcity is defined as the lowest 25%, 15% and 5% quartile of annual flows per estimation position, i.e. for 40 hydrological years (from 1970-71 up to 2009-10) (Table 6-4 to Table 6-9).

Table 6-4: Calculation of the Runoff Index of Hydrologic Region 1, as reflected at the Kannaviou Dam (runoff in m^3)

PERCENTILE	1 Year	2 Years	3 Years	4 Years	5 Years
AVERAGE	5,242,065	10,565,749	16,094,493	21,906,925	27,979,975
PERCENTILE 50%	4,314,601	10,446,412	15,395,002	21,914,400	28,459,026
PERCENTILE 25%	2,047,993	4,418,729	9,276,654	13,389,884	19,863,509
PERCENTILE 15%	1,306,757	2,960,191	5,671,538	10,387,726	14,069,444
PERCENTILE 5%	304,777	1,557,753	3,194,170	4,735,714	10,478,968

Table 6-5: Calculation of the Runoff Index of Hydrologic Region 2, as reflected at the Evretou Dam (runoff in m^3)

PERCENTILE	1 Year	2 Years	3 Years	4 Years	5 Years
AVERAGE	6,343,529	12,622,273	18,946,115	25,548,653	32,437,048
PERCENTILE 50%	5,190,484	12,727,746	18,437,054	23,793,897	31,808,873
PERCENTILE 25%	2,058,488	6,693,421	10,974,172	17,529,909	24,074,228
PERCENTILE 15%	1,499,075	3,233,392	8,812,203	12,011,613	17,602,469
PERCENTILE 5%	798,916	2,357,935	4,528,629	9,617,828	13,505,979

Table 6-6: Calculation of the Runoff Index of Hydrologic Region 3, as reflected at Hydrometric Station r3-7-1-50- Peristeronas (runoff in m^3)

PERCENTILE	1 Year	2 Years	3 Years	4 Years	5 Years
AVERAGE	12,247,528	24,297,816	36,520,836	48,892,601	61,334,431
50% PERCENTILE	11,729,030	22,794,725	38,284,818	50,870,970	65,579,907
PERCENTILE 25%	6,421,717	17,218,047	27,034,555	41,023,600	52,463,894
PERCENTILE 15%	5,527,406	11,027,832	21,586,899	29,815,395	40,919,036
PERCENTILE 5%	2,852,693	8,414,492	14,729,004	22,041,993	32,201,088

Table 6-7: Calculation of the Runoff Index of Hydrologic Region 6, as reflected at Hydrometric Station r6-1-1-80- Agios Onoufrios (runoff in m^3)

PERCENTILE	1 Year	2 Years	3 Years	4 Years	5 Years

AVERAGE	1,710,289	3,396,517	5,101,873	6,796,693	8,485,100
50% PERCENTILE	1,602,852	3,177,905	4,916,841	7,060,398	8,565,203
PERCENTILE 25%	691,789	1,642,164	3,061,447	4,512,715	6,579,759
PERCENTILE 15%	645,104	1,269,510	2,306,846	3,440,201	4,711,979
PERCENTILE 5%	360,236	1,003,862	1,635,570	2,342,054	3,622,528

Table 6-8: Calculation of the Runoff Index of Hydrologic Region 8, as reflected at the Kalavassos reservoir (runoff in m^3)

PERCENTILE	1 Year	2 Years	3 Years	4 Years	5 Years
AVERAGE	7,102,120	14,210,594	21,504,057	29,167,840	37,158,011
50% PERCENTILE	6,12,427,7257,994	14,557,128	21,223,901	30,345,274	39,515,540
PERCENTILE 25%	8	4,731,064	12,383,101	20,144,559	27,635,402
PERCENTILE 15%	843,239	2,707,654	6,118,402	12,447,796	20,213,924
PERCENTILE 5%	329,550	1,213,569	2,475,878	3,403,568	8,525,268

Table 6-9: Calculation of the Runoff Index of Hydrologic Region 9, as reflected at the Kouris reservoir (runoff in m^3)

PERCENTILE	1 Year	2 Years	3 Years	4 Years	5 Years
AVERAGE	31,222,771	62,358,123	93,904,690	126,803,535	160,846,690
50% PERCENTILE	27,432,611	60,117,000	91,769,107	126,646,835	155,825,398
PERCENTILE 25%	13,857,267	33,502,915	59,366,515	90,468,564	117,037,787
PERCENTILE 15%	11,622,819	24,866,364	49,167,911	72,613,742	96,913,438
PERCENTILE 5%	6,647,668	18,755,473	38,039,543	56,779,852	74,801,377

The following table (Table 6-10) presents the classification of the alert level for drought at the end of the hydrological year depending on the percentile of the runoff of a given hydrological year.

Table 6-10: Classification of the alert level depending on the runoff percentile, regardless of the aggregation level (from 1 to 5 years).

PERCENTILE WHERE THE EXAMINED RUNOFF IS INCLUDED	ALERT LEVEL	DROUGHT LEVEL
> 25%	NONE	NORMAL
15% - 25%	MODERATE	MODERATE
5% - 15%	HIGH	SEVERE

< 5%	VERY HIGH	EXTREME

To apply the runoff index to complement the SPI-12 index, first the degree of correlation of the two rations needs to be analysed to determine their degree of relevance. The following table (Table 6-11) presents the linear correlation coefficients between the annual runoff of each hydrological year and the SPI-12 index of September of every hydrological year. It is found that the linear correlation coefficient between two ratios is adequate for all Hydrologic Regions, so the use of the runoff index as a complement o the SPI-12 index is possible.

Table 6-11: Correlation coefficients for the annual runoff of each hydrological year with the SPI-12 index of September of the hydrological year in question

HYDROLOGIC REGION	CORRELATION COEFFICIENT ANNUAL RUNOFF HYDROLOGIC YEAR WITH SPI-12 SEPTEMBER
HYDROLOGIC REGION 1	0.810
HYDROLOGIC REGION 2	0.861
HYDROLOGIC REGION 3	0.837
HYDROLOGIC REGION 6	0.799
HYDROLOGIC REGION 7	-------
HYDROLOGIC REGION 8	0.738
HYDROLOGIC REGION 9	0.817

In addition, the previous hydrological years need to be simulated to assess compatibility with the characterisation of drought for both the SPI-12 and Runoff Index for Hydrologic Region 1 and the Kannaviou dam. The following table (Table 6-12) shows the application of the methodologies of SPI-12 indexes and the runoff index for Hydrologic Region 1 and the Kannaviou Dam with respect to the Drought Level. For the characterisation EXTREME, it seems that the runoff index is more conservative by issuing an alert warning VERY HIGH ALERT LEVEL for 3 hydrological years (1972-73, 2005-06 and 2007-08) and HIGH LEVEL for 6 hydrological years (1990-91, 1996-97, 2006-08, 2010-11 and 2013-14), out of a total 45 hydrological years, compared to the SPI-12 index, based on which extreme drought occurred for 2 hydrological years (1972-73 and 1990-91). Therefore, the SPI-12 index is applied at first as an indicative index, which needs to be confirmed by the Runoff Index.

Table 6-12: Compatibility analysis of SPI-12 and runoff indices and application in Hydrologic Region 1

Hydrologic Year	Runoff at Kannavious Dam (hm^3)	Alert Level according to Hydrologic Year Runoff Index	SPI -12	Drought Level based on SPI-12
1970-1971	4.37	NO-ALERT STATUS	0.08	NORMAL
1971-1972	1.51	MODERATE	-1.02	MODERATE DROUGHT
1972-1973	0.26	VERY HIGH	-2.57	EXTREME DROUGHT
1973-1974	1.83	MODERATE	-1.06	MODERATE DROUGHT
1974-1975	10.97	NO-ALERT STATUS	1.640	VERY WET SEASON
1975-1976	5.84	NO-ALERT STATUS	0.650	NORMAL
1976-1977	5.99	NO-ALERT STATUS	0.170	NORMAL
1977-1978	14.79	NO-ALERT STATUS	1.330	WET SEASON
1978-1979	3.16	NO-ALERT STATUS	-0.600	MILD DROUGHT
1979-1980	11.56	NO-ALERT STATUS	1.240	WET SEASON
1980-1981	10.40	NO-ALERT STATUS	1.150	WET SEASON
1981-1982	4.26	NO-ALERT STATUS	-0.140	MILD DROUGHT
1982-1983	5.77	NO-ALERT STATUS	0.060	NORMAL
1983-1984	5.64	NO-ALERT STATUS	0.200	NORMAL
1984-1985	7.55	NO-ALERT STATUS	0.150	NORMAL
1985-1986	2.90	NO-ALERT STATUS	-0.220	MILD DROUGHT
1986-1987	11.43	NO-ALERT STATUS	0.840	NORMAL
1987-1988	14.35	NO-ALERT STATUS	1.550	VERY WET SEASON
1988-1989	9.16	NO-ALERT STATUS	0.080	NORMAL
1989-1990	2.60	NO-ALERT STATUS	-1.200	MODERATE DROUGHT
1990-1991	0.32	HIGH	-2.210	EXTREME DROUGHT
1991-1992	9.16	NO-ALERT STATUS	0.810	NORMAL
1992-1993	5.64	NO-ALERT STATUS	-0.170	MILD DROUGHT
1993-1994	2.45	NO-ALERT STATUS	-1.310	MODERATE DROUGHT
1994-1995	4.67	NO-ALERT STATUS	0.060	NORMAL
1995-1996	2.09	NO-ALERT STATUS	-0.670	MILD DROUGHT
1996-1997	1.09	HIGH	-0.450	MILD DROUGHT
1997-1998	1.92	MODERATE	-0.390	MILD DROUGHT
1998-1999	5.42	NO-ALERT STATUS	0.350	NORMAL
1999-2000	2.15	NO-ALERT STATUS	-0.630	MILD DROUGHT

Hydrologic Year	Runoff at Kannavious Dam (hm^3)	Alert Level according to Hydrologic Year Runoff Index	SPI -12	Drought Level based on SPI-12
2000-2001	2.41	NO-ALERT STATUS	-0.490	MILD DROUGHT
2001-2002	9.93	NO-ALERT STATUS	1.260	WET SEASON
2002-2003	10.11	NO-ALERT STATUS	0.680	NORMAL
2003-2004	10.00	NO-ALERT STATUS	0.450	NORMAL
2004-2005	2.69	NO-ALERT STATUS	-0.570	MILD DROUGHT
2005-2006	0.28	VERY HIGH	-1.300	MODERATE DROUGHT
2006-2007	0.42	HIGH	-0.020	MILD DROUGHT
2007-2008	0.31	HIGH	-1.470	MODERATE DROUGHT
2008-2009	1.34	MODERATE	1.020	WET SEASON
2009-2010	2.93	NO-ALERT STATUS	0.660	NORMAL
2010-2011	0.69	HIGH	0.180	NORMAL
2011-2012	12.69	NO-ALERT STATUS	1.910	VERY WET SEASON
2012-2013	8.40	NO-ALERT STATUS	1.160	WET SEASON
2013-2014	0.81	HIGH	-1.23	MODERATE DROUGHT
2014-2015	7.83	NO-ALERT STATUS		

Finally, the table below (Table 6-18) shows the linear correlation coefficients of annual runoff with their respective volumes for an integration level of 2-5 years. As expected, the corresponding coefficients are reduced rapidly with the increasing level of integration.

Table 6-13: Compatibility analysis of SPI-12 and runoff indices and application in Hydrologic Region 2

Hydrologic Year	Runoff at Evretou Dam (hm^3)	Alert Level according to Hydrologic Year Runoff Index	SPI -12	Drought Level based on SPI-12
1970-1971	5.29	NO-ALERT STATUS	0.350	NORMAL
1971-1972	1.04	HIGH	-1.010	MODERATE DROUGHT
1972-1973	0.12	VERY HIGH	-2.840	EXTREME DROUGHT
1973-1974	1.76	MODERATE	-0.880	MODERATE DROUGHT
1974-1975	15.01	NO-ALERT STATUS	1.420	HIGH WET SEASON
1975-1976	7.93	NO-ALERT STATUS	1.060	HIGH WET SEASON
1976-1977	5.75	NO-ALERT STATUS	0.360	NORMAL
1977-1978	14.30	NO-ALERT STATUS	1.340	HIGH WET SEASON
1978-1979	2.52	NO-ALERT STATUS	-0.280	MILD DROUGHT
1979-1980	15.04	NO-ALERT STATUS	1.210	HIGH WET SEASON
1980-1981	12.15	NO-ALERT STATUS	0.810	HIGH WET SEASON
1981-1982	3.63	NO-ALERT STATUS	-0.540	MILD DROUGHT
1982-1983	5.24	NO-ALERT STATUS	0.080	NORMAL
1983-1984	3.04	NO-ALERT STATUS	0.040	NORMAL
1984-1985	10.30	NO-ALERT STATUS	0.190	NORMAL
1985-1986	4.97	NO-ALERT STATUS	-0.530	MILD DROUGHT
1986-1987	14.55	NO-ALERT STATUS	1.020	HIGH WET SEASON
1987-1988	15.99	NO-ALERT STATUS	1.320	HIGH WET SEASON
1988-1989	11.73	NO-ALERT STATUS	0.240	NORMAL
1989-1990	3.23	NO-ALERT STATUS	-1.340	MODERATE DROUGHT
1990-1991	0.66	VERY HIGH	-2.100	EXTREME DROUGHT
1991-1992	12.25	NO-ALERT STATUS	1.100	HIGH WET SEASON
1992-1993	7.65	NO-ALERT STATUS	0.100	NORMAL
1993-1994	2.82	NO-ALERT STATUS	-0.910	MODERATE DROUGHT
1994-1995	5.14	NO-ALERT STATUS	0.200	NORMAL
1995-1996	1.92	MODERATE	-0.760	MILD DROUGHT
1996-1997	0.81	VERY HIGH	-0.720	MILD DROUGHT
1997-1998	2.10	MODERATE	-0.630	MILD DROUGHT
1998-1999	6.68	NO-ALERT STATUS	0.360	NORMAL
1999-2000	1.79	MODERATE	-0.520	MILD DROUGHT
2000-2001	2.20	NO-ALERT STATUS	-0.820	MILD DROUGHT

2001-2002	9.41	NO-ALERT STATUS	0.910	HIGH WET SEASON
2002-2003	9.66	NO-ALERT STATUS	0.900	NORMAL
2003-2004	11.19	NO-ALERT STATUS	0.330	NORMAL
2004-2005	1.54	HIGH	-1.170	MODERATE DROUGHT
2005-2006	1.26	HIGH	-0.960	MODERATE DROUGHT
2006-2007	1.15	HIGH	0.100	NORMAL
2007-2008	2.22	NO-ALERT STATUS	-1.210	MODERATE DROUGHT
2008-2009	9.81	NO-ALERT STATUS	1.110	HIGH WET SEASON
2009-2010	9.93	NO-ALERT STATUS	0.560	NORMAL
2010-2011	5.30	NO-ALERT STATUS	0.290	NORMAL
2011-2012	11.51	NO-ALERT STATUS	1.820	VERY HIGH WET SEASON
2012-2013	12.68	NO-ALERT STATUS	1.380	HIGH WET SEASON
2013-2014	0.34	VERY HIGH	-1.760	SEVERE DROUGHT
2014-2015	8.73	NO-ALERT STATUS		

Table 6-14: Compatibility analysis of SPI-12 and runoff indices and application in Hydrologic Region 3

Hydrologic Year	Runoff (hm^3)	Alert Level according to Hydrologic Year Runoff Index	SPI -12	Drought Level according to SPI-12
1970-1971	15.04	NO-ALERT STATUS	1.19	HIGH WET SEASON
1971-1972	11.84	NO-ALERT STATUS	0.12	NORMAL
1972-1973	-------	---------	-3.27	EXTREME DROUGHT
1973-1974	-------	----------	-0.40	MILD DROUGHT
1974-1975	17.37	NO-ALERT STATUS	0.97	NORMAL
1975-1976	13.05	NO-ALERT STATUS	0.93	NORMAL
1976-1977	8.78	NO-ALERT STATUS	-0.06	MILD DROUGHT
1977-1978	13.24	NO-ALERT STATUS	0.32	NORMAL
1978-1979	8.86	NO-ALERT STATUS	0.07	NORMAL
1979-1980	18.45	NO-ALERT STATUS	0.73	NORMAL
1980-1981	20.86	NO-ALERT STATUS	0.83	NORMAL
1981-1982	8.03	NO-ALERT STATUS	-0.15	MILD DROUGHT
1982-1983	10.52	NO-ALERT STATUS	-0.10	MILD DROUGHT
1983-1984	8.65	MODERATE	-0.41	MILD DROUGHT
1984-1985	15.01	NO-ALERT STATUS	0.26	NORMAL

1985-1986	5.65	NO-ALERT STATUS	-0.84	MILD DROUGHT
1986-1987	17.11	NO-ALERT STATUS	0.39	NORMAL
1987-1988	21.49	NO-ALERT STATUS	1.06	HIGH WET SEASON
1988-1989	19.84	NO-ALERT STATUS	0.22	NORMAL
1989-1990	5.74	NO-ALERT STATUS	-0.89	MODERATE DROUGHT
1990-1991	2.80	VERY HIGH	-2.06	EXTREME DROUGHT
1991-1992	22.49	NO-ALERT STATUS	1.41	HIGH WET SEASON
1992-1993	22.40	NO-ALERT STATUS	0.74	NORMAL
1993-1994	11.65	NO-ALERT STATUS	0.06	NORMAL
1994-1995	16.25	NO-ALERT STATUS	0.12	NORMAL
1995-1996	5.63	MODERATE	-0.83	MILD DROUGHT
1996-1997	4.62	HIGH	-0.78	MILD DROUGHT
1997-1998	2.86	HIGH	-1.06	MODERATE DROUGHT
1998-1999	7.56	NO-ALERT STATUS	0.26	NORMAL
1999-2000	3.36	HIGH	-1.06	MODERATE DROUGHT
2000-2001	9.64	NO-ALERT STATUS	0.16	NORMAL
2001-2002	25.80	NO-ALERT STATUS	1.52	HIGH WET SEASON
2002-2003	17.06	NO-ALERT STATUS	1.29	HIGH WET SEASON
2003-2004	22.57	NO-ALERT STATUS	0.38	NORMAL
2004-2005	11.81	NO-ALERT STATUS	-0.37	MODERATE DROUGHT
2005-2006	5.41	HIGH	-0.53	MODERATE DROUGHT
2006-2007	9.31	NO-ALERT STATUS	0.56	NORMAL
2007-2008	1.87	VERY HIGH	-2.47	EXTREME DROUGHT
2008-2009	6.04	NO-ALERT STATUS	-0.01	MILD DROUGHT
2009-2010	16.75	NO-ALERT STATUS	0.77	NORMAL
2010-2011	7.92	NO-ALERT STATUS	-0.24	MILD DROUGHT
2011-2012	24.01	NO-ALERT STATUS	1.24	HIGH WET SEASON
2012-2013	8.60	NO-ALERT STATUS	0.16	NORMAL
2013-2014	1.63	VERY HIGH	-1.17	MODERATE DROUGHT
2014-2015	13.75	NO-ALERT STATUS		

Table 6-15: Compatibility analysis of SPI-12 and runoff indices and application in Hydrologic Region 6

Hydrologic Year	Runoff (hm^3)	Alert Level according to Hydrologic Year Runoff Index	SPI -12	Drought Level based on SPI-12
1970-1971	2.68	NO-ALERT STATUS	1.19	HIGH WET SEASON
1971-1972	2.01	NO-ALERT STATUS	0.17	NORMAL
1972-1973	----------	----------	-3.28	EXTREME DROUGHT
1973-1974	----------	----------	-0.34	MODERATE DROUGHT
1974-1975	3.67	NO-ALERT STATUS	0.91	NORMAL
1975-1976	2.69	NO-ALERT STATUS	0.71	NORMAL
1976-1977	1.14	NO-ALERT STATUS	0.05	NORMAL
1977-1978	1.59	NO-ALERT STATUS	-0.54	MILD DROUGHT
1978-1979	1.36	NO-ALERT STATUS	0.57	NORMAL
1979-1980	2.03	NO-ALERT STATUS	0.84	NORMAL
1980-1981	2.54	NO-ALERT STATUS	0.56	NORMAL
1981-1982	0.64	MODERATE	-0.57	MILD DROUGHT
1982-1983	1.00	NO-ALERT STATUS	-0.74	MILD DROUGHT
1983-1984	0.77	NO-ALERT STATUS	-0.30	MILD DROUGHT
1984-1985	1.62	NO-ALERT STATUS	0.26	NORMAL
1985-1986	0.69	MODERATE	-0.07	MILD DROUGHT
1986-1987	2.54	NO-ALERT STATUS	-0.53	MILD DROUGHT
1987-1988	2.46	NO-ALERT STATUS	0.48	NORMAL
1988-1989	2.96	NO-ALERT STATUS	0.31	NORMAL
1989-1990	1.01	NO-ALERT STATUS	-0.48	MILD DROUGHT
1990-1991	0.63	HIGH	-1.97	SEVERE DROUGHT
1991-1992	4.05	NO-ALERT STATUS	1.43	HIGH WET SEASON
1992-1993	3.08	NO-ALERT STATUS	0.83	NORMAL
1993-1994	1.88	NO-ALERT STATUS	0.38	NORMAL
1994-1995	2.30	NO-ALERT STATUS	0.50	NORMAL
1995-1996	0.67	MODERATE	-1.06	MODERATE DROUGHT
1996-1997	0.54	HIGH	-0.44	MILD DROUGHT
1997-1998	0.37	HIGH	-0.67	MILD DROUGHT
1998-1999	0.75	NO-ALERT STATUS	-0.20	MILD DROUGHT
1999-2000	0.32	VERY HIGH	-1.17	MODERATE DROUGHT
2000-2001	1.96	NO-ALERT STATUS	0.85	NORMAL

2001-2002	4.26	NO-ALERT STATUS	1.37	HIGH WET SEASON
2002-2003	3.40	NO-ALERT STATUS	1.63	VERY HIGH WET SEASON
2003-2004	2.71	NO-ALERT STATUS	0.80	NORMAL
2004-2005	0.71	NO-ALERT STATUS	0.35	NORMAL
2005-2006	0.65	MODERATE	-0.32	MODERATE DROUGHT
2006-2007	0.92	NO-ALERT STATUS	0.33	NORMAL
2007-2008	0.11	VERY HIGH	-2.67	EXTREME DROUGHT
2008-2009	0.67	NO-ALERT STATUS	-0.37	MILD DROUGHT
2009-2010	1.63	NO-ALERT STATUS	0.82	NORMAL
2010-2011	0.77	NO-ALERT STATUS	-0.17	MILD DROUGHT
2011-2012	2.20	NO-ALERT STATUS	0.66	NORMAL
2012-2013	0.65	MODERATE	-0.03	MILD DROUGHT
2013-2014	0.022	VERY HIGH	-1.03	MODERATE DROUGHT
2014-2015	1.80	NO-ALERT STATUS		

Table 6-16: Compatibility analysis of SPI-12 and runoff indices and application in Hydrologic Region 8

Hydrologic Year	Runoff at Kalavassos Dam (hm^3)	Alert Level according to Hydrologic Year Runoff Index	SPI -12	Drought Level based on SPI-12
1970-1971	5.98	NO-ALERT STATUS	0.35	NORMAL
1971-1972	4.72	NO-ALERT STATUS	-0.39	MODERATE DROUGHT
1972-1973	0.86	MODERATE	-3.18	EXTREME DROUGHT
1973-1974	3.01	NO-ALERT STATUS	-0.38	MILD DROUGHT
1974-1975	11.55	NO-ALERT STATUS	0.73	NORMAL
1975-1976	12.80	NO-ALERT STATUS	0.96	NORMAL
1976-1977	6.83	NO-ALERT STATUS	0.04	NORMAL
1977-1978	14.71	NO-ALERT STATUS	0.21	NORMAL
1978-1979	7.20	NO-ALERT STATUS	-0.09	MILD DROUGHT
1979-1980	15.56	NO-ALERT STATUS	0.72	NORMAL
1980-1981	19.67	NO-ALERT STATUS	0.98	NORMAL
1981-1982	5.58	NO-ALERT STATUS	-0.57	MILD DROUGHT
1982-1983	6.28	NO-ALERT STATUS	-0.93	MILD DROUGHT
1983-1984	3.68	NO-ALERT STATUS	-0.12	MILD DROUGHT
1984-1985	7.42	NO-ALERT STATUS	0.38	NORMAL

1985-1986	6.03	NO-ALERT STATUS	0.16	NORMAL
1986-1987	10.51	NO-ALERT STATUS	-0.02	MILD DROUGHT
1987-1988	12.84	NO-ALERT STATUS	0.95	NORMAL
1988-1989	11.26	NO-ALERT STATUS	0.21	NORMAL
1989-1990	2.83	NO-ALERT STATUS	-0.71	MILD DROUGHT
1990-1991	0.72	HIGH	-1.52	SEVERE DROUGHT
1991-1992	15.52	NO-ALERT STATUS	2.14	EXTREMELY HIGH WET SEASON
1992-1993	14.87	NO-ALERT STATUS	0.53	NORMAL
1993-1994	4.60	NO-ALERT STATUS	0.02	NORMAL
1994-1995	14.45	NO-ALERT STATUS	0.54	NORMAL
1995-1996	2.37	MODERATE	-0.76	MILD DROUGHT
1996-1997	0.91	MODERATE	-0.89	MILD DROUGHT
1997-1998	0.34	HIGH	-0.74	MILD DROUGHT
1998-1999	1.34	MODERATE	-0.19	MILD DROUGHT
1999-2000	0.21	VERY HIGH	-0.98	MILD DROUGHT
2000-2001	6.63	NO-ALERT STATUS	0.71	NORMAL
2001-2002	14.19	NO-ALERT STATUS	1.17	HIGH WET SEASON
2002-2003	10.66	NO-ALERT STATUS	0.80	NORMAL
2003-2004	14.11	NO-ALERT STATUS	1.23	HIGH WET SEASON
2004-2005	2.45	NO-ALERT STATUS	-0.14	MILD DROUGHT
2005-2006	0.35	HIGH	-1.07	MODERATE DROUGHT
2006-2007	0.57	HIGH	0.21	NORMAL
2007-2008	0.02	VERY HIGH	-2.75	EXTREME DROUGHT
2008-2009	2.46	NO-ALERT STATUS	0.35	NORMAL
2009-2010	7.97	NO-ALERT STATUS	0.74	NORMAL
2010-2011	3.15	NO-ALERT STATUS	0.02	NORMAL
2011-2012	11.73	NO-ALERT STATUS	1.35	HIGH WET SEASON
2012-2013	4.26	NO-ALERT STATUS	0.17	NORMAL
2013-2014	0.14	VERY HIGH	-1.69	SEVERE DROUGHT
2014-2015	8.76	NO-ALERT STATUS		

Table 6-17: Compatibility analysis of SPI-12 and runoff indices and application in Hydrologic Region 9

Hydrologic Year	Runoff at Kouris Dam (hm^3)	Alert Level according to Hydrologic Year Runoff Index	SPI -12	Drought Level based on SPI-12
1970-1971	29.90	NO-ALERT STATUS	0.30	NORMAL
1971-1972	25.66	NO-ALERT STATUS	-0.62	MODERATE DROUGHT
1972-1973	6.66	HIGH	-3.15	EXTREME DROUGHT
1973-1974	13.55	MODERATE	-1.10	MODERATE DROUGHT
1974-1975	56.58	NO-ALERT STATUS	1.18	HIGH WET SEASON
1975-1976	49.85	NO-ALERT STATUS	0.67	NORMAL
1976-1977	27.12	NO-ALERT STATUS	-0.16	MILD DROUGHT
1977-1978	68.70	NO-ALERT STATUS	0.85	NORMAL
1978-1979	28.80	NO-ALERT STATUS	-0.67	MILD DROUGHT
1979-1980	61.46	NO-ALERT STATUS	1.11	HIGH WET SEASON
1980-1981	76.61	NO-ALERT STATUS	1.27	HIGH WET SEASON
1981-1982	26.19	NO-ALERT STATUS	-0.50	MILD DROUGHT
1982-1983	37.70	NO-ALERT STATUS	0.02	NORMAL
1983-1984	27.75	NO-ALERT STATUS	0.00	NORMAL
1984-1985	47.50	NO-ALERT STATUS	0.27	NORMAL
1985-1986	19.89	NO-ALERT STATUS	-0.19	MILD DROUGHT
1986-1987	61.06	NO-ALERT STATUS	0.90	NORMAL
1987-1988	69.07	NO-ALERT STATUS	1.64	HIGH WET SEASON
1988-1989	45.24	NO-ALERT STATUS	0.12	NORMAL
1989-1990	12.14	MODERATE	-0.84	MODERATE DROUGHT
1990-1991	6.22	VERY HIGH	-1.83	SEVERE DROUGHT
1991-1992	37.87	NO-ALERT STATUS	1.18	HIGH WET SEASON
1992-1993	40.42	NO-ALERT STATUS	0.45	NORMAL
1993-1994	18.75	NO-ALERT STATUS	-0.45	MILD DROUGHT
1994-1995	32.73	NO-ALERT STATUS	0.43	NORMAL
1995-1996	13.96	NO-ALERT STATUS	-0.62	MILD DROUGHT
1996-1997	11.72	MODERATE	-0.10	MILD DROUGHT
1997-1998	13.02	MODERATE	-0.78	MILD DROUGHT
1998-1999	25.62	NO-ALERT STATUS	0.03	NORMAL
1999-2000	9.07	HIGH	-1.16	MODERATE DROUGHT
2000-2001	15.84	NO-ALERT STATUS	0.03	NORMAL

2001-2002	44.27	NO-ALERT STATUS	0.91	NORMAL
2002-2003	34.19	NO-ALERT STATUS	0.67	NORMAL
2003-2004	54.65	NO-ALERT STATUS	0.92	NORMAL
2004-2005	17.02	NO-ALERT STATUS	-0.24	MILD DROUGHT
2005-2006	7.75	HIGH	-1.36	MODERATE DROUGHT
2006-2007	11.05	HIGH	-0.20	MILD DROUGHT
2007-2008	6.40	VERY HIGH	-1.95	SEVERE DROUGHT
2008-2009	20.98	NO-ALERT STATUS	0.74	NORMAL
2009-2010	35.95	NO-ALERT STATUS	0.53	NORMAL
2010-2011	15.85	NO-ALERT STATUS	-0.01	MILD DROUGHT
2011-2012	58.97	NO-ALERT STATUS	1.83	HIGH WET SEASON
2012-2013	24.83	NO-ALERT STATUS	0.63	NORMAL
2013-2014	3.46	VERY HIGH	-1.85	SEVERE DROUGHT
2014-2015	22.69	NO-ALERT STATUS		

Table 6-18: Linear correlation coefficients of annual runoff with their respective volumes for an integration level of 2-5 years.

HYDROLOGIC REGION	RUNOFF CORRELATION COEFFICIENT 1 YEAR WITH 2 YEARS	RUNOFF CORRELATION COEFFICIENT 1 YEAR WITH 3 YEARS	RUNOFF CORRELATION COEFFICIENT 1 YEAR WITH 4 YEARS	RUNOFF CORRELATION COEFFICIENT 1 YEAR WITH 5 YEARS
HYDROLOGIC REGION 1	0.802	0.635	0.567	0.453
HYDROLOGIC REGION 2	0.784	0.613	0.495	0.357
HYDROLOGIC REGION 3	0.794	0.601	0.461	0.321
HYDROLOGIC REGION 6	0.838	0.670	0.497	0.317
HYDROLOGIC REGION 7	-------	-------	-------	-------
HYDROLOGIC REGION 8	0.821	0.671	0.544	0.384
HYDROLOGIC REGION 9	0.802	0.669	0.581	0.480

6.2.3 THE WET PERIOD RUNOFF INDEX

This index aims at the early detection of an impending drought, utilising the good correlation observed in historical samples between very low runoff in October - December and very low total runoff during the wet season. It uses the runoff of representative dams and hydrometric stations of the previous index (see Table 6-3). The wet season on which this index is based is the time period between October and April of the hydrological year under study and it is divided into five periods (October - December, October - January, October - February, October - March and October - April) for each hydrologic region. The sum of inflows shall be calculated and taken into account for the periods October - December, October - January, October - February, October - March and October - April for each dam or station separately for a given Hydrologic Region. The following tables (from Table 6-19 until Table 6-24) present the values for the 5%, 15%, 25% and 50% percentiles, along with the average values of the above data for the reference period (1970-71 to 2009-10 and which will be reviewed every 10 years).

Table 6-19: Determination of percentiles for the assessment of the Alert Level of the Wet Season Index in Hydrologic Region 1 (Kannaviou dam)

PERCENTILE	OCT-DEC	OCT-JAN	OCT-FEB	OCT-MAR	OCT-APR
AVERAGE	441,611	1,619,938	2,945,579	4,280,241	4,878,053
50% PERCENTILE	126,022	1,067,862	1,928,721	3,081,804	3,853,735
25% PERCENTILE	33,030	196,008	583,840	1,392,895	1,755,035
15% PERCENTILE	18,632	109,871	407,369	758,215	984,656
5% PERCENTILE	6,121	26,239	62,025	166,482	235,707

Table 6-20: Determination of percentiles for the assessment of the Alert Level of the Wet Season Index in Hydrologic Region 2 (Evretou dam)

PERCENTILE	OCT-DEC	OCT-JAN	OCT-FEB	OCT-MAR	OCT-APR
AVERAGE	643,098	2,230,775	3,950,623	5,542,976	6,146,777
50% PERCENTILE	237,514	1,247,000	2,736,517	4,206,254	4,896,547
25% PERCENTILE	63,992	341,323	1,047,919	1,575,372	2,015,733
15% PERCENTILE	26,148	176,066	577,148	1,169,279	1,495,380
5% PERCENTILE	4,843	69,710	273,100	471,234	782,062

Table 6-21: Determination of percentiles for the assessment of the Alert Level of the the Wet Season Index in Hydrologic Region 3 (r3-7-1-50-Peristeronas hydrometric station)

PERCENTILE	OCT-DEC	OCT-JAN	OCT-FEB	OCT-MAR	OCT-APR
AVERAGE	1,938,195	4,949,365	7,904,068	10,317,304	11,358,172
50% PERCENTILE	1,005,653	3,394,352	6,366,569	8,515,886	9,814,090
25% PERCENTILE	440,921	1,448,518	3,502,548	5,059,886	5,616,799
15% PERCENTILE	183,103	963,161	2,970,654	4,319,952	4,951,536

5% PERCENTILE	84,318	333,521	1,348,160	2,215,084	2,738,029

Table 6-22: Determination of percentiles for the assessment of the Alert Level of the Wet Season Index in Hydrologic Region 6 (r6-1-1-80 Agios Onoufrios hydrometric station)

PERCENTILE	OCT-DEC	OCT-JAN	OCT-FEB	OCT-MAR	OCT-APR
AVERAGE	345,270	762,169	1,218,728	1,530,423	1,600,570
50% PERCENTILE	140,530	508,743	1,038,738	1,404,957	1,411,776
25% PERCENTILE	48,773	230,947	435,511	595,555	639,113
15% PERCENTILE	18,075	145,524	298,598	540,868	583,485
5% PERCENTILE	0	20,740	174,539	284,007	353,719

Table 6-23: Determination of percentiles for the assessment of the Alert Level of the Wet Season Index in Hydrologic Region 8 (Kalavassos dam)

PERCENTILE	OCT-DEC	OCT-JAN	OCT-FEB	OCT-MAR	OCT-APR
AVERAGE	1,011,170	2,611,591	4,380,264	5,881,568	6,607,721
50% PERCENTILE	336,107	1,341,191	2,339,988	4,465,595	5,400,435
25% PERCENTILE	95,500	484,829	1,210,589	1,747,194	2,087,722
15% PERCENTILE	79,855	168,364	446,302	576,521	802,670
5% PERCENTILE	7,798	49,954	143,259	294,650	316,250

Table 6-24: Determination of percentiles for the assessment of the Alert Level of the Wet Season Index in Hydrologic Region 9 (Kouris dam)

PERCENTILE	OCT-DEC	OCT-JAN	OCT-FEB	OCT-MAR	OCT-APR
AVERAGE	4,806,455	11,451,785	18,467,444	25,196,420	28,758,213
50% PERCENTILE	3,627,509	8,551,131	13,505,568	20,432,013	24,605,523
25% PERCENTILE	2,294,750	4,866,506	7,855,403	11,486,692	13,261,451
15% PERCENTILE	1,843,200	3,452,184	6,093,057	8,792,041	11,057,550
5% PERCENTILE	1,198,989	2,386,280	4,753,144	6,035,807	6,552,470

The following table (Table 6-25) presents the current classification of the Alert Level based on the percentile of the runoff in the respective periods. This means that during a hydrological year the sum of the runoff of the months October through December is calculated. Depending on the percentile in which said value is included, the Alert Level warning is issued, based on which the measures required to tackle drought are defined. At the end of January the alert level is adjusted etc. The closer we approach the irrigation period, the lower the confidence interval of the Alert Level is. The following table (Table 6-25) presents the Alert Level depending on the percentile.

Table 6-25: Suggested Classification of the Alert Level based on Wet Season Runoff

PERCENTILE AT WHICH THE EXAMINED RUNOFF LIES	ALERT LEVEL
> 25%	NONE
15% - 25%	MODERATE
5% - 15%	HIGH
< 5%	VERY HIGH

The following table (Table 6-26) shows that the correlation coefficient for the hydrological years with low and average aquifer conditions (i.e. if dry years are excluded) is far higher when the start of the assessment is performed on January with a four-month projection to the end of April. That is, the correlation coefficient of cumulative volumes of October - January compared to those of October - Apris is much higher that the corresponding coefficient of October - December and October - April. Therefore, the decision to issue an Alert Level shall be taken at the end of January in any case regardless of the aquifer conditions of the hydrological year since the correlation with April is much higher than that of December. If finally it proves to be a dry year, then the correct decision for the alert level will have been taken for the whole hydrological year.

Table 6-26: Linear correlation coefficients per Hydrologic Year for all hydrological years and dry years (OCT-JAN values in brackets)

	RUNOFF CORRELATION COEFFICIENT OCT –DEC to OCT-JAN	RUNOFF CORRELATION COEFFICIENT OCT –DEC to OCT-FEB	RUNOFF CORRELATION COEFFICIENT OCT –DEC to OCT-MAR	RUNOFF CORRELATION COEFFICIENT OCT –DEC to OCT-APR
HYDROLOGIC REGION 1 (Kanavious Dam)				
ALL HYDROLOGIC YEARS	0.737	0.585	0.470	0.464
WET YEARS EXCLUDED	0.909	0.696 (0.876)	0.608 (0.791)	0.623 (0.791)
HYDROLOGIC REGION 2 (Evretou Dam)				
ALL HYDROLOGIC YEARS	0.738	0.563	0.434	0.426
WET YEARS EXCLUDED	0.932	0.829 (0.904)	0.738 (0.817)	0.719 (0.803)
HYDROLOGIC REGION 3				
ALL HYDROLOGIC YEARS	0.706	0.612	0.549	0.536
WET YEARS EXCLUDED	0.760	0.406 (0.779)	0.367 (0.790)	0.344 (0.775)
HYDROLOGIC REGION 6				
ALL HYDROLOGIC YEARS	0.832	0.712	0.636	0.638
WET YEARS EXCLUDED	0.721	0.597 (0.934)	0.560 (0.915)	0.5281 (0.862)
HYDROLOGIC REGION 8 (Kalavassos Dam)				
ALL HYDROLOGIC YEARS	0.818	0.652	0.588	0.556
WET YEARS EXCLUDED	0.899	0.647 (0.859)	0.615 (0.822)	0.567 (0.811)
HYDROLOGIC REGION 9 (Kouris Dam)				
ALL HYDROLOGIC YEARS	0.662	0.465	0.426	0.411
WET YEARS EXCLUDED	0.823	0.658 (0.921)	0.630 (0.910)	0.620 (0.895)

The following tables (Table 6-27 to Table 6-32) present the alert level simulation for Hydrologic Region 9 and the Kouris Dam for the hydrological years 1969-70 up to 2013-14. For the entire available period, only twice had the alert level warning “VERY HIGH” been issued and even without changing the warning level in the months of December through April. In 11 out of 40 years there is a transition from an alert status to another for one month from December to April. Of the total of 40 hydrological years of application, in 28 cases the December alert level is the same as the April alert level, while in 31 cases the January alert level is the same as the April alert level.

Table 6-27: Alert level depending on wet period runoff index for Hydrologic Region 1 (Kannaviou Dam)

Hydrologic Year	OCT-DEC	OCT-JAN	OCT-FEB	OCT-MAR	OCT-APR
1970-1971	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1971-1972	NORMAL	NORMAL	MODERATE	MODERATE	MODERATE
1972-1973	HIGH	HIGH	HIGH	VERY HIGH	VERY HIGH
1973-1974	MODERATE	NORMAL	NORMAL	NORMAL	MODERATE
1974-1975	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1975-1976	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1976-1977	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1977-1978	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1978-1979	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1979-1980	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1980-1981	MODERATE	NORMAL	NORMAL	NORMAL	NORMAL
1981-1982	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1982-1983	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1983-1984	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1984-1985	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1985-1986	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1986-1987	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1987-1988	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1988-1989	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1989-1990	NORMAL	MODERATE	NORMAL	NORMAL	NORMAL
1990-1991	HIGH	VERY HIGH	VERY HIGH	HIGH	HIGH
1991-1992	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1992-1993	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1993-1994	HIGH	NORMAL	NORMAL	NORMAL	NORMAL
1994-1995	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1995-1996	VERY HIGH	HIGH	MODERATE	NORMAL	NORMAL
1996-1997	MODERATE	HIGH	HIGH	HIGH	HIGH
1997-1998	NORMAL	NORMAL	MODERATE	MODERATE	MODERATE

Hydrologic Year	OCT-DEC	OCT-JAN	OCT-FEB	OCT-MAR	OCT-APR
1998-1999	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1999-2000	HIGH	HIGH	MODERATE	MODERATE	NORMAL
2000-2001	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2001-2002	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2002-2003	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2003-2004	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2004-2005	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2005-2006	VERY HIGH	VERY HIGH	VERY HIGH	VERY HIGH	VERY HIGH
2006-2007	NORMAL	MODERATE	HIGH	HIGH	HIGH
2007-2008	NORMAL	MODERATE	HIGH	HIGH	HIGH
2008-2009	MODERATE	MODERATE	NORMAL	MODERATE	MODERATE
2009-2010	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2010-2011	HIGH	HIGH	HIGH	HIGH	HIGH
2011-2012	MODERATE	NORMAL	NORMAL	NORMAL	NORMAL
2012-2013	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2013-2014	MODERATE	MODERATE	HIGH	HIGH	HIGH
2014-2015	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
NORMAL	32	33	33	33	33
MODERATE	6	5	4	4	4
HIGH	5	5	6	6	6
VERY HIGH	2	2	2	2	2

Table 6-28: Alert level depending on wet period runoff index for Hydrologic Region 2 (Evretou Dam)

Hydrologic Year	OCT-DEC	OCT-JAN	OCT-FEB	OCT-MAR	OCT-APR
1970-1971	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1971-1972	MODERATE	MODERATE	HIGH	HIGH	HIGH
1972-1973	VERY HIGH	VERY HIGH	VERY HIGH	VERY HIGH	VERY HIGH
1973-1974	MODERATE	NORMAL	MODERATE	MODERATE	MODERATE
1974-1975	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1975-1976	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1976-1977	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1977-1978	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1978-1979	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1979-1980	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1980-1981	HIGH	NORMAL	NORMAL	NORMAL	NORMAL
1981-1982	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1982-1983	HIGH	MODERATE	NORMAL	NORMAL	NORMAL
1983-1984	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1984-1985	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1985-1986	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1986-1987	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1987-1988	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1988-1989	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1989-1990	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1990-1991	HIGH	VERY HIGH	VERY HIGH	HIGH	VERY HIGH
1991-1992	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1992-1993	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1993-1994	HIGH	NORMAL	NORMAL	NORMAL	NORMAL
1994-1995	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1995-1996	VERY HIGH	MODERATE	HIGH	NORMAL	MODERATE
1996-1997	NORMAL	HIGH	HIGH	VERY HIGH	HIGH
1997-1998	NORMAL	NORMAL	MODERATE	MODERATE	NORMAL
1998-1999	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1999-2000	MODERATE	HIGH	HIGH	MODERATE	MODERATE
2000-2001	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL

Hydrologic Year	OCT-DEC	OCT-JAN	OCT-FEB	OCT-MAR	OCT-APR
2001-2002	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2002-2003	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2003-2004	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2004-2005	MODERATE	HIGH	NORMAL	MODERATE	MODERATE
2005-2006	NORMAL	MODERATE	MODERATE	HIGH	HIGH
2006-2007	NORMAL	HIGH	MODERATE	HIGH	HIGH
2007-2008	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2008-2009	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2009-2010	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2010-2011	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2011-2012	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2012-2013	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2013-2014	MODERATE	HIGH	VERY HIGH	VERY HIGH	VERY HIGH
2014-2015	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
NORMAL	33	33	33	33	33
MODERATE	5	4	4	4	4
HIGH	4	5	4	4	4
VERY HIGH	2	2	3	3	3

Table 6-29: Alert level depending on wet period runoff index for Hydrologic Region 3 (Hydrometric Station r3-7-1-50)

Hydrologic Year	OCT-DEC	OCT-JAN	OCT-FEB	OCT-MAR	OCT-APR
1970-1971	MODERATE	NORMAL	NORMAL	NORMAL	NORMAL
1971-1972	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1972-1973					
1973-1974					
1974-1975	MODERATE	NORMAL	NORMAL	NORMAL	NORMAL
1975-1976	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1976-1977	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1977-1978	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1978-1979	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1979-1980	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1980-1981	HIGH	NORMAL	NORMAL	NORMAL	NORMAL
1981-1982	NORMAL	NORMAL	MODERATE	NORMAL	NORMAL
1982-1983	MODERATE	NORMAL	NORMAL	NORMAL	NORMAL
1983-1984	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1984-1985	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1985-1986	NORMAL	NORMAL	MODERATE	HIGH	VERY HIGH
1986-1987	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1987-1988	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1988-1989	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1989-1990	HIGH	VERY HIGH	MODERATE	MODERATE	MODERATE
1990-1991	VERY HIGH	VERY HIGH	VERY HIGH	HIGH	VERY HIGH
1991-1992	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1992-1993	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1993-1994	HIGH	NORMAL	NORMAL	NORMAL	NORMAL
1994-1995	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1995-1996	HIGH	MODERATE	HIGH	MODERATE	MODERATE
1996-1997	NORMAL	HIGH	HIGH	HIGH	VERY HIGH
1997-1998	NORMAL	MODERATE	HIGH	HIGH	VERY HIGH
1998-1999	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1999-2000	HIGH	HIGH	VERY HIGH	VERY HIGH	VERY HIGH

Hydrologic Year	OCT-DEC	OCT-JAN	OCT-FEB	OCT-MAR	OCT-APR
2000-2001	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2001-2002	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2002-2003	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2003-2004	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2004-2005	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2005-2006	NORMAL	MODERATE	NORMAL	MODERATE	MODERATE
2006-2007	NORMAL	HIGH	NORMAL	NORMAL	NORMAL
2007-2008	NORMAL	HIGH	HIGH	VERY HIGH	VERY HIGH
2008-2009	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE
2009-2010	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2010-2011	MODERATE	NORMAL	MODERATE	NORMAL	NORMAL
2011-2012	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2012-2013	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2013-2014	MODERATE	HIGH	VERY HIGH	VERY HIGH	VERY HIGH
2014-2015	MODERATE	NORMAL	NORMAL	NORMAL	NORMAL
NORMAL	30	32	31	32	32
MODERATE	7	4	5	4	4
HIGH	6	5	4	4	0
VERY HIGH	0	2	3	3	7

Table 6-30: Alert level depending on wet period runoff index for Hydrologic

Hydrologic Year	OCT-DEC	OCT-JAN	OCT-FEB	OCT-MAR	OCT-APR
1970-1971	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1971-1972	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1972-1973					
1973-1974					
1974-1975	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1975-1976	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1976-1977	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1977-1978	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1978-1979	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1979-1980	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1980-1981	MODERATE	NORMAL	NORMAL	NORMAL	NORMAL
1981-1982	NORMAL	HIGH	HIGH	MODERATE	MODERATE
1982-1983	HIGH	NORMAL	NORMAL	NORMAL	NORMAL
1983-1984	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1984-1985	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1985-1986	NORMAL	NORMAL	MODERATE	HIGH	HIGH
1986-1987	NORMAL	NORMAL	MODERATE	NORMAL	NORMAL
1987-1988	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1988-1989	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1989-1990	HIGH	VERY HIGH	NORMAL	NORMAL	NORMAL
1990-1991	HIGH	VERY HIGH	HIGH	MODERATE	MODERATE
1991-1992	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1992-1993	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1993-1994	HIGH	NORMAL	NORMAL	NORMAL	NORMAL
1994-1995	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1995-1996	HIGH	MODERATE	NORMAL	MODERATE	NORMAL
1996-1997	NORMAL	HIGH	HIGH	HIGH	HIGH
1997-1998	NORMAL	MODERATE	HIGH	HIGH	HIGH
1998-1999	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1999-2000	HIGH	HIGH	VERY HIGH	VERY HIGH	VERY HIGH
2000-2001	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL

Hydrologic Year	OCT-DEC	OCT-JAN	OCT-FEB	OCT-MAR	OCT-APR
2001-2002	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2002-2003	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2003-2004	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2004-2005	NORMAL	NORMAL	NORMAL	NORMAL	MODERATE
2005-2006	NORMAL	NORMAL	NORMAL	MODERATE	MODERATE
2006-2007	NORMAL	MODERATE	NORMAL	NORMAL	NORMAL
2007-2008	MODERATE	HIGH	VERY HIGH	VERY HIGH	VERY HIGH
2008-2009	MODERATE	MODERATE	MODERATE	HIGH	HIGH
2009-2010	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2010-2011	MODERATE	NORMAL	MODERATE	NORMAL	NORMAL
2011-2012	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2012-2013	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2013-2014	HIGH	VERY HIGH	VERY HIGH	VERY HIGH	VERY HIGH
2014-2015	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
NORMAL	32	32	32	32	32
MODERATE	4	4	4	4	4
HIGH	7	4	4	4	4
VERY HIGH	0	3	3	3	3

Table 6-31: Alert level depending on wet period runoff index for Hydrologic Region 8 (Kalavassos Dam)

Hydrologic Year	OCT-DEC	OCT-JAN	OCT-FEB	OCT-MAR	OCT-APR
1970-1971	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1971-1972	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1972-1973	NORMAL	MODERATE	MODERATE	MODERATE	MODERATE
1973-1974	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1974-1975	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1975-1976	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1976-1977	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1977-1978	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1978-1979	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1979-1980	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1980-1981	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1981-1982	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1982-1983	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1983-1984	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1984-1985	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1985-1986	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1986-1987	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1987-1988	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1988-1989	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1989-1990	MODERATE	HIGH	NORMAL	NORMAL	NORMAL
1990-1991	HIGH	HIGH	HIGH	HIGH	HIGH
1991-1992	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1992-1993	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1993-1994	MODERATE	NORMAL	NORMAL	NORMAL	NORMAL
1994-1995	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1995-1996	HIGH	NORMAL	NORMAL	NORMAL	MODERATE
1996-1997	NORMAL	MODERATE	MODERATE	MODERATE	MODERATE
1997-1998	NORMAL	MODERATE	HIGH	HIGH	HIGH
1998-1999	HIGH	MODERATE	MODERATE	MODERATE	MODERATE
1999-2000	VERY HIGH	VERY HIGH	VERY HIGH	VERY HIGH	VERY HIGH
2000-2001	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL

Hydrologic Year	OCT-DEC	OCT-JAN	OCT-FEB	OCT-MAR	OCT-APR
2001-2002	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2002-2003	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2003-2004	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2004-2005	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2005-2006	HIGH	HIGH	HIGH	HIGH	HIGH
2006-2007	MODERATE	HIGH	HIGH	HIGH	HIGH
2007-2008	VERY HIGH	VERY HIGH	VERY HIGH	VERY HIGH	VERY HIGH
2008-2009	MODERATE	NORMAL	MODERATE	MODERATE	NORMAL
2009-2010	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2010-2011	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2011-2012	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2012-2013	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2013-2014	HIGH	HIGH	VERY HIGH	VERY HIGH	VERY HIGH
2014-2015	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
NORMAL	34	34	34	34	34
MODERATE	4	4	4	4	4
HIGH	5	5	4	4	4
VERY HIGH	2	2	3	3	3

Table 6-32: Alert level depending on wet period runoff index for Hydrologic Region 9 (Kouris Dam)

Hydrologic Year	OCT-DEC	OCT-JAN	OCT-FEB	OCT-MAR	OCT-APR
1970-1971	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1971-1972	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1972-1973	NORMAL	MODERATE	HIGH	HIGH	HIGH
1973-1974	NORMAL	NORMAL	MODERATE	NORMAL	NORMAL
1974-1975	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1975-1976	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1976-1977	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1977-1978	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1978-1979	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1979-1980	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1980-1981	MODERATE	NORMAL	NORMAL	NORMAL	NORMAL
1981-1982	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1982-1983	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1983-1984	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1984-1985	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1985-1986	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1986-1987	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1987-1988	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1988-1989	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1989-1990	MODERATE	HIGH	NORMAL	MODERATE	MODERATE
1990-1991	VERY HIGH	VERY HIGH	VERY HIGH	VERY HIGH	VERY HIGH
1991-1992	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1992-1993	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1993-1994	MODERATE	NORMAL	NORMAL	NORMAL	NORMAL
1994-1995	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1995-1996	HIGH	MODERATE	MODERATE	MODERATE	MODERATE
1996-1997	HIGH	HIGH	HIGH	HIGH	MODERATE

Hydrologic Year	OCT-DEC	OCT-JAN	OCT-FEB	OCT-MAR	OCT-APR
1997-1998	NORMAL	NORMAL	MODERATE	MODERATE	MODERATE
1998-1999	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1999-2000	VERY HIGH	VERY HIGH	VERY HIGH	VERY HIGH	HIGH
2000-2001	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2001-2002	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2002-2003	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2003-2004	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2004-2005	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2005-2006	HIGH	HIGH	HIGH	HIGH	HIGH
2006-2007	MODERATE	HIGH	MODERATE	MODERATE	HIGH
2007-2008	NORMAL	MODERATE	HIGH	HIGH	VERY HIGH
2008-2009	HIGH	MODERATE	NORMAL	NORMAL	NORMAL
2009-2010	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2010-2011	HIGH	MODERATE	HIGH	MODERATE	NORMAL
2011-2012	MODERATE	NORMAL	NORMAL	NORMAL	NORMAL
2012-2013	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
2013-2014	VERY HIGH	VERY HIGH	VERY HIGH	VERY HIGH	VERY HIGH
2014-2015	VERY HIGH	NORMAL	NORMAL	NORMAL	NORMAL
NORMAL	31	33	33	33	33
MODERATE	5	5	4	5	4
HIGH	5	4	5	4	4
VERY HIGH	4	3	3	3	3

6.2.4 THE MONTHLY RUNOFF INDEX

One of the major objectives of the Drought Management Plan is to monitor the pressure on the environment. Pressure on the broader natural environment may depend on the rainfall index (SPI), but river ecosystems are closely linked with the flow in rivers and especially with longer regime flows, with the main flows. The wet period runoff index offers a rather good indication of the possible pressure on riverine ecosystems, but it does not provide information on the duration of low flows.

The system is simple and to save working time, it is only operated when the hydrologic region has entered drought conditions or when the alert level based on the wet season inflow index is at least high. Although the daily flows are normally measured based on the monitoring network applied by the WDD, the monitoring concerns the calculation of the median value of daily flows of the current month at a preselected station representing the hydrologic region ad its comparison with the data of the station's daily month for the given month for the entire reference period (1970-71 through 2009-10). The basic criterion for the selection of station was the sample length and its good distribution in all months.

Table 6-33: Representative hydrometric stations where the Monthly Regime Index is applied

Region	Hydrometric Station	River
Hydrologic Region 1	r1-4-3-35 Ayia (Upstream of Kanavious Dam) – r1-3-5-05 (Lazarides)	Xeros
Hydrologic Region 2	r2-8-3-10 (Limnitis Saw Mill)	Limnitis
Hydrologic Region 3	r 3-7-1-50 (Peristeronas)	Serachis
Hydrologic Region 6	r 6-1-1-80 (Ayios Onoufrios)	Pediaios
Hydrologic Region 7	-------------	-------------
Hydrologic Region 8	r8-9-5-40 (Lageia)	Vassilikos
Hydrologic Region 9	r9-2-3-85 (Foinikaria)	Germasogia

Especially for Hydrologic Region 1, although the hydrometric station r1-3-5-05 (Lazarides) on r. Xeros is considered more appropriate because it has been in operation for more years and it presents consistent flow for the entire year, even during the summer, due to the fact that it is impossible to wirelessly transfer the data to the WDD (due to the location within the canyon), until the installation of the necessary equipment for remote transmission of data, hydrometric station r1-4-3-35 (Agia upstream of the Kannaviou dam) is used as an alternative, since it is automatic and serves the need for direct calculation of the index (on a monthly basis). However, the station is new and the available data concern the period from 1/10/2010 to 30/9/2012. To complete the time series from 1/10/1979 to 30/9/10, historical data from the r1-4-2-15 station have been modified (basin reduction); this station is upstream of r1-4-3-35 and its data relate to the period from 10/1979 to 09/2012 (average daily flow data as provided by the WDD). At each representative hydrometric station (Table 6-33) and for each month, the time series of average daily flows is defined and the average value is calculated (for the reference period from 1970-71 to 2009-10), which is compared to the values of the lowest 25% and 5% percentiles of the entire sample of average daily flows. The pressure level in the river ecosystem is characterised as follows:

Table 6-34: Definition of the Pressure Level on the River Ecosystem.

DESCRIPTION	PRESSURE LEVEL ON

	THE RIVER ECOSYSTEM
For the median value of the current month within the 25% percentile of all historical values for said month (less than 75% of the values).	IMPORTANT
For the median value of the current month within the 5% percentile of all historical values for said month (less than 95% of the values).	HIGH

Table 6-35: Standard amounts of daily runoff to estimate the monthly regime index in a representative hydrometric station of Hydrologic Region 1 for hydrometric station r1-3-5-05 (Lazarides)

MAGNITUDE (m^3/s)	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAI	JUN	JUL	AUG	SEP
AVERAGE	0.055	0.097	0.454	0.871	1.018	0.843	0.403	0.198	0.103	0.064	0.051	0.047
ST. DEV.	0.022	0.279	1.173	1.883	1.256	1.206	0.459	0.234	0.062	0.030	0.021	0.019
COEF. VARIATION.	0.395	2.889	2.583	2.162	1.234	1.430	1.140	1.182	0.600	0.458	0.413	0.409
MEDIAN	0.053	0.066	0.120	0.285	0.560	0.440	0.250	0.150	0.091	0.061	0.050	0.046
25% PERCENTILE	0.040	0.050	0.074	0.120	0.270	0.240	0.150	0.096	0.056	0.040	0.032	0.033
5% PERCENTILE	0.030	0.039	0.050	0.062	0.100	0.110	0.088	0.056	0.037	0.027	0.024	0.024
MAXIMUM	0.290	8.200	15.500	29.000	10.670	10.500	5.400	5.000	0.940	0.240	0.130	0.260
MINIMUM	0.022	0.033	0.039	0.048	0.053	0.070	0.000	0.038	0.025	0.020	0.017	0.019

Table 6-36: Standard amounts of daily runoff to estimate the monthly regime index in a representative hydrometric station of Hydrologic Region 1 for hydrometric station r1-4-3-35

MAGNITUDE (m^3/s)	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAI	JUN	JUL	AUG	SEP
AVERAGE	0.005	0.024	0.178	0.518	0.711	0.660	0.275	0.103	0.035	0.008	0.001	0.000
ST. DEV.	0.116	0.098	0.468	0.979	0.802	0.913	0.287	0.083	0.036	0.014	0.005	0.001
COEF. VARIATION.	21.792	4.061	2.635	1.887	1.129	1.384	1.043	0.812	1.022	1.780	3.578	3.817
MEDIAN	0.000	0.009	0.039	0.164	0.409	0.316	0.179	0.080	0.022	0.000	0.000	0.000
25% PERCENTILE	0.000	0.000	0.020	0.056	0.186	0.164	0.089	0.035	0.007	0.000	0.000	0.000
5% PERCENTILE	0.000	0.000	0.006	0.019	0.050	0.060	0.045	0.015	0.000	0.000	0.000	0.000
MAXIMUM	3.721	2.047	8.260	9.395	6.150	8.372	2.512	0.465	0.205	0.260	0.053	0.011
MINIMUM	0.000	0.000	0.000	0.011	0.000	0.030	0.000	0.000	0.000	0.000	0.000	0.000

Table 6-37: Standard amounts of daily runoff to estimate the monthly regime index in a representative hydrometric station of Hydrologic Region 2

MAGNITUDE (m^3/s)	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAI	JUN	JUL	AUG	SEP
AVERAGE	0.021	0.070	0.293	0.754	0.947	0.820	0.372	0.168	0.072	0.029	0.018	0.015
ST. DEV.	0.026	0.222	0.679	1.216	0.989	1.054	0.334	0.145	0.078	0.043	0.028	0.024
COEF. VARIATION.	1.247	3.181	2.315	1.612	1.045	1.285	0.899	0.866	1.098	1.503	1.572	1.586
MEDIAN	0.011	0.048	0.112	0.320	0.600	0.520	0.270	0.130	0.042	0.011	0.006	0.004
25% PERCENTILE	0.001	0.019	0.070	0.110	0.300	0.270	0.150	0.063	0.014	0.002	0.001	0.001
5% PERCENTILE	0.000	0.001	0.042	0.062	0.120	0.120	0.080	0.022	0.001	0.000	0.000	0.000
MAXIMUM	0.230	5.400	14.300	12.300	11.900	11.900	4.600	1.870	0.640	0.240	0.130	0.110
MINIMUM	0.000	0.000	0.001	0.042	0.059	0.072	0.000	0.006	0.000	0.000	0.000	0.000

Table 6-38: Standard amounts of daily runoff to estimate the monthly regime index in a representative hydrometric station of Hydrologic Region 3

MAGNITUDE (m^3/s)	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAI	JUN	JUL	AUG	SEP
AVERAGE	0.003	0.149	0.576	1.124	1.216	0.901	0.399	0.192	0.078	0.017	0.002	0.002
ST. DEV.	0.017	1.466	1.753	2.864	1.686	1.414	0.608	0.429	0.147	0.087	0.011	0.019
COEF. VARIATION.	4.814	9.828	3.046	2.548	1.386	1.569	1.525	2.233	1.879	5.035	4.963	11.188
MEDIAN	0.000	0.000	0.130	0.412	0.702	0.530	0.280	0.120	0.028	0.002	0.000	0.000
25% PERCENTILE	0.000	0.000	0.044	0.160	0.400	0.310	0.170	0.058	0.010	0.000	0.000	0.000
5% PERCENTILE	0.000	0.000	0.000	0.046	0.120	0.160	0.072	0.016	0.001	0.000	0.000	0.000
MAXIMUM	0.267	35.000	25.000	58.000	16.735	17.800	14.000	9.300	2.400	2.400	0.200	0.437
MINIMUM	0.000	0.000	0.000	0.007	0.047	0.047	0.000	0.001	0.000	0.000	0.000	0.000

Table 6-39: Standard amounts of daily runoff to estimate the monthly regime index in a representative hydrometric station of Hydrologic Region 6

MAGNITUDE (m^3/s)	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAI	JUN	JUL	AUG	SEP
AVERAGE	0.001	0.026	0.103	0.156	0.189	0.119	0.036	0.016	0.004	0.000	0.000	0.001
ST. DEV.	0.012	0.272	0.360	0.429	0.376	0.285	0.115	0.072	0.022	0.004	0.001	0.020
COEF. VARIATION.	10.766	10.472	3.510	2.756	1.994	2.397	3.165	4.518	5.709	11.569	20.321	15.047
MEDIAN	0.000	0.000	0.013	0.051	0.077	0.048	0.015	0.003	0.000	0.000	0.000	0.000
25% PERCENTILE	0.000	0.000	0.000	0.012	0.035	0.023	0.008	0.000	0.000	0.000	0.000	0.000
5% PERCENTILE	0.000	0.000	0.000	0.001	0.009	0.006	0.002	0.000	0.000	0.000	0.000	0.000
MAXIMUM	0.230	5.300	6.600	9.900	6.000	5.155	3.200	1.850	0.560	0.094	0.013	0.532
MINIMUM	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 6-40: Standard amounts of daily runoff to estimate the monthly regime index in a representative hydrometric station of Hydrologic Region 8

MAGNITUDE (m^3/s)	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAI	JUN	JUL	AUG	SEP
AVERAGE	0.007	0.097	0.289	0.515	0.566	0.529	0.242	0.110	0.038	0.010	0.003	0.006
ST. DEV.	0.020	0.955	0.795	1.089	0.734	0.720	0.222	0.161	0.067	0.023	0.006	0.064
COEF. VARIATION.	3.142	9.872	2.753	2.114	1.298	1.361	0.918	1.456	1.758	2.368	2.122	10.436
MEDIAN	0.001	0.009	0.029	0.150	0.390	0.290	0.190	0.071	0.014	0.002	0.000	0.000
25% PERCENTILE	0.000	0.000	0.015	0.024	0.100	0.084	0.072	0.020	0.001	0.000	0.000	0.000
5% PERCENTILE	0.000	0.000	0.000	0.007	0.017	0.015	0.007	0.003	0.000	0.000	0.000	0.000
MAXIMUM	0.400	20.000	12.100	14.100	10.200	5.800	1.250	3.000	0.950	0.450	0.046	1.450
MINIMUM	0.000	0.000	0.000	0.000	0.005	0.007	0.003	0.000	0.000	0.000	0.000	0.000

Table 6-41: Standard amounts of daily runoff to estimate the monthly regime index in a representative hydrometric station of Hydrologic Region 9

MAGNITUDE (m^3/s)	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAI	JUN	JUL	AUG	SEP
AVERAGE	0.017	0.163	0.474	0.861	1.101	0.875	0.470	0.225	0.081	0.018	0.006	0.005
ST. DEV.	0.055	1.300	0.997	1.681	1.328	1.128	0.432	0.218	0.098	0.031	0.018	0.019
COEF. VARIATION.	3.218	7.968	2.104	1.951	1.206	1.290	0.918	0.967	1.207	1.716	2.850	4.110
MEDIAN	0.001	0.037	0.159	0.389	0.700	0.590	0.360	0.190	0.054	0.003	0.000	0.000
25% PERCENTILE	0.000	0.007	0.078	0.140	0.320	0.322	0.199	0.084	0.013	0.000	0.000	0.000
5% PERCENTILE	0.000	0.000	0.000	0.056	0.083	0.090	0.055	0.002	0.000	0.000	0.000	0.000
MAXIMUM	1.130	30.000	13.600	33.000	13.300	15.000	4.500	4.200	1.076	0.360	0.230	0.377
MINIMUM	0.000	0.000	0.000	0.000	0.049	0.016	0.000	0.000	0.000	0.000	0.000	0.000

The following tables (from Table 6-42 until Table 6-48) we have noted for the representative hydrometric station of every Hydrologic Region the months when the pressure level on the riverine ecosystem was IMPORTANT in yellow and HIGH in red. It is characteristic that the months where the pressure level is IMPORTANT are quite a few and they are not concentrated on specific intervals, but present significant dispersion, which demonstrates the above. The months when the pressure level was marked as HIGH are concentrated during certain dry hydrological years, although between them a month with an IMPORTANT pressure level is sometimes inserted.

The characteristic of the river basins corresponding to these hydrometric stations is that due to their small size the hydrologic response to rainfall is sporadic, with short response times. This results in significant differences from month to month depending on the rainfall and also on the fact that for most basins main runoff is minimal so on several occasions there is zero flow during summer. Therefore, for almost all hydrometric stations, the flow values in the 25% and 5% percentiles from July to September, are zero. Hence, when the median value of a given month is zero, the question is whether the pressure level is HIGH, IMPORTANT or if there is no pressure on the ecosystem. Examination of the relevant tables shows that even the median value is zero (or near zero) in many of these cases, so there is no issue on finding the pressure level, when the median of a given month is zero, since zero flow is the usual situation observed. Obviously, this is a drawback of the method; however. the sine qua non requirement for the measurement position to have the lowest upstream abstractions leads to a selection of hydrometric stations located upstream of the river basins, which are small in surface and do not show a discharge of underground water in the bed of the hydrographic network (generally occurring downstream).

Table 6-42: Presentation of the months with IMPORTANT and HIGH level of pressure on the riverine ecosystem for the representative station of Hydrologic Region 1, hydrological station r1-3-5-05 (Lazarides)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970-71												
1971-72												
1972-73												
1973-74												
1974-75												
1975-76												
1976-77												
1977-78												
1978-79												
1979-80												
1980-81												
1981-82												
1982-83												
1983-84												
1984-85												
1985-86												
1986-87												
1987-88												
1988-89												
1989-90												
1990-91												
1991-92												
1992-93												
1993-94												
1994-95												
1995-96												
1996-97												
1997-98												
1998-99												
1999-00												
2000-01												
2001-02												
2002-03												
2003-04												
2004-05												
2005-06												
2006-07												
2007-08												
2008-09												
2009-10												
2010-11												

2011-12												
2012-13												
	HIGH LEVEL											
	IMPORTANT LEVEL											

The above table (Table 6-42) first shows that for the very wet hydrological year 2012-13 there are 6 months with a HIGH characterisation of pressure, which seems a contradiction at first. The investigation of the data shows that for these months of the hydrological year in question, daily flow are recorded as zero, which was not even recorded on very intense droughts of the past. Therefore, we consider that zero measurements in October - December and June - September are wrong and thus are excluded from this analysis. Therefore, out of a total 504 sample months (1970-71 to 2011-12) 101 months recorded an IMPORTANT pressure level (a percentage of 20%) and 16 months recorded a HIGH pressure level (a percentage of 3.2% months).

Months with a HIGH pressure level generally belong to the periods of the hydrological year that, as we will demonstrate below, belong to “prolonged drought” periods, pursuant to the SPI index for the years 1971-1974 and 1989-1991, while for the years 1990-1991, 1996- 97, 1997-98 and 2005-06 they do not belong to the above periods of “prolonged drought”.

Table 6-43: Presentation of the months with IMPORTANT and HIGH level of pressure on the riverine ecosystem for the representative station of Hydrologic Region 1, hydrological station r1-4-3-35 (Agia, upstream of Kannaviou dam)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1979-80												
1980-81												
1981-82												
1982-83												
1983-84												
1984-85												
1985-86												
1986-87												
1987-88												
1988-89												
1989-90												
1990-91												
1991-92												
1992-93												
1993-94												
1994-95												
1995-96												
1996-97												
1997-98												
1998-99												
1999-00												
2000-01												
2001-02												
2002-03												
2003-04												
2004-05												
2005-06												
2006-07												
2007-08												
2008-09												
2009-10												
2010-11												
2011-12												
2012-13												
2013-14												
	HIGH LEVEL											
	IMPORTANT LEVEL											
	WITHOUT DATA											

For this hydrometric station on the basis of the relevant table (Table 6-36), it seems that for the months from July to November the 5% and 25% percentiles are zero. Therefore, out of 420 sample months (1979-80 to 2013-14) 50 months recorded an IMPORTANT pressure level (a percentage of 11.9%) and 10 months recorded a HIGH pressure level (a percentage of 2.4% months).

In connection with both the Hydrological Region 1 hydrometric stations, it appears that the agreement on the HIGH pressure level occurs in both stations for the hydrological years 1990-91, 1996-97 and 1997-98 (although in different months within the year), but not for the year 2005-06 where the Lazarides station shows one month with a HIGH pressure level on the ecosystem, while for the Agia station there can be no clear conclusion as this month is August 2006.

The table below (Table 6-44) presents the corresponding table for Hydrologic Region 2. Unfortunately, as for Hydrologic Regions 3 & 6 (corresponding to the northern parts of the Troodos mountain), no data were collected for hydrological years 1972-73 and 1973-74 as the years in question belong to the interval of “prolonged drought” of the period 1971-1975. For this hydrometric station (as for Hydrologic Region 1), the values of the 5% and 25% percentiles for almost all months are above zero, allowing to draw conclusions for all 12 months of the year. Therefore, out of 496 sample months (1970-71 to 2013-14) 108 months recorded an IMPORTANT pressure level (a percentage of 21.8%) and 11 months recorded a HIGH pressure level (a percentage of 2.2% months). Months recorded with a HIGH level occur sporadically during the hydrological years 1990-91, 1996-98, 2007-09 and 2013-14. Apart from the year 1990-91, the other years are not included in the years of “prolonged drought” of the SPI index SPI (Table 6-53).

Table 6-44: Presentation of the months with IMPORTANT and HIGH level of pressure on the riverine ecosystem for the representative station of Hydrologic Region 2, hydrological station r2-8-3-10 Limnitis Saw Mill

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970-71												
1971-72												
1972-73												
1973-74												
1974-75												
1975-76												
1976-77												
1977-78												
1978-79												
1979-80												
1980-81												
1981-82												
1982-83												
1983-84												
1984-85												
1985-86												
1986-87												
1987-88												
1988-89												
1989-90												
1990-91												
1991-92												
1992-93												
1993-94												
1994-95												
1995-96												
1996-97												
1997-98												
1998-99												
1999-00												
2000-01												
2001-02												
2002-03												
2003-04												
2004-05												
2005-06												
2006-07												
2007-08												
2008-09												
2009-10												

2010-11												
2011-12												
2012-13												
2013-14												
	HIGH LEVEL											
	IMPORTANT LEVEL											
	WITHOUT DATA											

The table below (Table 6-45) presents the corresponding table for the hydrometric station of Hydrologic Region 3. For this station (on the basis of the relevant table ((Table 6-38)), it appears that the values of 5% and 25% percentiles of the months from July to November are zero (as well as the median), so there is no issue for the classification of these months. The results show that out of 286 sample months, 58 pertain to the IMPORTANT level (a percentage of 20%), while 9 months pertain to the HIGH level (a percentage of 3.1%). The hydrological years including months at a HIGH level are 1990-91, 1997-98, 1999-2000, 2007-08 and 2013-14. Of these, the last three years are not included in the “prolonged drought” under the SPI index (Table 6-53)

Table 6-45: Presentation of the months with IMPORTANT and HIGH level of pressure on the riverine ecosystem for the representative station of Hydrologic Region 3, hydrological station r3-7-1-50_Peristerona near Panagia Bridge.

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970-71												
1971-72												
1972-73												
1973-74												
1974-75												
1975-76												
1976-77												
1977-78												
1978-79												
1979-80												
1980-81												
1981-82												
1982-83												
1983-84												
1984-85												
1985-86												
1986-87												
1987-88												
1988-89												
1989-90												
1990-91												
1991-92												
1992-93												
1993-94												
1994-95												
1995-96												
1996-97												
1997-98												
1998-99												
1999-00												
2000-01												
2001-02												
2002-03												
2003-04												
2004-05												
2005-06												
2006-07												
2007-08												
2008-09												

2009-10												
2010-11												
2011-12												
2012-13												
2013-14												
	HIGH LEVEL											
	IMPORTANT LEVEL											
	WITHOUT DATA											

The table below (Table 6-46) presents the corresponding table for the hydrometric station of Hydrologic Region 6. For this station (on the basis of the relevant table ((Table 6-39)), it appears that the values of 5% and 25% percentiles of the months from May to December are zero (as well as the median), so there is no issue for the classification of these months. The results show that out of 168 sample months, 29 pertain to the IMPORTANT level (a percentage of 17.2%), while 9 months pertain to the HIGH level (a percentage of 5.4%). The hydrological years including months at a HIGH level are 1990-91, 1997-98, 1999-2000, 2007-08 and 2013-14. Of these, only the last year is not included in the “prolonged drought” under the SPI index (Table 6-53)

Table 6-46: Presentation of the months with IMPORTANT and HIGH level of pressure on the riverine ecosystem for the representative station of Hydrologic Region 6, hydrological station r6-1-1-80_Agios Onoufrios near Kampia.

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970-71												
1971-72												
1972-73												
1973-74												
1974-75												
1975-76												
1976-77												
1977-78												
1978-79												
1979-80												
1980-81												
1981-82												
1982-83												
1983-84												
1984-85												
1985-86												
1986-87												
1987-88												
1988-89												
1989-90												
1990-91												
1991-92												
1992-93												
1993-94												
1994-95												
1995-96												
1996-97												
1997-98												
1998-99												
1999-00												
2000-01												
2001-02												
2002-03												
2003-04												
2004-05												
2005-06												
2006-07												
2007-08												
2008-09												

2009-10												
2010-11												
2011-12												
2012-13												
2013-14												
	HIGH LEVEL											
	IMPORTANT LEVEL											
	WITHOUT DATA											

The following table (Table 6-47) presents the relevant table for the hydrometric station of Hydrologic Region 8, for which the measured flows start on the year 1983-84. For this station (on the basis of the relevant table ((Table 6-40)), it appears that the values of 5% and 25% percentiles of the months from June to November are zero (as well as the median), so there is no issue for the classification of these months. The results show that out of 217 sample months, 50 pertain to the IMPORTANT level (a percentage of 23%), while 6 months pertain to the HIGH level (a percentage of 2.8%). The hydrological years including months at a HIGH level are 1999-2000 and 2007-08. Both these years are not included in the “prolonged drought” under the SPI index (Table 6-53) For Hydrologic Region 8 (Larnaca District), the months with the lowest occurrence of the HIGH level are presented.

Table 6-47: Presentation of the months with IMPORTANT and HIGH level of pressure on the riverine ecosystem for the representative station of Hydrologic Region 8, hydrological station r8-9-5-40_Vassilikos near Lageia.

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1983-84												
1984-85												
1985-86												
1986-87												
1987-88												
1988-89												
1989-90												
1990-91												
1991-92												
1992-93												
1993-94												
1994-95												
1995-96												
1996-97												
1997-98												
1998-99												
1999-00												
2000-01												
2001-02												
2002-03												
2003-04												
2004-05												
2005-06												
2006-07												
2007-08												
2008-09												
2009-10												
2010-11												
2011-12												
2012-13												
2013-14												
	HIGH LEVEL											
	IMPORTANT LEVEL											
	WITHOUT DATA											

The following table (Table 6-48) presents the corresponding table for the hydrometric station of Hydrologic Region 9, for which the measured flows stop at the hydrological year 2009-10 and were provided the CYMOS database, including three monthly values for the year 2013-14. For this station (on the basis of the relevant table ((Table 6-41)), it appears that the values of 5% and 25% percentiles of the months from July to October are zero (as well as the median), so there is no issue for the classification of these months. The results show that out of 472 sample months, 62 pertain to the IMPORTANT level (a percentage of 13.1%), while 13 months pertain to the HIGH level (a percentage of 2.8%). The hydrological years including months at a HIGH level are 1999-2000, 2007-08 and 2013-14. Only the first two years are included in the “prolonged drought” under the SPI index (Table 6-53), while for the hydrological years from 2010-11 to 2012-13 data are not available for daily flows, because said years were wet, no HIGH pressure level months are expected to occur.

Table 6-48: Presentation of the months with IMPORTANT and HIGH level of pressure on the riverine ecosystem for the representative station of Hydrologic Region 9, hydrological station r9-2-3-85_Germasogeia near Foinikaria

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970-71												
1971-72												
1972-73												
1973-74												
1974-75												
1975-76												
1976-77												
1977-78												
1978-79												
1979-80												
1980-81												
1981-82												
1982-83												
1983-84												
1984-85												
1985-86												
1986-87												
1987-88												
1988-89												
1989-90												
1990-91												
1991-92												
1992-93												
1993-94												
1994-95												
1995-96												
1996-97												
1997-98												
1998-99												
1999-00												
2000-01												

2001-02												
2002-03												
2003-04												
2004-05												
2005-06												
2006-07												
2007-08												
2008-09												
2009-10												
2010-11												
2011-12												
2012-13												
2013-14												
	HIGH LEVEL											
	IMPORTANT LEVEL											
	WITHOUT DATA											

The analysis of the above tables demonstrates that the number months when the level of pressure on the aquatic ecosystems is designated as IMPORTANT is greater than those described as HIGH. The monthly values designated as HIGH or IMPORTANT appear grouped in time, while there are cases where sporadic and isolated values appear, especially the IMPORTANT values, during the wet years when sporadic zero values of monthly rainfall significantly affect runoff especially when the basins are generally small.

6.2.5 LARGE DAM STORAGE INDEX

The two large multi-purpose projects of the Southern Conveyor and Paphos have an interannual capability of surface water storage. It is obviously useful for the drought management system to include an assessment of surface water storage. In the case of Cyprus, with the significant interannual storage, it is considered necessary for the political management of the reservoirs during periods of drought to be integrated in the general management policy of the remaining periods, given that if not enough reserves have been ensured before the start of the drought, the cuts which will result in the abstractions will be extremely high.

The inflows of reference droughts (the most severe droughts for which there is an effort to ensure a storage reserve for the benefit of the lake environment) are presented in the table below and were calculated in the context of the revision of the 1st RBMP conducted by the WDD in 2013. Inflows concern the sum of the inflows to the dams:

- Kouris (including inflows from the Dhiarizos tunnel), Yermasoyia, Kalavassos, Lefkara and Dipotamos for the Southern Conveyor project.

- Asprokremmos, Kannaviou and Mavrokolympos for the Paphos project.

Table 6-49: Minimum inflow (hm^3) at the dams during the reference droughts based on the revised 1st DMP by the WDD.

Drought Duration	1 Year	2 Years	3 Years	4 Years	5 Years
SCP	10	30	60	100	140
Paphos Project	1.7	8	16	27	40

Based on the above reference drought inflows, the reserves of the dams were classified and matched to allowed total annual abstractions, as presented in the following tables (Table 6-50 and Table 6-51) for the Southern Conveyor and Paphos projects respectively. Especially for the Paphos project, the data referred to in the relevant table (Table 6-51) concern the revision based on the present DMP.

Table 6-50: Classification of the Southern Conveyor Storage Index based on the 1st RBMP

Storage at 1st April *V* (hm^3)	Drought Classification	Annual Abstraction (hm^3)	Action Classification
V > 120	Sufficiency	55	Zero Cuts
120 > V > 100	Minor Deficit	44	Small cuts
100 > V > 80	Moderate Deficit	35	Moderate cuts
80 > V > 50	Severe Deficit	25	Significant cuts
V < 50	Extremely Deficit	15	Very Significant cuts

Table 6-51: Classification of the Paphos Project Storage Index based on the revision of the 2nd RBMP.

Storage at 1st April *V* (hm^3)	Drought Classification	Annual Abstraction (hm^3)	Action Classification
V > 40	Sufficiency	17	Zero Cuts
40 > V > 25	Minor Deficit	14	Small cuts
25 > V > 15	Moderate Deficit	10	Moderate cuts
15 > V > 10	Severe Deficit	7	Significant cuts
V < 10	Extremely Deficit	4	Very Significant cuts

Figure 6-16 plots the inflows to the dams of the Southern Conveyor and the Paphos project, showing the coincidence of wet and dry years with their respective inflows, which corroborates the calculation accuracy and the data quality.

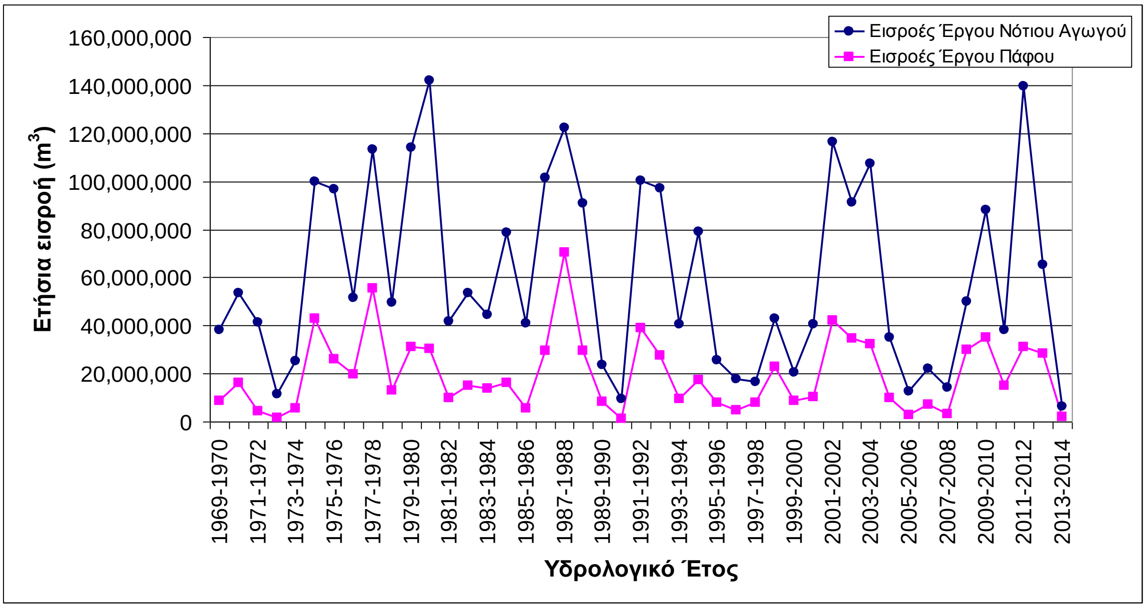

Figure 6-16: Diagram of the annual inflows to the dams of the Southern Conveyor and Paphos Projects.

6.2.6 GROUNDWATER BODIES MONITORING INDEX

It does not seem possible to use groundwater bodies as drought indicators. Firstly, there is an issue regarding the geometrical characteristics of the aquifers (thickness, impermeable floor depth etc.), the extent, limits, interconnection and interaction between them, the enrichment and discharge areas, their hydraulic characteristics etc. are not sufficiently known. This makes it difficult to understand the change in level, which many not be due solely to climate causes.

Furthermore, the most important problem is that there are significant abstractions from aquifers, which means that the impact of climate i the level change cannot be concretely quantified. An analysis of the figures shows that all groundwater bodies, with few exceptions, are being over-pumped. Both the monitoring of the level and of the sources shows that the underground storage system reflects mainly reflecting the intensification of uses and indirectly the climate regime. Therefore, the monitoring system should provide the ability to take decisions in a dynamic way on the abstractions of groundwater on an annual basis, ensuring the smooth recovery of the groundwater body. The need for this arises from the fact that the balances in previous contracts are an average of a specific time period (2000-2008) and their pumping regime is an unknown variable. Hence, the proposed abstraction volumes identified are also average values which have to be updated in real-time with new data, for a seamless system recovery. Especially in times of drought, the necessity of this update is imperative in order to prevent deterioration of the body's condition.

From the perspective of water storage, groundwater bodies should be assimilated to reservoirs with no more storage, as they have been exhausted. They should be left to recover, while an investigation is conducted on the recovery rate of the level, thanks to the winter season supply, in order to make decisions about the abstraction policy during the irrigation period. Among the defined indices, the (12 month) SPI index offers indications to take measures.

Moreover, to ensure the recovery rate of the groundwater bodies' level, indices per body should be defined to contribute to the decision making for the abstraction policy. For such an approach to be efficient, it should also take place at the right moment, based not only on the storage system, but mainly on the definition of an abstraction management policy.

Based on available data on the level and quality of the groundwater and on the crop policy definition on the month of January, we propose the analysis of data and use of the recovery rate of each groundwater body to determine the recovery rate and the relative level compared to the previous year. So, if for one year the rate is reduced compared with an acceptable rate defined for the body for specific levels, measures to reduce abstraction shall be taken. This assessment shall be performed in conjunction with the SPI index mentioned above and shall be based on meteorological parameters. The 1st Management Plan compared the SPI index of various periods with level measurement data, providing thus a better agreement to the annual index (SPI-12); this shows the sensitivity of the water storage system with respect to meteorological conditions and the intensity of uses, which basically deplete the stocks within the year.

The 1st MP refers to the issue arising to connect the index to the specific volume of abstraction, so as to have a clear management objective. Unfortunately due to lack of data on the pumping for the majority of the bodies, such a connection cannot be defined at the moment. For instance, the following figures (Figure 6-17 and Figure 6-18) show the SPI-12 index diagram with the rolling average of 12 months of the aquifer's level in 2 different Hydrologic Regions in Cyprus. An examination of the diagrams does not reveal any deterministic relationship between these two values, so no conclusions can be extracted regarding a joint development of the change in level compared to the SPI-12 index.

Naturally, the definition of such indices is ambiguous and should take other factors into account, such as the priority of uses, quality matters, the degree of vulnerability, changes in land use, etc. Nowadays, we believe that the reasons which prevented the researchers of the 1st MP from devising such an index system have not disappeared.

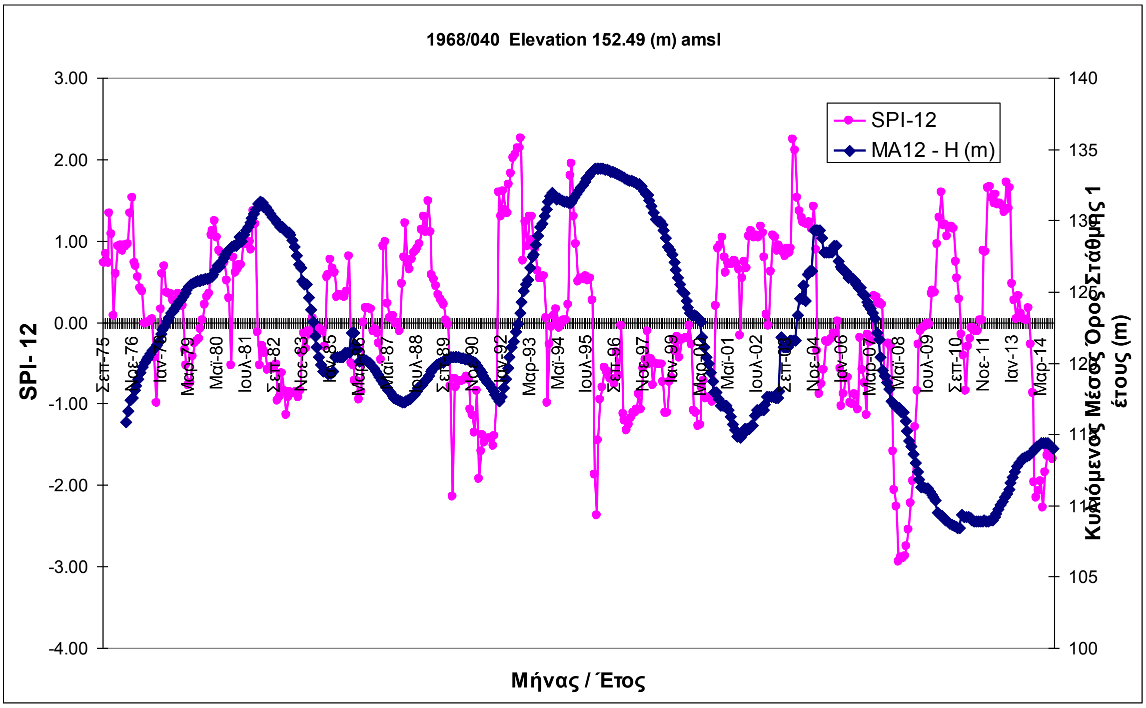

Figure 6-17: Correlation of the change of the water table level in Hydrologic Region 8 (Borehole code 1968/040 in GWB CY-18) with the corresponding SPI-12.

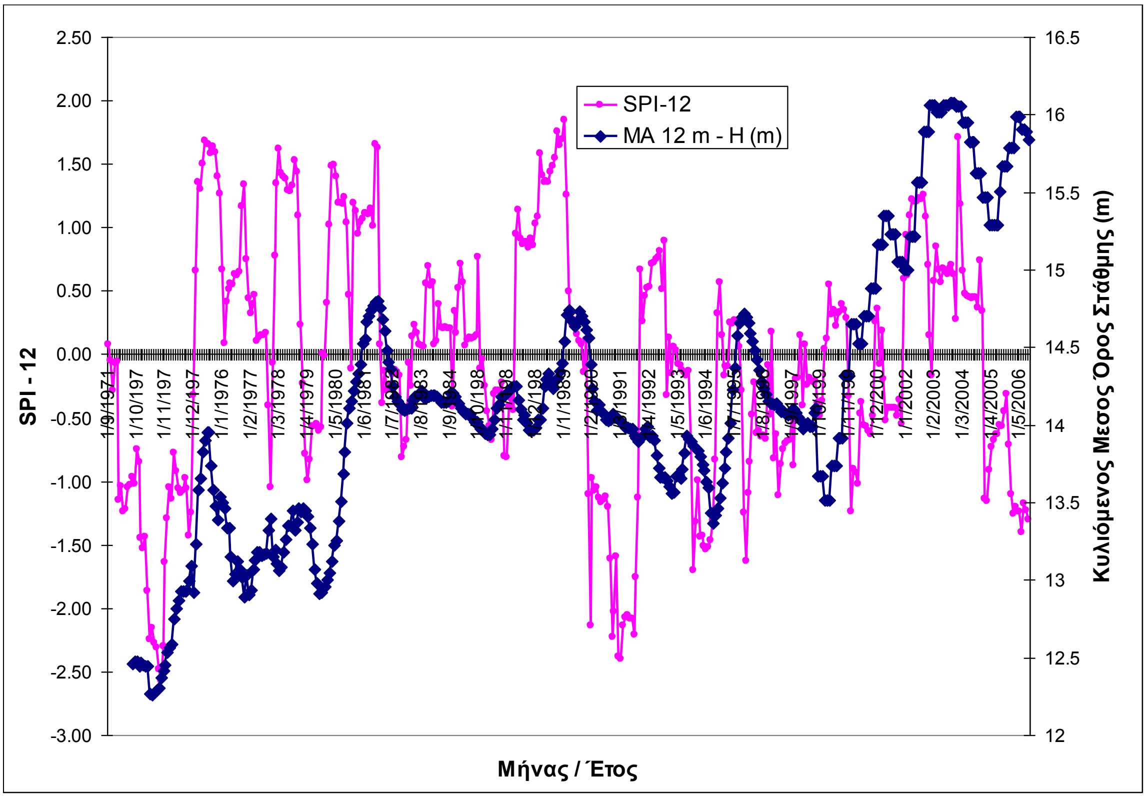

Figure 6-18: Correlation of the change of the water table level in Hydrologic Region 1 (Borehole code H6000-2142 in GWB CY-11) with the corresponding SPI-12.

The spring flows are an index of the dynamic reserves of groundwater, with a higher hydraulic head than the upwelling level. Springs are of particular importance in certain groundwater bodies (Troodos, Lefkara-Pachna), because they are an indicator for storage, as they reflect the effects of over-pumping and also a vital source for various uses. Therefore, we suggest to continue and expand the systematic monitoring of the quality and supply of spring water. The quantitative characteristics reflect largely the meteorological conditions as shown in the following figures, with the index SPI data and spring flows with codes s1-2-5-72 (Trozina), s3-2-1-15 (Chrysovrysi) and s1-4-1-40 (Apidies). The first one belongs to the GWB Lefkara-Pachna (CY_18) and the Hydrologic Region 1 and the other two to the GWB Troodos CY_19 and Hydrologic Region 3 and 1 respectively.

In all three diagrams, the very good correlation of the SPI-12 dex and the rolling average of the spring flows for the 12 month period is very clear to compare magnitudes of the same aggregation. We can therefore conclude that spring discharges are proportionate and depend on the SPI-12 index in terms of climate, meaning that this can be used a an operational indicator to forecast and assess the effect of drought on spring discharges.

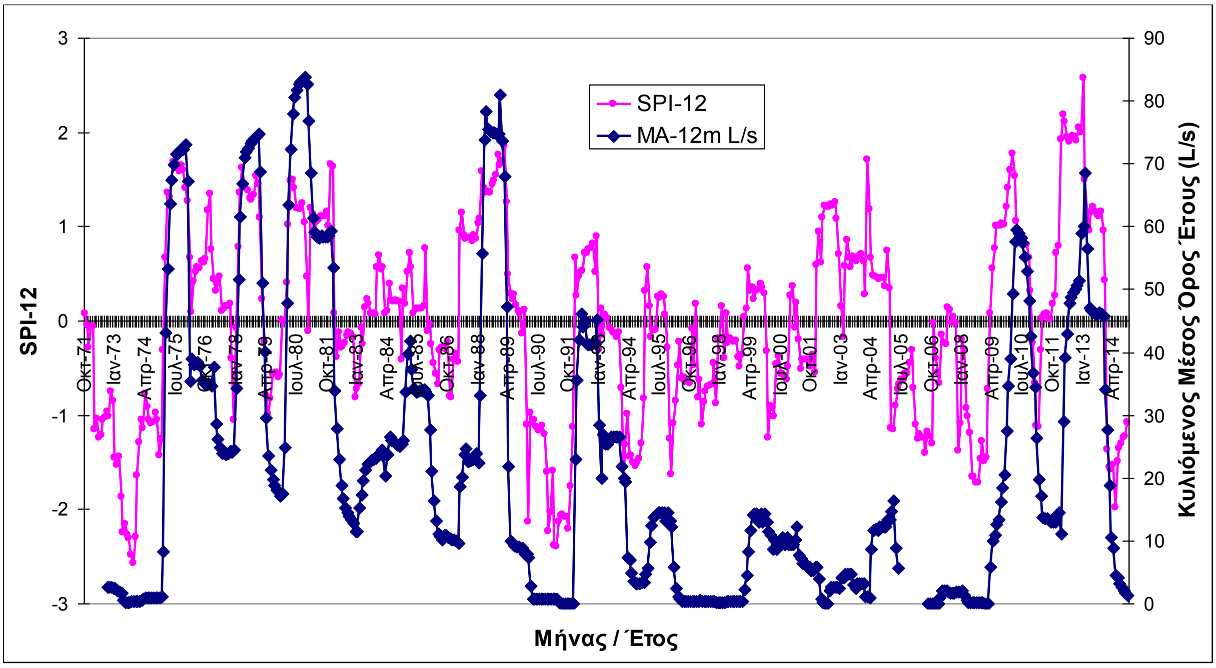

Figure 6-19: Diagram of the SPI-12 Index for Hydrologic Region 1 and of the rolling annual average (in L/s) for the spring with code s1-2-5-72 (Trozina).

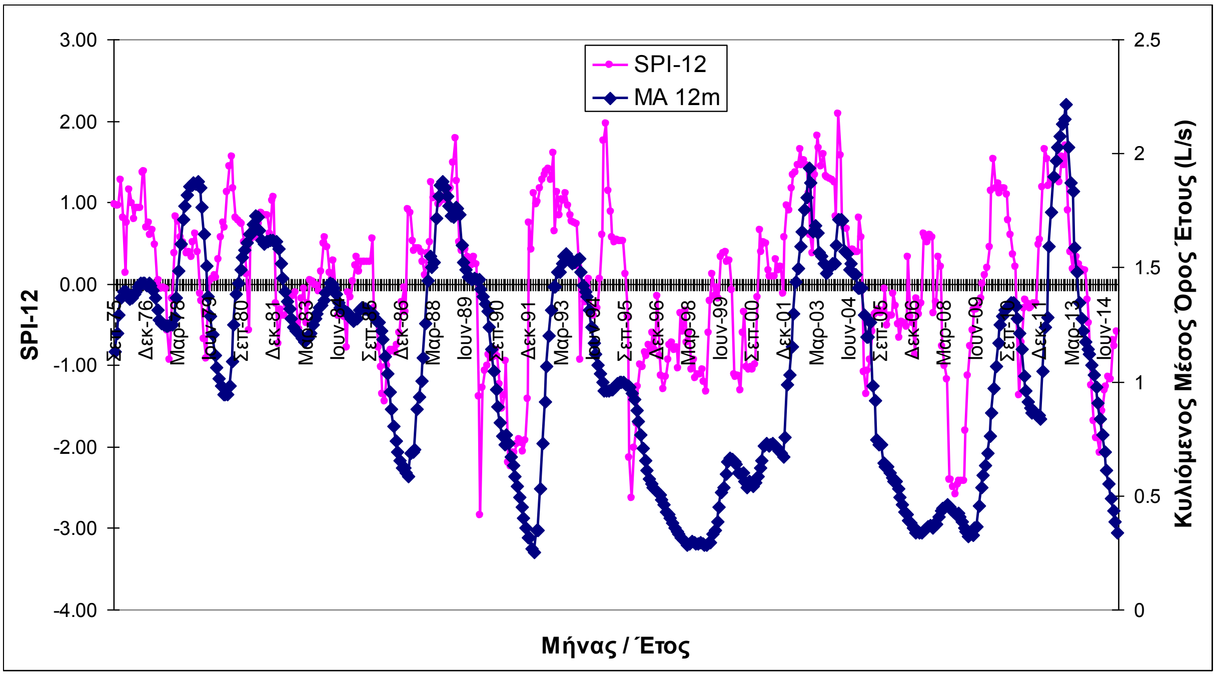

Figure 6-20: Diagram of the SPI-12 Index for Hydrologic Region 3 and of the rolling annual average (in L/s) for the spring with code s3-2-1-15 (Chrysovrysi).

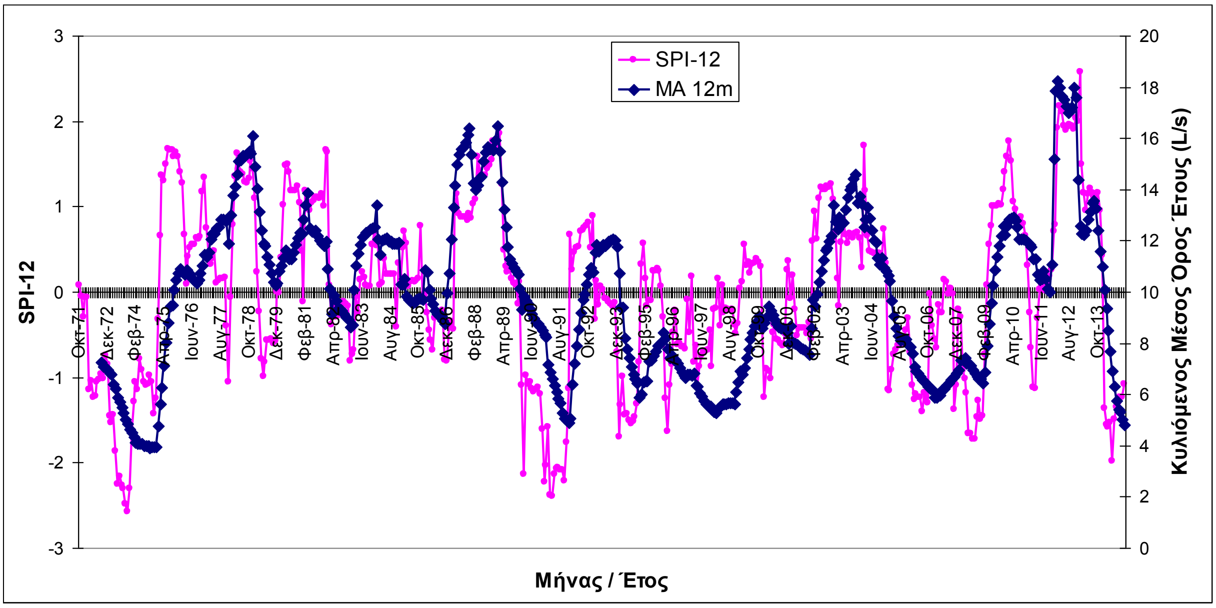

Figure 6-21: Diagram of the SPI-12 Index for Hydrologic Region 1 and of the rolling annual average (in L/s) for the spring with code s1-4-1-40 (Apidies).

6.3 PROLONGED DROUGHT INDICES

6.3.1 INTRODUCTION

The term “prolonged drought” is relative because any time limit for its application would be essentially arbitrary. The term here is used in correspondence to the “prolonged drought” defined in the Directive 2000/60 and in other accompanying documents, including in the “Drought Management Plan Report» (EU Environment Directorate, Technical Report 2008-23). It essentially describes an event of particularly harsh drought.

It should be noted that in non-EU Mediterranean countries, interannual water storage is the exception and, therefore, the severity of the drought as to its effects depends mainly on its duration. In Cyprus, where storage plays a key role in the management of water resources, the combined magnitude of the drought taken into account is critical, both regarding duration and intensity, i.e. the degree of decrease of rainfall or runoff. “Drought Magnitude” (DM) of the SPI index is a measure combining duration and intensity.

In the present plan, the term “prolonged drought" is maintained for compatibility with the terminology of Directive 2000/60, but it corresponds to an event of drought so rare and of such magnitude, so as to make impossible the maintenance of all protection measures for the water bodies provided for in the Management Plan and to not guarantee the avoidance of temporary deterioration of the ecological condition of the bodies. This term is functionally equivalent to the term in the Directive. Given that natural conditions lead to the characterisation of a drought event as “prolonged drought”, the indices determining prolonged drought are related to physical parameters (see Article 4.6 (b)). Although there may be a lag between the lack of rainfall and the lowering of the aquifer level, due to (a) the water retention of the natural vegetation and soil and (b) inertial flow through a porous medium, the main parameter that determines prolonged drought is related to the decrease in rainfall with respect to the average of a given period and should take into account magnitudes such as the intensity and duration of the natural phenomenon. It is important to distinguish between the natural phenomenon of drought and the impact of anthropogenic intervention such as distribution of water demand to different uses and water management practices, i.e. water scarcity.

The “Drought Management Plan Report” (EU Environment Directorate, Technical Report 2008-23) suggests three (3) types of indices for the recognition of prolonged drought. These indices are based on:

- Indices based on meteorology, i.e. either rainfall or runoff.
- Indices to determine deterioration of the bodies’ condition and
- Indices to determine economic and social impacts.

Paragraph 6.3.2 offers a basic index for the diagnosis of prolonged drought based on rainfall, using the SPI-12 index and applied per Hydrologic Region (from 1 to 9), as calculated by the Meteorology Department of the Republic of Cyprus. Paragraph 6.3.6 proposes to monitor the bodies' downgrading through a permanent monitoring program and Paragraph 6.3.7 proposes to adopt a simple index for economic and social impact based on irrigation fro government projects, which is not longer used as it is considered to be covered by the SPI-12 index. Moreover, Paragraph 6.3.4 proposes a hydrological index for the two largest water projects of Cyprus, meaning the Southern Conveyor and Paphos Projects.

Article 4 paragraph 6 of Directive 2000/60 states: "Temporary deterioration in the status of bodies of water shall not be in breach of the requirements of this Directive if this is the result of circumstances of natural cause or force majeure which are exceptional or could not reasonably have been foreseen, in particular extreme floods and prolonged droughts, when all of the following conditions have been met:

- All practicable steps are taken to prevent further deterioration in status (Article 4.6 (a)); the measures to be taken under such exceptional circumstances are included in the programme of measures and will not compromise the recovery of the quality of the body of water once the circumstances are over (Article 4.6 (c)).
- All practicable measures are taken with the aim of restoring the body of water as soon as reasonably practicable and are included in the next update of the RBMP (Article 4.6 (d) and 4.6 (e))."

It is important to emphasize that prolonged drought is due to natural causes and therefore a possible application of Article 4.6 of the Directive needs to be addressed with exceptional measures of WB protection aimed at mitigating the effects from natural phenomena and not from an irrational use of water resources.

In this chapter, after defining the phenomenon of prolonged drought and its characteristics, we examine whether such a prolonged drought phenomenon has occurred in the recent past in Cyprus and then we try to assess a possible impact of a similar phenomenon in surface and underground WB through mapping those WB which, due to the prolonged drought phenomenon, may not achieve the environmental objectives of the Directive.

6.3.2 INDEX BASED ON RAINFALL

A key feature of prolonged drought should be its rarity, referred to in Directive 2000/60. An analysis of Drought Magnitudes (DM) resulting from the historical rainfall SPI indices for different hydrologic regions suggests the following Drought Magnitude limits to classify an event in the "prolonged drought" category, as shown in the table below (Table 6-52).

Table 6-52: Limits of Prolonged Drought based on DM/SPI

SPI Index	Drought Magnitude
12 Months	30
24 Months	40
36 Months	50
48 Months	60
60 Months	70

In this case, the SPI-12 index is examined taking into account the morphology of Cyprus's river basins and the WFD guidance documents. For example, the document Update on Water Scarcity and Droughts indicator development, issued in May 2012 by the DG ENV (page 9) states that the SPI-12 index is the most suitable to assess both the reduced runoff in water streams and storage in reservoirs and the reduced supply to the aquifers. These limits have the advantage of clarity. However, they serve mainly as a conclusion. A rather good indication (arising from the analysis of time series) is that **an event evolves into prolonged drought if the SPI-12 index is lower than -1.5, when the DM index is equal to half the limit** of the above table (Table 6-52). Nonetheless, at the end of the Prolonged Drought, it should be DM≥30, otherwise the drought event is not defined as prolonged.

Table 6-53: Table with prolonged droughts in the period 1970-2014, based on the SPI-12 index.

Hydrologic Region	Historical Intervals of Prolonged Droughts and Drought Magnitude			
Hydrologic Region 1	10/1971-12/1974 (D=48.5)	12/1989-11/1991 (D=39.9)		
Hydrologic Region 2	11/1971-12/1974 (D=49.1)	12/1989-11/1991 (D=41.3)		
Hydrologic Region 3	12/1972-01/1975 (D=37.3)	12/1989-11/1991 (D=36.9)	10/1995-01/1999 (D=39.0)	
Hydrologic Region 6	11/1972-01/1975 (D=37.4)	12/1989-11/1991 (D=30.1)	11/1995-10/2000 (D=47.0)	11/2007-11/2009 (D=36.6)
Hydrologic Region 7	02/1972-11/1974 (D=36.4)	06/1989-11/1991 (D=31.3)	03/1995-10/2000 (D=57.6)	
Hydrologic Region 8	04/1972-01/1975 (D=42.4)	11/1995-10/2000 (D=46.5)	10/2007-08/2009 (D=31.6)	
Hydrologic Region 9	02/1972-12/1974 (D=49.8)	10/1989-11/1991 (D=32.1)	01/2005-02/2009 (D=45.5)	

The above table (Table 6-53) concentrates the historical periods in the years 1970-2014, which presented prolonged droughts per Hydrologic Region. We note that the main prolonged drought periods are as follows:

- Hydrologic Region 1 (Paphos) presents less prolonged drought periods (only 2) for all the years under consideration.
- Hydrologic Region 2 (Chrysochous area) is the most hit area with 3 prolonged drought periods of a magnitude below 40.
- From 10/1971 to 01/1975, when the highest drought magnitude value appears in Hydrologic Region 9 (Kouris dam) with drought magnitude D=49.8. The duration of the prolonged drought lasted about 4 consecutive years.
- From 06/1989 to 11/1991, when the highest drought magnitude value appears in Hydrologic Region 2 (Evretou dam) with drought magnitude D=41.3. The duration of the prolonged drought lasted about 4 consecutive years.
- From 03/1995 to 10/2000, when the highest drought magnitude value appears in Hydrologic Region 7 (Famagusta Area) with drought magnitude D=57.6, which is also the largest prolonged drought phenomenon recorded. The duration of the prolonged drought lasted about 5.5 consecutive years.
- The last extreme drought period which seemed to occur during hydrological year 2013-2014 seems to be interrupted, as there are positive SPI-12 values.

6.3.3 INDEX BASED ON LARGE DAM STORAGE

The dam reserve indices of the Southern Conveyor and Paphos projects are described in section 6.2.5. When a rational abstraction policy, based on reserves, is followed, very low storage is a reliable indicator of prolonged drought. The status “Extreme Shortage” of the storage capacity is proposed to constitute the limit for “prolonged drought” for management issues relating to these reservoirs. In particular, we propose to carry out limited outflows under these circumstances, only to protect the river bodies and not to enrich groundwater bodies.

However, we hold that this index, due to its not being clearly meteorological or hydrological, but a result of water resource management within the duration of a hydrological year, should not be used at all as an indicator for determining prolonged drought.

6.3.4 INDEX BASED ON RESERVOIR INFLOWS

The 1st RBMP states that when the inflows of one to five hydrological years in the reservoirs of the Southern Conveyor and Paphos are lower than those of the relevant table (Table 6-49), the ongoing drought is harsher than the reference drought, based on which the abstraction policy was drawn up and should therefore be defined as a prolonged drought, due the risk of causing a severe temporary deterioration of the ecological status of the lake bodies of the reservoirs. However, the dams comprising the Southern Conveyor and Paphos projects are continuously changing in the past years (e.g. Arminou and Cha-potami diversion at the Kouris dam); hence, the time series of inflows to the dams may not be homogeneous and should continually be reviewed as all the reference tie series should concern the same dams, while upstream abstractions are particularly important. Nonetheless, in the context of the calculation of the Hydrological Year Runoff Index for the Southern Conveyor project, inflows from the Kouris dam (Hydrologic Region 9) and Kalavasos (Hydrological Region 8) are used, while for the Paphos area, the inflows of the Kannaviou dam. Especially for the project of the Southern Conveyor, the inflows from the Kouris and Kalavasos reservoirs represent 61% of all Southern Conveyor dams inflows. Thus, the inflows of the two dams (Kouris and Kalavasos) satisfactorily describe the inflows in all dams. Respectively, the Kannaviou dam inflows represent 28% of all inflows; however, we consider that given the uncertainties that exist in the calculation of Asprokremmos dam inflows, the calculation of the Kannaviou dam inflows is sufficient to define the inflows of all three dams of the Paphos project.

Therefore, we believe that the Hydrological Year Runoff Index for Hydrologic Regions 8 and 9 offers a representative description of the inflow index of the Southern Conveyor dam and the corresponding index of Kannaviou dam (Hydrologic Region 1) of that of the Paphos project, as regards the determination of prolonged drought.

6.3.5 HYDROLOGIC YEAR RUNOFF INDEX

This index operates as a complementary test of the meteorological SPI index and an operational index to identify drought and prolonged drought. Given that this index directly depends on runoff values, it shall highlight possible shortcomings of the SPI index in predicting the impact on runoff that may arise from the hydrologic regime and not from the amount of rainfall per se. Although indices based on runoff are used by most EU countries, the small river basin size and the regime of Cyprus rivers are almost unique. In Cyprus, it is possible to extract reliable conclusions about the level of runoff for a period comprising the entire hydrological year or at least the entire wet season.

Regarding the runoff index of Cyprus, it is defined as the index of the sum of annual runoff, where *X*i is runoff of (1), two (2), three (3), four (4) or five (5) hydrological years.

6.3.6 WATER BODIES DOWNGRADING INDEX

This index is proposed to be identical to the characterisations of the condition of bodies resulting from the continuous monitoring programme (Table 6-34) and is equivalent to the Monthly Regime Index. For each Hydrologic Region (except for Hydrologic Region 7), one hydrometric station has been selected, for which the upstream river basin is kept at its natural form to the extent possible, without any appreciable abstractions, while it has a significant size so that the measured flows are as large as possible. Based on the Monthly Regime Index, the exception based on Article 4 Paragraph 6 seems to occur when the median of the average daily flows of a given month **is below the lowest 5% percentile** (ie. for the the HIGH pressure level) of all average daily flow of the given month in the reference sample (1970-71 to 2009-10) for the given month. As described in Paragraph 6.2.4, there might be an issue when the 5% percentiles of daily average flows per month, which define the limit of the temporary deterioration of water bodies (HIGH pressure level), have zero values at least for the dry months. In this case, the decision on the existence of a deterioration of water bodies may be unclear, if real flows in a month under consideration are equal to zero. Therefore, in a drought period, consideration should be paid to the timely evaluation of the measurements.

6.3.7 INDEX BASED ON THE NON-SATISFACTION OF THE DEMAND

A basic principle of water policy in Cyprus is to meet the water supply needs regardless of weather conditions. Thus, the relevant index focuses on the non-satisfaction of the irrigation demand. To keep the index assessment simple, it is limited to government projects. We propose as an indication of prolonged drought consequences the non-coverage of at least 50% of the irrigation demand by government projects compared with demand in periods were the storage capacity index corresponds to a “sufficient” state.

Nevertheless, given that the index is considered to be covered by previous indices, meaning the SPI-12 index, the reservoir inflow index and the water bodies' downgrading index, it is not examined further. Furthermore, this index (which was included in the 1st RBMP) does not indicate drought due to meteorological or hydrological causes, but as a result of water resource management and therefore, it is more suited to water scarcity (which is a result of water resource management), rather than drought.

6.3.8 COMBINED PROLONGED DROUGHT INDEX

Thus, the classification of a drought period as "prolonged", leading to the application of Paragraph 4 of Article 6 of Directive 2000/60 on temporary degradation of water bodies, arises from the application of three meteorological and hydrological indicators, namely:

- The SPI - 12 index and more specifically the drought magnitude that is the outcome of the intensity and the duration of the drought (see Paragraph 6.2.1).
- The Hydrologic Year Runoff Index from one (1) to five (5) years (see Paragraph 6.2.2).
- The Water Bodies Downgrading Index (see 6.3.6).

The first two indices, combined to the SPI-12 index, are used for the determination and the announcement of the Prolonged Drought in each of the Hydrologic Regions of Cyprus and the alert state of the infrastructure needed for the measurement of the mean daily discharges for each hydrometric station that is designated the evaluation of the Monthly Runoff Index. If this happens, then the measurement infrastructure should be set in high alert so that if the median value of the mean daily discharges of the specified month is less that the 5% of the whole set of daily discharges of the sample for each station, and the Exemption for the temporary downgrading of Article 4.6 is declared.

Article 4 paragraph 6 of Directive 2000/60 states: "Temporary deterioration in the status of bodies of water shall not be in breach of the requirements of this Directive if this is the result of circumstances of natural cause or force majeure which are exceptional or could not reasonably have been foreseen, in particular extreme floods and prolonged drought

For the purposes of Article 4.6, the recognition of drought conditions is carried out for each year and for the 6 years in total, by implementing the following steps:

- **STEP 1:** Drought periods are identified (negative SPI-12, with values below -1 for at least one month) and the Drought Magnitude (DM) is monitored for each period. If DM>30, then the conditions of prolonged drought are recognised for the drought event.
- **STEP 2:** The hydrological year runoff index is controlled and any prolonged drought conditions are identified, if the values are below those of the relevant tables of the 15% percentile of annual flows, with an aggregation limit of up to five (5) years (from Table 6-4 to Table 6-9).

- **STEP 3:** For the prolonged drought periods identified either in Step 1 or Step 2, the river monthly regime index is controlled. If the median of average daily flows of at least one of the examined months is lower than the values specified in the relevant tables (from Table 6-35 to Table 6-41), article 4.6 applies for that period.

Aggregation of up to 5 hydrological years to calculate the Hydrological Year Index is justified by the prolonged drought intervals calculated with the SPI-12 index, whose durations average 3 years. Since the processes of transformation of rain into runoff are slower than the transformation of rainfall, it is entirely appropriate for the control of prolonged drought with respect to runoff to require a longer time, even for river basins that are small in surface, such as those in Cyprus. Therefore the use of 5 years to control the aggregation of annual runoff is reasonable, as the runoff of a given year may be greater than the corresponding 15% percentile, however, the cumulative effect of previous years may not exceed the equivalent 15% percentile for the corresponding aggregation range. This is due to the fact that a long event of prolonged drought, based on the SPI-12 index, may present an escalation of the SPI-12 index from low values to very high (absolute) values. The escalation of the SPI-12 index to low values indicating drought may be reflected in an annual value of the Hydrologic Year Index, but in reality it corresponds to a slow and rampant drought that should be reflected for the entire 5 years.

Note that Prolonged Drought is not directly related to the actions taken against drought, where operational drought indices are used (see Paragraph 6.4). The Water Bodies' Downgrading Index is the most appropriate index for the declaration of the exception in Article 4.6 for the temporary deterioration of surface water bodies and is equivalent to the Monthly Runoff Index. When the monthly flows in the monitoring station of the relevant table (Table 6-33) decreases for a given month to levels lower than the median value of daily average flows for the entire flow sample, then the Exception of Article 4.6 of the WFD is declared for the entire Hydrologic Region.

The following table (Table 6-54) summarises the indices and the procedures used for determining Prolonged Drought and the Exeption under Article 4.6 of the WFD.

Table 6-54: Summary table of indices defining prolonged drought.

PROLONGED DROUGHT INDICES FOR SURFACE WATER BODIES	
A. MAIN INDEX - SPI-12 INDEX (CALCULATED PER MONTH)	
SPI Index	Drought Magnitude Limit (DM_{CRIT})
SPI - 12	30
OPERATIONAL INDEX FOR THE NOTIFICATION OF PROLONGED DROUGHT USING SPI - 12 IN REAL TIME	
1. IF DMi > 0.5 * DM_{CRIT} & SPI-12i < -1.5 (where i is the control month) 2. IF SPI-12i > 0 NOTIFICATION OF THE END OF THE PROLONGED DROUGHT 3. CONFIRMATION OF PROLONGED DROUGHT BASED ON DM AT THE END OF THE DROUGHT PERIOD	
B. MAIN INDEX - HYDROLOGICAL YEAR RUNOFF INDEX (HYRI) AN INDEX BASED ON RUNOFF AT DAMS & HYDROMETRIC STATIONS FOR EACH HYDROLOGIC REGION (CALCULATED PER HYDROLOGICAL YEAR)	
HYDROLOGICAL YEAR RUNOFF INDEX WITH HIGH AND VERY HIGH ALERT LEVEL (<15% percentile) FOR AGGREGATIONS OF UP TO FIVE YEARS [Table 6-4 to Table 6-9]	
OPERATIONAL INDEX OF NOTIFICATION OF PROLONGED DROUGHT USING HYRI IN REAL TIME (HYRI ANNEXED TO THE WET PERIOD RUNOFF INDEX)	
PROLONGED DROUGHT IS THE UNION OF TWO INTERVALS OF PROLONGED DROUGHT (SPI - 12 & HYRI)	
INDEX FOR THE NOTIFICATION OF THE EXCEPTION OF ARTICLE 4.6 WFD OR MONTHLY REGIME INDEX (MRI) C. WATER BODIES DOWNGRADING INDEX	
PERFORMED EVERY MONTH - MEDIAN OF THE DAILY FLOWS OF THE MONTH LESS THAT 5% OF THE TIME SERIES OF THE MONTH'S DAILY FLOWS EXCEPTION OF WATER BODIES FOR TEMPORARY DOWNGRADING BASED ON ARTICLE 4.6 WFD IMPLEMENTATION OF THE NECESSARY MEASURES UNDER THE RELEVANT TABLE (Table 6-64) FOR EXTREMELY HIGH ALERT	

6.3.9 ASSESSMENT OF THE PROPOSED SYSTEM FOR DETERMINING PROLONGED DROUGHT AND THE EXCEPTION OF ARTICLE 4.6 WFD

The present paragraph presents an assessment of the proposed system for determining the combined prolonged drought index in relation to the downgrading of water bodies with reference to historical years from 1970-1971 to the present day (usually the year 2012-13 which is the most recent year with available data of daily average flows as provided by the WDD). It is interesting that the appearances of HIGH values of the water bodies' downgrading index are contained in the intervals designated as prolonged droughts. The following tables (from Table 6-55 to Table 6-60) present the occurrences of HIGH downgrading index per hydrologic region and hydrological year. Thus, the hydrological year in question is examined as to whether it belongs to an interval of prolonged drought based on the magnitude of the meteorological SPI-12 index or on the Hydrological Year Runoff Index (for HIGH & VERY HIGH alert levels) for either 1 year or for an aggregation of up to 5 hydrological years. In the following tables, the time intervals are shown in red per month. Prolonged drought as defined by the Hydrological Year Runoff Index with an aggregation of more than one year is shown in green.

In the tables below the abbreviations are as follows: (a) HYRI: Hydrological Year Runoff Index and (b) MRI: Monthly Regime Index (or Water Bodies' Downgrading Index)

Table 6-55: Analysis of historical periods of prolonged drought and high pressure on the riverine ecosystem for Hydrologic Region 1 (based on hydrometric station r1-3-5-05_Xeros near Lazarides and inflows to the Kannaviou dam).

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1971-72												
SPI-12												
ARI												
MRI												
1972-73												
SPI-12												
ARI												
MRI												
1973-74												
SPI-12												
ARI												
MRI												
1989-90												
SPI-12												
ARI												
MRI												
1990-91												
SPI-12												
ARI												
MRI												
1996-97												
SPI-12												
ARI												
MRI												
1997-98												
SPI-12												
ARI												
MRI												
2005-06												
SPI-12												
ARI												
MRI												
2006-07												
SPI-12												
ARI												
MRI												
2007-08												
SPI-12												
ARI												

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
MRI												
2008-09												
SPI-12												
ARI												
MRI												
2009-10												
SPI-12												
ARI												
MRI												
2010-11												
SPI-12												
ARI												
MRI												
2013-14												
SPI-12												
ARI												
MRI												
	Prolonged Drought (SPI-12 & ARI 1 year) & High Pressure Level on Ecosystems											
	Prolonged Drought ARI aggregated from one (1) to five (5) previous years											
	Without Data											

Table 6-56: Analysis of historical periods of prolonged drought and high level of pressure on the river ecosystem in Hydrologic Region 2.

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1971-72												
SPI-12												
ARI												
MRI												
1972-73												
SPI-12												
ARI												
MRI												
1973-74												
SPI-12												
ARI												
MRI												
1989-90												
SPI-12												
ARI												
MRI												
1990-91												
SPI-12												
ARI												
MRI												
1996-97												
SPI-12												
ARI												
MRI												
1997-98												
SPI-12												
ARI												
MRI												
2005-06												
SPI-12												
ARI												
MRI												
2006-07												
SPI-12												
ARI												
MRI												
2007-08												
SPI-12												
ARI												
MRI												

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
2008-09												
SPI-12												
ARI												
MRI												
2013-14												
SPI-12												
ARI												
MRI												
	Prolonged Drought (SPI-12 & ARI 1 year) & High Pressure Level on Ecosystems											
	Prolonged Drought ARI aggregated from one (1) to five (5) previous years											
	Without Data											

Table 6-57: Analysis of historical periods of prolonged drought and high level of pressure on the river ecosystem in Hydrologic Region 3.

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1972-73												
SPI-12												
ARI												
MRI												
1973-74												
SPI-12												
ARI												
MRI												
1989-90												
SPI-12												
ARI												
MRI												
1990-91												
SPI-12												
ARI												
MRI												
1995-96												
SPI-12												
ARI												
MRI												
1996-97												
SPI-12												
ARI												
MRI												
1997-98												
SPI-12												
ARI												
MRI												
1998-99												
SPI-12												
ARI												
MRI												
1999-00												
SPI-12												
ARI												
MRI												
2000-01												
SPI-12												
ARI												
MRI												

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
2005-06												
SPI-12												
ARI												
MRI												
2006-07												
SPI-12												
ARI												
MRI												
2007-08												
SPI-12												
ARI												
MRI												
2008-09												
SPI-12												
ARI												
MRI												
2013-14												
SPI-12												
ARI												
MRI												

	Prolonged Drought (SPI-12 & ARI 1 year) & High Pressure Level on Ecosystems
	Prolonged Drought ARI aggregated from one (1) to five (5) previous years
	Without Data

Table 6-58: Analysis of historical periods of prolonged drought and high level of pressure on the river ecosystem in Hydrologic Region 6.

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1972-73												
SPI-12												
ARI												
MRI												
1973-74												
SPI-12												
ARI												
MRI												
1981-82												
SPI-12												
ARI												
MRI												
1989-90												
SPI-12												
ARI												
MRI												
1990-91												
SPI-12												
ARI												
MRI												
1995-96												
SPI-12												
ARI												
MRI												
1996-97												
SPI-12												
ARI												
MRI												
1997-98												
SPI-12												
ARI												
MRI												
1998-99												
SPI-12												
ARI												
MRI												
1999-00												
SPI-12												
ARI												
MRI												

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
2007-08												
SPI-12												
ARI												
MRI												
2008-09												
SPI-12												
ARI												
MRI												
2013-14												
SPI-12												
ARI												
MRI												
	Prolonged Drought (SPI-12 & ARI 1 year) & High Pressure Level on Ecosystems											
	Prolonged Drought ARI aggregated from one (1) to five (5) previous years											
	Without Data											

Table 6-59: Analysis of historical periods of prolonged drought and high level of pressure on the river ecosystem in Hydrologic Region 8.

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Από												
1970-71												
To												
1983-84												
MRI												
1971-72												
SPI-12												
ARI												
MRI												
1972-73												
SPI-12												
ARI												
MRI												
1973-74												
SPI-12												
ARI												
MRI												
1989-90												
SPI-12												
ARI												
MRI												
1990-91												
SPI-12												
ARI												
MRI												
1995-96												
SPI-12												
ARI												
MRI												
1996-97												
SPI-12												
ARI												
MRI												
1997-98												
SPI-12												
ARI												
MRI												
1998-99												
SPI-12												
ARI												

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
MRI												
1999-00												
SPI-12												
ARI												
MRI												
2005-06												
SPI-12												
ARI												
MRI												
2006-07												
SPI-12												
ARI												
MRI												
2007-08												
SPI-12												
ARI												
MRI												
2008-09												
SPI-12												
ARI												
MRI												
2013-14												
SPI-12												
ARI												
MRI												
	Prolonged Drought (SPI-12 & ARI 1 year) & High Pressure Level on Ecosystems											
	Prolonged Drought ARI aggregated from one (1) to five (5) previous years											
	Without Data											

Table 6-60: Analysis of historical periods of prolonged drought and high level of pressure on the river ecosystem in Hydrologic Region 9.

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1971-72												
SPI-12												
ARI												
MRI												
1972-73												
SPI-12												
ARI												
MRI												
1973-74												
SPI-12												
ARI												
MRI												
1989-90												
SPI-12												
ARI												
MRI												
1990-91												
SPI-12												
ARI												
MRI												
1999-00												
SPI-12												
ARI												
MRI												
2004-05												
SPI-12												
ARI												
MRI												
2005-06												
SPI-12												
ARI												
MRI												
2006-07												
SPI-12												
ARI												
MRI												
2007-08												
SPI-12												
ARI												
MRI												

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
2010-11												
To												
2012-13												
MRI												
2013-14												
SPI-12												
ARI												
MRI												
	Prolonged Drought (SPI-12 & ARI 1 year) & High Pressure Level on Ecosystems											
	Prolonged Drought ARI aggregated from one (1) to five (5) previous years											
	Without Data											

The review of the above tables shows that all months labelled with a HIGH water bodies' downgrading index occur in years with prolonged drought status, as defined above. Therefore, the proposed system is characterised as a relatively reliable and constitutes a useful tool both for reporting purposes to the EU regarding the exception of Article 4.6 and for monitoring and reacting to cases of significant but temporary downgrading of water bodies.

However, the months pertaining to the exception to the achievement of the environmental objectives of Article 4.6 of the WFD are relatively few in number compared with the periods of Prolonged Drought. Indeed, based on the Hydrological Year Index, two long intervals of prolonged drought are detected for the 6 Hydrologic Regions, namely:

1. From 1996 to 2001, and
2. From 2005 to 2010.

However, the increase in droughts forecast due to climate change is expected to increase the frequency of months with temporary downgrading of water bodies due to drought phenomena. Note that the hydrometric stations used for the calculation of the River Bodies' Downgrading Index are located in regions where in general no upstream water abstractions take place, meaning that there is not issue regarding water scarcity phenomena that would be due to poor or inadequate management policies of renewable water resources. Analysis of water scarcity phenomena will be discussed in Section 7.

6.4 OPERATIONAL USE OF THE INDEX SYSTEM

6.4.1 INTRODUCTION

This chapter describes the operational use of drought indices and in particular their correlation with actions depending on the alert level specified in each case by the particular combination of indices.

6.4.2 INDEX ASSESSMENT PROGRAMME

Section 6.2 introduced a system of indices to diagnose and monitor the evolution of the drought and record pressures on the environment, agriculture and other uses. This system is summarised in the relevant table (Table 6-1). The following table (Table 6-62) presents the calculation programme of the indices for a standard hydrological year.

First, the SPI-12 index is used, although it is updated by the Meteorology Department of the WDD with a few months' delay. A more immediate update of the SPI-12 index or the selection of a representative meteorological station to perform an initial SPI-12 assessment, which would later be confirmed by the official SPI-12 definition would be preferable. Depending on the SPI-12 index evolution, the alert level is activated based on the relevant table below per Hydrologic Region (Table 6-61)

Table 6-61: Determination of alert depending on the SPI-12 index

Accordingly, at the end of the hydrological year, the alert level is provided pursuant to Table 6-10 and ton the hydrological year runoff index. The wet period runoff index is used to safely predict hydrological year runoff, while the monthly regime index is activated in drought periods, as the index for the notification of the exception of Article (4.6), as regards the downgrading of water bodies due to prolonged drought among other causes.

Table 6-62: Index Assessment Programme during a Hydrological Year

Month	SPI Index	Hydrological Year Runoff Index & Wet Period Runoff Index	Rivel Flow Monthly Regime Index	Storage of the southern Conveyor and Paphos Projects	Underground Aquifers
OCT	Calculation of rolling indices for 12-60 months. SPI-12 is used for SWB. Depending on the SPI-12 value, the	Index calculation for 1-5 hydrological years	When there is indication for drought, assessment of the month's median for the defined stations to	Forecast of cuts to inform farmers.	Evaluation of annual change in groundwater level and spring flow taking into account the SPI-12 of
NOV					
DEC					

JAN	relevant measures are taken based on During prolonged drought calculation of the drought magnitude up to now. Prolonged drought is notified in real time if: DM>15 & SPI-12<-1.5. At the end of the drought period, the prolonged drought status is confirmed.	01/01 - Index calculation Oct-Dec	declare the Exception under Article 4.6 of the WFD for temporary downgrading.	Updated forecast of cuts to inform farmers.	months in selected boreholes and springs per Groundwater Body.
FEB		01/02 - Index calculation Oct-Jan **RELIABLE FORECAST FOR APRIL RUNOFF**			
MAR		01/03 - Index calculation Oct-Feb			
APR		01/04 - Index calculation Oct-Mar		Finalisation of the cuts programme to inform farmers.	
MAY		01/05 - Index calculation Oct-Apr HYDROLOGIC YEAR RUNOFF INDEX FORECAST			
JUN					
JUL					
AUG					
SEP		FINAL HYDROLOGIC YEAR RUNOFF INDEX CALCULATION			

Since the determination of hydrological indices is considerably more direct than that of SPI-12, then possibly the hydrological indexes are the key indices to assess the onset of drought. In any case, the SPI-12 index is a major index in the EU and it should be used in the Index Assessment programme.

6.4.3 DIAGNOSIS OF DROUGHT ONSET - ALERT LEVELS

In line with the “Drought Management Plan Report” (EU Environment Directorate, Technical Report 2008-23), the conditions of drought are characterised by the fact that they occur either in a status of alert or a status without alert. Moreover, four levels of alert are defined for the alert status: “Mild”, “moderate”, “high” and “extremely high”. The following table (Table 6-63) matches indices and levels. The corresponding 12 month SPI index is selected as the main index for each hydrologic region in order to select the alert level. The 12 month runoff index is used to control the SPI as in Cyprus, there is no history of application of the system. If the runoff index, which is defined as complementary to SPI-12, is worse than the SPI, the worst prediction should be considered. To report the drought alert level for the River Basin Area (the entire Cyprus), as required by the above EU report, the worse drought alert level of each Hydrologic Region should be indicated, as the River Basin is the administrative unit of Directive 2000/60. Of course, measures will be taken only in the hydrologic regions where they are necessary. As regards other indices in the following table (Table 6-63), the wet period runoff index is a tool for the timely warning of the responsible officials as its calculation can provide an indication of drought before the 12 month SPI index. Finally, the storage status index concerns the alert level with respect to the Southern Conveyor and Paphos projects and is directly linked to the permitted abstractions.

Table 6-63: Correspondence of Indices with the Alert level for Drought

Alert Status	Main Index	Auxilliary Indices		
	SPI-12	ARI	MRI	Storage in Dams at SCP and Paphos Project
NORMAL	> 0	> Median Value	> Median Value	SUFFICIENCY
MILD	-1 < SPI < 0	< Median Value	< Median Value	MINOR DEFICITS
MODERATE	-1.5 < SPI < -1	< 25%	< 25%	MODERATE DEFICITS
HIGH	-2 < SPI < -1.5	< 15%	< 15%	SEVERE DEFICITS
EXTREMELY HIGH	< -2	< 5 %	< 5 %	EXTREME DEFICITS

The following table (Table 6-64) shows the actions corresponding to the alert levels for drought.

Table 6-64: Correspondence of Alert Level and Actions of the Drought Management Plan

Alert Level	ACTIONS
NO ALERT	• Maintenance, modernisation and operation of drought index measurement infrastructure. • SPI is directly calculated by the Meteorology Department and sent to the WDD as soon as possible and in any event within the next month. • When this is not feasible, SPI-12 is directly calculated for a representative pluviometric station within each Hydrologic Region to obtain a direct estimate of SPI-12. • Desalination operates on the basis of rules not related to drought.
MILD	• Notification of responsible operators. • Notification of users for increased consumption awareness. • Increase of water supply served from desalination plants, to cover water supply needs without excess production. • Abstractions from large projects according to the storage capacity index

MODERATE	• Notification of responsible operators. • Notification of users for increased consumption awareness. • Definition of runoff and storage data at hydrometric stations and at dams for the calculation of relevant indices due to the beginning of a moderate drought period. • Increase of water supply served from desalination plants, to cover water supply needs without excess production. • Status announcement and intensive public notification program. • Intensive controls for restrictions to uncontrollable abstractions and pumping, as well as for wastage limitations. • Abstractions from large projects according to the storage capacity index
HIGH	• Notification of responsible operators. • Notification of users for consumption reduction. • Definition of runoff and storage data at hydrometric stations and at dams for the calculation of relevant indices due to the beginning of a severe drought period. • Increase of water supply served from desalination plants, to cover water supply needs without excess production. • Status announcement and intensive public notification program. • Intensive controls for restrictions to uncontrollable abstractions and pumping, as well as for wastage limitations. • Abstractions from large projects, in accordance with the storage capacity index, but no more than those corresponding to the action "significant shortage" (see Table 6-50 and Table 6-91). • Monthly regime index calculation (see Paragraph 6.2.4) and measures taken relevant to the upstream abstractions, if this is necessary. When the index falls below 5% upstream abstractions are minimised in the watercourse beds per Hydrologic Region until the recovery of the index above 5%.
EXTREMELY HIGH	• Notification of responsible operators. • Notification of users for consumption reduction. • Definition of runoff and storage data at hydrometric stations and at dams for the calculation of relevant indices due to the beginning of an extreme drought period. • Maximisation of the production of desalination plants, when storage of excess production is possible. • Status announcement and intensive public notification program. • Intensive controls for restrictions to uncontrollable abstractions and pumping, and to minimise wastage. • Abstractions from large projects, in accordance with the storage capacity index, but no more than those corresponding to the action "very significant shortage" (see Table 6-50 & Table 6-51). • Calculation of monthly regime index (see Paragraph 6.2.4) and measures on upstream abstractions, if necessary (index less than 5%). When the index falls below 5% upstream abstractions are minimised in the watercourse beds per Hydrologic Region until the recovery of the index above 5%. • Environmental outflows from dams will be limited to the strictly necessary to protect the river ecosystem, but not to enrich groundwater bodies.

6.5 DROUGHT MANAGEMENT IN THE SOUTHERN CONVEYOR PROJECT

6.5.1 INTRODUCTION

The Southern Conveyor project, as it has been formed by successive additions and interconnections of individual projects, is the most important water resources management system in Cyprus. The project interconnects surface resources along the south side of the Troodos mountain chain with underground aquifers along the south coast and allows the transfer and distribution of water, contributing to the water supply of about 75% of the population of the part of the island under government control and to the irrigation of up to 14,000 hectares of agricultural land. Water is supplied from a total of 4 Hydrologic Regions (Hydrologic Region 9, 8 and 1), covering demand in 4 Hydrologic Regions as well (Hydrologic Region 9, 8, 7 and 6). Hydrologic Region 1 contributes to the Southern Conveyor system through the Dhiarizos and Cha-potami river basin diversions at the Arminou dam and at the water supply from Cha-potami respectively.

Since 1970, Hydrologic Region 8 has undergone three periods of prolonged drought: (a) from 1972 and 1975, (b) from 1997 to 2001 and (c) from 2005 to 2011. Since 1970, Hydrologic Region 9 has undergone four periods of prolonged drought: (a) from 1972 and 1974, (b) from 1989 to 1991, (c) from 1997 to 2011 and (d) from 01/2005 to 02/2011. In the last period, the year 2014 recorded a severe drought period, which, due to its short time period, was not declared "prolonged" using the estimate of the Hydrological Year Runoff Index. Despite their rather high precipitation, Hydrologic Regions 8 & 9, suffer from water scarcity as water abstractions (from the groundwater of surface water) often exceed natural renewable reserves.

The map below (Figure 6-22) presents the main elements of the project.

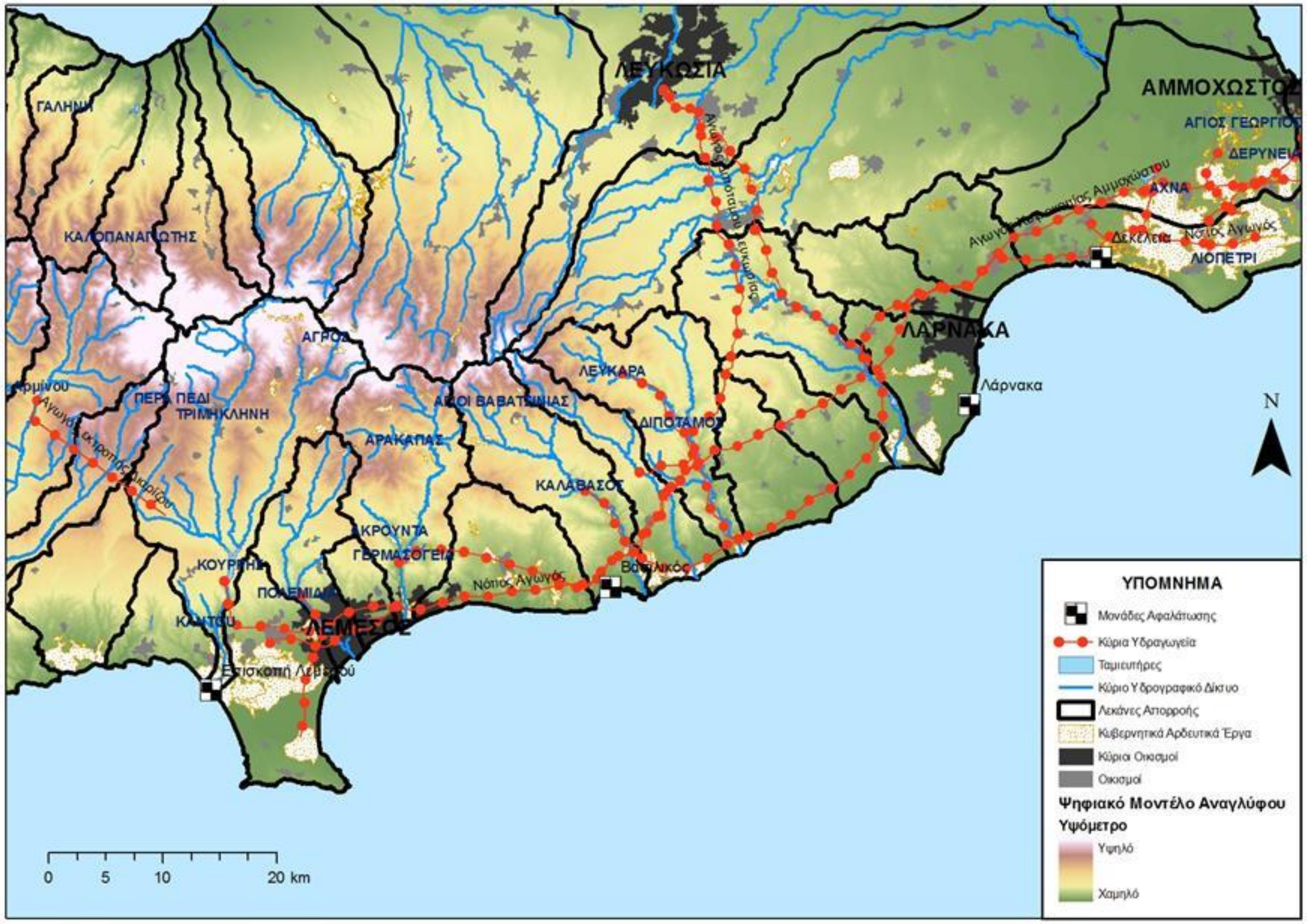

Figure 6-22: Summary map of Southern Conveyor Water System

6.5.2 CURRENT STATUS

In the present study, the term Southern Conveyor Project, from a management perspective, refers to the water resources and demand points that may be addressed as a whole due to the existence of the Southern Conveyor connection, even if the Southern Conveyor is not necessarily used, from the total supplied quantity of water (e.g. irrigation of Pentaschoinos by the Dipotamos dam or water supply of from Lefkara without any interference of the Southern Conveyor).

As it appears, the Southern Conveyor is a particularly complex project. At the same time, since it was completed over a long period during which its individual components were developed and operated autonomously, to ensure a common perception of the “Southern Conveyor Project”, for the purposes f the present study, the projects in the following list (a) will be considered to “strictly” comprise the resources of the Southern Conveyor, The resources included in the following lists (b) to (e) are considered part of the water resources of the project to address needs and are added to the resources of the dams in list (a):

(a) Surface resources (dams connected directly with the Southern Conveyor):

- Kouris and diversion of r. Dhiarizos from Arminou dam (4.3 hm^3) and from Cha-potami (Useful capacity 115 hm^3).
- Germasogeia (the current operation of the project essentially corresponds to its direct connection to the Southern Conveyor (Usable Capacity 13.5 hm^3). It is considered that in the future there will be complete connection.
- Kalavasos (Usable Capacity 17.1 hm^3).
- Dipotamos, including the diversion from Maroni (Useful Capacity 15.5 hm^3).
- Lefkara (Usable Capacity 13.85 hm^3).
- Achna (Usable Capacity 6.8 hm^3). In substance, it is treated as a storage point only at the final area of Kokkinohoria.

Total capacity of the dams that are directly connected to the Southern Convyeor amounts to 181.8 hm^3 and with the inclusion of Arminou dam they reach 186.1 hm^3. The reservoirs Dipotamos, Lefkara, Kouris and Kalavasos are water bodies used for drinking water and have been included in the Register of protected Areas. The following table (Table 6-65) presents the sub-projects of the Southern Conveyor and the dams that serve them.

Table 6-65: List of sub-projects of the Southern Conveyor and correspondence with the dams serving them.

MAIN PROJECT	SUB-PROJECTS	SERVING DAMS	OTHER MAJOR SURFACE ABSTRACTIONS
SOUTHERN CONVEYOR PROJECT	Southern Conveyor Water Supply Project	Kouris, Achna, Kalavasos, Dipotamos, Lefkara	Dhiarizos, Arminou, Cha-potami Diversion
	Akrotiri Irrigation Project	Kouris	
	Kiti Irrigation Project	Kouris, Kiti	
	Kokkinohoria Irrigation Project	Kouris	
	Athienou Irrigation Project	Kouris	
	Parekklisia Irrigation Project	Kouris	
	Mazotou Irrigation Project	Kouris	
	Vassilikos-Pentaschoinos Irrigation Project	Kalavasos, Dipotamos, Lefkara	Maroni Diversion
	Germasogeia-Polemidia Irrigation Project	Germasogeia, Polemidia	

(b) Dams that are not connected to the Southern Conveyor. These are the Polemidi and Kiti dams, which although they are not connected, help address the needs covered by the Southern Conveyor. The Kiti dam, in particular, should be viewed as a recharging resource for the corresponding aquifer and not as an independent surface resource. The dams of Tamasos and Klirou-Malounta could be classified as annexes to the Southern Conveyor, as they contribute to the water supply of Nicosia.

(c) Underground Aquifers. They include the following groundwater bodies which cover needs common to the Southern Conveyor:

- Akrotiri
- Garyllis
- Germasogeia
- Larnaca - Kiti
- Maroni
- Pentaschoinos
- Kokkinohoria

(d) Reuse of wastewater

- Limassol. To date, only wastewater coming from the Limassol-Amathus WWTP have been used for the needs also covered by the Southern Conveyor.

- of Nicosia. The impact of implementing water transfer to the Athienou irrigation project from the Mia milia-Nicosia WWTP is examined; said irrigation is supplied by the Southern Conveyor System by transferring 2 hm^3 of water annually.[5]
- of Larnaca. There is the scenario to implement a groundwater recharge project in Kiti to cover the needs of the irrigation project in the future, only if the high salinity of the recycled water produced in Larnaca decreases.
- Agia Napa and Paralimni. Recycled water is not used for recharge as all amounts are held to irrigate the green spaces of hotels and sports facilities of these tourist communities in the Agia Napa area.

(e) Desalination plants: The permanently operating system units are the following four:

- Dekelia Unit is the first desalination plant in Cyprus which started operating in 1997 in Dekelia with a capacity of 40,000 m^3/day. Following two successive extensions, its capacity reaches nowadays 60,000 m^3/day.
- Larnaca unit (airport area), started operating in 2001 with a capacity of 52,000 m^3/day. Since 2009, its capacity has increased to 62,000 m^3/day.
- Limassol unit (Episkopi), with a capacity of 40,000 m^3/day, expandable to 60,000 m^3/day. This unit is in operation since November 2011.
- Vassilikos unit, for which a contract was signed with EAC, with a capacity of 60,000 m^3/day. This unit is in operation since January 2012.

Accordingly, the permanent plants have a total immediate capacity of 222,000 m^3/day or approximately 72.9 hm^3 per year, with a 90% performance coefficient.

The table below (Table 6-66) shows the monthly and annual flows at the dams of the Southern Conveyor from hydrological year 1969-70 to 2013-14. It seems that inflows were lower than the reference drought(10 hm^3) twice in the hydrological years 1990-91 and 2013-14, while they were marginally higher than the reference drought in the hydrological years 1972-73 and 2005-06, albeit with a different reservoir configuration, making comparison difficult due to the diversion of Arminou and Maroni. The reference drought occurs at the 2.7% percentile of the annual inflows for the entire available sample from the hydrological year 1969-70 to 2013-14. The relevant table (Table 6-67) presents the stored volume in all reservoirs of the Southern Conveyor for respective hydrological years. The average annual inflow to the dams of the Southern Conveyor is equal to 61.5 hm^3, while the maximum value is equal to 149.5 hm^3, corresponding to the year 1980-81.

[5] The scenario for the desalination and transfer of Nicosia recycled water to the Kokkinohoria irrigation project has been abandoned for several years due to the reaction of stakeholders in the disposal of produced brine (including heavy metals) in the Larnaca bay.

Table 6-66: Table of monthly inflows (at 1000m^3) at the dams of the Southern Conveyor Project, including inflow for the Arminou Dam.

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1969-70	3,166	2,596	7,708	5,604	6,243	10,797	3,437	1,429	284	103	9	27	41,405
1970-71	101	1,781	2,394	5,796	9,129	7,917	18,712	6,652	1,812	475	835	110	55,713
1971-72	331	1,937	4,920	6,591	5,768	7,486	4,237	8,977	2,705	344	586	126	44,008
1972-73	707	1,201	1,691	2,142	2,982	2,285	752	247	153	54	14	12	12,243
1973-74	458	1,723	2,378	5,080	4,099	9,484	2,735	556	124	23	187	71	26,918
1974-75	406	777	3,694	19,546	46,942	20,946	4,748	4,963	1,465	368	173	52	104,081
1975-76	195	1,072	11,577	24,513	17,050	18,513	12,549	8,269	3,189	1,473	312	268	98,981
1976-77	2,689	3,599	5,322	14,516	8,428	8,571	7,512	3,018	695	319	3	32	54,701
1977-78	690	610	7,280	29,004	42,155	20,825	13,007	4,518	1,501	269	131	167	120,157
1978-79	941	2,001	8,018	11,527	18,164	7,595	2,562	1,715	1,600	27	3	161	54,314
1979-80	824	1,473	13,228	22,476	36,237	24,497	13,387	6,252	1,866	368	143	121	120,872
1980-81	231	1,040	1,724	37,765	53,516	28,722	16,477	6,863	2,119	629	221	182	149,488
1981-82	261	3,343	5,973	5,161	5,798	14,219	5,430	3,240	1,921	309	106	63	45,824
1982-83	558	1,185	1,912	6,604	10,057	19,905	9,620	5,253	2,174	409	118	211	58,005
1983-84	503	3,386	4,299	5,640	11,708	7,886	8,248	3,156	737	179	127	114	45,984
1984-85	202	8,421	5,711	17,658	21,430	13,492	7,393	3,381	1,274	223	129	111	79,424
1985-86	1,189	1,832	3,945	7,973	8,538	5,669	3,734	6,121	1,924	321	39	76	41,362
1986-87	583	1,302	5,439	13,790	5,392	50,430	15,146	6,667	2,375	990	275	273	102,661
1987-88	81	1,537	10,996	12,285	15,676	57,251	15,253	5,779	2,750	209	304	78	122,200
1988-89	1,407	2,569	9,570	49,768	10,560	9,646	4,439	2,028	648	52	29	28	90,742
1989-90	475	990	1,527	1,272	10,889	5,654	2,015	672	94	0	0	0	23,588
1990-91	0	2	347	1,213	2,176	4,325	1,217	208	1	0	0	0	9,489
1991-92	0	386	28,160	17,029	25,612	13,293	8,017	4,892	2,143	450	112	12	100,108
1992-93	20	2,841	26,426	12,994	14,544	24,091	8,520	5,701	1,807	142	37	4	97,127
1993-94	12	1,232	1,168	6,154	13,251	10,988	4,201	2,352	468	84	87	314	40,310
1994-95	548	36,888	10,731	11,041	7,377	5,515	3,525	1,515	689	654	323	124	78,929
1995-96	53	860	1,208	7,150	5,979	5,637	2,683	1,086	384	266	229	90	25,626
1996-97	369	145	2,522	1,316	3,474	2,676	6,083	771	301	0	0	0	17,657
1997-98	32	916	3,411	2,983	1,793	3,657	2,259	821	600	0	0	0	16,472
1998-99	0	413	5,961	4,227	18,285	6,347	5,036	570	1,139	202	0	782	42,963
1999-00	1,410	442	658	1,094	2,265	5,705	6,542	2,140	254	0	0	0	20,510
2000-01	0	2,220	7,700	12,828	8,575	5,405	2,420	1,097	52	0	0	0	40,297
2001-02	47	302	37,611	39,560	12,931	10,725	10,741	3,012	975	266	0	0	116,170
2002-03	30	409	7,151	5,927	27,189	30,663	13,338	4,399	1,915	369	0	0	91,390
2003-04	311	624	3,714	55,695	29,208	7,842	5,911	2,437	1,289	263	0	0	107,294
2004-05	470	2,782	3,814	7,699	11,662	4,796	2,569	636	698	0	0	0	35,127
2005-06	0	832	710	3,183	4,244	2,522	658	102	0	200	80	40	12,571
2006-07	515	3,131	363	735	9,325	3,955	1,556	1,920	98	236	184	184	22,203
2007-08	276	292	4,560	1,340	2,867	2,054	377	1,635	512	0	20	160	14,093
2008-09	155	315	1,445	5,862	13,028	12,394	9,517	5,356	882	22	58	775	49,809
2009-10	925	3,692	14,534	22,640	21,972	15,919	5,616	1,701	625	324	0	0	87,948
2010-11	0	0	5,441	3,862	7,377	11,226	6,576	2,934	588	0	0	225	38,229
2011-12	8	2,796	2,235	49,777	38,200	27,935	10,487	6,852	1,398	46	0	0	139,733
2012-13	1,303	2,492	27,830	12,407	9,214	4,417	4,753	2,260	59	0	0	474	65,209
2013-14	19	167	1,729	657	823	683	278	1,639	166	0	0	90	6,251

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
AVER.	500	2,412	7,083	13,157	14,270	12,768	6,539	3,240	1,077	237	108	124	61,520
ST. DEV.	665	5,462	8,154	13,962	12,616	11,839	4,764	2,407	867	285	166	176	39,496
C. V.	1.33	2.26	1.15	1.06	0.88	0.93	0.73	0.74	0.81	1.20	1.53	1.43	0.64

Figure 6-23 shows the diagram of annual inflows to the dams of the Southern Conveyor and the boundary line of the inflows of the reference drought for an aggregation period of one year.

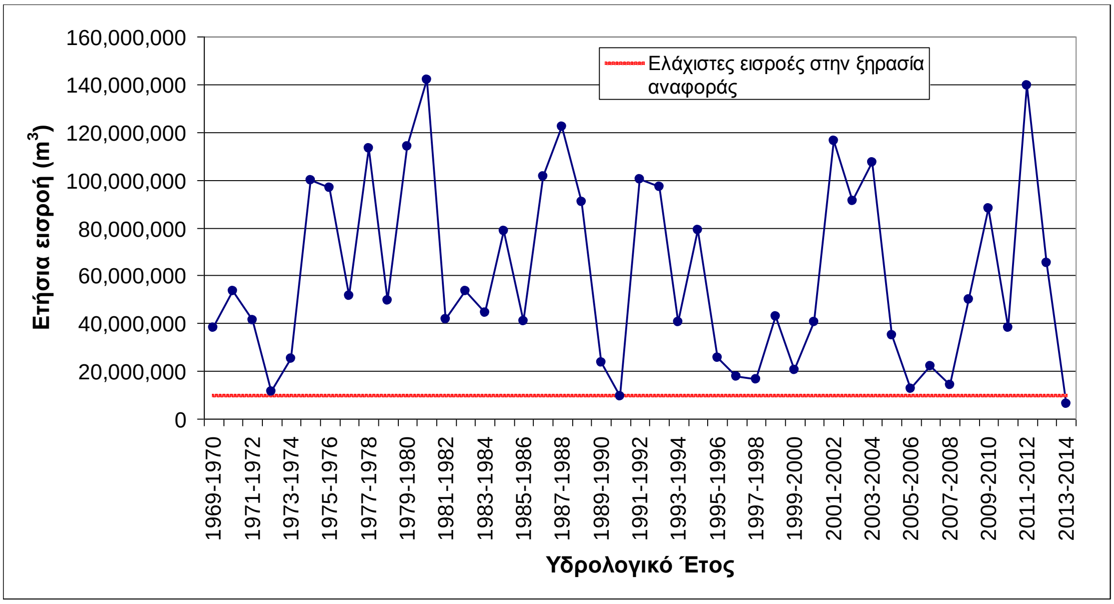

Figure 6-23: Diagram of annual inflows in the Southern Conveyor project compared to inflows in reference drought.

Table 6-67: Stored volume (in hm³) at the Southern Conveyor dams at the beginning of each month.

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1994-95	71.09	65.37	98.25	104.43	109.98	112.45	112.43	110.35	105.15	98.84	91.66	83.63
1995-96	75.98	68.69	65.44	62.33	66.25	68.52	69.14	66.49	60.75	54.66	48.73	42.64
1996-97	36.78	31.91	28.31	27.95	26.64	27.97	28.26	32.35	30.17	27.00	22.77	18.50
1997-98	14.73	11.68	10.45	11.90	12.85	12.62	14.36	14.75	13.52	11.90	9.35	6.69
1998-99	4.47	2.38	1.95	7.23	9.86	22.99	26.46	28.26	25.53	23.60	19.98	16.31
1999-00	13.62	11.83	10.17	9.06	8.91	10.07	14.55	19.82	20.24	17.76	14.66	11.28
2000-01	8.36	5.75	6.03	11.79	22.74	29.87	32.88	32.11	29.41	25.53	21.24	16.99
2001-02	13.11	9.94	7.97	43.86	81.65	90.89	97.28	103.79	101.80	96.86	90.87	83.18
2002-03	76.49	71.16	67.48	73.08	77.48	102.94	130.48	140.04	136.98	131.62	123.61	115.19
2003-04	107.04	100.56	96.39	96.69	148.54	173.16	174.83	173.85	168.65	161.73	152.72	143.48
2004-05	134.98	127.64	125.18	125.37	129.75	138.47	138.59	136.03	129.91	123.01	114.12	104.96
2005-06	96.71	89.28	84.75	80.99	79.52	82.61	81.69	78.29	72.21	64.93	57.86	50.37
2006-07	43.33	37.92	36.83	32.29	29.33	35.74	35.45	32.27	29.68	24.39	18.98	14.01
2007-08	9.25	5.16	2.75	5.32	4.56	5.69	5.30	4.17	4.45	3.29	1.50	1.04
2008-09	0.82	0.80	1.07	2.66	9.50	23.11	35.41	44.45	47.67	45.31	42.23	38.83
2009-10	36.09	33.99	35.99	49.50	71.12	90.49	102.72	104.80	102.66	98.56	94.15	87.94
2010-11	82.34	77.11	72.68	75.35	77.80	83.61	91.88	94.61	92.54	86.92	79.17	72.46
2011-12	66.29	61.41	60.72	60.96	107.42	138.54	157.98	158.45	158.03	152.14	142.25	132.28
2012-13	123.13	116.48	112.67	132.51	138.97	142.52	140.58	139.17	133.82	125.05	116.24	105.95
2013-14	97.07	88.63	81.95	78.24	73.44	68.92	63.44	57.14	53.88	49.35	44.24	38.98
MAXIMUM	134.98	125.27	135.74	160.85	173.99	174.34	171.25	165.19	157.22	148.1	139.23	126.41
MINIMUM	0.82	1.87	4.94	5.12	5.49	4.74	4.31	3.87	2.4	1.27	0.93	0.93
AVERAGE	55.6	50.9	50.4	54.6	64.3	73.1	77.7	78.6	75.9	71.1	65.3	59.2

The minimum stored volume at the Southern Conveyor dams decreased to the absolute minimum of 0.82 hm^3 of water in October 2008, while the maximum value was recorded in April 2004, with a storage of approximately 174.8 hm^3 of water, when the Kouris dam overflowed. The above table (Table 6-67) shows the monthly water volumes stored in the dams of the Southern Conveyor.

Water abstractions from various water sources of the Southern Conveyor are presented below for the calendar years from 2009 to 2014 (Table 6-68). It appears that average abstractions from the Southern Conveyor dams are equal to 55 hm^3, from boreholes they are equal to 6.5 hm^3, from desalination 34.9 hm^3 and from recycled water approximately 4.1 hm^3. In total, an average of 101.5 hm^3 has been taken from all water sources.

During the dry year of 2009, which is the final year of the prolonged drought of the period 2005-2009, abstractions from the dams of the Southern Conveyor were minimal (only 18 hm^3 of water). Conversely, in 2014, which was also a year of “extreme” drought, although it was not classified as prolonged (due to its short duration based on SPI-12), abstractions from Southern Conveyor dams were equal to 57.5 hm^3 of water.

In contrast, while abstractions from desalination ranged consistently above 45 hm^3 of water up to the year 2011, they decreased significantly in the years 2012 onwards reaching the lowest value (10.7 hm^3) in 2013.

Table 6-68: Water abstraction data from different sources of the Southern Conveyor Project

	ABSTRACTIONS DROM SCP DAMS	PUMPING WELLS ABSTRACTIONS	DESALINATION	RECLAIMED WATER	TOTAL
2009	18.1	10.53	49.42	3.02	84.17
2010	42.56	7.10	51.93	4.40	105.99
2011	45.78	5.53	46.60	3.90	101.80
2012	77.89	6.82	17.92	3.75	106.37
2013	90.49	3.93	10.71	4.75	109.88
2014	57.47	5.33	32.80	5.05	100.65
AVER.	55.38	6.54	34.90	4.15	101.48
ST. DEV.	26.04	2.26	17.41	0.74	9.11
C. V.	0.47	0.35	0.50	0.18	0.09

The table below (Table 6-69) shows water abstractions from all sources of the Southern Conveyor Project for various uses. Abstractions for water supply occupy the overwhelming percentage with an average value of 67 hm^3 per year, while irrigation amounts to an approximate average of 30 hm^3 per year. The minimum value ever reached for irrigation was in the dry year 2009, when abstraction amounted to 18 hm^3 approximately, while the maximum value was reached in 2013, when irrigation received more than 40 hm^3 of water. The difference in the maximum and minimum water rate allocated to irrigation is largely due to the self-evident fact that the Republic of Cyprus is in deficit as regards irrigation.

Table 6-69: Abstraction data from all water sources of the Southern Conveyor for various uses.

	ABSTRACTIONS WATER SUPPLY	ABSTRACTIONS IRRIGATION	ABSTRACTIONS RECHARGE	TOTAL
2009	61.09	17.63	5.45	84.17
2010	71.73	30.0	4.27	105.99
2011	70.26	28.52	3.02	101.80
2012	69.21	31.37	5.79	106.37
2013	66.28	40.20	3.39	109.88
2014	67.79	29.96	2.90	100.65
AVER.	67.73	29.61	4.14	101.48

6.5.3 ARMINOU DAM MANAGEMENT AND DIVERSION IN THE SOUTHERN CONVEYOR PROJECT

As regards the management of Arminou dam in r. Dhiarizos and the management policy of diversions to strengthen the Southern Conveyor project and the Kouris dam, we maintain the management policy of the 1st RBMP.

The Arminou reservoir is required to achieve multiple and, to some extent, conflicting objectives. These are:

- Environmental conservation in the river downstream of the dam. Taking into account the contributions of other water sources after the dam, it appears that the flows remaining to cover the next objective can also cover this requirement, provided there is good distribution within the year.
- Ensuring flows in the downstream part of the river, to supply the aquifer and cover abstractions for the needs in the river valley and the Paphos project.
- Ensuring flows for the operation of irrigation projects of high zones of the Dhiarizos valley with a project under construction.
- Strengthening the Kouris reservoir capacities.

The simulation of the operation of the dam and diversion tunnel and the drafting of an operational policy are detailed in Annex VII (Water Policy) of the 1st RBMP. We hereby summarise the proposals for the management of the storage-diversion start to Kouris relation, as derived from the simulations. These proposals are presented in the table below (Table 6-70). The table includes the storage limits for normal years and more stringent (higher) limits for dry years (based on the criterion of inflows shown in the same table). Thus, we aim to avoid a diversion to Kouris before securing the required quantities for the environment and local needs.

In addition, as regards the diversions from Cha-potami to the Kouris dam, note that "Annex VII - Water Policy" of the 1st RBMP on the Southern Conveyor project suggests not pursuing the diversion from Cha-potami to the Kouris reservoir so as to increase the availability of the resource for the needs of the environment and local communities.

Table 6-70: Limits for the Start of the Diversion from the Arminou Reservoir to Kouris

	Storage Limits for diversion start (hm^3)	Storage Limits for Dry Conditiolns (hm^3)	Criteria for Dry Conditions Limits
DEC.	2.5	-	
JAN.	2.5	-	
FEB.	2.5	4.0	Inflows DEC. and JAN. < 4 hm^3
MAR.	2.5	4.0	Inflows from DEC. to FEB. (incl) < 7 hm^3

APR.	2.5	4.0	Inflows from DEC. to MAR. (incl.) < 10 hm^3
MAY.	3.6	-	

6.5.4 SUGGESTED DECISION-MAKING PROCEDURE TO SCHEDULE ABSTRACTIONS

In relation to the needs served by the Southern Conveyor project, the table below (Table 6-71) presents the irrigation needs of irrigation projects served by it. It therefore appears that the annual irrigation needs amount to the volume of 44.7 hm^3.

Table 6-71: Annual irrigation needs in the projects supplied by the Southern Conveyor project (Source: Annex VII: Water Policy of the 1st RBMP)

UNIT	IRRIGATION NETWORKS	ESTIMATED DEMAND (m³/Year)
SCP	**SCP Total**	**44 600 000**
	A.E. Akrotiri	7 000 000
	A.E. Germasogeia / Polemidhia	1 700 000
	A.E. Kiti	1 200 000
	A.E. Kokkinochoria	22 000 000
	A.E. Athienou	2 700 000
	A.E. Vassilikos / Pentaschoinos	10 000 000

The table below (Table 6-72) presents the needs in water supply, tourism and industry also served by the Southern Conveyor project. The average quantities amount to 69 hm^3 of water.

Table 6-72: Annual water supply needs in the projects supplied by the Southern Conveyor project (Source: Annex VII: Water Policy of the 1st RBMP)

Water Supply Demand in hm³/Year	BASE YEAR (2011)	DESIGN YEAR (2031) SCENARIO 1 to 8
Residents	55	47-69
Tourism	8	8-13
Industry	6	6
TOTAL FOR SCP	**69**	**Between 61-88**

Considering average water supply demand at 75 hm^3 per year (for the year 2031), we devise a standard balance of desalination and water supply (Table 6-73) showing that for the full satisfaction of water supply, a total quantity of 2 hm^3 is required from either dams or groundwater. From the abstraction data, it appears that water supply boreholes of the delta of r. Kouris may be pumped for an average 2.5 hm^3 of water. Therefore, since desalination plants operate continuously at their rated capacities, the water supply of the area supplied by the Southern Conveyor is fully satisfied. Hence, total annual needs amount to 130 hm^3. This also include the necessary quantities for ecological flows, downstream of dams, reaching an average of up to 10.1 hm^3 in comparison with the corresponding value of 11 hm^3 in the 1st RBMP.

Table 6-73: Analysis of annual abstractions in periods of drought for water supply of the Southern Conveyor Project.

Water Supply Demand		Water Supply Demand		m^3/year	
Desalination potential during drought		Desalination potential during drought		m^3/day	
Exploitation Potential Percentage		Exploitation Potential Percentage			
Month	**Month**	**Monthly Demand**	**Numb. Days**	**Desalinated Water Production**	**Demand from Dams/GW**
		(m^3)		**(m^3)**	**(m^3)**
10	1.13	6,369,863	31	6,193,800	176,063
11	0.95	6,164,384	30	5,994,000	170,384
12	0.87	6,369,863	31	6,193,800	176,063
1	0.89	6,369,863	31	6,193,800	176,063
2	0.75	5,753,425	28	5,594,400	159,025
3	0.86	6,369,863	31	6,193,800	176,063
4	0.95	6,164,384	30	5,994,000	170,384
5	0.98	6,369,863	31	6,193,800	176,063
6	1.12	6,164,384	30	5,994,000	170,384
7	1.19	6,369,863	31	6,193,800	176,063
8	1.21	6,369,863	31	6,193,800	176,063
9	1.11	6,164,384	30	5,994,000	170,384
	TOTAL:	**75,000,000**	**365**	**72,927,000**	**2,073,000**

The use of recycled water covers the needs for irrigation and irrigation of green and public spaces. WDD data show that the amount of water that will be given for irrigation by the Limassol WWTP is 11.7 hm^3 for 2020 and 13.5 hm^3 for 2025. Therefore, a summary water balance reveals that the theoretical average annual required amount of water from the dams of the Southern Conveyor is 43 hm^3, given that no groundwater is pumped to supply irrigation in the Southern Conveyor project (abstractions from refilling the Germasogeia dam is included in abstractions from dams). If we assume that abstractions from desalination plants never reach the feasible amounts, for various reasons, we consider that the optimal amount of abstraction from the dams of the Southern Conveyor, in order to avoid all shortages, amounts to 55 hm^3, based on the analysis carried out in the framework of the 1st RBMP. This amount is 12 hm^3 higher than the above volume and is considered a reasonable amount for emergencies. If we consider that the average annual inflow to the dams of the Southern Conveyor is approximately 60 hm^3 (Table 6-66), it is expected that the amount of 55 hm^3 will not be covered for long periods and therefore the deficit will be particularly important.

The following table (Table 6-74) presents, under the 1st RBMP, the proposed value of abstractions from the Southern Conveyor reservoirs in connection to the available storage on the 1st April of the current year, depending on the designation of the sufficiency with respect to the available storage and the relevant action, by scheduling possible cuts in supply (mainly to irrigation) and determining their magnitude. Revision of this strategy as part of the 2nd RBMP was not deemed appropriate, hence the same applies to the 2nd RBMP.

Table 6-74: Proposed abstraction policy with respect to the Southern Conveyor Storage Index

Storage 1st April	CATEGORY CLASSIFICATION	ANNUAL ABSTRACTIONS	ACTION CLASSIFICATION
> 120 hm^3	SUFFICIENCY	55 hm^3	ZERO CUTS
100 hm^3 > & <120 hm^3	MINOR DEFICITS	44 hm^3	MINOR CUTS
80 hm^3 > & <100 hm^3	MODERATE DEFICITS	35 hm^3	MODERATE CUTS
50 hm^3 > & <80 hm^3	SEVERE DEFICITS	25 hm^3	SIGNIFICANT CUTS
< 50 hm^3	EXTREME DEFICITS	15 hm^3	VERY SIGNIFICANT CUTS

The tables below (Table 6-75 and Table 6-76) provide a forecast of the probability of cuts at the beginning of the irrigation season starting with storage at the SCP dams on 1 October and an update of the forecast on 1 January.

Table 6-75: Forecast of the probability of cuts at the beginning of the irrigation season starting with storage at the SCP dams on 1st October and an update of the forecast on 1st January.

Total Storage on SCP Dams on 1st October (in hm^3)	Decision Forecast for Possible Cuts at 1st April
V > 100 hm^3	NO EXPECTED CUTS
100 hm^3 > V > 80 hm^3	30% PROBABILITY OF MINOR CUTS
80 hm^3 > V > 40 hm^3	50% PROBABILITY CUTS
V < 40 hm^3	CUTS ARE ALMOST CERTAIN and 70% PROBABILITY OF VERY SIGNIFICANT CUTS

Table 6-76: Forecast of the probability of cuts at the beginning of the irrigation season starting with storage at the SCP dams on 1st January.

Total Storage on SCP Dams on 1st January (in hm^3)	Decision Forecast for Possible Cuts at 1st April
V > 100 hm^3	NO EXPECTED CUTS
100 hm^3 > V > 80 hm^3	30% PROBABILITY OF MINOR CUTS
80 hm^3 > V > 40 hm^3	60% PROBABILITY CUTS
V < 40 hm^3	CUTS ARE ALMOST CERTAIN and 90% PROBABILITY OF VERY SIGNIFICANT CUTS

6.5.5 ASSESSMENT OF THE DROUGHT MANAGEMENT PLAN IMPLEMENTATION - PROPOSALS

Based on the above Paragraph 6.5.2, it is interesting to verify of during the dry year 2013-14 the provisions of the 1st Drought Management Plan were followed. Storage at the Southern Conveyor dams amounted to 66.2 hm^3 of water on 1st April 2014. Based on the relevant table (Table 6-74), abstractions from the dams of the Southern Conveyor for the year 2014 should be equal to 25 hm^3 of water. The year has been assigned the classification SIGNIFICANT SHORTAGE, while cuts should be designated as IMPORTANT. Nonetheless, abstractions at the Souther Conveyor dams for the year 2014 amount to 54.5 hm^3 (Table 6-68), i.e. a figure twice the amount expected. These abstractions are provided for by the 1st Drought Management Plan when the storage on 1st April exceeds 120 hm^3, with a designation No CUTS.

Thus, it appears that the 1st Drought Management Plan was not implemented. Fortunately for the water resources of Cyprus, the dry hydrological year 2013-14 was discontinued and the natural runoff of the year 2014-15 completed the increased abstractions. However, of the drought had continued both in intensity and duration (which may have been classified as a “prolonged drought”), they might have been a serious issue in meeting water needs in the coming years.

The reason for the increased abstraction of the given year was twofold:

1. The high level of storage during the previous year. On 1st April of the year 2013, the storage was equal to approximately 142 hm^3, a value very close to the total storage of the dams of the Southern Conveyor.
2. The desalination operation was not as expected (according to the 1st Drought Plan) because due to the cost of the desalination and to the Economic Program of the Republic of Cyprus it was not possible for the desalination plants to operate at their maximum potential. Please find more details about the operation of desalination in Paragraph 6.9.2.

Thus, we arrive to the conclusion that in the year with Extreme Drought (2013-14) in the South conveyor project area there was temporary and exceptional non-implementation of the Management Plan for reasons related to the general financial situation of the National Economy of the Republic of Cyprus.

However, we recommend faithfully adhering to the Drought Management Plan in the future, even if the overall political and financial situation does not allow economically the full application of the Drought Management Plan.

In summary, the proposals for drought management in the South Conveyor project are:

1. Faithful implementation of the annual programme of abstraction of water from Southern Conveyor dams combined with the volume of desalination even when the economic conditions do not allow for the full operation of desalination under the terms

of the 1st RBMP. It was not considered necessary to change the abstraction planning as regards the storage of the 1st RBMP.

2. The abstraction programme of the 1st RBMP shall be followed both in times of drought and in normal conditions or in high aquifer conditions as abstraction, as abstraction management allows storage of sufficient volume in the reservoirs to face the periods of droughts that are bound to occur in the future.

3. Increased participation of recycled water in irrigation as well as increased water storage is required, due to lack of coincidence in time with respect to the periods calling for a maximisation of irrigation consumption. The study of the Tersefanou dam for the storage of outflows of the Larnaca WWTP is a key step in this direction, following the recycled water stored in the Polemidia reservoir. Moreover, underground aquifers should be found to receive quantities of recycled water to be used later for irrigation. Increasing the use of recycled water for irrigation will accordingly reduce abstractions for irrigation from underground aquifers in the area of the Southern Conveyor, which, in this region, are in poor condition in quantitative and qualitative terms.

6.6 DROUGHT MANAGEMENT AT THE PAPHOS PROJECT

6.6.1 INTRODUCTION

The Paphos project is the second most important water project in Cyprus and from a hydrological standpoint, it belongs entirely in Hydrologic Region 1. Water resources of the three dams of the Paphos project are directed at meeting the water supply and irrigation needs, while water supply will be supplemented mainly by the Paphos desalination plant, with a rated daily capacity of 15,000 m^3 in times of drought, once it is built and commissioned. Since 1970, Hydrologic Region 1 has undergone four periods of prolonged drought: (a) from 1971 and 1974, (b) from 1989 to 1991, (c) from 1996 to 2010 and (d) from 2005 to 2011. In the last period, the year 2014 recorded a severe drought period, which, despite its short time period, was declared “prolonged” using the Hydrological Year Runoff Index. In summary, Hydrologic Region 1 is one of the richest hydrologic regions of Cyprus and includes the river basins of r. Dhiarizos, r. Xeros and r. Ezousa.

6.6.2 CURRENT STATUS

Up to recently, the Paphos project used to be supplied by the Asprokremmos dam, featuring a capacity of 52.4 hm^3 and by the Mavrokolympos dam, of 2.2 hm^3. Recently, the Kannaviou dam was completed on r. Ezousa, with a capacity of 17 hm^3. Figure 6-26 shows a schematic representation of the Paphos project. The Souskiou dam construction is also scheduled (with a capacity of 0.2 hm^3) in the lowland bed of r. Dhiarizos, aimed at recharging the aquifer. Note that part of the runoff of r. Dhiarizos is diverted to r. Kouris through the Arminou dam, whose construction was completed in 1998. Runoff from the Souskiou dam include both outflows and overflows of the upstream Arminou dam and runoff from the intermediate basin. These surface water sources include abstractions from the lowland beds of r. Dhiarizos and Ezousa, either by direct surface abstraction using small canals or by pumping the hypodermic runoff at shallow depths of these riverbeds. The Paphos Project dams are:

- Asprokremmos with a usable capacity of 52.4 hm^3.
- Mavrokolympos with a usable capacity of 2.18 hm^3.
- Kannaviou with a usable capacity of 17.1 hm^3.

The Kannaviou dam first opened in 2006 providing 370,000 m^3 to refill the dowstream aquifers. Note that the Kannaviou dam does not contribute directly to the Paphos project, but indirectly by providing amounts of water to the Asprokremmos refinery, through the Ezousa pipeline any remaining quantities are stored in the Asprokremmos reservoir. The Ezousa Pipiline has a total length of 27 km starting from Kannaviou Dam and ending at the

Asprokremmos refinery. In the middle of the course, near the Pittarkou village a surge tank has been constructed. The pipeline is directed along the river Ezousa, except for the course at the south of the Episkopi community, where it steers to the west passing above the river to bypass the future dam of Episkopi. Along the pipeline, there are flows for the irrigation of riparian communities and towards Stroumbi-Polemi area. The same pipeline provides water to the Kannaviou refinery, which is located between the Kannaviou dam and its namesake community and supplies water to the “Mountainous Villages of Paphos”. The Asprokremmos dam is also used for irrigation.

The relevant table (Table 6-77) presents the monthly and annual inflows to the Paphos project dams, where it appears that only for two years (from 1972 to 1973 and from 1990 to 1991, corresponding to periods of prolonged drought), inflows are lower than the reference drought of the relevant table of the 1st RBMP (Table 6-49), while contribution from the Kannaviou dam is not included in those years. The reference drought occurs at the 2.8% percentile of the annual inflows for the entire available sample from the hydrological year 1969-70 to 2013-14.

Total storage amounts to 71.8 hm^3. Furthermore, we should take into account the possibility of abstraction and pumping from the beds of r. Dhiarizos and Ezousa, which will be enhanced with the completion of the Souskiou dam. Average annual inflow to these dams are respectively 13.0 hm^3, 1.0 hm^3 and 5.3 hm^3, totalling 19.1 hm^3, as shown in the table below. Also, average annual flows at the mouth of r. Dhiarizos amount to 16.0 hm^3, including the Arminou dam diversion for the recent years it is in operation. Respectively at the mouth of r. Ezousa, which does not include the abstractions from Kannaviou dam, the average annual flow is equal to 9.5 hm^3. It is also significant that while runoff of r. Dhiarizos represents the largest value of inflows, it has decreased significantly since the construction and operation of the Arminou dam.

The Paphos area, where the largest part of demand is located, is “seated” above the Groundwater Body CY_11A “Paphos”, which differs from the GWB CY_11B “Ezousa Riverbed” as they have different infiltration characteristics. Figure 6-24 presents the diagram of the borehole level with code P1192 in the area of the mouth of r. Dhiarizos. It seems that while the general trend is downward (especially compared with the late 1970s-early 1980s), there is some stabilisation of level and in fact, some trends towards restoration, which should be attributed to the reduction of abstractions for irrigation. A similar picture is presented and the GWB CY_11B “Ezousa Riverbed”, as shown in Figure 6-25 for the exploratory borehole code 1973/010. Almost every year except 2007-08, the level of the water table received its maximum value.

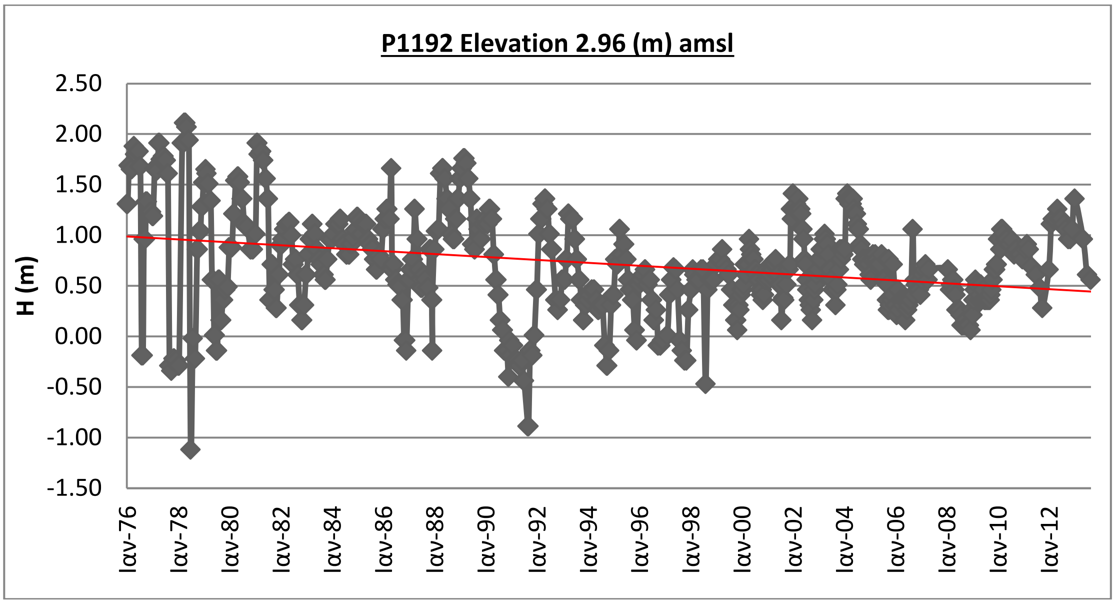

Figure 6-24: Diagram of the level of GWB CY-11A at borehole core P1192 at the mouth of r. Dhiarizos.

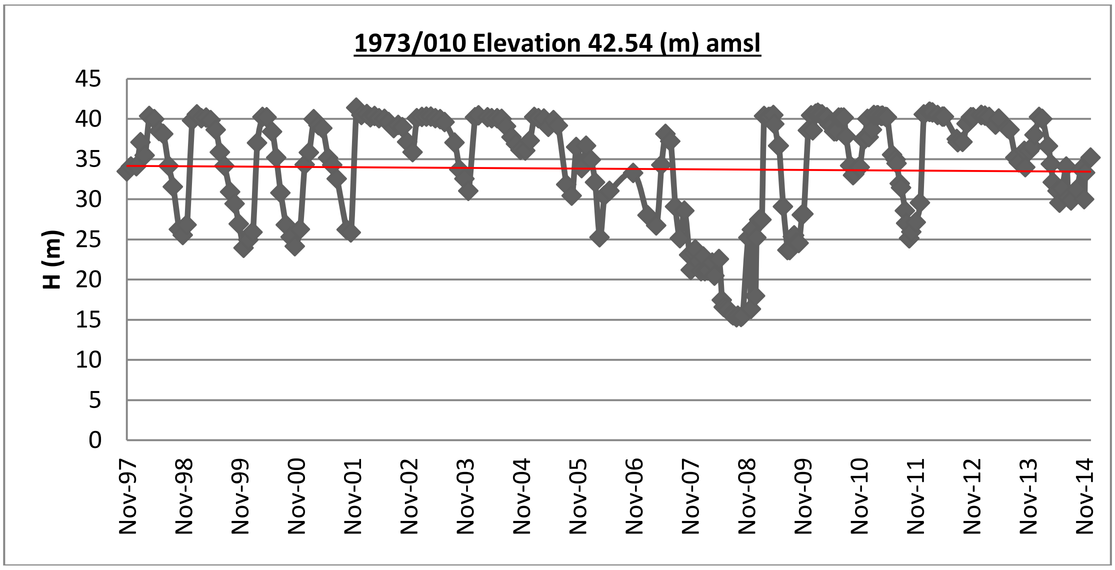

Figure 6-25: Diagram of the level of GWB CY-11B at borehole core P1973/010 at the mouth of r. Ezousa.

Figure 6-26: Summary map of the Paphos and Chrysochou Water System (the desalination plant is not in operation).

Table 6-77: Table of monthly inflows (in 1000m^3) at the Paphos project dams

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1970-71	4.9	193.3	400.3	551.3	4,148	3,667	5,707	993.9	256.0	85.0	19.6	8.7	16,034
1971-72	3.5	17.1	410.5	595.7	668.7	1,066	189.0	1,147	97.7	34.8	25.8	7.8	4,264
1972-73	165.8	10.1	3.1	195.8	579.4	355.5	197.4	73.2	16.2	0.0	0.0	0.0	1,596
1973-74	65.2	29.1	236.9	1,162	608.5	2,678	565.2	94.2	40.0	18.6	7.0	2.9	5,508
1974-75	0.7	111.4	1,798	8,795	19,426	8,065	2,631	1,852	275.2	74.6	30.2	16.7	43,075
1975-76	11.0	10.9	1,174	6,796	5,315	6,917	3,584	1,664	446.5	124.8	35.0	11.8	26,091
1976-77	384.8	913.2	1,658	4,804	2,185	4,693	3,406	1,129	280.5	100.1	14.0	10.1	19,578
1977-78	7.5	3.3	2,344	17,363	17,520	10,421	5,494	1,865	529.2	67.2	22.6	9.9	55,646
1978-79	9.4	15.6	2,048	4,118	3,482	2,041	528.6	156.7	500.3	38.9	10.6	3.6	12,953
1979-80	141.2	76.9	1,549	6,215	7,118	9,240	4,838	1,408	361.8	41.9	16.0	7.5	31,013
1980-81	116.4	33.7	41.5	8,032	11,812	5,875	3,318	1,049	216.0	41.4	20.6	10.9	30,566
1981-82	69.8	200.4	1,002	1,381	1,893	3,669	1,113	240.6	100.7	40.3	10.1	7.9	9,727
1982-83	75.4	36.4	110.6	1,052	3,181	6,013	3,094	1,185	301.1	49.0	18.6	8.4	15,125
1983-84	169.1	390.4	814.7	1,820	3,895	2,477	3,172	970.2	142.4	47.1	15.0	11.7	13,924
1984-85	76.2	704.2	611.1	3,996	6,106	2,725	1,472	262.6	109.7	43.0	12.9	7.1	16,126
1985-86	62.3	33.7	318.8	2,187	1,783	548.6	249.0	143.9	69.5	36.9	3.6	1.8	5,438
1986-87	66.3	26.3	623.9	3,765	1,855	17,365	3,988	1,536	241.4	64.4	17.7	5.8	29,553
1987-88	151.3	68.4	3,670	7,723	13,158	38,677	5,074	1,619	417.4	59.3	37.4	10.7	70,665
1988-89	131.0	331.4	10,041	13,123	2,823	1,865	862.3	398.7	48.6	16.4	12.1	7.6	29,659
1989-90	91.7	40.1	71.0	216.7	4,559	2,130	827.6	320.0	39.8	10.4	4.6	1.8	8,313
1990-91	65.7	20.4	24.0	178.8	245.3	278.3	213.0	48.0	16.9	7.6	2.1	0.0	1,100
1991-92	55.2	189.5	16,110	5,359	10,523	3,967	1,609	786.8	308.2	50.3	29.8	13.1	39,001
1992-93	97.2	227.8	6,718	4,222	4,702	9,073	1,552	801.6	303.8	37.0	13.3	2.5	27,750
1993-94	82.1	76.7	148.7	1,458	5,863	1,064	389.6	356.1	122.6	19.0	4.2	0.0	9,584
1994-95	139.3	2,910	1,531	6,643	3,022	1,466	584.0	503.6	364.8	16.4	4.1	1.0	17,186
1995-96	0.0	6.2	1.9	1,323	2,037	3,143	970.8	140.5	50.9	15.8	1.7	0.0	7,691
1996-97	208.1	41.8	527.2	51.1	1,372	260.3	1,919	149.6	128.7	3.5	0.8	0.1	4,662
1997-98	13.0	263.1	762.9	1,392	810.5	2,785	1,536	243.8	147.1	4.1	0.0	0.0	7,958
1998-99	0.0	182.1	3,726	3,644	8,861	2,554	3,534	410.3	47.6	14.6	5.7	3.2	22,983
1999-00	2.1	1.5	15.7	648.8	2,230	2,411	2,847	602.7	63.6	12.2	2.1	0.0	8,837
2000-01	0.0	337.8	480.7	1,575	5,712	1,375	537.7	158.3	29.4	7.0	0.4	0.0	10,213
2001-02	0.0	1.0	11,659	15,375	4,140	3,149	6,389	1,230	164.1	40.5	13.6	5.2	42,166
2002-03	1.1	3.0	2,368	2,748	13,796	10,871	3,647	777.8	318.2	23.6	2.7	0.0	34,555
2003-04	12.0	3.0	670.9	25,624	3,276	1,444	904.5	329.8	54.5	19.2	4.7	2.1	32,345
2004-05	0.0	54.9	375.6	493.7	2,504	3,535	1,797	1,034	65.8	3.2	0.0	0.0	9,862
2005-06	0.0	221.7	51.4	303.9	1,304	583.2	31.1	13.8	11.4	50.3	52.2	47.6	2,671
2006-07	1,336	403.2	24.2	215.3	2,253	934.2	344.0	1,253	44.8	45.1	59.0	37.3	6,948
2007-08	4.5	39.3	1,291.3	200.5	1,078	408.3	140.8	5.3	0.0	0.0	0.0	0.0	3,168
2008-09	0.0	0.0	840.7	3,032	8,140	7,592	2,422	1,052	126.6	2.5	0.0	0.0	23,209
2009-10	147.5	306.1	4,644	9,908	8,744	4,504	906.3	447.7	11.5	2.1	1.0	5.6	29,627
2010-11	3.8	0.8	248.4	858.3	2,342	4,489	1,720	693.8	71.9	4.3	2.8	22.8	10,458
2011-12	3.8	64.3	1,096	22,162	6,001	4,295	562.0	321.7	47.8	15.2	10.9	9.5	34,589
2012-13	83.2	330.8	10,652	2,341	2,009	1,352	1,204	597.4	16.3	0.0	0.0	0.0	18,586
2013-14	25.0	79.0	174.1	376.1	380.6	403.4	96.0	454.5	25.6	0.0	0.0	0.0	2,014
AVER.	91	201	2,083	4,562	4,781	4,573	1,935	692	158	32	13	7	19,127
ST. DEV.	205	455	3,519	5,891	4,540	6,260	1,724	535	146	29	14	9	15,382
C. V.	2.25	2.26	1.69	1.29	0.95	1.37	0.89	0.77	0.92				0.80

The table below (Table 6-78) presents the annual available surface water resources of the Paphos project from 2005-06 to date. For hydrological year 2013-14 there are no data from hydrometric stations, but they can be reasonably considered equal to zero, meaning that the available water resources are just 2 hm^3. Moreover, during the years 2005-06 and 2007-08, the corresponding values were equal to 2.98 and 3.27 hm^3 respectively, but during the wet periods the availability of surface water resources was extremely significant.

Table 6-78: Available surface water resources of the Paphos Project (in hm^3) in the past period from the year 2005 onwards.

	DAM INFLOWS TO PAPHOS DAMS	RUNOFF ON THE OUTLET OF DHIARIZOS R.	RUNOFF ON THE OUTLET OF EZOUSAS R.	TOTAL
2005-06	2.67	0.31	0.00	2.98
2006-07	6.95	1.68	0.00	8.63
2007-08	3.17	0.10	0.00	3.27
2008-09	23.21	1.33	3.67	28.21
2009-10	29.63	3.69	9.49	42.81
2010-11	10.46	0.10	1.31	11.87
2011-12	34.59	28.22	33.58	96.39
2012-13	18.59	15.78	10.92	45.29
2013-14	2.01	--------	-------	-------
AVER.	16.16	6.40	7.37	29.93
ST. DEV.	12.22	10.25	11.45	31.71
C. V.	0.76	1.60	1.55	1.06

Under the 1st RBMP, the data recorded by the WDD of Paphos regarding abstractions from the riverbeds of r. Dhiarizos and Ezousa from the calendar year 2000 to 2008 show that average annual abstraction from r. Dhiarizos per hydrological year (upstream of hydrometric station 1-2-7-90/Kouklia) is equal to 3.31 hm^3, of which 1.0 hm^3 originate from surface abstractions and the remaining 2.3 hm^3 from catching the hypodermic flow. Respectively at the mouth of r. Ezousa, an average of 3.9 hm^3 are pumped, of which 1.3 hm^3 originate from surface abstractions and the remaining 2.60 hm^3 from catching the hypodermic flow. However, these abstractions are widely dispersed from year to year to the point that no management practice becomes clear for these abstractions. In any case, the maximum abstraction potential is shown and can be considered to be equal to the actual abstraction in the year 2003-04, characterized by excellent aquifer conditions. For Dhiarizos, it seems that maximum abstractions are equal to 6.3 hm^3, while for Ezousa, 5 hm^3. Thefore, the average annual inflows of the three reservoir system (19 hm^3) can be added up to 11.3 hm^3. The challenge of course is whether the amount of 5 hm^3 will be available after the commissioning of the Kannaviou dam at the upstream basin of r. Ezousa. Abstraction from desalination plants is minimal and practically occurred only in 2011, when there was generally no water availability problem, while since 2012, the operation of the mobile desalination unit was interrupted. The table below (Table 6-79) shows the annual abstraction data from the Paphos project (surface and underground). Under normal hydrological conditions, annual abstractions vary around 23 hm^3, while in years of poor aquifer conditions (calendar year 2009), abstraction is equal to approximately 16 hm^3. During the dry season abstraction was significant, mainly due to the fact that the previous years were hydrologically rich.

Table 6-79: Abstraction data for the Paphos project (in hm^3).

	ABSTRACTIONS DAMS PAPHOS PROJECT	ABSTRACTIONS FROM PUMPING WELLS	PAPHOS DESALINATION	TOTAL
2009	9.81	6.07	--------	15.88
2010	12.72	8.00	0.09	20.81
2011	13.05	6.50	2.11	21.66
2012	15.03	7.51	-------	22.54
2013	17.26	7.00	-------	24.26
2014	17.58	6.47	------	24.05
AVER.	14.24	6.92	0.37	21.53
ST. DEV.	2.97	0.72	0.85	3.07
C. V.	0.21	0.10	2.33	0.14

The following table (Table 6-80) presents abstraction for every use, including water supply (along with tourism), irrigation (with stock breeding) and recharge of underground aquifers. It seems that the abstractions for water supply and irrigation are divided indicating the decreasing use in agriculture and increasing use in water supply and tourism.

Table 6-80: Abstraction for irrigation, water supply and recharge of the Paphos Project (in hm^3)

	ABSTRACTIONS WATER SUPPLY	ABSTRACTIONS IRRIGATION	ABSTRACTIONS RECHARGE	TOTAL
2009	9.200	6.390	0.290	15.88
2010	10.347	10.494	0.728	20.81
2011	10.344	10.300	1.016	21.66
2012	10.332	12.205	0.000	22.54
2013	11.283	12.789	0.192	24.26
2014	11.918	12.133	0.000	24.05
AVER.	10.57	10.72	0.37	21.53

The following table (Table 6-81) shows storage at the Paphos project dams, where we can observe that the smallest storage occurred in hydrological year 2008-09 with just 3 hm^3, although the stored volume of the Kannaviou dam, which was just launching its operation, is not included. During the last dry season (i.e. hydrological year 2013-14), storage was large due to large storage in the previous two, extremely wet, years, when the maximum storage of the system was achieved. The Asprokremmos reservoir overflowed during the years 2012 and 2013, well as the Kannaviou dam did in the same years.

Table 6-81: Stored volume (in hm³) at the Paphos project dams at the beginning of each month.

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1994-95	32.0	30.7	31.9	32.7	37.4	39.3	40.2	40.0	39.2	37.8	35.7	33.1
1995-96	30.9	28.8	28.1	27.4	28.5	30.8	33.4	33.7	32.3	30.0	27.3	24.3
1996-97	21.4	20.3	19.0	19.3	19.3	20.4	20.3	21.6	20.6	19.2	17.2	15.4
1997-98	14.0	13.0	12.8	13.6	14.7	15.2	17.3	17.9	16.9	15.7	13.8	11.8
1998-99	10.1	8.8	8.3	11.0	14.0	20.9	22.6	24.5	23.3	21.7	19.2	16.7
1999-00	14.5	12.9	11.8	11.2	11.5	12.9	14.4	15.8	15.2	13.7	11.8	9.9
2000-01	8.2	6.8	6.1	6.3	7.3	11.7	12.4	12.6	12.0	10.9	9.0	7.0
2001-02	4.9	3.2	2.9	11.9	24.2	27.3	29.5	34.0	34.2	32.8	30.6	27.7
2002-03	25.7	24.2	23.4	24.8	26.7	37.0	44.7	46.8	45.9	44.6	41.9	38.8
2003-04	36.3	34.8	33.9	34.1	53.9	54.5	54.5	53.9	52.5	50.7	47.8	44.8
2004-05	42.2	40.3	39.5	39.3	40.4	43.6	44.6	44.7	43.2	41.1	38.6	36.0
2005-06	33.6	31.8	31.2	30.5	30.4	31.2	31.4	30.7	29.2	26.8	24.1	21.1
2006-07	18.2	17.8	17.6	16.9	16.6	18.6	18.8	18.2	18.2	16.5	14.4	12.3
2007-08	10.2	8.4	7.5	8.2	7.8	8.4	8.2	7.8	7.3	6.5	5.6	4.7
2008-09	4.0	3.3	2.7	7.9	11.4	21.8	31.9	34.6	34.9	33.6	31.6	29.5
2009-10	27.7	26.1	25.8	32.7	43.3	54.0	57.1	57.2	56.3	54.4	51.9	49.3
2010-11	47.1	45.1	43.9	44.1	45.5	49.3	55.5	57.1	56.4	54.5	51.9	49.1
2011-12	46.7	44.3	43.2	43.8	71.1	71.6	71.7	71.5	71.0	69.3	66.5	63.5
2012-13	60.9	59.3	59.0	71.4	71.5	71.6	71.5	71.5	70.7	68.5	65.8	62.7
2013-14	60.0	57.9	56.5	55.7	55.4	55.0	54.5	53.3	52.4	50.2	47.5	44.5
MAXIMUM	60.9	59.3	59.0	71.4	71.5	71.6	71.7	71.5	71.0	69.3	66.5	63.5
MINIMUM	4.0	3.2	2.7	6.3	7.3	8.4	8.2	7.8	7.3	6.5	5.6	4.7
AVER.	27.4	25.9	25.2	27.1	31.5	34.8	36.7	37.4	36.6	34.9	32.6	30.1

Figure 6-27: Diagram of annual inflows in the Paphos project.

6.6.3 SUGGESTED DECISION-MAKING PROCEDURE TO SCHEDULE ABSTRACTIONS

Pursuant to the Management Plan of the 1st RBMP, the abstraction policy was devised based on the storage of the Paphos project dams on 1st April. The following table (Table 6-82) presents water abstractions from the reservoirs of the Project in connection to the available storage on the 1st April of the current year, depending on the designation of the sufficiency with respect to the available storage and the relevant action, by scheduling possible cuts in supply (mainly to irrigation) and determining their magnitude.

Table 6-82: Suggested Decision-Making Policy with respect to the Paphos Project Storage Capacity Index in the 1st RBMP

STORAGE ON 1st APRIL	CATEGORY CLASSIFICATION	ANNUAL ABSTRACTIONS	ACTION CLASSIFICATION
> 40 hm^3	SUFFICIENCY	18 hm^3	ZERO CUTS
40 hm^3 > & <25 hm^3	MINOR DEFICITS	14 hm^3	MINOR CUTS
25 hm^3 > & <15 hm^3	MODERATE DEFICITS	10 hm^3	MODERATE CUTS
15 hm^3 > & <10 hm^3	SEVERE DEFICITS	7 hm^3	SIGNIFICANT CUTS
< 10 hm^3	EXTREME DEFICITS	4 hm^3	VERY SIGNIFICANT CUTS

The tables below (Table 6-83 and Table 6-84) provide a forecast of the probability of cuts at the beginning of the irrigation season starting with storage at the Paphos project dams on 1 October and an update of the forecast on 1 January.

Table 6-83: Forecast of the probability of cuts at the beginning of the irrigation season starting with storage at the Paphos project dams on 1st October and an update of the forecast on 1st January.

Total Storage (V) on Dams on 1st October (in hm^3)	Forecast of Cuts Decision on 1st April
V > 40 hm^3	75% probability of zero cuts, 25% minor
40 hm^3 > V > 20 hm^3	60% probability of zero or minor cuts, 40% probability moderate or siginificant
20 hm^3 > V > 10 hm^3	35% probability of zero or minor cuts, 65% probability of moderate, significant or very significant cuts
V < 10 hm^3	Almost certain cuts but 50% probability for very significant cuts.

Table 6-84: Forecast of the probability of cuts at the beginning of the irrigation season starting with storage at the Paphos project dams on 1st January.

Total Storage (V) on Dams on 1st January (in hm^3)	Forecast of Cuts Decision on 1st April
$V > 40\ hm^3$	67% probability of zero cuts, 33% minor
$40\ hm^3 > V > 20\ hm^3$	55% probability of zero or minor cuts, 45% probability moderate or siginificant
$20\ hm^3 > V > 10\ hm^3$	Almost certain cuts but 50% probability for minor cuts.
$V < 10\ hm^3$	Certain Significant Cuts with 70% probability very significant and 30% probability significant.

6.6.4 ASSESSMENT OF THE DROUGHT MANAGEMENT PLAN IMPLEMENTATION

During the dry hydrological year 2013-14, annual abstractions from the Paphos Project dams were equal to 17.6 hm^3. Based on the storage on 1st April 2014, which was equal to 54.8 hm^3 and based on the data of the relevant table (Table 6-82), the system is classified as "sufficient" and therefore, the system's performance should be 18 hm^3 of water. Thus, it seams that although there were zero abstractions from the desalination of Paphos, due to the downtime of the mobile unit, abstractions from the dams followed the1 st Drought Management Plan and were in fact lower. Even though the year 2013-14 was dry, the previous wet years placed both dams (Asprokremmos and Kannaviou) in overflow regime, making possible to implement the Management Plan to the next dry year, with zero desalination. The Paphos desalination plant should nonetheless be installed and operate, based on the proposals regarding desalination operation for all periods (see Table 6-98).

6.6.5 REVISION OF THE MANAGEMENT PLAN DUE TO THE REDUCED CAPACITY OF THE PAPHOS DESALINATION PLANT

Although irrigation demand has decreased significantly, there is a increase in demand for water supply. Based on data of the WDD Paphos District office, irrigation demand ranges around 14 hm^3 per year. However, consumption in 2009 was limited to 6.4 hm^3 and in 2013 to 12.8 hm^3. Information by the WDD forecasts that irrigation in the reference year 2021 will be equal to approximately 14.2 hm^3, including stock breeding and golf court irrigation. Note that based on a Decision of the Cyprus Government, the WDD is required to supply private golf facilities through the water networks, at the price of desalinated water.

Water supply demand from the Paphos water project amounts to 7.5 hm^3, although the Kannaviou dam will also supply the mountain communities of Paphos with a separate pipeline.

Their annual irrigation and water supply demands have been estimated by the Paphos District WDD at 1.5 hm³ and 1.0 hm³ respectively. Water demand from the Paphos project, as formulated in the next few years, should be estimated in the range of 11.82 hm³ for the reference year 2021.

Additional water sources are (a) the desalination plant, once it is built and (b) reuse of recycled water. As already mentioned, only one desalination facility is promoted in the Paphos areas, of a rated capacity of 15,000 m³ per day on drought periods, while for normal hydrological conditions of lower alert level, the desalination plant shall be considered to operate according to the Management Plan. Desalination can provide up to 4.93 hm³ of water every year, exclusively directed at water supply. Moreover, water supply may be attributed a yearly average of up to 4.3 hm³ from groundwater at the mouth of r. Ezousa and Shiarizos, based on WDD information. Therefore, water supply can receive 4.3+4.9=9.2 hm³ of water and only 2.6 hm³ remain to be provided by dams. This quantity seems to be covered even marginally based on the dam inflows in the relevant table (Table 6-78) and from reserves from previous years. It would possibly be preferable to increase the capacity of the Paphos desalination plant.

Moreover, the outflow requirements from the environment should be taken into account; for the Kannaviou dam, they are estimated at 200,000 m³ per year, varying per month based on the variation of the time series and for the Asprokremmos dam at 300,000 m³ . As regards the environmental flows downstream of the Mavrokolympos dam, they were set at zero, while for the Asprokremmos dam, a targeted average quantity is provided (depending on the reserve in the Paphos project dams) to preserve the downstream ecosystem, set annually in the Strategic Environmental Assessment Study (SEAS) at 300 000 m³.

The table below (Table 6-85) shows a brief analysis of the operation of the Paphos desalination plant in a drought period, when the plant will be working at maximum capacity and the requirement for extra water from dams or groundwater.

Table 6-85: Analysis of annual abstractions in periods of drought for water supply of the Paphos project.

Water Supply Demand		11,820,000		m³/Year	
Desalination potential during drought		15,000		m³/day	
Exploitation Potential Percentage		90%			
Month	Percentage of Monthly Demand	Monthly Demand	Numb. Days.	Desalinated Water Production	Demand from dams and groundwater
		(m³)		(m³)	(m³)
10	1.13	1,113,050	31	418,500	694,550
11	0.95	935,750	30	405,000	530,750
12	0.87	856,950	31	418,500	438,450
1	0.89	876,650	31	418,500	458,150

2	0.75	738,750	28	378,000	360,750
3	0.86	847,100	31	418,500	428,600
4	0.95	935,750	30	405,000	530,750
5	0.98	965,300	31	418,500	546,800
6	1.12	1,103,200	30	405,000	698,200
7	1.19	1,172,150	31	418,500	753,650
8	1.21	1,191,850	31	418,500	773,350
9	1.11	1,093,350	30	405,000	688,350
	TOTAL:	**11,820,000**	**365**	**4,927,500**	**6,902,350**

Use of recycled water is particularly important, as it appears that it is possible to use up to 4.95 hm^3 of water for irrigation until the reference year 2021. Therefore, in times of drought it will not be possible to cover the extra 9.3 hm^3 required by irrigation.

As part of the revision of the Drought Plan, it was considered appropriate to slightly review the relevant table (Table 6-82), maintaining the threshold of storage on 1st April, due to the fact that the Paphos desalination facility will be of reduced capacity in relation to what was originally scheduled (i.e. a rated capacity 15,000 m^3, instead of 30,000 m^3 per day) and modifying the environmental flows. This modification is shown in the table below (Table 6-86). Respectively, the water demands for water supply and irrigation and the contribution of recycled water to irrigation shall be reviewed accordingly.

Table 6-86: Reviewed table of the suggested Abstraction Policy with respect to the Paphos Project Storage Capacity Index on 1st April

Storage on 1st April *V* (hm^3)	Category Classification	Annual Abstractions (hm^3)	Action Classification
V > 40	Sufficiency	17	Without Cuts
40 > V > 25	Minor Deficits	14	Minor Cuts (15% in irrigation)
25 > V > 15	Moderate Deficits	10	Moderate Cuts (30% in irrigation)
15 > V > 10	Severe Deficits	7	Significant Cuts (50% in irrigation)
V < 10	Extreme Deficits	4	Very Significant Cuts (more than 50%)

Based on the table above (Table 6-86), the table of target-abstractions is drawn up based on storage on 1st April. Abstractions aim at fully meeting demand in water supply with the lowest possible operation of desalination plants for economic reasons and in order to only have shortage in irrigation. Given that permanent plantations in the Paphos area (Annex VII of the 1st RBMP) constitute 83.3% of the total, it becomes clear that with the exception of the category "Moderate Shortage", permanent plantations will also suffer.

Table 6-87: Target-abstractions under the proposed abstraction policy.

Storage on 1st April *V* (hm³)	TARGET ABSTRACTIONS (m³)		
	WATER SUPPLY	IRRIGATION	DESALINATION
V > 40	7,483,134	9,281,845	0
40 > V > 25	6,110,432	7,889,568	1,372,702
25 > V > 15	3,502,709	6,497,292	3,980,426
15 > V > 10	2,544,714	4,455,286	4,927,500
V < 10	2,550,000	1,450,000	4,927,500

Based on the above data, a simple balance model was designed, where the tow reservoirs (Asprokremmos and Mavrokolympos) are grouped into one and the Kannaviou reservoir enhances the grouped system at the Asprokremmos refinery with a flow equal to the flow capacity of the Ezousa Pipeline (300 L/s), provided storage at the Kannaviou reservoir exceeds 7 hm^3. The model uses the following assumptions:

- Total water demand from the Asprokremmos-Mavrokolympos project introduced in the model amounts to: 14,231,845 m^3 for irrigation and 11,823,134 m^3 fro water supply, i.e. total of 26,054,979 m^3 per year (WDD data).
- Desalination quantities cover exclusively water supply. As mentioned above, its daily rated capacity reaches 15,000 m^3 in drought periods. Desalination was defined with a 90% performance coefficient.
- Part of water supply is covered by boreholes in the estuary area of the Ezousa - Dhiarizos system, with an average annual abstraction estimated at approximately 4.3 hm^3 (WDD data).
- The quantities of recycled water are exclusively directed to irrigation, after recharging the area of the alluvial deposits of the mouth of r. Ezousa and then they are pumped. Recycled water (based on WDD estimates) shall be introduced with an annual amount of 4,950,000 m^3 in the reference year 2021.
- In drought periods, abstractions from the dams are directed towards environmental preservation as a first priority and then towards irrigation.
- Environmental flows downstream of the Mavrokolympos dam are set to zero, while for the Kannaviou dam, they average annually at 200,000 m^3, with monthly fluctuations. (complemented by a decrease of downstream abstractions by300 000 m^3). The above amount is distributed on a yearly basis depending on the capacity of the reservoir on 1st April of each year. When storage on 1st April is equal to the average historical storage for the same month, then the environmental flow is assigned the full amount. If storage is larger or smaller than this value then environmental flows are given proportionately higher or lower for the year to come, considering a simple proportional relationship between the observed average storage and actual storage on 1st April. For the same

amount of environmental flow, extra desalination will be performed by the Paphos plant, when it is not operate at maximum capacity. We consider that these quantities of additional desalination (due to the recharge of the environmental flow of Kannaviou) will be small and therefore, to simplify calculations, we consider extra quantities of desalination to be null.

- The SEAS mentions an average environmental flow downstream of Asprokremmos dam at 300,000 m^3, when storage on 1st April equals the historic average storage for the given month.
- The minimum storage for environmental reasons for Asprokremmos Mavrokolympos dams is set at 5.0 hm^3 and 1.0 hm^3 respectively, as implied in the 1st Drought plan. For the Kannaviou dam, minimum storage for environmental reasons is set at 1.0 hm^3.
- The Kannaviou dam contributes indirectly with water amounts joining the Asprokremmos - Mavrokolympos system through the Ezousa pipeline, at a 300 L/s rate, provided storage at Kannaviou reservoir exceeds 7 hm^3.
- The Kannaviou dam, before the diversion of part of its water to the Asprokremmos refinery, must satisfy annual water demands for irrigation and water and water supply amounting to 2.5 hm^3, according to WDD data. These amounts are not part of demand from the Paphos project and form discrete quantities.
- Any water quantities from the Kannaviou dam to Asprokremmos refinery larger than demand in water supply, shall overflow and be stored in the Asprokremmos reservoir.
- The 1st Drought Plan states (in page 81) that *"... the condition set for minimum storage of 5 hm^3 at the end of drought was controlled for any case*". Therefore, our model uses as the minimum volume for the interruption of water supply 5.0 hm^3 for the Asprokremmos-Mavrokolympos system and 1.0 hm^3 for Kannaviou reservoir.

The function of the model is: First, amounts allocated to abstraction from groundwater and recycled water are subtracted from total demands on water supply and irrigation respectively. The amounts remaining to meet demand are due from the reservoirs and desalination. Desalination is planned based on the value of storage on 1st April of a given year. First, the water balance of Kannaviou dam is calculated based on a demand of 2.50 hm^3 for direct water supply, the environmental flow of 0.2 hm^3 per year and finally the enhancement of the Asprokremmos refinery, provided storage at Kannaviou reservoir exceeds 7 hm^3. When flows to the Asprokremmos refinery exceed demand in water supply, the excess is diverted and stored in the Asprokremmos dam.

The table below (Table 6-88) presents the summary water balance for the Paphos project, showing (given that abstraction from recycled water amounts to 5.0 hm^3 per year) that the requirement for water abstraction dem dams amounts to a maximum of 11.8 hm^3, including the enhancement in water supply by the Kannaviou dam (with the limiting factor of the storage volume of 7 hm^3 to supplement the Asprokremmos refinery). In the "no alert" period, where desalination is virtually zero, the necessary abstraction from dams, without any shortage, amounts to 17.3 hm^3, including the environmental flow, or 16.7 hm^3 without it. Thus, it seems that the limit of full sufficiency from dams is now lower than in the 1st RBMP by about 1 hm^3 (since actual average annual abstractions for ecological flows are less than 0.5 hm^3) and now, the sufficiency threshold for storage on 1st April is set at 17 hm^3.

Table 6-88: Summary Water Balance of the Paphos project for the reference year 2021

WATER BUDGET PARAMETERS	VOLUMES (in m^3)
IRRIGATION DEMANDS	14,231,845
WATER SUPPLY DEMANDS	11,823,134
TOTAL DEMANDS	26,054,979
DESALINATION (in case of drought)	4,927,500
RECLAIMED WATER	4,950,000
GROUNDWATER FOR WATER SUPPLY	4,340,000
MINIMUM WATER DEMAND FROM DAMS FOR WATER SUPPLY (with maximum desalination potential)	2,555,634
DAMS WATER DEMAND FOR IRRIGATION	9,281,845
DEMANDED WATER FOR ENVIRONMENTAL FLOW[6]	500,000
TOTAL DEMANDED WATER FROM DAMS (for water supply and irrigation) (with maximum desalination potential)	11,837,479
TOTAL DEMANDED WATER FROM DAMS (for water supply and irrigation and environmental flow) (with maximum desalination potential)	12,337,479
TOTAL DEMANDED WATER FROM DAMS (for water supply and irrigation) (without desalination potential)	16,764,979
TOTAL DEMANDED WATER FROM DAMS AND DESALINATION (without desalination potential)	17,264,979

The application of the model with historical inflows in the three dams from 1971-72 up to 2013-14 (includes 44 calendar years) calculates storage on 1st April of every year. Depending on the stored volume on 1st April, the relevant tables provide calculations for abstractions from dams for water supply and irrigation and respectively desalination for water supply. Shortage in water supply is assumed to be zero and any deficits occurring should only concern irrigation. The following table (Table 6-89) presents the frequency of occurrence of storage on 1st April for each critical storage interval. For the zero desalination scenario of the period without alert (Table 6-89), as reported in the Action Programme of the Drought Plan (Table 6-64), it appears that in about 41% of the simulation years, storage in dams would exceed 40 hm^3, thus preventing the occurrence of shortage. 9% of the year will present shortage in irrigation above 50%.

[6] The value of the ecological flow is a guide provided when the stored volume in dams is equal to the mean of the sample for the storage on April 1. Therefore it may be analog or greater (if the stock on 1 April of a given month) is greater than the average price or less respectively.

Table 6-89: Water balance simulation results (volumes in hm^3).

STORAGE ON 1st APRIL	ESTIMATED RECURRENCE FREQUENCY	CATEGORY CLASSIFICATION	ALLOWED ANNUAL ABSTRACTIONS	ACTION CLASSIFICATION	IRRIGATION FROM DAMS	WATER SUPPLY FROM DAMS	WATER SUPPLY FROM DESALINATION
> 40 hm^3	40.9%	SUFFICIENCY	17 hm^3	ZERO CUTS	9.2	7.5	0
40 hm^3 > & <25 hm^3	22.7%	MINOR DEFICITS	14 hm^3	MINOR CUTS (15% in irrigation)	7.8	6.2	1.3
25 hm^3 > & <15 hm^3	9.1%	MODERATE DEFICITS	10 hm^3	MODERATE CUTS (30% in irrigation)	6.4	3.6	3.9
15 hm^3 > & <10 hm^3	18.2%	SEVERE DEFICITS	7 hm^3	SIGNIFICANT CUTS (~50% in irrigation)	4.5	2.5	5
< 10 hm^3	9.1%	EXTREME DEFICITS	4 hm^3	VERY SIGNIFICANT CUTS (more than 50%)	1.5	2.5	5

The table below (Table 6-90) presents the average, maximum and minimum values for the following parameters: (a) Annual abstraction from dams, including ecological flow, (b) Annual inflow in dams, (c) annual shortage in absolute values and (d) inflows from desalination.

Table 6-90: Summary results from the application of the water balance model at the Paphos project.

	ANNUAL ABSTRACTIONS FROM DAMS (m^3)	ANNUAL INFLOWS TO DAMS (m^3)	ANNUAL DEFICIT (m^3)	DESALINATION (m^3)
AVERAGE	12,724,373	20,209,547	1,933,895	1,839,904
MAXIMUM	17,206,670	68,763,224	7,837,479	4,927,500
MINIMUM	1,003,676	1,999,340	0	0

Table 6-91: Correlation of abstraction from dams in relation to storage on 1st April each year.

	ANNUAL ABSTRACTIONS FROM DAMS (m^3)	STORAGE 1^H APRIL (m^3)
AVERAGE	12,724,373	33,876,709
MAXIMUM	17,206,670	70,376,082
MINIMUM	1,003,676	7,989,120

Figure 6-28 presents the chart of annual values for the parameters of the water balance, showing inflows at the Asprokremmos, Mavrokolympos and Kannaviou dams, storage on 1 April of the current year and annual abstractions. The dramatic reduction of desalinated water in years where water storage exceeds a specific limit is aimed at optimising the operation of water resources and using as much as possible stored water for water supply. Besides, Cyprus's desalination plant operation contract provides for the reduction of production to a minimum during periods when the dam filling is at its fullest.

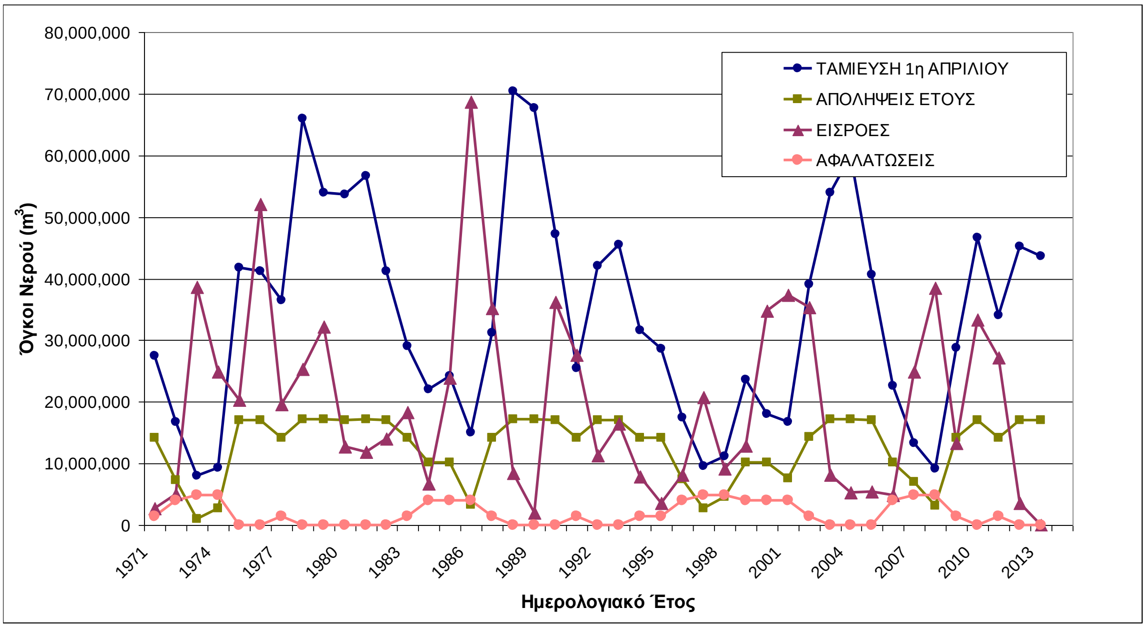

Figure 6-28: Diagram of annual parameters of the water balance of the Paphos project.

The revision of the relevant table of abstraction policy, with respect to storage on 1st April (Table 6-82) is shown in the table below (Table 6-92). Total demands for water supply and irrigation are equal to about 26 hm^3 (for the reference year 2020-21) and therefore, the approximate 17 hm^3 are due from the Paphos project dams, with a minimal operation of desalination plants. Hence, the amount of 17 hm^3 shows complete sufficiency in water resources.

Table 6-92: Suggested Decision-Making Policy with respect to the Paphos Project Storage Capacity Index in the 2st RBMP

Storage on 1st April *V* (hm^3)	Category Classification	Annual Abstractions (hm^3)	Action Classification
V > 40	Sufficiency	17	Without Cuts
40 > V > 25	Minor Deficits	14	Minor Cuts (15% in irrigation)
25 > V > 15	Moderate Deficits	10	Moderate Cuts (30% in irrigation)
15 > V > 10	Severe Deficits	7	Significant Cuts (50% in irrigation)
V < 10	Extreme Deficits	4	Very Significant Cuts (more than 50%)

6.7 DROUGHT MANAGEMENT AT THE CHRYSOCHOU PROJECT

6.7.1 INTRODUCTION

The Chrysochou irrigation project includes an irrigation network in a total area of 3100 ha, of which 2000 ha belong to the Chrysochou valley and the remaining 1100 ha in the coastal zone from Argaka to Pomos. To cover these needs, the following dams have been constructed:

- Evretou dam on r. Stavros tis Psokas with a usable capacity of 24 hm^3.
- Argaka dam on r. Makounta with a usable capacity of 1 hm^3.
- Agia Marina dam or r. Xeros with a usable capacity of 0.3 hm^3.
- Pomos dam on r. Livadi with a usable capacity of 0.9 hm^3.

The central coastal pipeline of the Chrysochou project has been built from the Evretou dam to the Pomos dam, concentrating all runoff from different points of abstraction. Amounts of water from the Evretou dam directly enhance irrigation networks supplied by the Argaka, Pomos and Agia Marina dams. The total storage capacity of the Chrysochou project amounts to 26.2 hm^3. The following diversions have also been completed: on s. Makounta (upstream of the Argaka dam) at the location Agios Merkourios (Agios Merkourios weir), on r. Gialia at the location Kambos Aspris Mersinias (very close to hydrometric station code 2-3-8-60) and on r. Livadi at the location Livadi, upstream of the Pomos dam. The above diversions, will carry winter runoff through the same pipeline (approximately 5 hm^3 per year) to the Evretou dam, as the elevation of all three diversion allows transfer by gravity of water and storage in the Evretou dam. To sum up, there is a total of seven water sources.

The most significant prolonged droughts for Hydrologic Region 2 (comprising the Chrysochou project) are (a) from 1971 to 1974, (b) from 1996 to 2001 and (c) from 2005 to 2009. Also, the last dry hydrological year 2013-14 was recorded as prolonged drought because of the Hydrological Year Runoff Index.

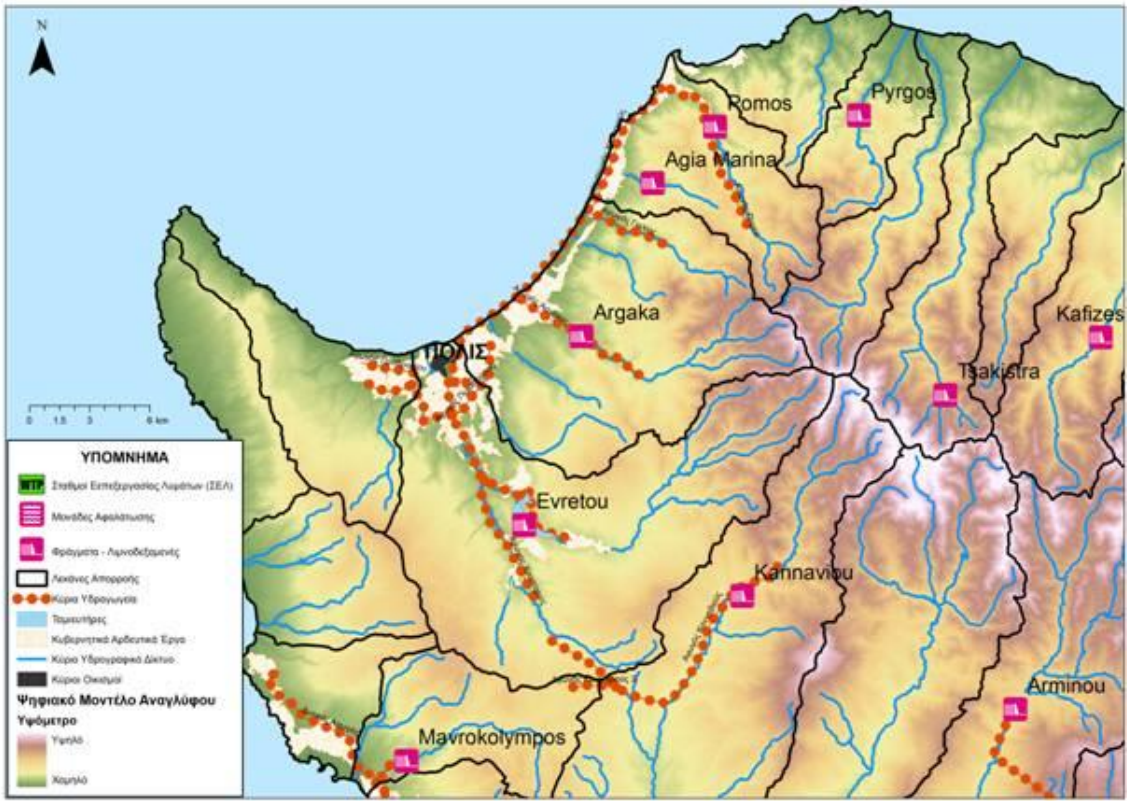

Figure 6-29: Cartographic presentation of Chrysochou Project

6.7.2 CURRENT STATUS

Irrigation is the largest demand component, while water supply, including tourism, has a share in demand, which is significantly smaller. Based on Issue VII of the 1st RBMP, annual water demand for irrigation in the Chrysochou Irrigation Project area amounts to 5 hm^3. As mentioned above, although the Evretou dam operates in the south of the region and a little further upstream the dams of Ag. Marina, Pomos and Argaka, supplying the government irrigation project of Chrysochou, water is pumped to cover irrigation demand, especially in years drier than average. In general for the Chrysochou are, agricultural activity has decreased due to a significant increase of tourist use (hotels and holiday houses). In this sense, stress of irrigation on water resources seems to tend todecrease to levels of 2.0 hm^3 per year, while the water supply use increases. It is also characteristic that the mean annual abstraction from all water sources for the years 1997 to 2014 is equal to 5.34 hm^3, of which 3.44 hm^3n originate from the Evretou dam. If one compares the above value in relation to the secured yield of the dam, based on the project design, amounting to 12.5 hm^3, the overestimation of inflows in the project design is manifest. The diversion of s. Makounta upstream of Argaka dam at the location Agios Merkourios, was built in the early 1990s and diversions began in 1994, while the diversion of s. Gialia came much later and only in the winter of 2009 was it possible to divert part of the runoff to the Evretou reservoir.

Unfortunately, the Evretou dam does not concentrate the expected runoff on the basis of the project design. As shown in table (Table 6-93), the inflow estimate for the dam is much greater than estimated. The Pomos, Agia Marina and Argaka dams often overflow, when abstractions of part of the water potential are carried out upstream of the dams, to reduce overflows in the sea and store the quantities in the Evretou reservoir, which has now an almost unlimited adjustment capacity. However, although the actual inflows are much lower than those expected, the Evertou dam overflowed in March-April 2012 and January-March 2013, due to supplements by the three diversions.

The Argaka dam overflowed in the years 1996, 1999, 2000, 2002, 2003, 2004, 2009, 2010, 2011, 2012 and 2013. The Pomos dam overflowed in the years 1999, 2000, 2001, 2002, 2003, 2004, 2009, 2010, 2011, 2012 and 2013. The Agia Marina dam overflowed in the years 2002, 2003, 2004, 2010, 2012 and 2013. It appears that although abstractions are conducted from diversions upstream of the three dams, in wet years the dams still overflow. This demonstrates that in the wet period, the volume of water that could be transferred for storage to Evretou dam could increase.

Table 6-93: Comparison of inflow estimates at the Chrysochou project dams

Dam	Design Study Estimation (hm^3)	Present Study Estimation (hm^3)	FAO estimation (hm^3)	Diffrerence
Evretou	12	6.4	6.4	-56%
Pomos	5.0	3.6	3.4	-28%
Argaka	8.5	2.7	2.6	-68%

6.7.3 HYDROGEOLOGICAL CONDITIONS

The Chrysochou project perimeter extends to the groundwater bodies Chrysochou-Gialia (CY_15-A) and Chrysochou River (CY_15-B), Letymbou-Giolou (CY_12) and Androlikou (CY_14).

The coastal aquifer **Chrysochou-Gialia (CY_15-A)** evolves mainly in Pleistocene fanglomerates and terrace deposits. A volume of 0.70 hm^3 is estimated to be pumped from this aquifer for water supply. This is why this aquifer is particularly important. It consists of gravel, silt and sandstone with intermediate marl layers. The riverbed consists of alluvial deposits, sand and silt. Downstream areas and in particular delta regions are comprised of low permeability silty clay lenses and silty zones often occur. The southwestern part of the impervious base of the aquifer consists mainly of Pliocene (Nicosia formation) and chalky marl. The northwestern part of the aquifer base consist of igneous rocks. lava and diabases. The average thickness of the aquifer is reported to be 20 to 30 m. The data of the Geological Survey Department show that it exceeds 50 m locally. Level data (Figure 6-30) show a gradual lowering of the level, which is easily recovered in wet periods. High concentrations of sulphate in part of the alluvial aquifer are attributed to the contribution of Letymbou-Giolou gypsum, while the waterfront has penetrated the coastal areas. Analysis of recent monitoring data showed excesses of chlorides, nitrates and sulphates (due to natural charges), while the electrical conductivity is increased. Moreover, previous studies have reported elevated boron concentrations (in the east-west Argaka-Limni faul zone), attributed to geological reasons. Therefore the state of the body is considered "poor".

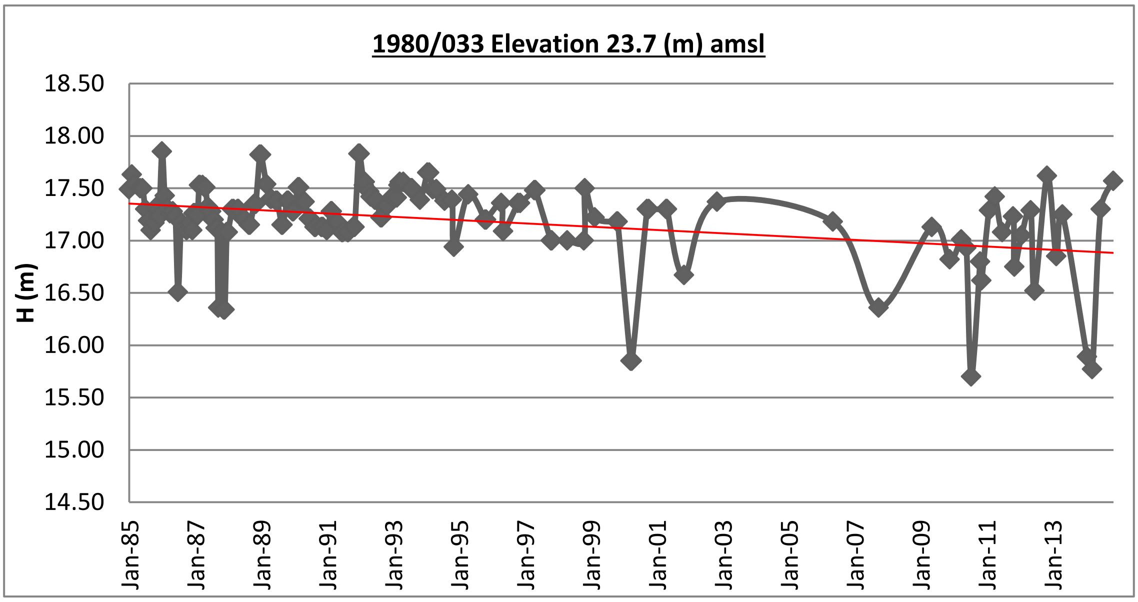

Figure 6-30: Diagram of the level of GWB Chrysochou (CY_15-A) at borehole code 1980/033

The alluvial aquifer of the **river Chrysochou (CY_15-B)** is reported at a better state thanks to direct inflows through filtrations from the flow of r. Chrysochou. Annual abstractions are estimated at 1.30 hm^3 for irrigation. Figure 6-31 presents the level diagram with Borehole code 1965/144, with the level in a continuous upward trend.

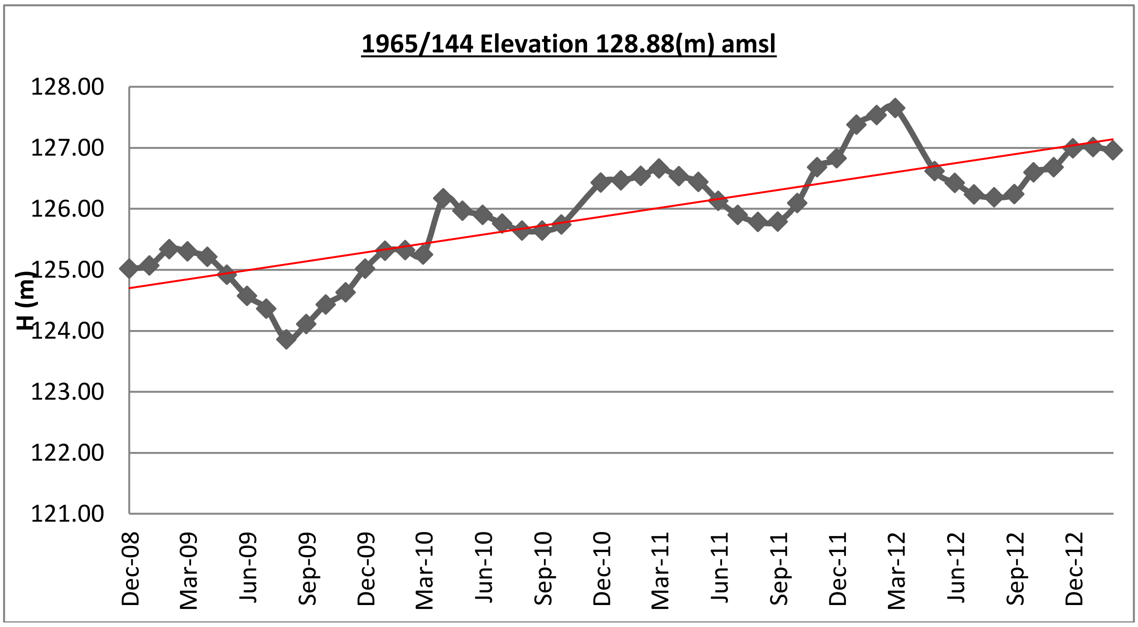

Figure 6-31: Diagram of the level of GWB Chrysochou (CY_15-B) at borehole code 1965/144

The groundwater body of **Androlikou (CY_14)** consists of a partially stressed coastal aquifer developed in karstic coral limestone. The estimated annual abstraction from the GWB is around 0.7 hm^3 water. There is hydraulic connection and water exchange with the sea at the northern boundary of the aquifer. Impermeable marl transform it into a “stressed” aquifer at its northern and eastern part. At its eastern boundary the aquifer is in contact with the sediment of the Chrysochous trench, along a fault of N-S orientation. It is estimated that the aquifer is hydraulically connected with the limestone aquifer of Kritou Terra - Arodes, through a limestone corridor at the southeastern boundary. The aquifer boundaries, the hydraulic connections and groundwater interchange with the surrounding aquifers are not yet defined. The main water supply source of the aquifer is rainfall. The discharges of the aquifer are made partly through fountains (Loutra tis Afroditis). The impermeable bedrock of the aquifer comprises mainly of the clays of the Mamonia formation. The karstic coral limestone are part of a Lower Miocene section (Pachna formation) known as the *Terra* limestone. The western part of the aquifer, in the area of Loutra tis Afroditis, is covered by Middle Miocene (Pachna formation) chalks, sandy marls and marls. The roof of the stressed part aquifer along the coastal zone and the eastern boundary consists of Plio-Pleistocene marl and sandy marl of the Nicosia formations and terrace deposits. The GWB level chart is shown in Figure 6-32, where in recent years there is an upward trend of the level due to the high aquifer conditions in recent years.

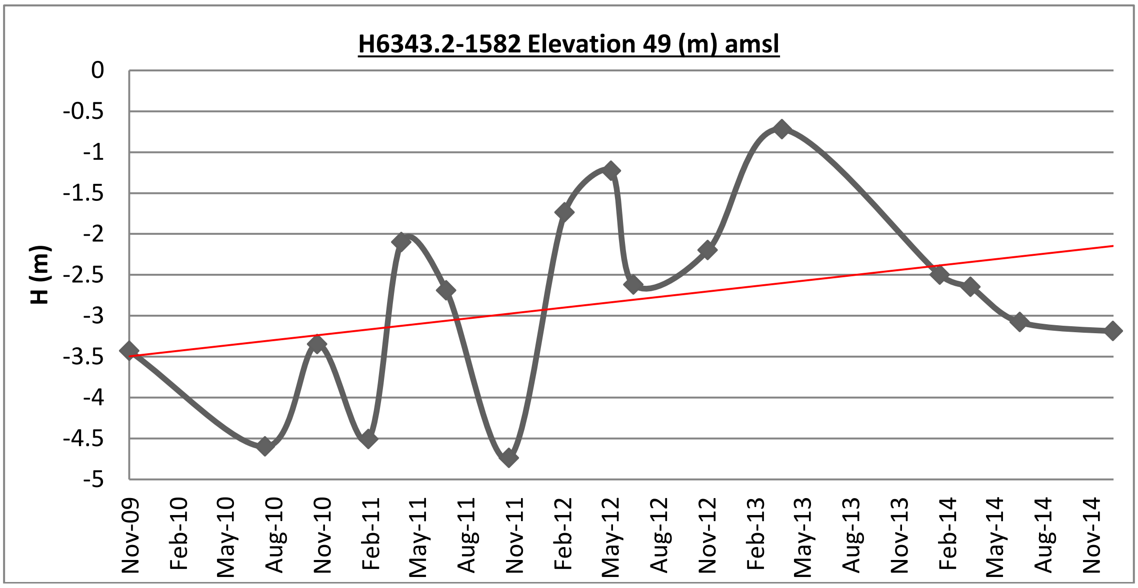

Figure 6-32: Chart of the level of GWB Androlikou (CY_14) at borehole location code H6343.2-1582.

The groundwater body of **Letymbou-Giolou (CY_12)** includes the aquifers of Letymbou-Polemi-Lemona (CY_12_FAO_33) and Stroumbi-Giolou (CY_12_FAO_34), both of which develop on gypsum. Only the Stroumbi-Giolou aquifer has been studied to some extent. The estimated annual abstraction from the GWB is around 2.9 hm^3 water. The impervious bedrock consists of parts of the Pachna formation (marl and marl chalks of the Middle Miocene). The gypsum belongs to the Kalavasos formation (Upper Miocene) and occur in alternation with marl, marl chalks and sandstone. Karstification develops in the deeper parts of the aquifer, while the SW part of the body is covered by parts of the Nicosia formation (marl, sandy marl, and sandstone).

The lithostratigraphic data of the GSD show significant thicknesses> 50m, while in previous studies thicknesses up to 150m have been reported. The greater part of the body presents aquifer wells with the exception of the NW part, where stress conditions are generated. There is indirect evidence for hydraulic connection of the body with the Ezousa aquifer, through the effect of the characteristic presence of sulphur on the quality of the aquifer's water, while similar phenomena are also found in the Ezousa Valley (Ammati), and in the NW part of the body, in the Chrysochous valley.

The level data (Figure 6-33) show a continuous downward trend up to 2000, and from there on, stabilizing trends prevail in the variation, showing even a restoration to 1980 levels, due to the very wet years 2012 and 2013.

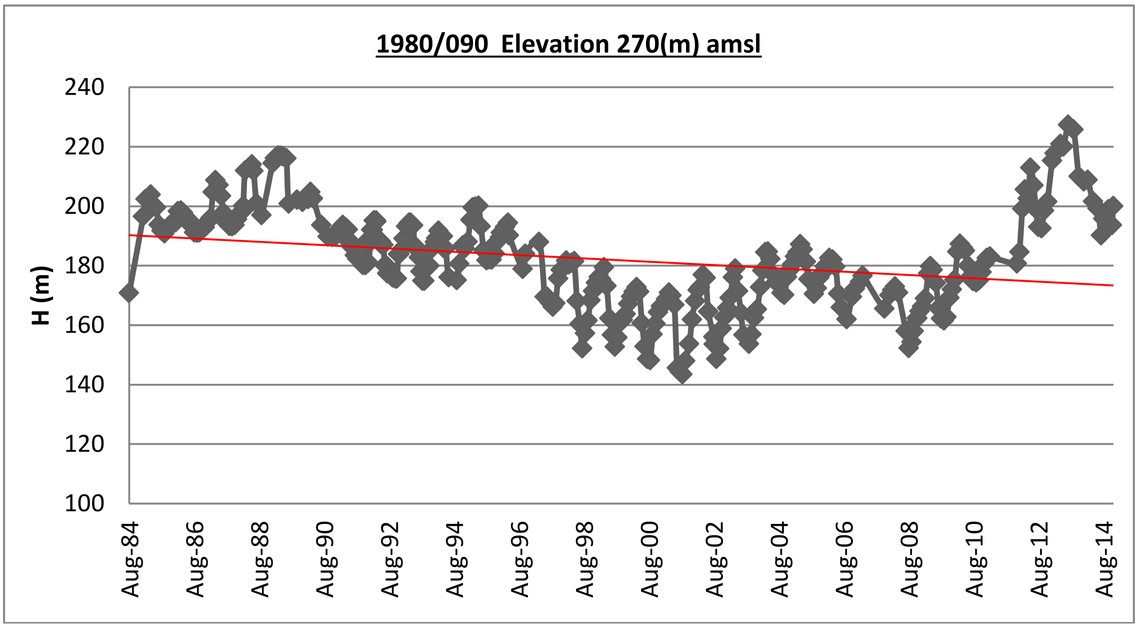

Figure 6-33: Chart of the level of GWB Letymbou-Giolou (CY_12) at borehole location code 1980/090.

Moreover, a part of the **Lefkara-Pachna GWB (CY_18)** is located in the western margin of the study area, where significant spring flows from Kefalovriso are observed at the location *Kritou Terra*. During the period 1966-1973 the average daily flow was about 1120 m^3. The source runoff is used for local irrigation and its excess is guided to the river bed of Chrysochou. The position of the source is shown in Figure 6-34.

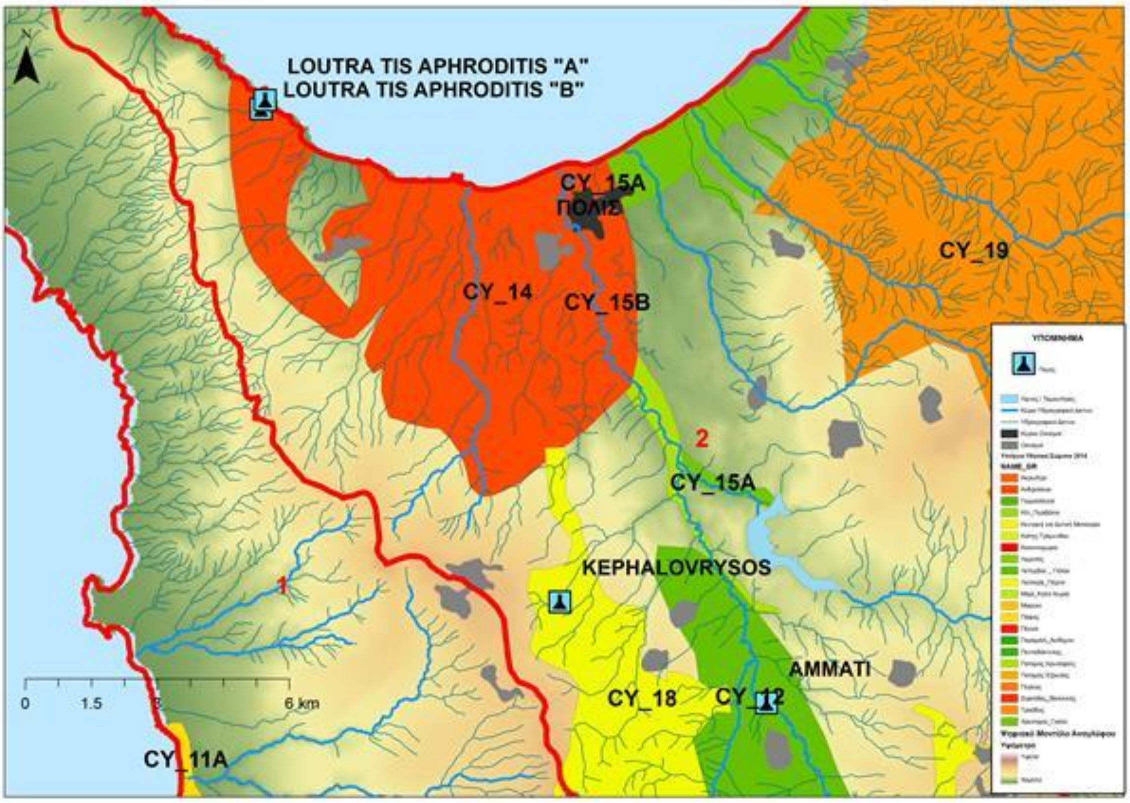

Figure 6-34: Location of the Kefalovriso source for which investigation is proposed for future utilisation for water supply in drought periods.

6.7.4 EVALUATION OF OPERATION IN PERIODS OF DROUGHT

No prolonged drought has been observed in Hydrologic Region 2, which belongs to the Chrysochou project, since 1991 based on the SPI index, but only drought events that rarely exceeded severe drought and only in April 2014 extreme drought. However, in 2014, which was an extremely dry year, abstractions from the Evretou dam peaked at 7.6 hm^3 because the Evretou dam had almost overflowed in the previous year (2013). Therefore, the burden in drought periods shifts to meeting the needs for drinking water. In contrast, in December 2008, storage in the Evretou dam reached its lowest value, at 3.17 hm^3 of water. An overall moderate, insignificant drought occurred during that period.

Based on the Hydrological Year Index, which for Hydrologic Region 2 concerned inflows in the Evretou dam, the Drought Level was classified as “Extreme” for the hydrological years 1972-73, 1990-91 and 2013-14. The Drought Level was classified as “Severe” for the hydrological years 1971-72, 1996-97 and 2005-07.

Based on the Wet Period Runoff Index, the Alert Level was classified as “Very High” for the hydrological years 1972-73, 1990-91 and 2013-14 (exactly the same as with the Wet Year Runoff Index). The Alert Level was also classified as “High” for the hydrological years 1971-72, 1996-97 and 2005-07.

Table 6-94: Volumes of water abstractions from the dams of the Chrysochou Project (in m^3)

YEAR	EVRETOU (Total Abstractions)	EVRETOU (Irrigation Abstractions)	EVRETOU (Abstractions for networks Support)	Abstractions from Argaka Dam	Abstractions from Pomos Dam	Abstractions from Ayia Marina Dam	Total Abstractions
1997	1,813,073	1,579,703	233,370	493,402	290,000	86,930	2,683,405
1998	1,371,486	1,234,816	136,670	520,858	406,520	151,950	2,450,814
1999	2,544,880	2,301,500	243,380	1,161,916	876,870	254,950	4,838,616
2000	2,576,914	2,327,344	249,570	825,930	887,630	208,260	4,498,734
2001	3,032,714	2,666,884	365,830	763,679	905,290	253,490	4,955,173
2002	3,485,855	3,205,275	280,580	1,235,465	1,169,490	382,030	6,272,840
2003	4,017,181	3,632,011	385,170	1,282,734	1,262,280	341,740	6,903,935
2004	4,326,597	3,861,447	465,150	1,270,127	1,127,140	447,340	7,171,204
2005	4,366,091	3,056,631	1,309,460	646,156	390,510	96,360	5,499,117
2006	3,316,633	2,760,283	556,350	746,807	803,900	181,470	5,048,810
2007	2,459,498	2,117,598	341,900	793,293	665,780	158,300	4,076,871
2008	3,727,000	2,755,000	972,000	954,561	602,450	113,790	5,397,801
2009	2,773,000	2,523,000	250,000	979,240	736,240	312,060	4,800,540
2010	4,064,000	3,577,000	487,000	1,081,324	885,080	269,650	6,300,054
2011	3,524,000	3,256,000	268,000	937,190	691,000	275,680	5,427,870
2012	3,709,000	3,466,000	243,000	946,742	816,320	329,630	5,801,692
2013	4,374,000	4,061,000	313,000	1,026,352	806,660	297,996	6,505,008
2014	6,353,000	5,455,000	898,000	837,288	365,920	1,630	7,557,838

As regards the coverage of needs, contrary to what would be expected, despite the great delay in the availability of irrigation volumes compared to those forecast, no significant shortages or trend for the abandonment of the area were noted. In contrast, the population and economic activities show a significant upward trend. The reason is the rapid change in the land use and activities in the area, which now focus on domestic and foreign tourism and on the development of “holiday homes”.

Indeed, the above table (Table 6-94) shows the abstractions of water from the dams of the Chrysochou project. For the years 2005-07, abstractions from dams dropped to their lowest values, ranging from 4.1 hm^3 to 5.5 hm^3, not far from the sample average (5.34 hm^3). As abstractions during the drought period are very close to normal values, the impact of drought in the Chrysochou area is small. Finally, Figure 6-35 presents the relevant table in a chart.

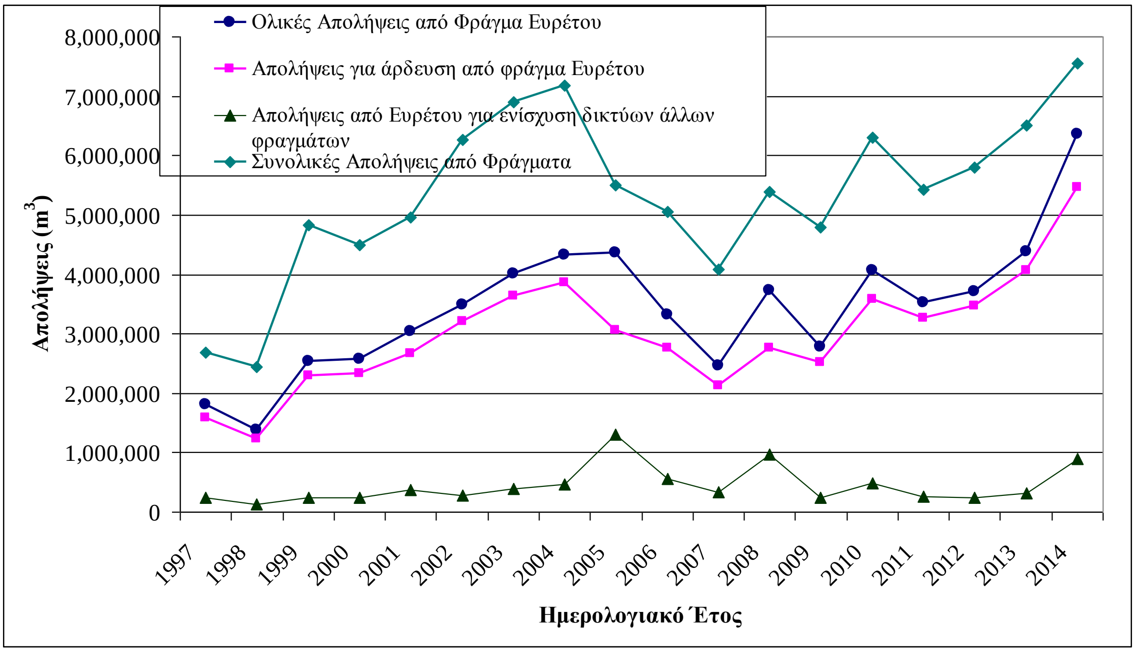

Figure 6-35: Chart of annual water abstractions from the Chrysochou Project dams.

6.7.5 CONCLUSIONS- PROPOSALS

In the wider region of Chrysochou, the overall balance is positive but as mentioned above, there is a significant contribution of pumping from the water bodies of Chrysochou and Androlikou. Of these, the Chrysochou water body show signs of a gradual decline of its level. This is because although demand for irrigation is decreasing, there is recently a great trend for the development of tourism and holiday homes, leading to an increased demand for drinking and garden irrigation water.

The analysis described above leads to the following conclusions:

1. In wet hydrological years, the quantity of water stored in the Evretou dam should be maximised, as the storage capacity of the project is quite large and therefore, there is sufficient water stored for possible period of drought to come.

2. Given the proximity to the groundwater bodies of Androlikou (CY_14) and Letymbou-Giolou (CY_12), the possibility of covering part of the water supply needs using these groundwater bodies in periods of drought could be explored. Moreover, a significant reserve can be secured from the **Lefkara-Pachna GWB (CY_18)** located in the western margin of the study area, where significant spring flows from Kefalovriso are observed. These springs are currently used to irrigate local agricultural land and part of the flow is channelled to r. Chrysochou. If the relevant investigation shows that the quality characteristics of the springs are satisfactory for drinking water and that the construction of the pipeline to the areas of interest is economically feasible and profitable, the case of boosting drinking water supply from these springs could be considered.

3. Due to increased consumption of water, the use of recycled water for irrigation should be investigated once the Chrysochou City WWTP is constructed, as farmland generally coincides with urban or tourist areas.

6.8 DROUGHT MANAGEMENT IN THE REMAINING AREAS OF INTEREST

6.8.1 INTRODUCTION

The following paragraphs present details of the evaluation of the operation of the areas listed below and propose general measures for managing the system during periods of drought. Under the Terms of Reference, the necessary measures must be proposed for addressing the environmental, economic and social impacts of water scarcity and drought in the areas of Troodos, Western Mesaoria and Pissouri.

6.8.2 PISSOURI AREA

The Pissouri area faces a major water shortage problem in terms of both drinking and irrigation water. This is caused by the depletion of the region's groundwater resources, as well as by the reduced runoff of Cha-potami during the last drought season and by the abstractions for strengthening the Kouris dam.

A large part of the Pissouri area is located over the Lefkara-Pachna groundwater body (CY_18). In addition, the aquifers of the gypsums of Pissouri and the namesake alluvial aquifer, which are not part of any water body, develop in the region. In general, the aquifers that develop in the area have a limited capacity. An earlier study (FAO) estimated the annual pumping volumes from the alluvial and gypsum aquifers at 0.82 hm^3, while the estimate of their capacity is smaller, at about 0.7 hm^3 per year. Therefore, the local aquifers were already overexploited during the preparation of the FAO reference study (2002). It is noted that the east - southeast aquifer of the gypsums has a very low capacity due to its size but also because of the existence of a karstic source, where a large part of the aquifer is relieved almost immediately. A study by the Geological Survey Department on the possibility of artificial recharge of the local aquifers by diverting water from Cha-potami did not provide appropriate results, while its implementation would have presented considerable problems (Document of the Geological Survey Department of 02/02/2011). Therefore, the possibility of the artificial recharge of the local aquifer of the Pissouri area was excluded.

The needs for drinking water are now covered mostly by water pumped from boreholes from the bed of River Dhiarizos and transported by pipeline; however, in 2009, the transport of water by tanker was also required. The irrigation needs are met using boreholes and the existing abstraction and a pipeline with a 300mm diameter from Cha-potami. Apart from Pissouri, this project also supplies the irrigations of the Community of Alektoras.

The needs of the Pissouri - Alektoras area for drinking, irrigation and livestock farming water were assessed in the framework of the 1st RBMP. Overall needs were estimated at about 1.14 hm^3 per year, of which 101,000 m^3 related to drinking water and nearly 1.0 hm^3 to irrigation.

The water supply of the Pissouri area can be covered by the Paphos Project. As regards irrigation, in the framework of the 1st RBMP, the construction of a 3 hm^3 dam in the riverbed of ChaPotami was proposed, which appeared in conjunction with the existing water supply and transport infrastructure, to ensure the abstraction of 700,000 m^3 per year with 65% reliability and 350,000 m^3 per year with 90% reliability. At the same time, the drop in the volume of flows in the riverbed downstream of the dam will be about 17% of the natural runoff. However, the construction of this dam was rejected both for technical reasons (stability of stops, cost-prohibitive sealing against leaks, etc.) and because the crops in the region are generally declining.

Instead, the WDD proposed the recharge dam of Souskiou in the bed o r. Dhiarizos, with a capacity of 225,000 m^3 of water to recharge in a controlled manner the aquifer of r. Dhiarizos (upstream and downstream of the dam) to meet the water needs of the Government Water Project of Pissouri, the Kouklia Community and their tourist area, and, if all drinking water needs are met and there is a surplus, to meet the irrigation needs of the Kouklia Community. The average annual water inflows to the underground aquifer (based on the project's Environmental Impact Assessment Study) are 0.6 hm^3 of water from the dam retention basin and 1.8 hm^3 of water from the downstream controlled overflows.

The irrigations of the Pissouri area will continue to be supplied with water from the boreholes in the bed of r. Cha-potami. Figure 6-36 presents the chart of annual runoff volumes at the outlet of r. Cha-potami (the data for the hydrological years from 2000 onwards have resulted following completion). This shows that, during periods of drought, flows at the mouth of Cha-potami are almost zero. Therefore, the boreholes will have diminishing yields as the duration of the drought grows.

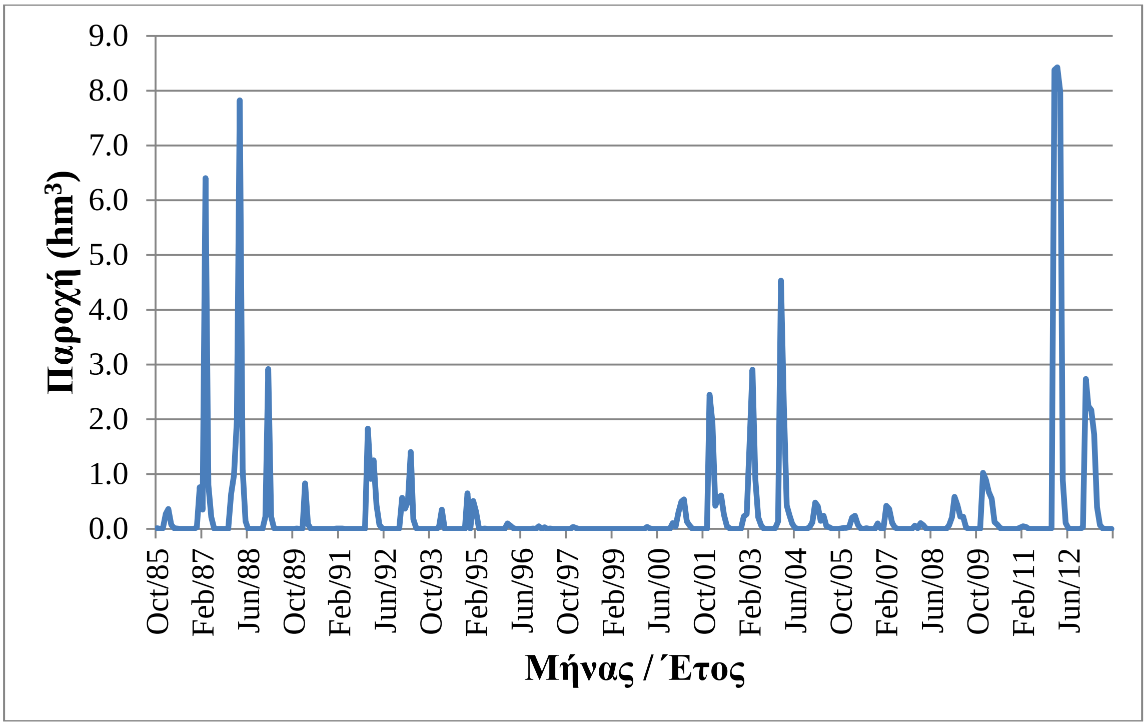

Figure 6-36: Monthly flows at r. Cha-potami, in the position Kouklia (hydrometric station r1-1-7-95)

The total annual drinking water and irrigation needs to be supplied with water by the recharge dam of Souskiou will be approximately 1.7 hm^3, of which 0.55 hm^3 correspond to the drinking water needs of the area of the GWP of Pissouri (which includes the settlements of Pissouri Avdimou, Alektoras, Archimandrita), the Kouklia Community and its resort areas. The corresponding water needs by the year 2030 are projected to be about 2.7 hm^3.

The construction of the Souskiou dam (for which a positive opinion for the proper design of the project is pending, as the project is expected in a NATURA area) qualified for technical-financial comparison with 4 other alternatives based on the same WDD design, which were the following:

1. Transfer of water from the Asprokremmos refinery.
2. Transfer of water from the Desalination Plant.
3. Transfer of water from the Arminou dam..
4. Transfer of water from the Chapotami aquifer.

For **alternative a** (Water transfer from the Asprokremmos refinery), the reports on the use of water produced by the Asprokremmos Refinery show that it cannot meet further needs of other regions because it already produces its maximum capacity and the existing pipelines transfer maximum quantity. Therefore, when the water needs of GWP of Pissour and of the Kouklia Community and the tourist region will not be enough for the existing boreholes in the Dhiarizos aquifer to cover, it will not be possible to transfer water from the Asprokremmos Refinery, unless the Refinery is previously extended.

Alternative b (transfer of water from the Desalination Plant) does not qualify as the desalination plant of Paphos will have a nominal output of 15,000 m^3 of water (compared to the 30,000 m^3

mobile unit that operated very briefly in the past) and therefore will have no excess, as the new plant (when installed) will supply the low area of Paphos and the surrounding urban and tourist areas. The siting of a new desalination plant in the Pissouri area is not possible for environmental reasons.

Alternative c (water transfer from the Arminou dam of r. Dhiarizos) impinges on the issue of shortages of the Southern Conveyor project (given that significant amounts of water are diverted at the Arminou dam to the Kouris dam) which enhances the Arminou dam. Moreover, the Arminou dam water requires filtration which will be achieved by a rapid filtration water treatment plant which will be installed downstream of the dam, to make the water suitable for covering water supply needs in the study areas.

Alternative d (water transfer from Cha-potami) is considered unfeasible, since due to the characteristics of the shallow aquifer there are issues of its qualitative status for human consumption.

6.8.3 TROODOS REGION

According to available data, several hundred boreholes operate in GWB Troodos for irrigation and for water supply. The surface of the GWB is approximately 2400 km^2, so it is rather difficult to draw generalized conclusions. According to the available data there was no level drop of the extent specified in the reports of Article, although the phenomenon exists and is most evident in the spring flows. Abstraction is in balance with the natural recharge only in a few small and effectively rechargeable aquifers. As shown by the latest level data, many aquifers partially recover under normal hydrometeorological conditions. For example, Figure 6-37 shows the diagram of the level of groundwater at borehole H5125-0867, located at the eastern end of the GWB, where there is a level drop in dry years, which however is immediately recovered during wet years. Respectively, in Figure 6-38 at borehole 1994/071 located at the upstream part of the river basin of Kouris and at the core of the Irrigation Project of Pitsilia, a generally increasing trend of the level is observed in recent years.

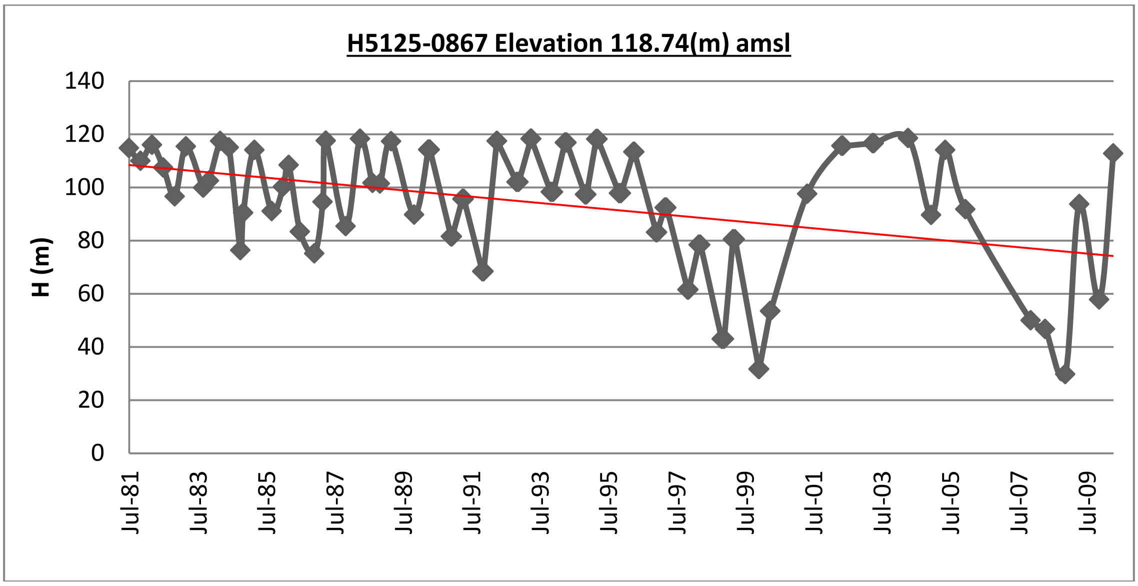

Figure 6-37: Chart of the level of GWB CY_19 Troodos at borehole code H5125-0867 at the location of the community of Parekklisia in the river basin of Argaki Pyrgou.

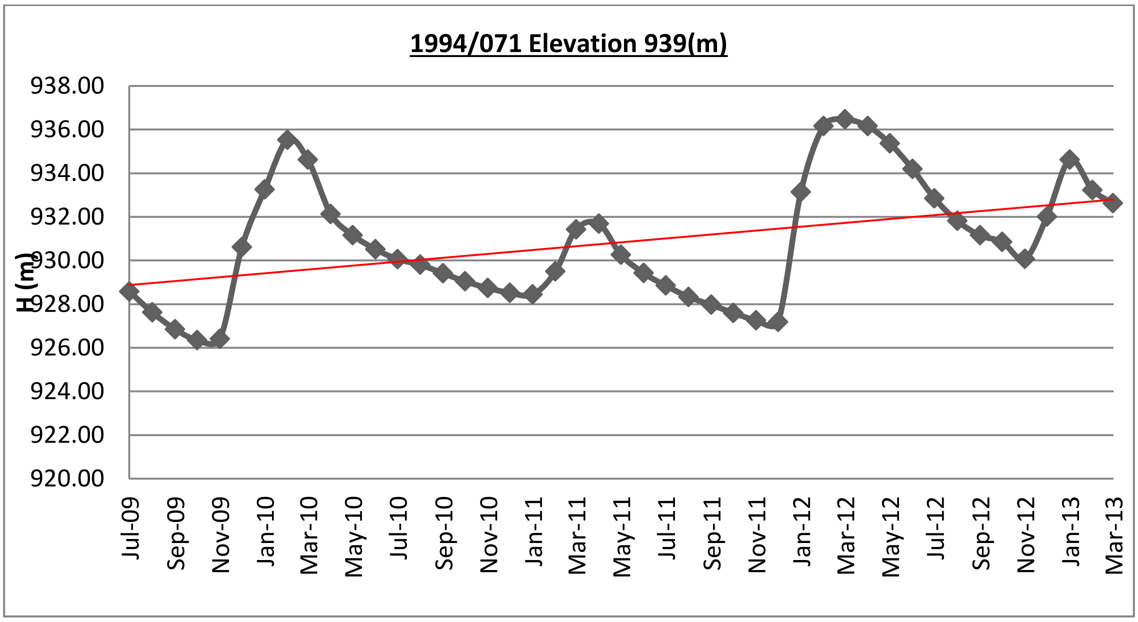

Figure 6-38: Chart of the level of GWB CY_19 Troodos at borehole code H5125071 at the location of the community of Kato Amiantos in the river basin of Kouris.

In the area of the groundwater body there are at least 27 reservoirs such as those of Xyliatos, Kalavasos, Dypotamos, Lefkara, Pano Platres, as well as smaller ones (e.g. Projects of Pitsilia, Pyrgos, Pomos, Argaka, etc.). The largest of these reservoirs, however, mainly serve needs that are outside the area of the GWB. The total number of reservoirs, as given by the available GIS data, is shown in the table below (Table 6-95).

Table 6-95: List of dams constructed within the limits of CY-19 Troodos GWB

Reservoir Name	District/Town	Storage (10^3 m^3)
Agros	Kyperounta-Agridia	99
Kalopanayiotis	Kalopanagiotis	363
Xyliatos	Xyliatos	1430
Kalavassos	Ora	17000
Arakapas	Arakapas	129
Paleochori	Palaichori Oreinis	620
Dipotamos	Pano Lefkara	15000
Lefkara	Pano Lefkara	13850
Kalo Chorio	Gouri	82
Lympia	Mosfiloti	220
Pomos	Pomos	859
Pyrgos	Pigaineia	285
Marathasa	Ag. Epifanios	
Ag. Marina	Ag. Marina Chrysochous	298
Argaka-Makounta	Makounta-Kinousa	990
Trimiklini	Trimiklini	340
Kato Lythrodontas & Pano Lythrodontas	Lythrodontas	64
Lefka-Kafiles	Campos	368
Galini	Galini-Kampos	23
Petra	Evrychou-Flasou	55
Akrounta	Akrounta	23
Vyzakia	Vyzakia	1690
Perapedi	Perapedi	55
Arakapas	Arakapas	129
Agioi Vavatsinias	Agioi Vavatsinias	53
TOTAL		4088

It is estimated that the annual demand for water supply is equal to 3 hm^3 and for irrigation 27.7 hm^3. Part of the irrigation demand is satisfied from sources, surface water diversions, and dams and tanks (Pitsilia Project and other water supply/irrigation projects).

Demand is met by spring flows, using wells and water reservoir projects (Projects of Pitsilia, Xyliatos). Most springs are used for water supply, while some are also used for irrigation. Water wells in the WDD database surpass the figure of 380 and are located mainly in the east. In any case, irrigation is several times larger than water supply, by one order of magnitude. It is therefore understood that in case of drought, it is sufficient to restrict irrigation to cover water supply demand, provided that the quality of water permits such use.

6.8.4 REGION OF WESTERN MESAORIA

The region of Western Mesaoria is one of the most problematic areas in terms of water shortage, both for water supply and for irrigation. The water supply and irrigation needs are mainly covered by water pumped from boreholes in the GWB of Western & Central Mesaoria

(CY_17). Furthermore, the dam of Tamasos has been constructed on r. Pedieos (storage 2.8 hm^3) and the dam of Klirou (2.0 hm^3 on r. Serrahi (Akaki)). The first is used for recharge and temporarily for water supply and the second purely for recharge and for water supply.

There are a few boreholes in the region, used locally for water supply to communities, but also to support water supply to Nicosia, where required, although Nicosia is now served with desalinated water through the Tersefanou conveyor, belonging to the Unified Southern Conveyor System. It is known that boreholes have been established with protection zones in the areas of Kokkinotrimithia, Menikio and Akaki.

A major problem of the region is the overexploitation of groundwater resources. This overexploitation was much more extensive in the past and continued until recently, since the vast storage capacity of the aquifer allowed a continuous level drop. However the continuation of the phenomenon for a long time led firstly to the lowering of the body's level limits and also makes pumping cost-prohibitive in many cases and thus today the lowering rate has relatively dropped. However, it seems that, in wet periods, the recovery of the aquifer level is almost immediate.

According to available sources, the aquifer is very complex. It consists of individual geological formations of varying permeability that are interconnected or isolated. Insufficient knowledge of the system, because of its complexity, unsatisfactory historical data and a basically inadequate monitoring system, prevent the proper differentiation of the individual “aquifers”. For this reason, this complex system of aquifers in Western and Central Mesaoria are considered as one water body. The main individual aquifers develop in the formations of Nicosia, Athalassa and in fanglomerates and river alluvial deposits and are:

- (CY_17_FAO_54) Nicosia - Athalassa Formation
- (CY_17_FAO_55) Riverbed of Elia
- (CY_17_FAO_56) Riverbed of Peristerona
- (CY_17_FAO_57) Riverbed of Akaki
- (CY_17_FAO_58) Riverbed of Pedieos
- (CY_17_FAO_59) Riverbed of Gialia

The main supply sources are the flows of rivers and rainfall. Five (5) rivers that exhibit significant water potential cross the aquifer. They supply the alluvial deposits and, through them, the members of the aquifers that are in contact with them. These rivers are the Gialias, the Pediaios, the Serrahi (Akaki), the Peristerona and the Elia. The contribution of the Elia River to supplying the aquifer is limited. The supply to the deeper, stressed members of the aquifer comes from the lateral transfers of water developing in igneous rocks.

In the framework of the 1st RBMP, it was estimated that total annual water needs in Western Mesaoria amount to approximately 12.4 hm^3 of which 9.3 hm^3 concern irrigation and 2.4 hm^3 water supply. Correspondingly, at the borders of the total GWB, abstractions reach 27 hm^3.

Furthermore, in the framework of the 1st RBMP, it was estimated that, to allow the aquifer to recover, annual pumping from the GWB should be limited to 20 hm^3.

Figure 6-39 presents the aquifer level diagram at Akaki, located in the river basin of r. Serrahi. The water potential of r. Serrahi is significant, as are its infiltrations. It thus seems that the elevation of the level is almost immediate during wet years. On the contrary, in periods with in low aquifer conditions, the lowering of the level is significant.

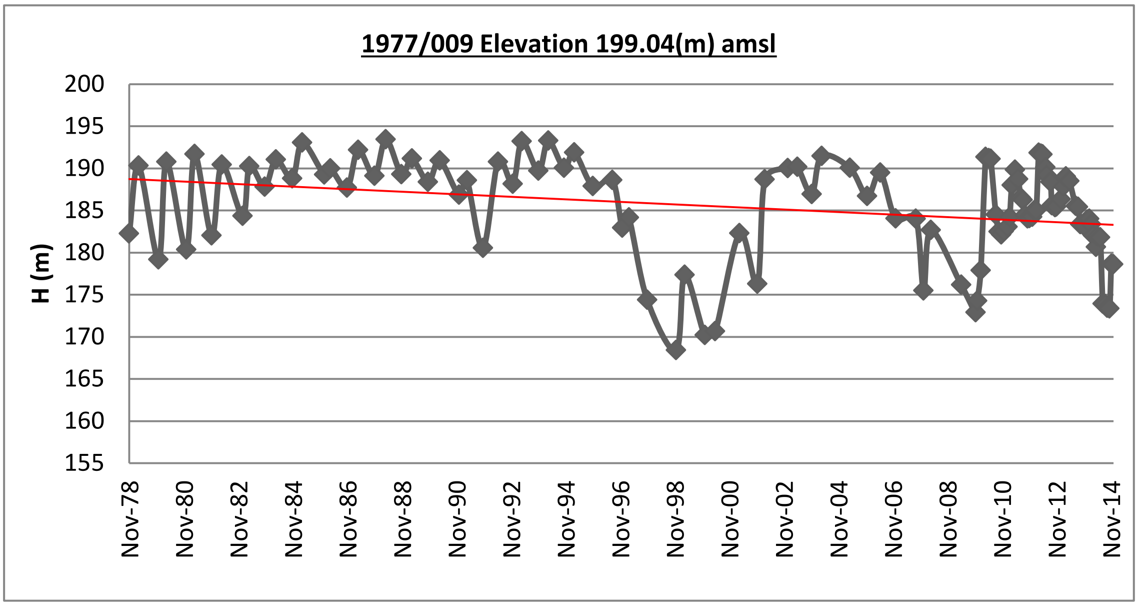

Figure 6-39: Diagram of the level of GWB CY_17 at the position of borehole 1977/009 in Akaki

Respectively, Figure 6-40 shows the diagram of the aquifer level at the position of the borehole with code H1362-0012 in the Astromeriti settlement area in the river basin of r. Xeros. As the water potential there is small, infiltrations are limited and therefore the downward trend of the aquifer is not restored even in wet periods although some signs of stabilisation are noted in recent years.

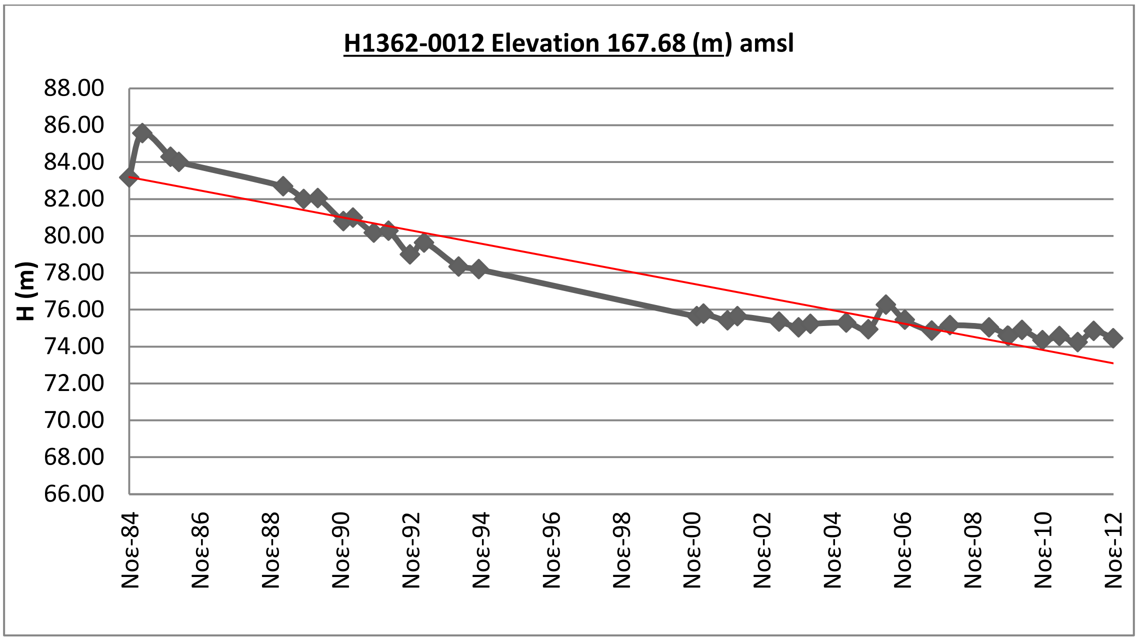

Figure 6-40: Diagram of the level of GWB CY_17 at the position of borehole H1362-0012 in Astromeritis

The Tamasos and Klirou dams can play a role in limiting the adverse situation, but also in periods of drought. As mentioned, they are mainly used for recharge and for water supply. The use of the Tamasos and Klirou dams for water supply however is temporary, until the Vassilikos conveyor is constructed (see below). The table below (Table 6-96) presents the annual recharge values, where in the dry year 2014, abstractions were only 200,000m^3 and only from the Klirou dam.

Table 6-96: Annual recharge volumes from the Tamasos and Klirou dams.

Year	Annual Groundwater Recharge Volumes from Tamassos Dam (m^3)	Annual Groundwater Recharge Volumes from Kliros Dam (m^3)	TOTAL (m^3)
2007	2,062,724	1,193,063	3,255,787
2008	0	0	0
2009	881,989	2,357,202	3,239,191
2010	1,158,312	0	1,158,312
2011	1,942,087	210,891	2,152,978
2012	699,000	0	699,000
2013	1,337,919	276,449	1,614,368
2014	0	200,000	200,000

From the Tamasos dam, 56,680 m^3 were allocated exclusively for water supply in 2013, 187,440 m^3 in 2014 and 51,500 m^3 in 2015 to the settlements Psimolofos, Kambia, Episkopeio and Pera. The installation of the rapid filtration water treatment plant of the Klirou dam was completed in 2013 and five supporting pumping stations were constructed. It is noted that during the wet years 2012-13, these dams were full and overflowed, which means that during wet periods abstraction from the Klirou dam can increase for water supply and abstractions from groundwater (the Tamasos dam is only temporarily used for water supply) can be correspondingly reduced.

In drought periods, water supply should certainly be ensured. This will be done through outflows of the Klirou dam but not from water supply wells, as the qualitative data show that it is outside the limits of the Directive for water intended for human consumption. By the end of 2015, the WDD Planning Service shall have completed the feasibility study of the Vassilikos Conveyor to supply Nicosia with desalinated water (from Vassilikos desalination), to ensure water supply from an alternative source to the Tersefanou conveyor, while also supplying 28 Communities in western Mesaoria, thereby ensuring the provision of adequate and good quality water to these communities that only used boreholes with qualitative and quantitative issues for water supply until now.

6.9 USE OF DESALINATION IN PERIODS OF DROUGHT

6.9.1 INTRODUCTION

As arising from the “Final Water Policy Report” (Annex VII) of the 1st Management Plan, desalinations of around 75 hm^3 for 2011 and 85 hm^3 for 2031 are required to serve the water supply needs of areas served by the projects of the Southern Conveyor and Paphos for zero water supply shortages during the worst periods of drought. Taking into account that theoretically about 90% of the installed capacity of these units may be made available for use, it is estimated that desalination plants in Cyprus should have an annual capacity of around 83 hm^3 for 2011 and 94 hm^3 for 2031, or approximately 230,000 m^3/ day and 260,000 m^3/day for the respective years.

For brevity, the Southern Conveyor system indicates the nearly unified, in terms of resources, government water supply system of the districts of Nicosia, Limassol, Larnaca and Famagusta. The permanently operating system units are the following four:

- The first desalination plant in Cyprus, which opened in 1997 in Dekelia with a capacity of 40,000 m^3/day (or 14.6 hm^3/year). After two successive increases, its capacity is now 60,000 m^3/day (or 21.9 hm^3/year).
- The Larnaca unit (airport area), which started its operations in 2001 with a capacity of 52,000 m^3/day (or 19.0 hm^3/year). Since 2009, its capacity has increased to 62,000 m^3/day (or 22.6 hm^3/year).
- The Limassol unit (Episkopi) with a capacity of 40,000 m^3/day (or 14.6 hm^3/year), expandable to 60,000 m^3/ day (or 21.9 hm^3/year). This unit is in operation since November 2011.
- The Vassilikos unit, for which a contract was signed with EAC, with a capacity of 60,000 m^3/day (or 21.9 hm^3/year). This unit is in operation since January 2012.

Thus, the permanent units now have a direct total capacity of 222,000 m^3/day (or 81 hm^3/year, assuming a 100% yield). For comparison purposes, this quantity is 30% higher than the average annual inflows into all the dams of the Southern Conveyor project.

Two temporary units were put into operation in 2009 for the short-term management of water scarcity. A mobile one in Moni (EAC power plant premises) with a capacity of 20,000 m^3/day and one that processes the saline waters from the aquifer of the alluvial deposits of the Garyllis river, with a capacity of 10,000 m^3/day. These two units have stopped operating - the one in Moni in late 2011, and the one in Garyllis in late 2013. Therefore, we believe that the full potential of the desalinations that boost the South Conveyor project are 222,000 m^3/day or 73 hm^3/year, assuming a 90% yield.

A mobile desalination unit with a capacity of 30,000 m^3/day was constructed in the Paphos region and put into operation in 2010 (at Kouklia, but it only operated for a month). The planning foresaw its replacement in the future with a permanent unit with a capacity of 40,000 m^3/day. Eventually, the WDD proposed the installation of a desalination plant in Paphos, with a nominal daily capacity of 15,000 m^3. In times of liquid years, desalination unit is provided to operate with much lower capacity.

6.9.2 DESALINATION OPERATION AND PERFORMANCE

Desalination is extremely necessary in the project of the Southern Conveyor whose executive role is considered crucial as it supplies water to the most important part of the urban areas of Cyprus (Nicosia, Limassol, Larnaca and Famagusta area) and a significant part of the irrigation areas from Kokkinochoria in the east to Limassol in the west. When the alarm levels in the context of drought is “NO ALERT” then desalination operation depends on economic factors associated with the return of the investment on desalination plants.

According to the Drought Management Plan, when the drought alert level becomes TOO HIGH, then all desalination plants operate at their full potential and any excessive quantity of desalinated water is stored for the Southern Conveyor project in the Dypotamos and Kalavasos reservoir and for Paphos project in the Asprokremmos reservoir, without any transfers having already been made except from a quantity of 1.66hm ^{3} in 2014 from Vassilikos plant to Dypotamos reservoir. When the alert level is MODERATE, MEDIUM or HIGH then desalination plants operate at a rate so as to fully cover the needs in water supply. Irrigation faces significant cuts and water is only given for permanent crops and greenhouses, and this as a small percentage of irrigation needs only to sustain plants, given the water abstraction program from the respective reservoirs (see Basic Measure 58).

The table below shoes the volumes of water channelled to the Southern Conveyor project from desalination (Table 6-97).

Table 6-97: Volumes of desalinated water channelled to the Southern Conveyor project

Hydrologic Year	Volume of Desalinated Water at SCP (m^3)
2009-2010	52,450,717
2010-2011	48,216,114
2011-2012	27,090,122
2012-2013	9,652,010
2013-2014	24,591,273

Desalination taking place during the very dry hydrological year 2013-14 was much lower than expected according to the table below (Table 6-98). Respectively, abstractions from the

Southern Conveyor dams significantly increased, much higher than projected in the 1st RBMP. Given the economic conditions of the Republic of Cyprus, the financial deficit of the country on the basis of the three-year Medium-Term Fiscal Framework necessarily creates an upper limit on the operation of desalination. This means that there was no compliance of Water Policy under the relevant measure of the 1st RBMP for desalination. So, while initially it seems that we refer to a violation of the 1st RBMP, however objective reasons related to the economic situation in the country prompted the authorities of the country in this exceptional deviation. Therefore, any non-compliance should be considered as a temporary deviation, and not a violation.

Table 6-98: Correlation between Desalination Operation and Drought

Alert for Drought	Degree of Desalination Exploitation
Extremely High	Full capacity exploitation by storing quantities exceeding the consumption needs.
High or Medium or Moderate	Maximising the coverage of water supply from desalination plants without generating quantities exceeding the consumption needs.
No alert	Dependence of exploitation degree by other factors.

As mentioned in the Basic Measure 58, the operation planning of desalination plants as regards the contents of the Drought Management Plan was not even implemented during the extremely dry hydrological year 2013 -2014, since, as a result of the economic crisis, expenditure on desalination was prohibitive; under these particular circumstances there was no other choice than exceptionally deviate from the plan.

In Paphos Project the use of desalination in Paphos Kouklia is minimal and only for two years after construction of the plant in 2010. In the years 2012, 2013 and 2014, abstraction from the desalination plant was zero after the operation of the mobile unit was interrupted, however the Drought Management Plan for the abstraction of water from the Paphos project dams, it was entirely implemented in the dry year 2013-14 due to full filling of reservoirs during the previous two liquid years.

Table 6-99: Volumes of desalinated water channelled to the Paphos project

YEAR	Volume of Desalinated Water at Paphos Project (m^3)
2010	0.09
2011	2.11
2012	0.00 (NO OPERATION)
2013	0.00 (NO OPERATION)
2014	0.00 (NO OPERATION)

YEAR	Volume of Desalinated Water at Paphos Project (m^3)
AVER.	0.37
ST. DEV.	0.85
C. V.	2.33

6.10 USE OF RECYCLED WATER IN PERIODS OF DROUGHT

6.10.1 INTRODUCTION

Recycled water is a resource having received increased attention in recent years. The importance of this resource is great, as it exploits amounts of water which would otherwise be lost from the water balance, especially for countries with dry climate and, as in the case of Cyprus, for countries whose development has led the balance of supply and demand for traditional resources to negative values.

At the same time, with the exploitation of water volumes that would otherwise be lost, the use of recycled limits the discharge of treated wastewater in coastal waters. This is particularly important for nutrient loads that although being, to a certain extent, desirable and usable for spatially scattered crops, they are not desirable in coastal waters, being spatially concentrated in areas of distribution pipelines.

The supply of recycled water for irrigation through the Government Water projects started in 1998, by providing a small amount of 1.3 hm^3. Today it reaches approximately 14 hm^3 for direct irrigation and about 3.8 hm^3 for enrichment (Ezousa), which, however, are pumped for irrigation. Also, approximately 1.5 to 2.0 hm^3 is produced from small units (camps, communities, etc.). We should expect an exponential increase in the available quantities in the future. The plan is to include in the quantities of recycled water the treated wastewater of Nicosia and the outflows from wastewater treatment centres of smaller communities planned or to be constructed. At the same time, there will be future extensions and new wastewater treatment infrastructure in cities that already today are the sources of this resource (Larnaca, Limassol, Paphos, Paralimni - Agia Napa) as an extension of sewerage networks and due to population growth.

Recycled water is used for irrigation of green areas, sports fields and crops, except edible raw vegetables, bulbs and tubers consumed raw, as well as the groundwater aquifer recharge. Based on the high demands for irrigation and the need for refilling groundwater aquifers, the exploitation fields are sufficient. The use of tertiary recycled water under the Code of Good Agricultural Practice takes place in areas near stations where the water is produced, used in existing priority crops, this way replacing equal amounts of freshwater, and also in new crops with high efficiency.

Groundwater enrichment is so far made only using the recycled water from Paphos in the Ezousa underground aquifer; if we come up with a solution to manage the salinity of the recycled water produced in Larnaca, the implementation of the enrichment project of the Kitio underground aquifer could be also projected. Similarly, the enrichment of the Akrotirio aquifer (CY-9) with the recycled water from Limassol is also projected.

Generally the recycled water is used from urban and rural areas. The following table presents the existing urban wastewater treatment plants, the outflows whereof are involved in the water balance with the treated/recycled water (Table 6-100).

Table 6-100: Municipal urban wastewater treatment plants

Station	Operator	Station Capacity (m^3/day) (hm^3/y)	Water Usage
Anthoupoli	WBL	13 000 (4.74)	Irrigation, Ovgos river
Vathia Gonia	WBL	21 000 (7.66)	Irrigation, Athalassa dam, on Kalogeros river and, where needed, within Kalogeros river in Aglantzia
Vathia Gonia	WDD	2 100 (0.77)	Irrigation
Mia Milia[7]	70% WBL & 30% TCC	30 000 (10.95)	Pediaios river
Limassol (Monastery)	SBLA	40 000 (14.6)	Irrigation, Polemidia Dam and to the sea via underwater pipe
Larnaca (Airport)	WBL	8 500 (3.10) (future expansion 18 000 (6.57))	Irrigation, sea
Paphos (Acheleia)	SBP	19 500 (7.12)	In tanks along Ezousa river for enrichment of the aquifer, with the exception of a small amount, about 300 m^3/day, available for irrigating fodder crops (clover) in Acheleia, as well as green areas and parks of the Station
Paralimni (Agia Napa)	PSB	21 000 (7.66)	Irrigation
Polemidia (Future)	SBLA	13 000 (4.75)	Irrigation
Episkopi (Future)	SBLA	6 000 (2.19)	Irrigation

By summing up the stations' capacities, an annual capacity results including extensions and future WWTP amounting to 67 hm^3 approximately. The "Mia Milia" Wastewater Treatment Plant for Nicosia area was recently constructed as a bicommunal project and is located in an area that is not under the effective control of the Government of Cyprus. It serves the municipal areas of Nicosia, Agios Dometios, Egkomi, parts of Strovolos and Aglantzia municipal areas, as well as parts of the occupied part of Nicosia.

Regarding the WWTP constructed and managed by the WDD in "Vathia Gonia" the operation is carried out by a private company. This Station treats wastewater transported by tankers, and covers the districts of Nicosia and Larnaca which are not connected to the central stations. The Station also processes various industrial waste such as residues from dairy plants, liquid waste

[7] The agreement signed as to the Mia Milia station provides for the exploitation of 70% of the water produced by the Greek Cypriot Community and 30% by the Turkish Cypriot Community (TCC).

with fats and oils, high organic loads, low organic loads, and process-related metal residues. All the above waste is also transported by tankers. The excessive sludge from other small biological treatment stations, camps and industries having their own station is also treated here.

Besides urban WWTP, the recycled water balance also involves rural WWTPs (with a population less than 2000 inhabitants) presented below (Table 6-101).

Table 6-101: Agricultural wastewater treatment plants

Station	Operator	Station Capacity (m^3/day) ($1000m^3$/year)	Water usage
Kyperounta (Limassol)	Kyperounta SB	300 (109.5)	Irrigation, adjacent river
Platres (Limassol)	Platres SB	300 (109.5)	Adjacent river
Agros (Limassol)	Agros SB	450 (164.2)	Adjacent river
Lythrodontas (Nicosia)	Agros SB	500 (182.5)	Irrigation, adjacent river
Pelendri (Limassol)	Pelendri SB	360 (131.4)	Green spaces, Irrigation
Dali (Nicosia)	Idalion SB	500 (182.5)	Abolished since 2013.

The supply/use of recycled water from wastewater treatment plants in Cyprus is mainly for two purposes: (a) irrigation, and (b) groundwater enrichment. Water quantities that cannot be allocated during winter in Larnaca and Limassol, since there is not demand and adequate storage space, are discarded to the sea.

Especially in the area of Paphos, the recycled water is used for the enrichment of Ezousa aquifer. This water, after further treatment through the porosity of the underground aquifer, is pumped and mixed in the irrigation channel with water from the Asprokremmos dam, participating in the Paphos irrigation project. The table below (Table 6-102) presents the estimates of the WDD regarding existing and future use of recycled water in Cyprus based on the full capacity of WWTP.

Table 6-102: Current and future quantities of recycled water (in m^3) based on the WWTP design capacity

	Year 2015	Year 2025
URBAN WWTPs	31,000,000	51,000,000
WWTP Farmers communities	1,569,865	6,173,975
TOTAL	32,569,865	57,173,975

Generally, based on the data of the WDD regarding the potential of the new treatment centres, it may be considered that in the future the theoretical potential of this resource will reach up to 60 hm³ in the long term (2025). Since the theoretical potential of the units may not be depleted, the available quantities are likely to be less. However, as a percentage of future urban and tourism consumption, the estimation of the resource's potential shows very significant values. In any case, the importance of the resource is really high. We should especially also take into account the very high rate of availability and reliability of the volumes produced, as they are based on urban consumption.

This does not mean that all this volume will be immediately available for irrigation. The time distribution for recycled water production within the year is basically in accordance with the urban consumption. Consequently, when the projected large quantities of recycled water are disposed to crops, a correspondingly significant water storage is required, produced outside the irrigation season in order to increase output of recycled water for irrigation. So far, water is stored only in underground aquifers (from Paphos) while some quantities from Limassol WWTP intended exclusively for irrigation are stored in Polemidia dam during winter. Also, the construction of a reservoir in Tersefanou has been scheduled, where recycled water from Larnaca will be stored. The nearest dam which could accept extra quantities from the Larnaca WWTP is the enriching Aradippou dam in Parthenitis river, which however has a limited water capacity of only 90.000 m^3. As part of the 1st RBMP, the estimated storage required is 15 hm^3, a significant amount of which should be considered when planning the recycling exploitation projects.

Generally, the recycled water is a stable and valuable source of water especially in dry periods. The policy of Cyprus is to incorporate to the maximum possible extent the recycled water in the water balance of the South Conveyor and Paphos projects, and make full use of this water in all other areas close to the Stations of production, both in existing and new crops with high efficiency. The quality is being controlled and remains stable. All WWTPs in Cyprus have tertiary treatment, filtration and chlorination in order to obtain high quality that allows the use of the recycled water in agriculture. Farmers use less fertilisers since the recycled water already contains enough nutrients.

6.10.2 ASSESSMENT OF RECYCLED WATER PARTICIPATION IN WATER SUPPLY IN DROUGHT PERIODS

Based on the data of the WDD regarding the use of recycled water, we observe a substantial involvement of the resource in the water balance of the resource. The table below (Table 6-103) presents the annual water volumes produced by urban WWTPs and those serving smaller settlements and various other facilities. For the last year with available date (2012), the annual volume of recycled water was equal to 22.2 hm^3 of water, among which 17.6 hm^3, i.e. 79% of the total quantity produced, were disposed for irrigation, as shown in the relevant table (Table 6-104).

Table 6-103: Volumes of recycled water produced by the Cyprus WWTP (in thousand cubic meters)

WWTP	2004	2005	2006	2007	2008	2009	2010	2011	2012	TOTAL
LIMASSOL	6,247	6,418	6,548	6,436	5,490	5,820	6,635	6,667	7,475	57,736.1
PAPHOS	1,838	2,178	2,952	2,554	2,380	2,325	2,341	2,294	3,910	22,771.9
AYIA NAPA	791	849	680	852	967	972	1,056	1,011	1,002	8,181.2
PARALIMNI	1,076	1,427	1,731	1,420	1,320	1,132	1,317	1,445	1,678	12,545.1
LARNACA	2,288	1,877	2,139	1,935	1,840	1,774	1,800	2,198	2,583	18,435.2
ANTHOUPOLI	298	298	292	292	295	573	828	977	1,137	4,990.3
BATHEIA GONIA WDD	458	366	420	335	311	315	293	231	171	2,898.8
BATHEIA GONIA SAL	0	0	0	0	0	0	647	1,700	2,252	4,598.4
TOTAL	12,995	13,411	14,763	13,824	12,603	12,912	14,918	16,522	20,209	132,157.1
COMMUNITIES, ARMY CAMPS etc	1,419	1,419	1,419	1,419	1,905	1,905	1,905	2,009	2,002	264,314.2
TOTAL	14,414	14,830	16,182	15,243	14,508	14,817	16,823	18,531	22,211	396,471.2

Table 6-104: Volumes of recycled water produced by the Cyprus WWTP intended for irrigation (in thousand cubic meters)

WWTP	2004	2005	2006	2007	2008	2009	2010	2011	2012	TOTAL
LIMASSOL	3,843	4,131	4,716	5,466	4,700	3,822	5,056	4,418	4,309	40,462
PAPHOS (directly to irrigation)	0	0	0	0	91	91	91	91	91	456
PAPHOS (irrigation via Ezousa recharge)	1,838	2,178	2,952	2,554	2,289	2,234	2,369	2,202	3,819	542,094
AYIA NAPA	791	849	680	852	967	972	1,057	1,011	1,002	8,182
PARALIMNI	1,076	1,427	1,731	1,420	1,320	1,132	1,318	1,445	1,678	12,546
LARNACA	1,992	1,816	1,911	1,935	1,840	1,216	1,734	1,815	1,922	16,182
ANTHOUPOLI	298	298	292	292	295	573	365	455	366	3,234
BATHEIA GONIA WDD	458	366	420	335	311	315	294	1,700	171	4,369
BATHEIA GONIA SAL	0	0	0	0	0	0	647	231	2,252	3,129
TOTAL	10,296	11,065	12,702	12,854	11,813	10,355	12,931	13,368	15,610	630,654
COMMUNITIES, ARMY CAMPS, etc	1,419	1,419	1,419	1,419	1,905	1,905	2,087	2,009	2,002	177,121
TOTAL	11,715	12,484	14,121	14,273	13,718	12,260	15,018	15,377	17,612	807,775

Especially for Paphos WWTP, large quantities of recycled water are led to the strengthening of Ezousa river alluvial deposits with volumes up to 3.8 hm^3 of water in 2012 (Table 6-104) with continuously growing quantities from year to year, until the Paphos WWTP's maximum processing is reached (approximately 5.5 hm^3 of water per year for 15,000 m^3/day). In this sense, this water is conducted after pumping to the irrigation channel of Paphos project being used for irrigation as well.

Storage of recycled water during periods with no irrigation needs is an important issue. If the storage capacity is not sufficient, then the overfill amounts flow into the sea. This is what happens in Larnaca and Limassol WWTPs. In Larnaca overfills are discharged to the sea only when maintenance operations are carried out in storage tanks of the secondary water, and there is no demand for recycled water. In Limassol during the winter months when there is no demand for recycled water then part of it is conducted to the Polemidia dam left, and the excessive quantity is discharged into the sea. The annual quantities discarded to the sea are proportional to the recycled water production and are presented in the table below (Table 6-105). Specifically for the Southern Conveyor project, participation of recycled water in the water mixture for irrigation may further increase as the overall system also includes the three biggest urban complexes of Cyprus, namely Nicosia, Larnaca and Limassol. However, it should be noted that it is not necessary that the volumes come especially from Nicosia or directed exclusively towards Kokkinochoria, since the overall balance of resources and consumption points may be uniformly addressed. For example, the use of recycled water from Larnaca or Limassol for irrigation networks covered by the dams of the Southern Conveyor system also contributes in the overall balance, as it discharges water quantities from the dams for enhancement of other networks (or indirectly for combined supply of enrichment and downstream ecological flow of dams) that would not accept recycled water.

Table 6-105: Recycled water volumes channelled into the sea due to incapacity for extra storage.

SWTP	2004	2005	2006	2007	2008	2009	2010	2011	2012	TOTAL
LIMASSOL	2,404	2,286	1,832	969	108	919	911	1,315	2,970	13,714
LARNACA	295	60	228	0	0	558	287	382	661	2,471
TOTAL	2,699	2,346	2,060	969	108	1,478	1,199	1,698	3,632	16,185

It seems therefore that the recycled water is an important water resource the use whereof should be generalized in the water balance of Cyprus. Especially in Cyprus, where shortage in irrigation is quite extended, especially in drought periods, when recycled water supply for irrigation is critical, at least for permanent crops.

As regards the Tersefanou dam, this relates to the use of recycled water of the Larnaca WWTP to irrigate crops in the surrounding area of Larnaca; new pipelines and irrigation networks will be built, and there will be a new storage space, the Tersefanou dam. The estimated average daily quantity of treated wastewater from the surrounding area of Larnaca through the upgraded WWTP is expected to amount to 28 200 m^3 for the year 2027 and 37 000 m^3 for the year 2047. The treated wastewater from tertiary treatment will initially be used to irrigate the area of Dromolaxia-Meneos municipality and the Tersefanou Community, by partially replacing the abstractions of groundwater, and irrigate new crops.

The proposed project concerns the following:

- Construction of a pumping station with capacity of 2 000 m^3/h to be installed in the Larnaca WWTP and will transfer water either directly to irrigation or to the Tersefanou dam, in cases of excess.
- Construction of the Tersefanou dam and reservoir with capacity of 4 hm^3 as a temporary water volume reservoir where there is a surplus in relation to the irrigation needs. The dam is rockfill with a clay core

Apart from the Tersefanou dam, recycled water storage construction works are planned, including:

1. Use of Western Nicosia Recycled Water - Phase A: Construction of a winter storage tank in Anthoupoli with a capacity of 0.5 hm^3, pumping stations and pipelines, and central draining irrigation pipes. Implementation Schedule: 2015-2017.
2. Use of Western Nicosia Recycled Water - Phase B: Construction of winter storage dam in Paliometocho wth capacity of 1 hm^3 and transfer pipes. Implementation Schedule: 2017-2019.

3. Use of Eastern Nicosia Recycled Water - Vathia Gonia: Construction of a winter storage tank with a capacity of 1.3 hm^3, of a pumping station, pipelines and expansion of irrigation networks. Implementation Schedule: 2015-2019.
4. Use of Eastern Nicosia Recycled Water - Mia Milia: Construction of a winter storage tank with a capacity of 1.6 hm^3, of a pumping station, pipelines and expansion of irrigation networks. Implementation Schedule: 2017-2020.
5. Use of Limassol Recycled Water: Construction of winter storage tank with capacity of 1.5 hm^3, and underground aquifer recharge project and connection pipes to the existing irrigation network. Implementation Schedule: 2015-2018.

6.11 EVALUATION OF THE 1ST DROUGHT MANAGEMENT PLAN

It has been 3 hydrological years, since the year of approval of the 1st RBMP (2011) until now that the 2nd RBMP is being prepared, i.e. 2011-12, 2012-13 and 2013-14, except from the current year (2014-15) for which there are still no data for recovery. From these three hydrological years the first two were wet and the last one 2013-14 was quite dry but not identified as Prolonged Drought since SPI-12 indicators were positive before the Drought Magnitude reached the threshold value DM = 30. In this sense, this interval of three hydrological years is not enough to evaluate the 1st Drought Plan, since only the last hydrological year would permit implementation. However, since the previous years were wet enough, then again the evaluation of the first dry year might be precarious, as water reserves both in surface and groundwater water bodies are important.

The following two tables present the implementation of the 1st Drought Plan fixing the values of abstractions based in the volume stored in dams of the Southern Conveyor and Paphos project on 1 April, as specified.

As regards the Southern Conveyor project (Table 6-106) for the hydrological year 2012-13 where storage on 1 April was high (123.1 hm^3), then according to the Plan the abstractions should have been equal to 55 hm^3 of water. These abstractions include the amounts of water released to the environment. However, the abstractions from the Southern Conveyor dams were equal to 83.8 hm^3, larger than the specified value. The abstractions are larger also for the other two hydrological years, even for the very dry year 2013-14. For this year (2013-14), and under the 1st RBMP, the abstraction should be equal to 25 hm^3, however it was 65.5 hm^3. This means that the actual abstraction was at least twice more than the expected. Regarding the hydrological year 2011-12, it seems that the deviation from the expected value was marginal.

Table 6-106: Implementation of the Drought Plan of the 1st RBMP in Southern Conveyor project

Thus, it appears that the 1st Drought Management Plan was not implemented. Fortunately for the water resources of Cyprus, the dry hydrological year 2013-14 was discontinued and the natural runoff of the year 2014-15 completed the increased abstractions. However, of the drought had continued both in intensity and duration (which may have been classified as a "prolonged drought"), they might have been a serious issue in meeting water needs in the coming years.

The reason for the increased abstraction of the given year was twofold:

1. The high level of storage during the previous year. On 1st April of the year 2013, the storage was equal to approximately 142 hm^3, a value very close to the total storage of the dams of the Southern Conveyor.
2. The desalination operation was not as expected (according to the 1st Drought Plan) because due to the cost of the desalination and to the Economic Program of the Republic of Cyprus it was not possible for the desalination plants to operate at their maximum potential.

Thus, we arrive to the conclusion that in the year with Extreme Drought (2013-14) in the South conveyor project area there was temporary and exceptional non-implementation of the Management Plan for reasons related to the general financial situation of the National Economy of the Republic of Cyprus. We finally conclude that "under these particular circumstances, there was no choice but to exceptionally deviate from those specified in the Drought Management Plan". While the Drought Management Plan certainly ensures its implementation during drought periods, however, its implementation during normal periods should be also provided, since the sustainable dam management will maintain an appropriate reserve to deal with drought periods.

The situation in the Paphos project is also reverse; abstractions were less than the limit laid down in the 1st RBMP even when desalination was almost zero. Hence the very significant storage in the previous dry years, the decreasing abstractions for irrigation, and the significant amounts of recycled water pumped for irrigation after enrichment of Ezousa river alluvial deposits. Generally, in Paphos, it seems that the pressures on water resources are not very important, and therefore it is possible to further support other areas with severe water shortages as the Southern Conveyor project through the Arminos dam. We should note that for the hydrological year 2013-14, although the inflow is very small (only 2.0 hm^3), however, the expected abstractions are the highest possible based on the very high storage on 1 April.

Table 6-107: Implementation of the Drought Plan of the 1st RBMP in Paphos project.

Hydrologic Year	Inflows (hm^3)	Abstractions (hm^3)	Storage 1^{η} OCT (hm^3)	Storage 1^{η} JAN (hm^3)	Storage 1^{η} APR (hm^3)	Abstractions Forecast from 1st WRMP(hm^3)
2011-12	31.18	16.46	46.67	43.75	71.72	18
2012-13	28.19	10.82	60.90	71.37	71.49	18
2013-14	2.01	13.59	60.00	55.74	54.54	18

7. WATER SCARCITY INDICES

7.1 INTRODUCTION

Water scarcity occurs when the available water resources are not enough to meet the long-term water needs. It refers to a long-term imbalance between available water resources and demand in a region (or a water supply system) exceeding the service capacity of the natural system. Water scarcity results from the rapid increase in water demand and/or low available water resources, due to population growth, expansion of water consuming crops, etc.. It is also caused by the lack of infrastructure in water management (dams, water transmission and distribution systems, etc.).

Moreover, the concept of water supply itself should be further developed itself, since it is not the same as the physical water availability, instead it depends to a great extent both on the characteristics of engineering structures for exploitation of water resources (water harvesting, storage, transfer, and distribution structures) and on the way they are managed. If there are no structures, this demand cannot be met; even under unlimited water supply conditions. On the other hand, if there are structures of sufficient capacity for interannual regulation of the runoff, which have retained sufficient water reserves from previous periods of high aquifer, demand can be fully met in a single hydrological year, even in cases of extreme drought conditions. The case of aquifers with large storage capacity is similar, since they respond much less to the meteorological drought, compared to the surface waters (river flow).

Water scarcity and drought are different phenomena in principle, although one of them can be responsible for enhancing the consequences of the other. In some areas, the severity and frequency of droughts may lead to water scarcity conditions, while overexploitation of available water resources can worsen the effects of droughts. Therefore, caution is required between the two phenomena; especially in water catchments affected by water scarcity.

7.2 THE CONCEPT OF WATER SCARCITY

Water scarcity refers to the relative shortage of water in a water supply system that may lead to restrictions on consumption Water scarcity is the extent to which demand exceeds the available resources and can be caused either by human actions, such as population growth, water misuse and inequitable access to water. Most Mediterranean countries are facing water scarcity.

It results that the assessment of water scarcity phenomena requires a comprehensive and systematic approach, involving a detailed description of hydrological and anthropogenic processes regarding these three factors: natural water supply, abstractions and technical works. And, since the function of the works does not have only one aspect, the potential effects of a drought depending on the administrative policy adopted, then the problem of optimal management of water resources arises, in order to, inter alia, minimise the probability of shortage (failure probability) in low aquifer conditions.

7.3 DEFINITION OF WATER SCARCITY INDICES

7.3.1 WEI & WEI+ WATER EXPLOITATION INDEX

The Water Exploitation Index (WEI), including its amendment WEI+, is used by the European Environment Agency to provide an overview of water scarcity at a European level and has been defined by the European Union as the main water scarcity index within the WFD. It is defined as the ratio (%) of the total annual water abstraction with respect to the average interannual availability of Renewable Water Resources (RWR). The WEI+ is still in process of determining how to calculate the corresponding Working Group, which is rather complicated, especially in complex hydrological systems that have undergone significant alterations by human activity through projects of water storage, abstraction and diversion from a basin to another. The main documents of the EU regarding the WEI+ index are:

1. Update on Water Scarcity and Droughts indicator development of Henriette Faergemann (DG ENV) (May 2012) which describes the WEI+ calculation method as agreed by the relevant WG and in force until today.

2. European Water Assets Accounts and updating the use of freshwater resources indicator (CSI 018) – Draft for consultation of data sources and technical application of the WEI+ formulas Report version 3.2 (2015).

3. The WFD Reporting Guidance 2016 recently published by the European Commission (Final Draft 6.0.2 - 28 October 2015) (available at http://cdr.eionet.europa.eu/help/WFD/WFD_521_2016) providing in Section 9.4.2.1 (p. 225) additional guidance on Reporting the WEI+, the most important specification being that the calculation of WEI+ at a national level should be done for the last 5 years[8]. The requirement to calculate the WEI+ index for the season or for the most unfavourable month is a valuable addition. The same text states that the WEI+ calculation for the most unfavourable month is not required when water scarcity does not present seasonal variation. We believe that water scarcity in Cyprus does not present seasonal variation as abstractions in water supply is comparable to the abstractions for irrigation, so water scarcity conditions appear broadly similar in all seasons of a specific year.

Based on this index, the following levels have been defined:

- for WEI values <20%: no water stress
- for WEI values 20% - 40%: water stress

[8] Guidance: Optional. Annual WEI+ at national level for the latest available reference year or an average of the latest available 5 year period.

- for WEI values > 40%: severe water stress

In areas with general stress in water resources (such as Cyprus) the WEI limit indicating significant water stress should be set at higher levels such as 60%. The value of 60% is considered in this 2^{nd} Drought/Water Scarcity Management Plan as the threshold for “severe water stress”.

It should be noted that the use of the WEI (and the WEI+ as we will see below) is still to be determined after its implementation in a number of countries. Obviously, in river basins that have undergone significant human interventions (such as the construction of reservoirs or diversions from a river basin to another) it is difficult to use of the WEI because you need to understand and describe all the parameters of the water balance imported in the calculation.

Today, drought indices are formed in a research level based on variations of the WEI. The most common is the WEI+, which is under integration process in the respective EU draft Directive covering European policy on drought issues. Specifically, the WEI+ has been implemented in several pilot river basins and the results led the Expert Group on Water Scarcity and Drought Indicator to the decision to include the index in the proposed index system. This decision was taken at the last meeting of the Group in May 2012. The current form of the WEI+ is the ratio of total water abstraction to the total available resources in a given period of time (e.g. yearly):

The WEI+ is the ratio (%) of the net water abstraction (total water abstraction less water return) to the renewable resources available in a given period of time (e.g. monthly, yearly):

WEI+ = (TWA – R) / RWR, where

TWA (Total Water Abstraction) (in volume units: hm^3): Total amount of water abstraction from all water users (water supply, industry, farming, agriculture, etc.) and all water bodies (underground and surface) in the reference area (e.g. river basin, river basin district).

R (Returned Water): Volume water return back in the overall system (in hm^3) (e.g. water used for cooling, hydroelectric power generation, water from treated wastewater, etc.)

RWR (Renewable Water Resources): Total renewable water available (in hm^3).

Based on the equation of the water balance in basins without anthropogenic interference, the following applies:

ExIn + P – Eta – ΔS = Qnat

where:

P (Precipitation): Total precipitation that falls from the atmosphere to the earth’s surface (rain, snow, hail) (in hm^3).

ETa (Actual Evapotranspiration): The total volume of water evaporating directly from the ground, wetlands, and natural water bodies, and transpired by vegetation-covered surfaces (in hm^3).

ExIn (External Inflow): Total runoff entering from neighbouring basins (surface or underground), contributing to the water potential (negative for outflows to neighbouring basins) (in hm^3).

D (Internal flow): Total surface and underground runoff in the river basin expressed as the difference between precipitation and the actual evapotranspiration of the basin (in hm^3).

ΔS (Change in Storage): The rate of change of total water storage in a specific time interval (> 0, if the storage is increased) in all water bodies (surface and groundwater), soil (as soil moisture), and reservoirs. It can be divided into ΔSnat (in physical bodies) and ΔSart (in artificial reservoirs) (in hm^3).

Qnat (Natural Runoff): The total runoff discharged from surface and ground water bodies to neighbouring basins or the sea (in hm^3).

Based on the above and in accordance with the equation of water balance, two alternative methods are proposed for calculating the RWR parameter in basins unaffected by anthropogenic interventions:

Option 1. RWR = ExIn + P – Eta – ΔS

Option 2. RWR = Qnat

In these options the ΔS is for natural water bodies, and Qnat is equal to the observed natural runoff.

The WEI+ is an indicator for the degree of exploitation of freshwater resources available in a regular period of time (e.g. yearly). The numerator is the net abstractions (excluding any returns) and the denominator is the natural renewable water resources (RWR). The index must be first calculated country-wide; in the case of Cyprus this coincides with the River Basin District. Moreover, it may be calculated -if the country decides so- per hydrologic region or even per river basin. The aim here is the calculation per river basin to serve as the basis for financing projects in areas with deficient degree of available resources exploitation.

As for the calculation of natural renewable resources (RWR), there are two options:

- Option 1, estimating: the external physical inflow Ex_{in} plus the precipitation P less the actual evapotranspiration ET less the diversification of natural water storage ΔS_{nat} (e.g. in groundwater or soil), i.e. RWR = Exin + P-E – ΔS_{nat} (including the total surface runoff Q and infiltration D in the groundwater where P-E = Q+D+ΔS_{na}t), and
- Option 2, estimating the available resources from: the net abstractions A from surface and underground waters (excluding returns) plus the outflow O (to the sea or other systems) less the variation of the artificial water storage ΔSart (e.g. in reservoirs), i.e. RWR = A+O-ΔSart.

In both approaches, to calculate the natural renewable resources the corresponding water storage (in reservoirs or underground) ΔS must be deducted, as it is not used in the index implementation period. On the other hand, if the water exploited has been stored in a previous period, it must be added to the natural renewable resources exploited in the period of index calculation.

These two options are equivalent from a hydrological point of view, since abstractions plus outflows less the ΔSart artificial water storage is equal to the surface runoff plus the infiltration in the groundwater less the variation of natural water storage. Also, in both options the lateral groundwater runoff (to neighbouring calculation areas) is negligible, or counterbalances the overall calculation of WEI+ for the entire Cyprus, adding up to zero. It is difficult of calculate water storage variation (natural or artificial) in a yearly or monthly basis, since the level (of groundwater or reservoirs respectively) is a result of both the storage itself and the abstraction. For this reason it is proposed to calculate the index in a rolling interannual basis (e.g. 5 years), so the storage of water is zero, since the natural renewable extraction from reservoirs or groundwater is in balance in an interannual basis[9]. As we will see, even the 5-year estimate is difficult in cases where there are reservoirs where the annual storage is a very significant proportion of the annual runoff in the river basin (e.g. river basin of Xeros river - Asprokremmos reservoir).

The calculation of the index in Cyprus can be either approximately the same for the whole country (by calculation of a single actual evapotranspiration) or more detailed, based on the abstraction and the available resources per river basin and then summing up the individual volumes at a country level. Since the WEI is calculated also per river basin, calculation should be also made based on the data of the individual basins.

The calculation presents some problems with both options:

- With Option 1 we do not know the runoff coefficients (the ones available do not take into account the abstractions and are therefore not reliable), and
- With the Option 2 the abstractions are estimated based on available data with some conclusions e.g. abstraction from groundwater (considered fixed annually, within the 5-year period).

The advantage of the first case is the (relative) simplicity. For the purposes of this research, the second case was used since no information was available about the actual evapotranspiration in Cyprus. In order to implement the above two options in basins which have undergone changes due to anthropogenic interventions, the observed runoff should be deducted to the naturalised one. This way, runoff should be corrected as to the water consumption (abstractions - returns) and the flow variation associated with the storage in artificial reservoirs. Accordingly, in these cases, the above options are amended as follows:

$$\text{Option 1. RWR} = \text{ExIn} + \text{P} - \text{Eta} - \Delta\text{S}$$

[9] If the abstraction of groundwater is not in balance in an interannual basis (abstraction of permanent reserves), the abstraction of the permanent reserves does not constitute naturally renewable resource and therefore should not be taken into account. However, it is noted that the abstraction of permanent reserves is included in the numerator of WEI in total abstraction.

Option 2. RWR = Outfow + (TWA – R) - ΔSart

where Outflow is the surface and underground outflow leaving the river basin district to the sea.

Regarding the assessment of the RWR parameter, the competent EU Working Group proposes the use of the option considered by the states to be a more appropriate basis of available data, minimising uncertainty. Some restrictions have already been identified:

- It is difficult to achieve runoff naturalisation in complex systems in a monthly basis.
- In cases of over-exploitation of aquifers (i.e. when abstractions are made from the permanent reserves), this percentage should be removed from the RWR parameter.
- Abstractions from underground aquifers often affect the supply of surface bodies with a certain delay. Thus, runoff naturalisation is not always accurate at short intervals.
- The total runoff entering from upstream basins (surface and/or underground) should be assessed with particular attention in transboundary basins when trying to naturalise runoff.

The environmental benefit must be taken into account in WEI+. However, at this stage there is no aligned calculation method, therefore, the relevant texts suggest not to include this in the index equation, but instead take into account when determining the limit/alert levels.

Regarding water transfer from basin to basin, these can be calculated, for the natural renewable water resources, as follows:

- only the abstractions of the basin covered by water resources of the basin itself, including any abstractions for transfer to other basins, and
- the available quantities of each basin only (i.e. without any inflow from other basins).

This approach takes account of the existing transfer projects and focuses on the degree of the basin’s water resources utilisation. This approach captures the spirit of the definition of WEI as an exploitation index for the basin’s water resources.

7.3.2 ASSESSMENT OF PARAMETERS OF WATER BALANCES FOR THE CALCULATION OF WEI+ IN CYPRUS

As noted above, because few catchment basins in Cyprus remain in natural form or, in any case, abstractions are small compared to natural runoff, the application of the WEI index+ is difficult due to both the complexity of the parameters of the water balance and to the fact that the WEI+ index is still an experimental framework in the context of the application of the WFD. However, in this Chapter will seek to implement this index. Due to the undeniable fact that river basins in Cyprus have been significantly affected by human activities, such as the construction of water reservoir projects and diversions from one river basin to another, but also because of the very substantial abstractions of water for human activity, we will use the equation WEI+ that corresponds to Option 2, namely:

Option 2. RWR = Outfow + (TWA – R) - ΔSart

Although it would be theoretically simpler, the implementation of Option 1 requires the development of integrated water balances, which results in the calculation of the actual evapotranspiration of the river basin. The simulation of the water balance in this form is difficult, although all the necessary data on rainfall, potential evapotranspiration and runoff exist, mainly because the interaction of surface/groundwater resources is significant (and thus the calculation of the ΔSnat is particularly difficult) and secondly because the river basins of Cyprus are small and their form (their length is substantially greater than their width - especially in the southern areas of Cyprus) complicates the sharing of relevant information. If however, despite this, another specialised study identifies these balances, then the application of Option 1 may provide more reliable data on the application of the WEI+ index.

The WEI+ index will be calculated **spatially, at river basin level** and, by extension, at hydrological region level and finally at the level of the RWB of Cyprus. The unit selected was the hydrological river basin, as all relevant information are included in this spatial unit. The WEI+ index **will be implemented temporally at the hydrological year level** for the past 5 years (as required by the WFD Reporting Guidance 2016), starting from the year 2008-09 (where there are data on the water balance of reservoirs) until the year 2012-13, which is the final year of runoff measurements at hydrometric stations. Although the WEI+ index for the year 2013-14 could be calculated (where there is information in the dams), for comparative purposes, it was decided that the five-year period should cover the years 2008-09 through 2012-13. Unfortunately, is this way, the very dry hydrological year 2013-14, with a potentially significant impact on the calculation of WEI+, is not taken into account.

The following information is used for the implementation of the WEI+:

- The calculation of runoff is made using the average daily flow measurements at hydrometric stations, as provided by the Hydrology Service of the WDD. These measurements will be incorporated in the OUTFLOW size of the WEI+ as follows: When the hydrometric station is located downstream of any dam and very near the outlet of the hydrological basin (e.g. river basin of r. Dhiarizos with the Arminou dam), in practical terms, the water volume of the flow measurements concerns the part of the basin runoff produced in its section that is located downstream of the dam, since overflows or leaks are non-existent or minimal, provided of course that intermediate abstractions (at least surface abstractions) will be added. If the dam is located very near the outlet of the basin (e.g. Asprokremmos dam, Kouris dam) where the intermediate river basin is to small to produce any notable runoff, the OUTFLOW will be zero, excluding any overflows, leaks through the dam body or water quantities left to refill downstream aquifers without being pumped directly (e.g. Germasogeia dam). In reality it is not zero; however, considering that the surface runoff coefficient in the lowland sections is particularly small, these flows are minimal and will not cause noticeable changes in the overall WEI+. For river basins where no significant dam has been constructed nor is there any hydrometric station with the necessary data, the OUTFLOW will be calculated indirectly, taking any of the above data as the benchmark (i.e. either inflows in the dam or runoff in the hydrometric station) and transferring them to the examined river basin, based on the ratio of surfaces and a factor (usually a reduction factor) including the effect of the mean altitude of the examined river basin in relation to the reference river basin.

- The TWA concerns all abstractions that take place in the river basin, be they from surface waters or groundwater. Abstractions from surface waters also concern dams/reservoirs, whether these concern water consumption (water, irrigation) or are due to diversions to another neighbouring basin. Abstractions from dams are measured and archived accurately by the corresponding Service of the WDD and are used as given to the Contractor. Surface water abstractions from the hydrographic network are calculated as follows: The Hydrometry Service delivered to the Contractor a shape file in the GIS with the point positions of water diversions and abstractions across Cyprus. Water abstractions in the hydrographic network take place mainly for irrigation through the construction of weirs, i.e. small dams vertical to the flow creating the overflow and thus diversion through cement furrows or small pipelines to adjacent irrigation networks. The abstractions in these diversions are rarely measured but, at least for the most significant of them, the surface and the type of crops irrigated by this diversion are provided. The annual irrigation needs arise based on the irrigated land surface on the theoretical water needs (m^3 per decare), as presented in the table below (Table 7-1). These abstractions are increased by 30% to take into account as far as possible abstractions for which there is no information, considering that positions with smaller abstractions will not have been recorded. The table of the diversions shape file presents the logical conclusion that no abstractions occur when the flow in the bed is zero. This evident information cannot be used directly however if there is no hydrometric station near and upstream of this diversion. However, it is considered that the quantity of surface diversion is constant for each hydrological year and equal to the value calculated.

Table 7-1: Water demand for irrigation per decare for each crop

Crop	Water demand (m^3 per decare)	Crop	Water demand (m^3 per decare)
Citrus fruit	720	Beans	450
Deciduous species (lowlands)	750	Pistachios	730
Deciduous species	650	Melons (low greenhouses)	320
Olives	430	Melons	450
Vegetables (spring)	550	Clover	1200
Potatoes (early spring harvest)	210	Table grapes	260
Potatoes (summer)	400	Grass	1300
Greenhouses	600	Ornamental bushes	400
Summer vegetables	450		

Abstractions from groundwater are a much more complex issue, as it is not always clear from which underground aquifer system each abstraction originates, as the Groundwater Bodies (GWBs) delineated in the framework of the WFD sometimes overlap. Therefore, there is an objective difficulty in identifying the GWB from which each abstraction takes place. However, for a first application of the WEI+ index, it would be reasonable to assume that abstractions take place from every GWB cartographically represented on the soil surface in the delineation of the GWBs of the WFD. The water potential for each GWB was defined as presented in the report "Updating of Article 5 of the Framework Water Directive (2000/60/EC) on the Review of Pressures and Impacts of Human Activity on the State of Surface Water and Groundwater, and Article 14(1)(b) for the Review of Significant Water Management issues in Cyprus" carried out on behalf of the WDD in December 2014. Chapter 16 "Abstractions from GWBs" presents the water balances for each of the 19 GWBs delineated before the latest revision. For each GWB we provide the horizontal projection on the soil surface, the natural enrichment from rainfall and river runoff, the abstractions, the underground leaks, and the overexploitation (where appropriate) resulting as the difference between the input of the underground aquifer and its outflows. The abstraction estimates are used for the period after 2000 and until 2008 since we consider that they remain unchanged until the hydrological year 2012-13. All these values will now be classified at a river basin level through a simple operation in GIS where the surface of the river basin above of each GWB is calculated. Based on the ratio of the surfaces, an equal percentage of abstraction from renewable reserves and of overexploitation of the permanent reserves in this specific GWB is classified. As specified in the definition of WEI+ in RWR the abstractions of the permanent reserves must not be taken into account. Since, in practically all GWBs, the renewable water reserves are depleted, and a small or large part of the permanent reserves is pumped, the pumping of renewable reserves should be accumulated in RWR, as a part of the total runoff as well as the surface and underground runoff, which is finally equal to rainfall less actual evapotranspiration less abstractions.

Table 7-2: Groundwater Bodies in Cyprus.

A/A	Initial Code GWB 1° WRMP	Revised GWB Name 2nd WRMP	Name
1	CY-1	CY-1	Kokkinochoria
2	CY-3	CY-3A	Koiti Treminthou
3		CY-3B	Kiti-Pervolia
4	CY-4	CY-4	Softades-Vassilikos
5	CY-5	CY-5	Maroni
6	CY-6	CY-6	Mari-Kalo Chorio
7	CY-7	CY-7	Germasogeia

A/A	Initial Code GWB 1° WRMP	Revised GWB Name 2nd WRMP	Name
8	CY-8	CY-8	Limmasol
9	CY-9	CY-9	Akrotiri
10	CY-10	CY-10	Paramali-Avdimou
11	CY-11	CY-11A	Paphos
12		CY-11B	Koiti Ezoussa
13	CY-12	CY-12	Letimvou-Yiolou
14	CY-13	CY-13	Pegeia
15	CY-14	CY-14	Androlikou
16	CY-15	CY-15A	Chrysochou-Gialia
17		CY-15B	Koiti Chrysochou
18	CY-16	CY-16	Pyrgos
19	CY-17	CY-17	Central & Western Messaoria
20	CY-18	CY-18	Lefkara-Pachna
21	CY-19	CY-19	Troodos

The assumption that the abstractions of permanent groundwater reserves are stable each year is substantially equivalent to assuming that every year the groundwater enrichment is also stable and independent of the rainfall since consumption is stable. This assumption is obviously not correct and is one of the disadvantages of the WEI+ index, however, for simplicity, when applying the index, this assumption is considered as rolling and reduced in the overall five-year period. Besides, as we shall see below, the WEI+ is calculated as a single interannual value, therefore, considering as stable the abstraction from groundwater and surface water per year is not significant for the final index calculation.

ΔS_{art} is the reservoir storage change in a time pace of one hydrological year, i.e. the storage on 1 October of the next year less the storage on 1 October of the current hydrological year. ΔS_{art} accepts positive values as the storage in the reservoir increases and negative values as the storage is reduced. Based on the relationship determining the RWR, it results that the ratio of renewable reserves decreases as the storage increases. This conclusion makes it difficult to translate the index, as in interannual adjustment reservoirs it is reasonable to store water in the case of wet hydrological years with increased aquifer conditions and make it available in dry periods. That RWR factor may be small in wet periods of increased storage and higher in dry periods where the volumes stored may be released from previous wet periods. This automatically creates a distortion of the WEI+ index, where in wet periods with great storage in large reservoirs (e.g. Kouris dam) the WEI+ index presents considerable pressure in the water resources, while in dry years, when the volumes stored are released, the WEI+ index is less than expected. The meaning of the negative value may be that, when there is storage in a reservoir, the stored water is considered to be part of the upstream basin runoff, but, since it is not used to satisfy any water needs, then it should be removed from the RWR. In this case, ΔS_{art} increases, RWR is reduced, and thus the WEI+ index increases within that hydrological year.

However, in hydrological years with release of water volumes stored in previous years, it means that the volume of water released from the reservoir is intended to cover water needs so it should be added to the RWR. As a matter of fact, in periods of release of stored water resources, ΔS_{art} falls; as a result, RWR increases while the WEI+ index decreases.

When there are diversions from a basin to another through dams, i.e. when the diversion is channeled to the dam retention basin, it is clear that the diverted amount is not part of the basin RWR, the water potential whereof is enhanced by the diverted quantities. If those are not removed, the ABSTR_DAM quantity representing the abstractions from the Kouris dam and added together to calculate the RWR will include the diverted quantities, leading to an overestimation of the RWR with water quantities not included in the runoff of the same basin. On the other hand, the destination basin presents abstractions which however are not only due to the runoff of this basin. Based on the relevant documents, we propose that diverting quantities should be included in the final value of ΔS_{art}, without proposing any specific method of calculation. It should be noted again that the WEI+ index is still under development, at least in regard to complex hydrologic systems. Since the change of ΔS_{art} should lead to a reduction of RWR (based on the above), then the diverted quantities should be added to the ΔS_{art} since according to the RWR calculation formula, ΔS_{art} is negative in RWR. Therefore, to reduce the RWR, ΔS_{art} should increase equally. If the abstractions from the dam are less than the diversions, then the difference “diversions - abstractions” should be removed from the RWR. Please note that the new method of determination is not explicitly stated in the relevant EU texts, but it is a proposal of the Consultant. It is likely that the final configuration of the index calculation method will require an update on the estimates presented here.

If we divert water resources from one basin to another directly for consumption for any relevant use then there is no way that this consumption corresponds as a parameter of the WEI+ in the destination basin. This would be feasible only if the drought index included the demand and the corresponding demand coverage either from exclusively local water resources either by diverting water resources. For example, it is not possible to find which river basin a cubic meter consumed in Kokkinochoria area, or a cubic meter of water consumed in the Nicosia area comes from. This water volume is considered abstraction from the basin of origin (as ABSTR_DAM), but cannot be assigned in any way to the destination basin as a WEI+ parameter, unless somehow classified as part of RWR as in the case of the basin of Kouris river, where the Kouris dam itself directly receives a part of the runoff of the Arminou dam (Dhiarizos river basin) and of the diversion to Chapotami.

Regarding desalination, it is clear that they are not part of the available (freshwater) resources and the available natural runoff, but it is a question whether the needs covered by it should be taken into account or not. Given the approach to water transfer, it is proposed not to take account of these needs, since they do not exert pressure in the same river basin.

Finally, with regard to recycling water, the question arises whether the needs covered met by it should be taken into account or not. Given that:

- Abstractions include abstractions for both first use (e.g. water supply) and second use (in this case irrigation), and
- Recycled water covering the second use is actually return, and should thus be deducted from the abstractions

So we may as well ignore abstraction for irrigation with recycled water[10]. Furthermore, the water return from recycling is considered negligible since:

- recycled water comes at an important part from the treatment of waste water from irrigation with desalinated water, which has been excluded from the calculations above, and
- recycled water covers a relatively small percentage of total water consumption[11].

Particularly in the case of the Southern Conveyor project and the Paphos Project, where desalinated water is channelled directly to the pipes and therefore these quantities cannot be assigned to a particular river basin. However, if the quantity is stored in a reservoir, it should be removed from the ΔS_{art} of the reservoir, in the same way that diversions in dams are treated.

The following paragraphs analyse the method of calculating the WEI+ index for each hydrologic region and for each river basin. In the following tables, the parameters are codified as follows:

- ABSTR_GW: Total groundwater abstractions, including renewable and permanent reserves (if there are abstractions from the permanent reserves).
- ABSTR_PERM: Groundwater abstractions corresponding to permanent reserves. The difference between ABSTR_GW and ABSTR_PERM corresponds to abstractions from renewable reserves and is calculated in the RWR.
- ABSTR_DAM: Abstractions of water stored in reservoirs only for irrigation or water supply purposes, i.e. when these quantities leave the body of water. Abstractions for refilling aquifers and/or leaks from the dam body are considered as OUTFLOW.
- ABSTR_SF: Surface water abstractions directly from the hydrographic network through overflow and diversion projects (not from boreholes drilled in the riverbed).

[10] the abstractions for irrigation are calculated as such only from fresh (surface or underground) water

[11] It must be noted that recycling covers 26% of irrigation water from GWPs, which cover about 25% of total irrigation needs, so recycling covers about 7% of the irrigation needs, representing approximately 5% of total needs.

- ΔSart: The change in storage in reservoirs during the time step of the calculations, i.e. the hydrologic year. The ΔSart quantity becomes positive as storage increases and negative as storage decreases.
- RETURN: The percentage of consumed water that returns to the system as runoff suitable for any kind of use (e.g. returns from drainage networks). It was considered that this amount would be zero in the area of Cyprus, as the drainings from irrigation networks are considered to be bound by the upper soil layer and evaporate before their runoff to the main hydrographic network is possible. Moreover, because in Cyprus there are projects for water transfer from one river basin to another (e.g. the Southern Conveyor project), is not clear which river basin produces the flow and in which river basin water consumption and the resulting return take place. For example, a significant part of the irrigation water in the region of Kokkinohoria (Hydrologic Region 7) comes from the basins supplying the Southern Conveyor project. Therefore, it would be wrong to apply the return of irrigation water in Hydrologic Region 7, as the irrigation water has been “produced” in another river basin.
- OUTFLOW: The amount of surface runoff flowing to the outlet of the basin and measured either at the locations of the hydrometric stations (if they are installed at the outlet of river basins) or downstream of dams, if and where overflows are recorded. Finally, the quantities left from dams as downstream flow to underground aquifers but also leaks through the dam body, where the dam is located very close to the sea, are also calculated as OUTFLOW. If there is a hydrometric station downstream of the dam, it is considered that the above amounts are part of the runoff measured at the hydrometric station and therefore the aggregation of these quantities is not required.

7.3.3 CALCULATION OF THE WEI+ INDEX IN HYDROLOGIC REGION 1

Hydrologic Region 1 comprises the surrounding area of Paphos, which includes the following river basins, for which the WEI+ index is calculated (from east to west):

1. Cha-Potami River Basin with a river basin surface of 114.7 km^2.
2. River Basin of R. Dhiarizos with a river basin surface of 278.2 km^2.
3. River Basin of R. Xeros
4. River Basin of R. Ezousa with a river basin surface of 238.6 km^2.
5. Geroskipou River Basin with a river basin surface of 91.1 km^2.
6. River Basin of R. Mavrokolympos with a river basin surface of 59.3 km^2.
7. Pegeia River Basin with a river basin surface of 35.0 km^2.
8. Avga River Basin with a river basin surface of 53.2 km^2.

9. Western Akamas River Basin with a river basin surface of 43.9 km^2.

The total surface of Hydrologic Region 1 is 1173.5 km^2 and average altitude is the next paragraphs summarise the calculations for each river basin and Figure 7-1 presents the relevant map with all necessary information for the development of WEI+ calculations.

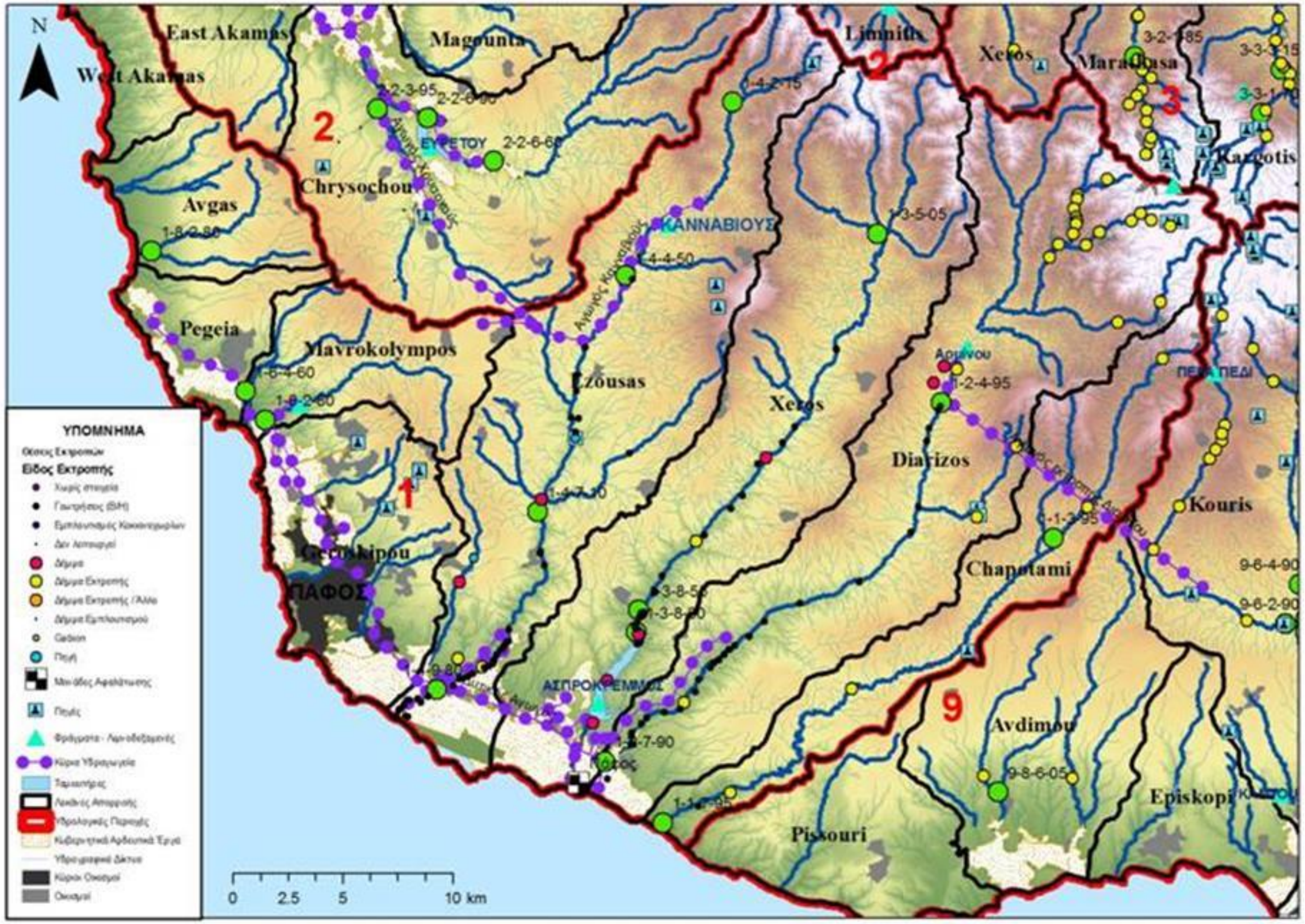

Figure 7-1: Map of Hydrologic Region 1 (Paphos Area) with positions of dams, diversions and hydrometric stations.

Cha-Potami River Basin: No significant has been constructed in this basin, except for the small diversion dam of part of the runoff through the Dhiarizos Tunnel (from the Arminou Dam) to the Kouris dam. Diversions to the Kouris dam are not systematically and accurately measured and it is only known that 99,700 m^3 and 325,660 m^3 were respectively diverted during the hydrological years 2010-11 and 2011-12. Hydrometric station r1-1-7-95_Chapotami near Kouklia Pafou has been installed at the outlet of the river basin; this is considered reliable and the measurement samples reach up to the hydrological year 1999-2000. Measurements for recent years resulted by filling in from the r1-1-3-95_Chapotami near Kissousa station (hydrometric station located in the upstream part of the river basin) until the year 2009-10 and until 2012-13 from hydrometric station r1 -2-7-90_Dhiarizos near Kouklia Pafou. Therefore, the OUTFLOW parameter of RWR is equal to the runoff in said hydrometric station. No project for the utilisation of water resources has been constructed in the river basin, with the exception of the small Sotiras (or Symvoulou) dam, which serves the adjacent tourist facility of Happy Valley, including the Aristou Development golf facilities (see below). There is no information on the overall storage capacity of the corresponding reservoir, but is estimated to be small, given that annual abstractions amount to 300,000 m^3. Assuming that the volume of the reservoir is small, the parameter ΔSart is assumed to be zero.

Abstractions directly from the hydrographic network (except for the diversions of the Dhiarizos tunnel mentioned above) are also 300,000 m^3 a year for the irrigation of the Aristou Dev. golf courses and about 80 decares for seasonal use and orchards for which data were available. As regards the GWBs, the Cha-Potami river basin intersects three GWBs, namely (a) CY_11-A - Paphos, (b) CY_18 - Lefkara - Pachna and (c) CY_19 - Troodos. The following table (Table 7-3) presents the calculation sheet of the annual WEI+ index for the river basin of Cha-potami. The mean WEI+ is 20.9%, denoting an area that is not under pressure on water resources, but there are hydrological years with a significantly greater WEI+ index. In a relatively dry year (2010-11), the annual index is greater than 100% because abstractions are considered stable for all hydrological years, representing an undeniable drawback of the approach.

Table 7-3: Calculation of the annual WEI+ in the river basin of Cha-Potami.

CATCHMENT CHAPOTAMI									
Hydrologic Year (Volumes in hm³)	WEI+	RWR	ABSTR_GW	ABSTR_SF	ABSTR_PERM	RETURN	OUTFLOW	ΔSart
2008-09	58.87%	3.334	1.599	0.363	0.43	0.000	1.799	0.000
2009-10	39.95%	4.912	1.599	0.363	0.43	0.000	3.377	0.000
2010-11	118.45%	1.741	1.599	0.463	0.43	0.000	0.106	0.000
2011-12	8.15%	28.088	1.599	0.689	0.43	0.000	26.227	0.000
2012-13	17.86%	10.992	1.599	0.363	0.43	0.000	9.456	0.000
2013-14								
AVERAGE	20.87%	9.814	1.60	0.45	0.43	0.00	8.19	0.00
INTERANNUAL WEI+: 20.9%								

River Basin of Dhiarizos: The 4.3 hm³ Arminou Dam has been constructed in this river basin, which serves for diverting part of the basin runoff to the Kouris dam (Hydrologic Region 9) through the Dhiarizos Tunnel. Diversions to the Kouris dam are the only abstractions of the Arminou dam and are calculated to have an annual volume of 14.8 hm³ of water. Other smaller volumes are available from the Arminou dam for refilling the aquifer in the downstream riverbed of r. Dhiarizos.

Outflows in the river basin of r. Dhiarizos are measured at the outlet of the basin, at the location of the hydrometric station r1-2-7-90_Diarizos near Kouklia Pafou; therefore, the OUTFLOW is equal to the runoff in this position. Data on abstractions from the irrigation network were taken from the shapefile, where the available information indicates diversions for the irrigation of a total of 2200 decares with tree and seasonal crops. The ΔSart arises from the data on the stored volumes of the dam at the beginning and end of each hydrological year. Abstractions from the underground aquifer (renewable and permanent) arise from the previous methodology where the river basin of r. Dhiarizos intersects the GWBs (a) CY_11-A - Paphos, (b) CY_18 - Lefkara - Pachna and (c) CY_19 - Troodos.

The following table (Table 7-4) presents the calculation sheet of the annual WEI+ index for the river basin of r. Dhiarizos. The mean WEI+ is 75%, denoting an area that is under significant pressure on water resources, but there are hydrological years with a significantly smaller WEI+ index. In relatively dry years (compared to the others), the annual index is greater than 100% because abstractions are considered stable for all hydrological years.

Table 7-4: Calculation of the annual WEI+ in the river basin of r. Dhiarizos.

DHIARIZOS CATCHMENT (ARMINOU DAM)									
Hydrologic Year (Volumes in	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart

hm³)									
2008-09	109.97%	20.24	3.42	1.673	17.16	0.38	0.000	1.329	2.964
2009-10	88.72%	30.69	3.42	1.673	22.14	0.38	0.000	3.691	-0.153
2010-11	103.56%	14.63	3.42	1.673	10.06	0.38	0.000	0.103	0.241
2011-12	61.61%	72.33	3.42	1.673	39.47	0.38	0.000	28.222	0.07
2012-13	61.41%	42.50	3.42	1.673	21.01	0.38	0.000	15.776	-1.01
2013-14									
AVERAGE	75.00%	36.08	3.42	1.67	21.97	0.38	0.00	9.82	0.42
INTERANNUAL WEI+: 75.0%									

River Basin of R. Xeros: The Asprokremmos dam, with a usable volume of 52.4 hm^3 of water, has been constructed in this basin already in 1982. The dam is constructed very near the outlet of the hydrological basin into the sea and therefore the OUTFLOW is considered zero, with the exception of water leaks through the dam body. The Asprokremmos dam is one of the largest dams in Cyprus and the main supplier of the Paphos Irrigation Project.

Since the hydrological year 2010-2011, the Asprokremmos reservoir is boosted by the newly constructed Kannavia dam, located in the upper course of the river basin of r. Ezousa. As discussed in the methodological approach of the WEI+ index, because these quantities do not belong to the water potential of the basin itself, they should be removed from the water resources of the basin of r. Xeros, so that the RWR index will be smaller. This is done by respectively changing the ΔSart parameter, by adding for each hydrological year the water quantities diverted to the Asprokremmos dam after deducting the ΔSart from the RWR, so the ΔSart should be increased in order to reduce the RWR (as diverted quantities will not be taken into account). However, the quantities diverted are small with an average 0.39 hm^3 for the years 2011, 2012 and 2013, while in 2014 the corresponding quantities are zero. In the shapefile showing the positions of abstractions on the main riverbed of r. Xeros, while they are many in terms of numbers of points, however, they relate to groundwater boreholes near the riverbed of r. Xeros used for the water supply of Paphos. We believe that these quantities are included in abstractions from yearly underground renewable sources and therefore abstractions directly from the riverbed of r. Xeros amounted to 62,300 m^3 from the local irrigation association. Abstractions from the underground aquifer (renewable and permanent) arise from the previous methodology where the river basin of r. Xeros intersects the GWBs (a) CY_11-A - Paphos, (b) CY-12 - Letymbou-Giolou, (c) CY_18 - Lefkara - Pachna and (d) CY_19 - Troodos. The following table (Table 7-5) presents the calculation sheet of the annual WEI+ index for the river basin of r. Xeros, highlighting the methodological weaknesses in the calculation of the WEI+ index. During the hydrological year 2009-10, there was a particularly significant storage of water, as during this hydrological year the reservoir stored approximately 18.5 hm^3 of water, which per se constitutes a very significant proportion of the water resources of the basin. Because the positive value of ΔSart is deducted from annual renewable sources, the value of RWR becomes negative, leading to an extensively negative (in absolute terms) value of WEI+. In any event, when there is significant interannual storage, the calculation of the annual WEI+ becomes problematic. The OUTFLOW is equal to outflows from the dam to the downstream part of the main branch.

Table 7-5: Calculation of the annual WEI+ in the river basin of r. Xeros.

XEROS CATCHMENT (ASPROKREMMOS DAM)									
Hydrologic Year (Volumes in hm^3)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	293.67%	6.33	12.06	0.081	6.46	0.23	0.000	0.127	12.16
2009-10	2123.28%	0.91	12.06	0.081	7.27	0.23	0.000	0.168	18.44
2010-11	108.91%	16.94	12.06	0.081	6.31	0.23	0.000	0.201	1.48
2011-12	268.16%	7.49	12.06	0.081	7.94	0.23	0.000	0.141	12.50
2012-13	99.10%	20.31	12.06	0.081	7.99	0.23	0.000	0.131	-0.28
2013-14	62.66%	38.58	12.06	0.081	12.04	0.23	0.000	0.084	-14.55
AVERAGE	133.43%	15.09	12.06	0.08	8.00	0.23	0.00	0.14	4.96
INTERANNUAL WEI+: 133.4%									

River Basin of R. Ezousa: The Kannavia dam, with a usable volume of 18.0 hm^3 of water, has been constructed in the upper course of the river basin, already in 2004. The Kannavia dam is part of the system of the Paphos project, enhances the water potential of the Asprokremmos dam with some water quantities, while some smaller ones are made available for filling the aquifers of the riverbed of r. Ezousa. The flows measured at the outlet of the basin and at the position of hydrometric station r1-4-9-80_Ezousas near Acheleia are taken as OUTFLOW, which is considered to also record outflows for refilling the Kannavia dam.

Water abstractions from the dam are recorded in the column ABSTR_DAM. In the shapefile showing the positions of abstractions on the main riverbed of r. Ezousa, while they are many in terms of numbers of points, however, they relate to groundwater boreholes near the riverbed of r. Ezousa used for the water supply of Paphos and for irrigation. We believe that these quantities are included in abstractions from yearly underground renewable sources and therefore abstractions directly from the riverbed of r. Ezousa amount to 1,500 m^3 from a local diversion for the irrigation of Paphos and the Mavrokolympos dam (as stated in the handwritten files).

Abstractions from the underground aquifer (renewable and permanent) arise from the previous methodology where the river basin of r. Dhiarizos intersects the GWBs (a) CY_11-A - Paphos, (b) CY_11-B - Ezousa River, (c) CY-12 - Letymbou-Giolou, (d) CY_18 - Lefkara - Pachna and (e) CY_19 - Troodos. The following table (Table 7-6) presents the calculation sheet of the annual WEI+ index for the river basin of r. Ezousa, highlighting the methodological weaknesses in the calculation of the WEI+ index. The interannual WEI+ index is 50.6%.

Table 7-6: Calculation of the annual WEI+ in the river basin of r. Ezousa.

EZOUSA CATCHMENT (KANNAVIOUS DAM)									
Hydrologic Year (Volumes in hm^3)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	242.20%	2.33	4.15	0.002	1.49	1.086	0.000	3.666	5.892
2009-10	59.52%	15.46	4.15	0.002	5.05	1.086	0.000	9.495	2.15
2010-11	89.51%	10.10	4.15	0.002	4.89	1.086	0.000	1.310	-0.836
2011-12	26.60%	42.03	4.15	0.002	7.03	1.086	0.000	33.576	1.644
2012-13	52.25%	21.47	4.15	0.002	7.07	1.086	0.000	10.921	-0.416
2013-14									
AVERAGE	50.65%	18.28	4.15	0.00	5.11	1.09	0.00	11.79	1.69
INTERANNUAL WEI+: 50.6%									

River Basin of R. Geroskipou: There has been no water resource storage or exploitation project constructed in this basin, which comprises the city of Paphos. There seem to be significant abstractions from the underground aquifer, as the river basin "sits" on Groundwater Body C_11A of the coastal aquifer of Paphos. The OUTFLOW arises in connection with the corresponding Mavrokolympos basin (see below) with an additional impairment of 20% because the basin terrain is lower than Mavrokolympos. The following table (Table 7-7) presents the calculation sheet of the annual WEI+ index for the river basin of r. Geroskipou.

Table 7-7: Calculation of the annual WEI+ in the river basin of r. Geroskipou.

GEROSKIPOU CATCHMENT									
Hydrologic Year (Volumes in hm^3)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	79.29%	4.22	3.35	0.00	0.00	0.10	0	0.977	0.00
2009-10	99.51%	3.37	3.35	0.00	0.00	0.10	0	0.118	0.00
2010-11	70.68%	4.74	3.35	0.00	0.00	0.10	0	1.491	0.00
2011-12	92.86%	3.61	3.35	0.00	0.00	0.10	0	0.359	0.00
2012-13	93.21%	3.59	3.35	0.00	0.00	0.10	0	0.346	0.00
2013-14	53.53%	6.26	3.35	0.00	0.00	0.10	0	3.009	0.00
AVERAGE	85.75%	3.91	3.349	0.000	0.000	0.102	0.000	0.658	0.000
INTERANNUAL WEI+: 85.7%									

River Basin of R. Mavrokolympos: The Mavrokolympos dam, with a usable volume of 2.2 hm^3 of water, which is part of the Paphos Project, has been constructed in the river basin already in 1966. The reservoir receives part of the runoff of the Kannavia dam, so these quantities are also deducted from ΔSart. The Mavrokolympos dam has been constructed at the outlet of the basin to the sea so (in direct reference to what has been stated for the Asprokremmos dam) the interannual WEI+ index is expected to be at the 100% threshold. The OUTFLOW downstream of the dam is equal to the outflows, but there is another branch of the hydrographic network that flows freely into the sea without a water reservoir project. The runoff of the other branch of the total basin results from the annual inflows of the Mavrokolympos dam on the ratio of the two surfaces on a reduction factor of the runoff coefficient (of 0.80), due to the fact that the river basin of the dam has a higher average altitude from the other. Abstractions directly from the hydrographic network appear to be zero. Abstractions from the underground aquifer (renewable and permanent) arise from the previous methodology where the river basin of r. Mavrokolympos intersects the GWBs (a) CY_11 - Paphos, (b) CY-12 - Letymbou-Giolou, and (c) CY_18 - Lefkara - Pachna. The following table (Table 7-8) presents the calculation sheet of the annual WEI+ index for the river basin of r. Ezousa, highlighting the methodological weaknesses in the calculation of the WEI+ index. The interannual WEI+ index is 160.2%, i.e. higher than 100%, due to the continuous pumping of permanent underground reserves.

Table 7-8: Calculation of the annual WEI+ in the river basin of r. Mavrokolympos.

MAVROKOLYMPOS CATCHMENT (MAVROKOLYMPOS DAM)									
Hydrologic Year (Volumes in hm^3)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	-282.10%	-0.57	0.978	0	0.640	0.394	0	0.220	2.017
2009-10	152.93%	1.34	0.978	0	1.070	0.394	0	0.027	0.341
2010-11	91.92%	2.32	0.978	0	1.152	0.394	0	0.336	-0.246
2011-12	164.05%	1.49	0.978	0	1.465	0.394	0	0.081	0.640
2012-13	117.92%	2.16	0.978	0	1.565	0.394	0	0.078	0.07
2013-14	73.50%	3.45	0.978	0	1.555	0.394	0	0.679	-0.629
AVERAGE	160.24%	1.35	0.978	0.000	1.178	0.394	0.000	0.148	0.564
INTERANNUAL WEI+: 160.2%									

River Basin of R. Avgas. There has been no water resource storage or exploitation project constructed in this basin. The following table (Table 7-9) presents the calculation sheet of the annual WEI+ index for the river basin of r. Avgas.

Table 7-9: Calculation of the annual WEI+ in the river basin of r. Avgas.

AVGAS CATCHMENT									
Hydrologic Year (Volumes in hm^3)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	64.17%	1.59	1.019	0.00	0.00	0.002	0.00	0.571	0.00
2009-10	93.80%	1.09	1.019	0.00	0.00	0.002	0.00	0.069	0.00
2010-11	53.96%	1.89	1.019	0.00	0.00	0.002	0.00	0.871	0.00
2011-12	83.04%	1.23	1.019	0.00	0.00	0.002	0.00	0.210	0.00
2012-13	83.57%	1.22	1.019	0.00	0.00	0.002	0.00	0.202	0.00
2013-14	36.71%	2.78	1.019	0.00	0.00	0.002	0.00	1.758	0.00
AVERAGE	72.69%	1.40	1.019	0.000	0.000	0.002	0.000	0.385	0.000
INTERANNUAL WEI+: 72.7%									

River Basin of R. Pegeia: There has been no water resource storage or exploitation project constructed in this basin. This basin is a marginal river basin without any human activity generating abstractions on its water resources. The OUTFLOW arises in connection with the corresponding Mavrokolympos basin with an additional impairment of 20% because the basin terrain is lower than Mavrokolympos. The following table (Table 7-10) presents the calculation sheet of the annual WEI+ index for the river basin of r. Pegeia.

Table 7-10: Calculation of the annual WEI+ in the river basin of r. Pegeia.

PEGEIA CATCHMENT									
Hydrologic Year (Volumes in hm³)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	84.75%	1.82	1.54	0.00	0.00	0.10	0.00	0.375	0.00
2009-10	103.48%	1.49	1.54	0.00	0.00	0.10	0.00	0.045	0.00
2010-11	76.46%	2.02	1.54	0.00	0.00	0.10	0.00	0.573	0.00
2011-12	97.44%	1.58	1.54	0.00	0.00	0.10	0.00	0.138	0.00
2012-13	97.75%	1.58	1.54	0.00	0.00	0.10	0.00	0.133	0.00
2013-14	59.32%	2.60	1.54	0.00	0.00	0.10	0.00	1.156	0.00
AVERAGE	90.85%	1.70	1.543	0.000	0.000	0.097	0.000	0.253	0.000
INTERANNUAL WEI+: 90.9%									

River Basin of R. Western Akamas: There has been no water resource storage or exploitation project constructed in this basin. This basin is a marginal river basin without any human activity generating abstractions on its water resources. The OUTFLOW arises in connection with the corresponding Mavrokolympos basin with an additional impairment of 40% because the basin terrain is lower than Mavrokolympos. The following table (Table 7-11) presents the calculation sheet of the annual WEI+ index for the river basin of r. Western Akamas. Obviously, as there are no abstractions, it is not possible to calculate the WEI+. but only the RWR.

Table 7-11: Calculation of the annual WEI+ in the river basin of r. Western Akamas.

WEST AKAMAS CATCHMENT									
Hydrologic Year (Volumes in hm³)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	0.00%	0.35	0.00	0.00	0.00	0.00	0.00	0.353	0.00
2009-10	0.00%	0.04	0.00	0.00	0.00	0.00	0.00	0.043	0.00
2010-11	0.00%	0.54	0.00	0.00	0.00	0.00	0.00	0.538	0.00
2011-12	0.00%	0.13	0.00	0.00	0.00	0.00	0.00	0.130	0.00
2012-13	0.00%	0.12	0.00	0.00	0.00	0.00	0.00	0.125	0.00
2013-14	0.00%	1.09	0.00	0.00	0.00	0.00	0.00	1.086	0.00
AVERAGE	0.00%	0.24	0.000	0.000	0.000	0.000	0.000	0.238	0.000
INTERANNUAL WEI+: 0.0%									

The following table (Table 7-12) calculates the WEI+ index for the entire hydrologic region 1. The total interannual WEI+ index is equal to 76%, showing that the water resources of Hydrologic Region 1 are subject to significant pressure.

Table 7-12: Calculation of the annual average WEI+ index of Hydrologic Region 1

HYDROLOGIC REGION 1									
	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
	75.78%	87.85	28.1	2.20	36.25	2.72	0.00	31.63	7.63

Finally, we attempted to calculate the total runoff coefficient (surface and underground), which can be defined as the quotient of RWR to the average annual rainfall. The average annual rainfall for the five hydrological years is equal to 689.5 mm. The surface of the hydrologic region is equal to 1173.5 km^2 and therefore, the runoff coefficient is equal to 10.9%.

7.3.4 CALCULATION OF THE WEI+ INDEX IN HYDROLOGIC REGION 2

Hydrologic Region 2 comprises the surrounding area of Chrysochou, which includes the following river basins, for which the WEI+ index is calculated (from east to west):

1. Eastern Akamas River Basin with a river basin surface of 67.3 km^2.
2. Chrysochou River Basin with a river basin surface of 205.2 km^2.
3. River Basin of R. Makounta with a river basin surface of 141.1 km^2.
4. River Basin of R. Xeros with a river basin surface of 67.8 km^2.
5. River Basin of R. Kosina with a river basin surface of 36.6 km^2.
6. River Basin of R. Katouri with a river basin surface of 36.1 km^2.
7. River Basin of R. Pyrgos with a river basin surface of 57.4 km^2.
8. River Basin of R. Limnitis with a river basin surface of 91.1 km^2.
9. River Basin of R. Campos with a river basin surface of 51.3 km^2.

The next paragraphs summarise the calculations for each river basin and Figure 7-2 presents the relevant map with all necessary information for the development of WEI+ calculations. The most important project of water resources utilization for Hydrologic Region 2 is the irrigation project of Chrysochou, which includes the largest water reservoir project in the area, namely the Evretou dam, which was constructed in 1986 and has a useful capacity of 24 hm^3 of water. Hydroloc Region 2 has significant hydrologic potential, while abstractions, although significant are much lower than those of Hydrologic Regions 1, 8 and 9.

River Basin of R. Chrysochou: The Evretou dam, with a usable volume of 24 hm^3 of water, which is part of the Crysochou Project, has been constructed in the river basin already in 1986. The Evretou dam is constructed in the middle course of one of the two branches of the basin (r.

Stavros tis Psokas), therefore the OUTFLOW quantity will be significant and is recorded by the hydrometric station r2-2-8-95_Chrysochou near Coast, after supplementing the data of the station through organic correlation with other hydrometric stations of the wider study area. The quantities ABSTR_DAM and ΔSart are transferred from the water balance data of the dam. The average annual water abstraction for irrigation from the Evretou reservoir amount to 3.3.hm^3. Small amounts of water are diverted to enhance irrigation projects supplied by the dams Pomos, Argaka and Ayia Marina and are not directly enhanced by these dams. No points of surface water abstraction from the hydrographic network are recorded, hence said amount is zero. Abstractions from the underground aquifer (renewable and permanent) arise from the previous methodology where the river basin of r. Chrysochou intersects GWB (a) CY-12 - Letymbou-Giolou, (b) CY-14 Androlikou, (c) CY-15 Chrysochou - Gialia, and (d) CY_18 - Lefkara - Pachna. The following table (Table 7-13) presents the calculation sheet of the annual WEI+ index for the river basin of r. Chrysochou, highlighting the methodological weaknesses in the calculation of the WEI+ index. The interannual WEI+ index is 122.7%.

Table 7-13: Calculation of the annual WEI+ in the river basin of r. Chrysochou.

CHRYSOCHOU CATCHMENT (EVRETOU DAM)									
Hydrologic Year (Volumes in hm^3)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	555.22%	1.01	2.329	0	3.26	0.833	0.00	2.018	5.766
2009-10	223.35%	2.66	2.329	0	3.62	0.833	0.00	2.041	4.492
2010-11	85.65%	7.09	2.329	0	3.74	0.833	0.00	1.502	-0.348
2011-12	107.90%	5.81	2.329	0	3.94	0.833	0.00	5.661	5.287
2012-13	78.54%	8.01	2.329	0	3.96	0.833	0.00	2.541	-0.010
AVERAGE	122.74%	4.91	2.329	0.000	3.703	0.833	0.000	2.753	3.037
INTERANNUAL WEI+: 122.7%									

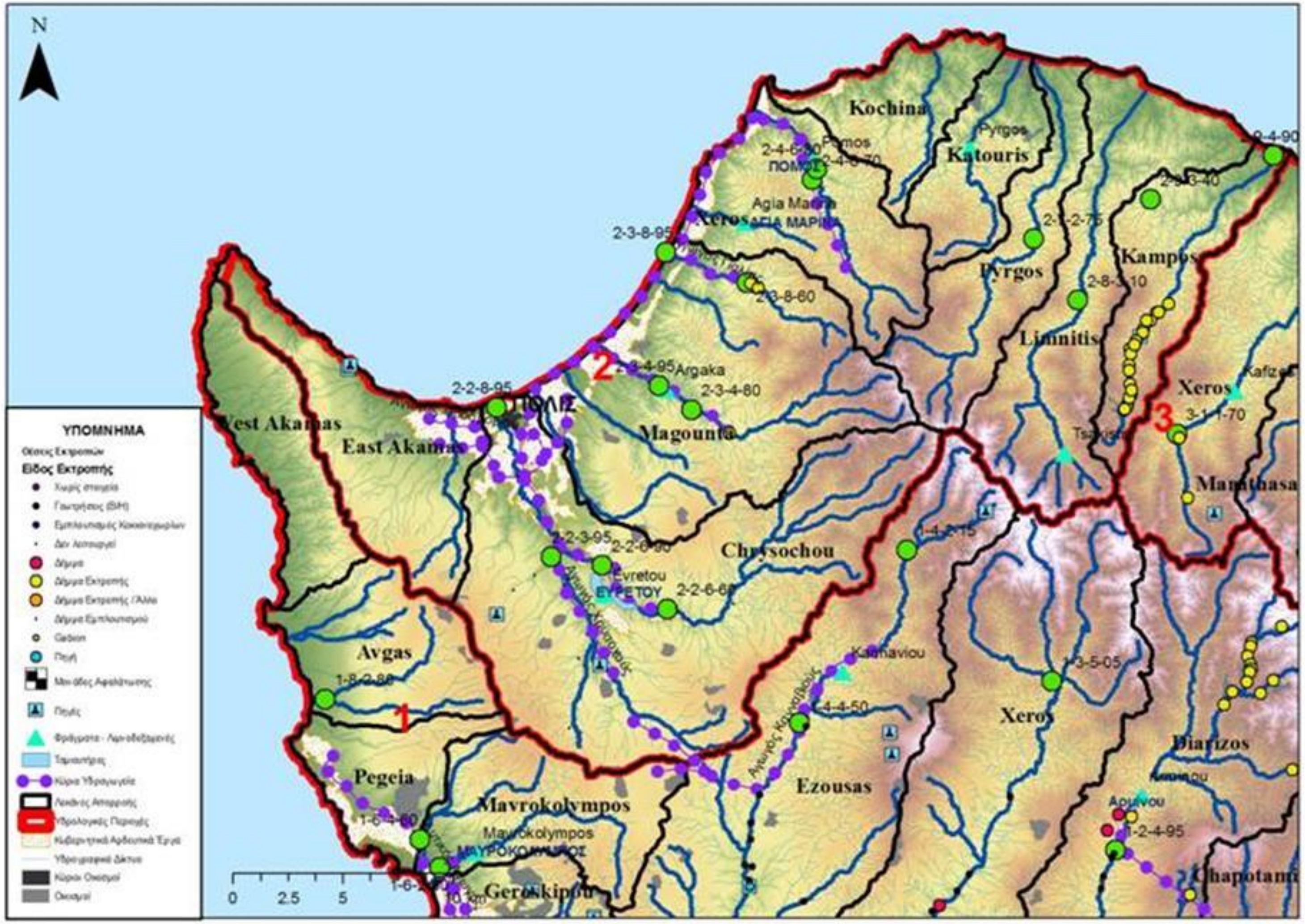

Figure 7-2: Map of Hydrologic Region 2 (Chrysochou Area) with positions of dams, diversions and hydrometric stations.

River Basin of R. Makounta: The Argaka dam, with a usable volume of 999,000 m^3 of water, has been constructed in the main branch of the river basin, in 1964. As mentioned above, the irrigation project that is supplied by the Argaka reservoir is enhanced directly by the Evretou dam with small amounts of water. Runoff to other branches arises from the inflow to the dam and on the basis of matching the surfaces on a reduction factor of the runoff coefficient (equal to 0.8) There is no water balance data for the Argaka dam for hydrologic years 1994-95 and 1995-96.

Two important points of surface water abstractions from the hydrographic network are recorded, based on handwritten reports (Diversion Weir of Agios Merkourios and Diversion Weir of Gialia), where the respective amount is recorded. Abstractions from the underground aquifer (renewable and permanent) arise from the previous methodology where the river basin of r. Makounta intersects (a) CY-15 Chrysochou - Gialia, and (b) CY_19 - Troodos. The following table (Table 7-14) presents the calculation sheet of the annual WEI+ index for the river basin of r. Makounta. The interannual WEI+ index is 56.2%.

Table 7-14: Calculation of the annual WEI+ in the river basin of r. Makounta.

MAKOUNTA CATCHMENT (MAKOUNTA DAM)									
Hydrologic Year (Volumes in hm^3)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	59.56%	4.94	1.245	1.699	1.064	0.105	0	0.667	-0.372
2009-10	72.44%	3.71	1.245	1.444	0.969	0.105	0	0.156	-0.003
2010-11	65.35%	3.94	1.245	1.328	0.988	0.105	0	0.476	-0.005
2011-12	41.23%	3.71	1.245	0.283	1.015	0.105	0	1.324	0.056
2012-13	39.44%	3.39	1.245	0.091	0.915	0.105	0	1.217	-0.023
2013-14	40.94%	3.04	1.245	0.000	0.952	0.105	0	0.214	-0.735
AVERAGE	56.23%	3.94	1.245	0.969	0.990	0.105	0.000	0.060	0.768
INTERANNUAL WEI+: 56.2%									

River Basin of R. Xeros: The dams of Pomos and Agia Marina, with usable capacity of 860,000 m^3 and 290,000 m^3 of water respectively, have been constructed since 1965. Irrigation projects supplied by these dams are enhanced directly by the Evretou dam with small amounts of water. Direct abstractions from the hydrographic network are zero while the OUTFLOW is minimal, as these dams have been built at the outlet of both branches of the basin while leaks from the body of the dams are accounted as RETURN.

Abstractions from the underground aquifer (renewable and permanent) arise from the previous methodology where the river basin of r. Xeros intersects (a) CY-15 Chrysochou - Gialia, and (b) CY_19 - Troodos. The following table (Table 7-15) presents the calculation sheet of the annual WEI+ index for the river basin of r. Xeros. The interannual WEI+ index is 97.2%.

Table 7-15: Calculation of the annual WEI+ in the river basin of r. Xeros.

XEROS CATCHMENT POMOS & AYIA MARINA DAMS)									
Hydrologic Year (Volumes in hm^3)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	-799.77%	-0.21	0.768	0	0.948	0.065	0.000	0.380	0.131
2009-10	-634.57%	-0.29	0.768	0	1.103	0.065	0.000	0.370	0.135
2010-11	-1046.39%	-0.17	0.768	0	1.009	0.065	0.000	0.318	0.135
2011-12	-879.21%	-0.21	0.768	0	1.041	0.065	0.000	0.295	0.137
2012-13	-670.84%	-0.29	0.768	0	1.179	0.065	0.000	0.258	0.135
2013-14	234.80%	0.54	0.768	0	0.508	0.065	0.000	0.545	0.122
AVERAGE	97.16%	1.88	0.768	0.000	1.056	0.065	0.000	0.324	0.135
INTERANNUAL WEI+: 97.2%									

River Basin of R. Kosina: No dam has been constructed in this basin and no abstractions are performed directly from the hydrographic network. Runoff as OUTFLOW arises as a percentage of the surfaces with the river basin of the hydrometric station r2-7-2-75_Pyrgos near Fleva with a further impairment of 40% due to the terrain.

Abstractions from the underground aquifer (renewable and permanent) arise from the previous methodology where the river basin of r. Kosina intersects CY_19 - Troodos. The following table (Table 7-16) presents the calculation sheet of the annual WEI+ index for the river basin of r. Kosina. The interannual WEI+ index is 9.9%.

Table 7-16: Calculation of the annual WEI+ in the river basin of r. Kosina.

KOSINAS CATCHMENT									
Hydrologic Year (Volumes in hm^3)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	12.89%	3.35	0.431	0.000	0.000	0.036	0.000	2.953	0.000
2009-10	9.26%	4.66	0.431	0.000	0.000	0.036	0.000	4.265	0.000
2010-11	17.46%	2.47	0.431	0.000	0.000	0.036	0.000	2.075	0.000
2011-12	5.85%	7.38	0.431	0.000	0.000	0.036	0.000	6.980	0.000
2012-13	10.93%	3.95	0.431	0.000	0.000	0.036	0.000	3.553	0.000
2013-14									
AVERAGE	9.90%	4.36	0.431	0.000	0.000	0.036	0.000	3.965	0.000
INTERANNUAL WEI+: 9.9%									

River Basin of R. Katouri: The Pyrgos dam, with capacity of 285.000 m^3 is constructed in the basin. Runoff as OUTFLOW arises as a percentage of the surfaces with the river basin of the hydrometric station r2-7-2-75_Pyrgos near Fleva with a further impairment of 30% due to the terrain. As there is no abstraction data, annual abstractions from the dam are considered equal to the dam capacity, on the assumption that the dam is emptied at the end of the hydrologicl year, therefore ΔSart will equal zero.

Abstractions from the underground aquifer (renewable and permanent) arise from the previous methodology where the river basin of r. Katouri intersects (a) CY-16 Pyrgos, and (b) CY_19 - Troodos. The following table (Table 7-17) presents the calculation sheet of the annual WEI+ index for the river basin of r. Katouri. The interannual WEI+ index is 11.9%.

Table 7-17: Calculation of the annual WEI+ in the river basin of r. Katouri.

KATOURIS CATCHMENT (PYRGOS DAM)									
Hydrologic Year (Volumes in hm^3)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	15.45%	3.98	0.614	0.000	0.285	0.036	0.000	3.113	0.000
2009-10	11.19%	5.49	0.614	0.000	0.285	0.036	0.000	4.623	0.000
2010-11	20.70%	2.97	0.614	0.000	0.285	0.036	0.000	2.103	0.000
2011-12	7.13%	8.61	0.614	0.000	0.285	0.036	0.000	7.748	0.000
2012-13	13.16%	4.67	0.614	0.000	0.285	0.036	0.000	3.803	0.000
2013-14									
AVERAGE	11.94%	5.14	0.614	0.000	0.285	0.036	0.000	4.278	0.000
INTERANNUAL WEI+: 11.9%									

River Basin of R. Pyrgos: No dam has been constructed in this basin and no abstractions are performed directly from the hydrographic network. Runoff as OUTFLOW is measured at the location of hydrometric station r2-7-2-75_Pyrgos near Fleva with appropriate processing and supplements.

Abstractions from the underground aquifer (renewable and permanent) arise from the previous methodology where the river basin of r. Pyrgos intersects (a) CY-16 Pyrgos, and (b) CY_19 - Troodos. The following table (Table 7-18) presents the calculation sheet of the annual WEI+ index for the river basin of r. Pyrgos. The interannual WEI+ index is 9.8%.

Table 7-18: Calculation of the annual WEI+ in the river basin of r. Pyrgos.

PYRGOS CATCHMENT									
Hydrologic Year (Volumes in hm^3)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	12.72%	5.82	0.740	0	0.000	0.055	0	5.134	0
2009-10	9.14%	8.10	0.740	0	0.000	0.055	0	7.415	0
2010-11	17.24%	4.29	0.740	0	0.000	0.055	0	3.608	0
2011-12	5.77%	12.82	0.740	0	0.000	0.055	0	12.136	0
2012-13	10.78%	6.86	0.740	0	0.000	0.055	0	6.176	0
2013-14									
AVERAGE	9.76%	7.58	0.740	0.000	0.000	0.055	0.000	6.894	0.000
INTERANNUAL WEI+: 9.8%									

River Basin of R. Limniti: In this basin the Tsakistra dam with usable capacity of only 100.000 m^3 was constructed in 2000 and no direct abstractions are made from the hydrographic network. There is no abstraction data for the Tsakistra dam, hence we consider that the annual extraction is equal to its capacity. Runoff as OVERFLOW is measured at the location of hydrometric station r2-8-3-10_Limnitis Saw Mill, which is highly reliable.

Abstractions from the underground aquifer (renewable and permanent) arise from the previous methodology where the river basin of r. Limnitis intersects (a) CY-17 Central and Western Mesaoria, and (b) CY_19 - Troodos. The following table (Table 7-19) presents the calculation sheet of the annual WEI+ index for the river basin of r. Limniti. The interannual WEI+ index is 6.5%.

Table 7-19: : Calculation of the annual WEI+ in the river basin of r. Limniti.

LIMNITIS CATCHMENT (TSAKISTRA DAM)									
Hydrologic Year (Volumes in hm^3)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	7.03%	12.53	0.780	0.000	0.100	0.066	0.000	11.71	0.000
2009-10	7.19%	12.24	0.780	0.000	0.100	0.066	0.000	11.43	0.000
2010-11	12.54%	7.02	0.780	0.000	0.100	0.066	0.000	6.21	0.000
2011-12	3.64%	24.21	0.780	0.000	0.100	0.066	0.000	23.40	0.000
2012-13	7.78%	11.32	0.780	0.000	0.100	0.066	0.000	10.50	0.000
2013-14									
AVERAGE	6.54%	13.46	0.780	0.000	0.100	0.066	0.000	12.649	0.000
INTERANNUAL WEI+ (TO THE SUM OF PARAMETERS): 6.5%									

<u>River Basin of R. Campos:</u> No dam has been constructed in this basin, while abstractions are performed directly from the hydrographic network for the Campos irrigation part. The OUTFLOW arises in connection with that of the basin of r. Limnitis (see previous basin) on the ratio of their surfaces without further impairment since the basins have the same characteristics. The abstractions from the hydrographic network are calculated based on the data.

Abstractions from the underground aquifer (renewable and permanent) arise from the previous methodology where the river basin of r. Campos intersects only CY_19 - Troodos. The following table (Table 7-20) presents the calculation sheet of the annual WEI+ index for the river basin of r. Campos. The interannual WEI+ index is 11.7%.

Table 7-20: Calculation of the annual WEI+ in the river basin of r. Campos.

KAMPOS CATCHMENT									
Hydrologic Year (Volumes in hm^3)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	15.17%	4.20	0.501	0.137	0.000	0.042	0	3.606	0.000
2009-10	10.98%	5.80	0.501	0.137	0.000	0.042	0	5.208	0.000
2010-11	20.37%	3.13	0.501	0.137	0.000	0.042	0	2.534	0.000
2011-12	6.99%	9.12	0.501	0.137	0.000	0.042	0	8.524	0.000

2012-13	12.92%	4.93	0.501	0.137	0.000	0.042	0	4.338	0.000
2013-14									
AVERAGE	11.72%	5.44	0.501	0.137	0.000	0.042	0.000	4.842	0.000
INTERANNUAL WEI+ (TO THE SUM OF PARAMETERS): 11.7%									

The following table (Table 7-21) calculates the WEI+ index for the entire hydrologic region 2. The total interannual WEI+ index is equal to 31.6%, showing that the water resources of Hydrologic Region 2 are subject to water pressure, even if it is not significant.

Table 7-21: Calculation of the annual average WEI+ index of Hydrologic Region 2.

HYDROLOGIC REGION 2									
	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
	31.73%	47.50	7.831	1.106	6.134	1.238	0.000	36.649	2.984

Finally, we attempted to calculate the total runoff coefficient (surface and underground), which can be defined as the quotient of RWR to the average annual rainfall. The average annual rainfall for the five hydrological years is equal to 688.8 mm. The surface of the hydrologic region is equal to 753.6 km^2 and therefore, the runoff coefficient is equal to 9.1%.

7.3.5 CALCULATION OF THE WEI+ INDEX IN HYDROLOGIC REGION 3

Hydrologic Region 3 comprises the surrounding area of Morfou, which includes the following river basins, for which the WEI+ index is calculated (from east to west):

1. River Basin of R. Xeros with a river basin surface of 77.1 km^2.
2. River Basin of R. Marathasa with a river basin surface of 72.1 km^2.
3. River Basin of R. Kargotis with a river basin surface of 88.3 km^2.
4. River Basin of R. Atsas with a river basin surface of 42.3 km^2.
5. River Basin of R. Elia with a river basin surface of 142.9 km^2.
6. River Basin of R. Serrahi with a river basin surface of 494.0 km^2.
7. River Basin of R. Xeros with a river basin surface of 69.7 km^2.

The above surfaces referred only to the free parts of Cyprus. A common characteristic of all river basins is the S-N orientation and that due to tectonic conditions they are elongated basins with almost equal surfaces. The next paragraphs summarise the calculations for each river basin and Figure 7-3 presents the relevant map with all necessary information for the development of WEI+ calculations.

The most important project of water resources utilization for Hydrologic Region 3 is the irrigation project of Xyliatos-Vyzakia, which includes the largest water reservoir project in the area, namely the Xyliatos dam on the basin of r. Elia, which was constructed in 1982 and has a useful capacity of 1.43 hm^3 of water. Hydrologic Region 3 has significant hydrologic potential, while abstractions, although significant are much lower than those of Hydrologic Regions 1, 8 and 9.

River Basin of R. Xeros: In this basin the Kafizes dam has been constructed in 1953 with a capacity of 113,000 m^3 water. Because there are is no abstraction data for this dam, we consider that the annual abstraction is equal to the capacity of the dam. The outflow to the basin arises from the runoff of the basin of r. Limniti (see Hydrologic Region 2) by the ratio of surfaces and ratio coefficient.

Abstractions from the underground aquifer (renewable and permanent) arise from the previous methodology where the river basin of r. Xeros (a) CY-17 Central and Western Mesaoria, and (b) CY_19 - Troodos. The following table (Table 7-22) presents the calculation sheet of the annual WEI+ index for the river basin of r. Xeros. The interannual WEI+ index is 17.3%.

Table 7-22: Calculation of the annual WEI+ in the river basin of r. Xeros.

XEROS CATCHMENT (KAFIZES DAM)									
Hydrologic Year (Volumes in hm^3)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	18.44%	5.66	0.918	0.013	0.113	0.077	0.00	4.694	0
2009-10	18.83%	5.55	0.918	0.013	0.113	0.077	0.00	4.578	0
2010-11	30.23%	3.45	0.918	0.013	0.113	0.077	0.00	2.488	0
2011-12	10.10%	10.34	0.918	0.013	0.113	0.077	0.00	9.375	0
2012-13	20.18%	5.17	0.918	0.013	0.113	0.077	0.00	4.208	0
2013-14									
AVERAGE	17.30%	6.04	0.918	0.013	0.113	0.077	0.000	5.069	0.000
INTERANNUAL WEI+: 17.3%									

River Basin of R. Marathasa: In this basin, in 1966 the 363,000m^3 water capacity dam of Kalopanagiotis was constructed, while in 1962 the 368,000 m^3 water capacity dam of Lefka was constructed. Water balance data from the WDD exist only for the dam of Kalopanagiotis. With the construction of these dams we consider that there are no more abstractions from the hydrographic network. The runoff as OUTFLOW arises from the hydrometric station r3-2-1-85_Marathasa US Dam Kalopanagiotis, which when the stored water volume of the dam is less than its capacity has a resulting zero outflow, otherwise the entire runoff overflows and the outflow is equal to the runoff to the hydrometric station upstream of the dam. The outflows are not added up below due to the intermediate river basin, but is considered to lead to a more conservative variants of the WEI+ to favour safety.

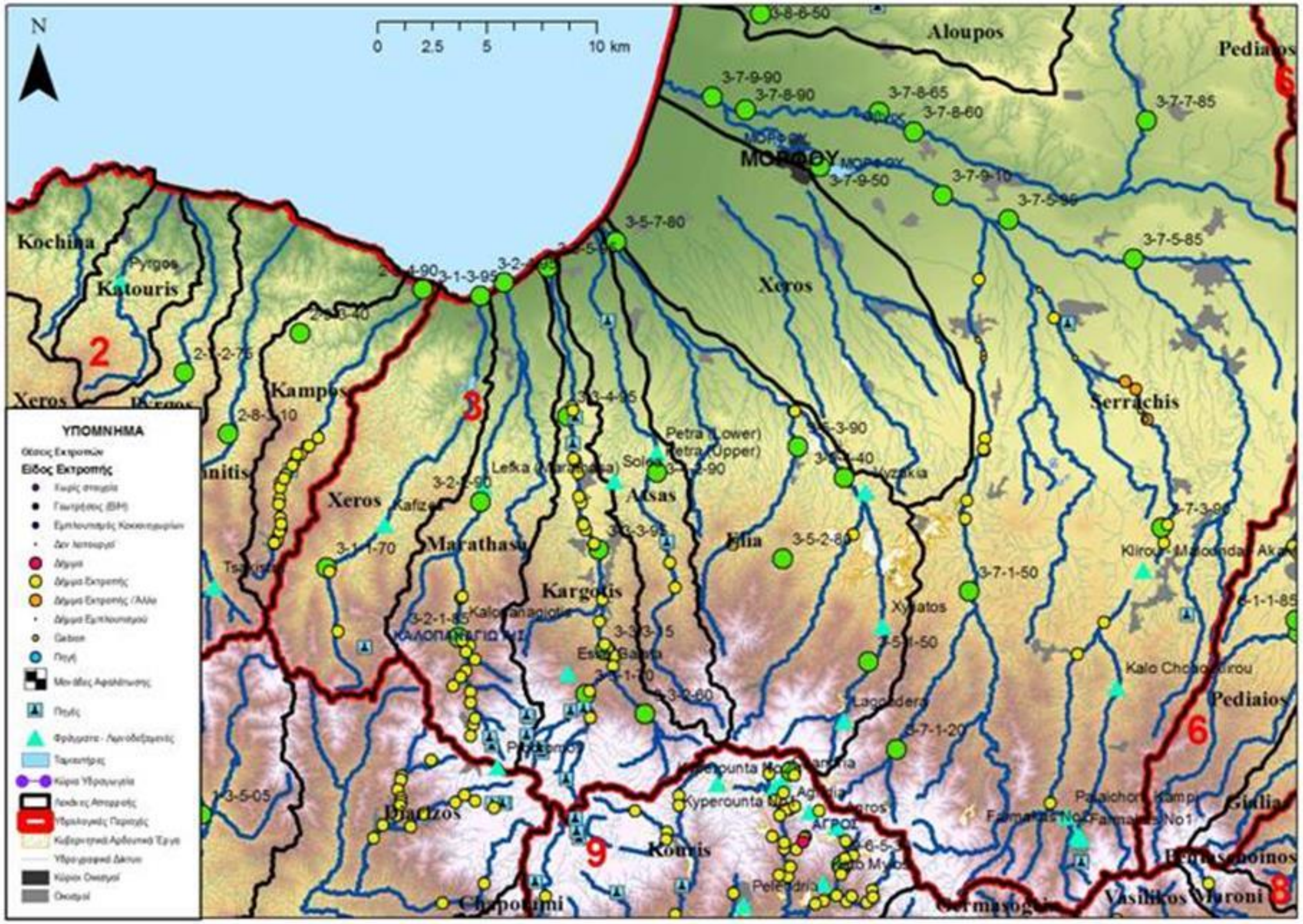

Figure 7-3: Map of Hydrologic Region 3 (Morphou District) with the locations of dams, diversions and hydrometric stations.

Abstractions from the underground aquifer (renewable and permanent) arise from the previous methodology where the river basin of r. Marathasa (a) CY-17 Central and Western Mesaoria, and (b) CY_19 - Troodos. The following table (Table 7-23) presents the calculation sheet of the annual WEI+ index for the river basin of r. Marathasa. The interannual WEI+ index is 19.5%.

Table 7-23: Calculation of the annual WEI+ in the river basin of r. Marathasa.

MARATHASSA CATCHMENT (KALOPANAYIOTIS DAM)									
Hydrologic Year (Volumes in hm^3)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	29.35%	5.19	0.849	0.000	0.673	0.072	0.000	4.005	0.269
2009-10	31.17%	4.97	0.849	0.000	0.701	0.072	0.000	3.420	-0.074
2010-11	15.32%	9.97	0.849	0.000	0.678	0.072	0.000	8.537	0.024
2011-12	14.16%	10.74	0.849	0.000	0.673	0.072	0.000	9.378	0.083
2012-13	18.38%	8.69	0.849	0.000	0.749	0.072	0.000	7.092	-0.075
2013-14									
AVERAGE	19.51%	7.91	0.849	0.000	0.695	0.072	0.000	6.486	0.045
INTERANNUAL WEI+: 19.5%									

River Basin of R. Kargotis: In this basin the small reservoir of Esso Galatas has been constructed with a water volume capacity of only 35,000m^3. The runoffs that are considered as OUTFLOW arise from the measurements of the hydrometric station r3-3-4-95_Kargotis near Skouriotissa. The abstractions from the hydrographic network are measured and recorded accordingly. The construction of the Solea dam (which was recently completed) with a capacity of about 4,5 hm^3 will also allow the diversion from River Kargotis to the Solea dam, which is located at the boundaries of the river basin of river Atsas. No data available

Abstractions from the underground aquifer (renewable and permanent) arise from the previous methodology where the river basin of r. Kargotis (a) CY-17 Central and Western Mesaoria, and (b) CY_19 - Troodos. The following table (Table 7-24) presents the calculation sheet of the annual WEI+ index for the river basin of r. Kargotis. The interannual WEI+ index is 22.6%.

Table 7-24: Calculation of the annual WEI+ in the river basin of r. Kargotis.

KARGOTIS CATCHMENT (ESSO GALATAS DAM)									
Hydrologic Year (Volumes in hm^3)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	32.39%	7.88	1.041	1.476	0.035	0.088	0.000	5.414	0
2009-10	21.78%	11.71	1.041	1.476	0.035	0.088	0.000	9.249	0
2010-11	33.00%	7.73	1.041	1.476	0.035	0.088	0.000	5.267	0
2011-12	13.79%	18.50	1.041	1.476	0.035	0.088	0.000	16.038	0
2012-13	24.21%	10.54	1.041	1.476	0.035	0.088	0.000	8.076	0
2013-14									
AVERAGE	22.63%	11.27	1.041	1.476	0.035	0.088	0.000	8.809	0.000
INTERANNUAL WEI+: 22.6%									

If the volume of water from the Solea dam (4,500,000m^3) that will be diverted to r. Kargotis is added to the surface abstraction then the interannual WEI+ index amounts to 44%, given that the abstractions will be at least equal to the dam capacity.

River Basin of R. Atsas: No dam has been constructed in this basin, with the exception of the very small dams of Ano and Kato Petra with a total volume of 55,000m^3. The runoffs that are considered as OUTFLOW arise in proportion to those of r. Kargotis. The abstractions from the surface hydrographic network are accordingly recorded.

Abstractions from the underground aquifer (renewable and permanent) arise from the previous methodology where the river basin of r. Atsas (a) CY-17 Central and Western Mesaoria, and (b) CY_19 - Troodos. The following table (Table 7-25) presents the calculation sheet of the annual WEI+ index for the river basin of r. Atsas. The interannual WEI+ index is 25.2%.

Table 7-25: Calculation of the annual WEI+ in the river basin of r. Atsas.

ATSAS CATCHMENT									
Hydrologic Year (Volumes in hm^3)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	35.63%	3.64	1.235	0.006	0.055	0.047	0	2.388	0.000
2009-10	24.32%	5.33	1.235	0.006	0.055	0.047	0	4.079	0.000
2010-11	36.28%	3.57	1.235	0.006	0.055	0.047	0	2.323	0.000
2011-12	15.57%	8.32	1.235	0.006	0.055	0.047	0	7.073	0.000
2012-13	26.94%	4.81	1.235	0.006	0.055	0.047	0	3.562	0.000
2013-14									
AVERAGE	25.24%	5.13	1.235	0.006	0.055	0.047	0.000	3.885	0.000
INTERANNUAL WEI+: 25.2%									

River Basin of R. Elia: In this basin two major dams have been constructed; the Xyliatos dam and the Vyzakia dam with capacities equal to 1,34 hm^3 and 1.69hm^3 respectively. The Vyzakia dam is newer and was completed in 1994. These dams supply water to the two significant irrigation projects of the area bearing the same name. Apart from the abstractions from the dams, no other surface water abstractions are made. The water balance data is provided by the WDD while there is a form of strengthening of the dam downstream of Vyzakia by the upstream of Xyliatos. The outflow (OUTFLOW) from the river basin is measured at the location of the hydrometric station r3-5-4-40_Elia near Vyzakia with appropriate processing so as to include the entire river basin.

Abstractions from the underground aquifer (renewable and permanent) arise from the previous methodology where the river basin of r. Elias intersects aquifers (a) CY-17 Central and Western Mesaoria, and (b) CY_19 - Troodos. The following table (Table 7-26) presents the calculation sheet of the annual WEI+ index for the river basin of r. Elia. The interannual WEI+ index is 54.7%.

Table 7-26: : Calculation of the annual WEI+ in the river basin of r. Elia.

ELIA CATCHMENT (XYLIATOS & VYZAKIA DAMS)									
Hydrologic Year (Volumes in hm³)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	103.24%	3.00	2.107	0.071	0.916	0.250	0.000	0.132	-0.021
2009-10	48.23%	7.33	2.107	0.071	1.360	0.250	0.000	5.242	1.196
2010-11	81.15%	4.31	2.107	0.071	1.317	0.250	0.000	1.049	-0.012
2011-12	29.93%	12.36	2.107	0.071	1.523	0.250	0.000	8.745	-0.167
2012-13	75.15%	4.66	2.107	0.071	1.327	0.250	0.000	0.707	-0.702
2013-14									
AVERAGE	54.74%	6.33	2.107	0.071	1.289	0.250	0.000	3.175	0.059
INTERANNUAL WEI+: 54.7%									

River Basin of R. Serrachi: In this basin a series of small dams have been constructed, those of Kalo Chorio, Palaichori-Kampi, Farmakas 1 & 2 and the newly constructed dam of Klirou - Malounta. The latter is also the largest (water volume 2.0hm³) but, since 2007 when it operated, has only been used for recharge of groundwater based on the data supplied by the WDD. The river basin is the largest of the Hydrological Region 3.

Outflows of the river basin (only regarding free areas) are calculated using the hydrometric station [r3-7-3-90_Akaki near Malounta] with the appropriate treatment for the entire basin. As regards abstractions from the hydrographic network, there is no clear information (irrigated land surfaces), even though the map shows abstraction positions and they were improperly set to zero, as these abstractions should be included once they are updated by the WDD.

Abstractions from the underground aquifer (renewable and permanent) arise from the previous methodology where the river basin of r. Serrachi (a) CY-17 Central and Western Mesaoria, and (b) CY_19 - Troodos and the CY_20 Pentadaktylos. The following table (Table 7-27) presents the calculation sheet of the annual WEI+ index for the river basin of r. Serrachi. The interannual WEI+ index is 42.8%.

Table 7-27: Calculation of the annual WEI+ in the river basin of r. Serrahi.

SERRACHIS CATCHMENT (KLHROU – MALOUNTA DAM)									
Hydrologic Year (Volumes in hm^3)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	71.60%	20.57	14.023	0.000	0.702	2.575	0.000	8.416	0.000
2009-10	33.55%	43.89	14.023	0.000	0.702	2.575	0.000	31.740	0.000
2010-11	55.91%	26.34	14.023	0.000	0.702	2.575	0.000	14.189	0.000
2011-12	27.05%	54.43	14.023	0.000	0.702	2.575	0.000	42.277	0.000
2012-13	54.75%	26.90	14.023	0.000	0.702	2.575	0.000	14.747	0.000
2013-14									
AVERAGE	42.78%	34.42	14.023	0.000	0.702	2.575	0.000	22.274	0.000
INTERANNUAL WEI+: 42.8%									

<u>River Basin of R. Xeros:</u> It concerns a very small basin on the sidelines of the Hydrologic Region. Outflows of the river basin (only regarding free areas) are calculated using the hydrometric station [r3-7-3-90_Akaki near Malounta] with the appropriate treatment for the entire basin.

Abstractions from the underground aquifer (renewable and permanent) arise from the previous methodology where the river basin of r. Xeros (a) CY-17 Central and Western Mesaoria, and (b) CY_19 - Troodos and the CY_20 Pentadaktylos. The following table (Table 7-27) presents the calculation sheet of the annual WEI+ index for the river basin of r. Xeros. The interannual WEI+ index is 41.9%.

Table 7-28: Calculation of the annual WEI+ in the river basin of r. Xeros.

XEROS CATCHMENT									
Hydrologic Year (Volumes in hm^3)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	67.38%	3.76	2.535	0.000	0.000	0.491	0.000	1.718	0.000
2009-10	48.77%	5.20	2.535	0.000	0.000	0.491	0.000	3.154	0.000
2010-11	65.28%	3.88	2.535	0.000	0.000	0.491	0.000	1.840	0.000
2011-12	58.33%	4.35	2.535	0.000	0.000	0.491	0.000	2.302	0.000
2012-13	50.16%	5.05	2.535	0.000	0.000	0.491	0.000	3.009	0.000
2013-14									
AVERAGE	56.98%	4.45	2.535	0.000	0.000	0.491	0.000	2.405	0.000
INTERANNUAL WEI+: 57.0%									

The following table (Table 7-29) calculates the WEI+ index for the entire hydrologic region. The total interannual WEI+ index is equal to 35.9%, showing that the water resources of Hydrologic Region 3 are subject to water pressure, even if it is not significant.

Table 7-29: Calculation of the annual average WEI+ index of Hydrologic Region 3.

HYDROLOGIC REGION 3									
	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
	35.95%	75.56	22.707	1.566	2.888	3.599	0.000	52.102	0.104

Finally, we attempted to calculate the total runoff coefficient (surface and underground), which can be defined as the quotient of RWR to the average annual rainfall. The average annual rainfall for the five hydrological years is equal to 502.8 mm. The surface of the hydrologic region is equal to 502.8 km^2 and therefore, the runoff coefficient is equal to 15.2%.

7.3.6 CALCULATION OF THE WEI+ INDEX IN HYDROLOGIC REGION 6

Hydrologic Region 6 comprises the surrounding area of Nicosia, which only includes two river basins, for which the WEI+ index is calculated (from west to east):

1. River Basin of Pedieos with river basin area 265,9 km^2 that includes only the free part of Cyprus.
2. River Basin of R. Gialia with river basin area 279,4 km^2 that includes only the free part of Cyprus.

The most important utilization project for the water resources of Hydrologic Region 6 is the Tamasos dam on the basin of river Pedieos, which was constructed in 2002 and has a useful capacity of 2,80hm^3 of water. Because of Nicosia, Hydrologic Region 6 has significant water needs, which are mainly covered by the Southern Conveyor project, as otherwise the pressure on water resources would be stifling. At the same time, this hydrologic region has the lowest rainfall rates in Cyprus, second only to the Famagusta district. The relevant map is shown in Figure 7-4 with all necessary information for the calculation of the WEI+ index.

River Basin of R. Pedieos: In this basin the Tamasos dam has been recently constructed and is used for water supply and recharge of groundwater, while there are also the older dams of Athalassa and Agios Georgios with respective storage volumes of 791,000m^3 and 90,000m^3 of water. There is no data on the balance of these dams, therefore we consider that the annual abstractions are equal to their capacity, although the second was constructed for recharge purposes. Outflows of the river basin (only regarding free areas) are calculated using the hydrometric station r6-1-1-80_Agios Onoufrios near Kampia with the appropriate treatment for the entire basin. As regards abstractions from the hydrographic network, there is no clear information (irrigated land surfaces), even though the map shows abstraction positions and they were improperly set to zero, as these abstractions should be included once they are updated by the WDD.

Abstractions from the underground aquifer (renewable and permanent) arise from the previous methodology where the river basin of r. Pedieos (a) CY-17 Central and Western Mesaoria, and (b) CY_19 - Troodos and the CY_20 Pentadaktylos. The following table (Table 7-30) presents the calculation sheet of the annual WEI+ index for the river basin of r. Pedieos. The interannual WEI+ index is 108.1%, meaning that the river basin of r. Pedieos is exhausting all its renewable reserves, although a significant percentage of water demand is covered by the Southern Conveyor project.

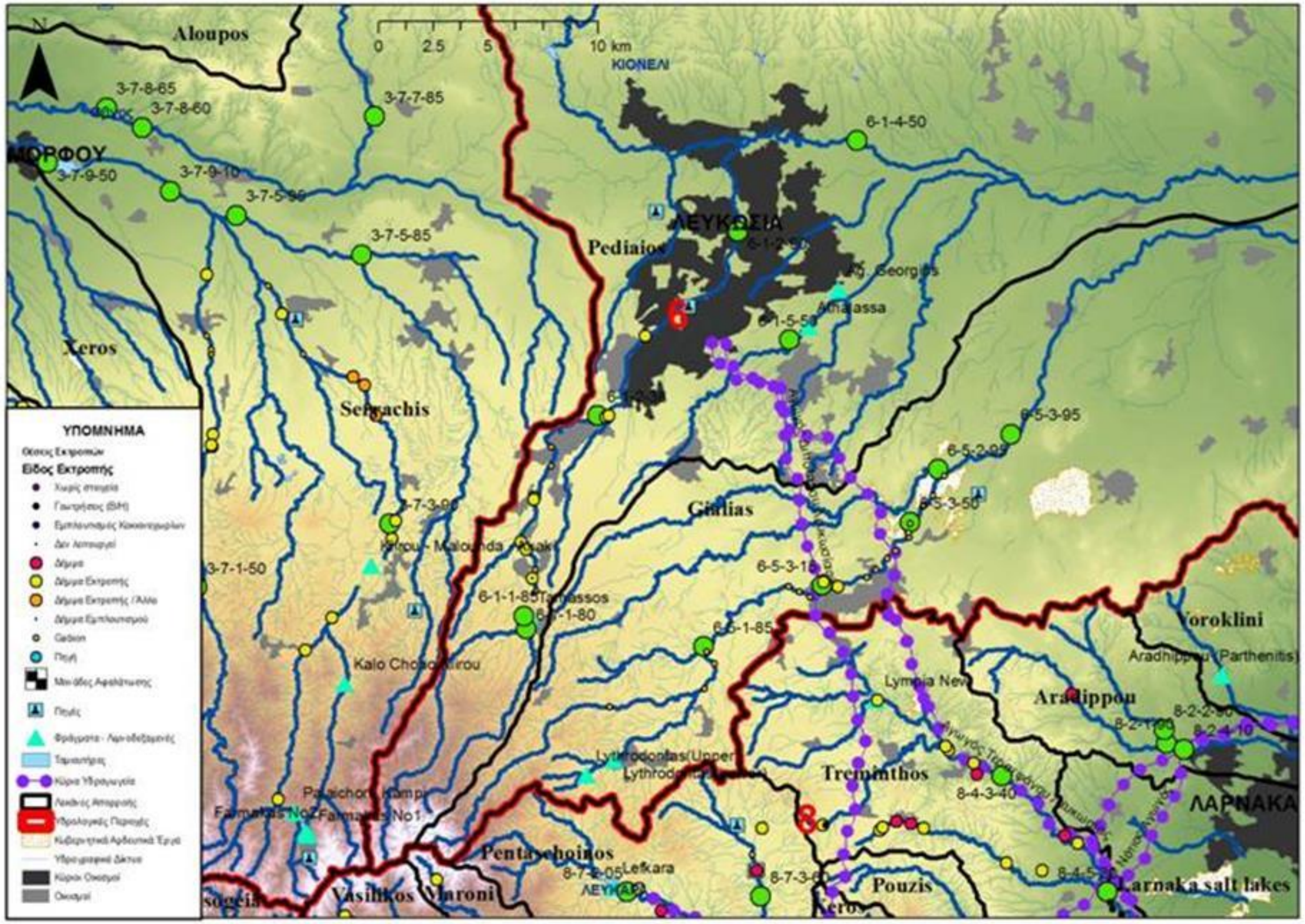

Figure 7-4: Map of Hydrologic Region 6 (Nicosia District) with the locations of dams, diversions and hydrometric stations.

Table 7-30: Calculation of the annual WEI+ in the river basin of r. Pedieos.

PEDIAIOS CATCHMENT (TAMASSOS DAM)									
Hydrologic Year (Volumes in hm³)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	113.67%	9.22	9.688	0.791	0.972	1.930	0.97	0.670	0
2009-10	99.08%	10.58	9.688	0.791	1.248	1.930	1.25	1.633	-0.395
2010-11	109.67%	9.56	9.688	0.791	2.032	1.930	2.03	0.766	-0.24
2011-12	105.84%	9.90	9.688	0.791	0.789	1.930	0.79	2.200	0.848
2012-13	113.91%	9.21	9.688	0.791	1.435	1.930	1.43	0.650	0
2013-14									
AVERAGE	108.14%	9.69	9.688	0.791	0.001	1.930	0.000	1.184	0.043
INTERANNUAL WEI+ (TO THE SUM OF PARAMETERS): 108.1%									

River Basin of R. Gialia: No major reservoir project has been constructed in this basin, with the exception of the small dams of Ano and Kato Lythrodontas with a total volume of 64,000 m^3. Outflows of the river basin (only regarding free areas) are calculated using the hydrometric station r6-5-3-15_Gialias near Nisou with the appropriate treatment for the entire basin. As regards abstractions from the hydrographic network, there is no clear information (irrigated land surfaces), except for the abstractions for the Irrigation Association of Frangos (amounting to 9,000 m^3 per year); however, these abstractions should be included once they are updated by the WDD.

Abstractions from the underground aquifer (renewable and permanent) arise from the previous methodology where the river basin of r. Gialia (a) CY-17 Central and Western Mesaoria, and (b) CY_19 - Troodos and the CY_20 Pentadaktylos. The following table (Table 7-31) presents the calculation sheet of the annual WEI+ index for the river basin of r. Gialia. The interannual WEI+ index is 93.9%, meaning that the river basin of r. Gialia is exhausting all its renewable reserves, although a significant percentage of water demand is covered by the Southern Conveyor project.

Table 7-31: Calculation of the annual WEI+ in the river basin of r. Gialia.

GIALIAS CATCHMENT (LYTHRODONTAS DAM)									
Hydrologic Year (Volumes in hm^3)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	122.21%	5.22	6.308	0.0095	0.064	1.160	0.000	0.000	0
2009-10	71.82%	8.89	6.308	0.0095	0.064	1.160	0.000	3.663	0
2010-11	115.80%	5.51	6.308	0.0095	0.064	1.160	0.000	0.289	0
2011-12	71.26%	8.95	6.308	0.0095	0.064	1.160	0.000	3.733	0
2012-13	118.07%	5.40	6.308	0.0095	0.064	1.160	0.000	0.183	0
2013-14									
AVERAGE	93.86%	6.78	6.294	0.010	0.064	1.157	0.000	1.574	0.000
INTERANNUAL WEI+: 93.9%									

The following table (Table 7-32) calculates the WEI+ index for the entire hydrologic region. The total interannual WEI+ index is equal to 102.3%, showing that the water resources of Hydrologic Region 6 are subject to very significant water pressure, depleting the renewable reserves.

Table 7-32: Calculation of the annual average WEI+ index of Hydrologic Region 6.

HYDROLOGIC REGION 6									
	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
	102.27%	16.49	15.996	0.801	1.359	3.090	1.294	2.757	0.043

Finally, we attempted to calculate the total runoff coefficient (surface and underground), which can be defined as the quotient of RWR to the average annual rainfall. The average annual rainfall for the five hydrological years is equal to 382.5 mm. The surface of the hydrologic region is equal to 545.3 km^2 and therefore, the runoff coefficient is equal to 7.8%.

7.3.7 CALCULATION OF THE WEI+ INDEX IN HYDROLOGIC REGION 7

Hydrologic Region 7 coinciding with the Kokkinohoria area in the Famagusta District contains no major surface body and therefore no hydrologic drought indices have been calculated. The Kokkinohoria area is well known for its very significant abstractions from the local aquifer that has been formatted as GWB under the WFD with code CY-1. For this reason irrigation in the Kokkinohoria area is significantly enhanced by the Southern Conveyro project to reduce abstractions from groundwater so that it may, at some point, recover, although this is not expected soon, since there is low infiltration due to the clay soil layer. The relevant map is shown in Figure 7-5 with all necessary information for Hydrologic Region 7.

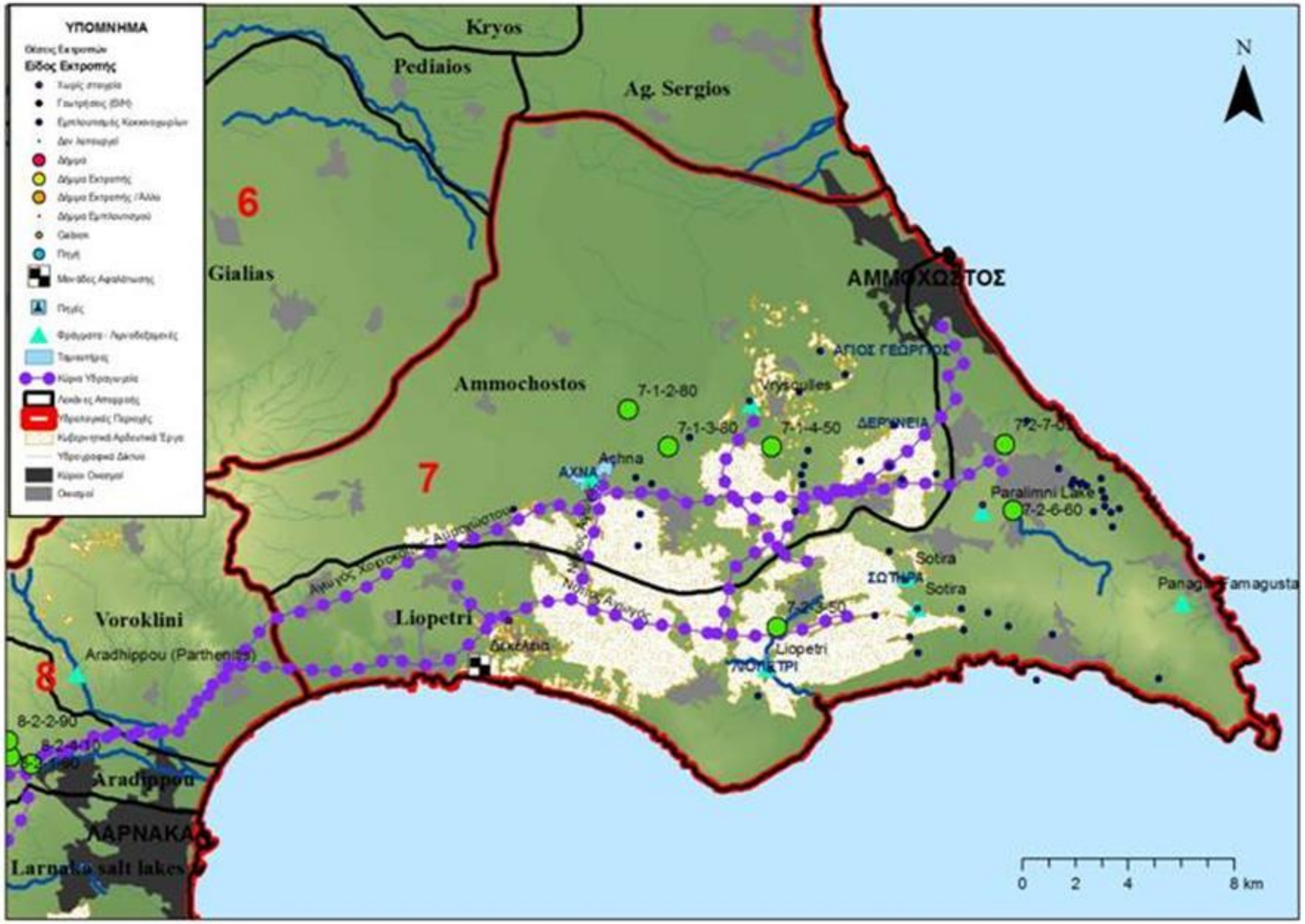

Figure 7-5: Map of Hydrologic Region 7 (Famagusta - Kokkinohoria District) with the locations of dams, diversions and hydrometric stations.

In practice, the only water reservoir project is the Achna reservoir which is a terminal storage/regulating project at the end of the Southern Conveyor project and therefore not considered as a water body with independent operation. Therefore the WEI+ index does not have a calculation object and is in fact derived from the water balance of GWB CY_01, as summarised in the table below (Table 7-33). Since there is no clear and specific hydrographic network in Region 7, to calculate the Outflow it is assumed that the surface runoff is equal to 4% of rainfall. The WEI+ index is higher than all other regions, much higher than 100% as there is overexploitation of permanent reservoirs.

Table 7-33: Calculation of WEI+ for Hydrologic Region 7 (Kokkinohoria Area)

HYDROLOGIC REGION 7									
Hydrologic Year (Volumes in hm^3)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008 – 2013	126.6%	17.30	21.90	0.00	0.00	11.80	0.00	7.20	0.00

7.3.8 CALCULATION OF THE WEI+ INDEX IN HYDROLOGIC REGION 8

Hydrologic Region 8 (along with Hydrologic Region 9) is the area of the most significantwater resource utilization project, namely of the Southern Conveyor project. Hydrologic Region 3 comprises the surrounding area of Larnaca which includes the following river basins, for which the WEI+ index is calculated (from west to east):

1. Vassilikos River Basin with a river basin surface of 161.5 km^2.
2. River Basin of R. Maroni with a river basin surface of 100.8 km^2.
3. River Basin of R. Maroni with a river basin surface of 172.2 km^2.
4. River Basin of R. Xeros with a river basin surface of 92.5 km^2.
5. River Basin of R. Pouzi with a river basin surface of 79.4 km^2.
6. River Basin of R. Treminthos with a river basin surface of 171.2 km^2.
7. River Basin of R. Larnaca Salt Lakes with a river basin surface of 99.7 km^2.
8. River Basin of R. Aradippou with a river basin surface of 78.6 km^2.
9. River Basin of R. Aradippou with a river basin surface of 84.0 km^2.

The next paragraphs summarise the calculations for each river basin and Figure 7-6 presents the relevant map with all necessary information for the development of WEI+ calculations.

River Basin of R. Vassilikos: In this basin the Kalavasos dam has been constructed in 1985 with a capacity of 17.1hm^3 water. On the upper course of the basin a series of small reservoirs have been constructed and are all included in the Irrigation Project of Pitsilia, with a total capacity of about 1.0hm^3. We consider that for these dams the annual abstraction will be equal to their capacity, which are exceptionally included in ABSTR_SF parameter as the AVSTR_DAM includes abstractions from the Kalavassos dam, directed to the Souhtern Conveyor project.

Outflows of the river basin (only regarding free areas) are calculated using the hydrometric station r8-9-7-50_Vassilikos near Kalavasos with the appropriate treatment for the entire basin. As regards abstractions from the hydrographic network, there is no clear information (irrigated land surfaces), even though the map shows abstraction positions and they were improperly set to zero, as these abstractions should be included once they are updated by the WDD.

Abstractions from the underground aquifer (renewable and permanent) arise from the previous methodology where the river basin of r. Vassilikos (a) CY-4 Softades - Vassilikos, (b) CY_5 - Maroni, (c) CY-6 - Mari - Kalo Chorio, (d) CY_18 Lefkara - Pachna and CY_19 Troodos. The following table (Table 7-34) presents the calculation sheet of the annual WEI+ index for the river basin of r. Vassilikos. The interannual WEI+ index is 109.9%, meaning that the river basin of r. Pedieos is exhausting all its renewable resources.

Table 7-34: Calculation of the annual WEI+ in the river basin of r. Vassilikos.

VASSILIKOS CATCHMENT (KALAVASSOS DAM)									
Hydrologic Year (Volumes in hm^3)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	131.05%	4.12	2.74	0.97	1.69	0.239	0.00	0.32	1.358
2009-10	317.51%	1.92	2.74	0.97	2.37	0.239	0.00	0.70	4.622
2010-11	112.30%	4.63	2.74	0.97	1.49	0.239	0.00	0.00	0.331
2011-12	406.49%	1.71	2.74	0.97	3.26	0.239	0.00	2.35	7.365
2012-13	65.88%	22.83	2.74	0.97	11.33	0.239	0.00	0.04	-7.991
2013-14	63.82%	12.29	2.74	0.97	4.14	0.239	0.00	0.00	-4.686
AVERAGE	109.87%	7.043	2.740	0.970	4.028	0.239	0.000	0.681	1.137
INTERANNUAL WEI+: 109.9%									

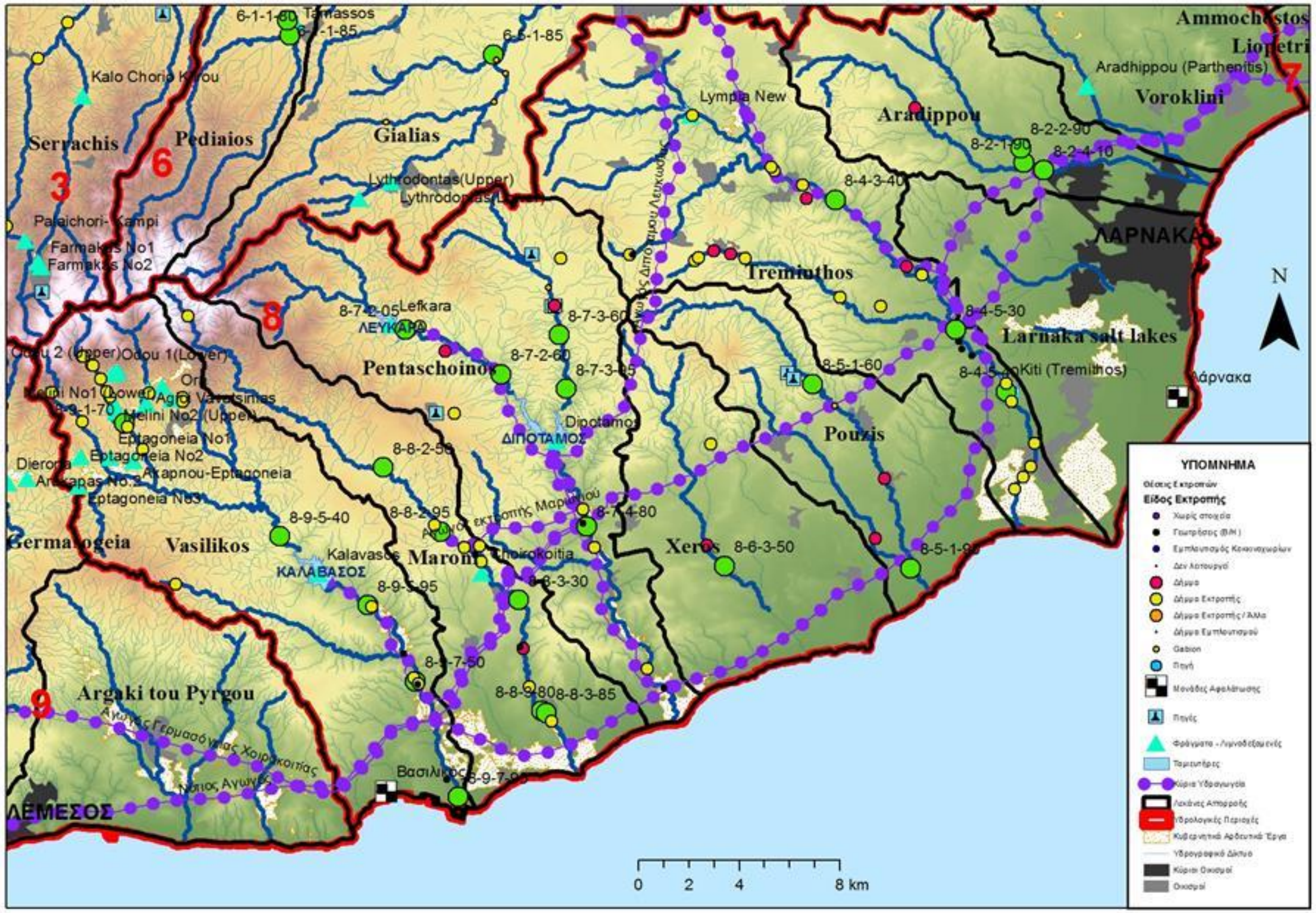

Figure 7-6: Map of Hydrologic Region 8 (Larnaca District) with the locations of dams, diversions and hydrometric stations.

River Basin of R. Maroni: In this basin no dam has been constructed, but there is a diversion in the middle course, diverting quantities of water to support the Vasiliko - Pentaschonos irrigation project. Unfortunately however these diversions are not measured, therefore it is impossible to design the water balance. The quantities of water abstraction from the bed of river Maroni are calculated based on the surface and type of crops irrigated. The outflow of the river basin are calculated based on the measured runoff at the location of hydrometric station r8-8-2-95. Abstractions from the underground aquifer (renewable and permanent) arise from the previous methodology where the river basin of r. Maroni (a) CY-4 Softades - Vassilikos, (b) CY_5 - Maroni, (c) CY-6 - Mari - Kalo Chorio, (d) CY_18 Lefkara - Pachna and CY_19 Troodos. The following table (Table 7-35) presents the calculation sheet of the annual WEI+ index for the river basin of r. Maroni. The interannual WEI+ index is 76.0%, meaning that the river basin of r. Maroni uses part of its renewable reservoir, when the water quantities diverted to Pentaschinos are also calculated.

Table 7-35: Calculation of the annual WEI+ in the river basin of r. Maroni.

MARONI CATCHMENT									
Hydrologic Year (Volumes in hm^3)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	97.23%	5.33	3.51	1.670	0.000	0.203	0	0.351	0
2009-10	65.54%	7.90	3.51	1.670	0.000	0.203	0	2.927	0
2010-11	85.94%	6.03	3.51	1.670	0.000	0.203	0	1.050	0
2011-12	61.11%	8.48	3.51	1.670	0.000	0.203	0	3.500	0
2012-13	81.47%	6.36	3.51	1.670	0.000	0.203	0	1.381	0
2013-14	102.03%	5.08	3.51	1.670	0.000	0.203	0	0.100	0
AVERAGE	75.97%	6.82	3.51	1.67	0.00	0.20	0.00	1.84	0.00
INTERANNUAL WEI+: 76.0%									

River Basin of R. Pentaschoinos: In this basin the Dypotamos and Lefkara dams have been constructed with a capacity of 15.5 hm^3 and 13.85 hm^3 respectively. The Lefkara dam was constructed in 1973 while the Dypotamos dam in 1985. As the Dypotamos dam is built very close to the outlet of the basin the OUTFLOW value is zero. The total average annual abstractions for both dams are about 5.6 hm^3 while abstractions from the hydrographic network are about 3.8 hm^3.

Abstractions from the underground aquifer (renewable and permanent) arise from the previous methodology where the river basin of r. Pentaschoinosi (a) CY-4 Softades - Pentaschoinos, (b) CY-6 - Mari - Kalo Chorio, (c) CY_18 Lefkara - Pachna and CY_19 Troodos. The following table (Table 7-36) presents the calculation sheet of the annual WEI+ index for the river basin of r. Pentaschoinos. The interannual WEI+ index is 102.7%, meaning that the river basin of r. Pentaschoinos is exhausting all its renewable resources. The enhancement of the Dypotamos reservoir by the desalination plant of Vassilikos does not concern the reporting period, as well as it occurs later for the first-time.

Table 7-36: Calculation of the annual WEI+ in the river basin of r. Pentaschoinos.

PENTASCHOINOS CATCHMENT (DYPOTAMOS & LEFKARA DAMS)									
Hydrologic Year (Volumes in hm^3)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	97.02%	6.74	2.58	3.76	0.194	0.268	0.000	1.540	1.071
2009-10	268.47%	3.52	2.58	3.76	3.118	0.268	0.000	1.315	6.985
2010-11	81.85%	14.04	2.58	3.76	5.149	0.268	0.000	1.143	-1.674
2011-12	105.32%	13.00	2.58	3.76	7.345	0.268	0.000	1.689	2.112
2012-13	85.80%	16.96	2.58	3.76	8.204	0.268	0.000	1.518	-1.158
2013-14	75.15%	15.43	2.58	3.76	5.248	0.268	0.000	0.000	-4.102
AVERAGE	102.71%	10.85	2.58	3.76	4.80	0.27	0.00	1.44	1.47
INTERANNUAL WEI+: 102.7%									

River Basin of R. Xeros: No dams have been constructed on this basin. Abstractions from the underground aquifer (renewable and permanent) arise from the previous methodology where the river basin of r. Xeros (a) CY-4 Softades - Pentaschoinos, (b) CY-6 - Mari - Kalo Chorio, (c) CY_18 Lefkara - Pachna and CY_19 Troodos. The following table (Table 7-37) presents the calculation sheet of the annual WEI+ index for the river basin of r. Xeros. The interannual WEI+ index is 63.5%.

Table 7-37: Calculation of the annual WEI+ in the river basin of r. Xeros.

XEROS CATCHMENT									
Hydrologic Year (Volumes in hm^3)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	107.30%	1.861	1.997	0.00	0.00	0.201	0.00	0.07	0
2009-10	53.62%	3.724	1.997	0.00	0.00	0.201	0.00	1.93	0
2010-11	93.07%	2.146	1.997	0.00	0.00	0.201	0.00	0.35	0
2011-12	37.20%	5.368	1.997	0.00	0.00	0.201	0.00	3.57	0
2012-13	75.97%	2.628	1.997	0.00	0.00	0.201	0.00	0.83	0
2013-14	105.25%	1.897	1.997	0.00	0.00	0.201	0.00	0.10	0
AVERAGE	63.48%	3.15	1.997	0.000	0.000	0.201	0.000	1.350	0.000
INTERANNUAL WEI+: 63.5%									

River Basin of R. Pouzi: No dams have been constructed on this basin. Abstractions from the underground aquifer (renewable and permanent) arise from the previous methodology where the river basin of r. Pouzi (a) CY-4 Softades - Pentaschoinos, (b) CY-6 - Mari - Kalo Chorio, (c)

CY_18 Lefkara - Pachna (d) CY_3 Kiti-Perivolia and CY_19 Troodos. The outflows are calculated by the hydrometric station [r8-5-1-60_Pouzis near Alethriko] with appropriate processing with the area ratio. Abstractions from the hydrographic network refer to 3000 decares of perishables.

The following table (Table 7-38) presents the calculation sheet of the annual WEI+ index for the river basin of r. Pouzi. The interannual WEI+ index is 77.6%.

Table 7-38: Calculation of the annual WEI+ in the river basin of r. Pouzi.

POUZI CATCHMENT									
Hydrologic Year (Volumes in hm^3)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	103.34%	3.326	1.877	1.56	0	0.167	0	0.056	0
2009-10	69.79%	4.925	1.877	1.56	0	0.167	0	1.655	0
2010-11	96.27%	3.570	1.877	1.56	0	0.167	0	0.301	0
2011-12	54.25%	6.335	1.877	1.56	0	0.167	0	3.066	0
2012-13	86.25%	3.984	1.877	1.56	0	0.167	0	0.715	0
2013-14	102.38%	3.357	1.877	1.56	0	0.167	0	0.087	0
AVERAGE	77.61%	4.43	1.877	1.560	0.000	0.167	0.000	1.159	0.000
INTERANNUAL WEI+: 77.6%									

River Basin of R. Treminthos: In this basin the Kiti dam with capacity of 1.614hm^3 has been constructed in the downstream part of the basin as well as the 220,000m^3 water capacity dam of Lympia. As there is no water balance data of these dams we consider that the annual abstractions from them are equal to their capacity. The outflows from river basin are calculated based on the measured flow at the location of hydrometric station r8-4-5-30, which is located upstream of the Kiti dam, but the measurements are used as outflow (OUTFLOW) from the basin, after deducting the capacity of the Kiti dam for each hydrological year. Direct abstractions from the hydrographic network are calculated on the basis of irrigated areas in the diversions shape file in the GIS.

Abstractions from the underground aquifer (renewable and permanent) arise from the previous methodology where the river basin of r. Treminthos (a) CY-3 Kiti - Perivolia (b) CY-6 - Mari - Kalo Chorio, (c) CY_18 Lefkara - Pachna and CY_19 Troodos. The following table (Table 7-39) presents the calculation sheet of the annual WEI+ index for the river basin of r. Treminthos. The interannual WEI+ index is 99.1%, meaning that the river basin of r. Treminthos is at the limit of exhausting all its renewable resources.

Table 7-39: Calculation of the annual WEI+ in the river basin of r. Treminthos.

TREMINTHOS CATCHMENT (KITI DAM)									
Hydrologic Year (Volumes in hm^3)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	104.54%	10.47	3.531	5.577	1.834	0.475	0	0.000	0
2009-10	98.13%	11.15	3.531	5.577	1.834	0.475	0	0.683	0
2010-11	104.54%	10.47	3.531	5.577	1.834	0.475	0	0.000	0
2011-12	86.50%	12.65	3.531	5.577	1.834	0.475	0	2.183	0
2012-13	104.54%	10.47	3.531	5.577	1.834	0.475	0	0.000	0
2013-14	104.54%	10.47	3.531	5.577	1.834	0.475	0	0.000	0
AVERAGE	99.11%	11.04	3.531	5.577	1.834	0.475	0.000	0.573	0.000
INTERANNUAL WEI+: 99.1%									

River Basin of R. Aradippou; No dam has been constructed in this basin and the outflow from the basin are calculated on the basis of flow measurements at the location of hydrometric station r8-2-4-10_Aradippou near Aradippou. The abstractions from the hydrographic network are zero. Abstractions from the underground aquifer (renewable and permanent) arise from the previous methodology where the river basin of r. Aradippou (a) CY-6 - Mari - Kalo Chorio and (b) CY_18 Lefkara -. The following table (Table 7-40) presents the calculation sheet of the annual WEI+ index for the river basin of r. Aradippou. The interannual WEI+ index is 107.1%, meaning that the river basin of r. Aradippou is exhausting all its renewable resources.

Table 7-40: Calculation of the annual WEI+ in the river basin of r. Aradippou.

ARADIPPOU CATCHMENT									
Hydrologic Year (Volumes in hm^3)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	118.64%	0.78	0.927	0	0	0.180	0	0.035	0
2009-10	110.15%	0.84	0.927	0	0	0.180	0	0.095	0
2010-11	79.60%	1.16	0.927	0	0	0.180	0	0.418	0
2011-12	119.54%	0.78	0.927	0	0	0.180	0	0.029	0
2012-13	121.35%	0.76	0.927	0	0	0.180	0	0.017	0
2013-14	106.65%	0.87	0.927	0	0	0.180	0	0.122	0
AVERAGE	107.12%	0.87	0.927	0.000	0.000	0.180	0.000	0.119	0.000
INTERANNUAL WEI+: 107.1%									

The following table (Table 7-41) calculates the WEI+ index for the entire hydrologic region. The total interannual WEI+ index is equal to 91.7%, showing that the water resources of Hydrologic Region 8 are subject to very significant water pressure, depleting the renewable reserves.

Table 7-41: Calculation of the annual average WEI+ index of Hydrologic Region 8.

HYDROLOGIC REGION 8									
	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
	91.68%	47.84	19.66	13.54	10.66	2.22	0.00	8.80	2.60

Finally, we attempted to calculate the total runoff coefficient (surface and underground), which can be defined as the quotient of RWR to the average annual rainfall. The average annual rainfall for the five hydrological years is equal to 467.8 mm. The surface of the hydrologic region is equal to 1040.8 km^2 and therefore, the runoff coefficient is equal to 9.8%.

7.3.9 CALCULATION OF THE WEI+ INDEX IN HYDROLOGIC REGION 9

Hydrologic Region 9 (along with Hydrologic Region 8) is the area of the most significantwater resource utilization project, namely of the Southern Conveyor project. Hydrologic Region 3 comprises the surrounding area of Larnaca which includes the following river basins, for which the WEI+ index is calculated (from west to east):

1. Pissouri River Basin with a river basin surface of 72.4 km^2.
2. Avdimou River Basin with a river basin surface of 118.8 km^2.

3. Episkopi River Basin with a river basin surface of 56.7 km^2.
4. River Basin of R. Kouris with a river basin surface of 338.2 km^2.
5. River Basin of R. Akrotiri with a river basin surface of 142.2 km^2.
6. River Basin of R. Garyllis with a river basin surface of 103.4 km^2.
7. River Basin of R. Germasogeia with a river basin surface of 178.8 km^2.
8. Argaki tou Pyrgou River Basin with a river basin surface of 114.6 km^2.

The next paragraphs summarise the calculations for each river basin and Figure 7-7 presents the relevant map with all necessary information for the development of WEI+ calculations.

River Basin of R. Pissouri: There has been no water resource storage or exploitation project constructed in this basin. The outflow of the basin arises from the annual rainfall of the Pissouri station, assuming a surface runoff coefficient of 5%, a quite reasonable value for a coastal basin at a low altitude. Abstractions from the underground aquifer (renewable and permanent) arise from the previous methodology where the river basin of r. Pissouri intersects only the CY_18 Lefkara - Pachna aquifer. The following table (Table 7-42) presents the calculation sheet of the annual WEI+ index for the river basin of r. Pissouri. The interannual WEI+ index of r. Pissouri is equal to 42.0%

Table 7-42: Calculation of the annual WEI+ in the river basin of r. Pissouri.

PISSOURI CATCHMENT									
Hydrologic Year (Volumes in hm^3)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	30.47%	1.94	1.170	0	0.00	0.115	0.00	1.47	0
2009-10	26.19%	2.26	1.170	0	0.00	0.115	0.00	1.78	0
2010-11	28.98%	2.04	1.170	0	0.00	0.115	0.00	1.56	0
2011-12	24.00%	2.47	1.170	0	0.00	0.115	0.00	1.99	0
2012-13	25.53%	2.32	1.170	0	0.00	0.115	0.00	1.84	0
AVERAGE	42.04%	2.78	1.170	0.000	0.000	0.115	0.000	1.728	0.000
INTERANNUAL WEI+: 42.0%									

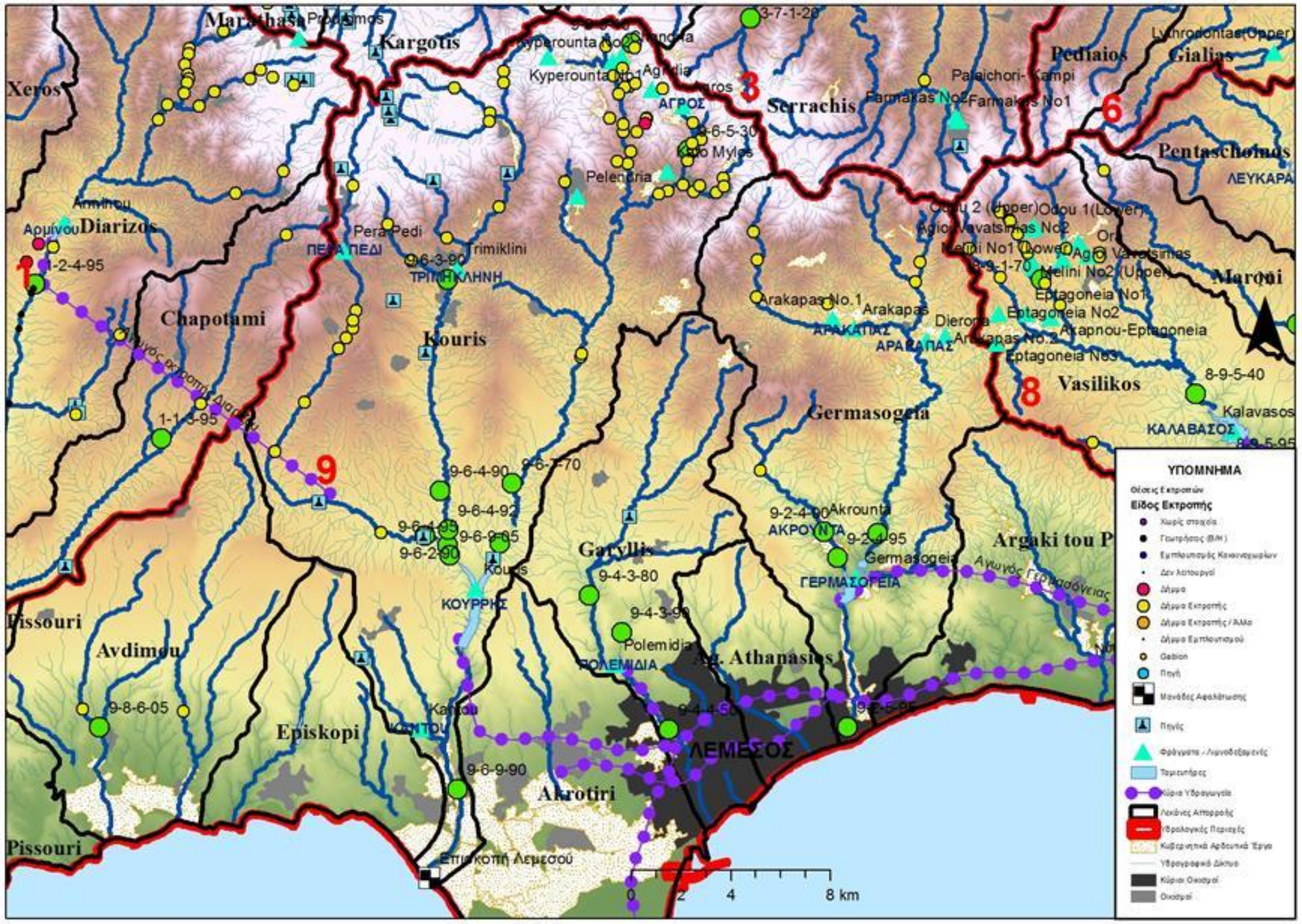

Figure 7-7: Map of Hydrologic Region 9 (Limassol District) with the locations of dams, diversions and hydrometric stations.

River Basin of R. Avdimou: There has been no water resource storage or exploitation project constructed in this basin. The outflow of the basin arises from the annual rainfall of the Avdimou station, assuming a surface runoff coefficient of 10%, a quite reasonable value for a coastal basin at a relatively high mean altitude. Abstractions from the underground aquifer (renewable and permanent) arise from the previous methodology where the river basin of r. Avdimou intersects the CY_18 Lefkara - Pachna and the CY_10 Paramali_Afdimou aquifers. The following table (Table 7-43) presents the calculation sheet of the annual WEI+ index for the river basin of r. Avdimou. The interannual WEI+ index of r. Avdimou is equal to 29.2%

Table 7-43: Calculation of the annual WEI+ in the river basin of r. Avdimou.

AVDIMOU CATCHMENT									
Hydrologic Year (Volumes in hm^3)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	31.20%	8.03	2.506	0	0.00	0.533	0.00	6.06	0.00
2009-10	30.96%	8.09	2.506	0	0.00	0.533	0.00	6.12	0.00
2010-11	34.11%	7.35	2.506	0	0.00	0.533	0.00	5.37	0.00
2011-12	24.24%	10.34	2.506	0	0.00	0.533	0.00	8.37	0.00
2012-13	27.47%	9.13	2.506	0	0.00	0.533	0.00	7.15	0.00
29.18%	8.59	2.506	0.000	0.000	0.533	0.000	6.615	0.000	29.18%
INTERANNUAL WEI+: 29.2%									

River Basin of R. Episkopi: There has been no water resource storage or exploitation project constructed in this basin. The outflow of the basin arises from the annual rainfall of the Avdimou station, assuming a surface runoff coefficient of 5%, a quite reasonable value for a coastal basin at a low altitude. Abstractions from the underground aquifer (renewable and permanent) arise from the previous methodology where the river basin of r. Episkopi only intersects the CY_9 Akrotir and thei CY_18 Lefkara - Pachna aquifers.. The following table (Table 7-44) presents the calculation sheet of the annual WEI+ index for the river basin of r. Episkopi. The interannual WEI+ index of r. Episkopi is equal to 38.9%

Table 7-44: Calculation of the annual WEI+ in the river basin of r. Episkopi.

EPISKOPI CATCHMENT									
Hydrologic Year (Volumes in hm^3)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	41.25%	2.22	0.917	0	0.00	0.141	0.00	1.45	0.00
2009-10	40.98%	2.24	0.917	0	0.00	0.141	0.00	1.46	0.00
2010-11	44.53%	2.06	0.917	0	0.00	0.141	0.00	1.28	0.00
2011-12	33.06%	2.77	0.917	0	0.00	0.141	0.00	2.00	0.00
2012-13	36.92%	2.48	0.917	0	0.00	0.141	0.00	1.71	0.00

AVERAGE	38.93%	2.36	0.917	0.000	0.000	0.141	0.000	1.579	0.000
INTERANNUAL WEI+: 38.9%									

River Basin of R. Kouris: In this basin the Kouris dam with a water reservoir volume of 113 hm^3 has been constructed in 1988 and it is also the largest reservoir project in Cyprus. The Kouris dam receives significant amounts of water from the Arminou dam and the ChaPotami diversion, which will be deducted from the RWR quantity, as these quantities are not the result of the natural runoff of the basin, but the result of technical diversion projects. If these quantities are not deducted, then the ABSTR_DAM value representing abstraction from the Kouris dam and summed up for the calculation of the RWR will also include the diverted quantities, hence leading to an overevaluation of the RWR with water quantities that are not includd within the same basin. Based on the relevant documents, we propose that diverting quantities should be included in the final value of ΔS_{art}, without proposing any specific method of calculation. It should be noted again that the WEI+ index is still under development, at least in regard to complex hydrologic systems. Since the change of ΔS_{art} should lead to a reduction of the RWR (on the basis of the abovementioned) then the diverted quantities should be added to the $\Delta S_{art,}$ because under the RWR calculation formula, the ΔS_{art} is a negative value in the RWR . Therefore, to reduce the RWR the $\Delta S_{art.}$should be equally increased. Please note that the new method of determination is not explicitly stated in the relevant EU texts, but it is a proposal of the Consultant. It is likely that the final configuration of the index calculation method will require an update on the estimates presented here.

The outflows from the Kouris dam are the quantities allowed for the recharge of groundwater and refilling of aquifers and leaks through the dam body. Abstractions from the hydrographic network are significant and amount to about 4hm^3 of water per year.

Abstractions from the underground aquifer (renewable and permanent) arise from the previous methodology where the river basin of r. Kouris (a) CY-9 Akrotiri, (b) CY_18 Lefkara - Pachna and (c) CY_19 Troodos. The following table (Table 7-45) presents the calculation sheet of the annual WEI+ index for the river basin of r. Kouris. Given its significant annual quantities serious problems arise in the calculation of the annual value of the RWR and therefore, of the WEI+. Therefore the total WEI+ index cannot arise from the average of the respective annual values but should be based on the total cumulative quantities of individual annual quantities. Even then, however, the total period of five years is too short to allow any effect of the significant annual water storage in said period. The interannual WEI+ index is equal to 183.3%, which is reasonable, especially since the water abstractions of the river basin arising from the significant enhancement of the water resources of the basin have been deducted from the basins of Dhiarizos and Cha-potami.

Table 7-45: Calculation of the annual WEI+ in the river basin of r. Kouris.

CATCHMENT π. KOURIS (KOURIS DAM)									
Hydrologic Year (Volumes in hm³)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	-76.65%	-21.96	4.819	3.97	8.04	0.614	0.00	0.12	38.29
2009-10	-167.69%	-19.78	4.819	3.97	24.38	0.614	0.00	0.81	53.14
2010-11	90.95%	43.73	4.819	3.97	30.98	0.614	0.00	0.87	-3.71
2011-12	-279.08%	-21.02	4.819	3.97	49.88	0.614	0.00	2.48	81.55
2012-13	103.88%	62.07	4.819	3.97	55.68	0.614	0.00	2.80	4.59
2013-14	55.69%	104.97	4.819	3.97	49.67	0.614	0.00	0.67	-46.45
AVERAGE	183.35%	24.67	4.819	3.970	36.439	0.614	0.000	1.291	21.237
INTERANNUAL WEI+: 183.3%									

River Basin of Akrotiri: There has been no water resource storage or exploitation project constructed in this basin. The outflow of the basin arises from the annual rainfall of the Fasouri station, assuming a surface runoff coefficient of 5%, a quite reasonable value for a coastal basin at a low altitude. Abstractions from the underground aquifer (renewable and permanent) arise from the previous methodology where the river basin of r. Episkopi only intersects aquifers (a) CY_8 Limassol, (b) CY_9 Akrotiri and CY_18 Lefkara - Pachna. The following table (Table 7-46) presents the calculation sheet of the annual WEI+ index for the river basin of Akrotiri. The interannual WEI+ index in Akrotiri is equal to 56.6%.

Table 7-46: Calculation of the annual WEI+ in the river basin of r. Akrotiri.

AKROTIRI CATCHMENT									
Hydrologic Year (Volumes in hm³)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	58.39%	7.54	4.404	0	0.00	0.110	0.00	3.25	0.00
2009-10	57.22%	7.70	4.404	0	0.00	0.110	0.00	3.40	0.00
2010-11	62.00%	7.10	4.404	0	0.00	0.110	0.00	2.81	0.00
2011-12	50.51%	8.72	4.404	0	0.00	0.110	0.00	4.42	0.00
2012-13	55.79%	7.89	4.404	0	0.00	0.110	0.00	3.60	0.00
AVERAGE	56.53%	7.79	4.404	0.000	0.000	0.110	0.000	3.497	0.000
INTERANNUAL WEI+: 56.5%									

River Basin of R. Garyllis: In this basin the Polemidia dam with a reservoir volume of 3.4 hm^3 was constructed in 1965. In this dam quantities of recycled water from the recycling and reuse plant of Limassol are stored and said quantities should be deducted from the ΔS_{art} as they are not water resources of the river basin.

Abstractions from the underground aquifer (renewable and permanent) arise from the previous methodology where the river basin of r. Garyllis (a) CY-9 Akrotiri, (b) CY_18 Lefkara - Pachna and (c) CY_19 Troodos. The following table (Table 7-47) presents the calculation sheet of the annual WEI+ index for the river basin of r. Garyllis. The interannual WEI+ index is 88.0%.

Table 7-47: Calculation of the annual WEI+ in the river basin of r. Garyllis.

GARYLIIS CATCHMENT (POLEMIDHIA DAM)									
Hydrologic Year (Volumes in hm^3)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	77.14%	3.78	1.97	0.075	0.869	0.209	0.000	0.118	-0.96
2009-10	104.09%	2.54	1.97	0.075	0.599	0.209	0.000	0.284	0.18
2010-11	75.70%	3.37	1.97	0.075	0.503	0.209	0.000	0.215	-0.81
2011-12	108.25%	3.23	1.97	0.075	1.448	0.209	0.000	0.547	0.61
2012-13	80.82%	3.39	1.97	0.075	0.689	0.209	0.000	0.406	-0.45
2013-14	68.62%	3.80	1.97	0.075	0.558	0.209	0.000	0.128	-1.27
AVERAGE	87.97%	3.26	1.973	0.075	0.822	0.209	0.000	0.314	-0.287
INTERANNUAL WEI+ (TO THE SUM OF PARAMETERS): 88.0%									

River Basin of R. Germasogeia: In this basin the Germasogeia dam with reservoir volume 13.5 hm^3 was constructed in 1968 and it indirectly contributes to the Southern Conveyor project, mainly due to the quantities of water that are released for recharge, which however are pumped for the Southern Conveyor project.

Abstractions from the underground aquifer (renewable and permanent) arise from the previous methodology where the river basin of r. Germasogeia (a) CY-9 Akrotiri, (b) CY_18 Lefkara - Pachna and (c) CY_19 Troodos. The following table (Table 7-48) presents the calculation sheet of the annual WEI+ index for the river basin of r. Germasogeia. The interannual WEI+ index is 90.2%.

Table 7-48: Calculation of the annual WEI+ in the river basin of r. Germasogeia.

GERMASOGEIA CATCHMENT (GERMASOGEIA DAM)									
Hydrologic Year (Volumes in hm^3)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	76.93%	14.90	8.261	0.27	2.929	0.236	0.000	0.000	-3.673
2009-10	80.81%	17.70	8.261	0.27	5.775	0.236	0.000	0.000	-3.634
2010-11	128.26%	11.45	8.261	0.27	6.149	0.236	0.000	0.000	2.999
2011-12	74.78%	20.03	8.261	0.27	6.449	0.236	0.000	0.000	-5.287
2012-13	104.45%	16.43	8.261	0.27	8.633	0.236	0.000	0.000	0.496
2013-14	190.13%	7.86	8.261	0.27	6.412	0.236	0.000	0.000	6.848
AVERAGE	90.16%	16.10	8.261	0.270	5.987	0.236	0.000	0.000	-1.820
INTERANNUAL WEI+ (TO THE SUM OF PARAMETERS): 90.2%									

River Basin of Argaki tou Pyrgou: There has been no water resource storage or exploitation project constructed in this basin. The outflow of the basin arises from the annual rainfall of the Moni station, assuming a surface runoff coefficient of 5%, a quite reasonable value for a coastal basin at a low altitude. Abstractions from the underground aquifer (renewable and permanent) arise from the previous methodology where the river basin of r. Episkopi only intersects aquifers (a) CY_7 Germasogeia, (b) CY_19 Troodos and CY_18 Lefkara - Pachna. The following table (Table 7-49) presents the calculation sheet of the annual WEI+ index for the river basin of Argaki in Pyrgos. The interannual WEI+ index is 41.6%.

Table 7-49: Calculation of the annual WEI+ in the river basin of Argaki in Pyrgos.

ARGAKI OF PYRGOS CATCHMENT									
Hydrologic Year (Volumes in hm^3)	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
2008-09	42.40%	3.70	1.568	0	0.00	0.219	0.00	2.35	0.00
2009-10	38.34%	4.09	1.568	0	0.00	0.219	0.00	2.74	0.00
2010-11	50.17%	3.13	1.568	0	0.00	0.219	0.00	1.78	0.00
2011-12	33.50%	4.68	1.568	0	0.00	0.219	0.00	3.33	0.00
2012-13	48.27%	3.25	1.568	0	0.00	0.219	0.00	1.90	0.00
AVERAGE	41.61%	3.77	1.568	0.000	0.000	0.219	0.000	2.420	0.000
INTERANNUAL WEI+: 41.6%									

The following table (Table 7-50) calculates the WEI+ index for the entire hydrologic region. The total interannual WEI+ index is equal to 105.6%, showing that the water resources of Hydrologic Region 9 are subject to very significant water pressure, not only depleting the renewable reserves but also abstracting from permanent reserves.

Table 7-50: Calculation of the annual average WEI+ index of Hydrologic Region 9.

HYDROLOGIC REGION 9									
	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
	105.57%	69.32	25.62	4.315	43.247	2.176	0.000	17.443	19.130

Finally, we attempted to calculate the total runoff coefficient (surface and underground), which can be defined as the quotient of RWR to the average annual rainfall. The average annual rainfall for the five hydrological years is equal to 633.7 mm. The surface of the hydrologic region is equal to 1163.6 km^2 and therefore, the runoff coefficient is equal to 9.4%.

7.3.10 UNIVERSAL ASSESSMENT OF THE WEI+ INDEX ACROSS CYPRUS

The spatial distribution of WEI+ water scarcity indices in Cyprus are shown in Figure 7-10. It is shown that uses of water in river basins in general deplete renewable reserves, with the exception of the basins in Hydrologic Region 2 and mainly in Region 3 where the generally small water requirements and the high aquifer conditions preserve the WEI+ index within the limits of the characterization of "no significant water pressure the water reserves". On the contrary, in the basins in Central and SE Cyprus and especially in Hydrologic Regions 8 and 9, which is also the area of Southern Conveyor project, the depletion of renewable reserves is almost universal.

The table below (Table 7-51) shows the application of the WEI+ Index for hydrologic regions under the control of the Republic of Cyprus. The total WEI+ index is equal to 73.1%, leading to the familiar conclusion that Cyprus is under significant pressure regarding water resources , even with a lenient 60% limit. The highest values of WEI+ appear in Hydrologic Regions 6, 7 and 9 (Nicosia, Kokkinohoria and Limassol areas) and they are even above 100%. It is known that in the Kokkinohoria region, permanent reserves are being pumped, although the region significantly draws its water from the Southern Conveyor project. The lowest values appear in Regions 2 & 3, where, except from the Evretou dam (Region 2), there is no other significant water reservoir and water exploitation project.

It seems that Hydrologic Regions 6, 7, 8 and 9 are more vulnerable to drought conditions and that on average they annualy deplete their renewable reserves and draw from permanent reserves. Any negative development in management practices (e.g. inadequate operation of desalination plants and increased abstracton from dams or groundwater) will exert more pressure on renewable water resources. Any onset of drought phenomena will further amplify water scarcity phenomena, as they will reduce the inflow of water in the system. Hydrologic Region 9 is in critical condition, but given the anticipated decrease in water demand for irrigation, it may improve if the quantities of water that are diverted to Hydrologic Region 9 are not increased. Hydrologic regions 2 and 3 are in good condition and therefore are not vulnerable to the occurrence of water scarcity phenomena.

Table 7-51: Summary table of WEI+ values for all Hydrologic Regions of Cyprus.

APPLICATION OF WEI+ INDEX TO CYPRUS (Volumes in hm^3)									
HYDROLOGIC REGION	WEI+	RWR	ABSTR_GW	ABSTR SF	ABSTR DAM	ABSTR PERM	RETURN	OUTFLOW	ΔSart
AREA 1	75.78%	87.85	28.11	2.20	36.25	2.72	0.00	31.63	7.63
AREA 2	31.73%	47.50	7.83	1.11	6.13	1.24	0.00	36.65	2.98
AREA 3	35.95%	75.56	22.71	1.57	2.89	3.60	0.00	52.10	0.10
AREA 6	102.26%	16.48	15.98	0.80	0.07	3.09	0.00	2.76	0.043
AREA 7	126.59%	17.30	21.90	0.00	0.00	11.80	0.00	7.20	0.00
AREA 8	91.68%	47.84	19.66	13.54	10.66	2.22	0.00	8.80	2.60

AREA 9	105.57%	69.32	25.62	4.315	43.247	2.176	0.000	17.443	19.130
TOTAL	73.1%	361.84	141.81	23.53	99.25	26.84	0.00	156.58	32.49

The WEI+ value for Cyprus, as calculated, conforms to the previously published values of the index by the EU as coarsely calculated for the entire Cyprus. For example, the figure below (available on the EEA website: http://www.eea.europa.eu/data-and-maps/indicators/use-of-freshwater-resources/use-of-freshwater-resources-assessment-2) shows the WEI+ index for the entire European Union, where the WEI+ index for Cyprus is about 65% for the year of calculation 2007.

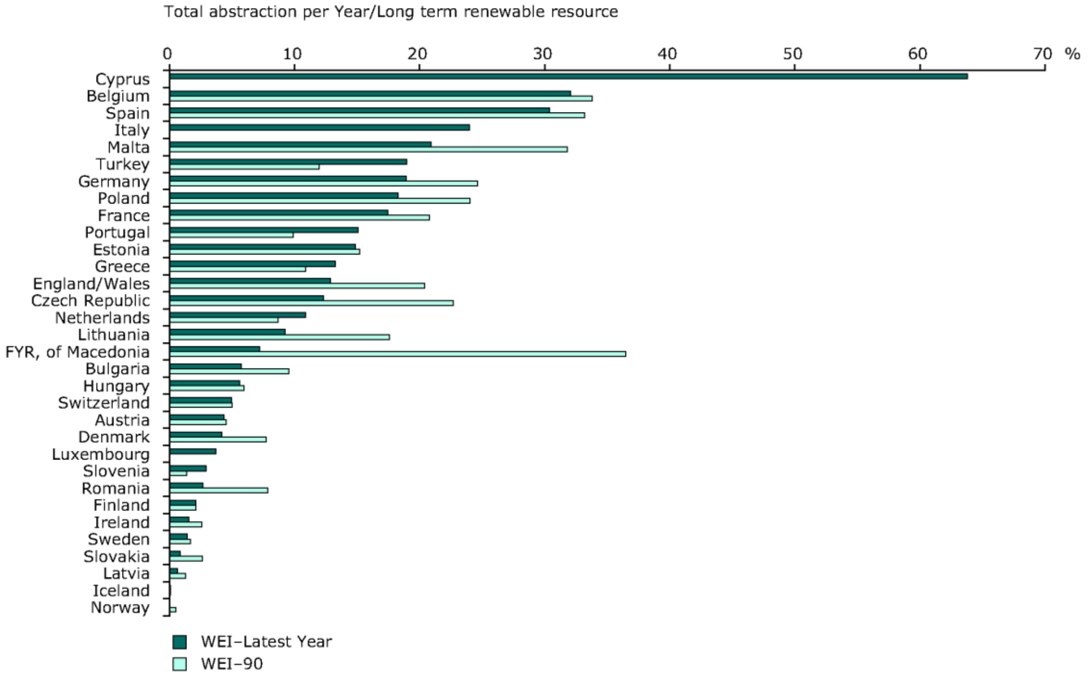

Figure 7-8: Comparative assessment of WEI+ indices in EE countries, where Cyprus ranks first for year 2007, without publication of data for the 1990-2000 decade.

Moreover, during the consultation to determine the WEI+ index, the index was calculated for all European countries (available at http://forum.eionet.europa.eu/nrc-eionet-freshwater/library/public-section/2012-state-water-thematic-assessments/material-vulnerability-assessment-july-2012/consultation-wei/download/en/1/Consultation_WEI%2B.xls) where the WEI+ index for Cyprus was coarsely calculated based on the water balance and estimated as ranging from 62% to 77%. It therefore appears that the calculation of the WEI+ index in this project is fully conforming to the relevant estimates concerning Cyprus so far.

Furthermore, the total runoff coefficient for Cyprus was calculated, assuming that the average annual rainfall for past years is equal to 501 mm, according to information from the WDD. The average annual rate of total runoff (surface and underground) was estimated as equal to 12% for the whole of Cyprus and is a totally reasonable value and very close to the estimate of the WDD (M. Panaretou) equal to 10%.

The Hydrology and Hydrogeology Service has calculated, on the basis of a simplified balance, the RWR as 323 hm^3 of water for the entire part of Cyprus under the control of the Republic of Cyprus, which is almost identical to the assessment of the present study (361 hm^3). Moreover, the same calculation shows that the abstraction from groundwater is equal to 145 hm^3, while the assessment of the present study is equal to 141 hm^3. Furthermore, the total abstraction from groundwater and surface water was calculated in the WDD study as equal to 236 hm^3, while in the present study it is equal to 264 hm^3. The abstraction of surface water in this study is higher, because the direct water abstractions from the hydrographic network are also calculated, utilising any relevant information of the geodatabase data of the WDD.

In conclusion, we consider that the calculation of the water scarcity WEI+ index in Cyprus is compatible not only with the estimates of WDD but also with the EU reports on Cyprus. However, the added value of this study is that the calculation of the WEI+ index is made for each river basin and therefore for each Hydrologic Region, thus accurately portraying the unequal distribution of water use in Cyprus. The map of Cyprus with the regions under the control of the Republic of Cyrpus is shown in Figure 7-10, where each basin is marked with the relevant WEI index+ value. Respectively, Figure 7-10 shows the same map, indicating the WEI+ index value for each Hydrologic Region.

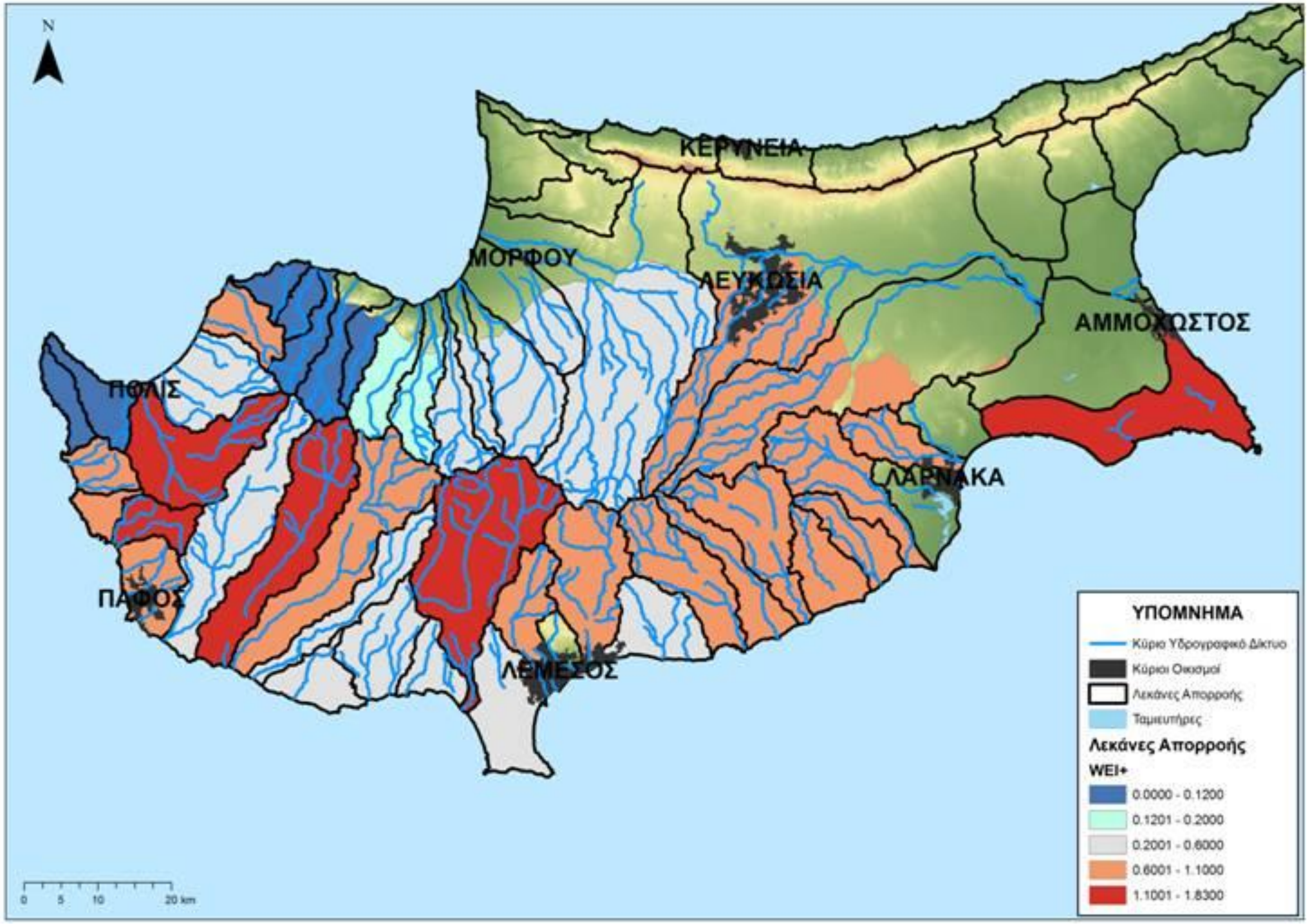

Figure 7-9: : Spatial distribution of water scarcity WEI+ indices in the river basins of Cyprus.

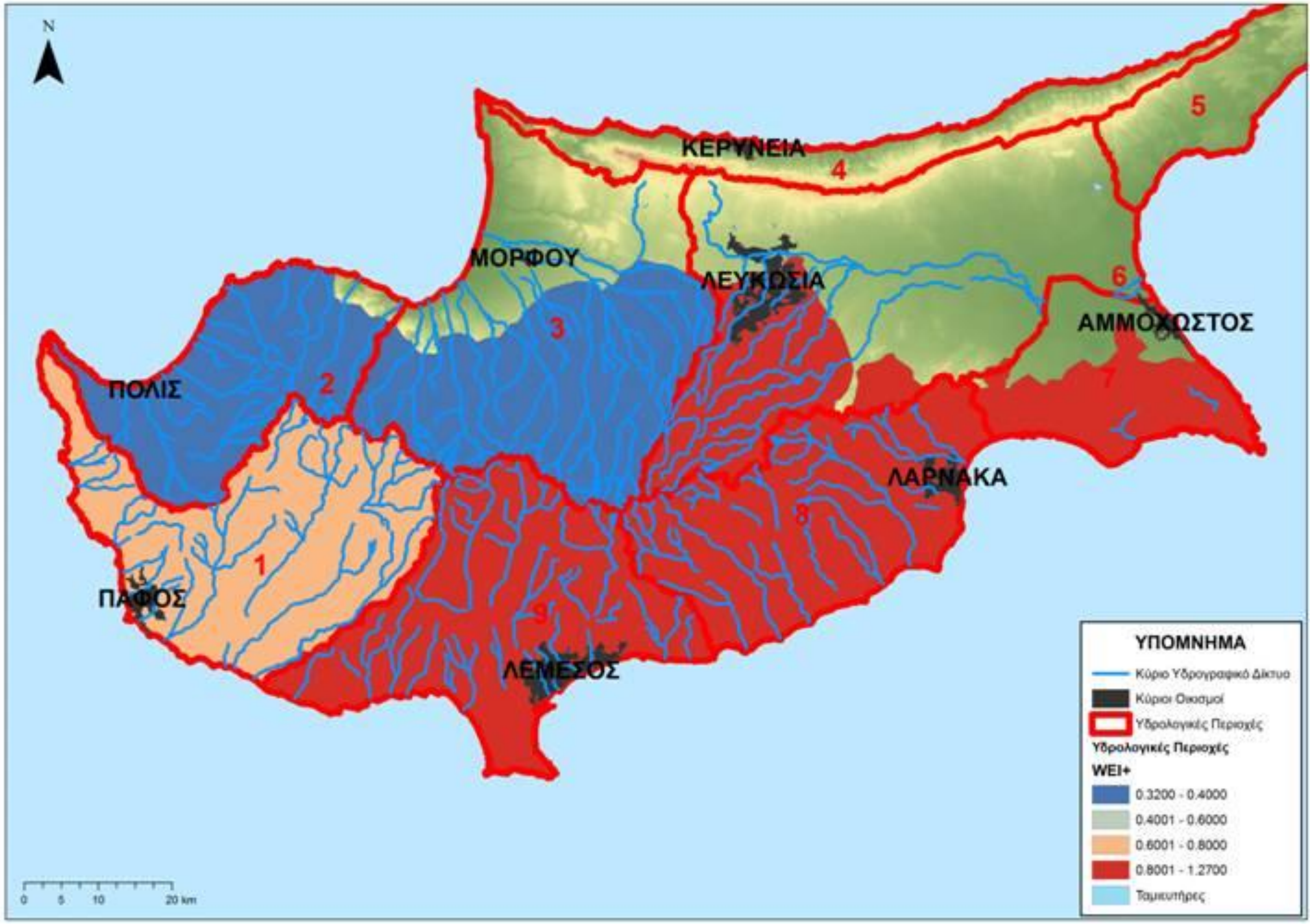

Figure 7-10: Spatial distribution of water scarcity WEI+ indices in the Hydrologic Regions of Cyprus.

8. ASSESSMENT OF THE IMPACT OF DROUGHT &WATER SCARCITY IN ACHIEVING THE ENVIRONMENTAL OBJECTIVES OF ARTICLE 4

8.1 THE ENVIRONMENTAL OBJECTIVES OF ARTICLE 4 OF THE DIRECTIVE IN THE EVENT OF PROLONGED DROUGHT

The main purpose of the EC Directive 2000/60 (Article 1) is to establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater. The ultimate goal of the implementation of the Directive is (Annex V), as regards surface WB, for natural water bodies to achieve Good Ecological Status and for heavily modified and artificial water bodies to achieve a Good/Higher Ecological Potential, while all surface WB should achieve Good Chemical Status . Finally, groundwater bodies should achieve Good Quantitative and Qualitative status. To achieve the above objective of the Directive, River Basin Management Plans are applied for each water body and a Programme of Measures (Article 11) is proposed, which will be operational as long as the Environmental Objectives are specified in accordance with Article 4.

The above environmental objectives may not be achieved for some water bodies in the relevant management period and may be included in the exceptions, as mentioned in paragraphs 4, 5, 6 and 7 of Article 4 of the Directive. A key requirement for the inclusion of a WB in the exceptions is the application does not permanently exclude or compromise the achievement of environmental objectives in other water bodies of the same RBD and that it is consistent with the implementation of other Community or environmental legislation (paragraph 8, article 4).

Specifically *during prolonged drought it is possible to exempt certain WB from the obligation to achieve environmental objectives under Article 4.6 of the Directive,* which states that:

"*Temporary deterioration in the status of bodies of water shall not be in breach of the requirements of this Directive if this is the result of circumstances of natural cause or force majeure which are exceptional or could not reasonably have been foreseen, in particular extreme floods and prolonged droughts, or the result of circumstances due to accidents which could not reasonably have been foreseen*, when all of the following conditions have been met:

1. All practicable steps are taken to prevent further deterioration in status and in order not to compromise the achievement of the objectives of this Directive in other bodies of water not affected by those circumstances;
2. The conditions under which circumstances that are exceptional or that could not reasonably have been foreseen may be declared, including the adoption of the appropriate indicators are stated in the RBMP.
3. The measures to be taken under such exceptional circumstances are included in the programme of measures and will not compromise the recovery of the quality of the body of water once the circumstances are over.
4. The effects of the circumstances that are exceptional or that could not reasonably have been foreseen are reviewed annually and, subject to the reasons set out in paragraph 4(a), all practicable measures are taken with the aim of restoring the body of water to its status prior to the effects of those circumstances as soon as reasonably practicable, and
5. A summary of the effects of the circumstances and of such measures taken or to be taken in accordance with points 1 and 4 are included in the next update of the river basin management plan.

The definition of terms (Guidance Document 20):is essential to understanding Article 4.6.

- **Temporary deterioration:** The length of a temporary deterioration is linked to the length of the circumstances of natural cause, which are exceptional or could not reasonably have been foreseen and the practicability of the measures that can be taken to restore the status of the water bodies.
- **Natural causes:** Refers to events like floods and droughts which give rise to situations which cause deterioration of WB status (e.g. by supplying the public with drinking water during drought). It should be emphasized that it is essential to determine the natural causes triggering temporary deterioration of a WB for its inclusion in the exemptions of Article 4.6. In particular, Guidance Document 29 makes a clear distinction between the common drought, which must be addressed with the implementation of the Programme of Measures of the Management Plan and the prolonged drought, which activates paragraph 6 of Article 4 of the Directive.

Unlike non-prolonged droughts, during which the needs of the environment should be respected at all times so as to meet the environmental objectives of the WFD, ***during a prolonged drought, and provided that the requirements of Article 4.6 have been met, the priority needs related to human activity (e.g. drinking water) may be temporarily met at the expense of environmental needs, namely allowing a temporary non-achievement of environmental objectives.***

The prolonged drought management involves making decisions about the allocation of reduced resources, both for the environment and for human activities. These decisions should carefully take into account the environmental and socio-economic aspects (in line with the conditions of paragraphs 4.6 (1) to (4) of Article 4 of the Directive.

In addition to the possible effects on drinking water, prolonged drought can cause significant impact on all water uses, particularly irrigation, cooling water supply and other industrial uses, as well as other household uses (such as garden irrigation). Therefore, it is necessary to determine in advance a clear hierarchy of the main uses, where limitations are imposed step by step upon the increase of the duration, intensity and impacts of droughts. Ensuring the necessary quantities of drinking water should be considered a high priority during prolonged drought, but combined with a high priority to ensure a minimum ecological flow.

Below the exemption categories of Article 4 are presented, based on paragraphs 4.5 and 7:

Article 4, paragraph 4: The achievement of the environmental objectives of paragraph 1 of Article 4 may be extended for the purposes of phased achievement of the objectives for bodies of water, provided that no further deterioration occurs in the status of the affected body of water when all of the conditions set out in the paragraph are met.

Article 4, paragraph 5: Member States may aim to achieve less stringent environmental objectives than those required under paragraph 1 of Article 4 for specific bodies of water when they are so affected by human activity, or their natural condition is such that the achievement of these objectives would be infeasible or disproportionately expensive, and if all the conditions of the paragraph are met.

Article 4, paragraph 7: Member States will not be in breach of the Directive when:

- failure to achieve good groundwater status, good ecological status or, where relevant, good ecological potential or to prevent deterioration in the status of a body of surface water or groundwater is the result of new modifications to the physical characteristics of a surface water body or alterations to the level of bodies of groundwater, or

- failure to prevent deterioration from high status to good status of a body of surface water is the result of new sustainable human development activities

The surface and groundwater WB exempted from achieving the environmental objectives of the Directive, based on article 4 (4) and (7) of the RBD are shown (Table 8-1) below, in accordance with the relevant RBMP. The justification for the inclusion of WB in the exemptions can be found the Deliverable “Determination of exemptions from achieving the environmental objectives of Directive 2000/60/EC and setting out of intended objectives”

Table 8-1: Surface WB/HMWB with less than good status (ecological and chemical)

WB Category	Code Catchment	Code WB	Name WB	Length WB (km)	Area WB km^2	HMWB 2015	Type WB	Status WB	Κατάσ ταση ΦΧ	Ecological Status / Potential	Αβεβ αιότητ ός	Κατάσ ή	Αβεβ αιότητ ός
RWB	1-1	CY_1-1-a_RP	ChaPotami	5,9		NO	P	M	M	M	*2*	G	2
RWB	1-1	CY_1-1-b_RI	ChaPotami	17,2		NO	I	M	G	M	*1*	G	1
RWB	1-1	CY_1-1-e_RI	Maletis	9,6		NO	I	M	G	M	*2*	G	4
RWB	1-3	CY_1-3-c_RIh	Xeros	11,7		YES	Ih	M	G	M	*1*	G	4
RWB	1-4	CY_1-4-d_RI_HM	Ezoussa	7,4		YES	I	M	G	M	*4*	G	4
RWB	1-4	CY_1-4-e_RIh_HM	Ezoussa	4,8		YES	Ih	M	G	M	*4*	G	4
RWB	1-4	CY_1-4-j_RIh	Agios nepios	7,1		NO	Ih	M	G	M	*4*	G	4
RWB	1-4	CY_1-4-k_RIh	Barkas	14,1		NO	Ih	M	G	M	*4*	G	4
RWB	1-4	CY_1-4-L_RIh	Mylari	12,9		NO	Ih	M	G	M	*3*	G	4
RWB	1-4	CY_1-4-m_RIh	Kosiatis	13,2		NO	Ih	M	G	M	*4*	G	4
RWB	1-6	CY_1-6-a_RIh	Mavrokolympos	11,9		NO	Ih	M	G	M	*3*	G	4
RWB	1-6	CY_1-6-c_RIh_HM	Mavrokolympos	2,7		YES	Ih		G	M	*4*	G	4
RWB	1-6	CY_1-6-d_RIh	Xeros	17,1		NO	Ih	M	G	M	*3*	G	4
RWB	2-2	CY_2-2-a_RIh	Nerades & Amakou	21,0		NO	Ih	M	G	M	*4*	G	2
RWB	2-2	CY_2-2-b_RI	Garyllis	6,2		NO	I	M	G	M	*1*	G	1
RWB	2-2	CY_2-2-f_RI_HM	Stavros Psokas	2,7		YES	I	M	G	M	*4*	G	4
RWB	2-2	CY_2-2-g_RI_HM	Chrysochou	2,8		YES	I	M	G	M	*2*	G	4
RWB	2-2	CY_2-2-h_RIh_HM	Chrysochou	6,8		YES	Ih		G	M	*4*	G	4
RWB	2-3	CY_2-3-a_RIh	Mirimikofou	15,0		NO	Ih	M	G	M	*4*	G	4

WB Category	Code Catchment	Code WB	Name WB	Length WB (km)	Area WB km^2	HMWB 2015	Type WB	Status WB	Κατάσταση ΦΧ	Ecological Status / Potential	Αβεβαιότητ ός	Κατάσ χημική	Αβεβαιότητ ός
RWB	2-3	CY_2-3-b_RIh	Argaki tis Limnis	8,5		NO	Ih		M	M	*1*	F	3
RWB	2-6	CY_2-6-b_RIh_HM	Katouris	5,3		YES	Ih	M	G	M	*3*	G	4
RWB	2-9	CY_2-9-b_RP	Kampos	7,3		NO	P	G	M	M	*1*	G	1
RWB	3-3	CY_3-3-b_RP	Kargotis	13,4		NO	P	M	M	M	*1*	G	1
RWB	3-3	CY_3-3-c_RI	Kargotis	11,4		YES	I	M	G	M	*2*	U	0
RWB	3-3	CY_3-3-d_RP	Argaki tou Karvouna	12,6		NO	P	M	M	M	*2*	G	2
RWB	3-4	CY_3-4-b_RIh	Atsas	2,1		NO	Ih		M	M	*3*	G	1
RWB	3-4	CY_3-4-c_RIh_HM	Atsas	6,0		YES	Ih	M	G	M	*4*	U	0
RWB	3-5	CY_3-5-c_RI_HM	Lagoudera	12,6		YES	I	M	G	M	*1*	F	1
RWB	3-5	CY_3-5-d_RIh_HM	Elia	13,3		YES	Ih	M	G	M	*4*	F	4
RWB	3-7	CY_3-7-e_RI	Kampi	7,5		NO	I	M	G	M	*2*	G	2
RWB	3-7	CY_3-7-j_RIh_HM	Akaki	4,5		YES	Ih	M	G	M	*4*	U	0
RWB	3-7	CY_3-7-n_RIh	Koutis & Aloupos	22,4		NO	Ih	M	G	M	*3*	G	4
RWB	6-1	CY_6-1-c_RIh_HM	Pediaios	1,0		YES	Ih	M	G	M	*4*	G	3
RWB	6-5	CY_6-5-b_RI	Gialias	12,8		NO	I	POOR	M	POOR	*1*	G	3
RWB	6-5	CY_6-5-f_RIh_HM	Koutsos	6,2		YES	Ih	M	G	M	*4*	G	3
RWB	7-2	CY_7-2-a_RIh	Bathys	6,6		NO	Ih	M	G	M	*3*	U	0
RWB	8-6	CY_8-6-a_RIh	Xeropotamos	18,9		NO	Ih	M	G	M	*4*	G	4
RWB	8-7	CY_8-7-c_RI_HM	Syriatis	6,7		YES	I	M	G	M	*1*	G	3
RWB	8-7	CY_8-7-f_RI_HM	Pentaschoinos	7,3		YES	I		G	M	*4*	G	4

WB Category	Code Catchment	Code WB	Name WB	Length WB (km)	Area WB km^2	HMWB 2015	Type WB	Status WB	Κατάσταση ΦΧ	Ecological Status / Potential	Αβεβαιότητα	Κατάσταση Χημική	Αβεβαιότητα
RWB	8-7	CY_8-7-g_RIh_HM	Pentaschoinos	9,5		YES	Ih		M	M	*4*	G	4
RWB	8-8	CY_8-8-b_RIh	Ayios Minas	2,9		NO	Ih	M	G	M	*3*	G	4
RWB	8-8	CY_8-8-c_RIh_HM	Ayios Minas	8,1		YES	Ih	M	G	M	*1*	G	4
RWB	8-9	CY_8-9-c_RI	Vassilikos	33,0		NO	I	G	M	M	*2*	G	1
RWB	8-9	CY_8-9-e_RI_HM	Vassilikos	9,0		YES	I		G	M	*4*	U	0
RWB	8-9	CY_8-9-f_RIh_HM	Vassilikos	4,5		YES	Ih		M	M	*4*	U	0
RWB	8-9	CY_8-9-g_RIh	Exobounia	9,7		NO	Ih	M	G	M	*4*	G	2
RWB	9-1	CY_9-1-b_RIh	Pyrgos	11,0		NO	Ih	M	G	M	*4*	U	0
RWB	9-2	CY_9-2-b_RP	Ayios Pavlos	6,5		NO	P	M	M	M	*2*	G	4
RWB	9-2	CY_9-2-c_RI	Germasogeia	5,2		NO	I	M	G	M	*2*	G	4
RWB	9-2	CY_9-2-d_RI_HM	Germasogeia	2,6		YES	I	M	G	M	*2*	G	4
RWB	9-2	CY_9-2-h_RIh_HM	Germasogeia	6,4		YES	Ih	M	G	M	*3*	G	4
RWB	9-2	CY_9-2-i_RIh	Pissokamina	7,6		NO	Ih	M	G	M	*4*	G	4
RWB	9-2	CY_9-2-L_RI_HM	Yialliades	2,1		NO	I		M	M	*1*	G	1
RWB	9-4	CY_9-4-c_RI	Garyllis	3,9		NO	I	POOR	BAD	POOR	*2*	F	1
RWB	9-4	CY_9-4-e_RIh_HM	Garyllis	3,8		YES	Ih		M	M	*4*	U	0
RWB	9-4	CY_9-4-g_RIh	Fassoulla	7,8		NO	Ih	M	G	M	*4*	G	4
RWB	9-6	CY_9-6-a_RP	Ayios Ioannis	5,3		NO	P	G	BAD	M	*2*	G	2
RWB	9-6	CY_9-6-b_RP	Ampelikos-Agros	17,6		NO	P	M	POOR	M	*2*	G	2
RWB	9-6	CY_9-6-d_RP_HM		1,4		NO	P	G	G	M*	*2*	G	2

WB Category	Code Catchment	Code WB	Name WB	Length WB (km)	Area WB km^2	HMWB 2015	Type WB	Status WB	Κατάσ τaση ΦΧ	Ecological Status / Potential	ός Αβεβ αιότητ	Χημικ ή Κατάσ	ός Αβεβ αιότητ
RWB	9-6	CY_9-6-e_RP	Ampelikos-Xylourikos	11,4		NO	P	G	M	M	*1*	G	1
RWB	9-6	CY_9-6-f_RI	Limnatis	7,0		NO	I	G	M	M	*1*	G	4
RWB	9-6	CY_9-6-L_RP	Kouris	19,5		NO	P	POOR	M	POOR	*2*	F	2
RWB	9-6	CY_9-6-m_RP_HM	Kouris	13,1		NO	P	G	M	M	*1*	G	1
RWB	9-6	CY_9-6-o_RP	Moniatis	5,9		NO	P	M	M	M	*2*	G	2
RWB	9-6	CY_9-6-r_RI_HM	Kryos	15,0		YES	I	M	G	M	*1*	G	4
RWB	9-6	CY_9-6-t_RI_HM	Kouris	11,4		YES	I	M	G	M	*4*	U	0
RWB	9-8	CY_9-8-a_RIh	Paramali	28,0		NO	Ih	M	G	M	*4*	G	4
RWB	9-8	CY_9-8-b_RI	Avdimou	11,3		NO	I	M	G	M	*2*	G	4
RWB	9-8	CY_9-8-c_RIh	Avdimou	4,2		NO	Ih	M	G	M	*4*	G	4
RWB-D	3-7-3	CY_3-7-i_RI_HM_IR	Akaki-manounta		0,2	YES				M	*1*	G	1
RWB-D	9-2-5	CY_9-2-g_RI_HM_IR	Germasogeia		0,7	YES				M	*1*	F	1
RWB-D	9-4-3	CY_9-4-d_RI_HM_IR	Polemidhia		0,2	YES				BAD	*2*	F	1
LWB		CY_8-3-2_11_L1	Larnaca- MAgor Salt lake				L1			M*	*4*	U ****	4
LWB		CY_8-3-2_17_L2	Larnaca_Airport Lake		0,0		L2			M*	*4*	U **	-
LWB		CY_8-3-2_13_L2	Larnaca_Soros lake		0,2		L2			M*	*4*	U **	-
LWB		CY_8-3-2_12_L2	Larnaca_Orfani lakeή		1,5		L2			M*	*4*	U ****	4
LWB		CY_9-5-3_10_L2	Salt lake Akrotiri		10,1		L2			M*	*4*	U **	-
LWB		CY_7-2-6_16_L2-HM	Paralimni		2,9	YES	HM			U **	-	U **	-
LWB		CY_7-1-2_34_L3-A	Achna		0,7	YES	A			U***	-	G	4

WB Category	Code Catchment	Code WB	Name WB	Length WB (km)	Area WB km^2	HMWB 2015	Type WB	Status WB	Κατάσ ταση ΦΧ	Ecological Status / Potential	ός Αβεβ αιότητ	Χημικ ή Κατάσ	ός Αβεβ αιότητ
LWB		CY_8-1-2_09_L2-HM	Oroklini		0,06	YES	L2			U **		U **	

Ecological Status	*H:High*	*G:Good*	*M:Moderate*	*POUR:Incomplete*	*BAD:Poor*	*U:Unknown*
Chemical Status	*G:Good*				*F:Less than GOOD*	*U:Uknown*

* *Expert judgment*

** *Unknown due to lack of data*

*** *Unknown due to lack of advanced classification system*

**** *Although there were some excesses on priority substances, it should be further investigated*

8.2 CONDITIONS FOR DECLARING PROLONGED DROUGHTS

The concept of prolonged drought concerns long time scales, exceeding the hydrological year. For this purpose, a drought forecasting and assessment methodology, developed in Chapter 6.3, is proposed and is based on characteristic drought indicators (meteorological and hydrological) of the study area. If based on the values of these indicators it is shown that a severe drought is in progress, then extraordinary management measures should be taken, which include the exemption of some water bodies from the obligation to achieve the environmental objectives. As such a low value of the index is likely to indicate a period of particularly persistent drought, these measures should be maintained throughout the duration of the hydrologic year, regardless of changes in rainfall (and flow) of the next few months. Termination of the emergency measures will be made only when the indicators of prolonged drought recede to a level indicating the end of the drought.

The technical details of the methodology (indicators and thresholds) are explained in Chapter 6.3 .

8.3 IDENTIFICATION OF SURFACE WATER BODIES OF HIGH VULNERABILITY TO DROUGHT

The analysis of drought indices made in Chapters 6.2 and 6.3 for each of the Hydrologic Regions of Cyprus shows that in practice all RBD Cyprus is in a regime of high vulnerability to drought. Both the occurrence of prolonged drought and the Exemption of Article 4.6 of the WFD concerning the temporary deterioration of water bodies, that was thoroughly analysed in previous Chapters, show that in each Hydrologic Region , more so in some, less so in others, there are extensive periods of prolonged droughts and periods calling for the Exemption of Article 4.6, as presented in the relevant tables (from Table 6-55 up to Table 6-60) .

The table below (Table 8-2) lists the prolonged drought periods per Hydrologic Region (Column 0) and the hydrologic years included in the prolonged drought period with a serial number starting in year 1970-71. It is therefore shown that all Cyprus is particularly vulnerable to drought on an average of 13 years (however, Hydrologic Region 7 is not included, as the HYRI index does not apply there)

Table 8-2: Display of the prolonged drought periods per Hydrologic Region.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1																																
2																																
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	33	34	35	36	37	38	39	40	41	42	43	44
1												
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3												
6												
7												
8												
9												

8.4 IDENTIFICATION OF GROUNDWATER BODIES OF HIGH VULNERABILITY TO DROUGHT

The GWB which may not achieve the environmental objectives of Article 4 are identified by:

1. the recognized presence of salination phenomena,
2. their qualitative and quantitative deterioration,
3. their use for abstractions in various uses.

The table below (Table 8-3) shows the GWB which, due to their current quantitative deterioration or any quantitative deterioration they may present in the future as a result of human activity, are not expected to achieve the objectives of Article 4 and have been included in the exemptions. Of these, only one (CY_1 Kokkinochoria) is included in the case of Article 4 Paragraph 5. These GWB are also recognized as of high vulnerability to drought.

Table 8-3: GWB of high vulnerability to drought

Code	Name	Final Status – 2021	Final Status - 2027	Exemption Justification Article 4 WFD
CY-1	Kokkinochoria	Poor	Poor	Under Article 4.5. WFD.
CY-3A	Koitis Treminthou	Poor	Poor	More time is needed for the GWB recovery
CY-3B	Kiti-Pervolia	Poor	Poor	More time is needed for the GWB recovery
CY-4	Softades-Vassilikos	Poor	Poor	More time is needed for the GWB recovery
CY-5	Maroni	Poor	Poor	More time is needed for the GWB recovery
CY-6	Mari-Kalo Chorio	Poor	Poor	More time is needed for the GWB recovery
CY-8	Limmasol	Poor	Poor	More time is needed for the GWB recovery
CY-9	Akrotiri	Poor	Poor	More time is needed for the GWB recovery
CY-10	Paramali-Avdimou	Poor	Poor	More time is needed for the GWB recovery
CY-12	Letimvou-Yiolou	Poor	Poor	More time is needed for the GWB recovery
CY-13	Pegeia	Poor	Poor	More time is needed for the GWB recovery
CY-15A	Chrysochou-Yialia	Poor	Poor	More time is needed for the GWB recovery

Code	Name	Final Status – 2021	Final Status - 2027	Exemption Justification Article 4 WFD
CY-15B	Κοίτη Chrysochou	Poor	Poor	More time is needed for the GWB recovery
CY-17	Central & Western Messaoria	Poor	Poor	More time is needed for the GWB recovery
CY-18	Lefkara-Pachna	Poor	Poor	More time is needed for the GWB recovery

8.5 IDENTIFICATION OF GROUNDWATER BODIES OF HIGH VULNERABILITY TO WATER SCARCITY

In Chapter 5 the drought index was analyzed per river basin, hydrologic region and catchment area and Cyprus RBD based on the Water Exploitation Index WEI+. Based on this, the hydrologic regions were indicated where very significant stress is exerted on the annual renewable water resources (WEI+> 60%) as well as the hydrologic regions where simple stress is exerted on water resources (20% <WEI+<60%).

9. ASSESSMENT OF VULNERABILITY TO DROUGHT AND WATER SCARCITY

9.1 INTRODUCTION

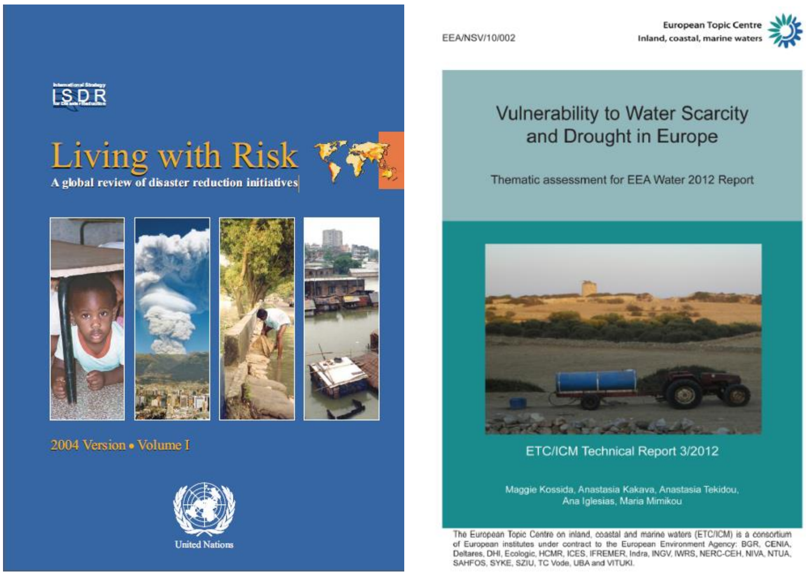
Based on ANNEX II: TERMS OF REFERENCE - TECHNICAL SPECIFICATIONS of this Contract it is stated in Activity 3: Revision of the Drought Management Plan that the Contractor will conduct a "Risk assessment regarding the future increase of water scarcity and drought phenomena (from natural or anthropogenic causes and their potential impact. To this end there will be an identification and classification into vulnerability zones (drought vulnerability), taking into account social, economic and environmental factors, such as land use, farming practices, distribution and change of population, water demand-use and trends (upward or downward), water transmission and distribution networks and irrigated areas, etc. using simulation models". This chapter describes the quantification approach of vulnerability to drought and water scarcity in the context of the "Activity 3: Revision of the Drought Management Plan".

One of the most widely known and scientifically accepted definitions of vulnerability was proposed by the organization "International Strategy for Disaster Reduction" [ISDR] and reads as follows (International Strategy for Disaster Reduction. Living with risk: a global review of disaster reduction initiatives. Vol. 1. United Nations Publications, 2004, page 6 (Photograph 9-1)) Vulnerability defined as "the conditions determined by physical, social, economic, and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards"[12]. Generally, the predominant perception of vulnerability that is becoming more popular in the scientific community combines (a) the system's exposure to natural hazards (exposure), with (b) the dynamics of a community/system in responding to natural hazards using available resources (coping capacity), namely with its social resilience and resistance.

Social resilience is defined by the extent that a social system is capable of increasing the dynamics in response to natural disasters using the experience obtained from previous disasters, in view of the occurrence of future natural hazard events to improve protection and reduce risk.

Therefore, vulnerability includes all the above concepts in a common content and should be treated as a single concept. Hence, in this text when referring to vulnerability, at the same time we also mean risk, and resilience and resistance and these are not separately classified.

[12] The English text: "Vulnerability: The conditions determined by physical, social, economic, and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards."



Photograph 9-1: The two main publications on the definition of Vulnerability.

The assessment of vulnerability to water scarcity is a complex, multi-parametric problem. Exposure to pressures and risks may still be similar even in quite different conditions, but vulnerability is influenced by the priorities set, the financial situation and coping capacity of the affected area and the management strategies adopted. Vulnerability to Drought and Water Scarcity in the not yet fully clarified in the international scientific community. As regards European Treaties, unlike the case of floods where the terms vulnerability, hazard and risk are systematically defined, the corresponding definitions have not yet been formulated for Drought/Water shortage. This is mainly due to the following reasons: (a) drought/water scarcity affect multiple scales (both time and spatial) and levels (from moderate to extreme), (b) are a complex result of both natural and anthropogenic factors, (c) show a wide range of effects on multiple economic aspects and (d) their coping depends on the current socio-economic conditions and the system's coping capacity. The above reasons make it difficult to describe a single manner to determine the substance and degree of vulnerability. Therefore in any case of vulnerability assessment, the main parameters and the manner of their completion should be defined. Figure 9-1 presents the conceptual figure of vulnerability parameters and their correlation and connection with the Driver, Pressure, State, Impact, Response (DPSIR) framework. This figure was obtained from the significant publication within the EU (Photograph 9-1, right) “Kossida, M., et al. Vulnerability to water scarcity and drought in Europe: Thematic assessment for EEA Water 2012 Report, ETC. ICM Technical Report 3/2012–European Topic Centre on Inland, Coastal and Marine Waters, 2012”.

This figure shows that vulnerability is the result of (a) exposure to drought/water scarcity (exposure), (b) the sensitivity (sensitivity) for each sector of water use, and (c) the capacity of a community/system to address natural hazards using the available resources (adaptive capacity). Therefore, the combination of the possible effects of water scarcity in terms of sensitivity of the water use affected (e.g. Water supply, irrigation) and risk exposure (e.g. large urban centres VS small mountain communities) is the first part of vulnerability. The other part is covered by the response capacity, which is generally defined by the technical projects used for the water supply in specific areas and uses.

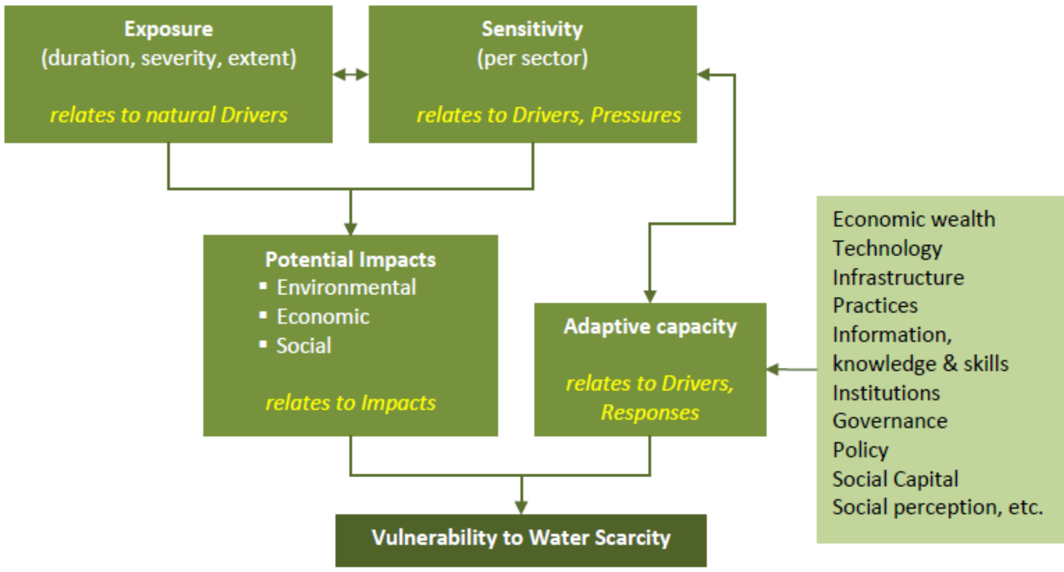


Figure 9-1: Conceptual figure of the parameters of vulnerability to water scarcity (Kossida, et al., 2012.

Therefore, the analysis of defining vulnerability zones uses of fixing vulnerability zones will be made with reference to the three main uses of water, which are: (a) water supply (which includes tourism and industry), (b) irrigation (which includes stock farming), and (c) the environment.

9.2 VULNERABILITY ZONES PER WATER USE

9.2.1 INTRODUCTION

Vulnerability, based on international practice too, is expressed in classes with the relevant designation, as shown in the table below. Five relevant vulnerability classes are formed, ranging from very low to very high and the graph in the relevant maps follows the colour palette of the table below (Table 9-1)..

Table 9-1: Categorisation of vulnerability classes and corresponding colour per class.

Class	Vulnerability Classification
1	Very Low
2	Low
3	Moderate
4	High
5	Very High

Vulnerability for Cyprus will be calculated based on three major parameters:

1. Vulnerability to water supply: Water supply is the most important human consumption and is the first priority in case of competing uses in Cyprus (as well as internationally). In this sense, vulnerability to water supply is usually lower than other competing uses. Water supply also includes the water demand in tourism and industry.

2. Vulnerability to irrigation: Irrigation is the consumption with the largest volumes of water required and of lower priority compared to water supply and the environment. Vulnerability is also significantly associated with whether an irrigated area is part of organised irrigation area where the water source is a dam or system of dams.

3. Vulnerability to the environment: Vulnerability to the environment per river basin is associated with the length of the hydrographic network or the surface of lakes located within the basin and in the protected areas that depend on the availability of water resources within them.

As we mentioned above, we find that the shortages in meeting water demand in Cyprus are as follows:

Water supply, as first priority does not show shortages, even in times of drought. Water supply is now largely covered by desalination and by reservoirs in the dams and therefore, even in drought periods, the possibility of water supply shortages is very small. In this sense, the vulnerability of water supply to drought will be from VERY LOW to LOW possibly even MODERATE or HIGH in a few cases. Even in areas not supplied with water by projects (such as the Southern Conveyor Project) but from local sources (wells, etc.) usually a small decrease in irrigation consumption is enough for channelling these quantities to water supply. The vulnerability threshold from VERY LOW to LOW (MODERATE) obviously relates to the number of residents served. If, for example, full coverage of the water demand is not achieved in a large urban centre, then the impact of this event will be greater than in the hypothetical case of a small community. Water supply also included the needs of **tourism** and **industry**, especially those that are water demanding and served by common water supply networks.

On the contrary, irrigation as lower in priority, may have small to extremely large shortages in periods of drought. The key difference lies in the water source. For example, a large number of permanent plantations are now irrigated by recycled water which is a reliable supply and also continuously monitored in terms of its quality. In the case of irrigating an area with recycled water, vulnerability to irrigation is considered as LOW. On the contrary, if an irrigation project draws water directly from the hydrographic network via a diversion weir, then its vulnerability will be VERY HIGH, as in conditions of drought the supplies in the hydrographic network generally tend to zero. Somewhere in between lies the vulnerability to irrigation for areas supplied with water from projects involving organised arrangements (e.g. the Southern Conveyor Project, the Paphos Project) but are not directly supplied with recycled water nor with water from desalination plants, in case of permanent crops. In such a case, vulnerability ranges from MODERATE to VERY HIGH depending on the surface and the water needs of the rural area.

Therefore the criteria for attributing to each use one of the above vulnerability classes are the identification of shortages in meeting the needs; these shortages arise from the amount of demand in water (e.g. total population of the Municipality, irrigation project area) and from the projects existing for the water supply of said use and include, first the capacity of the specific resource (e.g. dam, wells) for covering water needs and the capacity of the water transmission and distribution for the transfer of the water quantities required. In fact, given the water conditions in Cyprus, the vulnerability of any water use depends absolutely on (or is identical to) the vulnerability of the water resource from which it is supplied, on the parameter of the corresponding priority over competing uses. The increasing entry of desalination and recycled water in the water mixture of Cyprus in the water supply (mainly) and in irrigation respectively enhances significantly the vulnerability of uses supplying water, as desalination and recycled water are theoretically considered as unlimited water sources. An analysis follows for each vulnerability parameters.

9.2.2 WATER SUPPLY- TOURISM - INDUSTRY

As mentioned above, because the water supply is first priority over other competing uses it presents the smallest shortages. The contribution of desalination in the water mixture forwarded to water supply, especially in the Southern Conveyor system, is so important that, can theoretically cover in its own right the demand in water supply, obviously in periods of drought as well. For the Paphos project the contribution of reduced (compared with older planning) desalination is sufficient to minimize shortages, with the contribution of the reservoirs of Asprokremmos and Kannavia. In other areas, water supply needs are met primarily by well drilling. In general, in these areas that are mainly found in the hilly and mountainous zone of Troodos Mountain which dominates the region, water supply is mainly made by well drilling where the Troodos GWB (CY_19) is in good condition, both in terms of quantity and of quality. An exception is the zone of Western Mesaoria (GWB: CY_17 Central and Western Mesaoria) where measurements show that water is not suitable for human consumption. However, as described in Paragraph 6.8.4 the expansion of the Nicosia water project to this area is already underway. In periods of drought and in the case of the exceptions of Article 4.6 of the WFD on temporary downgrading, a deviation from the environmental objectives set is accepted, given that water supply needs are covered. Elaborating on the above, it is obvious that the abstraction for irrigation will be reduced to a minimum (maintenance of permanent crops, etc.) to the benefit of water supply and, as abstraction for water supply is much less than that of irrigation, theoretically even a small reduction of the abstraction for irrigation would be enough to fully meet in practice the demand in water supply. Therefore it is clear that, since water supply shortages are minimal (or small) even in dry periods, vulnerability will be generally low and certainly well below vulnerability to irrigation. The fact the coverage of water supply needs is deemed as first priority use compared to other water uses, under Directive 2000/60 plays an important role in determining vulnerability to drought. Finally, to determine vulnerability for covering water supply, it is examined whether the urban centre, which in this case is the system threatened with drought, is in a phase of population growth or is a tourist area.

In general, vulnerability to drought is considered low when the water supply source for covering water needs is either groundwater bodies in good quantitative and qualitative condition or artificial reservoirs, given that abstractions from them is regulated and water needs are covered by priority. Similarly, vulnerability to water supply is very low when the needs are covered by water from desalination plants, which is a reliable and complete source of drinking water. Therefore the areas supplied by the Southern Conveyor Project will have low vulnerability and the categorisation as VERY LOW, LOW and MODERATE will be made either as a function of the population of the Municipality/Community and/or of the tourism activity. The larger the population of a Municipality/Community and/or the tourism activity, the higher the vulnerability will be, but always within the range VERY LOW---→MODERATE. For example, the vulnerability of the Nicosia Municipality is classified as MODERATE (the maximum possible, based on the above) because its importance as an urban/commercial centre and as seat of the Government of the Republic of Cyprus requires that it is attributed with the maximum vulnerability possible.

As regards the settlements of the most mountainous Municipalities, the water supply of which depends mainly on well drilling, during drought periods their vulnerability is deemed as VERY LOW to MODERATE, the bottom rank for cases of mountainous settlements that attract tourism. For example, the settlement of Kakopetria which has a permanent population of 1219 inhabitants and is a tourist attraction, was designated as MODERATE. As the demand for irrigation is also met by the underground aquifer (with the exception of the areas of Pitsilia Project and peripheral areas of Vyzakia Project, etc.), then in this case usually the abstraction from drilling increases at the expense of irrigation consumption and a small reduction in irrigation - which is also the common practice - is enough to cover water shortages.

The total population recorded in the 2011 Census in the free areas of Cyprus was 840,407, an increase of 21.9% since 2001. The percentage of population in urban areas was estimated at 67.4% compared to 68.7% in 2001 and 67.7% in 1992; therefore, a retention of population in rural areas was generally observed, although the residents continued decreasing in mountain villages. This data per district show that the population in Paphos and Larnaca grew faster than in the other districts in the last decade. The population of non-Cypriot nationals has increased significantly. Foreigners who habitually reside in Cyprus, namely those who reside in Cyprus for at least one year, represent 20.3% of the recorded population, amounting to 170,383 from 64,811 (9.4% of the total population) in 2001

Table 9-2: 2011 Census data [www.cystat.gov.cy]

	Region	Municipalities/Communities	Total Population		
			Total	Men	Women
	Total	401	**840 407**	**408 780**	**431 627**
1	**Region Nicosia**	111	**326 980**	158 262	168 718
3	**Region Famagusta**	9	**46 629**	23 188	23 441
4	**Region Larnaca**	55	**143 192**	70 116	73 076
5	**Region Limmasol**	110	**235 330**	113 636	121 694
6	**Region Paphos**	116	**88 276**	43 578	44 698

The total number of Municipalities and Communities of Cyprus is 401.

As regards population of each district, the most populous District is **Nicosia,** which has a total population of 326,980 and a total of 111 Municipalities and Communities. Two (2) Municipalities of Nicosia District account for a population of 50,000-100,000 inhabitants (Municipality of Nicosia and Municipality of Strovolos). Six more Municipalities have populations of 10,000-50,000. As regards Communities, 14 have a population of 2,000-10,000, 13 of 1,000-2,000, fifteen of 500-1000, eighteen of 200-500 and 43 communities have a population of less than 200 inhabitants.

The **Limassol district** has a total population of 235,330 inhabitants and a total of 11 Municipalities and Communities. Apart from the Municipality of Limassol, which is the largest Municipality of Cyprus in terms of population (101,000), the District also has one (1) Municipality with a population of 20,000-50,000 inhabitants (Kato Polemidia) and 3 more with a population of 10,000-20,000. Moreover, in addition to other communities, the district of Limassol has 50 more communities with populations of less than 200 inhabitants.

The **Larnaca district** is the third largest in Cyprus in terms of population, with 143,192 inhabitants and a total of 55 Municipalities and Communities. The Municipality of Larnaka has 51,468 inhabitants and the Municipality of Aradippou has 19,228. In the District, 13 district communities have populations of less than 200 inhabitants.

The **Paphos district** has a total population of 88,276 inhabitants and a total of 116 Municipalities and Communities. The District also accounts for the highest number of communities with population of less than 200 inhabitants (71), with a total population of 4,520 people.

In the **Famagusta district,** the census covered only the free areas, where 46.629 inhabitants reside in total. The total number of Municipalities and Communities is 9, including 1 Municipality with population of 10,000-19,000, 2 of 5,000-10,000, while five municipalities have a population of 2,000-5,000 inhabitants and a community has a population of 1,000-2,000.

Below we consider that the areas that are supplied by the Southern Conveyor system will generally have VERY LOW vulnerability, with the exception of areas that have a significant population or attract significant tourist activity and which are designated as LOW or/and MODERATE vulnerability if the settlement has tourist activity. Naturally, we consider the

Municipalities of Nikosia, Strovolos, Lakatamia, etc, as significant population areas, since population in these areas is much larger than that of other Municipalities or Communities. In general, tourism activity (which is disproportionately higher than the resident population) raises the level of vulnerability of the settlement by one class. This also applies to the Paphos project, where water supply shortages are also small, although desalination is not working during this period. However, the relevant table (Table 6-80) shows that abstraction for water supply from the Paphos project is generally equal to the demand. The situation in the water project of the Mountainous Villages of Paphos is similarly good, as the area is currently supplied with 1,0hm^3 per year from the Kannavia dam. Therefore, in this case too vulnerability is generally low.

Vulnerability in the settlements of Troodos mountain, as they are supplied by well drillings from the “CY-19 Troodos” aquifier - which is in a generally good condition- is considered VERY LOW for settlements with small population. For settlements with larger populations, vulnerability falls to class LOW (and/or MODERATE). We consider Municipalities/Communities with resident population of up to 500 (maximum 15% of the population of Municipalities/Communities supplied by the CY-19 aquifer) as VERY LOW vulnerability, Municipalities/communities of 500-1000 inhabitants as LOW and of more than 1000 inhabitants as MODERATE.

If the settlement is watered by well drillings from an aquifer that is of poor quantitative condition and is included in the Exception of Article 4 of the WFD, then for annual extraction of less than 6500m^3 vulnerability ranks as LOW, for annual extraction between 6500 and 20,000 m^3 vulnerability ranks as MODERATE, for annual extraction between 20,000 and 40,000m^3 vulnerability ranks as HIGH and for abstraction over 40,000m^3 vulnerability ranks as VERY HIGH. Aquifers classified as Small Aquifers of Local Importance (SALI) are respectively treated as aquifers of poor quantitative condition, since most of them have limited water supply. The definition of the 6500m^3 threshold concerning small communities is determined by the critical population of 100 inhabitants, on the assumption of 180L/day/capita which is equivalent to an annual demand of 6,500m^3 of water. Similarly, for the 80,000m^3 per year ceiling concerning urban areas, on the assumption of a daily demand of 215l/day/capita, the reference residence population is 1000 inhabitants.

The amounts of water corresponding to water supply per year per settlement and per aquifer were obtained from the study ECONOMIC ANALYSIS OF WATER USE, CALCULATION OF TOTAL COST OF WATER SERVICES, IDENTIFICATION OF EXISTING COST RECOVERY LEVELS carried out for the WDD in 2009 and in particular, ANNEX B_1: CONSUMPTION FOR WATER AND IRRIGATION BY MUNICIPALITIES/COMMUNITIES, IRRIGATION ORGANISATIONS AND INDIVIDUALS BY HYDROLOGIC REGION AND WATER BODY OUTSIDE GWP AREAS and ANNEX B_3: ESTIMATION OF CONSUMPTION QUANTITIES FOR TOURIST USE.

Table 9-3: Criteria of designation of vulnerability to water.

PROJECT - WATER SUPPLY SOURCE/PARAMETERS	DESIGNATION OF VULNERABILITY TO WATER SUPPLY:
SOUTHERN CONVEYOR PROJECT, PAPHOS PROJECT, ABSTRACTIONS FROM CY_11, CY_14 and CY_19	(In tourist attraction settlements vulnerability designation refers to the next level of the relevant table (Table 9-1)
Residents < 500	VERY LOW
500 <Residents< 1,000	LOW
Residents < 1,000	MODERATE
ABSTRACTIONS FROM CY_9, CY_17 and CY_18	(In tourist attraction settlements vulnerability designation refers to the next level of the relevant table (Table 9-1)
Abstraction Volume <6,500m^3	LOW
40,000 > Abstraction volume > 6,500	MODERATE
80,000 > Abstraction volume > 40,000	HIGH
Abstraction Volume > 80,000m^3	VERY HIGH

The above table (Table 9-3) presents the criteria of designation of vulnerability to water depending on the water source and the size of the settlement and in relation to the resident population, as well as in relation to the estimated abstraction volume. The table below (Table 9-4) presents the analysis and vulnerability designation per municipality and settlement in Cyprus depending on the water source, as regards the foregoing.

Table 9-4: Mapping of vulnerability to water and tourism per Municipality and settlement.

CODE	REGION, MUNICIPALITY/COMMUNITY	POPULATION	SOURCE	VULNERABILITY CLASSIFICATION	REMARKS
		Total			
	Total	840,407			
1	**Nicosia Region**	**326,980**			
1000	Munic/ity Nicosia	55,014	SCP	MODERATE	TOURISTIC AREA
1010	Munic/ity Agiou Dometiou	12,456	SCP	LOW	
1011	Munic/ity Egkomis	18,010	SCP	MODERATE	TOURISTIC AREA
1012	Munic/ity Strobolou	67,904	SCP	LOW	
1013	Munic/ity Aglantzias	20,783	SCP	MODERATE	TOURISTIC AREA

1021	Munic/ity Lakatameias	38,345	SCP	MODERATE	
1022	Settlement Anthoupolis	1,756	CY-17	VERY HIGH	
1023	Munic/ity Latsia	16,774	SCP	LOW	
1024	Geri	8,235	SCP	VERY LOW	
1100	Sia	754	SCP	VERY LOW	
1101	Mathiatis	646	SCP	VERY LOW	
1102	Alampra	1,585	SCP	VERY LOW	
1103	Agia Barbara Nicosia	2,204	SCP	VERY LOW	
1104	Kotsiatis	160	CY-17	MODERATE	
1105	Nisou	2,179	SCP	VERY LOW	
1106	Pera Xorio	2,637	SCP	VERY LOW	
1107	Munic/ity Idaliou	10,466	SCP	LOW	
1108	Limpia	2,694	SCP	VERY LOW	
1109	Lythrodontas	3,043	SCP	VERY LOW	
1110	Louroukina	11	SCP	VERY LOW	
1120	Potamia	505	SCP	VERY LOW	
1121	Agios Sozomenos	11	CY-17	LOW	
1200	Kampi	97	CY_19	VERY LOW	
1201	Farmakas	480	CY_19	VERY LOW	
1202	Apliki	87	CY_19	VERY LOW	
1203	Lazanias	39	CY_19	VERY LOW	
1204	Goirri	196	CY_19	VERY LOW	
1205	Fikardou	15	CY_19	VERY LOW	
1206	Agios Epifanios Oreinis	412	CY_19	VERY LOW	
1207	Kalo Xorio Oreinis	734	CY_19	LOW	
1208	Malointa	490	CY_19	VERY LOW	
1209	Klirou	1,847	CY_19	MODERATE	
1210	Aredioi	1,225	CY-17	HIGH	
1211	Agios Ioannis Malountas	472	CY-19	VERY LOW	
1212	Agrokipia	509	CY_19	LOW	
1213	Mitsero	860	CY_19	LOW	
1220	Kapedes	572	CY_19	LOW	
1221	Kataliontas	24	CY_19	VERY LOW	
1222	Analiontas	443	CY_19	VERY LOW	
1223	Kampia	475	CY-18	MODERATE	
1224	Margi	146	CY-18	LOW	
1225	Tseri	7,035	SCP	VERY LOW	
1226	Politiko	419	CY-17	MODERATE	
1227	Pera	1,372	CY-17	HIGH	

1228	Episkopeio	524	CY-17	MODERATE	
1229	Psimolofou	1,626	CY-17	VERY HIGH	
1230	Ergates	1,792	SCP	VERY LOW	
1231	Anageia	1,514	SCP	VERY LOW	
1232	Pano Deutera	2,789	SCP	VERY LOW	
1233	Kato Deutera	2,054	SCP	VERY LOW	
1240	Agioi Trimithias	1,529	CY-17	VERY HIGH	
1241	Palaiometocho	4,145	SCP	VERY LOW	
1242	Deneia	373	CY-17	MODERATE	
1243	Kokkinotrimithia	4,077	CY-17	VERY HIGH	
1244	Mammari	1,592	CY-17	VERY HIGH	
1300	Palaiχori Morfou	686	CY_19	LOW	
1301	Askas	170	CY_19	VERY LOW	
1302	Alona	67	CY_19	VERY LOW	
1303	Fterikoidi	90	CY_19	VERY LOW	
1304	Polistupos	128	CY_19	VERY LOW	
1305	Lagoudera	84	CY_19	VERY LOW	
1306	Saranti	44	CY_19	VERY LOW	
1307	Libadia Nicosia	18	CY_19	VERY LOW	
1308	Alithinoi	9	CY_19	VERY LOW	
1309	Platanistasa	117	CY_19	VERY LOW	
1310	Palaiχori Oreinis	333	CY_19	VERY LOW	
1320	Xyliatos	138	CY_19	VERY LOW	
1321	Agios Georgios Kaukallou	26	CY_19	VERY LOW	
1322	Nikitari	447	CY_19	VERY LOW	
1323	Buzakia	347	CY-17	MODERATE	
1324	Agia Msrina Xyliatou	568	CY_19	LOW	
1325	Agioi Iliofotoi	60	CY_19	VERY LOW	
1326	Kato Moni	339	CY_19	VERY LOW	
1327	Orointa	604	CY-17	HIGH	
1328	Pano Koutrafas	4	CY-17	LOW	
1329	Kato Koutrafas	17	CY-17	LOW	
1330	Potami	558	CY-18	MODERATE	
1350	Pano ZoDeia	15	CY-18	LOW	
1360	Akaki	3,003	CY-17	VERY HIGH	
1361	Peristerona Nicosia	2,226	CY-17	VERY HIGH	
1362	Astromeritis	2,307	CY-17	VERY HIGH	
1368	Meniko	1,023	SCP	VERY LOW	
1400	SPilia	123	CY_19	VERY LOW	
1402	Agia Eirini Nicosia	27	CY_19	VERY LOW	

1403	Kannabia	129	CY-11	LOW	
1404	Kakopetria	1,274	CY_19	MODERATE	TOURISTIC AREA
1405	Agios Theodoros Soleas	49	CY_19	VERY LOW	
1406	Galata	581	CY_19	LOW	TOURISTIC AREA
1407	Sinaoros	228	CY_19	VERY LOW	
1408	Kaliana	200	CY_19	VERY LOW	
1409	Tembria	498	CY_19	VERY LOW	
1410	Korakou	521	CY_19	LOW	
1411	Eurixou	827	CY_19	LOW	
1412	Flasou	240	CY_19	VERY LOW	
1415	Linoi	161	CY_19	VERY LOW	
1416	Katidata	114	CY_19	VERY LOW	
1417	Skouriotissa (Foukasa)	11	CY_19	VERY LOW	
1420	Pedoulas	132	CY_19	LOW	TOURISTIC AREA
1421	Mulikoiri	17	CY_19	VERY LOW	
1422	Moutoullas	174	CY_19	VERY LOW	
1423	Oikos	158	CY_19	VERY LOW	
1424	Kalopanagiotis	263	CY_19	LOW	TOURISTIC AREA
1425	GerakiEs	75	CY_19	LOW	TOURISTIC AREA
1426	Tsakistra	79	CY_19	VERY LOW	
1427	Kampos	271	CY_19	VERY LOW	
1456	Pano Pyrgos	22	CY_19	VERY LOW	
1457	Kato Pyrgos	1,036	CY_19	MODERATE	TOURISTIC AREA
1460	Pigenia	107	CY_19	VERY LOW	
1461	Pachiammos	70	CY_19	VERY LOW	
1467	Mansoira	9	MYTS	LOW	
1468	MosFili	20	MYTS	LOW	
3	**Region Famagusta**	**46,629**			
3100	Agia Napa	3,212	SCP	MODERATE	TOURISTIC AREA
3101	Paralimni	14,963	SCP	MODERATE	TOURISTIC AREA
3102	Derineia	5,844	SCP	LOW	
3103	Sotira Famagusta	5,474	SCP	LOW	
3104	Liopetri	4,591	SCP	LOW	
3105	Frfnaros	4,298	SCP	LOW	
3110	Avgorou	4,604	SCP	LOW	

3111	Aχna	2,087	SCP	LOW	
3114	Aχeritou	1,556	SCP	LOW	
4	**Region Larnaca**	**143,192**			
4000	Munic/ity Larnaca	51,468	SCP	MODERATE	
4010	Munic/ity Aradippou	19,228	SCP	LOW	
4011	Libadia	7,206	SCP	VERY LOW	
4012	Dromolaxia	5,064	SCP	VERY LOW	
4013	Meneoi	1,625	SCP	VERY LOW	
4100	Kellia	387	SCP	VERY LOW	
4101	Troilloi	1,175	SCP	VERY LOW	
4102	Boroklini (Oroklini)	6,134	SCP	MODERATE	TOURISTIC AREA
4103	Abdellero	218	SCP	VERY LOW	
4104	Pila	2,771	SCP	LOW	TOURISTIC AREA
4105	Xylotimbou	3,655	SCP	VERY LOW	
4106	Ormideia	4,189	SCP	VERY LOW	
4107	Xylofagou	6,231	SCP	VERY LOW	
4108	Pergamos	193	SCP	VERY LOW	
4110	Kiti	4,252	SCP	VERY LOW	
4111	Peribolia Larnaca	3,009	SCP	LOW	TOURISTIC AREA
4112	Tersefanou	1,299	SCP	VERY LOW	
4113	Softades	62	SCP	VERY LOW	
4120	Mazotos	832	SCP	VERY LOW	
4121	Alaminos	345	SCP	VERY LOW	
4122	Anafotida	790	SCP	VERY LOW	
4123	Aplanta	6	SCP	VERY LOW	
4124	Kibisili	233	SCP	VERY LOW	
4125	AleThriko	1,101	SCP	VERY LOW	
4126	Klaudia	427	SCP	VERY LOW	
4127	Agglisides	1,146	SCP	VERY LOW	
4128	Menogeia	50	SCP	VERY LOW	
4202	AThiEnou	5,017	SCP	VERY LOW	
4210	Kalo Xorio Larnaca	1,518	SCP	VERY LOW	
4211	Agia Anna	339	SCP	VERY LOW	
4212	MosFiloti	1,365	SCP	VERY LOW	
4213	Psevdas	1,261	SCP	VERY LOW	
4214	Pyrga Larnaca	812	SCP	VERY LOW	
4215	Kornos	2,083	SCP	VERY LOW	
4216	Delikipos	23	SCP	VERY LOW	

4300	Zigi	589	SCP	VERY LOW	
4301	Mari	158	SCP	VERY LOW	
4302	Kalavassos	737	SCP	VERY LOW	
4303	Toχni	424	SCP	LOW	TOURISTIC AREA
4304	Xoirokoitia	632	SCP	VERY LOW	
4305	Psematismenos	271	SCP	VERY LOW	
4306	Maroni	710	SCP	VERY LOW	
4307	Agios Theodoros Larnaca	663	SCP	VERY LOW	
4308	Skarinou	393	SCP	VERY LOW	
4309	Kofinou	1,312	SCP	VERY LOW	
4310	Kato Lefkara	128	SCP	VERY LOW	
4311	Pano Lefkara	762	SCP	LOW	TOURISTIC AREA
4312	Kato Drys	129	SCP	VERY LOW	
4313	Babla	52	SCP	VERY LOW	
4314	Lageia	28	CY_19	VERY LOW	
4315	Ora	206	CY_19	VERY LOW	
4316	Melini	59	CY_19	VERY LOW	
4317	Odoi	213	CY_19	VERY LOW	
4318	Agioi Babatsinias	131	CY_19	VERY LOW	
4319	Babatsinia	81	CY_19	VERY LOW	
5	**Region Limmasol**	**235,330**			
5000	Munic/ity Limmasol	101,000	SCP	MODERATE	TOURISTIC AREA
5011	Munic/ity Mesa Geitonias	14,477	SCP	LOW	
5012	Munic/ity Agiou Athanasiou	14,347	SCP	LOW	TOURISTIC AREA
5013	Munic/ity Germasogeias	13,421	SCP	MODERATE	TOURISTIC AREA
5020	Pano Polemidhia	3,470	SCP	VERY LOW	
5021	Ipsonas	11,117	SCP	VERY LOW	
5022	Munic/ity Kato Polemidion	22,369	SCP	LOW	
5100	Palodeia	1,568	CY_19	MODERATE	
5101	Paramitha	569	CY_19	LOW	
5102	Spitali	316	CY_18	LOW	
5103	Fasoila Limmasol	560	SCP	VERY LOW	
5104	Mathikoloni	174	SCP	VERY LOW	
5105	Gerasa	69	CY_19	VERY LOW	
5106	Apsioi	208	CY_19	VERY LOW	
5107	Apesia	474	CY_19	VERY LOW	

5108	Korfi	199	CY_19	VERY LOW	
5109	Limnatis	314	CY_19	VERY LOW	
5110	Kapileio	34	CY_19	VERY LOW	
5120	Mouttagiaka	2,939	SCP	LOW	TOURISTIC AREA
5121	Armenochori	218	SCP	VERY LOW	
5122	Foinikaria	339	SCP	VERY LOW	
5123	Akrointa	455	CY_19	VERY LOW	
5124	Agios Tichon	3,455	SCP	LOW	TOURISTIC AREA
5125	Parekklisia	2,738	SCP	LOW	TOURISTIC AREA
5126	Pentakomo	644	CY_18	MODERATE	
5127	Monagroulli	536	SCP	VERY LOW	
5128	Moni	622	SCP	VERY LOW	
5129	Pyrgos Limmasol	2,363	CY_19	HIGH	TOURISTIC AREA
5130	Asgata	417	CY_19	VERY LOW	
5131	Basa Kellakiou	73	CY_19	VERY LOW	
5132	Sanida	42	CY_19	VERY LOW	
5133	Prastio Kellakiou	103	CY_19	VERY LOW	
5134	Klonari	18	CY_19	VERY LOW	
5135	Bikla	1	CY_19	VERY LOW	
5136	Kellaki	299	CY_19	VERY LOW	
5137	Akapnoi	20	CY_19	VERY LOW	
5138	Eptagoneia	353	CY_19	VERY LOW	
5140	Dierona	192	CY_19	VERY LOW	
5141	Arakapas	307	CY_19	VERY LOW	
5142	Agios Pailos	135	CY_19	VERY LOW	
5143	Agios Konstantinos	137	CY_19	VERY LOW	
5144	Sukopetra	120	CY_19	VERY LOW	
5145	Loubaras	363	CY_19	VERY LOW	
5146	Kalo Xorio Limmasol	497	CY_19	VERY LOW	
5147	Zoopigi	140	SCP	VERY LOW	
5200	Akrotiri	870	CY-09	HIGH	
5201	Asomatos Limmasol	726	SCP	VERY LOW	
5202	Tserkezoi	50	SCP	VERY LOW	
5203	Traχoni Limmasol	3,952	SCP	VERY LOW	
5210	Kolossi	5,651	SCP	VERY LOW	
5211	Erimi	2,432	SCP	VERY LOW	
5212	Episkopi Limmasol	3,681	SCP	LOW	TOURISTIC AREA
5213	Kantoi	349	SCP	VERY LOW	

5214	Sotira Limmasol	143	CY-18	LOW	
5220	Prastio Avdimou	245	CY-18	LOW	
5221	Paramali	220	CY-10	MODERATE	
5222	Avdimou	535	CY-10	MODERATE	
5223	Platanisteia	45	CY-18	LOW	
5224	Agios Thomas	50	CY-18	LOW	
5225	Alektora	64	CY-18	LOW	
5226	Anogura	301	CY-18	MODERATE	
5227	Pissouri	1,819	CY-18	VERY HIGH	TOURISTIC AREA
5300	Soini-Zanakia	837	CY-18	MODERATE	
5302	Alassa	282	CY-18	MODERATE	
5303	Kato Kibides	5	CY-18	LOW	
5304	Pano Kibides	707	CY_19	LOW	
5305	Agios Ambrosios Limmasol	323	CY_19	VERY LOW	
5306	Agios Tgerapon	125	CY_19	VERY LOW	
5307	Lofou	46	CY_19	VERY LOW	
5308	Pachna	865	CY_19	LOW	
5310	Agios Georgios Limmasol	111	CY_19	VERY LOW	
5311	Doros	135	CY_19	VERY LOW	
5312	Laneia	281	CY_19	LOW	
5313	Silikou	137	CY_19	VERY LOW	
5314	Monagri	175	CY-19	VERY LOW	
5315	Trimiklini	307	CY_19	VERY LOW	
5316	Agios Mamas	114	CY_19	VERY LOW	
5317	Kouka	27	CY_19	VERY LOW	
5318	Moniatis	275	CY_19	VERY LOW	
5320	Dora	145	CY_19	VERY LOW	
5322	Arsos Limmasol	202	CY_19	VERY LOW	
5323	Kissoisa	6	CY-18	VERY LOW	
5324	Malia	64	CY-18	LOW	
5325	Basa Koilaniou	163	CY_19	VERY LOW	
5326	Bouni	149	CY_19	VERY LOW	
5327	Pera Pedi	120	CY_19	VERY LOW	
5328	Mandria Limmasol	107	CY_19	VERY LOW	
5329	Potamioi	36	CY_19	VERY LOW	
5330	Omodos	322	CY_19	VERY LOW	
5331	Koilani	216	CY_19	VERY LOW	
5340	Agios Dimitrios	54	CY_19	VERY LOW	
5341	Palaiomulos	20	CY_19	VERY LOW	

5342	Prodromos	123	CY_19	VERY LOW	
5343	Kaminaria	44	CY_19	VERY LOW	
5344	Treis Elies	25	CY_19	VERY LOW	
5345	Lemithou	88	CY_19	VERY LOW	
5350	Kato Platres (Tornarides)	148	CY_19	LOW	TOURISTIC AREA
5351	Pano Platres	239	CY_19	LOW	TOURISTIC AREA
5352	Foini	391	CY_19	VERY LOW	
5355	Amiantos	228	CY_19	VERY LOW	
5360	Agios Theodoros Limmasol	65	CY_19	VERY LOW	
5361	Agios Ioannis Limmasol	339	CY_19	VERY LOW	
5362	Kato Milos	50	CY_19	VERY LOW	
5363	Potamitissa	62	CY_19	VERY LOW	
5364	Dimes	165	CY_19	VERY LOW	
5365	Pelendri	1,074	CY_19	MODERATE	
5366	Agros	806	CY_19	MODERATE	TOURISTIC AREA
5367	Agridia	104	CY_19	VERY LOW	
5368	Xandria	162	CY_19	VERY LOW	
5369	Kyperointa	1,516	CY_19	MODERATE	
6	**Region Paphos**	**88,276**			
6000	Munic/ity Paphos	32,892	PAPHOS PROJECT	HIGH	TOURISTIC AREA
6010	Munic/ity Geroskipou	7,878	PAPHOS PROJECT	HIGH	TOURISTIC AREA
6011	Konia	2,209	PAPHOS PROJECT	HIGH	TOURISTIC AREA
6012	Agia Marinoida	266	PAPHOS PROJECT	VERY LOW	
6014	Acheleia	145	PAPHOS PROJECT	VERY LOW	
6020	Xlorakas	5,356	PAPHOS PROJECT	HIGH	TOURISTIC AREA
6021	Lempa	506	PAPHOS PROJECT	LOW	
6022	Empa	4,855	PAPHOS PROJECT	MODERATE	
6023	Tremithoisa	1,041	PAPHOS PROJECT	MODERATE	
6024	Mesa Xorio	586	PAPHOS PROJECT	LOW	
6025	Mesogi	1,689	PAPHOS PROJECT	MODERATE	
6026	Tala	2,695	PAPHOS PROJECT	HIGH	TOURISTIC AREA

6027	Kissonerga	2,004	PAPHOS PROJECT	HIGH	TOURISTIC AREA
6100	Kouklia Paphos	892	CY_18	HIGH	
6101	Mandria Paphos	893	PAPHOS PROJECT	LOW	
6102	Nikokleia	121	MYTS	MODERATE	
6103	Souskiou	10	MYTS	LOW	
6104	Timi	1,220	PAPHOS PROJECT	MODERATE	
6106	Agia Barbara Paphos	172	PAPHOS PROJECT	VERY LOW	
6107	Anarita	876	PAPHOS PROJECT	MODERATE	
6110	Marathounta	309	PAPHOS PROJECT	VERY LOW	
6111	Armou	600	PAPHOS PROJECT	MODERATE	
6112	Episkopi Paphos	220	PAPHOS PROJECT	VERY LOW	
6113	Nata	181	PAPHOS PROJECT	VERY LOW	
6114	Choletria	264	MYTS	MODERATE	
6115	Axilou	61	PAPHOS PROJECT	VERY LOW	
6116	Eledio	44	PAPHOS PROJECT	VERY LOW	
6120	Tsada	1,043	MYTS	HIGH	
6121	Koili	466	MYTS	MODERATE	
6122	Stroumpi	540	CY-12	MODERATE	
6123	Polemi	848	PAPHOS PROJECT	LOW	
6124	Kallepeia	326	CY-12	MODERATE	
6125	Letimvou	249	CY-12	MODERATE	
6127	Koirdaka	7	MYTS	LOW	
6128	Lemona	51	PAPHOS PROJECT	VERY LOW	
6129	Choilou	147	PAPHOS PROJECT	VERY LOW	
6130	Akoursos	22	MYTS	LOW	
6132	Kathikas	438	PAPHOS PROJECT	VERY LOW	
6133	Munic/ity Pegeias	3,953	PAPHOS PROJECT	HIGH	TOURISTIC AREA
6200	Pano Archimandrita	43	CY-18	LOW	
6201	Fasoila Paphos	56	MYTS	LOW	
6202	Moisere	2	CY-18	LOW	
6204	Mamonia	51	MYTS	MODERATE	
6205	Agios Georgios Paphos	101	MYTS	MODERATE	

6206	Stavrokonnou	56	PAPHOS PROJECT	MODERATE	
6207	Prastio Paphos	8	MYTS	LOW	
6208	Trachypedoula	64	PAPHOS PROJECT	MODERATE	
6210	Kelokedara	193	PAPHOS PROJECT	VERY LOW	
6211	Salamioi	265	PAPHOS PROJECT	VERY LOW	
6212	Kidasi	11	CY_11	VERY LOW	
6213	Kedares	80	PAPHOS PROJECT	VERY LOW	
6214	Mesana	31	PAPHOS PROJECT	VERY LOW	
6215	Praitori	23	PAPHOS PROJECT	VERY LOW	
6216	Filoisa Kelokedaron	17	PAPHOS PROJECT	VERY LOW	
6217	Arminou	24	PAPHOS PROJECT	VERY LOW	
6218	Agios Nikolaos Paphos	61	PAPHOS PROJECT	VERY LOW	
6219	Agios Ioannis Paphos	29	CY-18	LOW	
6220	AmargEti	209	MYTS	MODERATE	
6221	Agia Marina Kelokedaron	37	PAPHOS PROJECT	VERY LOW	
6222	Pentalia	63	PAPHOS PROJECT	VERY LOW	
6223	Faleia	2	MYTS	VERY LOW	
6224	Galataria	56	CY_19	VERY LOW	
6225	Koilineia	39	CY_19	VERY LOW	
6226	Bretsia	1	CY_19	VERY LOW	
6227	Statos-Agios Fotios	243	PAPHOS PROJECT	VERY LOW	
6229	Mamointali	18	MYTS	LOW	
6230	Pano Panagia	481	MYTS	MODERATE	
6231	Asprogia	60	PAPHOS PROJECT	VERY LOW	
6300	Psathi	110	PAPHOS PROJECT	VERY LOW	
6301	Agios Dimitrjanos	91	PAPHOS PROJECT	VERY LOW	
6302	Kannabioi	175	CY_11	MODERATE	
6303	Thrinia	55	MYTS	MODERATE	
6304	Milia Paphos	14	PAPHOS PROJECT	VERY LOW	
6305	Kritou Marottou	85	PAPHOS PROJECT	VERY LOW	
6306	Fiti	150	PAPHOS PROJECT	VERY LOW	

6307	Lasa	67	PAPHOS PROJECT	VERY LOW	
6308	Drimou	110	PAPHOS PROJECT	VERY LOW	
6310	Simou	185	PAPHOS PROJECT	VERY LOW	
6311	Anadioi	17	PAPHOS PROJECT	VERY LOW	
6312	Sarama	2	MYTS	VERY LOW	
6313	Evretou	3	MYTS	VERY LOW	
6315	Filoisa Chrysochous	31	PAPHOS PROJECT	VERY LOW	
6318	Meladeia	17	MYTS	VERY LOW	
6319	Melandra	2	MYTS	VERY LOW	
6320	Lyssos	205	MYTS	MODERATE	
6321	Peristerona Paphos	302	MYTS	MODERATE	
6330	THeletra	269	CY-12	MODERATE	
6331	Yiolou	762	CY-12	HIGH	
6332	Pano Akourdaleia	44	MYTS	LOW	
6333	Milioi	89	CY-12	LOW	
6334	Kato Akourdaleia	65	MYTS	LOW	
6335	Tera	36	MYTS	LOW	
6336	Kritou Tera	86	MYTS	LOW	
6337	Skoilli	65	CY-15	LOW	
6338	Xoli	83	MYTS	LOW	
6339	Loukroinou	4	MYTS	VERY LOW	
6340	Karamoillides	33	MYTS	VERY LOW	
6341	Chrysochou	132	MYTS	LOW	
6343	Munic/ity Poleos Chrysochous	2,018	CY-15	VERY HIGH	TOURISTIC AREA
6344	Neo Xorio Paphos	519	CY_14	HIGH	TOURISTIC AREA
6345	Goudi	204	CY_15	MODERATE	
6350	Kato Arodes	39	PAPHOS PROJECT	VERY LOW	
6351	Pavo Arodes	135	PAPHOS PROJECT	VERY LOW	
6352	Iveia	385	PAPHOS PROJECT	VERY LOW	
6353	Droiseia	405	PAPHOS PROJECT	LOW	TOURISTIC AREA
6355	Androlikou	34	CY_14	VERY LOW	
6360	Pelathoisa	57	MYTS	LOW	
6361	Kuvoisa	71	CY_19	VERY LOW	
6362	Makounta	116	MYTS	LOW	
6363	Argaka	1,078	MYTS	HIGH	

6364	Gialia	202	CY_19	VERY LOW	
6365	Agia Mariva Chrysochous	647	CY_19	LOW	
6366	Nea Mikril Diversionta	50	CY_19	VERY LOW	
6367	Pomos	448	CY_19	VERY LOW	
6368	Stevi	173	MYTS	LOW	
6369	Agios Isidoros	7	MYTS	LOW	

Under the Management Plan, companies engaged in industrial activity are registered in a GIS file. Overall, it is deemed that industrial plants are systems of high resilience to drought, as the abstraction requirements for industrial plants are either form common networks (such as water supply) or from groundwater bodies and are relatively low. In terms of abstraction from groundwater bodies, the local concentration of industrial plants is considered manageable and therefore the vulnerability of industrial use to drought in Cyprus is generally classified as low.

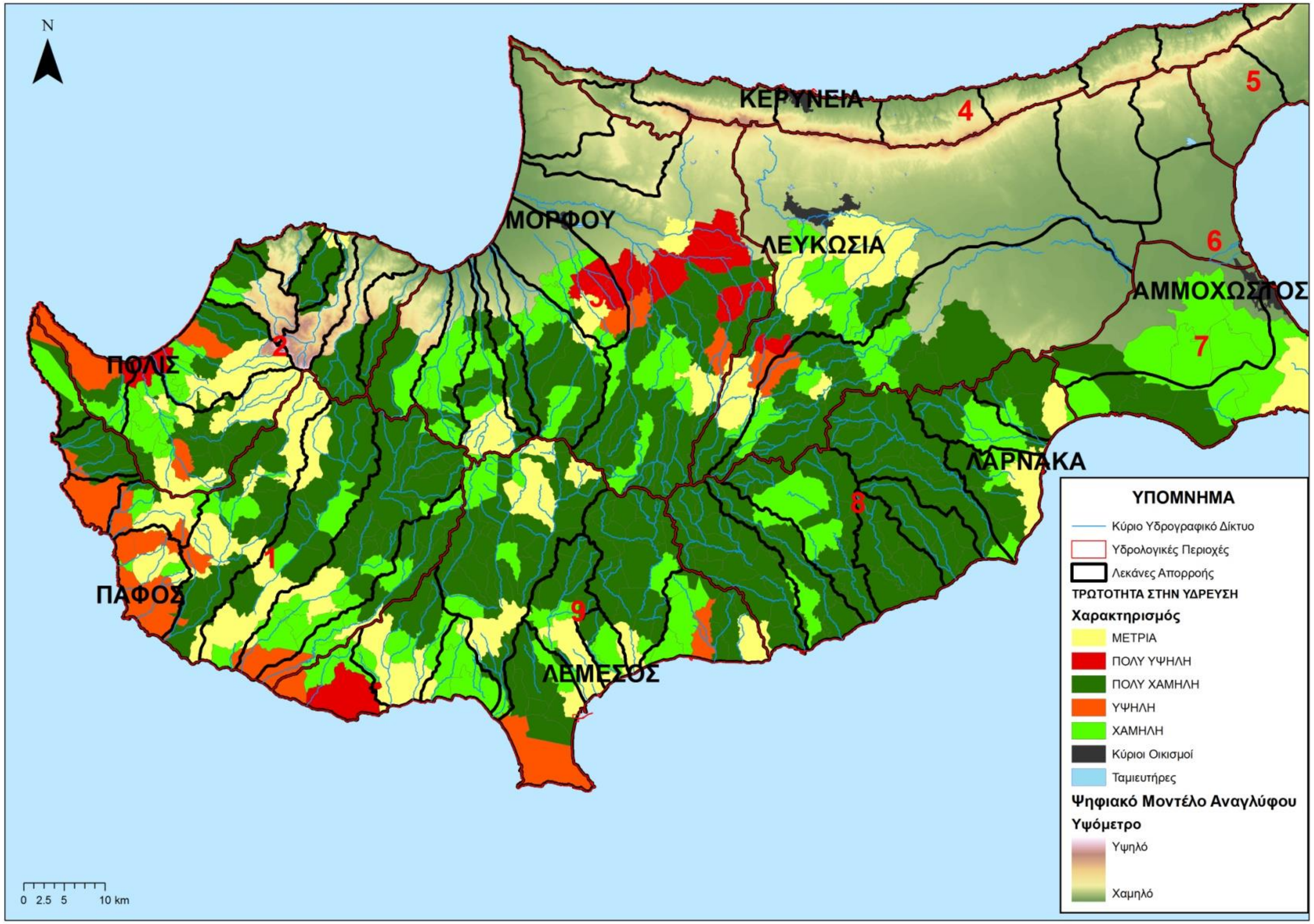


Figure 9-2: Illustration of vulnerability in water for Cyprus.

9.2.3 IRRIGATION

It is obvious that the vulnerability of collective irrigation networks to drought depends on the resilience to drought of the water source and on the size of demand for irrigation. As irrigation takes last priority, compared to water supply and environmental preservation, we make the reasonable assumption that the lower threshold of vulnerability in irrigation will be MODERATE (as opposed to water supply, which is VERY LOW) and will be graduated accordingly up to the classification "VERY HIGH" for irrigated large surface areas with high shortages and high percentage of permanent crops, the drying of which due to poor irrigation will imply the total destruction of crops for several years. The data sources are:

- Shape file with irrigation GWP, indicating the water source for each part of the irrigation projects.
- Shape file with the areas of the Municipalities and Communities of Cyprus. It is possible that part of a polygon of a Municipality or Community is included in an GWP, but the remaining area of the Municipality/Community is irrigated outside the GWP. The intersection of the two shape files
- The amounts of water corresponding to irrigation per year per settlement and per aquifer that are not included in the GWP were obtained from the study ECONOMIC ANALYSIS OF WATER USE, CALCULATION OF TOTAL COST OF WATER SERVICES, IDENTIFICATION OF EXISTING COST RECOVERY LEVELS carried out for the WDD in 2009 and in particular, ANNEX B_1: CONSUMPTION FOR WATER AND IRRIGATION BY MUNICIPALITIES/COMMUNITIES, IRRIGATION ORGANISATIONS AND INDIVIDUALS BY HYDROLOGIC REGION AND WATER BODY OUTSIDE GWP AREAS.

Based on the above, we formulate a reasoning that designates vulnerability classification based on (a) the source of water, and (b) the demand for irrigation water.

The water sources in general are: (a) GWP of combined dams/drilling and transmission projects, (b) GWP irrigated by recycled water, (c) irrigation projects supplied exclusively by drilling, and (d) irrigation projects supplied from diversions at watercourse beds by means of small dams (weirs).

As regards vulnerability of **organised irrigation projects** we consider that irrigation shortages play an important role in the designation of vulnerability. We consider the vulnerability of the organised irrigation projects of Chrysochous, Xyliatos-Vyzakia and Pitsilias as MODERATE, because first, the necessary water resources for irrigation are not significant and are indeed further reduced and second, the availability of water resources in Western Cyprus are significantly larger compared to the easternmost areas. Moreover, these water sources are not used for water supply therefore there is no other priority except for the environment. As regards the vulnerability of organised irrigation networks supplied by the Southern Conveyor and the Paphos system the following apply: Based on the contents of the Water Policy issue of the 1st RBMP and of the Present Issue it seems that shortages in the irrigation project of the Southern Conveyor are significant in dry periods. In the 1st RBMP it is stated that "the 60 hm³ abstraction policy brings about a maximum shortage, in the 36 years of the simulation, equal to about 44hm³. Even the 50 hm³ abstraction policy corresponds to a maximum shortage of about 33 hm³, although the reliability of this abstraction approximates 90%". Therefore, the vulnerability of irrigation to drought in areas irrigated by the Southern Conveyor project is classified as HIGH and/or VERY HIGH, as this system is also used for the water supply of the Municipalities of Nicosia, Larnaca and Limassol, hence irrigation takes lower priority. Similarly, the Paphos project is also classified as HIGH or/and VERY HIGH vulnerability, as shortages are not so extensive, but are in any case also significant in terms of demand. The table below (Table 9-5) presents the area data for the parts of the Southern Conveyor irrigation project and the Are surface elements of the irrigation departments of the Southern Conveyor and the Vassilikos - Pentaschoinos project.

On the contrary, as regards irrigation areas **irrigated by recycled water** the vulnerability of organised irrigation networks is considered LOW, as these water quantities are considered quantitatively and qualitatively ensured, since their quality is constantly monitored.

Table 9-5: Area data of parts of the Southern Conveyor Project and the Vasiliko -Pentaschoinos project (source: WDD website)

Segment	Area (ha)	Total Area (ha)
SOUTHERN CONVEYOR PROJECT		
Kokkinochoria	9.270	
Athienou	451	
Troullwn-Avdelerrou	46	
Akrotiri	1 737	
Kitio	1 206	
Mazwtos	615	
Parekklisia	351	
Aradippou	250	13 926
VASSILIKOS – PENTASCHOINOS PROJECT		
Vassilikos	801	
Pentaschoinos	422	
Maroni	206	1 429

Based on the above reasoning, vulnerability is designated per polygon arising from the intersection of the shape file of GWP of irrigation projects and the shape file of the boundaries of the Municipalities and Communities of Cyprus, as shown in the table below (Table 9-8). The irrigation area Pissouri is known to have significant shortages, hence vulnerability is classified as VERY HIGH, as well as in the area of Kition. The area of Kokkinochoria is designated with VERY HIGH vulnerability due to the cultivation of Cyprus potato, which is an important export product of Cyprus. The irrigation area of LYMPIA has high vulnerability, as it is irrigated from the Lympia Dam of capacity of only 220,000m^3 on the river Tremithos.

Table 9-6: Table of irrigation projects controlled by the WDD.

Code	Settlement Name	Vulnerability	IRRIGATION PROJECT (KYE)
6106	AGIA BARBARA	HIGH	MAJOR IRRIGATION PAPHOS PROJECT
6012	AGIA MARINOYDA	HIGH	MAJOR IRRIGATION PAPHOS PROJECT
6107	ANARIEA	HIGH	MAJOR IRRIGATION PAPHOS PROJECT
6014	ACHELEIA	HIGH	MAJOR IRRIGATION PAPHOS PROJECT
6010	GEROSKHPOY	HIGH	MAJOR IRRIGATION PAPHOS PROJECT

6022	EMPA	HIGH	MAJOR IRRIGATION PAPHOS PROJECT
6027	KISSONERGA	HIGH	MAJOR IRRIGATION PAPHOS PROJECT
6013	KOLONH	HIGH	MAJOR IRRIGATION PAPHOS PROJECT
6100	KOYKLIA PAPHOS	HIGH	MAJOR IRRIGATION PAPHOS PROJECT
6021	LEMPA	HIGH	MAJOR IRRIGATION PAPHOS PROJECT
6101	MANDRIA PAPHOS	HIGH	MAJOR IRRIGATION PAPHOS PROJECT
6102	NIKOKLEIA	HIGH	MAJOR IRRIGATION PAPHOS PROJECT
6000	PAPHOS	HIGH	MAJOR IRRIGATION PAPHOS PROJECT
6133	PEGEIA	HIGH	MAJOR IRRIGATION PAPHOS PROJECT
6026	TALA	HIGH	MAJOR IRRIGATION PAPHOS PROJECT
6104	TIMH	HIGH	MAJOR IRRIGATION PAPHOS PROJECT
6020	CHLORAKAS	HIGH	MAJOR IRRIGATION PAPHOS PROJECT
6365	AGIA MARINA	MODERATE	IRRIGATION PROJECT POLIS CHRYSOCHOYS
6355	ANDROLIKOY	MODERATE	IRRIGATION PROJECT POLIS CHRYSOCHOYS
6363	ARGAKA	MODERATE	IRRIGATION PROJECT POLIS CHRYSOCHOYS
6331	GIOLOY	MODERATE	IRRIGATION PROJECT POLIS CHRYSOCHOYS
6345	GOYDI	MODERATE	IRRIGATION PROJECT POLIS CHRYSOCHOYS
6353	DROYSEIA	MODERATE	IRRIGATION PROJECT POLIS CHRYSOCHOYS
6313	EYRETOY	MODERATE	IRRIGATION PROJECT POLIS CHRYSOCHOYS
6330	THELETRA	MODERATE	IRRIGATION PROJECT POLIS CHRYSOCHOYS
6340	KARAMOYLLHDES	MODERATE	IRRIGATION PROJECT POLIS CHRYSOCHOYS
6334	K. AKOYRDALEIA	MODERATE	IRRIGATION PROJECT POLIS CHRYSOCHOYS
1464	KOKKINA	MODERATE	IRRIGATION PROJECT POLIS CHRYSOCHOYS
6361	KYNOYSA	MODERATE	IRRIGATION PROJECT POLIS CHRYSOCHOYS
6307	LASA	MODERATE	IRRIGATION PROJECT POLIS CHRYSOCHOYS
6339	LOYKROYNOY	MODERATE	IRRIGATION PROJECT POLIS CHRYSOCHOYS
6362	MAKOYNTA	MODERATE	IRRIGATION PROJECT POLIS CHRYSOCHOYS
6333	MHLIOY	MODERATE	IRRIGATION PROJECT POLIS CHRYSOCHOYS
6366	NEA DHMMATA	MODERATE	IRRIGATION PROJECT POLIS CHRYSOCHOYS
6344	NEO CHORIO PAPHOS	MODERATE	IRRIGATION PROJECT POLIS CHRYSOCHOYS
1461	PACHYAMMOS	MODERATE	IRRIGATION PROJECT POLIS CHRYSOCHOYS
6360	PELATHOYSA	MODERATE	IRRIGATION PROJECT POLIS CHRYSOCHOYS
6321	PERISTERONA	MODERATE	IRRIGATION PROJECT POLIS CHRYSOCHOYS
6343	POLIS	MODERATE	IRRIGATION PROJECT POLIS CHRYSOCHOYS
6367	POMOS	MODERATE	IRRIGATION PROJECT POLIS CHRYSOCHOYS
6312	SARAMA	MODERATE	IRRIGATION PROJECT POLIS CHRYSOCHOYS
6310	SIMOY	MODERATE	IRRIGATION PROJECT POLIS CHRYSOCHOYS
6337	SKOYLLH	MODERATE	IRRIGATION PROJECT POLIS CHRYSOCHOYS
6368	STENH	MODERATE	IRRIGATION PROJECT POLIS CHRYSOCHOYS
6315	FILOYSA	MODERATE	IRRIGATION PROJECT POLIS CHRYSOCHOYS
6338	CHOLH	MODERATE	IRRIGATION PROJECT POLIS CHRYSOCHOYS
6341	CHRYSOCHOY	MODERATE	IRRIGATION PROJECT POLIS CHRYSOCHOYS
5200	AKROTHRI	LOW	IRRIGATION AREA AG. NIKOLAOY (RECLAIMED WATER)
5210	KOLOSSI	VERY HIGH	IRRIGATION AREA PISSOYRIOY
5203	TRACHONI LEMESOY	VERY HIGH	IRRIGATION AREA PISSOYRIOY

4307	AYIOS THEODOROS	HIGH	ARDEYTIKO BASILIKOY - PENTASCHOINOY
4300	ZYGI	HIGH	ARDEYTIKO BASILIKOY - PENTASCHOINOY
4302	KALABASOS	HIGH	ARDEYTIKO BASILIKOY - PENTASCHOINOY
4309	KOFINOY	HIGH	IRRIGATION AREA VASSILIKOY - PENTASCHOINOY
4301	MARI	HIGH	IRRIGATION AREA VASSILIKOY - PENTASCHOINOY
4306	MARONI	HIGH	IRRIGATION AREA VASSILIKOY - PENTASCHOINOY
4315	ORA	HIGH	IRRIGATION AREA VASSILIKOY - PENTASCHOINOY
4308	SKARINOY	HIGH	IRRIGATION AREA VASSILIKOY - PENTASCHOINOY
4303	TOCHNH	HIGH	IRRIGATION AREA VASSILIKOY - PENTASCHOINOY
4305	PSEMATISMENOS	HIGH	IRRIGATION AREA VASSILIKOY - PENTASCHOINOY
4110	KITI	VERY HIGH	IRRIGATION AREA KITIOY (E.S.N.A)
4013	MENEOY	VERY HIGH	IRRIGATION AREA KITIOY (E.S.N.A)
4111	PERIBOLIA LARN.	VERY HIGH	IRRIGATION AREA KITIOY (E.S.N.A)
4113	SOFTADES	VERY HIGH	IRRIGATION AREA KITIOY (E.S.N.A)
4112	TERSEFANOY	VERY HIGH	IRRIGATION AREA KITIOY (E.S.N.A)
4103	ABDELLERO	MODERATE	IRRIGATION AREA ABDELLEROY (E.S.N.A)
3100	AYIA NAPA	VERY HIGH	IRRIGATION PROJECT KOKKINOCHORION (E.S.N.A)
4202	ATHIENOY	MODERATE	IRRIGATION AREA ATHHENOY (E.S.N.A)
3000	AMMOCHOSTOS	VERY HIGH	IRRIGATION PROJECT KOKKINOCHORION (E.S.N.A)
3110	AUGOROY	VERY HIGH	IRRIGATION PROJECT KOKKINOCHORION (E.S.N.A)
3114	ACHERITOY	VERY HIGH	IRRIGATION PROJECT KOKKINOCHORION (E.S.N.A)
3111	ACHNA	VERY HIGH	IRRIGATION PROJECT KOKKINOCHORION (E.S.N.A)
3102	DERYNEIA	VERY HIGH	IRRIGATION PROJECT KOKKINOCHORION (E.S.N.A)
3104	LIOPETRI	VERY HIGH	IRRIGATION PROJECT KOKKINOCHORION (E.S.N.A)
1110	LOYROYKINA	MODERATE	IRRIGATION AREA ATHHENOY (E.S.N.A)
4105	XYLOTYMBOY	VERY HIGH	IRRIGATION PROJECT KOKKINOCHORION (E.S.N.A)
4107	XYLOFAGOY	VERY HIGH	IRRIGATION PROJECT KOKKINOCHORION (E.S.N.A)
4106	ORMIDEIA	VERY HIGH	IRRIGATION PROJECT KOKKINOCHORION (E.S.N.A)
4201	PETROFANI	MODERATE	IRRIGATION AREA ATHHENOY (E.S.N.A)
3103	SOTHRA AMMOCH.	VERY HIGH	IRRIGATION PROJECT KOKKINOCHORION (E.S.N.A)
4101	TROYLLOI	MODERATE	IRRIGATION AREA TROYLLON (E.S.N.A)
3105	FRENAROS	VERY HIGH	IRRIGATION PROJECT KOKKINOCHORION (E.S.N.A)

5200	AKROTHRI	HIGH	IRRIGATION PROJECT AKROTHRIOY (E.S.N.A)
5212	EPISKOPI LEM.	HIGH	IRRIGATION PROJECT AKROTHRIOY (E.S.N.A)
5211	ERHMH	HIGH	IRRIGATION PROJECT AKROTHRIOY (E.S.N.A)
5213	KANTOY	HIGH	IRRIGATION PROJECT AKROTHRIOY (E.S.N.A)
5210	KOLOSSI	HIGH	IRRIGATION PROJECT AKROTHRIOY (E.S.N.A)
5203	TRACHONI LEMESOY	HIGH	IRRIGATION PROJECT AKROTHRIOY (E.S.N.A)
5202	TSERKEZOI	HIGH	IRRIGATION PROJECT AKROTHRIOY (E.S.N.A)
5021	YPSONAS	HIGH	IRRIGATION PROJECT AKROTHRIOY (E.S.N.A)
1102	ALAMPRA	VERY HIGH	IRRIGATION AREA LYMPION
1108	LYMPIA	VERY HIGH	IRRIGATION AREA LYMPION
4212	MOSFILOTH	VERY HIGH	IRRIGATION AREA LYMPION
5125	PAREKKLHSIA	MODERATE	IRRIGATION AREA PAREKKLHSIAS
1121	AYIOS SOZOMENOS	LOW	IRRIGATION AREA BATHIAS GONIAS - RECLAIMED WATER
4010	ARADIPPOY	LOW	ARDEYOMENH PERIOCHH LARNACAS (DROMOLAXIA) - RECLAIMED WATER
1024	GERI	LOW	IRRIGATION AREA BATHIAS GONIAS - RECLAIMED WATER
1107	DALI	LOW	IRRIGATION AREA BATHIAS GONIAS - RECLAIMED WATER
4012	DROMOLAXIA	LOW	IRRIGATION AREA LARNACAS (DROMOLAXIA) - RECLAIMED WATER
4210	KALO CHORIO LARNACAS	LOW	IRRIGATION AREA LARNACAS (DROMOLAXIA) - RECLAIMED WATER
4126	KLAYDIA	LOW	IRRIGATION AREA LARNACAS (DROMOLAXIA) - RECLAIMED WATER
4000	LARNACA	LOW	IRRIGATION AREA LARNACAS (DROMOLAXIA) - RECLAIMED WATER
1120	POTAMIA	LOW	IRRIGATION AREA BATHIAS GONIAS - RECLAIMED WATER
5127	MONAGROYLLI	LOW	IRRIGATION PROJECT ANAKYKLOMENOY NEROY LEMESOY (SALA) - AG. GEORGOS ALAMANOY
5128	MONH	LOW	IRRIGATION PROJECT ANAKYKLOMENOY NEROY LEMESOY (SALA) - AG. GEORGOS ALAMANOY
5126	PENTAKOMO	LOW	IRRIGATION PROJECT ANAKYKLOMENOY NEROY LEMESOY (SALA) - AG. GEORGOS ALAMANOY
5127	MONAGROYLLI	LOW	IRRIGATION AREA PAREKKLHSIAS (E.S.N.A) – CHRηSη και ανακυκLOμένου
5128	MONH	LOW	IRRIGATION AREA PAREKKLHSIAS (E.S.N.A) CHRηSη και ανακυκLOμένου
5125	PAREKKLHSIA	LOW	IRRIGATION AREA PAREKKLHSIAS (E.S.N.A)
5129	PYRGOS	LOW	IRRIGATION AREA PAREKKLHSIAS (E.S.N.A) CHRηSη και ανακυκLOμένου

1321	AYIOS GEORGIOS KAYKALLOY	MODERATE	IRRIGATION PROJECT BYZAKIAS
1362	ASTROMERITHS	MODERATE	IRRIGATION PROJECT BYZAKIAS
1323	BYZAKIA	MODERATE	IRRIGATION PROJECT BYZAKIAS
1329	KATO KOYTRAFAS	MODERATE	IRRIGATION PROJECT BYZAKIAS
1322	NIKHTARI	MODERATE	IRRIGATION PROJECT BYZAKIAS
1328	PANW KOYTRAFAS	MODERATE	IRRIGATION PROJECT BYZAKIAS
1330	POTAMI	MODERATE	IRRIGATION PROJECT BYZAKIAS
5222	AYDHMOY	VERY HIGH	IRRIGATION AREA AYDHMOY - PARAMALI
5221	PARAMALI	VERY HIGH	IRRIGATION AREA AYDHMOY - PARAMALI
5227	PISSOYRI	VERY HIGH	IRRIGATION AREA AYDHMOY - PARAMALI
1324	AGIA MARINA XYLIATOY	MODERATE	IRRIGATION PROJECT XYLIATOY
1321	AYIOS GEORGIOS KAYKALLOY	MODERATE	IRRIGATION PROJECT XYLIATOY
1320	XYLIATOS	MODERATE	IRRIGATION PROJECT XYLIATOY
5123	AKROYNTA	HIGH	IRRIGATION AREA GERMASOGEIA - POLEMIDIA
5200	AKROTHRI	HIGH	IRRIGATION AREA GERMASOGEIA - POLEMIDIA
5013	GERMASOGEIA	HIGH	IRRIGATION AREA GERMASOGEIA - POLEMIDIA
5022	KATO POLEMIDIA	HIGH	IRRIGATION AREA GERMASOGEIA - POLEMIDIA
5210	KOLOSSI	HIGH	IRRIGATION AREA GERMASOGEIA - POLEMIDIA
5000	LIMASSOL	HIGH	IRRIGATION AREA GERMASOGEIA - POLEMIDIA
5020	PANW POLEMIDIA	HIGH	IRRIGATION AREA GERMASOGEIA - POLEMIDIA
5203	TRACHONI LEMESOY	HIGH	IRRIGATION AREA GERMASOGEIA - POLEMIDIA
5202	TSERKEZOI	HIGH	IRRIGATION AREA GERMASOGEIA - POLEMIDIA
5021	YPSONAS	HIGH	IRRIGATION AREA GERMASOGEIA - POLEMIDIA
5122	FOINIKARIA	HIGH	IRRIGATION AREA GERMASOGEIA - POLEMIDIA
5360	AYIOS THEODOROS	MODERATE	IRRIGATION PROJECT PITSILIAS
5143	AG. KONSTANTINOS	MODERATE	IRRIGATION PROJECT PITSILIAS
5367	AGRIDIA	MODERATE	IRRIGATION PROJECT PITSILIAS
5367	AGRIDIA	MODERATE	IRRIGATION PROJECT PITSILIAS
5366	AGROS	MODERATE	IRRIGATION PROJECT PITSILIAS
5137	AKAPNOY	MODERATE	IRRIGATION PROJECT PITSILIAS
1302	ALONA	MODERATE	IRRIGATION PROJECT PITSILIAS
1302	ALONA	MODERATE	IRRIGATION PROJECT PITSILIAS
1302	ALONA	MODERATE	IRRIGATION PROJECT PITSILIAS
1301	ASKAS	MODERATE	IRRIGATION PROJECT PITSILIAS
5140	DIERONA	MODERATE	IRRIGATION PROJECT PITSILIAS

5364	DYMES	MODERATE	IRRIGATION PROJECT PITSILIAS
5138	EPTAGONEIA	MODERATE	IRRIGATION PROJECT PITSILIAS
5147	ZOOPHGH	MODERATE	IRRIGATION PROJECT PITSILIAS
5146	KALO CHORIO	MODERATE	IRRIGATION PROJECT PITSILIAS
5354	KATO AMJANTOS	MODERATE	IRRIGATION PROJECT PITSILIAS
5362	KATO MYLOS	MODERATE	IRRIGATION PROJECT PITSILIAS
5369	KYPEROYNTA	MODERATE	IRRIGATION PROJECT PITSILIAS
1305	LAGOYDERA	MODERATE	IRRIGATION PROJECT PITSILIAS
5145	LOYBARAS	MODERATE	IRRIGATION PROJECT PITSILIAS
5145	LOYBARAS	MODERATE	IRRIGATION PROJECT PITSILIAS
4316	MELINH	MODERATE	IRRIGATION PROJECT PITSILIAS
5318	MONIATHS	MODERATE	IRRIGATION PROJECT PITSILIAS
4315	ORA	MODERATE	IRRIGATION PROJECT PITSILIAS
5365	PELENDRI	MODERATE	IRRIGATION PROJECT PITSILIAS
1309	PLATANISTASA	MODERATE	IRRIGATION PROJECT PITSILIAS
1304	VERYSTYPOS	MODERATE	IRRIGATION PROJECT PITSILIAS
5363	POTAMITISSA	MODERATE	IRRIGATION PROJECT PITSILIAS
5133	PRASTIO KELLAKIOY	MODERATE	IRRIGATION PROJECT PITSILIAS
1306	SARANTI	MODERATE	IRRIGATION PROJECT PITSILIAS
1400	SPHLIA	MODERATE	IRRIGATION PROJECT PITSILIAS
5144	SYKOPETRA	MODERATE	IRRIGATION PROJECT PITSILIAS
1201	FARMAKAS	MODERATE	IRRIGATION PROJECT PITSILIAS
1303	FTERIKOYDI	MODERATE	IRRIGATION PROJECT PITSILIAS
5368	CHANDRIA	MODERATE	IRRIGATION PROJECT PITSILIAS

As regards irrigation areas **irrigated by well drilling,** vulnerability is generally considered MODERATE, when the network is supplied from groundwater bodies in good quantitative condition, HIGH when supplied from groundwater systems in poor quantitative condition and VERY HIGH when groundwater bodies have been overexploited for long-term periods, even if the amount of pumping is small.

For underground aquifers in good quantitative condition (e.g. CY-19) vulnerability in irrigation is classified as MODERATE for abstraction up to 100,000m^3 per year (corresponding to the 85% percentile of the abstractions recorded), HIGH for abstraction up to 260,000 m^3 per year (corresponding to the 95% percentile of the abstractions recorded) and VERY HIGH for abstraction exceeding 260,000 m^3 per year.

For underground aquifers in poor quantitative condition vulnerability in irrigation is classified as MODERATE for small abstraction up to 60,000m^3 per year (corresponding to the 40% percentile of the abstractions recorded), HIGH for abstraction up to 125,000 m^3 per year (corresponding to the 60% percentile of the abstractions recorded) and VERY HIGH for abstraction exceeding 125,000 m^3 per year. We see that the least favourable classification concerns irrigation networks supplied from GWB of poor quantitative condition for much smaller percentile of the abstractions recorded.

Small Aquifers of Local Importance are similarly treated like GWB of poor quantitative condition. The following table (Table 9-7) records the GWB that are included in the exceptions of Article 4 of the WFD and are in poor overall condition.

Table 9-7: Recording of GWB in poor condition included in the exceptions of Article 4 of the WFD.

Code	Name	Final Status – 2021	Final Status - 2027	Exemption Verification Article 4 of WFD
CY-1	Kokkinochoria	Poor	Poor	Exemption Article 4.5 WFD
CY-3A	Koitis Treminthou	Poor	Poor	More time is needed for the GWB recovery
CY-3B	Kiti-Pervolia	Poor	Poor	More time is needed for the GWB recovery
CY-4	Softades-Vassilikos	Poor	Poor	More time is needed for the GWB recovery
CY-5	Maroni	Poor	Poor	More time is needed for the GWB recovery
CY-6	Mari-Kalo Chorio	Poor	Poor	More time is needed for the GWB recovery
CY-8	Limmasol	Poor	Poor	More time is needed for the GWB recovery
CY-9	Akrotiri	Poor	Poor	More time is needed for the GWB recovery
CY-10	Paramali-Avdimou	Poor	Poor	More time is needed for the GWB recovery
CY-12	Letimvou-Yiolou	Poor	Poor	More time is needed for the GWB recovery
CY-13	Pegeia	Poor	Poor	More time is needed for the GWB recovery
CY-15A	Chrysochou-Yialia	Poor	Poor	More time is needed for the GWB recovery
CY-15B	Koiti Chrysochou	Poor	Poor	More time is needed for the GWB recovery
CY-17	Central & Western Messaoria	Poor	Poor	More time is needed for the GWB recovery
CY-18	Lefkara-Pachna	Poor	Poor	More time is needed for the GWB recovery

Therefore, the following table (Table 9-8) presents the record of abstractions per settlement and per GWB and vulnerability in irrigation is classified in accordance with the above.

Table 9-8: Vulnerability classification for areas irrigated from groundwater.

CODE	MUNICIPALITY/COMMUNITY	ANNUAL ABSTRACTION	VULNERABILITY CLASSIFICATION	REMARKS
	Total	(m^3)		
		GWB KOKKINOXWRIWN (CY_1)		
3114	AXERIOY	585 038	VERY HIGH	
		GWB MARI-KALO XWRIO (CY_6)		
4304	XOIROKOITIA	512 444	VERY HIGH	
		GWB AKRWTHRI (CY_9)		
5212	EPISKOPI Limmasol	256 352	VERY HIGH	
		GWB PAPHOS (CY_11)		
6302	KANABIOY – MELAMIOY	129 653	HIGH	
6127	KOYRDAKA	27 500	MODERATE	
		GWB LETYMBOY - YIOLOY (CY_12)		
6115	AXYLOY	6 836	MODERATE	
6116	ELEDIO	43 380	MODERATE	
6330	THELETRA	61 453	HIGH	
6124	KALLEPEIA	146 176	VERY HIGH	
6128	LEMWNA	73 381	HIGH	
6125	LETYMBOY	92 068	HIGH	
6122	STROYMPI	348 706	VERY HIGH	
		GWB ANDROLIKOY (CY_14)		
6355	ANDROLIKOY	215	LOW	
		GWB PYRGOS (CY_16)		
1457	KATW PYRGOS	791 024	VERY HIGH	
		GWB KENTRIKH & DYTIKH MESAORIA (CY_17)		
1240	AGIOI TRIMITHIAS	124 853	VERY HIGH	
1010	AYIOS DOMETIOS	4 500	MODERATE	
6219	AYIOS IWANNHS PAPHOS	865 079	VERY HIGH	
1121	AYIOS SWZOMENOS	936	MODERATE	
1013	AGLANTZIA	7 800	MODERATE	
1360	AKAKI	3 727 623	VERY HIGH	
1210	AREDIOY	7 582	MODERATE	
1362	ASTROMERITHS	2 426 458	VERY HIGH	
1363	AYLWNA	252 766	VERY HIGH	
1024	GERI	699 963	VERY HIGH	
1107	DALI	1 450 447	VERY HIGH	

1242	DENEIA	148 405		VERY HIGH	
1011	EGKWMH NICOSIA	66 336		HIGH	
1228	EPISKOPEIO	105 076		VERY HIGH	
1230	ERGATES	1 220 203		VERY HIGH	
1233	KATW DEYTERA	250 464		VERY HIGH	
1326	KATW MONH	60 315		HIGH	
1364	KATWKOPIA	1 240 858		VERY HIGH	
1243	KOKKINOTRIMITHIA	527 802		VERY HIGH	
1104	KOTSIATHS	60 983		HIGH	
1021	LAKATAMEIA	159 346		VERY HIGH	
1023	LATSIA	411 142		VERY HIGH	
1000	LEYKWSIA	343 775		VERY HIGH	
1244	MAMMARH	183 415		VERY HIGH	
1368	MENIKO	669 602		VERY HIGH	
1105	NHSOY	336 434		VERY HIGH	
1327	OROYNTA	809 791		VERY HIGH	
1241	PALAIOMETOXO	792 312		VERY HIGH	
1232	PANW DEYTERA	2 429 308		VERY HIGH	
1350	PANW ZWDEIA	248 801		VERY HIGH	
1328	PANW KOYTRAFAS	397 995		VERY HIGH	
1227	PERA	99 898		HIGH	
1106	PERA XWRIO	4 750		MODERATE	
1361	PERISTERWNA NICOSIA	4 848 347		VERY HIGH	
1226	POLITIKO	37 132		MODERATE	
1330	POTAMI	517 103		VERY HIGH	
1120	RIVERS	751 384		VERY HIGH	
1012	STROBOLOS	61 402		HIGH	
1225	TSERI	115 831		VERY HIGH	
1229	PSIMOLOFOY	105 352		VERY HIGH	
GWB LEYKARA - PAXNA (CY_18)					
4127	AGGLISIDES	620 508		VERY HIGH	
5305	AYIOS AMBROSIOS LEMESOY	5 163		MODERATE	
5306	AYIOS THERAPWN	90 067		HIGH	
6218	AYIOS NIKOLAOS PAPHOS	126 326		VERY HIGH	
5124	AYIOS TYXWN	2 775		MODERATE	
4125	ALETHRIKO	125 231		VERY HIGH	
5225	ALEKTORA	672 503		VERY HIGH	
4122	ANAFWTIDA	790 483		VERY HIGH	
5226	ANWGYRA	74 120		HIGH	

6217	ARMINOY	15 317		MODERATE	
5322	ARSOS LEMESOY	4 141		MODERATE	
5326	BOYNI	53 140		MODERATE	
5321	GEROBASA	2 860		MODERATE	
5320	DWRA	27 803		MODERATE	
5311	DWROS	61 265		HIGH	
4210	KALO XWRIO LARNACAS	43 048		MODERATE	
1223	KAMPIA	25 745		MODERATE	
4312	KATW DRYS	39 937		MODERATE	
5303	KATW KIBIDES	14 907		MODERATE	
6213	KEDARES	1 375		MODERATE	
6210	KELOKEDARA	225 697		VERY HIGH	
4124	KIBISILI	417 046		VERY HIGH	
4126	KLAYDIA	110 786		HIGH	
5331	KOILANI	52 617		MODERATE	
5108	KORFH	8 310		MODERATE	
5317	KOYKA	429		MODERATE	
5312	LANEIA	118 671		HIGH	
5109	LIMNATHS	82 977		MODERATE	
5307	LOFOY	3 978		MODERATE	
5104	MATHIKOLWNH	53 847		MODERATE	
4128	MENOGEIA	133 038		VERY HIGH	
5314	MONAGRI	43 078		MODERATE	
5120	MOYTTAGIAKA	15 526		MODERATE	
5330	OMODOS	80 395		HIGH	
5100	PALODEIA	4 899		MODERATE	
6200	PANW ARXIMANDRITA	32 864		MODERATE	
5304	PANW KIBIDES	1 377		MODERATE	
5101	PARAMYTHA	4 516		MODERATE	
5308	PAXNA	105 445		HIGH	
5126	PENTAKWMO	184 424		VERY HIGH	
5227	PISSOYRI	1 170 045		VERY HIGH	
5223	PLATANISTEIA	39 750		MODERATE	
5329	POTAMIOY	20 149		MODERATE	
6215	PRAITWRI	42 761		MODERATE	
5300	SOYNI-ZANAKIA	25 329		MODERATE	
5102	SPITALI	23 749		MODERATE	
5214	SWTHRA LEMESOY	142 147		VERY HIGH	
6208	TRAXYPEDOYLA	111 722		HIGH	
5103	FASOYLA LEMESOY	59 684		MODERATE	

6216	FILOYSA KELOKEDARWN	23 860		MODERATE	
GWB TROODOS (CY_19)					
4211	AGIA ANNA	54 314		MODERATE	
6106	AGIA BARBARA PAPHOS	114 994		HIGH	
4318	AGIOI BABATSINIAS	56 358		MODERATE	
5340	AYIOS DHMHTRIOS	45 928		MODERATE	
1206	AYIOS EPIFANIOS OREINHS	11 932		MODERATE	
1414	AYIOS EPIFANIOS SOLEAS	995		MODERATE	
4307	AYIOS THEODWROS LARNACAS	32 673		MODERATE	
5360	AYIOS THEODWROS LEMESOY	4 975		MODERATE	
1405	AYIOS THEODWROS SOLEAS	6 067		MODERATE	
5361	AYIOS IWANNHS LEMESOY	58 786		MODERATE	
5143	AYIOS KWNSTANTINOS	16 136		MODERATE	
5316	AYIOS MAMAS	49 793		MODERATE	
1430	AYIOS NIKOLAOS NICOSIA	4 206		MODERATE	
5142	AYIOS PAYLOS	5 448		MODERATE	
5367	AGRIDIA	54 709		MODERATE	
1212	AGROKHPIA	2 390		MODERATE	
5366	AGROS	116 253		HIGH	
1308	ALHTHINOY	3 761		MODERATE	
1302	ALWNA	87 200		MODERATE	
5141	ARAKAPAS	183 352		HIGH	
5130	ASGATA	28 316		MODERATE	
1301	ASKAS	4 182		MODERATE	
6231	ASPROGIA	11 737		MODERATE	
5106	APSIOY	9 839		MODERATE	
4319	BABATSINIA	56 358		MODERATE	
4313	BABLA	29 519		MODERATE	
5131	BASA KELLAKIOY	58 179		MODERATE	
1406	GALATA	46 649		MODERATE	
1425	GERAKIES	13 427		MODERATE	
5105	GERASA	11 316		MODERATE	
1204	GOYRRH	65 584		MODERATE	
4216	DELIKHPOS	9 900		MODERATE	
5140	DIERWNA	214 129		HIGH	
5364	DYMES	414 130		VERY HIGH	

5138	EPTAGWNEIA	232 846		HIGH	
1411	EYRYXOY	59 511		MODERATE	
5147	ZWOPHGH	61 565		MODERATE	
1404	KAKOPETRIA	90 853		MODERATE	
1408	KALJANA	66 161		MODERATE	
5146	KALO XWRIO LEMESOY	85 318		MODERATE	
5343	KAMINARIA	60 106		MODERATE	
1200	KAMPI	110 472		HIGH	
1427	KAMPOS	136 705		HIGH	
1403	KANNABIA	310		MODERATE	
1220	KAPEDES	11 796		MODERATE	
5110	KAPHLEIO	39 490		MODERATE	
1416	KATYDATA	37 892		MODERATE	
5354	KATW AMJANTOS	84 894		MODERATE	
5362	KATW MYLOS	18 585		MODERATE	
5350	KATW PLATRES	64 619		MODERATE	
5136	KELLAKI	58 179		MODERATE	
5323	KISSOYSA	5 428		MODERATE	
1209	KLHROY	53 817		MODERATE	
5134	KLWNARI	4 632		MODERATE	
1410	KORAKOY	33 765		MODERATE	
4215	KONNOS	77 860		MODERATE	
6361	KYNOYSSA	32 824		MODERATE	
5369	KYPEROYNTA	394 443		VERY HIGH	
4314	LAGEIA	17 631		MODERATE	
1203	LAZANIAS	34 829		MODERATE	
5345	LEMITHOY	19 023		MODERATE	
1435	LEFKA	4 206		MODERATE	
1415	LINOY	34 545		MODERATE	
1307	LIBADIA NICOSIA	10 748		MODERATE	
5145	LOYBARAS	62 101		MODERATE	
1109	LYTHRODONTAS	285 001		VERY HIGH	
1101	MATHIATIS	76 015		MODERATE	
5324	MALIA	32 653		MODERATE	
4316	MELINI	15 914		MODERATE	
1213	MITSERO	36 624		MODERATE	
5127	MONAGROYLLI	279 048		VERY HIGH	
5128	MONH	113 971		MODERATE	
5318	MONIATIS	43 999		MODERATE	
4212	MOSFILIWTI	33 746		MODERATE	

1421	MYLIKOURI	1 616		MODERATE	
1452	XEROBOUNOS	20 957		MODERATE	
4317	ODOY	60 034		MODERATE	
4315	ORA	71 129		MODERATE	
5341	PALAIOMYLOS	61 676		MODERATE	
1310	PALAICHORI OREINIS	49 184		MODERATE	
5351	PANW PLATRES	2 568		MODERATE	
1456	PANW PYRGOS	27 417		MODERATE	
5125	PAREKKLHSIA	364 252		VERY HIGH	
1461	PACHYAMMOS	38 337		MODERATE	
1420	PEDOULAS	27 583		MODERATE	
5365	PELENDRI	394 432		VERY HIGH	
5327	PERA PEDI	25 053		MODERATE	
1460	PIGENEIA	35 946		MODERATE	
1309	PLATANISTASA	6 931		MODERATE	
1304	POLYSTYPOS	2 256		MODERATE	
5363	POTAMITISSA	143 145		HIGH	
5133	PRASTIO KELLAKIOY	47 240		MODERATE	
5342	PRODROMOS	151 633		HIGH	
4214	PYRGA LARNACAS	108 680		MODERATE	
5129	PYRGOS	227 230		HIGH	
5132	SANIDA	35 006		MODERATE	
1100	SIA	9 094		MODERATE	
1407	SINAOROS	12 746		MODERATE	
1417	SKOYRIWTISSA	13 764		MODERATE	
1400	SPILIA	419		MODERATE	
5144	SYKOPETRA	68 223		MODERATE	
1409	TEMBRIA	27 118		MODERATE	
5344	TREIS ELIES	70 018		MODERATE	
5315	TRIMIKLINI	71 932		MODERATE	
1426	TSAKISTRA	110 299		HIGH	
1201	FARMAKAS	252 268		MODERATE	
1205	FIKARDOY	2 339		MODERATE	
1412	FLASSOY	75 424		MODERATE	
5352	FOINI	16 010		MODERATE	
1303	FTERIKOYDI	38 153		MODERATE	
4213	PSEVDAS	40 840		MODERATE	
MIKROI YDROFOROI TOPIKHS SHMASIAS (MYTS)					
4103	AVDELLERO	43 413		MODERATE	
6220	AMARGETTI	112 044		HIGH	

6111	ARMOY	38 613		MODERATE	
6353	DROUSHEIA	43 097		MODERATE	
6112	EPISKOPI PAPHOS	222 529		VERY HIGH	
6024	MESSA CHORIO	122 902		HIGH	
6222	PENTALIA	32 714		MODERATE	
6123	POLEMI	218 158		VERY HIGH	
6211	SALAMIOY	5 058		MODERATE	
6227	STATOS - AYIOS FOTIOS	524 484		VERY HIGH	
6114	HOLETRIA	62 848		HIGH	
6129	HOULOU	144 321		VERY HIGH	
1321	AYIOS GEORGIOS KAYKALLOY	148 016		VERY HIGH	
6301	AYIOS DEMETRJIANOS	2 708		MODERATE	
6130	AKOURSOS	7 595		MODERATE	
6224	GALATARIA	44 606		MODERATE	
6308	DRYMOY	3 010		MODERATE	
6352	INEIA	13 625		MODERATE	
6132	KATHIKAS	17 462		MODERATE	
6350	KATW ARODES	1 254		MODERATE	
4100	KELLIA	35 266		MODERATE	
6121	KOILH	51 124		MODERATE	
6011	KONIA	49 863		MODERATE	
6305	KRITOY MAROTTOY	13 910		MODERATE	
6336	KRITOY TERA	148 656		VERY HIGH	
6228	LAPHTHIOY	233		MODERATE	
4000	LARNACA	16 425		MODERATE	
6307	LASA	4 596		MODERATE	
4011	LIBADIA LARNACA	156 820		VERY HIGH	
6320	LYSSOS	170 478		MODERATE	
6204	MAMONIA	347 535		VERY HIGH	
6110	MARATHOYNTA	26 194		MODERATE	
6025	MESOGHI	123 730		HIGH	
6304	MHLIA PAPHOS	1 271		MODERATE	
6202	MOYSERE	2 438		MODERATE	
6113	NATA	118 902		HIGH	
6230	PANAYIA	132 900		VERY HIGH	
6351	PANW ARODES	10 511		MODERATE	
6103	SOUSKIOU	76 597		HIGH	
6206	STAVROKONNOY	10 208		MODERATE	
6026	TALA	167 926		VERY HIGH	

6023	TREMITHOUSSA	251 485		VERY HIGH	
6120	TSADA	100 836		HIGH	
6201	FASOYLA PAPHOS	69 456		HIGH	
6306	FYTI	43 505		MODERATE	
6300	PSATHI	49 828		MODERATE	

As regards irrigation areas **irrigated by diversions of the river beds,** vulnerability is considered VERY HIGH, as in periods of drought watercourse supplies are dramatically decreased (if not eliminated), hence there is no possibility of abstraction. Besides, when the level of stress on a river system is designated as HIGH, the measures to address water shortage in case of extreme drought set abstractions to zero. The relevant settlements are presented in the following table.

Table 9-9: List of settlements with irrigation networks supplied by small diversions (weirs) of river beds.

Name Settelemnt for irrigation	Vulnerability	WATER INTAKE
ANW LEFKARA	VERY HIGH	Small Diversion at Petrokolympos 250 ha ftharta and Olives
AYIOS IOANNIS	VERY HIGH	Water Intake 4΄΄ at R. Limnatis
MAZWTOS	VERY HIGH	Small Diversion at R. Pouzi
KOFINOY	VERY HIGH	Small Diversion Saratzina at R. Xeros Larnaca
MANDRIA	VERY HIGH	Water Intake 12΄΄ at ChaPotami
MARWNI	VERY HIGH	Small Diversion at Koliokremmos
TERSEFANOY	VERY HIGH	To Tank και 100 ha ftharta
LYMPIA	VERY HIGH	Lympia dam
KOYTRAFA	VERY HIGH	Fraggos Farms from gabion at R. Asino
AYIOS THEODOROS	VERY HIGH	Small Diversion at Kampos height 2.5m at R. Atsas - Olives - Orchard - Almonds
PANW PLATRES	VERY HIGH	Small Diversion at R. Kouris με 8΄΄ Water Intake Orchard- Seasonal.
MACHAIRAS	VERY HIGH	Water Intake 8΄΄ at R. Limnatis – 8 ha Orchard-Seasonal
HANDRIA	HIGH	Water Intake 8΄΄ at R. Limnatis – Winter Months
GIALIAS	HIGH	Water Intake at R. Makounta
OIKOS	VERY HIGH	Small Water Intake at R. Marathassa
KALOPANAYIOTIS	VERY HIGH	Various Water Intakes at the bed of R. Marathassa.
MOUTOULAS	VERY HIGH	Three Water Intakes at the bed of R. Marathassa
PARAMALI	VERY HIGH	Small Diversion at R. Siapanis
AKAPNOU EPTAGWNIA	VERY HIGH	Small Diversion at R. Vassiliko

The resilience **of stock farming** to drought does not depend only on the size of water consumption, because by definition stock farming is directly dependent on the production of animal feed for the efficient breeding of livestock. Therefore, stock farming vulnerability to drought is directly related to the level of supply adequacy of appropriate animal feed. Stock farming typically refers to stabled livestock farming units (cattle, poultry, sows and dairy and beef cattle) and free range animal population, like sheep and goats. The contribution percentage of stock farming to the theoretical water demand of Cyprus is estimated as approximately equal to 2%. Indeed, the livestock activity units registered under the Management Plan, have a very low average annual water consumption and as a result the units are not threatened by water scarcity in case of a drought event.

With the exception of sheep, which for at least five months feed on pasture, all other farm animals are kept in stables and fed exclusively with simple or complex (mixtures) animal feed that is probably imported from abroad and therefore there is no question of vulnerability to drought from lack of animal feed.

As regards free range animals (sheep and goats), we observe that natural pastures are located on hilly and mountainous areas where meteorological temperature and rainfall variation due to drought is somewhat smaller compared to the corresponding small variation of lowland areas and this is why it is considered that a drought event will not significantly reduce the grassland vegetation to an extent affecting the breeding of animals. However, as free-range animals are kept in natural pastures for five months and the rest of year feed on coarse fodder (hay, dried cereal hay, legumes and grassland plant hay, dried alfalfa and various silage) it is considered that this farming too, perhaps at a different time, is affected by the potential of a drought event, though to a lesser extent. In conclusion, it is found that in Cyprus, it is estimated overall that stock farming is less vulnerable to drought and therefore stock farming vulnerability is considered low.

Figure 9-3 shows the vulnerability in irrigation for the free areas of the Republic of Cyprus.

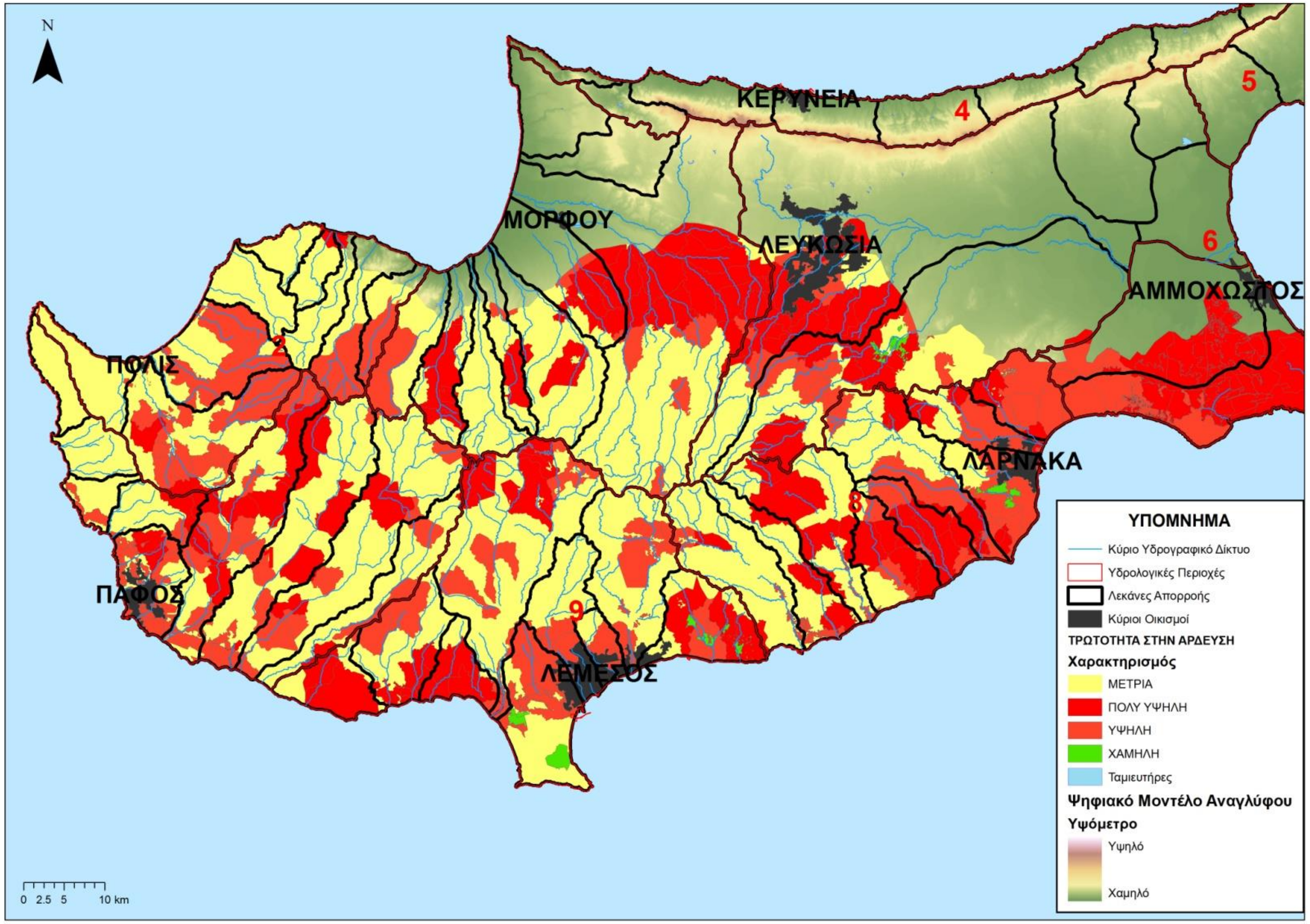


Figure 9-3: Illustration of vulnerability in irrigation for Cyprus.

9.2.4 VULNERABILITY TO THE ENVIRONMENT

The assessment of environmental vulnerability will be made per main water basin. To assess the vulnerability of water basins in the study area, with respect to the environment, we used the percentage of HS located within the network of Natura Protected Areas that are significantly correlated with the availability of water resources, as these areas are biodiversity cores, in which, during such conditions, biodiversity is threatened and vulnerability increases. Naturally, the sustainability of protected areas is directly dependent on the availability of water resources, whether these flow in the hydrographic network or are located in natural lakes and dams.

These areas, along with the part of the hydrographic network and lakes included in said areas, are presented in Figure 9-4.

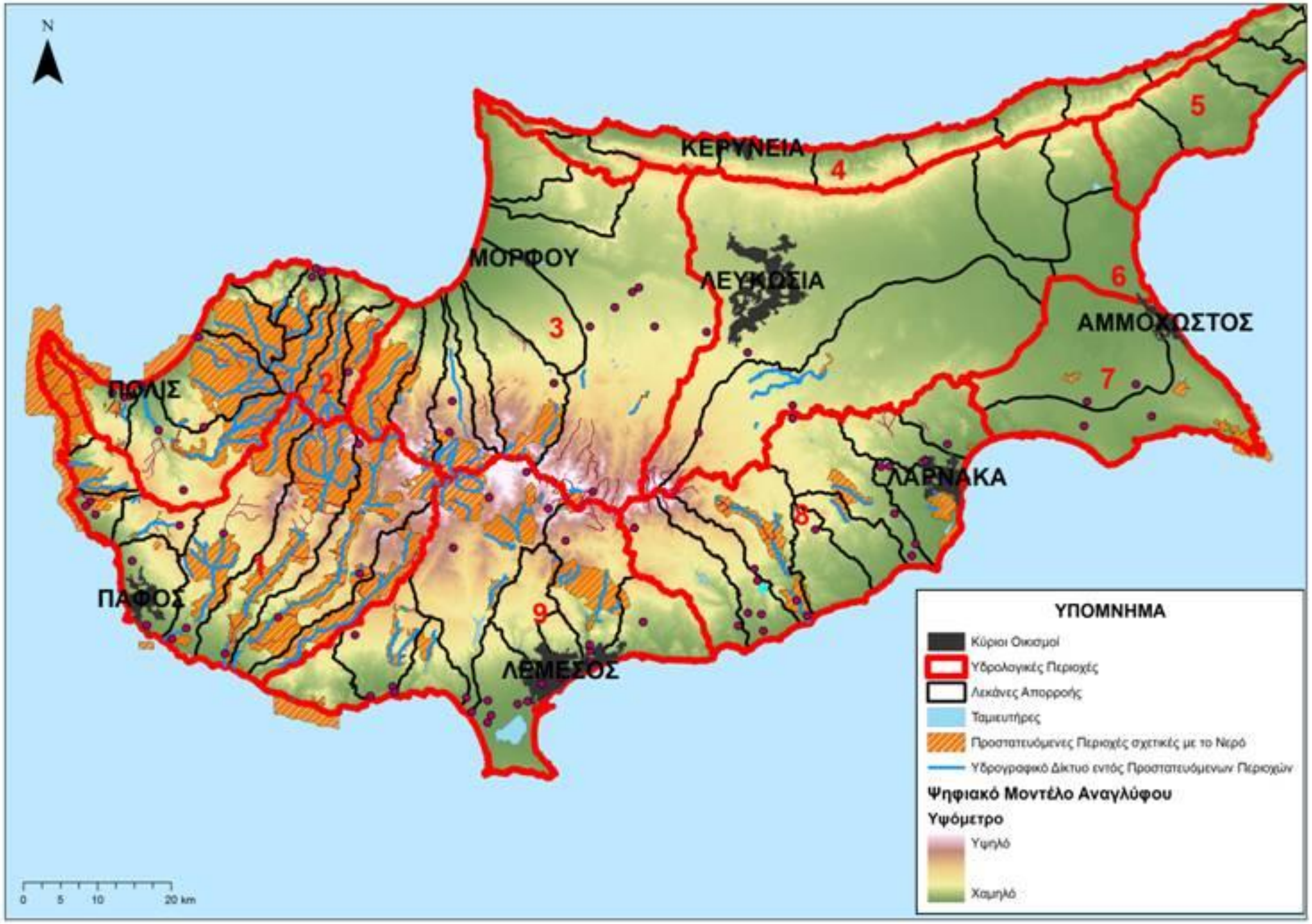


Figure 9-4: Map of the protected areas of Cyprus that are directly related to water

For rivers and lakes located within the above protected areas the total length and area per water basin is respectively calculated. The discretization per water basin favours the cartographical illustration of the entire Cyprus without missing data gaps. For each water basin the corresponding size is normalized with respect to the highest value to which the highest value of 100% is given. The results are classified by the averages of lakes and rivers per water basin, with the higher value first and the five vulnerability classes arise. The overall vulnerability is the average of the percentage of surface Water Bodies in terms of length or area included in protected areas.

Based on the column of average percentage the vulnerability classification results as follows:

VERY LOW: 0 to 0.2.

LOW: 0.2 to 0.4.

MODERATE: 0.4 to 0.6.

HIGH: 0.6 to 0.8.

VERY HIGH: 0.8 to 1.0.

The table below (Table 9-10) presents the designation of vulnerability to the environment based on the above analysis.

Table 9-10: Classification of environmental vulnerability per water basin.

CATCHMENT	RIVERS		LAKES/RESERVOIRS		AVERAGE PERCENTAGE	VULNERABILITY CLASSIFICATION
	LENGTH (km)	PERCENTAGE (%)	AREA (km^2)	PERCENTAGE (%)		
Ayios Athanassios	0.000	0.000	0.000	0.000	0.000	VERY LOW
Akrotiri	0.000	0.000	10.053	0.314	1.000	VERY HIGH
Famagusta	0.000	0.000	0.665	0.021	0.067	VERY LOW
Αραδίππου	0.000	0.000	0.000	0.000	0.000	VERY LOW
Argaki Pyrgos	0.000	0.000	0.000	0.000	0.000	VERY LOW
Atsas	0.000	0.000	0.000	0.000	0.000	VERY LOW
Avdimou	14.856	0.020	0.000	0.000	0.064	VERY LOW
Avgas	16.821	0.023	0.000	0.000	0.073	VERY LOW
ChaPotami	57.323	0.078	0.000	0.000	0.248	LOW
Chrysochou	48.855	0.066	1.138	0.036	0.325	LOW
Dhiarizos	97.680	0.132	0.356	0.011	0.455	MODERATE
East Akamas	3.225	0.004	0.000	0.000	0.013	VERY LOW
Elia	11.240	0.015	0.053	0.002	0.054	VERY LOW
Episkopi	5.039	0.007	0.000	0.000	0.022	VERY LOW
Ezoussa	69.713	0.094	0.926	0.029	0.392	LOW
Garyllis	1.034	0.001	0.168	0.005	0.019	VERY LOW
Germasogeia	21.200	0.029	0.681	0.021	0.159	VERY LOW
Geroskipou	0.000	0.000	0.000	0.000	0.000	VERY LOW
Gialias	27.766	0.038	0.000	0.000	0.121	VERY LOW
Kampos	7.837	0.011	0.000	0.000	0.035	VERY LOW
Kargotis	31.260	0.042	0.000	0.000	0.134	VERY LOW

Katouris	9.108	0.012	0.000	0.000	0.038	VERY LOW
Kosina	4.147	0.006	0.000	0.000	0.019	VERY LOW
Kouris	46.679	0.063	3.323	0.104	0.532	MODERATE
Salt Lakes Larnaca	2.664	0.004	6.531	0.204	0.662	HIGH
Limnitis	32.317	0.044	0.000	0.000	0.140	VERY LOW
Liopetri	0.000	0.000	2.904	0.091	0.290	LOW
Makounta	41.009	0.056	0.000	0.000	0.178	VERY LOW
Marathassa	4.786	0.006	0.000	0.000	0.019	VERY LOW
Maroni	0.000	0.000	0.000	0.000	0.000	VERY LOW
Mavrokolympo s	8.504	0.012	0.182	0.006	0.057	VERY LOW
Pediaios	0.000	0.000	0.359	0.011	0.035	VERY LOW
Pegeia	0.000	0.000	0.000	0.000	0.000	VERY LOW
Pentaschoinos	25.100	0.034	1.370	0.043	0.245	LOW
Pissouri	0.178	0.000	0.000	0.000	0.000	VERY LOW
Pouzis	4.549	0.006	0.000	0.000	0.019	VERY LOW
Pyrgos	23.044	0.031	0.000	0.000	0.099	VERY LOW
Serrachis	8.366	0.011	0.182	0.006	0.054	VERY LOW
Treminthos	7.735	0.010	0.000	0.000	0.032	VERY LOW
Vassilikos	0.000	0.000	0.870	0.027	0.086	VERY LOW
Voroklini	0.000	0.000	0.000	0.000	0.000	VERY LOW
Western Akamas	0.000	0.000	0.000	0.000	0.000	VERY LOW
Xeros (ΥΔ 1)	68.523	0.093	2.254	0.070	0.519	MODERATE
Xeros (ΥΔ 2)	19.205	0.026	0.000	0.000	0.083	VERY LOW
Xeros (ΥΔ 3)	18.665	0.025	0.000	0.000	0.080	VERY LOW
Xeros (ΥΔ 3)	0.000	0.000	0.000	0.000	0.000	VERY LOW
Xeros (ΥΔ 8)	0.000	0.000	0.000	0.000	0.000	VERY LOW
TOTAL	**738.4**	**100%**	**32.0**	**100%**		

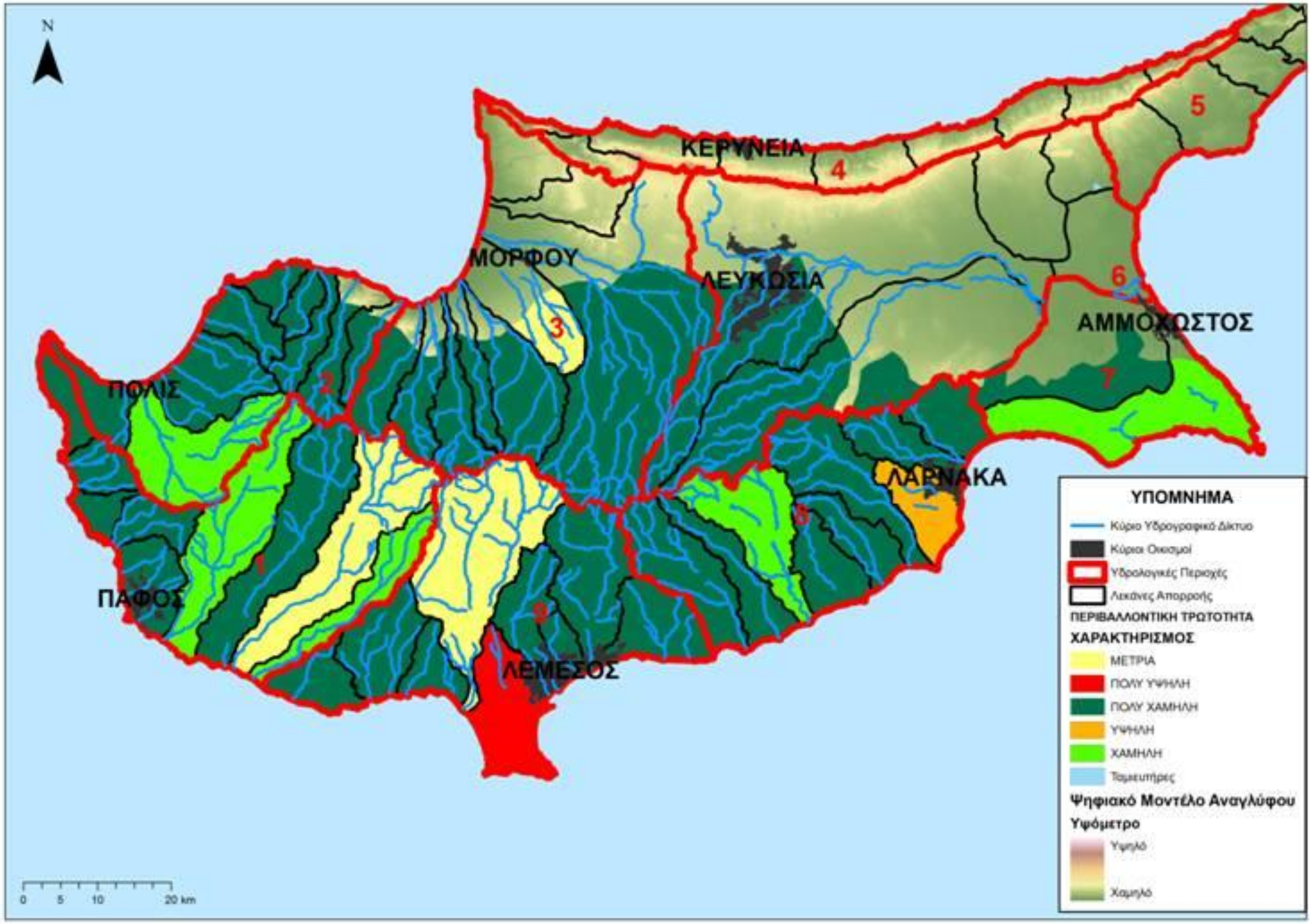


Figure 9-5: Illustration of environmental vulnerability for Cyprus.

10. PREPARATION OF MEASURES FOR THE PREVENTION AND ADDRESSING OF ENVIRONMENTAL, ECONOMIC AND SOCIAL IMPACTS

10.1 INTRODUCTION

This is a general reference to the European drought management framework and to preparing measures for the prevention and addressing of the environmental, economic and social impacts of drought.

10.2 EUROPEAN APPROACH AND MANAGEMENT FRAMEWORK TO DROUGHT

Drought management and addressing water scarcity, with emphasis on the Mediterranean region, are objects that have been studied by the working groups of the European Union and individual researchers. EU reports (MED WS&D WG, 2007 EC, 2007a EC, 2009) present the organisational, methodological and operational aspects of management, the design and implementation of response measures, as well as the compatibility of these measures with the objectives of the European Water Framework Directive 2000/60. Specifically, for the selection of measures various factors are examined, such as the institutional and legal framework, the assessment of risk and vulnerability, the involvement of stakeholders in the management and the readiness of society through long-term planning. Finally, specific practices and measures implemented in Mediterranean countries such as Spain, Cyprus, Egypt, France, Tunisia and Palestine (MED WS&D WG, 2007) have been recorded and evaluated.

10.2.1 EUROPEAN DIRECTIVE 2000/60

With Water Framework Directive 2000/60 the European Union restructured its policy as regards the protection of water, establishing a European framework for the management and protection of water resources at water basin level. Its objective is to achieve good ecological status, both for surface and for groundwater, by applying integrated management at water basin level and by implementing the relevant management plans and measures. It examines the issues of floods and droughts and suggests that the limitation of these phenomena is a basic object. It also supports issues such as pricing policies, management measures of demand and participatory processes in water resources management.

Specifically, the Water Directive 2000/60/EC sets the following principles:

- use of the European Directive 2000/60 as main methodology framework to achieve adaptation to climate change for areas vulnerable to water shortages, in order to reduce the impact of drought.
- preservation of underground aquifers in good quantitative condition sot that water systems may be more robust to the impact of climate change.
- examination, as appropriate, of whether drought allows the implementation of Article 4.6 of Directive 2000/60, taking into account the climatic forecasts.
- consideration of the requirements of Article 4.7 of Directive 2000/60 when measures that may cause water deterioration are taken to address water scarcity.
- diagnosis of the reasons that caused of water scarcity in the past and may cause it in the future.
- monitoring of water demand and forecast for the future.
- gathering of quantitative information to assess the reliability of water supply in the future, under climate change conditions.
- detection of climate changes in natural variability by means of long time series (use of existing metering networks).
- taking of additional measures to prevent water scarcity and respond to future droughts.
- adaptation of water resources management to climate change conditions, focusing on sustainability.;
- integrated approach to the combination of measures related to reduction of demand and increase of supply.
- implementation of robust and flexible aquatic systems.
- involvement of stakeholders in measure taking.
- assessment of the impact that other measures on climate change have on water scarcity and drought risk.

Although the Water Framework Directive contributes to the mitigation of drought effects, this is not one of its key objectives (MED WS&D WG, 2007). Specifically, it does not take into account the criteria and response actions to the risk of drought, references to drought are rare and ambiguous, while the drought management and mitigation actions are optional and complementary for Member States (MEDROPLAN, Iglesias et al., 2007).

10.2.2 EC COMMUNICATION EU ON WATER SCARCITY AND DROUGHT

The need for further developments and covering gaps in the European legislative framework in the quantitative dimension of water resources issues and specifically the phenomena of water scarcity and drought led to the European Commission Communication in 2007 on addressing the challenge of water scarcity and droughts in the European Union (EC, 2007c). The communication identified some general policy directions and specific measures on water scarcity and drought, which can be applied in addition and in line with the Framework Directive on water. These include:

1. Correct water pricing.

- Improvement of land use planning.
- Funding of rational use of water

2. Allocating water and water-related funding more efficiently.

3. Improvement of drought risk management.

- Development of drought risk management plans.
- Developing an observatory and an early warning system on drought.
- . Further optimising the use of the EU Solidarity Fund and European Mechanism for Civil Protection.

4. Considering additional water supply infrastructures

5. Fostering water efficient technologies and practices.

6. Fostering the emergence of a water-saving culture in Europe

7. Improve knowledge and data collection

- A water scarcity and drought information system throughout Europe
- Research and technological development opportunities

10.2.3 EUROPEAN DRAFT 2012

Recently, a study was prepared for the European Commission on the Gap Analysis of the Water Scarcity and Droughts Policy in the EU (Gap Analysis, ACTeon et al., 2012), which highlighted the lack of coherence between the current situation on drought and water scarcity in Europe and the suggested response policies. In the context of the study, gaps in the current European legislation were identified in order to propose new measures and policies to address water scarcity and drought. Specifically, the study resulted in:

• Assessment of existing/available measures and policies (at different levels: national, river basin and local) to prevent, manage or mitigate/address water scarcity and drought. To this end a database was established (measure/policy instruments database) containing all policy instruments, measures and supporting actions implemented by the Member States. These actions and measures were categorised as follows:

(a) prevention, preparedness, response or recovery,

(b) depending on their focus, incentives, pressures and/or impacts, and

(c) depending on the area they affect (agriculture-forestry, water supply, energy, industry)

• Identification of gaps (conceptual, information and assessment, as well as related with policy, governance and implementation) in the current European legislation

• Proposal of possible new measures (or even combination of measures) together with their possible impact (environmental, economic and social) and their feasibility. A total of seven areas of alternative policy interventions with specific measures identified, while it should be noted that the proposed measures have been separated for water scarcity (five areas) and drought (two areas).

The results and conclusions of the specific study in the context of gap analysis of water scarcity and drought policy in the EU updated the Blueprint to Safeguard Europe's Water Resources (EC, 2012a · EC, 2012b · EC , 2012c), which was published in December 2012. The Blueprint notes the strong stresses on water resources in European countries, due to urban development, economic activities, demographic change, changes in land use, resulting in many areas become more vulnerable to droughts and show a increasing water scarcity risk. Moreover, the blueprint notes the lack of adequate drought management in many Member States and therefore at European level in general.

Specifically, the blueprint emphasises on the following issues related to addressing drought and water scarcity phenomena:

• Green growth, green infrastructure (especially for natural water retention measures).

• Efficient management of natural resources, particularly in water cycle efficiency through appropriate measures in all relevant sectors (agriculture, industry, distribution networks, buildings and energy production). This approach is also thoroughly examined in the European Environment Agency's report on the efficient management of water resources (EEA, 2012).

• Implementation of appropriate financial instruments, such as pricing policies, cost recovery and measurement of water consumption, as well as support by voluntary labelling and certification schemes.

• Promotion of water reuse (especially for agricultural and industrial uses).

• Improvement of early warning systems for drought/Continued development of the European Drought Observatory.

• Improvement of cost - benefit analysis for appropriate/alternative measures.

According to the blueprint, priority should be given to efficiency measures in water policy with the adequate support by the relevant financial institutions providing incentives for improving water efficiency. It is also emphasized that the taking of measures on additional/alternative water sources (desalination, water transfer, groundwater aquifer recharge, storage reservoirs, reuse, rainwater harvesting) should be accompanied by a cost-benefit analysis.

10.3 DROUGHT MANAGEMENT MEASURES

10.3.1 GENERAL

Drought management measures are divided into long term and short term. At the same time, they are subdivided into the following categories, depending on their area of focus:

- water demand management measures,
- water availability increase measures,
- drought/water scarcity impact minimisation measures.

10.3.2 LONG TERM MANAGEMENT MEASURES FOR WATER SUPPLY AND DEMAND

The main long-term measures to avoid an imbalance between water supply and demand are summarised in the relevant table (Table 10-1) (MED WS & D WG, 2007 Water Scarcity Drafting Group, 2006). These measures can be:

- technological, in case of technical projects or technologies;
- economic, when addressing water as an economic good,
- social, when referring to activities related to the participation and awareness of society.

To achieve a rational and integrated water resources management it should be emphasized that priority should be given to the use of already available resources and therefore to measures of efficiency and demand management, before seeking additional sources (EC, 2009). As regards alternative water sources, emphasis should be placed on practices and technologies of recycling and reuse to meet agricultural, industrial, and urban needs, whenever possible.

The axes relating to demand management are specialised below.

- The introduction of new technologies and change of irrigation methods include: (a) better control of irrigation, (b) technological upgrades such as the replacement of gravity networks in pressurized systems, (c) review of irrigation needs, (d) infiltration and evaporation control, (e) creation of a consumption-cutting mechanism for emergencies and (g) replacement of water consuming crops by low water demand crops.
- The reduction of leakages in distribution networks cannot be eliminated even in the most modern and well-maintained networks. Nevertheless, the actions for their reduction are particularly important, given that they are estimated as ranging from 20-30% (France, Spain) to 60-80% (Croatia, Albania).

- Water saving technology in homes, gardens, and other facilities are related to the pressure regulation of the water supply network, the dual selection of the amount of water to be used in toilets and the regulation of water flow (drip irrigation/sprinklers). It is also appropriate to provide for such technologies in building regulations. The effect of these measures is relatively limited, as domestic consumption is generally a small percentage of the total, while the cost of technologies is slowly amortised.
- Metering the quantity of the water consumed allows the detection of leakages and enhances public awareness on water conservation issues. It is estimated that the reduction in consumption amounts to10-25% when metering programs are initiated (MED WS & D WG, 2007). The introduction of new technologies and the change of processes in industry mainly consists of wastewater reuse, and can reduce consumption by up to 90% (MED WS & D WG, 2007). The economic approach of measures against water scarcity is associated with many factors, such as agricultural economy, the legal and institutional framework and the social and agricultural policy. Measures can range from simple economic incentives in domestic tariffs, in the pricing of irrigation water, to even the creation of “water banks”', which manage water use rights. The latter approach is applied in America (USA, Canada, Chile), Australia and the Mediterranean (only in the Canary Islands) and it is emphasized that it involves significant risks.
- Finally, social participation includes: (a) information and education of the public, (b) establishing mechanisms for the resolution of crisis and other institutional issues, (c) user participation in decisions through consultation, and (d) information and awareness campaigns.

Table 10-1: Long-term measures to avoid an imbalance between demand and supply of water and recording of the relevant Measures of the 2^{nd} RBMP.

	Technological approaches	Economic approaches	Social approaches
Demand management measures	Water saving Appliances/Technologies (domestic consumption) (MEASURE ΣΜ-x-02) (from 1^{st} RBMP: MEASURES 108, 117,131, 132, 133, 134, 135, 136 and 137).	Tariff policy	Education and information of users
	Water consumption metering (MEASURE 110) - (MEASURE BM-c-04)	Tariff policy (especially in connection with irrigation water)	Bodies/Institutions: Dispute resolution/management and administrative arrangements
	Reduction of leakages in distribution networks (MEASURE 109)	Financial incentives and fines	Broad public/user involvement (through consultation)
	New technologies and changing processes in industry	Water banks and markets	Information and education campaigns
	New technologies and changing processes in agriculture (improved control and irrigation methods, etc.)	(MEASURE BM-c-04)	

	Water reuse	(MEASURE ΣΜ-x-01)	
Water availability increase measures	Physical storage in the basin (rivers, lakes, wetlands, underground aquifers)		
	Underground aquifer recharge	MEASURE ΣΜ-xiv-01 & MEASURE ΣΜ-xiv-02 The construction of Souskiou dam is also proposed.	
	Reservoirs	A significant number has been constructed	
	Use of alternative water sources: • Desalination • Rainwater harvesting • Greywater recycling in homes • Use of alternative water resources in industry • Sustainable Drainage Systems (SUDS) • Direct and indirect water reuse • Use of alternative water resources for irrigation	MEASURE ΣΜ-xii-01: Construction of Paphos Desalination Plant	MEASURE 119: Correlation of the degree of desalination plant utilisation based on the procedures described in the Drought Management Plan.
	Construction of small reservoirs	A significant number has been constructed	
	Transfer of water from other, adjacent river basins.	Dhiarizos (and Cha-potami) to Kouris, Ezousa to Asprokremmos, etc.)	

Most of this RBMP measures, that are part of the "Efficiency and reuse measures", include the proposals in the above table (Table 10-1). Each measure also indicates the measure code of this RBMP, whether it is a new measure or an ongoing activity.

Therefore the Measures concerning exclusively Drought and Water Scarcity Management are 3 in total. These measures are:

MEASURE 1: "For the Southern Conveyor and the Paphos projects, dependence of water abstractions to the value of the reservoir volume in all dams, at the end of the influx period (April). This correlation of abstractions, shown in the Drought Management Plan, should be reviewed regularly". (see Table 10-2).

MEASURE 2: "Update of the appropriate mechanism for drought monitoring and management". (see Table 10-3).

MEASURE 3: "Correlation of the degree of desalination plant utilisation based on the procedures described in the Drought Management Plan". (see Table 10-4).

Below the relevant tables are given, with information on the proposed measures to address drought.

Table 10-2: Proposed Measure on the formulation of an abstraction policy depending on storage in the dams of the Southern Conveyor and the Paphos project on 1 April.

<table>
<tr><td>NAME OF MEASURE:</td><td>For the Southern Conveyor and the Paphos projects, dependence of water abstractions to the value of the reservoir volume in all dams, at the end of the influx period (April). This correlation of abstractions, shown in the Drought Management Plan, should be reviewed regularly.</td></tr>
<tr><td>TYPE OF MEASURE:</td><td>STANDARD</td></tr>
<tr><td>CODE OF MEASURE:</td><td>---------</td></tr>
<tr><td>CATEGORY OF MEASURE:</td><td>Control of Surface and Groundwater abstraction and Surface water storage</td></tr>
<tr><td>1ST MANAGEMENT PLAN:</td><td>ONGOING ACTION (S/N: 58)</td></tr>
<tr><td>DESCRIPTION:</td><td>The permissible water abstraction from the dams of the Southern Conveyor project (Kouris, Germasogeia, Kalavasos, Dypotamos, Polemidia, Achna with inputs from Dhiarizos diversion (dam of Arminos and Cha-Potami) and the diversion of river Maroni) and from the dams of the Paphos project (Asprokremmos, Mavrokolympos and Kannavia) is specified, based on the dams’ reservoirs on 1 April. The following tables present the relevant planning.

Table 1: Planning of annual water abstractions from the Southern Conveyor Project dams
<table>
<tr><th>Storage on 1st April V (hm³)</th><th>Category Designation</th><th>Annual Abstraction (hm³)</th><th>Action Designation</th></tr>
<tr><td>V > 120</td><td>Adequate</td><td>55</td><td></td></tr>
<tr><td>.120 > V > 100</td><td>Moderate Shortage</td><td>44</td><td>Minor cuts</td></tr>
<tr><td>100 > V > 80</td><td>Moderate Shortage</td><td>35</td><td>Moderate cuts</td></tr>
<tr><td>80 > V > 50</td><td>Significant Shortage</td><td>25.</td><td>Significant cuts</td></tr>
<tr><td>V < 50</td><td>Extreme Shortage</td><td>15</td><td>Very significant cuts</td></tr>
</table>
Table 2: Planning of annual water abstractions from the Paphos Project dams
<table>
<tr><th>Storage on 1st April V (hm³)</th><th>Category Designation</th><th>Annual Abstraction (hm³)</th><th>Action Designation</th></tr>
<tr><td>V > 40</td><td>Adequate</td><td>17</td><td>No cuts</td></tr>
<tr><td>40 > V > 25</td><td>Moderate Shortage</td><td>14</td><td>Minor cuts (15% in irrigation)</td></tr>
<tr><td>25 > V > 15</td><td>Moderate Shortage</td><td>10</td><td>Moderate cuts (30% in irrigation)</td></tr>
<tr><td>15 > V > 10</td><td>Significant Shortage</td><td>7</td><td>Significant cuts (50% in irrigation)</td></tr>
<tr><td>V < 10</td><td>Extreme Shortage</td><td>4</td><td>Very significant cuts</td></tr>
</table>
The implementation of the measure “as is“ and the redefinition of the values of the tables in the next RBMP revision after collecting the relevant data is proposed.</td></tr>
<tr><td>IMPLEMENTATION TIME/PRIORITY:</td><td>High</td></tr>
</table>

PERFORMANCE TIME:	Short-term
ASSOCIATED ENTITIES:	WDD
EFFICIENCY (Degree of Measure Efficiency):	The Efficiency of the Measure is considered High. The objective of the Measure is to ensure a minimum volume of water (approximately 7% of the useful volume) in large dams after the end of the dry period (drought of reference) for the conservation of lake ecosystems.
ESTIMATED COST OF IMPLEMENTATION:	0 € (The implementation cost results from the energy required for desalination and recycled water infrastructure but is cited in another Measure)
ESTIMATED ANNUAL COST OF OPERATION/MAINTENANCE:	This is a management measure and therefore there is no issue of operation or maintenance costs.
FINANCING TOOL:	National Funding
REMARKS:	

Table 10-3: Proposed Measure on the update of the appropriate mechanism for drought monitoring and management.

NAME OF MEASURE:	Update of the appropriate mechanism for drought monitoring and management.
TYPE OF MEASURE:	SUPPLEMENTARY
CODE OF MEASURE:	-----------
CATEGORY OF MEASURE:	Efficiency and reuse measures
1ST MANAGEMENT PLAN:	Ongoing Action of the 1st RBMP (s/n: 112)
DESCRIPTION:	According to the Drought Management Plan indices were established for monitoring the intensity and duration of the drought if and when it occurs in one place in one of the Hydrologic Regions of Cyprus. These indices are: 1. Index SPI – 12: The index is recorded and calculated by the Department of Metereology of the Republic of Cyprus and forwarded to the competent WDD service (Division of Hydrology and Hydrogeology) with a few months delay. **It is proposed that the monthly SPI-12 index of a specific month and for a representative weather station is dispatched to the WDD within a few days from the start of the next month, to allow a direct overview of drought based on the SPI-12 index.** 2. Hydrologic Year Runoff Index aggregating up to 5 years. 3. Wet Period Runoff Index 4. Monthly Regime Index (or Index of Degradation Riverine Ecosystem) 5. Dam Storage Index for the Southern Conveyor and Paphos projects 6. The measurement arrangements for the supply at the hydrometric stations have been completed and are in operation monitoring the Monthly Regime Index, with the exception of the installation and operation of the automatic telemetry equipment in the existing station r1-3-5-05 Lazarides which will replace station r1-4-3-35 - Agia-Upstream Kannavia dam for the calculation of the Monthly Regime Index in Hydrologic Region 1. **Therefore the purchase and commissioning of operation of data remote transmission equipment to the WDD of hydrometric station r1-3-5-05 Lazarides.** 7. The Action Plan has been specified for the case of drought phenomena occurrence. Indices have been specified for the implementation of the Exemption of Article 4.6 of the Directive. 8. This Plan has been supplemented by methodology for the assessment of the WEI+ Water Scarcity Index, which is calculated at river basin level.
IMPLEMENTATION TIME/PRIORITY:	High
PERFORMANCE TIME:	Short-term
ASSOCIATED ENTITIES:	WDD/Drought Management Committee/Meteorological Service
EFFICIENCY (Degree of Measure Efficiency):	Large
ESTIMATED COST OF IMPLEMENTATION:	Procurement Cost of Station for Data Transmission to the WDD of hydrometric station r1-3-5-05 Lazarides (Estimated cost €10,000)
ESTIMATED ANNUAL COST OF OPERATION/MAINTENANCE:	1,000€

FINANCING TOOL:	As the cost is small, it can be covered by National Funding.
REMARKS:	

Table 10-4: Proposed Measure on the utilisation of desalination plants based on the procedures described in the Drought Management Plan

NAME OF MEASURE:	Correlation of the degree of desalination plant utilisation based on the procedures described in the Drought Management Plan.
TYPE OF MEASURE:	SUPPLEMENTARY
CODE OF MEASURE:	------
CATEGORY OF MEASURE:	Desalination Plants
1ST MANAGEMENT PLAN:	ONGOING ACTION OF THE 1st RBMP (s/n: 119)
DESCRIPTION:	According to the Drought Management Plan when the alert level to drought IS VERY HIGH then all desalination plants operate at their full capacity in order to fully meet the needs for water supply. When the alert level is EXTREMELY HIGH then the desalination plants operate at their maximum capacity to meet the needs for water supply, given the planning for water abstraction from the respective reservoirs (see Basic Measure 58) and any excess is stored in the Kalavasou and Dypotamos reservoirs for the Southern Conveyor project and at the Asprokremmos reservoir for the Paphos project. As mentioned in the Basic Measure 58, the operation planning of desalination plants as regards the contents of the Drought Management Plan was not even implemented during the extremely dry hydrological year 2013 - 2014, since, as a result of the economic crisis, expenditure on desalination was prohibitive and it was therefore decided, as a temporary deviation from the Drought Management Plan, to abstract larger quantities of water from the dams of the Southern Conveyor. The Measure must be implemented in the near future upon improvement of the financial figures of the Republic to enable the storage of the required volumes of water in the dams of the Southern Conveyor Project and the Paphos Project to a lesser extent, where of course, a desalination plant with a nominal daily capacity equal to 15,000m^3 should be constructed.
IMPLEMENTATION TIME/PRIORITY:	High
PERFORMANCE TIME:	Short-term
ASSOCIATED ENTITIES:	WDD/Drought Management Committee/Meteorological Service
EFFICIENCY (Degree of Measure Efficiency):	Large
ESTIMATED COST OF IMPLEMENTATION:	The construction of the Desalination Plant of Paphos is required- Measure ΣM-xii-01 provides the cost of construction of the Desalination Plant of Paphos (€12,000,000)
ESTIMATED ANNUAL COST OF OPERATION/MAINTENANCE:	As shown in Measure ΣM-xii-01
FINANCING TOOL:	National Funding/Structural Funds.
REMARKS:	

11. CONCLUSIONS OF THE DROUGHT MANAGEMENT PLAN - PROPOSALS

The objective of this Issue was to revise the Drought Management Plan of the 1st RBMP adopted by the Republic of Cyprus in 2011. It is generally considered that the existing 1st Drought Management Plan is satisfactory and no substantial changes thereto are required. The revision concerns the following:

1. Processing and Review of the Drought Indices and Prolonged Drought Indices per Hydrologic Region of Cyprus that leads to the Exception process under Article 4.6 of the WFD.
2. Overview of historical periods during which the impact of drought and water scarcity in the hydrologic regions did not allow the achievement of the environmental objectives of Article 4 of the WFD and identification and recording of bodies of water for which it may not be possible to achieve the objectives set.
3. Overview, processing and revision of the Drought Management Plans for specific areas of Cyprus that are directly associated with large and organised water works.
4. Determination of the Water Scarcity Index in Cyprus, as represented by the Water Exploitation Index (WEI+), not only for Cyprus overall, but also per Hydrologic Region and per river basin. In general, it is shown that Cyprus exerts significant stress on renewable water resources, while there are two hydrologic regions in which there is simply (non-significant) pressure on water resources.
5. Determination of the vulnerability of Cyprus to drought and water scarcity, taking account of social, economic and environmental factors. The analysis of vulnerability is broken down into water supply, irrigation and the environment.

Summarising the results of this issue:

Drought Indices:

Regarding the Drought Indices, the items described in the 1st RBMP were maintained, as the indices were considered sufficient. A system of six indicators was developed:

- The **Precipitation Index SPI-12** is the main tool for the diagnosis and monitoring of drought intensity.
- The **Hydrologic Year Runoff Index** for the runoffs of one and up to five hydrological years allows the control of the conclusions of the SPI index and covers weaknesses of the SPI-12 index in detecting runoff changes.

- The dam **Storage Index** for the Southern Conveyor and Paphos projects has a direct management significance, since it is related to the abstractions policy.
- The **Wet Period Runoff Index** contributes to the early detection of drought.
- The **Monthly Regime Index** of average daily flow of rivers is only used during drought and contributes to the early detection of increased pressures on the riverine ecosystems.
- For the detection of increased pressures on the groundwater bodies, the index proposed depends on the monitoring of the level in selected locations per water body, and the comparison of change between decision making dates (usually in January). Given that the groundwater bodies must recover quantitatively and qualitatively, any indication of reversal of the recovery trend (level reduction or/and quality aggravation) should be detected promptly and immediate action should follow regarding the volumes to be pumped. This practice must be revised once the groundwater bodies recover.

Prolonged Drought Indices:

In reference to the provisions of the Framework Directive 2000/60, "prolonged drought" was defined as an event so infrequent and with such a magnitude that it is not possible to retain all measures for protection of water bodies, as these are prescribed in the Management Plan.

Thus, the classification of a drought period as "prolonged", leading to the application of Paragraph 6 of Article 4 of Directive 2000/60 on temporary degradation of water bodies, arises from the application of three meteorological and hydrological indicators, namely:

- The **SPI - 12 index** and more specifically the drought magnitude e that is the outcome of the intensity and the duration of the drought (see Paragraph 6.2.1).
- The **Hydrologic Year Runoff Index** (see Paragraph 6.2.2).
- The **Water Bodies Downgrading Index** (see 6.3.6).

The first two indices in parallel are used for the determination and the announcement of the Prolonged Drought in each of the Hydrologic Regions of Cyprus and the alert state of the infrastructure needed for the measurement of the mean daily discharges for each hydrometric station that is designated the evaluation of the Monthly Runoff Index. If this happens, then the measurement infrastructure should be set in high alert so that if the median value of the mean daily discharges of the specified month is less that the 5% of the whole set of daily discharges of the timeseries for the station, and the Exemption for the temporary downgrading of Article 4.6 is declared.

In the context of the Prolonged Drought, for each hydrometric station that is designated for the control of the Monthly Runoff Index (or Index of Degradation Riverine Ecosystem), the periods of the stress in river systems designated as HIGH were determined. Accordingly, the monitoring and characterization system for water bodies in the context of Directive 2000/06 was suggested to be used for diagnosing the downgrading of water bodies.

Review of the Application of the 1st Drought Management Plan for the South Conveyor Project:

From the data analysis that took place it was proven that during the year with Exceptional Drought (2013-14) at the area of the South Conveyor, there was a temporal deviation and not application of the Management Plan for the following reasons:

1. The high level of storage during the previous year. On 1st April of the year 2013, the storage was equal to approximately 142 hm^3, a value very close to the total storage of the dams of the Southern Conveyor.
2. The desalination operation was not as expected (according to the 1st Drought Plan) because due to the cost of the desalination and to the Economic Program of the Republic of Cyprus it was not possible for the desalination plants to operate at their maximum potential. Therefore, as desalinations did not provide the expected results (based on the 1st RBMP) abstractions from the dams were much greater than those specified.

In summary, the proposals for drought management in the South Conveyor project are:

1. Faithful implementation of the annual programme of abstraction of water from Southern Conveyor dams combined with the volume of desalination even when the economic conditions do not allow for the full operation of desalination under the terms of the 1st RBMP. It was not considered necessary to change the abstraction planning as regards the storage of the 1st RBMP. With the full operation of the desalination, almost complete coverage of the needs in water is provided.
2. The abstraction programme of the 1st RBMP shall be followed both in times of drought and (if possible) in normal conditions or in high aquifer conditions, as abstraction management allows storage of sufficient volume in the reservoirs to face the periods of droughts that are bound to occur in the future.
3. Increased participation of recycled water in irrigation as well as increased water storage is required, due to lack of coincidence in time with respect to the periods calling for a maximisation of irrigation consumption. The study of the Tersefanou dam for the storage of outflows of the Larnaca WWTP is a key step in this direction, following the recycled water stored in the Polemidia reservoir. Moreover, underground aquifers should be found to receive volumes of recycled water to be used for irrigation at a later time (the aquifer in the area ofAkrotiri could be used for this purpose). Increasing the use of recycled water for irrigation will accordingly reduce abstractions for irrigation from underground aquifers in the area of the Southern Conveyor, which, in this region, are in poor condition in quantitative and qualitative terms.

Review of the Application of the 1st Drought Management Plan for the Paphos Project and Proposal of Measures:

During the dry hydrological year 2013-14, annual abstractions from the Paphos Project dams were similar to those given in the 1st RBMP and the system is classified as “sufficient”. Thus, it seems that although there were zero abstractions from the desalination of Paphos, abstractions from the dams faithfully followed the1 st Drought Management Plan. In general, it appears that the full operation of the desalination plant and the recycled water system fully covers (or marginally does not cover) demand for water supply, even in times of drought, while shortages in irrigation are due only to the insufficiency of the three reservoirs, while the needs of permanent crops are covered using recycled water.

The Abstractions Programme was modified for the Paphos Project dams, given the storage on the 1st April, due to the fact that, once constructed, the Paphos desalination plant shall have a reduced capacity (nominal capacity of 15,000 m^3/d instead of 30,000 m^3/d with respect to the references in the 1st RBMP).

Review of the Application of the 1st Drought Management Plan for the Chrysochou Project and Proposal of Measures:

In the wider region of Chrysochou, the overall balance is positive but as mentioned above, there is a significant contribution of pumping from the water bodies of Chrysochou and Androlikou. Abstractions from the Chrysochou Project during the drought period are very close to normal values, therefore the impact of drought in the Chrysochou area is small.

The analysis described above leads to the following conclusions:

1. In wet hydrological years, the quantity of water stored in the Evretou dam should be maximised, as the storage capacity of the project is now large and can therefore store larger amounts of water to be used for under the conditions of periods of drought.
2. Given the proximity to the groundwater bodies of Androlikou **(CY_14)** and **Letymbou-Giolou (CY_12),** the possibility of covering part of the water supply needs using these groundwater bodies could be explored. Moreover, a significant reserve can be secured from the **Lefkara-Pachna GWB (CY_18)** located in the western margin of the study area, where significant spring flows from Kefalovriso is observed. An investigation is however required both as regards the quality status of the water sources and a cost - benefit analysis for the construction of a pipeline to the urban centres of the region.
3. Due to increased consumption of water, the use of recycled water for irrigation should be investigated, as farmland generally coincides with urban or tourist areas.

Review of the Application of the 1st Drought Management Plan for the Troodos area and Proposal of Measures:

Demand is met by spring flows, using wells and water reservoir projects (Projects of Pitsilia, Xyliatos). Most springs are used for water supply, while some are also used for irrigation. Water wells in the WDD database surpass the figure of 380 and are located mainly in the east. In any case, irrigation is several times larger than water supply, by one order of magnitude. It is therefore understood that in case of drought, it is sufficient to restrict irrigation to cover water supply demand, provided that the quality of water permits such use.

Review of the Application of the 1st Drought Management Plan for the Pissouri area and Proposal of Measures:

Demand in the water supply of Pissouri area is projected to be fully covered by the recharge dam of Souskiou in the bed of Dhiarizos river, once it is built. Irrigation demand shall be covered by the boreholes in the Cha-potami riverbed, as it has been done up to now.

Review of the Application of the 1st Drought Management Plan for the Western Mesaoria area and Proposal of Measures:

By the end of 2015, the WDD Planning Service shall have completed the feasibility study of the Vassilikos Conveyor to supply Nicosia with desalinated water (from Vassilikos desalination), to ensure water supply from an alternative source to the Tersefanou conveyor, while also supplying 28 Communities in Western Mesaoria, thereby ensuring the provision of adequate and good quality water to these communities that only used boreholes with qualitative and quantitative issues for water supply until now. As regards irrigation, because the study of groundwater body CY_17 has shown it to be one of the most problematic areas to date, it is considered that the use of underground sources should be limited, by restructuring crops.

Water Scarcity Index:

The Water Exploitation Index (WEI), including its amendment WEI+, is used by the European Environment Agency to provide an overview of water scarcity at a European level and has been defined by the European Union as the main water scarcity index within the WFD. It is defined as the ratio (%) of the total annual water abstraction with respect to the average interannual availability of water resources. The WEI+ index refers only to fresh water reserves and the pressures on the annual renewable reserves and does not include other quantities of water involved in the water balance outside of the hydrological cycle, i.e. it does not include neither desalinations nor, or course, recycled water, which emerges from desalination through the treatment of urban wastewater. The quantities of desalination and recycled water are excluded and do not participate in the calculation of the WEI index+.

The WEI+ Index presents the pressure on water resources for Hydrologic Regions under the control of the Republic of Cyprus. The total WEI+ index is equal to 73.1%, leading to the familiar conclusion that Cyprus is under significant pressure regarding water resources , even with a lenient 60% limit. The highest values of WEI+ appear in Hydrologic Regions 6, 7 and 9 (Nicosia, Kokkinohoria and Limassol areas), even above 100%, meaning that the permanent reserves are being pumped. It is known that in the Kokkinohoria region, permanent reserves are being pumped, although the region significantly draws its water from the Southern Conveyor project. The lowest values appear in Regions 2 & 3, where, except from the Evretou dam (Region 2), there is no other significant water reservoir and water exploitation project.

Vulnerability Assessment:

The vulnerability of water resources in drought and water scarcity was approached based on a methodology that calculates vulnerability per water use. These uses are (a) water supply that includes tourism and stock farming, (b) irrigation that includes stock farming and (c) the environment.

Finally, vulnerability per water use in cases of drought and water scarcity is calculated, by connecting the use with four factors in total: (a) vulnerability of the water resource in drought, (b) the priority of the use (water supply, environment and irrigation), (c) the amount of water required to meet the needs (water supply in urban areas, irrigation in major irrigated surfaces) and (d) water supply projects. For example, areas that are supplied by the larger system of the Southern Conveyor comprising desalination will have much less vulnerability with respect to an area irrigated by a surface water source (e.g a dam), as during periods of prolonged drought it is very likely (statistically certain) that seasonal plantations will not be irrigated.

Vulnerability ratings are assigned based on the above methodology: VERY LOW, LOW, MEDIUM, HIGH and VERY HIGH; they are represented on a map using the polygons of the administrative boundaries of the Municipalities and Communities of Cyprus with regard to water supply as basic shape file geographic information. In irrigation, the above shape file is compared to the corresponding GWP file regarding the surfaces supplied with water, as it is highly likely that within the administrative boundaries of the settlement there is a portion thereof supplied with water from a GWP and another portion irrigated thanks to boreholes.

To assess the vulnerability to drought and water scarcity with respect to the environment, we used the percentage of HS located within the network of Natura Protected Areas that are significantly correlated with the availability of water resources, as these areas are biodiversity cores, in which, during such conditions, biodiversity is threatened and vulnerability increases. The definition of vulnerability is performed per river basin, by recording the length of the hydrographic network within the Natura protected areas which are related to water.

Based on the above methodology, vulnerability is reported in water, supply, irrigation and the environment and it is presented on the map based on vulnerability classes in the relevant colour palette.

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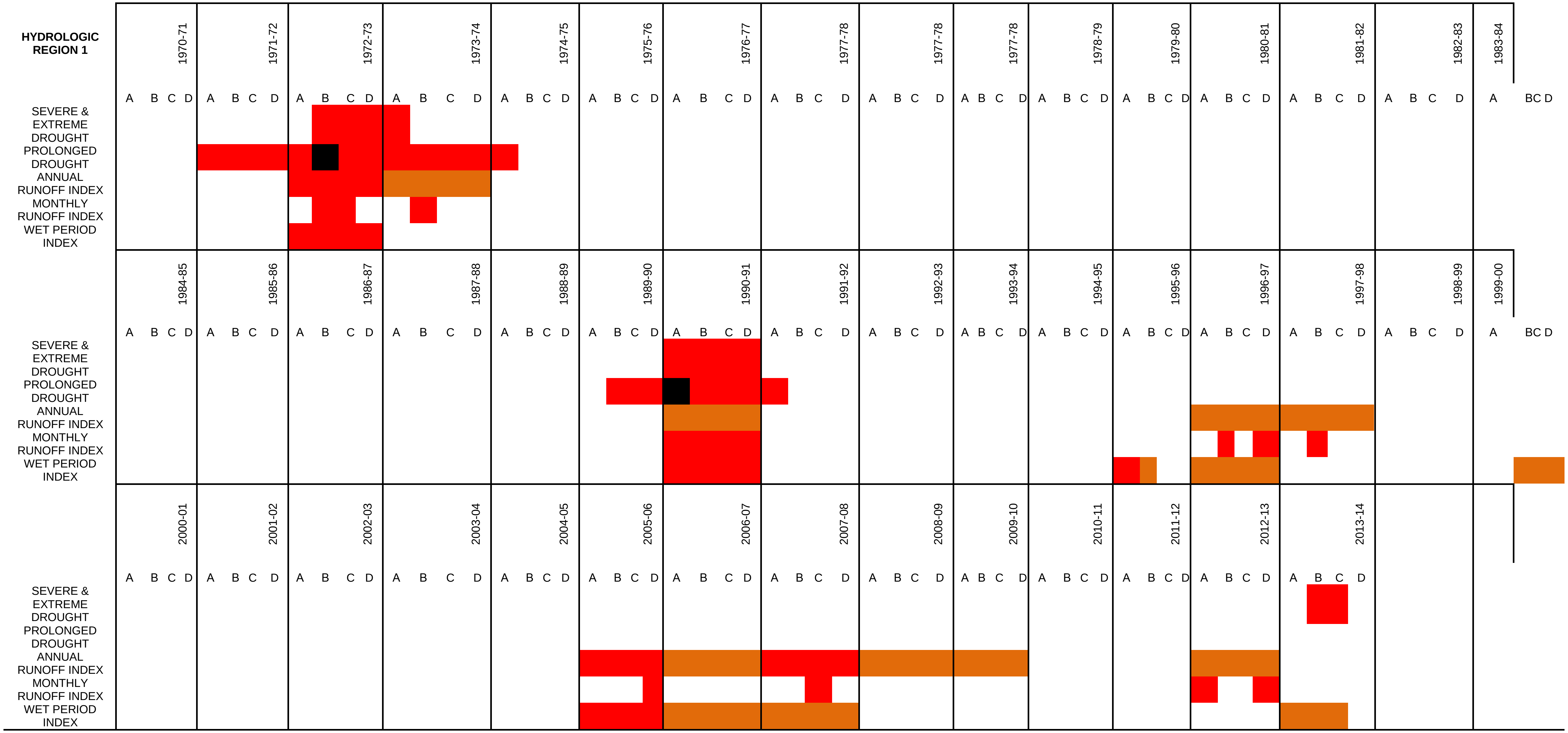
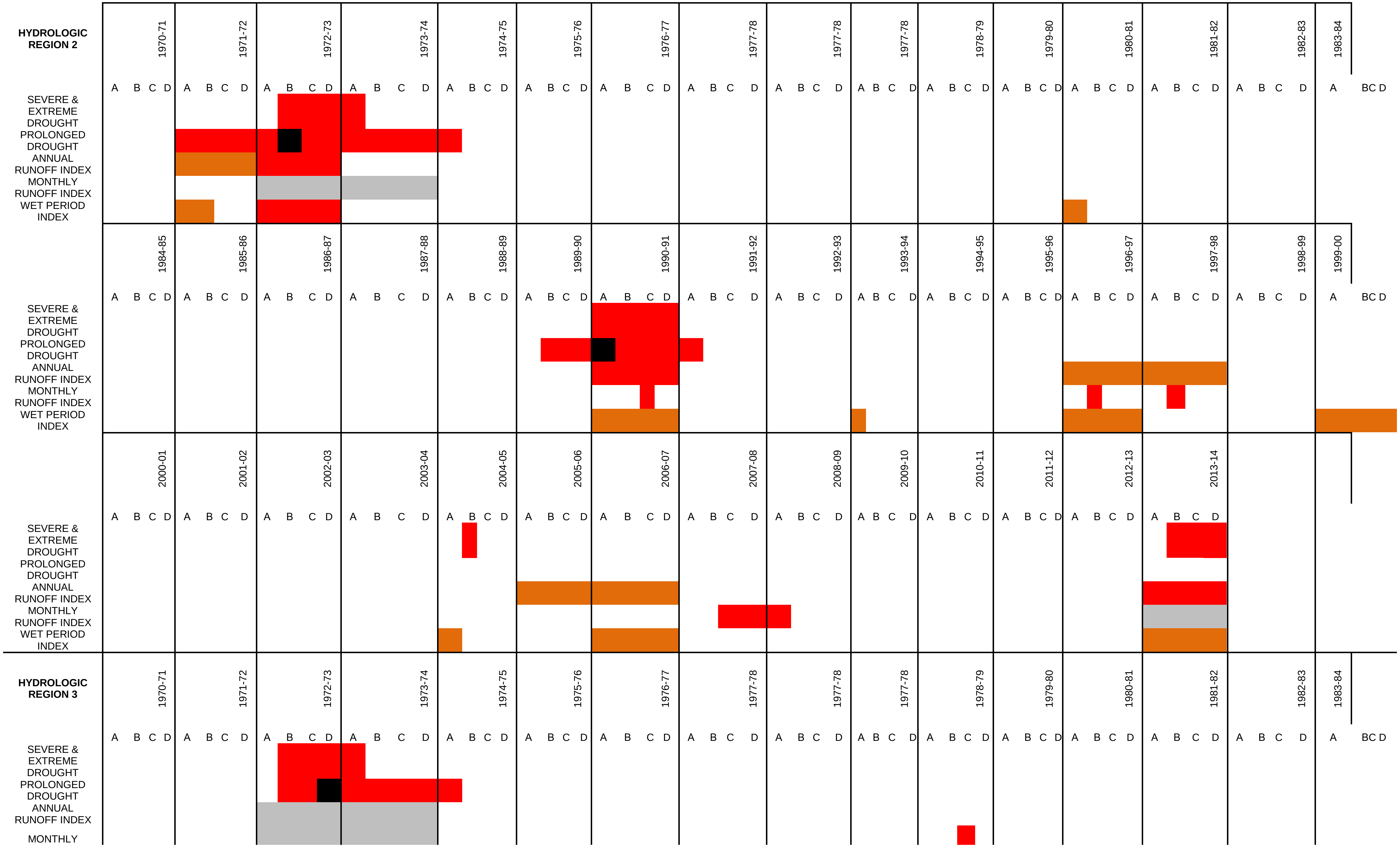
A. ANNEXES

A.1 ANNEX 1

TABLE OF DROUGHT INDICATORS

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2010-11
2011-12
2012-13
2013-14
A B C D
SEVERE & EXTREME DROUGHT
PROLONGED DROUGHT
ANNUAL RUNOFF INDEX
MONTHLY RUNOFF INDEX
WET PERIOD INDEX
HYDROLOGIC REGION 3
1970-71
1971-72
1972-73
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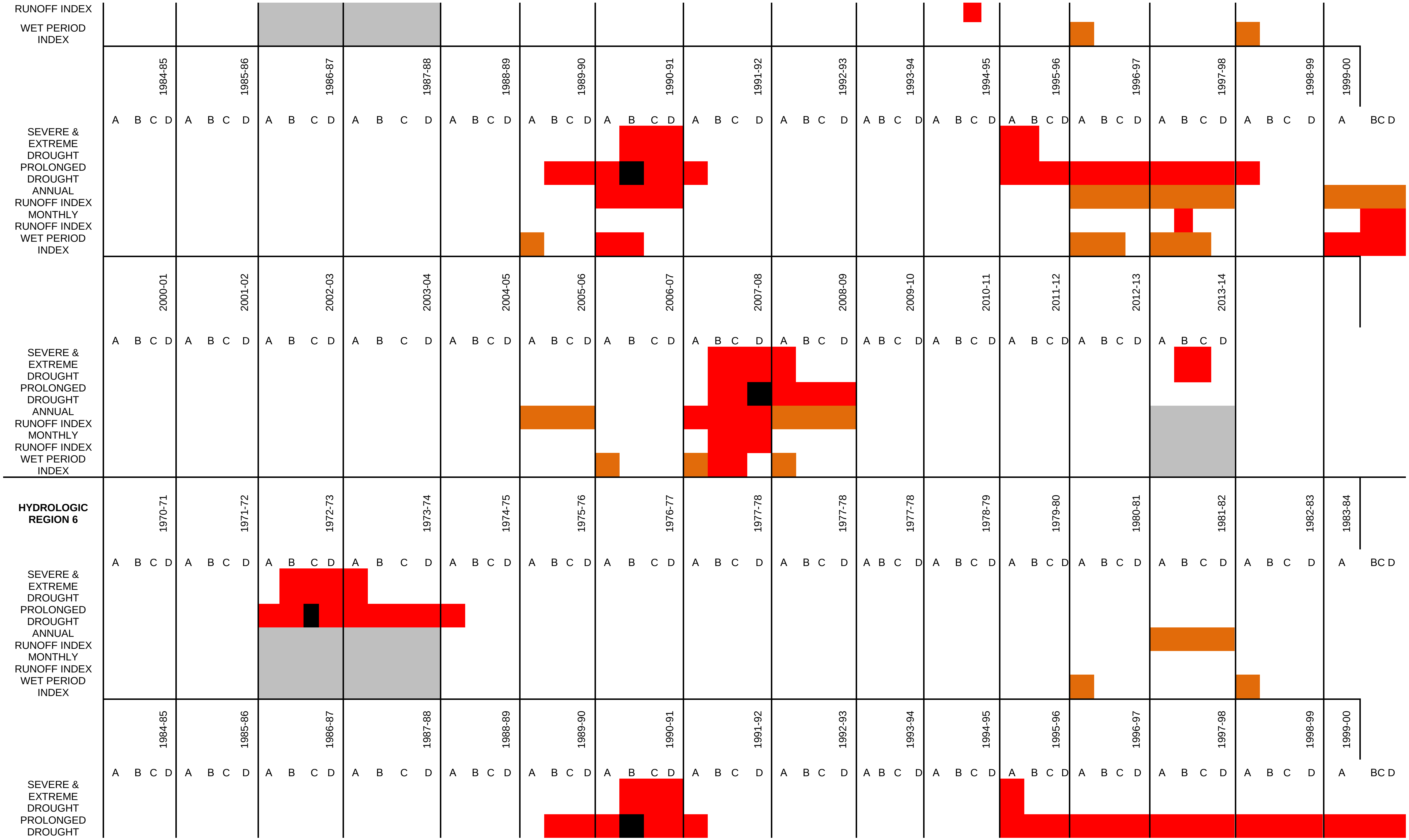
1982-83
1983-84
SEVERE & EXTREME DROUGHT
PROLONGED DROUGHT
ANNUAL RUNOFF INDEX
MONTHLY


RUNOFF INDEX
WET PERIOD INDEX
1984-85 1985-86 1986-87 1987-88 1988-89 1989-90 1990-91 1991-92 1992-93 1993-94 1994-95 1995-96 1996-97 1997-98 1998-99 1999-00
A B C D
SEVERE & EXTREME DROUGHT
PROLONGED DROUGHT
ANNUAL RUNOFF INDEX
MONTHLY RUNOFF INDEX
WET PERIOD INDEX
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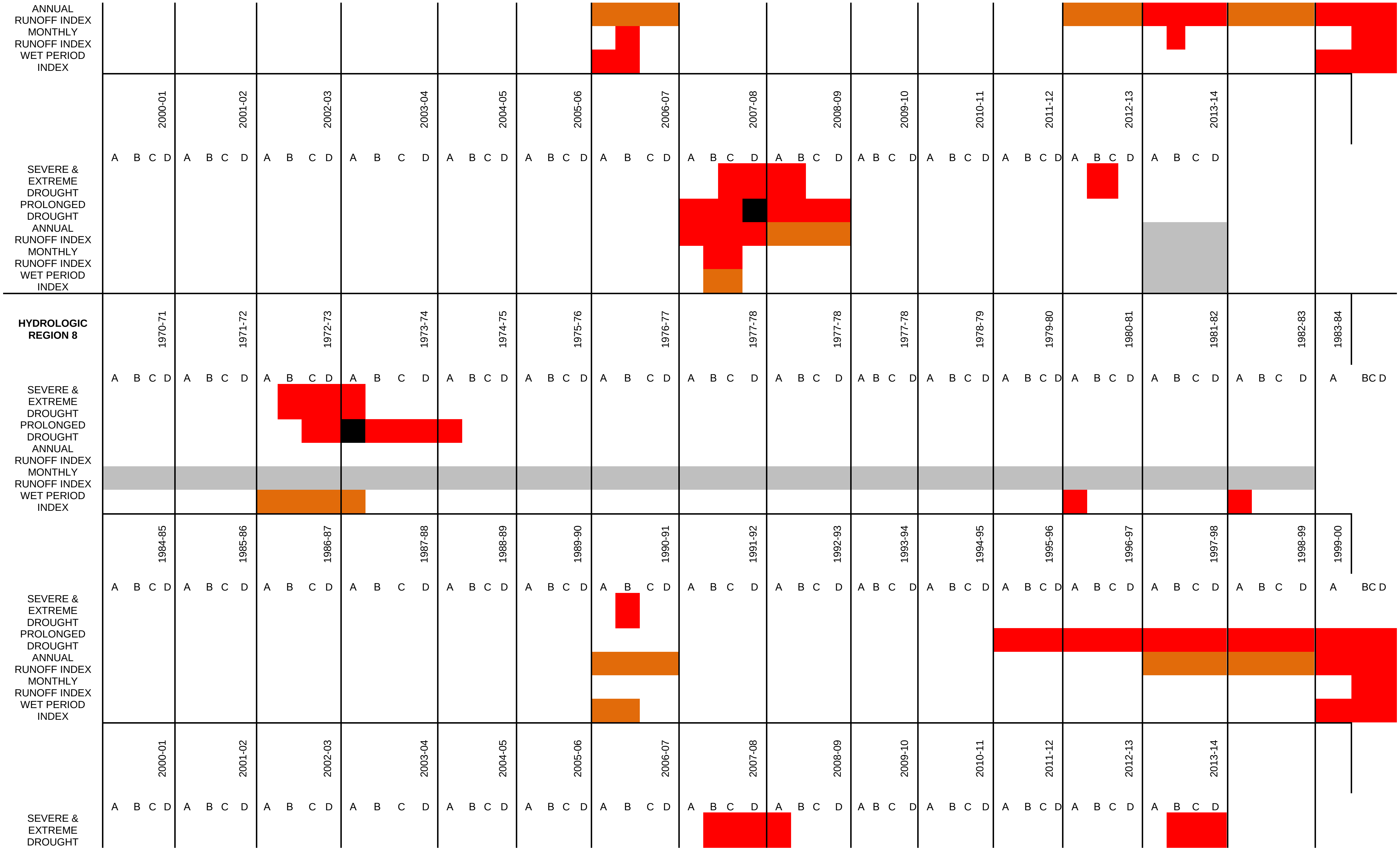
HYDROLOGIC REGION 6
1970-71 1971-72 1972-73 1973-74 1974-75 1975-76 1976-77 1977-78 1977-78 1977-78 1978-79 1979-80 1980-81 1981-82 1982-83 1983-84


ANNUAL RUNOFF INDEX
MONTHLY RUNOFF INDEX
WET PERIOD INDEX
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A B C D
SEVERE & EXTREME DROUGHT
PROLONGED DROUGHT
ANNUAL RUNOFF INDEX
MONTHLY RUNOFF INDEX
WET PERIOD INDEX
HYDROLOGIC REGION 8
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2003-04
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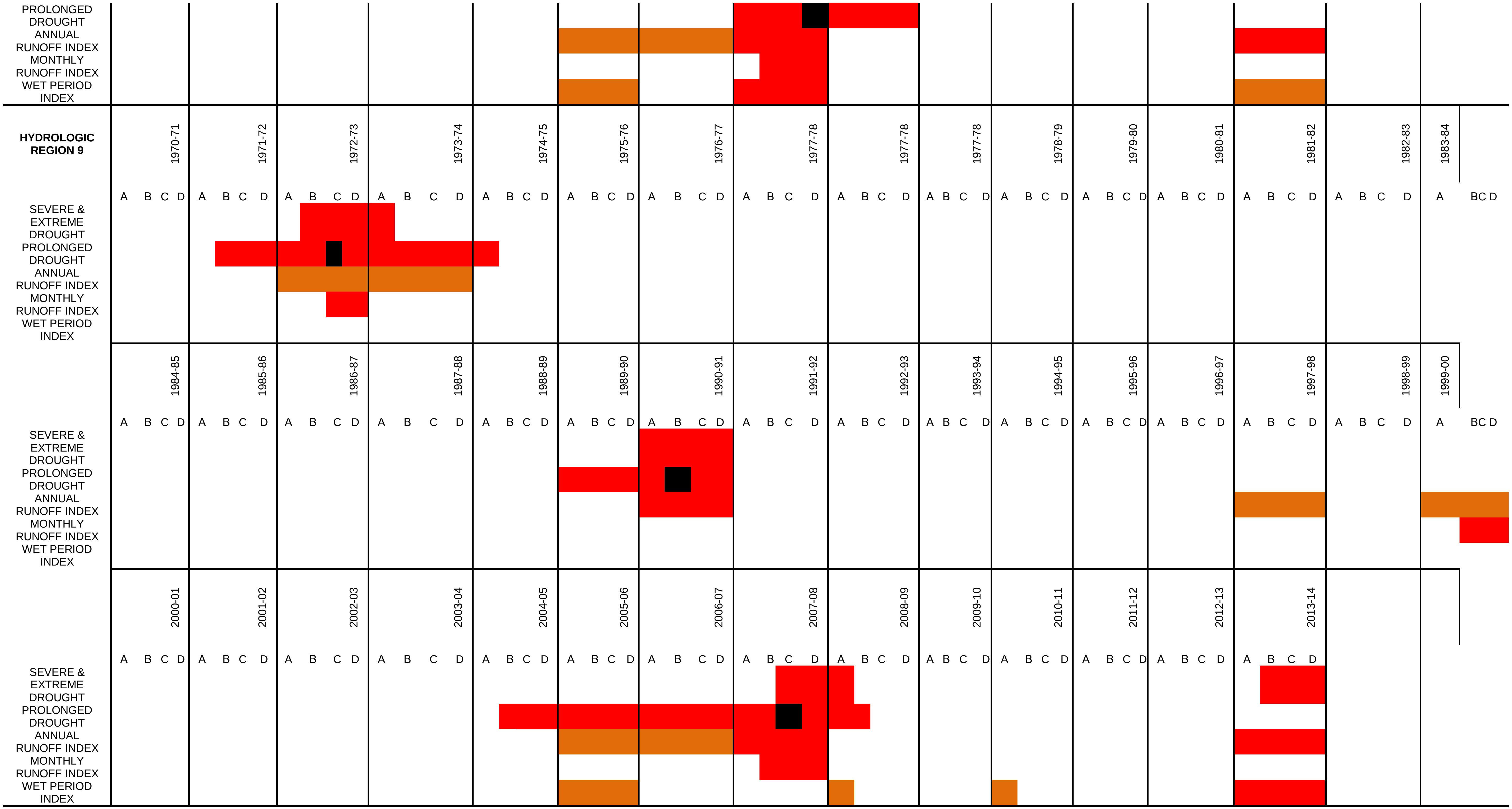
2010-11
2011-12
2012-13
2013-14
SEVERE & EXTREME DROUGHT



LEGEND

EXTREME DROUGHT - VERY HIGH ALERT LEVEL

SEVERE DROUGHT - HIGH ALERT LEVEL

ONSET OF PROLONGED DROUGHT BASED ON DM<0.5*Dmcrit & SPI-12<-1.5

NO DATA

A.2 ANNEX 2

TABLES OF MONTHLY INFLOWS IN THE DAMS OF CYPRUS

Table 5: Table of monthly inflows in the dam of Arminos

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR)
1969-70	557,386	611,687	994,192	1,107,585	1,426,206	2,620,833	1,125,153	443,194	123,216	77,220	6,868	0	9,093,539
1970-71	199,717	649,219	961,451	1,340,761	2,544,971	2,562,539	3,964,788	2,092,993	697,930	167,855	424,508	124,094	15,730,826
1971-72	184,784	550,998	1,263,302	1,170,671	1,173,479	1,734,445	911,143	2,691,904	898,446	70,512	258,570	34,338	10,942,590
1972-73	121,220	286,918	347,368	441,597	681,960	602,664	351,281	21,481	0	0	0	2,316	2,856,804
1973-74	313,031	278,454	482,323	1,255,317	738,656	2,093,791	565,931	126,729	5,191	0	2,635	878	5,862,936
1974-75	21,800	92,073	1,326,387	7,345,838	11,475,127	6,464,242	2,533,791	2,126,532	480,566	174,882	21,162	0	32,062,400
1975-76	79,535	308,319	1,315,208	4,875,931	3,238,248	4,808,853	2,709,472	1,850,234	783,375	342,018	102,613	65,161	20,478,967
1976-77	422,751	743,448	1,578,728	4,091,757	1,875,788	3,048,854	2,676,731	1,165,879	370,366	201,633	0	0	16,175,936
1977-78	160,668	337,786	2,135,316	9,897,996	10,836,289	7,578,215	4,643,554	2,073,828	709,110	116,907	30,584	57,575	38,577,828
1978-79	233,575	600,508	2,247,911	3,708,454	3,232,520	2,053,066	883,193	507,157	388,972	21,641	0	0	13,876,998
1979-80	207,383	509,473	2,437,965	6,719,777	6,642,263	8,528,487	4,736,185	1,805,516	672,058	108,682	24,675	30,345	32,422,809
1980-81	220,719	443,194	673,974	7,972,698	10,556,798	6,512,155	3,553,536	1,671,360	627,099	159,709	4,152	799	32,396,192
1981-82	132,319	861,633	2,229,545	1,847,040	2,101,777	4,035,060	1,757,603	887,186	506,998	260,806	32,900	878	14,653,745
1982-83	171,768	461,241	718,693	2,303,809	4,064,607	6,484,205	4,220,323	1,899,744	693,139	171,688	15,492	1,038	21,205,747
1983-84	198,120	1,328,783	1,782,358	2,588,092	4,609,877	2,933,863	3,167,838	1,351,941	428,261	58,454	2,715	0	18,450,302
1984-85	35,855	1,379,890	1,181,052	3,521,594	5,298,362	3,214,154	1,811,106	685,952	198,918	14,853	0	0	17,341,736

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR)
1985-86	245,713	475,136	854,446	2,609,653	2,218,365	1,106,787	704,319	603,462	100,377	0	0	0	8,918,258
1986-87	69,953	260,247	1,575,534	5,374,224	2,611,250	10,345,981	4,350,487	2,237,530	672,377	177,118	125,771	0	27,800,472
1987-88	391,208	683,557	3,322,756	4,270,632	5,877,420	17,735,739	4,621,993	1,914,917	742,649	231,100	342,018	67,797	40,201,785
1988-89	375,397	890,380	5,136,257	8,848,704	2,444,354	2,415,606	1,203,411	522,490	128,486	0	0	0	21,965,086
1989-90	198,199	495,099	686,751	693,139	3,230,125	2,105,770	861,633	206,584	0	0	0	0	8,477,300
1990-91	0	81,132	271,506	475,136	785,771	1,027,731	452,297	23,078	0	0	0	0	3,116,651
1991-92	0	98,780	7,578,056	3,651,758	5,237,480	3,405,805	2,719,853	1,514,046	502,686	66,679	0	0	24,775,142
1992-93	3,593	600,188	5,605,803	2,746,205	4,200,360	5,857,346	2,420,397	1,478,910	464,994	15,252	0	0	23,393,049
1993-94	0	230,141	416,043	975,825	3,411,395	1,588,311	691,542	434,250	3,593	0	0	0	7,751,101
1994-95	188,537	5,310,740	2,297,421	5,039,633	2,758,982	1,789,545	410,853	573,996	38,570	0	0	0	18,408,276
1995-96	3,274	315,187	370,526	1,466,133	1,081,729	1,324,790	1,429,400	405,582	105,488	0	0	0	6,502,109
1996-97	65,161	297,459	954,264	623,666	1,117,966	583,179	1,074,126	560,580	254,896	31,543	0	0	5,562,841
1997-98	44,799	276,537	406,221	282,846	489,510	926,315	740,254	382,105	256,493	19,405	2,955	10,221	3,837,659
1998-99	10,621	48,871	0	2,603,312	4,673,326	2,475,602	2,187,288	597,099	388,301	32,868	83,541	66,955	13,167,783
1999-00	322,935	228,000	383,000	1,244,000	1,906,000	2,470,000	3,191,000	1,317,000	291,000	13,000	0	0	11,365,935
2000-01	119,000	462,000	1,166,000	1,630,000	3,340,000	1,819,000	876,000	465,000	72,000	0	0	0	9,949,000
2001-02	102,000	252,000	8,883,000	7,998,000	4,496,000	3,853,000	4,538,000	1,193,000	0	166,000	0	0	31,481,000
2002-03	121,000	367,000	2,036,000	1,959,000	5,843,000	7,464,000	4,403,000	1,606,000	901,000	343,000	0	0	25,043,000
2003-04	160,000	395,000	1,622,088	10,164,199	5,905,079	621,000	1,314,046	350,040	0	0	0	0	20,531,451
2004-05	89,000	663,106	966,296	2,179,311	3,290,273	1,837,940	1,196,316	385,565	579,000	49,000	49,000	49,000	11,333,806
2005-06	150,000	763,773	544,000	952,921	1,916,695	1,458,229	566,295	361,856	40,000	167,000	11,000	6,000	6,937,769
2006-07	467,975	1,184,014	452,247	822,000	3,287,173	1,891,828	1,020,000	650,000	182,000	46,000	21,000	0	10,024,237

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR)
2007-08	17,000	196,000	1,306,000	681,000	1,553,000	969,000	342,000	131,000	2,000	0	0	0	5,197,000
2008-09	135,000	232,000	522,000	2,513,000	5,610,000	5,245,000	3,834,000	1,994,000	530,000	74,000	95,000	168,000	20,952,000
2009-10	228,300	689,000	3,827,000	6,483,000	6,100,000	4,012,000	1,384,000	675,000	282,000	117,000	0	0	23,797,300
2010-11	0	53,000	910,019	1,220,897	2,287,274	3,968,000	1,890,000	957,000	280,000	30,000	0	49,000	11,645,190
2011-12	185,000	564,315	1,683,000	12,434,267	10,205,000	9,763,234	4,324,278	2,128,085	935,000	386,074	169,921	121,360	42,899,535
2012-13	385,000	849,000	8,134,000	3,908,000	3,658,000	2,258,000	2,019,000	1,010,000	373,000	101,103	0	46,000	22,741,103
2013-14	204,000	349,523	554,711	613,563	617,539	585,731	322,000	564,594	540,506	0	0	0	4,352,167
AVER.	167,629	594,551	1,869,794	3,436,732	3,792,222	3,692,887	2,104,431	1,036,542	361,113	89,178	40,602	20,039	17,205,719
ST. DEV.	137,490	783,907	2,081,640	3,049,505	2,774,981	3,306,731	1,475,247	729,948	289,669	103,471	91,384	38,756	10,563,965
C. V.	0.82	1.32	1.11	0.89	0.73	0.90	0.70	0.70	0.80	1.16	2.25	1.93	0.61

Table 6: Table of monthly inflows in the dam of Asprokremmos

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1969-70	0	14,688	536,803	957,312	1,214,784	2,427,840	574,301	385,603	36,893	1,123	0	0	6,149,347
1970-71	0	158,803	343,526	380,333	2,960,237	2,474,496	3,995,136	598,752	122,342	27,043	0	0	11,060,669
1971-72	1,555	10,800	350,870	394,934	418,522	651,283	17,626	743,558	24,451	0	3,974	0	2,617,574
1972-73	121,133	6,307	0	165,888	509,069	258,250	132,710	38,102	1,642	0	0	0	1,233,101
1973-74	38,016	21,773	207,101	809,136	330,480	1,729,728	339,984	2,938	2,678	0	0	0	3,481,834
1974-75	0	99,014	1,491,696	5,900,256	13,970,880	5,469,120	1,823,040	1,402,272	108,346	6,480	0	0	30,271,104
1975-76	0	0	974,938	5,166,979	3,941,628	5,027,616	2,655,936	1,133,568	258,509	25,574	518	0	19,185,266
1976-77	268,186	750,470	1,186,272	3,046,464	1,476,576	3,019,680	2,238,624	618,451	146,362	4,147	0	0	12,755,232
1977-78	0	0	1,493,597	11,716,704	12,070,080	7,698,240	3,935,520	1,285,632	384,134	9,677	0	0	38,593,584
1978-79	0	7,430	1,663,200	3,000,672	2,445,120	1,412,640	284,256	49,075	345,859	0	0	0	9,208,253
1979-80	15,015	37,205	776,461	3,116,011	4,372,987	5,156,588	3,262,023	964,259	238,359	0	0	0	17,938,908
1980-81	0	0	0	4,287,613	6,953,803	4,134,561	2,411,241	704,373	98,081	0	0	0	18,589,672
1981-82	0	119,644	522,666	784,116	967,885	1,933,274	550,726	61,588	0	0	0	0	4,939,899
1982-83	0	0	51,387	604,374	1,549,339	3,334,093	2,036,897	713,984	144,056	0	0	0	8,434,129
1983-84	80,235	287,540	418,548	942,022	1,963,168	1,339,712	1,974,644	468,915	27,870	0	0	0	7,502,656
1984-85	9,228	356,467	254,928	1,697,263	2,966,365	1,481,224	828,371	59,906	15,111	0	0	0	7,668,862
1985-86	0	0	131,534	978,024	865,056	175,781	50,217	11,653	9,266	0	0	0	2,221,531
1986-87	0	0	300,605	1,878,329	745,285	9,920,803	2,670,626	951,845	62,013	0	0	0	16,529,505
1987-88	40,000	20,000	2,900,000	6,196,000	9,856,000	30,000,000	3,649,000	993,000	264,000	0	0	0	53,918,000
1988-89	0	248,000	6,892,000	7,318,000	1,944,000	1,354,000	620,000	295,000	0	0	0	0	18,671,000

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1989-90	0	0	0	30,000	2,993,000	1,363,000	547,000	225,000	0	0	0	0	5,158,000
1990-91	0	0	0	150,000	174,000	120,000	104,000	0	0	0	0	0	548,000
1991-92	0	167,000	12,208,000	3,706,000	7,339,000	2,545,000	977,000	537,000	211,000	0	0	0	27,690,000
1992-93	0	171,000	5,000,000	3,163,000	3,494,000	6,793,000	1,092,000	586,000	234,000	0	0	0	20,533,000
1993-94	0	46,000	112,000	1,191,000	3,994,000	698,000	220,000	260,000	79,000	0	0	0	6,600,000
1994-95	92,000	1,985,000	862,000	4,749,000	2,040,000	1,023,000	348,000	303,000	305,000	0	0	0	11,707,000
1995-96	0	0	0	1,174,000	1,498,000	2,020,000	588,000	20,000	0	0	0	0	5,300,000
1996-97	208,000	41,000	500,000	20,000	1,121,000	111,000	1,306,000	51,000	99,000	0	0	0	3,457,000
1997-98	13,000	198,000	695,000	1,088,000	566,000	2,058,000	808,000	110,000	100,000	0	0	0	5,636,000
1998-99	0	160,000	2,910,000	2,365,049	6,360,979	1,575,004	1,984,469	231,000	0	0	0	0	15,586,501
1999-00	0	0	13,000	563,000	1,606,000	1,577,000	2,053,000	258,000	0	0	0	0	6,070,000
2000-01	0	334,000	441,000	1,124,000	4,089,000	664,000	363,000	64,000	0	0	0	0	7,079,000
2001-02	0	0	7,926,000	11,428,000	3,126,000	2,303,000	4,600,000	813,000	26,000	0	0	0	30,222,000
2002-03	0	0	1,435,000	1,378,000	9,890,000	7,547,000	2,241,000	392,000	142,000	0	0	0	23,025,000
2003-04	0	0	573,445	19,187,482	0	370,000	516,931	173,634	0	0	0	0	20,821,493
2004-05	0	44,679	223,865	0	1,281,352	2,967,635	1,179,036	904,056	12,277	0	0	0	6,612,899
2005-06	0	198,087	50,000	281,178	1,248,765	554,000	0	0	0	0	0	0	2,332,030
2006-07	829,245	304,109	15,000	206,471	2,174,000	898,000	326,000	1,243,000	16,000	0	0	0	6,011,824
2007-08	0	35,000	1,123,000	158,000	997,000	359,000	127,000	0	0	0	0	0	2,799,000
2008-09	0	0	678,000	2,756,000	7,461,000	6,952,000	2,126,000	986,000	112,000	0	0	0	21,071,000
2009-10	145,000	265,000	4,306,000	9,136,000	8,036,000	3,426,000	797,000	398,000	0	0	0	0	26,509,000
2010-11	0	0	239,023	756,000	2,198,000	4,170,000	1,554,000	591,000	52,000	0	0	21,000	9,581,023

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
2011-12	0	59,000	1,032,000	18,766,861	303,000	0	0	140,494	0	0	0	0	20,301,355
2012-13	77,000	310,000	7,115,000	134,000	122,000	227,000	692,000	453,000	4,000	0	0	0	9,134,000
2013-14	25,000	79,041	132,844	193,867	144,232	182,973	0	321,471	5,564	0	0	0	1,084,992
AVER.	43,614	145,224	1,513,029	3,178,785	3,195,058	3,100,056	1,302,229	456,514	81,951	1,645	100	467	13,018,672
ST. DEV.	132,966	317,159	2,548,379	4,511,837	3,378,158	4,746,211	1,234,214	402,007	106,449	5,676	596	3,130	11,170,285
C. V.	3.05	2.18	1.68	1.42	1.06	1.53	0.95	0.88	1.30	3.45	5.97	6.71	0.86

Table 7: Table of monthly inflows in the dam of Germasogeia

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1969-70	754,171	528,033	2,819,520	1,131,320	1,516,370	2,760,571	591,999	200,427	39,885	5,644	0	0	10,347,938
1970-71	0	313,308	488,274	1,075,632	2,233,792	1,607,929	5,349,311	1,552,743	228,396	0	13,797	0	12,863,180
1971-72	6,397	413,396	1,287,723	1,660,607	1,523,419	1,518,878	907,564	2,033,114	825,914	81,274	35,871	0	10,294,157
1972-73	14,047	237,677	234,793	322,213	532,423	297,379	183,118	55,688	0	0	0	0	1,877,339
1973-74	99,085	320,206	419,416	1,321,462	997,117	2,339,148	712,280	193,403	30,603	0	0	0	6,432,719
1974-75	0	0	669,134	4,275,686	12,097,094	4,488,906	1,123,794	775,117	331,494	64,091	5,519	0	23,830,836
1975-76	0	157,532	4,167,571	6,978,562	5,213,291	4,560,397	2,811,994	2,056,945	746,646	394,206	133,701	70,237	27,291,084
1976-77	411,264	851,625	1,402,234	4,199,178	2,319,080	2,090,809	2,201,182	985,452	281,450	63,590	0	0	14,805,865
1977-78	73,874	110,498	1,730,969	6,589,749	12,122,179	4,966,769	3,124,299	1,350,811	445,379	98,834	34,993	29,976	30,678,330
1978-79	82,152	474,477	2,403,114	3,224,637	5,241,447	2,010,538	871,693	517,246	501,318	3,888	0	0	15,330,511
1979-80	33,363	195,159	3,393,708	5,778,259	10,801,988	6,659,986	3,476,739	1,804,844	564,907	82,152	627	0	32,791,733
1980-81	35,871	157,156	416,908	10,894,283	14,524,038	6,998,630	5,331,752	1,779,759	518,250	116,268	33,864	19,064	40,825,842
1981-82	52,176	788,287	1,557,760	1,309,421	1,626,742	3,835,450	1,471,217	1,037,252	440,989	13,044	0	627	12,132,965
1982-83	47,159	156,152	377,399	1,582,343	2,380,537	5,238,938	2,030,606	1,089,930	308,918	28,471	0	30,603	13,271,058
1983-84	125	611,816	872,947	1,234,920	2,803,310	2,066,477	1,739,624	894,771	216,105	27,969	125	0	10,468,189
1984-85	0	1,441,994	1,358,587	4,790,048	5,771,361	3,121,163	1,723,569	702,999	191,772	23,203	1,003	15,427	19,141,127
1985-86	242,444	346,670	1,151,387	2,688,703	2,381,541	1,735,359	1,197,920	1,027,595	536,060	108,742	18,312	29,851	11,464,583
1986-87	157,908	248,213	1,318,075	3,062,841	1,172,709	14,929,156	3,069,112	1,650,573	577,450	219,742	99,586	66,474	26,571,840
1987-88	45,792	145,325	2,541,715	3,032,035	3,456,953	13,110,336	2,897,424	1,258,330	576,288	180,144	283,565	73,267	27,601,174
1988-89	254,534	658,886	2,016,403	12,146,803	2,159,309	1,865,635	996,883	476,755	153,014	45,360	25,920	25,488	20,824,992

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1989-90	31,363	119,837	360,806	314,582	3,152,390	1,242,864	644,026	246,758	54,950	0	0	0	6,167,578
1990-91	0	1,296	39,658	163,814	408,240	1,051,661	214,099	33,005	0	0	0	0	1,911,773
1991-92	0	0	6,634,397	4,264,013	5,105,430	3,018,816	1,862,698	1,134,691	561,341	321,926	81,734	8,899	22,993,945
1992-93	16,416	593,309	6,712,243	2,562,106	3,222,547	5,107,968	1,896,221	1,044,144	364,090	109,987	30,067	1,901	21,660,998
1993-94	9,245	76,378	171,850	1,459,642	3,463,517	2,622,067	1,095,725	586,656	126,403	21,341	0	14,947	9,647,770
1994-95	0	10,558,700	2,847,300	1,936,352	1,272,811	1,001,499	708,163	409,828	150,022	80,591	0	0	18,965,266
1995-96	0	36,483	151,188	1,995,354	1,440,208	969,898	502,072	179,691	26,600	0	0	0	5,301,494
1996-97	0	0	477,000	297,000	823,000	487,000	1,234,000	146,000	0	0	0	0	3,464,000
1997-98	0	9,000	276,000	404,000	253,000	466,000	160,000	71,000	0	0	0	0	1,639,000
1998-99	0	0	386,000	558,195	2,441,071	550,094	354,550	2,000	36,000	0	0	0	4,327,910
1999-00	0	0	5,000	41,000	243,000	386,000	745,000	219,000	1,000	0	0	0	1,640,000
2000-01	0	371,000	733,000	2,160,000	1,446,000	900,000	426,000	129,000	0	0	0	0	6,165,000
2001-02	0	0	5,947,000	5,349,000	1,432,000	981,000	852,000	333,000	28,000	0	0	0	14,922,000
2002-03	0	0	1,226,000	804,000	3,815,000	3,550,000	53,000	714,000	194,000	0	0	0	10,356,000
2003-04	0	6,000	521,646	7,325,989	1,215,000	1,186,000	1,028,221	401,017	163,000	38,000	0	0	11,884,872
2004-05	0	340,383	679,594	1,321,162	1,988,129	728,628	365,628	111,138	62,409	0	0	0	5,597,072
2005-06	0	40,898	116,510	197,321	759,587	381,413	131,137	0	0	0	0	0	1,626,867
2006-07	5,000	213,000	32,000	105,000	1,125,512	607,000	177,000	98,000	0	0	0	0	2,362,512
2007-08	0	0	5,000	44,000	235,000	121,000	42,000	0	0	0	0	0	447,000
2008-09	0	0	114,000	1,914,000	1,940,000	1,879,000	1,339,000	471,000	70,000	0	0	34,000	7,761,000
2009-10	64,000	177,000	2,051,000	2,894,000	2,564,000	1,986,000	638,000	223,000	115,000	0	0	0	10,712,000
2010-11	0	0	449,471	855,000	840,000	1,233,000	628,000	327,000	24,000	0	0	0	4,356,471

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
2011-12	0	19,000	258,000	8,631,270	3,543,500	1,261,000	646,000	574,256	43,735	0	0	0	14,976,761
2012-13	77,000	255,000	6,678,000	1,875,000	1,015,000	531,000	639,000	173,000	0	0	0	69,000	11,312,000
2013-14	19,000	34,007	125,667	131,057	133,154	111,524	79,272	105,935	0	0	0	0	739,616
AVER.	56,275	466,838	1,502,799	2,775,590	2,994,484	2,634,731	1,294,953	648,375	211,898	47,299	17,749	10,884	12,661,875
ST. DEV.	133,770	1,566,297	1,861,872	2,893,596	3,306,804	3,036,822	1,258,934	599,347	235,036	85,362	49,198	21,101	9,704,283
C. V.	2.38	3.36	1.24	1.04	1.10	1.15	0.97	0.92	1.11	1.80	2.77	1.94	0.77

Table 8: Table of monthly inflows in the dam of Dypotamos

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1969-70	176,920	114,381	189,048	91,292	162,813	336,153	62,744	21,197	19,677	7,592	3,389	27,002	1,212,208
1970-71	3,942	242,307	28,147	1,067,259	939,736	574,395	2,140,647	926,592	157,202	28,852	64,664	6,387	6,180,130
1971-72	5,901	56,384	144,888	647,378	306,396	607,702	315,235	579,438	114,295	14,551	4,102	3,442	2,799,713
1972-73	25,910	86,914	242,600	425,372	427,059	400,360	177,837	107,496	41,815	12,606	12,162	9,842	1,969,975
1973-74	36,976	124,033	346,211	607,042	609,450	571,348	253,788	153,406	59,674	17,990	17,356	14,046	2,811,321
1974-75	3,942	15,692	10,818	829,121	6,160,207	2,893,989	472,274	536,885	136,570	31,282	14,433	8,963	11,114,177
1975-76	12,136	43,117	740,190	1,460,010	1,014,142	1,545,489	1,485,041	1,076,322	247,331	82,240	25,477	25,529	7,757,023
1976-77	1,129,405	461,532	476,216	1,250,082	660,384	743,782	427,849	133,225	57,665	24,710	3,389	3,442	5,371,681
1977-78	3,942	15,692	458,565	1,817,105	1,754,585	763,257	447,342	97,643	39,569	7,592	3,389	3,442	5,412,123
1978-79	14,095	16,980	100,648	411,955	951,714	507,384	200,467	107,675	57,858	14,998	3,389	161,189	2,548,353
1979-80	430,195	117,804	1,066,887	965,214	4,112,155	2,017,667	837,166	289,629	89,527	22,266	7,125	5,522	9,961,157
1980-81	5,522	5,522	23,691	1,275,912	4,689,633	3,273,543	1,273,606	431,276	147,801	37,532	10,866	2,761	11,177,663
1981-82	2,494	33,315	39,987	51,948	103,924	1,105,516	216,600	60,015	149,446	4,097	0	0	1,767,342
1982-83	0	0	713	154,347	107,902	271,228	86,132	14,640	0	0	0	0	634,961
1983-84	38,137	362,052	479,119	420,556	1,011,166	454,535	557,295	200,978	40,322	9,797	0	0	3,573,956
1984-85	0	433,972	300,416	941,880	1,528,522	882,975	437,704	182,763	63,767	4,275	0	0	4,776,273
1985-86	6,591	9,155	110,348	188,613	438,274	198,720	473,745	1,590,725	225,293	46,171	6,450	0	3,294,086
1986-87	11,222	12,280	103,827	190,108	117,797	2,580,164	552,162	212,839	62,564	4,190	0	0	3,847,154
1987-88	30,000	47,000	482,000	648,000	1,066,000	4,180,000	740,000	218,000	135,000	0	0	0	7,546,000
1988-89	20,000	160,000	715,000	5,575,000	960,000	700,000	343,000	84,000	20,000	0	0	0	8,577,000

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1989-90	0	0	10,000	15,000	880,000	540,000	77,000	67,000	0	0	0	0	1,589,000
1990-91	0	0	0	110,000	115,000	118,000	0	0	0	0	0	0	343,000
1991-92	0	0	4,681,000	2,753,000	5,554,000	1,753,000	686,000	630,000	215,000	0	0	0	16,272,000
1992-93	0	199,000	3,947,000	2,197,000	2,280,000	2,994,000	796,000	749,000	244,000	0	0	0	13,406,000
1993-94	0	100,000	77,000	537,750	1,026,290	1,951,970	585,146	271,390	84,896	24,730	86,920	60,456	4,806,548
1994-95	175,460	5,548,500	1,122,280	270,646	218,797	103,069	245,945	180,819	275,805	211,425	141,328	36,490	8,530,564
1995-96	53,313	136,342	429,478	846,655	930,275	526,243	403,451	124,772	77,083	78,569	108,491	45,107	3,759,779
1996-97	191,000	0	254,000	138,000	199,000	88,000	182,000	40,000	0	0	0	0	1,092,000
1997-98	0	29,000	601,000	125,000	103,000	136,000	41,000	0	0	0	0	0	1,035,000
1998-99	0	9,000	344,000	44,814	731,473	193,007	111,156	0	6,000	0	0	0	1,439,450
1999-00	0	0	0	1,000	14,000	19,000	174,000	19,000	0	0	0	0	227,000
2000-01	0	143,000	988,000	1,748,000	537,000	343,000	139,000	49,000	0	0	0	0	3,947,000
2001-02	0	5,000	2,745,000	3,282,000	879,000	477,000	602,000	275,000	36,000	0	0	0	8,301,000
2002-03	0	0	160,000	290,000	2,455,000	4,317,000	1,462,000	276,000	112,000	0	0	0	9,072,000
2003-04	43,000	0	348,663	4,504,828	0	0	202,983	78,168	0	0	0	0	5,177,642
2004-05	0	0	159,358	483,240	647,148	179,479	107,660	46,517	2,000	0	0	0	1,625,402
2005-06	0	38,398	0	20,879	64,692	11,945	0	0	0	0	0	0	135,913
2006-07	16,000	53,000	0	14,000	519,009	216,000	100,000	226,000	0	0	0	0	1,144,009
2007-08	0	0	8,000	1,000	0	0	0	0	0	0	0	0	9,000
2008-09	0	0	20,000	28,000	33,000	226,000	91,000	2,000	0	0	0	246,000	646,000
2009-10	7,000	5,000	903,000	1,946,000	1,664,000	1,380,000	281,000	81,000	38,000	0	0	0	6,305,000
2010-11	0	0	838,602	387,000	362,000	909,000	471,000	260,000	10,000	0	0	30,000	3,267,602

	OCT	**NOE**	**DEC**	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**YEAR**
2011-12	5,000	78,000	76,000	3,287,234	3,038,026	1,185,082	284,438	773,587	35,000	0	0	0	8,762,366
2012-13	95,000	21,000	1,266,000	585,000	427,000	92,000	151,000	27,832	0	0	0	53,000	2,717,832
2013-14	0	0	5,796	5,792	30,822	91,277	0	5,778	0	0	0	0	139,465
AVER.	57,798	198,258	569,039	968,960	1,131,808	962,886	424,873	254,587	68,208	15,579	11,658	16,878	4,680,532
ST. DEV.	182,469	832,939	970,576	1,247,688	1,467,610	1,122,175	444,937	334,615	79,188	35,833	30,147	44,868	3,909,586
C. V.	3.16	4.20	1.71	1.29	1.30	1.17	1.05	1.31	1.16	2.30	2.59	2.66	0.84

Table 9: Table of monthly inflows in the dam of Evretou

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1969-70	1,037	4,406	219,629	458,006	730,080	1,222,560	455,155	243,389	5,530	0	0	0	3,339,792
1970-71	0	89,338	157,853	317,088	1,175,731	1,414,368	1,776,384	343,181	13,738	0	0	0	5,287,680
1971-72	0	0	41,904	144,547	192,618	350,957	68,602	237,514	1,642	0	0	0	1,037,783
1972-73	0	0	0	0	41,731	38,966	0	36,202	0	0	0	0	116,899
1973-74	5,357	14,256	31,277	546,221	227,750	737,856	187,315	11,232	0	0	0	0	1,761,264
1974-75	0	432	324,000	4,043,520	5,968,512	3,350,592	744,768	495,936	76,032	2,765	0	0	15,006,557
1975-76	0	2,678	254,534	1,888,704	1,489,059	2,300,832	1,253,664	552,960	165,542	20,045	0	0	7,928,019
1976-77	3,283	123,293	443,664	1,700,352	684,288	1,456,704	915,840	360,634	36,893	25,056	0	0	5,750,006
1977-78	0	0	689,040	4,339,872	5,219,424	2,358,720	1,245,888	399,859	46,742	605	0	0	14,300,150
1978-79	7,517	5,011	232,848	706,752	886,464	462,240	176,256	34,560	6,048	0	0	0	2,517,696
1979-80	0	112,493	1,196,554	3,891,456	2,784,583	4,675,968	1,905,120	428,803	46,138	0	0	0	15,041,114
1980-81	0	0	5,098	4,695,149	4,587,840	1,793,664	773,280	266,803	25,488	0	0	0	12,147,322
1981-82	0	7,862	221,789	477,792	737,856	1,547,424	509,242	83,981	41,040	0	0	0	3,626,986
1982-83	0	0	13,478	325,814	1,288,224	2,373,408	861,408	334,800	44,410	0	0	0	5,241,542
1983-84	7,946	66,976	377,269	493,723	752,407	630,372	493,603	197,880	14,975	285	0	0	3,035,436
1984-85	0	389,493	660,748	2,799,980	4,383,787	1,238,032	564,368	234,590	24,641	0	0	0	10,295,640
1985-86	8,346	183,916	468,485	2,097,600	1,149,105	554,829	213,923	255,754	37,757	696	0	0	4,970,412
1986-87	0	11,824	147,252	1,948,460	1,083,030	9,679,704	1,165,499	427,946	82,469	7,353	0	0	14,553,538
1987-88	596	5,167	407,279	1,612,920	3,371,132	8,644,367	1,397,009	456,164	76,309	3,180	7,154	6,359	15,987,636
1988-89	15,401	88,033	3,749,867	6,097,757	937,964	559,400	204,782	52,164	14,407	5,664	497	894	11,726,830

1989-90	4,173	12,718	103,037	310,502	1,340,473	954,855	412,545	85,549	9,340	696	0	0	3,233,888
1990-91	994	5,465	9,837	29,113	172,589	259,828	153,413	27,722	5,365	0	0	0	664,325
1991-92	199	3,279	3,819,916	2,169,041	3,065,102	1,742,784	894,245	464,709	77,004	9,638	1,192	199	12,247,308
1992-93	0	8,247	1,901,761	1,260,885	1,100,915	2,598,278	548,669	211,936	16,394	1,292	0	0	7,648,377
1993-94	0	1,689	5,465	355,000	2,156,000	302,000	0	0	0	0	0	0	2,820,154
1994-95	0	834,200	765,700	2,006,391	1,013,410	404,458	43,359	34,971	0	0	36,936	0	5,139,425
1995-96	0	0	0	181,914	373,405	1,024,272	291,339	8,038	0	0	0	42,985	1,921,953
1996-97	0	0	84,000	0	192,000	70,000	444,000	16,000	0	0	0	0	806,000
1997-98	0	13,000	61,000	268,000	239,000	817,000	666,000	40,000	0	0	0	0	2,104,000
1998-99	0	13,000	1,121,000	1,434,089	2,269,233	603,976	1,221,943	0	12,000	0	0	0	6,675,241
1999-00	0	0	52,000	71,000	398,000	651,000	454,000	168,000	0	0	0	0	1,794,000
2000-01	0	38,000	95,000	437,000	1,195,000	360,000	57,000	13,000	0	0	0	0	2,195,000
2001-02	3,000	0	2,684,000	3,048,000	999,000	848,000	1,655,000	153,000	18,000	0	0	0	9,408,000
2002-03	0	0	840,000	967,000	3,995,000	2,863,000	862,000	133,000	1,000	0	0	0	9,661,000
2003-04	0	6,000	106,000	7,036,021	3,433,681	556,264	48,208	0	0	0	0	0	11,186,173
2004-05	0	9,000	18,886	115,039	965,970	252,351	175,979	0	4,347	0	0	0	1,541,572
2005-06	47,000	58,228	8,000	90,350	572,636	377,646	104,395	0	0	0	0	0	1,258,254
2006-07	21,309	33,680	13,000	3,000	794,000	102,000	163,000	23,000	0	0	0	0	1,152,989
2007-08	0	0	1,096,000	255,000	556,000	271,000	41,000	0	0	0	0	0	2,219,000
2008-09	10,000	0	73,000	1,060,000	3,759,000	3,286,000	1,409,000	209,000	0	0	0	0	9,806,000
2009-10	0	20,000	1,151,000	4,282,000	3,242,000	1,181,000	50,000	0	0	0	0	0	9,926,000
2010-11	0	0	73,061	522,000	1,475,000	2,405,000	767,000	62,000	0	0	0	0	5,304,061
2011-12	11,000	2,000	150,000	9,704,577	1,468,675	50,000	116,849	6,999	0	0	0	0	11,510,100

2012-13	0	0	5,806,000	2,777,270	2,334,455	1,196,023	564,705	1,000	0	0	0	0	12,679,453
2013-14	33,354	8,000	10,926	19,760	107,612	133,096	0	28,886	0	0	0	0	341,634
AVER.	4,011	48,260	659,803	1,710,859	1,664,661	1,526,684	579,017	158,692	20,072	1,717	1,017	1,121	6,375,916
ST. DEV.	9,253	137,538	1,188,817	2,126,586	1,504,785	1,967,845	527,438	169,407	32,747	4,993	5,581	6,453	4,893,564
C. V.	2.31	2.85	1.80	1.24	0.90	1.29	0.91	1.07	1.63	2.91	5.49	5.76	0.77

Table 10: Table of monthly inflows in the dam of Kalavasou

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1969-70	219,144	195,661	1,191,272	554,609	750,652	1,318,281	271,981	90,349	16,989	2,383	0	0	4,611,321
1970-71	0	116,095	206,300	527,309	1,105,800	767,849	2,457,623	699,952	97,287	0	4,256	0	5,982,471
1971-72	1,859	153,182	544,074	814,083	754,142	725,324	416,960	916,496	351,806	34,316	11,066	0	4,723,307
1972-73	4,082	88,071	99,202	157,959	263,566	142,010	84,130	25,103	0	0	0	0	864,123
1973-74	28,792	118,651	177,207	647,823	493,605	1,117,035	327,241	87,183	13,036	0	0	0	3,010,573
1974-75	0	0	282,715	2,096,079	5,988,454	2,143,629	516,302	349,410	141,203	27,061	1,702	0	11,546,556
1975-76	0	58,373	1,760,835	3,421,116	2,580,749	2,177,769	1,291,909	927,238	318,041	166,441	41,245	61,115	12,804,830
1976-77	119,503	315,567	592,456	2,058,572	1,148,020	998,444	1,011,284	444,226	119,886	26,849	0	0	6,834,808
1977-78	21,466	40,945	731,350	3,230,507	6,000,872	2,371,828	1,435,390	608,924	189,713	41,729	10,795	26,083	14,709,602
1978-79	23,872	175,816	1,015,337	1,580,821	2,594,686	960,111	400,480	233,166	213,541	1,642	0	0	7,199,472
1979-80	9,694	72,315	1,433,871	2,832,689	5,347,335	3,180,405	1,597,311	813,595	240,628	34,686	193	0	15,562,723
1980-81	10,423	58,233	176,147	5,340,728	7,189,871	3,342,121	2,449,556	802,287	220,753	49,090	10,447	16,588	19,666,244
1981-82	15,161	292,097	658,167	641,920	805,290	1,831,578	675,918	467,577	187,843	5,507	0	546	5,581,605
1982-83	13,703	57,862	159,454	775,715	1,178,443	2,501,799	932,917	491,323	131,587	12,021	0	26,629	6,281,454
1983-84	0	6,845	239,102	410,330	1,225,592	808,031	667,558	291,550	28,538	1,253	0	0	3,678,800
1984-85	0	232,257	417,272	1,740,240	2,288,825	1,415,331	852,284	350,073	112,706	12,052	0	2,314	7,423,353
1985-86	53,316	57,269	268,412	940,019	1,287,103	936,162	461,139	1,242,175	619,930	148,860	13,498	6,652	6,034,535
1986-87	36,251	45,892	284,320	996,902	426,142	6,140,492	1,630,330	689,347	202,755	52,641	1,639	0	10,506,711
1987-88	5,357	37,238	971,827	1,073,088	1,699,279	6,597,504	1,654,560	533,088	208,742	28,685	20,909	5,184	12,835,462
1988-89	61,862	120,010	668,131	6,441,120	1,565,568	1,406,592	717,984	224,813	46,570	6,221	2,678	2,592	11,264,141

1989-90	3,197	20,563	56,246	56,419	1,346,285	840,672	371,261	128,563	10,109	346	0	0	2,833,661
1990-91	0	778	7,430	44,323	97,373	372,902	175,997	25,142	950	0	0	0	724,896
1991-92	0	0	3,736,627	2,964,384	4,201,066	2,452,896	1,162,080	639,360	203,904	128,218	30,672	3,370	15,522,576
1992-93	3,283	147,053	4,614,624	2,117,664	2,112,480	3,667,680	1,267,488	700,704	193,622	32,054	7,344	2,592	14,866,589
1993-94	2,678	25,747	56,074	577,300	1,473,200	1,492,100	642,800	333,900	0	700	0	0	4,604,499
1994-95	12,300	6,637,400	2,096,200	2,652,000	1,536,000	772,391	485,396	182,659	75,243	0	0	0	14,449,589
1995-96	0	21,677	24,447	579,804	661,191	502,473	234,297	125,949	77,806	20,947	71,905	45,218	2,365,714
1996-97	55,000	47,000	102,000	43,000	205,000	134,000	235,000	89,000	0	0	0	0	910,000
1997-98	0	3,000	95,000	76,000	60,000	73,000	16,000	13,000	0	0	0	0	336,000
1998-99	0	1,000	78,000	120,950	755,792	222,232	139,354	0	18,000	0	0	0	1,335,328
1999-00	0	0	0	1,000	12,000	47,000	128,000	19,000	0	0	0	0	207,000
2000-01	0	262,000	942,000	2,751,000	1,146,000	798,000	532,000	196,000	0	0	0	0	6,627,000
2001-02	8,000	8,000	5,623,000	4,988,000	1,471,000	907,000	644,000	405,000	140,000	0	0	0	14,194,000
2002-03	0	0	489,000	492,000	3,929,000	3,499,000	1,824,000	319,000	109,000	0	0	0	10,661,000
2003-04	23,000	0	324,563	7,478,000	3,773,984	1,795,000	534,161	178,397	0	0	0	0	14,107,105
2004-05	0	20,971	163,150	531,980	1,150,114	496,735	79,449	4,000	2,000	0	0	0	2,448,398
2005-06	0	40,541	0	13,000	159,087	142,050	0	0	0	0	0	0	354,679
2006-07	22,000	66,000	0	12,000	314,010	76,000	9,000	64,000	4,000	0	0	0	567,010
2007-08	0	0	0	0	17,000	4,000	0	0	0	0	0	0	21,000
2008-09	0	0	83,000	447,000	451,000	639,000	489,000	220,000	23,000	0	0	112,000	2,464,000
2009-10	85,000	72,000	1,229,000	2,344,000	1,932,000	1,554,000	496,000	128,000	134,000	0	0	0	7,974,000
2010-11	0	0	487,306	352,000	383,000	1,046,000	583,000	239,000	17,000	0	0	38,000	3,145,306
2011-12	0	89,000	88,000	4,435,307	3,856,991	2,579,385	531,879	145,936	2,540	0	0	0	11,729,039

2012-13	24,000	112,000	1,857,000	837,000	549,000	261,000	228,000	38,000	0	0	0	352,000	4,258,000
2013-14	0	32,052	6,304	23,988	35,969	38,751	0	2,531	0	0	0	0	139,597
AVER.	19,177	218,870	756,365	1,560,439	1,696,056	1,451,013	681,356	321,889	99,394	18,527	5,074	15,575	6,843,735
ST. DEV.	39,414	982,017	1,198,902	1,826,274	1,780,128	1,470,954	626,346	308,407	125,371	38,219	13,234	55,293	5,454,392
C. V.	2.06	4.49	1.59	1.17	1.05	1.01	0.92	0.96	1.26	2.06	2.61	3.55	0.80

Table 11: Table of monthly inflows in the dam of Kanavia

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1969-70	9,706	9,099	64,542	241,003	379,733	848,029	324,593	209,399	58,719	35,486	20,624	7,279	2,208,212
1970-71	4,853	19,229	25,295	147,465	985,849	1,083,391	1,509,832	379,733	131,754	57,991	19,593	8,735	4,373,720
1971-72	1,395	5,277	27,540	176,400	221,652	386,405	170,455	384,100	72,853	34,758	21,838	7,765	1,510,438
1972-73	1,092	3,154	3,094	19,654	35,729	85,895	57,930	34,152	14,498	0	0	0	255,197
1973-74	13,467	5,217	10,798	303,180	255,561	872,293	208,004	91,172	37,245	18,623	7,037	2,851	1,825,447
1974-75	667	2,851	170,091	2,530,136	4,504,018	2,355,435	715,790	413,702	165,178	68,121	30,209	16,682	10,972,880
1975-76	10,979	10,919	110,038	1,310,260	1,105,228	1,668,762	794,042	501,053	183,922	99,240	34,455	11,768	5,840,665
1976-77	20,139	90,505	362,869	1,569,885	608,422	1,540,769	1,054,274	494,380	131,815	95,964	13,952	10,130	5,993,104
1977-78	7,461	3,276	713,424	4,923,180	4,628,372	2,384,552	1,359,395	545,942	138,972	57,506	22,626	9,888	14,794,593
1978-79	9,402	7,461	232,571	932,347	870,474	565,959	229,902	106,337	148,981	38,883	10,616	3,579	3,156,513
1979-80	39,611	11,404	632,564	2,703,018	2,395,450	3,751,832	1,434,007	414,916	113,738	41,856	15,954	7,461	11,561,809
1980-81	6,855	5,399	8,371	3,234,037	4,243,180	1,590,510	814,060	320,892	108,764	41,370	20,624	10,858	10,404,919
1981-82	8,068	50,894	368,753	533,203	829,940	1,617,807	522,891	168,878	96,692	40,339	10,130	7,886	4,255,481
1982-83	6,612	14,680	24,325	337,149	1,356,362	2,430,047	936,593	442,819	149,406	49,013	18,562	8,371	5,773,939
1983-84	14,134	54,837	305,849	777,845	1,678,045	1,048,572	1,091,944	481,763	109,370	47,072	14,983	11,707	5,636,121
1984-85	7,765	297,538	300,571	2,072,152	2,773,383	1,159,216	595,683	190,655	90,202	43,008	12,921	7,097	7,550,190
1985-86	12,739	13,163	148,557	1,108,868	843,176	355,469	185,802	127,508	58,598	36,942	3,579	1,820	2,896,220
1986-87	4,125	6,491	162,751	1,501,339	973,596	6,749,658	1,218,056	555,041	170,394	64,360	17,652	5,763	11,429,227
1987-88	6,915	9,888	463,868	1,230,188	2,749,119	7,770,569	1,284,783	589,617	141,823	59,326	37,427	10,737	14,354,261
1988-89	10,494	28,146	2,473,176	5,047,533	760,679	460,411	207,336	90,566	43,372	16,439	12,132	7,583	9,157,867

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1989-90	3,458	7,461	27,540	155,047	1,342,834	679,394	247,372	85,167	36,214	10,373	4,610	1,820	2,601,290
1990-91	1,880	1,820	3,033	5,156	33,424	122,109	88,382	42,280	14,619	7,643	2,123	0	322,470
1991-92	0	1,274	2,899,132	1,425,514	2,604,748	1,273,257	551,401	224,079	86,987	50,287	29,845	13,103	9,159,626
1992-93	4,550	12,617	1,128,886	888,065	930,527	1,989,654	385,192	188,653	61,327	37,003	13,345	2,548	5,642,367
1993-94	1,759	2,366	2,305	202,180	1,596,576	334,844	152,985	87,775	42,341	18,987	4,246	0	2,446,364
1994-95	14,255	734,049	593,257	1,600,216	843,176	397,931	217,770	190,473	53,502	16,378	4,064	971	4,666,042
1995-96	0	1,031	1,941	76,978	436,814	1,034,256	353,042	120,168	50,348	15,832	1,698	0	2,092,109
1996-97	121	789	27,236	31,119	207,033	149,345	543,697	98,633	29,663	3,518	789	61	1,092,005
1997-98	0	5,095	32,938	202,423	203,454	694,984	591,801	133,756	47,072	4,125	0	0	1,915,648
1998-99	0	61	617,035	918,395	1,916,862	571,419	1,150,724	179,311	47,558	14,558	5,702	3,154	5,424,779
1999-00	2,062	1,456	2,730	85,834	478,609	619,340	573,117	311,672	63,572	12,193	2,062	0	2,152,648
2000-01	0	3,761	39,672	354,983	1,207,865	520,768	154,744	94,266	29,360	7,037	425	0	2,412,880
2001-02	0	1,031	2,593,647	3,074,258	1,014,238	845,603	1,789,475	416,735	138,123	40,460	13,649	5,217	9,932,437
2002-03	1,092	3,033	810,784	863,801	3,451,564	3,027,550	1,374,560	385,799	167,179	23,597	2,730	0	10,111,688
2003-04	0	0	77,463	5,571,819	2,678,147	1,045,175	387,619	156,200	54,473	19,229	4,671	2,123	9,996,919
2004-05	0	7,522	80,799	311,611	922,641	567,173	615,094	129,873	53,502	3,154	0	0	2,691,371
2005-06	0	2,305	1,395	6,794	38,277	29,238	31,058	13,831	11,404	50,287	52,228	47,618	284,436
2006-07	59,932	35,062	9,160	8,856	70,972	36,214	17,046	9,827	28,753	45,071	58,962	37,306	417,160
2007-08	4,489	4,307	111,311	36,517	80,860	49,256	13,831	5,277	0	0	0	0	305,849
2008-09	0	0	25,659	160,871	454,830	443,487	176,460	66,180	14,619	2,548	0	0	1,344,654
2009-10	546	33,060	254,651	694,802	693,952	1,077,931	106,337	45,738	11,525	2,062	1,031	5,641	2,927,278
2010-11	3,761	789	4,368	58,294	110,644	278,794	142,430	64,846	19,897	4,307	2,790	1,820	692,739

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
2011-12	3,822	5,277	22,990	2,493,558	5,223,720	4,165,959	561,956	126,476	47,800	15,226	10,919	9,463	12,687,166
2012-13	161	6,821	2,770,208	2,093,473	1,813,114	1,098,213	491,704	118,440	12,284	0	0	0	8,404,417
2013-14	0	0	26,000	148,000	208,000	204,000	96,000	105,000	20,000	0	0	0	807,000
AVER.	6,781	34,555	426,072	1,182,259	1,376,201	1,358,579	578,027	223,593	74,737	30,686	12,746	6,564	5,310,799
ST. DEV.	10,955	117,489	768,879	1,421,217	1,356,609	1,616,351	477,998	173,441	52,879	25,010	13,822	9,204	4,230,056
C. V.	1.62	3.40	1.80	1.20	0.99	1.19	0.83	0.78	0.71	0.82	1.08	1.40	0.80

Table 12: Table of monthly inflows in the dam of Kouris

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1969-70	1,930,462	1,683,487	3,471,968	3,798,881	3,778,598	6,300,846	2,480,488	1,106,019	207,722	87,813	5,727	0	24,852,010
1970-71	97,358	1,080,367	1,664,397	3,074,660	4,761,726	4,912,059	8,441,296	3,284,648	1,286,537	445,271	752,140	103,443	29,903,902
1971-72	317,130	1,302,167	2,904,044	3,412,312	3,127,610	4,556,510	2,529,167	5,286,936	1,355,260	212,017	534,516	122,891	25,660,560
1972-73	659,316	736,153	994,939	1,033,000	1,560,476	1,295,247	232,538	14,079	96,762	38,299	0	0	6,660,809
1973-74	288,853	1,093,014	1,282,242	2,244,251	1,745,529	5,265,221	1,345,954	64,667	1,909	0	167,513	53,929	13,553,082
1974-75	402,319	760,969	2,721,378	12,228,246	22,221,786	11,217,677	2,570,091	3,191,466	828,858	245,543	151,526	42,714	56,582,573
1975-76	182,427	813,467	4,764,112	12,421,531	8,089,162	9,988,767	6,776,899	3,994,552	1,789,793	806,785	111,437	111,437	49,850,371
1976-77	918,580	1,903,617	2,802,630	6,899,790	4,236,755	4,665,084	3,806,040	1,418,854	235,282	202,352	0	28,873	27,117,857
1977-78	590,712	442,646	4,320,512	17,202,347	22,054,750	12,623,168	7,897,235	2,429,184	824,801	120,743	81,728	107,500	68,695,326
1978-79	820,745	1,333,904	4,471,799	6,230,452	9,203,697	4,054,208	1,054,118	818,597	814,063	1,551	0	0	28,803,133
1979-80	350,895	1,076,549	7,212,386	12,757,990	15,515,939	12,468,063	7,354,367	3,281,069	966,066	228,720	135,299	115,136	61,462,480
1980-81	179,564	818,955	1,107,212	20,105,556	26,586,443	14,804,900	7,279,082	3,784,564	1,208,507	422,721	165,724	143,651	76,606,878
1981-82	191,137	2,229,576	3,715,363	3,145,054	3,235,731	7,388,968	3,042,446	1,667,380	1,118,188	286,348	106,068	61,684	26,187,942
1982-83	496,694	971,435	1,374,470	4,085,229	6,359,308	11,844,063	6,544,241	3,653,321	1,733,001	368,076	117,761	154,031	37,701,631
1983-84	464,719	2,366,784	2,648,718	3,511,340	6,530,541	4,484,923	5,172,158	1,738,847	448,015	140,191	126,709	114,420	27,747,366
1984-85	201,756	6,276,983	3,585,314	10,087,796	11,641,233	7,966,436	4,317,887	2,117,781	896,507	183,501	128,260	92,944	47,496,398
1985-86	886,784	1,416,900	2,393,438	4,117,141	4,361,837	2,739,567	1,502,191	1,920,360	501,334	8,814	0	39,438	19,887,804
1986-87	378,104	994,729	3,708,359	9,473,042	3,634,017	26,393,044	9,805,097	4,065,645	1,511,695	711,888	174,012	206,149	61,055,783
1987-88	0	1,300,000	6,500,000	6,800,000	8,650,000	30,700,000	9,600,000	3,690,000	1,830,000	0	0	0	69,070,000
1988-89	1,071,000	1,630,000	5,700,000	21,855,000	5,514,000	5,504,000	2,308,000	1,227,000	428,000	0	0	0	45,237,000

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1989-90	440,000	850,000	1,100,000	836,000	4,930,000	2,860,000	863,000	230,000	29,000	0	0	0	12,138,000
1990-91	0	0	300,000	887,000	1,511,000	2,588,000	786,000	150,000	0	0	0	0	6,222,000
1991-92	0	386,000	10,891,000	6,038,000	7,917,000	5,346,000	4,016,000	2,289,000	986,000	0	0	0	37,869,000
1992-93	0	1,826,000	9,114,000	4,917,000	5,547,000	10,771,000	4,298,000	2,941,000	1,005,000	0	0	0	40,419,000
1993-94	0	1,004,000	846,000	3,182,540	6,426,500	3,978,500	1,652,800	1,129,100	256,500	37,200	0	238,200	18,751,340
1994-95	359,800	11,433,500	3,970,225	5,681,405	4,191,975	3,447,742	2,085,974	741,781	188,207	361,763	181,485	87,077	32,730,934
1995-96	0	665,588	530,782	3,656,185	2,902,649	3,587,349	1,543,261	655,110	202,373	166,551	48,814	0	13,958,662
1996-97	89,000	98,000	1,655,000	758,000	2,141,000	1,932,000	4,274,000	476,000	301,000	0	0	0	11,724,000
1997-98	32,000	861,000	2,328,000	2,246,000	1,279,000	2,922,000	2,016,000	737,000	600,000	0	0	0	13,021,000
1998-99	0	403,000	5,051,000	2,584,000	9,233,000	3,586,000	2,913,000	568,461	1,079,000	202,000	0	0	25,619,461
1999-00	0	440,000	607,000	1,050,000	1,424,000	1,667,000	2,207,000	1,417,000	253,000	0	0	0	9,065,000
2000-01	0	1,371,000	2,866,000	4,051,000	3,052,000	2,519,000	1,233,000	699,000	52,000	0	0	0	15,843,000
2001-02	39,000	289,000	12,322,000	15,287,000	5,626,000	4,019,000	3,921,000	1,757,000	748,000	266,000	0	0	44,274,000
2002-03	0	409,000	2,710,000	3,013,000	7,592,000	9,665,000	6,794,000	2,244,000	1,397,000	369,000	0	0	34,193,000
2003-04	245,000	618,000	2,292,431	24,634,075	16,974,201	4,240,000	2,523,712	1,771,472	1,126,000	225,000	0	0	54,649,890
2004-05	60,000	1,359,590	1,950,762	3,499,541	5,135,534	2,798,226	1,185,792	415,174	614,641	0	0	0	17,019,260
2005-06	0	659,627	589,126	1,126,279	2,808,666	1,616,736	527,241	102,279	0	200,000	80,000	40,000	7,749,953
2006-07	472,455	1,399,105	331,257	604,000	3,438,169	2,392,475	876,000	838,000	94,000	236,000	184,000	184,000	11,049,461
2007-08	276,000	292,000	1,906,000	1,295,000	1,314,000	940,000	335,000	0	0	0	20,000	20,000	6,398,000
2008-09	15,000	315,000	1,217,000	2,504,000	4,709,000	5,102,000	3,641,000	2,413,000	789,000	22,000	58,000	199,000	20,984,000
2009-10	470,000	1,010,000	6,388,000	8,168,000	8,867,000	6,820,000	2,405,000	1,184,000	315,000	324,000	0	0	35,951,000
2010-11	0	0	1,537,247	2,078,000	2,451,000	4,092,000	3,102,000	1,915,000	518,000	0	0	157,000	15,850,247

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
2011-12	0	575,000	1,688,000	20,323,084	16,156,460	12,855,056	4,817,717	2,092,622	419,000	45,832	0	0	58,972,771
2012-13	22,000	1,138,000	10,913,000	4,527,000	2,660,000	2,609,000	2,093,000	805,000	59,000	0	0	0	24,826,000
2013-14	0	100,479	709,997	495,735	623,264	441,805	182,543	652,127	165,998	0	0	90,000	3,461,949
AVER.	287,751	1,282,991	3,359,047	6,398,344	6,704,879	6,488,192	3,430,030	1,710,624	650,667	154,800	74,016	55,856	30,597,196
ST. DEV.	380,793	1,830,135	2,935,730	6,302,492	5,996,823	6,055,090	2,596,150	1,308,836	536,638	191,350	142,068	69,851	19,567,608
C. V.	1.32	1.43	0.87	0.99	0.89	0.93	0.76	0.77	0.82	1.24	1.92	1.25	0.64

Table 13: Table of monthly inflows in the dam of Lefkara

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1969-70	85,267	74,735	36,055	27,632	34,972	81,417	30,217	11,249	0	0	0	0	381,545
1970-71	0	29,356	6,547	50,668	87,908	54,271	322,831	188,129	42,651	742	0	0	783,102
1971-72	0	12,232	38,824	56,427	56,932	77,480	67,903	161,013	57,401	2,225	0	0	530,437
1972-73	3,643	52,273	119,845	203,560	198,596	149,965	74,733	44,987	14,899	3,592	2,055	2,312	870,458
1973-74	4,646	66,670	152,854	259,627	253,296	191,270	95,317	57,377	19,003	4,581	2,620	2,949	1,110,211
1974-75	0	0	10,260	116,791	474,590	202,162	65,950	110,150	26,957	0	0	0	1,006,859
1975-76	0	0	144,253	231,679	152,822	241,075	183,633	214,104	86,901	22,993	0	0	1,277,460
1976-77	109,750	66,539	48,008	107,914	63,287	73,013	65,231	36,137	363	1,038	0	0	571,281
1977-78	0	0	38,498	164,685	222,346	100,390	102,608	31,246	1,381	0	0	0	661,155
1978-79	0	0	26,935	78,855	172,626	63,181	35,048	38,311	13,006	4,524	0	0	432,487
1979-80	0	11,131	121,193	141,781	459,923	170,617	120,937	62,981	5,013	0	0	0	1,093,578
1980-81	0	0	0	148,104	525,717	302,652	142,616	65,178	23,633	3,803	0	0	1,211,702
1981-82	0	0	1,743	12,729	26,374	57,625	23,960	7,395	24,233	0	0	0	154,059
1982-83	0	0	0	6,338	30,350	49,227	25,707	4,014	0	0	0	0	115,637
1983-84	264	38,697	59,104	62,696	137,371	72,203	110,960	30,054	4,421	0	0	0	515,770
1984-85	0	36,077	49,386	98,401	199,644	105,743	61,293	26,885	9,388	0	0	0	586,816
1985-86	0	2,401	20,969	38,611	69,530	59,685	99,280	340,047	41,207	8,609	528	0	680,869
1986-87	0	928	23,980	67,397	41,168	386,897	89,674	48,224	20,249	1,320	0	0	679,837
1987-88	0	7,000	500,000	732,000	804,000	2,663,000	361,000	80,000	0	0	0	0	5,147,000
1988-89	0	0	470,000	3,750,000	361,000	170,000	73,000	15,000	0	0	0	0	4,839,000

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1989-90	0	0	0	50,000	580,000	170,000	60,000	0	0	0	0	0	860,000
1990-91	0	0	0	8,000	44,000	194,000	41,000	0	0	0	0	0	287,000
1991-92	0	0	2,217,000	1,010,000	2,835,000	722,000	290,000	199,000	177,000	0	0	0	7,450,000
1992-93	0	76,000	2,038,000	1,200,000	1,382,000	1,550,000	262,000	266,000	0	0	0	0	6,774,000
1993-94	0	26,000	17,000	397,000	861,000	943,000	225,000	31,000	0	0	0	0	2,500,000
1994-95	0	2,710,000	695,000	501,000	157,000	190,000	0	0	0	0	0	0	4,253,000
1995-96	0	0	72,000	72,000	45,000	51,000	0	0	0	0	0	0	240,000
1996-97	34,000	0	34,000	80,000	106,000	35,000	158,000	20,000	0	0	0	0	467,000
1997-98	0	14,000	111,000	132,000	98,000	60,000	26,000	0	0	0	0	0	441,000
1998-99	0	0	102,000	55,350	631,197	75,802	41,262	0	0	0	0	0	905,611
1999-00	0	2,000	0	1,000	24,000	154,000	181,000	32,000	0	0	0	0	394,000
2000-01	0	30,000	838,000	1,099,000	372,000	349,000	90,000	24,000	0	0	0	0	2,802,000
2001-02	0	0	2,402,000	2,270,000	544,000	487,000	608,000	242,000	23,000	0	0	0	6,576,000
2002-03	30,000	0	162,000	347,000	3,420,000	2,215,000	565,000	158,000	103,000	0	0	0	7,000,000
2003-04	0	0	226,892	3,401,048	1,339,706	263	2,000	8,000	0	0	0	0	4,977,909
2004-05	0	0	29,636	47,504	421,080	143,395	143,638	59,486	17,421	0	0	0	862,159
2005-06	0	53,032	4,000	29,513	112,711	29,695	0	0	0	0	0	0	228,950
2006-07	0	7,000	0	0	398,883	62,000	63,000	71,000	0	0	0	0	601,883
2007-08	0	0	1,000	0	2,000	0	0	0	0	0	0	0	3,000
2008-09	0	0	11,000	37,000	164,000	260,000	128,000	6,000	0	0	0	184,000	790,000
2009-10	19,000	73,000	772,000	1,766,000	1,205,000	830,000	95,000	85,000	23,000	0	0	0	4,868,000
2010-11	0	0	67,000	190,000	239,000	582,000	262,000	193,000	19,000	0	0	0	1,552,000

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
2011-12	3,000	31,000	25,000	2,430,696	1,599,532	785,888	222,117	685,335	37,687	0	0	0	5,820,256
2012-13	2,000	41,000	518,000	222,000	153,000	84,000	67,000	0	0	0	0	0	1,087,000
2013-14	0	0	0	0	0	0	15,999	9,933	0	0	0	0	25,931
AVER.	6,479	76,913	271,355	482,267	469,035	338,776	126,620	81,383	17,574	1,187	116	4,206	1,875,910
ST. DEV.	21,262	402,195	569,009	885,364	703,002	552,020	134,951	124,747	33,275	3,743	495	27,417	2,227,056
C. V.	3.28	5.23	2.10	1.84	1.50	1.63	1.07	1.53	1.89	3.15	4.28	6.52	1.19

Table 14: Table of monthly inflows in the dam of Mavrokolympos

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1969-70	0	1,413	49,124	59,097	82,660	106,697	29,079	9,938	584	0	0	0	338,591
1970-71	0	15,273	31,437	23,479	201,429	108,747	202,287	15,432	1,936	0	0	0	600,019
1971-72	559	1,039	32,109	24,380	28,478	28,622	892	19,164	387	0	0	0	135,630
1972-73	43,559	607	0	10,241	34,639	11,349	6,720	982	26	0	0	0	108,122
1973-74	13,670	2,094	18,952	49,950	22,487	76,017	17,215	76	42	0	0	0	200,503
1974-75	0	9,523	136,509	364,234	950,645	240,353	92,307	36,141	1,714	0	0	0	1,831,425
1975-76	0	0	89,219	318,968	268,207	220,950	134,479	29,215	4,090	0	0	0	1,065,128
1976-77	96,438	72,177	108,559	188,064	100,473	132,707	113,349	15,939	2,316	0	0	0	830,022
1977-78	0	0	136,683	723,295	821,306	338,317	199,268	33,135	6,078	0	0	0	2,258,080
1978-79	0	715	152,204	185,237	166,378	62,082	14,393	1,265	5,472	0	0	0	587,744
1979-80	86,561	28,285	139,879	395,822	349,168	331,822	141,797	28,744	9,751	0	0	0	1,511,830
1980-81	109,586	28,320	33,120	510,323	614,573	149,956	92,518	24,067	9,169	0	0	0	1,571,633
1981-82	61,695	29,820	110,366	63,226	94,896	117,649	39,763	10,170	4,032	0	0	0	531,619
1982-83	68,789	21,714	34,936	110,717	275,305	248,921	120,881	28,528	7,605	0	0	0	917,397
1983-84	74,693	48,020	90,304	100,588	253,909	88,398	105,061	19,548	5,131	0	0	0	785,652
1984-85	59,208	50,224	55,557	226,950	365,981	84,269	47,959	12,042	4,388	0	0	0	906,577
1985-86	49,603	20,536	38,743	100,193	74,507	17,391	12,944	4,781	1,686	0	0	0	320,384
1986-87	62,141	19,787	160,529	385,345	135,673	694,455	99,119	28,634	9,013	0	0	0	1,594,697
1987-88	104,408	38,493	305,934	296,381	552,643	905,939	140,686	36,454	11,599	0	0	0	2,392,536
1988-89	120,521	55,248	675,499	757,323	118,126	50,237	34,959	13,085	5,259	0	0	0	1,830,257

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1989-90	88,239	32,615	43,475	31,642	223,600	87,948	33,277	9,789	3,542	0	0	0	554,128
1990-91	63,795	18,587	20,935	23,654	37,833	36,157	20,659	5,766	2,315	0	0	0	229,701
1991-92	55,190	21,196	1,003,024	227,507	579,579	148,433	80,260	25,690	10,225	0	0	0	2,151,104
1992-93	92,624	44,210	589,579	170,583	277,530	290,235	74,395	26,908	8,440	0	0	0	1,574,504
1993-94	80,347	28,364	34,367	65,047	272,318	31,050	16,576	8,343	1,256	0	0	0	537,668
1994-95	33,083	190,883	76,178	293,578	139,272	45,314	18,216	10,079	6,345	0	0	0	812,946
1995-96	0	5,184	0	72,504	101,929	88,794	29,797	322	566	0	0	0	299,095
1996-97	0	0	0	0	44,000	0	69,000	0	0	0	0	0	113,000
1997-98	0	60,000	35,000	102,000	41,000	32,000	136,200	0	0	0	0	0	406,200
1998-99	0	22,000	199,000	361,000	583,000	408,000	399,000	0	0	0	0	0	1,972,000
1999-00	0	0	0	0	145,000	215,000	221,000	33,000	0	0	0	0	614,000
2000-01	0	0	0	96,000	415,000	190,000	20,000	0	0	0	0	0	721,000
2001-02	0	0	1,139,000	873,000	0	0	0	0	0	0	0	0	2,012,000
2002-03	0	0	122,000	506,000	454,000	296,000	31,000	0	9,000	0	0	0	1,418,000
2003-04	12,000	3,000	20,000	864,643	597,841	29,125	0	0	0	0	0	0	1,526,610
2004-05	0	2,699	70,967	182,093	299,593	0	2,565	0	0	0	0	0	557,916
2005-06	0	21,336	0	15,889	16,851	0	0	0	0	0	0	0	54,076
2006-07	446,484	64,000	0	0	8,000	0	1,000	0	0	0	0	0	519,484
2007-08	0	0	57,000	6,000	0	0	0	0	0	0	0	0	63,000
2008-09	0	0	137,000	115,000	224,000	197,000	120,000	0	0	0	0	0	793,000
2009-10	2,000	8,000	83,000	77,000	14,000	0	3,000	4,000	0	0	0	0	191,000
2010-11	0	0	5,000	44,000	33,000	40,000	24,000	38,000	0	0	0	0	184,000

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
2011-12	0	0	41,000	902,077	473,856	128,967	0	54,753	0	0	0	0	1,600,653
2012-13	6,000	14,000	767,000	114,000	74,000	27,000	20,000	26,000	0	0	0	0	1,048,000
2013-14	0	0	15,249	34,253	28,383	16,444	0	28,000	0	0	0	0	122,329
AVER.	44,335	23,973	168,170	247,603	255,634	149,773	67,736	14,810	3,225	0	0	0	997,130
ST. DEV.	76,813	34,135	273,253	261,460	239,720	189,256	79,769	14,870	3,714	0	0	0	682,299
C. V.	1.73	1.42	1.62	1.06	0.94	1.26	1.18	1.00	1.15	N/A	N/A	N/A	N/A

Table 15: Table of monthly inflows in the dam of Polemidia

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1969-70	27,751	44,647	210,024	205,212	229,993	517,534	105,063	31,539	10,342	410	0	0	1,382,515
1970-71	0	3,686	1,843	95,130	221,084	174,594	401,617	179,304	34,714	0	0	0	1,111,972
1971-72	0	0	95,950	184,629	209,308	241,052	89,806	120,833	127,694	3,584	0	0	1,072,855
1972-73	0	0	0	0	0	0	0	0	145,409	0	0	0	145,409
1973-74	199,682	32,154	16,487	104,449	102,811	365,981	82,228	4,198	410	0	0	0	908,399
1974-75	0	0	80,385	830,574	2,518,040	1,007,626	232,860	104,551	32,666	0	0	0	4,806,701
1975-76	0	0	297,577	745,581	549,893	483,333	323,485	186,984	48,128	3,174	0	0	2,638,156
1976-77	1,741	73,421	58,369	494,597	313,552	207,567	187,496	66,049	3,994	0	0	0	1,406,784
1977-78	0	0	53,249	989,193	2,121,748	942,089	469,099	128,923	33,280	5,530	0	0	4,743,110
1978-79	1,024	27,341	483,230	574,879	1,139,006	414,826	146,433	73,114	23,552	0	0	0	2,883,406
1979-80	2,048	1,126	625,875	1,472,526	2,862,107	1,520,654	650,246	255,286	76,698	20,480	1,024	0	7,488,071
1980-81	0	7,066	16,487	1,984,121	3,345,440	1,461,262	571,397	261,737	76,801	13,722	2,560	0	7,740,591
1981-82	0	64,205	183,912	230,812	296,860	750,599	306,793	81,306	38,605	1,536	0	0	1,954,630
1982-83	9,318	9,114	33,485	176,130	456,606	997,385	357,379	124,417	27,751	12,698	5,837	9,216	2,219,336
1983-84	13,210	41,472	159,848	150,222	410,218	324,918	424,759	171,112	31,744	14,131	6,758	4,301	1,752,695
1984-85	6,451	126,568	236,034	967,689	1,091,594	528,389	316,009	112,334	39,936	3,584	7,270	3,482	3,439,341
1985-86	17,203	22,323	85,607	409,092	529,515	277,302	121,448	187,087	46,900	614	3,277	73,729	1,774,097
1986-87	14,439	23,962	118,376	491,525	231,221	3,427,360	514,258	229,276	60,212	15,975	6,963	0	5,133,565
1987-88	7,578	23,757	558,290	1,093,642	1,192,971	4,034,598	1,047,562	276,995	111,310	51,405	34,714	30,720	8,463,542
1988-89	89,601	117,761	416,772	4,099,111	678,918	475,140	201,935	90,830	58,573	43,316	41,882	48,640	6,362,479

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1989-90	52,634	74,036	76,903	94,516	664,070	347,037	216,373	88,372	53,146	53,249	50,688	10,342	1,781,367
1990-91	28,979	29,287	41,370	55,297	61,543	217,192	125,441	71,783	49,767	29,389	28,467	27,136	765,652
1991-92	49,357	54,375	1,303,974	831,496	921,467	588,806	383,492	243,305	99,329	99,739	70,964	56,833	4,703,135
1992-93	69,633	147,355	1,380,365	557,061	600,289	1,373,197	490,501	243,407	109,876	70,145	57,037	43,828	5,142,694
1993-94	49,972	46,797	47,002	209,400	471,100	226,400	125,264	87,410	24,391	0	0	0	1,287,736
1994-95	0	1,996,993	292,600	103,333	95,987	106,648	28,175	0	0	0	0	0	2,623,736
1995-96	0	0	0	244,234	276,053	165,628	29,747	0	16,051	0	0	0	731,713
1996-97	0	0	63,000	19,000	63,000	67,000	153,000	0	0	0	0	0	365,000
1997-98	0	8,000	41,000	23,000	18,000	13,000	8,000	0	0	0	0	0	111,000
1998-99	0	0	53,000	67,000	629,000	86,000	63,000	0	0	0	0	0	898,000
1999-00	0	0	0	0	48,000	35,000	70,000	16,000	0	0	0	0	169,000
2000-01	0	138,000	104,000	418,000	313,000	153,000	59,000	1,000	0	0	0	0	1,186,000
2001-02	0	0	771,000	881,000	223,000	82,000	55,000	0	0	0	0	0	2,012,000
2002-03	0	0	216,000	217,000	705,000	829,000	139,000	0	0	0	0	0	2,106,000
2003-04	2,000	0	62,899	1,516,375	0	0	0	0	0	0	0	0	1,581,275
2004-05	0	0	76,870	156,371	402,481	87,353	23,734	0	0	0	0	0	746,810
2005-06	0	91,236	27,000	45,429	120,553	67,000	43,000	0	0	0	0	0	394,217
2006-07	131,000	51,000	0	71,000	365,000	282,000	101,000	47,000	0	0	0	0	1,048,000
2007-08	0	0	10,000	33,000	12,000	0	0	0	0	0	0	0	55,000
2008-09	0	0	68,000	297,000	174,000	0	0	0	0	0	0	0	539,000
2009-10	8,200	20,000	339,000	404,000	426,000	204,000	1,000	2,000	0	0	0	0	1,404,200
2010-11	0	0	19,000	24,000	64,000	115,000	18,000	0	0	0	0	0	240,000

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
2011-12	0	6,000	18,000	1,476,562	861,469	0	2,000	6,000	0	0	0	0	2,370,030
2012-13	0	4,000	943,000	235,000	78,000	3,000	26,000	2,000	0	0	0	0	1,291,000
2013-14	0	0	16,259	74,650	46,687	0	0	6,086	0	0	0	0	143,681
AVER.	17,374	73,015	215,601	518,952	580,902	515,566	193,569	77,783	30,695	9,837	7,054	6,849	2,247,198
ST. DEV.	38,901	296,128	326,606	727,525	754,594	811,366	220,782	90,395	39,257	21,333	16,914	17,019	2,175,360
C. V.	2.24	4.06	1.51	1.40	1.30	1.57	1.14	1.16	1.28	2.17	2.40	2.48	0.97

Table 16: Table of monthly inflows in the dam of Xyliatos

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1974-75	0	0	72,157	1,251,951	2,115,986	577,782	52,732	229,777	27,665	2,114	0	0	4,330,166
1975-76	0	0	433,017	946,254	355,451	1,265,869	1,004,107	249,643	55,972	6,997	212	0	4,317,520
1976-77	45,100	72,061	376,879	874,857	271,274	618,577	183,406	160,139	13,151	0	0	0	2,615,443
1977-78	0	0	328,317	1,578,262	1,079,306	462,067	221,789	50,630	11,059	0	0	0	3,731,430
1978-79	0	13,824	180,662	394,502	477,187	129,773	41,558	44,496	46,570	2,678	0	0	1,331,251
1979-80	2,419	34,992	524,362	959,040	965,177	578,016	331,344	77,155	9,763	0	0	0	3,482,269
1980-81	0	6,653	28,858	1,559,261	1,788,480	487,555	218,765	76,637	53,050	1,814	0	0	4,221,072
1981-82	1,296	71,194	277,344	141,955	455,214	741,917	126,749	47,347	36,115	432	0	0	1,899,563
1982-83	0	8,726	37,757	234,576	453,254	807,840	181,872	142,819	135,994	9,850	173	0	2,012,861
1983-84	5,098	50,717	124,243	275,011	462,484	150,509	222,480	63,158	9,590	1,296	0	0	1,364,587
1984-85	605	236,218	212,717	531,187	659,232	736,992	234,317	90,115	14,515	1,382	0	0	2,717,280
1985-86	7,949	32,054	99,965	156,298	242,698	85,795	70,848	45,014	9,936	1,123	0	0	751,680
1986-87	8,813	19,786	318,298	456,797	59,098	1,904,602	277,603	66,355	16,243	3,283	0	1,901	3,132,778
1987-88	8,381	22,118	459,302	664,330	815,357	2,134,080	210,125	58,406	14,688	1,469	0	0	4,388,256
1988-89	10,973	47,002	956,966	2,649,888	314,237	360,547	124,675	47,088	15,120	5,616	4,666	432	4,537,210
1989-90	8,467	22,810	29,549	30,240	518,314	313,805	58,061	20,563	3,629	0	0	0	1,005,437
1990-91	518	2,678	10,454	26,957	92,621	312,768	40,435	7,949	2,765	0	0	0	497,146
1991-92	0	10,454	1,509,408	415,670	1,117,757	686,880	202,435	112,666	45,965	37,325	33,782	8,208	4,180,550
1992-93	10,627	98,323	1,040,515	579,658	1,104,192	1,016,928	252,202	256,694	56,851	12,269	3,542	1,382	4,433,184
1993-94	3,715	29,290	33,091	342,144	663,379	602,467	136,685	46,829	7,690	691	0	12,528	1,878,509

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1994-95	20,650	1,450,829	587,088	449,626	228,701	133,315	79,747	39,053	9,850	173	0	0	2,999,030
1995-96	1,037	8,035	14,170	120,960	134,266	219,802	97,373	21,427	11,146	0	0	0	628,214
1996-97	1,296	8,640	107,050	42,854	179,366	119,405	419,731	39,139	25,488	691	0	0	943,661
1997-98	1,814	49,680	65,318	70,416	34,646	180,317	53,482	15,034	3,370	0	0	0	474,077
1998-99	9,936	19,181	197,856	277,949	472,781	98,669	62,294	13,046	83,117	9,677	950	778	1,246,234
1999-00	1,123	8,381	31,277	88,733	142,474	183,427	239,242	46,397	5,357	0	0	0	746,410
2000-01	864	68,947	412,128	271,555	358,042	171,936	52,445	14,256	1,555	0	8,813	1,987	1,362,528
2001-02	1,642	11,318	1,632,614	1,401,408	488,506	214,013	516,154	125,021	68,515	44,669	16,070	9,418	4,529,347
2002-03	12,614	19,699	187,661	230,947	1,062,893	1,002,240	281,405	97,286	62,294	7,517	1,123	173	2,965,853
2003-04	5,270	12,010	119,664	3,277,411	1,779,840	273,802	133,574	54,518	16,070	2,678	0	0	5,674,838
2004-05	1,901	5,789	35,683	91,930	151,891	43,027	36,634	10,109	6,912	0	0	0	383,875
2005-06	173	89,424	15,466	147,917	425,434	137,462	62,208	14,602	3,370	26,957	0	0	923,011
2006-07	7,862	64,627	9,763	22,982	809,914	298,685	118,368	578,448	73,094	6,221	0	0	1,989,965
2007-08	0	6,739	72,058	24,365	131,587	28,426	8,294	5,530	0	0	0	0	276,998
2008-09	0	1,555	63,936	105,235	325,382	208,483	84,154	48,298	11,232	3,110	0	3,283	854,669
2009-10	5,270	24,970	346,378	969,926	1,010,880	507,859	53,482	38,966	6,998	691	0	0	2,965,421
2010-11	0	1,469	50,285	184,896	120,787	299,894	171,677	30,845	7,171	864	605	0	868,493
2011-12	691	23,414	116,294	1,897,690	746,198	612,835	99,360	109,210	14,083	4,320	1,642	1,037	3,626,774
2012-13	3,283	17,021	383,789	166,320	73,267	34,560	21,686	10,109	2,074	0	0	0	712,109
2013-14													

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
AVER.	4,856	68,478	294,932	613,127	581,732	480,588	173,936	82,174	25,590	5,023	1,835	1,055	2,333,326
ST. DEV.	8,120	231,110	386,566	745,319	504,425	471,743	176,826	103,615	29,268	9,892	6,038	2,771	1,552,123
C. V.	1.67	3.37	1.31	1.22	0.87	0.98	1.02	1.26	1.14	1.97	3.29	2.63	20.73

A.3 ANNEX 3

TABLE OF VALUES FOR THE CALCULATION OF THE HYDROLOGIC YEAR RUNOFF INDEX

Table 17: Table of inflows (in m^3) and aggregation up to 5 years of annual inflows in the dam of Kanavia - Hydrologic Year Runoff Index

	1 YEAR	2 YEARS	3 YEARS	4 YEARS	5 YEARS
1970-1971	4,373,720	------------	------------	------------	------------
1971-1972	1,510,438	5,884,158	------------	------------	------------
1972-1973	255,198	1,765,636	6,139,356	------------	------------
1973-1974	1,825,448	2,080,646	3,591,084	7,964,804	------------
1974-1975	10,972,880	12,798,328	13,053,526	14,563,964	18,937,684
1975-1976	5,840,666	16,813,546	18,638,994	18,894,192	20,404,630
1976-1977	5,993,104	11,833,770	22,806,650	24,632,098	24,887,296
1977-1978	14,794,594	20,787,698	26,628,364	37,601,244	39,426,692
1978-1979	3,156,512	17,951,106	23,944,210	29,784,876	40,757,756
1979-1980	11,561,811	14,718,323	29,512,917	35,506,021	41,346,687
1980-1981	10,404,920	21,966,731	25,123,243	39,917,837	45,910,941
1981-1982	4,255,481	14,660,401	26,222,212	29,378,724	44,173,318
1982-1983	5,773,939	10,029,420	20,434,340	31,996,151	35,152,663
1983-1984	5,636,121	11,410,060	15,665,541	26,070,461	37,632,272
1984-1985	7,550,191	13,186,312	18,960,251	23,215,732	33,620,652
1985-1986	2,896,221	10,446,412	16,082,533	21,856,472	26,111,953
1986-1987	11,429,226	14,325,447	21,875,638	27,511,759	33,285,698
1987-1988	14,354,260	25,783,486	28,679,707	36,229,898	41,866,019
1988-1989	9,157,867	23,512,127	34,941,353	37,837,574	45,387,765
1989-1990	2,601,290	11,759,157	26,113,417	37,542,643	40,438,864
1990-1991	322,469	2,923,759	12,081,626	26,435,886	37,865,112
1991-1992	9,159,627	9,482,096	12,083,386	21,241,253	35,595,513
1992-1993	5,642,367	14,801,994	15,124,463	17,725,753	26,883,620
1993-1994	2,446,364	8,088,731	17,248,358	17,570,827	20,172,117
1994-1995	4,666,042	7,112,406	12,754,773	21,914,400	22,236,869
1995-1996	2,092,108	6,758,150	9,204,514	14,846,881	24,006,508
1996-1997	1,092,004	3,184,112	7,850,154	10,296,518	15,938,885
1997-1998	1,915,648	3,007,652	5,099,760	9,765,802	12,212,166

	1 YEAR	2 YEARS	3 YEARS	4 YEARS	5 YEARS
1998-1999	5,424,779	7,340,427	8,432,431	10,524,539	15,190,581
1999-2000	2,152,647	7,577,426	9,493,074	10,585,078	12,677,186
2000-2001	2,412,881	4,565,528	9,990,307	11,905,955	12,997,959
2001-2002	9,932,436	12,345,317	14,497,964	19,922,743	21,838,391
2002-2003	10,111,689	20,044,125	22,457,006	24,609,653	30,034,432
2003-2004	9,996,919	20,108,608	30,041,044	32,453,925	34,606,572
2004-2005	2,691,369	12,688,288	22,799,977	32,732,413	35,145,294
2005-2006	284,435	2,975,804	12,972,723	23,084,412	33,016,848
2006-2007	417,161	701,596	3,392,965	13,389,884	23,501,573
2007-2008	305,848	723,009	1,007,444	3,698,813	13,695,732
2008-2009	1,344,654	1,650,502	2,067,663	2,352,098	5,043,467
2009-2010	2,927,276	4,271,930	4,577,778	4,994,939	5,279,374
2010-2011	692,740	3,620,016	4,964,670	5,270,518	5,687,679
2011-2012	12,687,166	13,379,906	16,307,182	17,651,836	17,957,684
2012-2013	8,404,418	21,091,584	21,784,324	24,711,600	26,056,254
2013-2014	807,000	9,211,418	21,898,584	22,591,324	25,518,600
PERCENTILE 50%	4,314,601	10,446,412	15,395,002	21,914,400	28,459,026
PERCENTILE 25%	2,047,993	4,418,729	9,276,654	13,389,884	19,863,509
PERCENTILE 15%	1,306,757	2,960,191	5,671,538	10,387,726	14,069,444
PERCENTILE 5%	304,777	1,557,753	3,194,170	4,735,714	10,478,968
AVERAGE	5,242,065	10,565,749	16,094,493	21,906,925	27,979,975
417,161	HIGH ALERT LEVEL				
284,435	VERY HIGH ALERT LEVEL				

Table 18: Table of inflows (in m^3) and aggregation up to 5 years of annual inflows in the dam of Evretou - Hydrologic Year Runoff Index

	1 YEAR	2 YEARS	3 YEARS	4 YEARS	5 YEARS
1970-1971	5,287,680	------------	------------	------------	------------
1971-1972	1,037,783	6,325,463	------------	------------	------------
1972-1973	116,899	1,154,682	6,442,362	------------	------------
1973-1974	1,761,264	1,878,163	2,915,946	8,203,626	------------
1974-1975	15,006,557	16,767,821	16,884,720	17,922,503	23,210,183
1975-1976	7,928,019	22,934,576	24,695,840	24,812,739	25,850,522
1976-1977	5,750,006	13,678,026	28,684,583	30,445,847	30,562,746
1977-1978	14,300,150	20,050,157	27,978,176	42,984,733	44,745,997
1978-1979	2,517,696	16,817,846	22,567,853	30,495,872	45,502,429
1979-1980	15,041,114	17,558,810	31,858,960	37,608,967	45,536,986
1980-1981	12,147,322	27,188,435	29,706,131	44,006,282	49,756,288
1981-1982	3,626,986	15,774,307	30,815,421	33,333,117	47,633,267
1982-1983	5,241,542	8,868,528	21,015,850	36,056,963	38,574,659
1983-1984	3,035,436	8,276,978	11,903,964	24,051,286	39,092,399
1984-1985	10,295,640	13,331,076	18,572,619	22,199,604	34,346,926
1985-1986	4,970,412	15,266,052	18,301,488	23,543,031	27,170,016
1986-1987	14,553,538	19,523,950	29,819,590	32,855,026	38,096,569
1987-1988	15,987,636	30,541,174	35,511,586	45,807,226	48,842,662
1988-1989	11,726,830	27,714,466	42,268,004	47,238,416	57,534,056
1989-1990	3,233,888	14,960,717	30,948,353	45,501,891	50,472,303
1990-1991	664,325	3,898,212	15,625,042	31,612,678	46,166,216
1991-1992	12,247,308	12,911,632	16,145,520	27,872,350	43,859,986
1992-1993	7,648,377	19,895,685	20,560,010	23,793,897	35,520,727
1993-1994	2,820,154	10,468,531	22,715,839	23,380,164	26,614,051
1994-1995	5,139,425	7,959,579	15,607,956	27,855,264	28,519,589
1995-1996	1,921,953	7,061,378	9,881,532	17,529,909	29,777,217
1996-1997	806,000	2,727,953	7,867,378	10,687,532	18,335,909
1997-1998	2,104,000	2,910,000	4,831,953	9,971,378	12,791,532
1998-1999	6,675,241	8,779,241	9,585,241	11,507,194	16,646,619
1999-2000	1,794,000	8,469,241	10,573,241	11,379,241	13,301,194
2000-2001	2,195,000	3,989,000	10,664,241	12,768,241	13,574,241
2001-2002	9,408,000	11,603,000	13,397,000	20,072,241	22,176,241
2002-2003	9,661,000	19,069,000	21,264,000	23,058,000	29,733,241
2003-2004	11,186,173	20,847,173	30,255,173	32,450,173	34,244,173

	1 YEAR	2 YEARS	3 YEARS	4 YEARS	5 YEARS
2004-2005	1,541,572	12,727,746	22,388,746	31,796,746	33,991,746
2005-2006	1,258,254	2,799,826	13,986,000	23,647,000	33,055,000
2006-2007	1,152,989	2,411,243	3,952,815	15,138,989	24,799,989
2007-2008	2,219,000	3,371,989	4,630,243	6,171,815	17,357,989
2008-2009	9,806,000	12,025,000	13,177,989	14,436,243	15,977,815
2009-2010	9,926,000	19,732,000	21,951,000	23,103,989	24,362,243
2010-2011	5,304,061	15,230,061	25,036,061	27,255,061	28,408,050
2011-2012	11,510,100	16,814,161	26,740,161	36,546,161	38,765,161
2012-2013	12,679,453	24,189,553	29,493,614	39,419,614	49,225,614
2013-2014	341,634	13,021,086	24,531,186	29,835,248	39,761,248
PERCENTILE 50%	5,190,484	12,727,746	18,437,054	23,793,897	31,808,873
PERCENTILE 25%	2,058,488	6,693,421	10,974,172	17,529,909	24,074,228
PERCENTILE 15%	1,499,075	3,233,392	8,812,203	12,011,613	17,602,469
PERCENTILE 5%	798,916	2,357,935	4,528,629	9,617,828	13,505,979
AVERAGE	6,343,529	12,622,273	18,946,115	25,548,653	32,437,048

Table 19: Table of inflows (in m^3) and aggregation up to 5 years of annual discharges in Hydrologic Region 1 - Hydrologic Year Runoff Index

	1 YEAR	2 YEARS	3 YEARS	4 YEARS	5 YEARS
1970-1971	15,039,456	------------	------------	------------	------------
1971-1972	11,841,001	26,880,457	------------	------------	------------
1972-1973	------------	------------	------------	------------	------------
1973-1974	------------	------------	------------	------------	------------
1974-1975	17,367,656	29,208,657	44,248,113	------------	------------
1975-1976	13,051,412	30,419,068	42,260,069	57,299,525	------------
1976-1977	8,777,830	21,829,242	39,196,898	51,037,900	66,077,356
1977-1978	13,238,156	22,015,987	35,067,399	52,435,055	64,276,056
1978-1979	8,860,276	22,098,432	30,876,263	43,927,675	61,295,330
1979-1980	18,446,788	27,307,063	40,545,220	49,323,050	62,374,462
1980-1981	20,861,531	39,308,319	48,168,594	61,406,751	70,184,581
1981-1982	8,032,223	28,893,754	47,340,542	56,200,818	69,438,974
1982-1983	10,521,739	18,553,962	39,415,493	57,862,280	66,722,556
1983-1984	8,649,461	19,171,200	27,203,423	48,064,954	66,511,742
1984-1985	15,010,597	23,660,059	34,181,797	42,214,021	63,075,552
1985-1986	5,651,382	20,661,979	29,311,441	39,833,179	47,865,403
1986-1987	17,113,901	22,765,283	37,775,880	46,425,341	56,947,080
1987-1988	21,486,719	38,600,620	44,252,002	59,262,599	67,912,061
1988-1989	19,836,877	41,323,596	58,437,497	64,088,879	79,099,476
1989-1990	5,735,015	25,571,892	47,058,612	64,172,512	69,823,894
1990-1991	2,804,717	8,539,733	28,376,610	49,863,329	66,977,230
1991-1992	22,494,360	25,299,077	31,034,093	50,870,970	72,357,689
1992-1993	22,401,528	44,895,888	47,700,605	53,435,621	73,272,498
1993-1994	11,646,838	34,048,366	56,542,726	59,347,443	65,082,459
1994-1995	16,246,774	27,893,612	50,295,140	72,789,500	75,594,217
1995-1996	5,626,065	21,872,839	33,519,677	55,921,205	78,415,565
1996-1997	4,619,005	10,245,069	26,491,843	38,138,682	60,540,209
1997-1998	2,861,160	7,480,165	13,106,229	29,353,003	40,999,841
1998-1999	7,563,146	10,424,306	15,043,310	20,669,375	36,916,149
1999-2000	3,361,778	10,924,924	13,786,084	18,405,088	24,031,153
2000-2001	9,635,271	12,997,049	20,560,194	23,421,354	28,040,359
2001-2002	25,796,708	35,431,978	38,793,756	46,356,902	49,218,062
2002-2003	17,062,477	42,859,185	52,494,455	55,856,233	63,419,379

	1 YEAR	2 YEARS	3 YEARS	4 YEARS	5 YEARS
2003-2004	22,569,257	39,631,734	65,428,442	75,063,713	78,425,491
2004-2005	11,811,223	34,380,480	51,442,957	77,239,665	86,874,935
2005-2006	5,406,824	17,218,047	39,787,304	56,849,781	82,646,489
2006-2007	9,309,905	14,716,729	26,527,952	49,097,209	66,159,686
2007-2008	1,872,289	11,182,194	16,589,018	28,400,241	50,969,498
2008-2009	6,041,240	7,913,529	17,223,434	22,630,258	34,441,481
2009-2010	16,753,485	22,794,725	24,667,014	33,976,919	39,383,743
2010-2011	7,921,915	24,675,400	30,716,640	32,588,929	41,898,835
2011-2012	24,010,761	31,932,676	48,686,161	54,727,401	56,599,690
2012-2013	8,603,770	32,614,531	40,536,446	57,289,931	63,331,171
2013-2014	------------	------------	------------	------------	------------
PERCENTILE 50%	11,729,030	22,794,725	38,284,818	50,870,970	65,579,907
PERCENTILE 25%	6,421,717	17,218,047	27,034,555	41,023,600	52,463,894
PERCENTILE 15%	5,527,406	11,027,832	21,586,899	29,815,395	40,919,036
PERCENTILE 5%	2,852,693	8,414,492	14,729,004	22,041,993	32,201,088
AVERAGE	12,247,528	24,297,816	36,520,836	48,892,601	61,334,431

Table 20: Table of inflows (in m^3) and aggregation up to 5 years of annual discharges in Hydrologic Region 6 - Hydrologic Year Runoff Index

	1 YEAR	2 YEARS	3 YEARS	4 YEARS	5 YEARS
1970-1971	2,677,925	------------	------------	------------	------------
1971-1972	2,013,613	4,691,538	------------	------------	------------
1972-1973	------------	------------	------------	------------	------------
1973-1974	------------	------------	------------	------------	------------
1974-1975	3,668,799	5,682,412	8,360,337	------------	------------
1975-1976	2,689,965	6,358,765	8,372,377	11,050,303	------------
1976-1977	1,137,145	3,827,110	7,495,910	9,509,522	12,187,447
1977-1978	1,588,539	2,725,684	5,415,650	9,084,449	11,098,062
1978-1979	1,359,308	2,947,848	4,084,993	6,774,958	10,443,757
1979-1980	2,025,780	3,385,089	4,973,628	6,110,773	8,800,738
1980-1981	2,537,725	4,563,505	5,922,813	7,511,353	8,648,498
1981-1982	640,180	3,177,905	5,203,685	6,562,993	8,151,533
1982-1983	1,001,984	1,642,164	4,179,889	6,205,669	7,564,977
1983-1984	769,510	1,771,494	2,411,674	4,949,399	6,975,179
1984-1985	1,617,164	2,386,674	3,388,658	4,028,838	6,566,563
1985-1986	687,373	2,304,537	3,074,047	4,076,031	4,716,211
1986-1987	2,543,317	3,230,690	4,847,854	5,617,364	6,619,348
1987-1988	2,458,674	5,001,991	5,689,364	7,306,528	8,076,038
1988-1989	2,964,123	5,422,797	7,966,114	8,653,487	10,270,651
1989-1990	1,005,786	3,969,909	6,428,583	8,971,900	9,659,273
1990-1991	631,815	1,637,601	4,601,724	7,060,398	9,603,715
1991-1992	4,046,903	4,678,718	5,684,504	8,648,627	11,107,301
1992-1993	3,083,527	7,130,430	7,762,245	8,768,031	11,732,154
1993-1994	1,882,455	4,965,982	9,012,885	9,644,700	10,650,486
1994-1995	2,302,855	4,185,310	7,268,837	11,315,740	11,947,555
1995-1996	674,745	2,977,600	4,860,054	7,943,582	11,990,485
1996-1997	538,326	1,213,071	3,515,926	5,398,381	8,481,908
1997-1998	367,325	905,652	1,580,396	3,883,251	5,765,706
1998-1999	748,310	1,115,635	1,653,962	2,328,706	4,631,561
1999-2000	320,065	1,068,375	1,435,701	1,974,027	2,648,771
2000-2001	1,955,272	2,275,337	3,023,647	3,390,973	3,929,299
2001-2002	4,260,292	6,215,564	6,535,629	7,283,939	7,651,265
2002-2003	3,395,835	7,656,127	9,611,399	9,931,464	10,679,774

	1 YEAR	2 YEARS	3 YEARS	4 YEARS	5 YEARS
2003-2004	2,710,623	6,106,458	10,366,750	12,322,022	12,642,088
2004-2005	705,036	3,415,659	6,811,494	11,071,786	13,027,058
2005-2006	649,133	1,354,168	4,064,792	7,460,627	11,720,919
2006-2007	917,735	1,566,867	2,271,903	4,982,526	8,378,361
2007-2008	110,680	1,028,415	1,677,547	2,382,583	5,093,206
2008-2009	670,226	780,906	1,698,641	2,347,774	3,052,809
2009-2010	1,632,912	2,303,139	2,413,819	3,331,553	3,980,686
2010-2011	766,469	2,399,381	3,069,607	3,180,287	4,098,022
2011-2012	2,199,641	2,966,110	4,599,022	5,269,249	5,379,929
2012-2013	649,797	2,849,438	3,615,906	5,248,819	5,919,045
2013-2014	------------	------------	------------	------------	------------
PERCENTILE 50%	1,602,852	3,177,905	4,916,841	7,060,398	8,565,203
PERCENTILE 25%	691,789	1,642,164	3,061,447	4,512,715	6,579,759
PERCENTILE 15%	645,104	1,269,510	2,306,846	3,440,201	4,711,979
PERCENTILE 5%	360,236	1,003,862	1,635,570	2,342,054	3,622,528
AVERAGE	1,710,289	3,396,517	5,101,873	6,796,693	8,485,100

Table 21: Table of inflows (in m³) and aggregation up to 5 years of annual inflows in the dam of Kalavasou - Hydrologic Year Runoff Index

	1 YEAR	2 YEARS	3 YEARS	4 YEARS	5 YEARS
1970-1971	5,982,471	------------	------------	------------	------------
1971-1972	4,723,308	10,705,779	------------	------------	------------
1972-1973	864,123	5,587,431	11,569,902	------------	------------
1973-1974	3,010,573	3,874,696	8,598,004	14,580,475	------------
1974-1975	11,546,555	14,557,128	15,421,251	20,144,559	26,127,030
1975-1976	12,804,831	24,351,386	27,361,959	28,226,082	32,949,390
1976-1977	6,834,807	19,639,638	31,186,193	34,196,766	35,060,889
1977-1978	14,709,602	21,544,409	34,349,240	45,895,795	48,906,368
1978-1979	7,199,472	21,909,074	28,743,881	41,548,712	53,095,267
1979-1980	15,562,722	22,762,194	37,471,796	44,306,603	57,111,434
1980-1981	19,666,244	35,228,966	42,428,438	57,138,040	63,972,847
1981-1982	5,581,604	25,247,848	40,810,570	48,010,042	62,719,644
1982-1983	6,281,453	11,863,057	31,529,301	47,092,023	54,291,495
1983-1984	3,678,799	9,960,252	15,541,856	35,208,100	50,770,822
1984-1985	7,423,354	11,102,153	17,383,606	22,965,210	42,631,454
1985-1986	6,034,535	13,457,889	17,136,688	23,418,141	28,999,745
1986-1987	10,506,711	16,541,246	23,964,600	27,643,399	33,924,852
1987-1988	12,835,461	23,342,172	29,376,707	36,800,061	40,478,860
1988-1989	11,264,141	24,099,602	34,606,313	40,640,848	48,064,202
1989-1990	2,833,661	14,097,802	26,933,263	37,439,974	43,474,509
1990-1991	724,895	3,558,556	14,822,697	27,658,158	38,164,869
1991-1992	15,522,577	16,247,472	19,081,133	30,345,274	43,180,735
1992-1993	14,866,588	30,389,165	31,114,060	33,947,721	45,211,862
1993-1994	4,604,499	19,471,087	34,993,664	35,718,559	38,552,220
1994-1995	14,449,589	19,054,088	33,920,676	49,443,253	50,168,148
1995-1996	2,365,714	16,815,303	21,419,802	36,286,390	51,808,967
1996-1997	910,000	3,275,714	17,725,303	22,329,802	37,196,390
1997-1998	336,000	1,246,000	3,611,714	18,061,303	22,665,802
1998-1999	1,335,328	1,671,328	2,581,328	4,947,042	19,396,631
1999-2000	207,000	1,542,328	1,878,328	2,788,328	5,154,042
2000-2001	6,627,000	6,834,000	8,169,328	8,505,328	9,415,328
2001-2002	14,194,000	20,821,000	21,028,000	22,363,328	22,699,328
2002-2003	10,661,000	24,855,000	31,482,000	31,689,000	33,024,328

	1 YEAR	2 YEARS	3 YEARS	4 YEARS	5 YEARS
2003-2004	14,107,105	24,768,105	38,962,105	45,589,105	45,796,105
2004-2005	2,448,399	16,555,504	27,216,504	41,410,504	48,037,504
2005-2006	354,678	2,803,077	16,910,182	27,571,182	41,765,182
2006-2007	567,010	921,688	3,370,087	17,477,192	28,138,192
2007-2008	21,000	588,010	942,688	3,391,087	17,498,192
2008-2009	2,464,000	2,485,000	3,052,010	3,406,688	5,855,087
2009-2010	7,974,000	10,438,000	10,459,000	11,026,010	11,380,688
2010-2011	3,145,306	11,119,306	13,583,306	13,604,306	14,171,316
2011-2012	11,729,038	14,874,344	22,848,344	25,312,344	25,333,344
2012-2013	4,258,000	15,987,038	19,132,344	27,106,344	29,570,344
2013-2014	139,595	4,397,595	16,126,633	19,271,939	27,245,939
PERCENTILE 50%	6,157,994	14,557,128	21,223,901	30,345,274	39,515,540
PERCENTILE 25%	2,427,728	4,731,064	12,383,101	20,144,559	27,635,402
PERCENTILE 15%	843,239	2,707,654	6,118,402	12,447,796	20,213,924
PERCENTILE 5%	329,550	1,213,569	2,475,878	3,403,568	8,525,268
AVERAGE	7,102,120	14,210,594	21,504,057	29,167,840	37,158,011

Table 22: Table of inflows (in m^3) and aggregation up to 5 years of annual inflows in the dam of Kouris - Hydrologic Year Runoff Index

	1 YEAR	2 YEARS	3 YEARS	4 YEARS	5 YEARS
1970-1971	29,903,902				
1971-1972	25,660,560	55,564,463			
1972-1973	6,660,809	32,321,369	62,225,272		
1973-1974	13,553,082	20,213,891	45,874,452	75,778,354	
1974-1975	56,582,573	70,135,656	76,796,464	102,457,025	132,360,927
1975-1976	49,850,371	106,432,944	119,986,026	126,646,835	152,307,396
1976-1977	27,117,857	76,968,228	133,550,801	147,103,883	153,764,692
1977-1978	68,695,326	95,813,183	145,663,554	202,246,127	215,799,209
1978-1979	28,803,133	97,498,459	124,616,316	174,466,687	231,049,260
1979-1980	61,462,480	90,265,613	158,960,939	186,078,796	235,929,167
1980-1981	76,606,878	138,069,358	166,872,491	235,567,817	262,685,674
1981-1982	26,187,942	102,794,821	164,257,300	193,060,434	261,755,759
1982-1983	37,701,631	63,889,574	140,496,452	201,958,932	230,762,065
1983-1984	27,747,366	65,448,997	91,636,939	168,243,818	229,706,297
1984-1985	47,496,398	75,243,764	112,945,395	139,133,338	215,740,216
1985-1986	19,887,804	67,384,202	95,131,567	132,833,199	159,021,141
1986-1987	61,055,783	80,943,586	128,439,984	156,187,350	193,888,981
1987-1988	69,070,000	130,125,783	150,013,586	197,509,984	225,257,350
1988-1989	45,237,000	114,307,000	175,362,783	195,250,586	242,746,984
1989-1990	12,138,000	57,375,000	126,445,000	187,500,783	207,388,586
1990-1991	6,222,000	18,360,000	63,597,000	132,667,000	193,722,783
1991-1992	37,869,000	44,091,000	56,229,000	101,466,000	170,536,000
1992-1993	40,419,000	78,288,000	84,510,000	96,648,000	141,885,000
1993-1994	18,751,340	59,170,340	97,039,340	103,261,340	115,399,340
1994-1995	32,730,934	51,482,274	91,901,274	129,770,274	135,992,274
1995-1996	13,958,662	46,689,596	65,440,936	105,859,936	143,728,936
1996-1997	11,724,000	25,682,662	58,413,596	77,164,936	117,583,936
1997-1998	13,021,000	24,745,000	38,703,662	71,434,596	90,185,936
1998-1999	25,619,461	38,640,461	50,364,461	64,323,123	97,054,057
1999-2000	9,065,000	34,684,461	47,705,461	59,429,461	73,388,123
2000-2001	15,843,000	24,908,000	50,527,461	63,548,461	75,272,461
2001-2002	44,274,000	60,117,000	69,182,000	94,801,461	107,822,461
2002-2003	34,193,000	78,467,000	94,310,000	103,375,000	128,994,461

2003-2004	54,649,890	88,842,890	133,116,890	148,959,890	158,024,890
2004-2005	17,019,260	71,669,150	105,862,150	150,136,150	165,979,150
2005-2006	7,749,953	24,769,213	79,419,104	113,612,104	157,886,104
2006-2007	11,049,461	18,799,414	35,818,674	90,468,564	124,661,564
2007-2008	6,398,000	17,447,461	25,197,414	42,216,674	96,866,564
2008-2009	20,984,000	27,382,000	38,431,461	46,181,414	63,200,674
2009-2010	35,951,000	56,935,000	63,333,000	74,382,461	82,132,414
2010-2011	15,850,247	51,801,247	72,785,247	79,183,247	90,232,707
2011-2012	58,972,771	74,823,017	110,774,017	131,758,017	138,156,017
2012-2013	24,826,000	83,798,771	99,649,017	135,600,017	156,584,017
2013-2014	3,461,949	28,287,949	87,260,719	103,110,966	139,061,966
PERCENTILE 50%	27,432,611	60,117,000	91,769,107	126,646,835	155,825,398
PERCENTILE 25%	13,857,267	33,502,915	59,366,515	90,468,564	117,037,787
PERCENTILE 15%	11,622,819	24,866,364	49,167,911	72,613,742	96,913,438
PERCENTILE 5%	6,647,668	18,755,473	38,039,543	56,779,852	74,801,377
AVERAGE	31,222,771	62,358,123	93,904,690	126,803,535	160,846,690

A.4 ANNEX 4

TABLE OF VALUES FOR THE CALCULATION OF THE WET PERIOD RUNOFF INDEX

Table 23: Runoff at the dam of Kanavia (in m^3) to calculate the Wet Period Index

	OCT-DEC	OCT-JAN	OCT-FEB	OCT-MAR	OCT-APR
1970-1971	49,377	196,842	1,182,691	2,266,082	3,775,914
1971-1972	34,212	210,612	432,264	818,669	989,124
1972-1973	7,340	26,994	62,723	148,618	206,548
1973-1974	29,482	332,662	588,223	1,460,516	1,668,520
1974-1975	173,609	2,703,745	7,207,763	9,563,198	10,278,988
1975-1976	131,936	1,442,196	2,547,424	4,216,186	5,010,228
1976-1977	473,513	2,043,398	2,651,820	4,192,589	5,246,863
1977-1978	724,161	5,647,341	10,275,713	12,660,265	14,019,660
1978-1979	249,434	1,181,781	2,052,255	2,618,214	2,848,116
1979-1980	683,579	3,386,597	5,782,047	9,533,879	10,967,886
1980-1981	20,625	3,254,662	7,497,842	9,088,352	9,902,412
1981-1982	427,715	960,918	1,790,858	3,408,665	3,931,556
1982-1983	45,617	382,766	1,739,128	4,169,175	5,105,768
1983-1984	374,820	1,152,665	2,830,710	3,879,282	4,971,226
1984-1985	605,874	2,678,026	5,451,409	6,610,625	7,206,308
1985-1986	174,459	1,283,327	2,126,503	2,481,972	2,667,774
1986-1987	173,367	1,674,706	2,648,302	9,397,960	10,616,016
1987-1988	480,671	1,710,859	4,459,978	12,230,547	13,515,330
1988-1989	2,511,816	7,559,349	8,320,028	8,780,439	8,987,775
1989-1990	38,459	193,506	1,536,340	2,215,734	2,463,106
1990-1991	6,733	11,889	45,313	167,422	255,804
1991-1992	2,900,406	4,325,920	6,930,668	8,203,925	8,755,326
1992-1993	1,146,053	2,034,118	2,964,645	4,954,299	5,339,491
1993-1994	6,430	208,610	1,805,186	2,140,030	2,293,015
1994-1995	1,341,561	2,941,777	3,784,953	4,182,884	4,400,654
1995-1996	2,972	79,950	516,764	1,551,020	1,904,062
1996-1997	28,146	59,265	266,298	415,643	959,340
1997-1998	38,033	240,456	443,910	1,138,894	1,730,695
1998-1999	617,096	1,535,491	3,452,353	4,023,772	5,174,496

	OCT-DEC	OCT-JAN	OCT-FEB	OCT-MAR	OCT-APR
1999-2000	6,248	92,082	570,691	1,190,031	1,763,148
2000-2001	43,433	398,416	1,606,281	2,127,049	2,281,793
2001-2002	2,594,678	5,668,936	6,683,174	7,528,777	9,318,252
2002-2003	814,909	1,678,710	5,130,274	8,157,824	9,532,384
2003-2004	77,463	5,649,282	8,327,429	9,372,604	9,760,223
2004-2005	88,321	399,932	1,322,573	1,889,746	2,504,840
2005-2006	3,700	10,494	48,771	78,009	109,067
2006-2007	104,154	113,010	183,982	220,196	237,242
2007-2008	120,107	156,624	237,484	286,740	300,571
2008-2009	25,659	186,530	641,360	1,084,847	1,261,307
2009-2010	288,257	983,059	1,677,011	2,754,942	2,861,279
2010-2011	8,918	67,212	177,856	456,650	599,080
2011-2012	32,089	2,525,647	7,749,367	11,915,326	12,477,282
2012-2013	2,777,190	4,870,663	6,683,777	7,781,990	8,273,694
2013-2014	26,000	174,000	382,000	586,000	682,000
AVERAGE	441,611	1,619,938	2,945,579	4,280,241	4,878,053
PERCENTILE 50%	126,022	1,067,862	1,928,721	3,081,804	3,853,735
PERCENTILE 25%	33,030	196,008	583,840	1,392,895	1,755,035
PERCENTILE 15%	18,632	109,871	407,369	758,215	984,656
PERCENTILE 5%	6,121	26,239	62,025	166,482	235,707
10,494	VERY HIGH ALERT LEVEL				
113,010	HIGH ALERT LEVEL				

Table 24: Runoff at the dam of Evretou (in m^3) to calculate the Wet Period Index

	OCT-DEC	OCT-JAN	OCT-FEB	OCT-MAR	OCT-APR
1970-1971	247,190	564,278	1,740,010	3,154,378	4,930,762
1971-1972	41,904	186,451	379,070	730,026	798,628
1972-1973	0	0	41,731	80,698	80,698
1973-1974	50,890	597,110	824,861	1,562,717	1,750,032
1974-1975	324,432	4,367,952	10,336,464	13,687,056	14,431,824
1975-1976	257,213	2,145,917	3,634,976	5,935,808	7,189,472
1976-1977	570,240	2,270,592	2,954,880	4,411,584	5,327,424
1977-1978	689,040	5,028,912	10,248,336	12,607,056	13,852,944
1978-1979	245,376	952,128	1,838,592	2,300,832	2,477,088
1979-1980	1,309,046	5,200,502	7,985,085	12,661,053	14,566,173
1980-1981	5,098	4,700,246	9,288,086	11,081,750	11,855,030
1981-1982	229,651	707,443	1,445,299	2,992,723	3,501,965
1982-1983	13,478	339,293	1,627,517	4,000,925	4,862,333
1983-1984	452,191	945,914	1,698,321	2,328,693	2,822,296
1984-1985	1,050,241	3,850,221	8,234,008	9,472,041	10,036,409
1985-1986	660,748	2,758,348	3,907,453	4,462,282	4,676,205
1986-1987	159,076	2,107,537	3,190,566	12,870,271	14,035,770
1987-1988	413,042	2,025,962	5,397,094	14,041,461	15,438,470
1988-1989	3,853,301	9,951,058	10,889,022	11,448,421	11,653,204
1989-1990	119,928	430,430	1,770,903	2,725,758	3,138,303
1990-1991	16,295	45,408	217,997	477,825	631,238
1991-1992	3,823,394	5,992,435	9,057,536	10,800,320	11,694,565
1992-1993	1,910,008	3,170,893	4,271,808	6,870,086	7,418,755
1993-1994	7,154	362,154	2,518,154	2,820,154	2,820,154
1994-1995	1,599,900	3,606,291	4,619,701	5,024,159	5,067,518
1995-1996	0	181,914	555,319	1,579,591	1,870,930
1996-1997	84,000	84,000	276,000	346,000	790,000
1997-1998	74,000	342,000	581,000	1,398,000	2,064,000
1998-1999	1,134,000	2,568,089	4,837,322	5,441,298	6,663,241
1999-2000	52,000	123,000	521,000	1,172,000	1,626,000
2000-2001	133,000	570,000	1,765,000	2,125,000	2,182,000
2001-2002	2,687,000	5,735,000	6,734,000	7,582,000	9,237,000
2002-2003	840,000	1,807,000	5,802,000	8,665,000	9,527,000
2003-2004	112,000	7,148,021	10,581,701	11,137,965	11,186,173

	OCT-DEC	OCT-JAN	OCT-FEB	OCT-MAR	OCT-APR
2004-2005	27,886	142,925	1,108,895	1,361,246	1,537,226
2005-2006	113,228	203,578	776,214	1,153,859	1,258,254
2006-2007	67,989	70,989	864,989	966,989	1,129,989
2007-2008	1,096,000	1,351,000	1,907,000	2,178,000	2,219,000
2008-2009	83,000	1,143,000	4,902,000	8,188,000	9,597,000
2009-2010	1,171,000	5,453,000	8,695,000	9,876,000	9,926,000
2010-2011	73,061	595,061	2,070,061	4,475,061	5,242,061
2011-2012	163,000	9,867,577	11,336,252	11,386,252	11,503,101
2012-2013	5,806,000	8,583,270	10,917,725	12,113,748	12,678,453
2013-2014	52,280	72,040	179,652	312,748	312,748
AVERAGE	643,098	2,230,775	3,950,623	5,542,976	6,146,777
PERCENTILE 50%	237,514	1,247,000	2,736,517	4,206,254	4,896,547
PERCENTILE 25%	63,992	341,323	1,047,919	1,575,372	2,015,733
PERCENTILE 15%	26,148	176,066	577,148	1,169,279	1,495,380
PERCENTILE 5%	4,843	69,710	273,100	471,234	782,062

Table 25: Runoff at the hydrometric station of Hydrologic Region 3 (in m^3) to calculate the Wet Period Index

	OCT-DEC	OCT-JAN	OCT-FEB	OCT-MAR	OCT-APR
1970-1971	430,963	2,280,096	5,253,120	6,672,672	12,878,525
1971-1972	1,446,765	3,500,493	5,307,951	8,099,535	9,211,071
1972-1973	----------	----------	----------	----------	----------
1973-1974	----------	----------	----------	----------	----------
1974-1975	424,915	4,557,773	12,476,333	15,220,397	15,668,813
1975-1976	1,749,168	5,499,792	7,229,937	10,347,249	12,132,273
1976-1977	896,227	3,861,475	4,900,867	7,062,595	8,197,027
1977-1978	1,000,253	5,854,205	9,995,357	11,841,725	12,767,933
1978-1979	981,331	3,288,211	7,260,019	7,999,603	8,189,942
1979-1980	3,582,490	8,238,586	13,746,854	16,222,214	17,658,182
1980-1981	181,440	8,412,854	16,845,494	19,010,678	19,887,638
1981-1982	1,017,792	1,632,096	3,140,640	6,657,984	7,343,136
1982-1983	184,464	1,834,013	4,260,989	8,330,429	9,133,085
1983-1984	1,099,526	2,747,174	5,630,193	6,732,657	8,041,617
1984-1985	2,501,280	6,039,360	10,003,392	13,160,448	14,340,672
1985-1986	625,968	1,799,280	3,494,448	4,191,696	4,900,262
1986-1987	1,608,422	4,511,549	5,145,379	15,656,285	16,803,331
1987-1988	2,171,578	5,503,162	8,866,684	19,683,964	20,999,836
1988-1989	4,201,718	16,841,174	18,107,798	19,246,550	19,832,774
1989-1990	168,998	328,234	3,090,787	4,899,139	5,351,011
1990-1991	1,728	165,370	683,856	2,370,384	2,735,165
1991-1992	8,407,584	10,722,240	17,662,841	19,966,265	20,993,561
1992-1993	6,964,358	10,108,454	15,547,334	20,162,822	21,146,918
1993-1994	157,766	2,700,000	7,102,944	10,168,416	10,993,536
1994-1995	11,315,203	13,701,571	14,815,267	15,497,827	15,900,451
1995-1996	94,349	1,387,325	2,957,302	4,582,486	5,319,478
1996-1997	647,136	933,984	1,732,061	2,298,845	4,044,989
1997-1998	658,973	1,150,589	1,482,365	2,344,205	2,738,534
1998-1999	1,172,362	2,707,690	5,542,474	6,234,538	6,643,037
1999-2000	27,475	334,454	873,102	1,667,982	2,880,174
2000-2001	3,031,776	5,211,648	7,382,016	8,701,344	9,344,160
2001-2002	7,941,888	17,094,240	19,391,616	20,867,328	23,134,464
2002-2003	1,011,053	2,272,147	7,625,146	13,795,142	15,652,224

	OCT-DEC	OCT-JAN	OCT-FEB	OCT-MAR	OCT-APR
2003-2004	1,158,106	16,354,829	21,013,707	21,704,907	22,030,290
2004-2005	2,088,115	4,454,611	7,483,277	9,132,826	10,284,019
2005-2006	599,702	1,387,152	3,526,848	4,424,890	4,993,488
2006-2007	677,635	889,402	4,201,373	5,542,128	6,194,362
2007-2008	470,794	677,203	1,431,994	1,740,442	1,806,797
2008-2009	235,872	987,034	2,981,578	4,556,218	5,424,278
2009-2010	2,716,243	8,106,394	12,161,232	15,262,733	16,013,462
2010-2011	400,982	1,627,517	3,045,773	5,349,542	7,028,899
2011-2012	807,840	10,719,648	16,716,678	21,505,571	22,787,833
2012-2013	4,112,381	5,889,802	7,109,510	7,891,776	8,403,955
2013-2014	-----------	-----------	-----------	-----------	-----------
AVERAGE	1,938,195	4,949,365	7,904,068	10,317,304	11,358,172
PERCENTILE 50%	1,005,653	3,394,352	6,366,569	8,515,886	9,814,090
PERCENTILE 25%	440,921	1,448,518	3,502,548	5,059,886	5,616,799
PERCENTILE 15%	183,103	963,161	2,970,654	4,319,952	4,951,536
PERCENTILE 5%	84,318	333,521	1,348,160	2,215,084	2,738,029

Table 26: Runoff at the hydrometric station of Hydrologic Region 6 (in m^3) to calculate the Wet Period Index

	OCT-DEC	OCT-JAN	OCT-FEB	OCT-MAR	OCT-APR
1970-1971	121,087	529,413	1,308,725	1,448,261	1,995,053
1971-1972	227,627	774,539	987,108	1,361,652	940,893
1972-1973	----------	----------	----------	----------	----------
1973-1974	----------	----------	----------	----------	----------
1974-1975	188,611	1,032,048	2,830,896	3,239,568	3,256,848
1975-1976	653,616	1,277,683	1,595,016	2,239,387	2,585,160
1976-1977	293,069	710,813	804,470	1,039,738	1,085,962
1977-1978	324,173	941,242	1,366,762	1,519,171	1,570,493
1978-1979	167,443	478,397	1,090,368	1,226,448	1,253,059
1979-1980	465,264	880,070	1,646,623	1,851,910	1,958,786
1980-1981	19,008	928,282	2,139,610	2,370,298	2,443,910
1981-1982	61,085	104,803	253,066	556,070	584,496
1982-1983	16,934	291,946	504,576	920,074	976,061
1983-1984	211,853	349,920	627,294	684,404	744,798
1984-1985	365,818	807,322	1,116,979	1,507,939	1,596,845
1985-1986	111,456	239,414	434,765	522,288	582,250
1986-1987	143,424	289,958	323,482	2,517,350	2,562,710
1987-1988	302,054	774,403	1,270,006	2,373,506	2,443,231
1988-1989	570,499	2,755,987	2,905,805	2,982,269	3,003,178
1989-1990	0	6,480	700,790	915,840	945,130
1990-1991	0	16,848	188,352	567,821	622,858
1991-1992	1,524,096	1,873,238	3,308,074	3,743,012	3,831,226
1992-1993	949,536	1,492,301	2,314,656	2,814,221	2,873,750
1993-1994	0	541,037	1,176,682	1,759,536	1,832,803
1994-1995	1,885,334	2,096,410	2,187,648	2,240,784	2,272,147
1995-1996	0	170,813	436,257	591,605	650,875
1996-1997	113,443	143,338	268,186	307,757	521,078
1997-1998	110,592	222,480	256,176	347,414	363,485
1998-1999	135,734	273,024	618,538	645,494	673,142
1999-2000	0	21,427	63,805	149,427	298,381
2000-2001	1,017,360	1,558,051	1,802,477	1,908,058	1,952,208
2001-2002	2,199,571	3,363,379	3,768,854	3,958,157	4,210,790
2002-2003	198,720	488,074	2,002,234	3,102,970	3,249,504

	OCT-DEC	OCT-JAN	OCT-FEB	OCT-MAR	OCT-APR
2003-2004	118,195	1,704,067	2,497,398	2,622,246	2,665,705
2004-2005	121,478	365,472	569,462	597,110	609,206
2005-2006	86,486	261,446	506,563	594,000	627,350
2006-2007	137,635	147,312	617,069	715,824	768,355
2007-2008	36,461	50,803	96,267	107,931	107,931
2008-2009	33,523	159,840	379,814	522,115	563,155
2009-2010	209,088	840,326	1,346,803	1,584,403	1,598,832
2010-2011	28,253	286,675	426,125	627,437	752,803
2011-2012	286,070	1,293,754	1,824,559	2,124,022	2,152,793
2012-2013	445,392	540,778	612,490	636,163	648,778
2013-2014	-----------	-----------	-----------	-----------	-----------
AVERAGE	345,270	762,169	1,218,728	1,530,423	1,600,570
PERCENTILE 50%	140,530	508,743	1,038,738	1,404,957	1,411,776
PERCENTILE 25%	48,773	230,947	435,511	595,555	639,113
PERCENTILE 15%	18,075	145,524	298,598	540,868	583,485
PERCENTILE 5%	0	20,740	174,539	284,007	353,719

Table 27: Inflow at the Kalavasos dam (in m^3) to calculate the Wet Period Index

	OCT-DEC	OCT-JAN	OCT-FEB	OCT-MAR	OCT-APR
1970-1971	322,395	849,704	1,955,504	2,723,353	5,180,976
1971-1972	699,115	1,513,198	2,267,340	2,992,664	3,409,624
1972-1973	191,355	349,314	612,880	754,890	839,020
1973-1974	324,650	972,473	1,466,078	2,583,113	2,910,354
1974-1975	282,715	2,378,794	8,367,248	10,510,877	11,027,179
1975-1976	1,819,208	5,240,324	7,821,073	9,998,842	11,290,751
1976-1977	1,027,526	3,086,098	4,234,118	5,232,562	6,243,846
1977-1978	793,761	4,024,268	10,025,140	12,396,968	13,832,358
1978-1979	1,215,025	2,795,846	5,390,532	6,350,643	6,751,123
1979-1980	1,515,880	4,348,569	9,695,904	12,876,309	14,473,620
1980-1981	244,803	5,585,531	12,775,402	16,117,523	18,567,079
1981-1982	965,425	1,607,345	2,412,635	4,244,213	4,920,131
1982-1983	231,019	1,006,734	2,185,177	4,686,976	5,619,893
1983-1984	245,947	656,277	1,881,869	2,689,900	3,357,458
1984-1985	649,529	2,389,769	4,678,594	6,093,925	6,946,209
1985-1986	378,997	1,319,016	2,606,119	3,542,281	4,003,420
1986-1987	366,463	1,363,365	1,789,507	7,929,999	9,560,329
1987-1988	1,014,422	2,087,510	3,786,789	10,384,293	12,038,853
1988-1989	850,003	7,291,123	8,856,691	10,263,283	10,981,267
1989-1990	80,006	136,425	1,482,710	2,323,382	2,694,643
1990-1991	8,208	52,531	149,904	522,806	698,803
1991-1992	3,736,627	6,701,011	10,902,077	13,354,973	14,517,053
1992-1993	4,764,960	6,882,624	8,995,104	12,662,784	13,930,272
1993-1994	84,499	661,799	2,134,999	3,627,099	4,269,899
1994-1995	8,745,900	11,397,900	12,933,900	13,706,291	14,191,687
1995-1996	46,124	625,928	1,287,119	1,789,592	2,023,889
1996-1997	204,000	247,000	452,000	586,000	821,000
1997-1998	98,000	174,000	234,000	307,000	323,000
1998-1999	79,000	199,950	955,742	1,177,974	1,317,328
1999-2000	0	1,000	13,000	60,000	188,000
2000-2001	1,204,000	3,955,000	5,101,000	5,899,000	6,431,000
2001-2002	5,639,000	10,627,000	12,098,000	13,005,000	13,649,000
2002-2003	489,000	981,000	4,910,000	8,409,000	10,233,000
2003-2004	347,563	7,825,563	11,599,547	13,394,547	13,928,708

	OCT-DEC	OCT-JAN	OCT-FEB	OCT-MAR	OCT-APR
2004-2005	184,121	716,101	1,866,215	2,362,950	2,442,399
2005-2006	40,541	53,541	212,628	354,678	354,678
2006-2007	88,000	100,000	414,010	490,010	499,010
2007-2008	0	0	17,000	21,000	21,000
2008-2009	83,000	530,000	981,000	1,620,000	2,109,000
2009-2010	1,386,000	3,730,000	5,662,000	7,216,000	7,712,000
2010-2011	487,306	839,306	1,222,306	2,268,306	2,851,306
2011-2012	177,000	4,612,307	8,469,298	11,048,683	11,580,562
2012-2013	1,993,000	2,830,000	3,379,000	3,640,000	3,868,000
2013-2014	38,356	62,344	98,313	137,064	137,064
AVERAGE	1,011,170	2,611,591	4,380,264	5,881,568	6,607,721
PERCENTILE 50%	336,107	1,341,191	2,339,988	4,465,595	5,400,435
PERCENTILE 25%	95,500	484,829	1,210,589	1,747,194	2,087,722
PERCENTILE 15%	79,855	168,364	446,302	576,521	802,670
PERCENTILE 5%	7,798	49,954	143,259	294,650	316,250

Table 28: Inflow at the Kouris dam (in m^3) to calculate the Wet Period Index

	OCT-DEC	OCT-JAN	OCT-FEB	OCT-MAR	OCT-APR
1970-1971	2,842,122	5,916,782	10,678,508	15,590,566	24,031,862
1971-1972	4,523,341	7,935,653	11,063,263	15,619,773	18,148,941
1972-1973	2,390,408	3,423,408	4,983,884	6,279,131	6,511,669
1973-1974	2,664,109	4,908,360	6,653,889	11,919,110	13,265,064
1974-1975	3,884,666	16,112,913	38,334,699	49,552,376	52,122,467
1975-1976	5,760,006	18,181,537	26,270,699	36,259,467	43,036,366
1976-1977	5,624,826	12,524,616	16,761,371	21,426,455	25,232,495
1977-1978	5,353,870	22,556,216	44,610,966	57,234,134	65,131,369
1978-1979	6,626,447	12,856,899	22,060,596	26,114,804	27,168,922
1979-1980	8,639,830	21,397,820	36,913,759	49,381,822	56,736,189
1980-1981	2,105,730	22,211,287	48,797,730	63,602,629	70,881,711
1981-1982	6,136,076	9,281,130	12,516,861	19,905,829	22,948,274
1982-1983	2,842,599	6,927,828	13,287,137	25,131,200	31,675,441
1983-1984	5,480,221	8,991,561	15,522,102	20,007,025	25,179,183
1984-1985	10,064,053	20,151,849	31,793,082	39,759,518	44,077,405
1985-1986	4,697,122	8,814,263	13,176,099	15,915,666	17,417,857
1986-1987	5,081,192	14,554,235	18,188,252	44,581,296	54,386,393
1987-1988	7,800,000	14,600,000	23,250,000	53,950,000	63,550,000
1988-1989	8,401,000	30,256,000	35,770,000	41,274,000	43,582,000
1989-1990	2,390,000	3,226,000	8,156,000	11,016,000	11,879,000
1990-1991	300,000	1,187,000	2,698,000	5,286,000	6,072,000
1991-1992	11,277,000	17,315,000	25,232,000	30,578,000	34,594,000
1992-1993	10,940,000	15,857,000	21,404,000	32,175,000	36,473,000
1993-1994	1,850,000	5,032,540	11,459,040	15,437,540	17,090,340
1994-1995	15,763,525	21,444,930	25,636,905	29,084,647	31,170,621
1995-1996	1,196,370	4,852,555	7,755,204	11,342,553	12,885,814
1996-1997	1,842,000	2,600,000	4,741,000	6,673,000	10,947,000
1997-1998	3,221,000	5,467,000	6,746,000	9,668,000	11,684,000
1998-1999	5,454,000	8,038,000	17,271,000	20,857,000	23,770,000
1999-2000	1,047,000	2,097,000	3,521,000	5,188,000	7,395,000
2000-2001	4,237,000	8,288,000	11,340,000	13,859,000	15,092,000
2001-2002	12,650,000	27,937,000	33,563,000	37,582,000	41,503,000
2002-2003	3,119,000	6,132,000	13,724,000	23,389,000	30,183,000
2003-2004	3,155,431	27,789,506	44,763,707	49,003,707	51,527,419

	OCT-DEC	OCT-JAN	OCT-FEB	OCT-MAR	OCT-APR
2004-2005	3,370,352	6,869,894	12,005,428	14,803,654	15,989,446
2005-2006	1,248,753	2,375,032	5,183,698	6,800,433	7,327,674
2006-2007	2,202,817	2,806,817	6,244,985	8,637,461	9,513,461
2007-2008	2,474,000	3,769,000	5,083,000	6,023,000	6,358,000
2008-2009	1,547,000	4,051,000	8,760,000	13,862,000	17,503,000
2009-2010	7,868,000	16,036,000	24,903,000	31,723,000	34,128,000
2010-2011	1,537,247	3,615,247	6,066,247	10,158,247	13,260,247
2011-2012	2,263,000	22,586,084	38,742,543	51,597,600	56,415,316
2012-2013	12,073,000	16,600,000	19,260,000	21,869,000	23,962,000
2013-2014	810,476	1,306,212	1,929,476	2,371,281	2,553,824
AVERAGE	4,951,772	11,369,341	18,270,597	24,912,345	28,454,235
PERCENTILE 50%	4,060,833	8,551,131	13,505,568	20,432,013	24,605,523
PERCENTILE 25%	2,390,306	4,894,409	8,055,801	11,774,971	13,170,252
PERCENTILE 15%	1,848,800	3,393,797	6,085,792	8,361,906	10,731,969
PERCENTILE 5%	1,188,902	2,361,130	4,680,000	5,986,150	6,503,986

A.5 ANNEX 5

TABLE OF VALUES FOR THE CALCULATION OF THE MONTHLY REGIME INDEX

Table 29: Median values of mean daily discharges (in m^3/s) per month for hydrometric station r1-3-5-05_Xeros near Lazarides and 5% and 25% percentiles of the mean daily discharges of the entire sample.

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970-1971	0.060	0.077	0.110	0.120	0.335	0.560	0.675	0.240	0.105	0.075	0.068	0.060
1971-1972	0.059	0.065	0.110	0.100	0.140	0.150	0.097	0.140	0.066	0.054	0.053	0.053
1972-1973	0.059	0.062	0.059	0.059	0.080	0.100	0.072	0.052	0.038	0.035	0.032	0.030
1973-1974	0.039	0.045	0.069	0.065	0.125	0.380	0.120	0.068	0.045	0.040	0.040	0.038
1974-1975	0.037	0.040	0.170	0.380	2.250	0.710	0.345	0.210	0.135	0.068	0.054	0.054
1975-1976	0.060	0.066	0.098	0.760	0.650	0.800	0.565	0.310	0.190	0.110	0.065	0.061
1976-1977	0.059	0.073	0.140	0.250	0.285	0.670	0.485	0.210	0.120	0.085	0.057	0.049
1977-1978	0.057	0.063	0.200	2.400	1.850	0.930	0.680	0.300	0.175	0.100	0.082	0.072
1978-1979	0.073	0.084	0.150	0.480	0.355	0.300	0.165	0.110	0.105	0.069	0.054	0.050
1979-1980	0.056	0.073	0.220	1.150	0.970	1.800	0.600	0.280	0.160	0.100	0.079	0.066
1980-1981	0.074	0.076	0.086	1.000	2.350	0.680	0.455	0.230	0.145	0.077	0.061	0.058
1981-1982	0.057	0.090	0.150	0.260	0.395	0.750	0.235	0.130	0.085	0.058	0.052	0.046
1982-1983	0.052	0.062	0.068	0.210	0.910	1.000	0.630	0.270	0.135	0.077	0.056	0.051
1983-1984	0.055	0.110	0.190	0.370	0.540	0.450	0.520	0.200	0.098	0.065	0.051	0.050
1984-1985	0.046	0.130	0.140	0.560	1.075	0.510	0.245	0.130	0.081	0.061	0.050	0.044
1985-1986	0.060	0.089	0.079	0.375	0.390	0.164	0.116	0.081	0.050	0.033	0.029	0.037

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1986-1987	0.044	0.050	0.050	1.150	0.450	3.600	0.450	0.260	0.140	0.085	0.056	0.052
1987-1988	0.060	0.085	0.160	0.290	1.600	3.800	0.570	0.270	0.160	0.100	0.072	0.063
1988-1989	0.063	0.130	0.620	1.300	0.380	0.250	0.150	0.110	0.074	0.043	0.042	0.041
1989-1990	0.050	0.077	0.096	0.100	0.370	0.320	0.140	0.082	0.049	0.035	0.031	0.032
1990-1991	0.037	0.043	0.049	0.072	0.125	0.130	0.090	0.044	0.030	0.022	0.019	0.022
1991-1992	0.030	0.045	0.810	0.460	1.490	0.680	0.320	0.200	0.140	0.092	0.070	0.055
1992-1993	0.055	0.053	0.700	0.530	0.870	0.730	0.325	0.210	0.110	0.074	0.056	0.054
1993-1994	0.048	0.057	0.072	0.110	0.760	0.260	0.135	0.092	0.051	0.036	0.029	0.029
1994-1995	0.057	0.071	0.340	0.770	0.455	0.260	0.180	0.120	0.083	0.040	0.029	0.030
1995-1996	0.038	0.055	0.057	0.120	0.170	0.430	0.210	0.093	0.049	0.032	0.027	0.027
1996-1997	0.042	0.041	0.100	0.064	0.096	0.100	0.200	0.095	0.052	0.027	0.024	0.022
1997-1998	0.032	0.040	0.160	0.160	0.165	0.100	0.225	0.120	0.067	0.043	0.029	0.028
1998-1999	0.033	0.043	0.390	0.340	0.865	0.360	0.480	0.140	0.089	0.062	0.046	0.040
1999-2000	0.033	0.043	0.390	0.340	0.865	0.360	0.480	0.140	0.089	0.062	0.046	0.040
2000-2001	0.039	0.044	0.200	0.220	0.375	0.270	0.145	0.100	0.051	0.032	0.027	0.029
2001-2002	0.040	0.048	3.000	1.550	0.675	0.480	0.690	0.290	0.145	0.090	0.064	0.046
2002-2003	0.060	0.064	0.120	0.220	1.725	1.950	0.530	0.210	0.160	0.110	0.084	0.071
2003-2004	0.075	0.093	0.200	2.200	1.550	0.410	0.200	0.190	0.084	0.058	0.051	0.047
2004-2005	0.048	0.053	0.086	0.180	0.395	0.240	0.215	0.085	0.057	0.045	0.041	0.038
2005-2006	0.053	0.098	0.072	0.170	0.250	0.290	0.120	0.066	0.037	0.029	0.022	0.026
2006-2007	0.039	0.093	0.053	0.072	0.425	0.250	0.088	0.320	0.145	0.078	0.063	0.050
2007-2008	0.053	0.069	0.320	0.140	0.400	0.260	0.140	0.078	0.050	0.039	0.038	0.040

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
2008-2009	0.066	0.080	0.088	0.110	1.575	1.450	0.850	0.510	0.215	0.140	0.110	0.120
2009-2010	0.130	0.190	0.510	1.550	1.500	0.560	0.240	0.120	0.088	0.080	0.080	0.043
2010-2011	0.043	0.043	0.115	0.150	0.457	0.669	0.382	0.157	0.088	0.072	0.072	0.072
2011-2012	0.088	0.113	0.069	3.246	2.177	0.970	0.429	0.180	0.180	0.155	0.148	0.135
2012-2013	0.000	0.000	0.807	1.448	1.145	0.594	0.198	0.090	0.017	0.000	0.000	0.000
2013-2014	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
AVERAGE	0.053	0.070	0.271	0.595	0.791	0.691	0.330	0.171	0.098	0.065	0.053	0.048
ST. DEV.	0.019	0.032	0.471	0.717	0.642	0.789	0.208	0.095	0.050	0.032	0.026	0.023
COEFF. VAR.	0.367	0.454	1.735	1.204	0.812	1.141	0.631	0.557	0.504	0.492	0.494	0.484
5% PERCENTILE	0.03	0.039	0.05	0.068	0.12	0.12	0.09	0.064	0.038	0.027	0.024	0.024
25% PERCENTILE	0.042	0.051	0.08	0.13	0.3	0.25	0.16	0.1	0.061	0.041	0.03225	0.033

Table 30: Median values of mean daily discharges (in m^3/s) per month for hydrometric station r1-4-3-35 (Agia-Upstream Kannavia dam) and 5% and 25% percentiles of the mean daily discharges of the entire sample.

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1979-1980	0.002	0.028	0.179	1.079	0.874	1.563	0.558	0.223	0.096	0.026	0.007	0.007
1980-1981	0.011	0.022	0.041	0.595	1.842	0.744	0.419	0.184	0.096	0.026	0.002	0.002
1981-1982	0.004	0.048	0.080	0.156	0.279	0.688	0.205	0.082	0.056	0.011	0.000	0.000
1982-1983	0.004	0.016	0.032	0.110	0.558	0.874	0.465	0.179	0.074	0.013	0.000	0.000
1983-1984	0.000	0.046	0.112	0.298	0.521	0.409	0.698	0.205	0.062	0.011	0.000	0.000
1984-1985	0.000	0.099	0.117	0.428	0.967	0.484	0.233	0.097	0.035	0.000	0.000	0.000
1985-1986	0.000	0.037	0.039	0.298	0.307	0.119	0.069	0.033	0.006	0.000	0.000	0.000
1986-1987	0.000	0.007	0.019	0.465	0.288	2.512	0.326	0.180	0.061	0.015	0.000	0.000
1987-1988	0.002	0.022	0.063	0.166	0.819	2.233	0.419	0.136	0.058	0.011	0.002	0.000
1988-1989	0.004	0.046	0.409	0.819	0.242	0.162	0.077	0.030	0.004	0.000	0.000	0.000
1989-1990	0.000	0.007	0.030	0.056	0.223	0.260	0.083	0.022	0.000	0.000	0.000	0.000
1990-1991	0.000	0.000	0.000	0.030	0.050	0.060	0.029	0.004	0.000	0.000	0.000	0.000
1991-1992	0.000	0.000	0.353	0.242	1.209	0.465	0.223	0.121	0.049	0.013	0.000	0.000
1992-1993	0.000	0.000	0.223	0.298	0.447	0.409	0.163	0.097	0.022	0.002	0.000	0.000
1993-1994	0.000	0.000	0.015	0.043	0.391	0.171	0.066	0.037	0.007	0.000	0.000	0.000
1994-1995	0.000	0.015	0.186	0.447	0.260	0.160	0.100	0.069	0.015	0.000	0.000	0.000
1995-1996	0.000	0.011	0.015	0.056	0.130	0.335	0.140	0.041	0.009	0.000	0.000	0.000
1996-1997	0.000	0.000	0.030	0.019	0.033	0.060	0.127	0.026	0.005	0.000	0.000	0.000
1997-1998	0.000	0.000	0.030	0.045	0.088	0.045	0.100	0.032	0.005	0.000	0.000	0.000
1998-1999	0.000	0.007	0.136	0.242	0.586	0.223	0.335	0.084	0.023	0.006	0.000	0.000

1999-2000	0.000	0.000	0.007	0.032	0.140	0.186	0.092	0.084	0.014	0.000	0.000	0.000
2000-2001	0.000	0.000	0.028	0.091	0.163	0.140	0.060	0.019	0.000	0.000	0.000	0.000
2001-2002	0.000	0.000	0.409	1.042	0.428	0.316	0.484	0.205	0.065	0.024	0.009	0.000
2002-2003	0.000	0.015	0.058	0.205	1.405	1.637	0.419	0.166	0.075	0.015	0.000	0.000
2003-2004	0.000	0.011	0.030	1.172	1.302	0.298	0.156	0.073	0.022	0.000	0.000	0.000
2004-2005	0.000	0.002	0.033	0.052	0.195	0.171	0.161	0.041	0.016	0.000	0.000	0.000
2005-2006	0.000	0.024	0.024	0.073	0.172	0.205	0.084	0.022	0.002	0.000	0.000	0.000
2006-2007	0.000	0.037	0.024	0.037	0.260	0.156	0.101	0.128	0.031	0.000	0.000	0.000
2007-2008	0.000	0.000	0.205	0.063	0.242	0.156	0.065	0.024	0.000	0.000	0.000	0.000
2008-2009	0.000	0.000	0.011	0.019	0.902	0.800	0.409	0.205	0.043	0.013	0.000	0.000
2009-2010	0.002	0.019	0.205	1.135	0.977	0.335	0.144	0.054	0.020	0.000	0.000	0.000
2010-2011	0.000	0.000	0.041	0.063	0.213	0.409	0.224	0.082	0.025	0.003	0.000	0.000
2011-2012	0.000	0.010	0.026	1.376	1.397	1.129	0.346	0.173	0.075	0.025	0.016	0.003
AVERAGE	0.001	0.016	0.097	0.341	0.543	0.543	0.230	0.096	0.032	0.006	0.001	0.000
ST. DEV.	0.002	0.021	0.115	0.400	0.471	0.616	0.172	0.068	0.030	0.009	0.003	0.001
COEFF. VAR.	2.585	1.324	1.179	1.174	0.868	1.136	0.749	0.712	0.921	1.376	3.054	3.771
5% PERCENTILE	0.000	0.000	0.006	0.019	0.050	0.060	0.045	0.015	0.000	0.000	0.000	0.000
25% PERCENTILE	0.000	0.000	0.020	0.056	0.186	0.164	0.089	0.035	0.007	0.000	0.000	0.000

Table 31: Median values of mean daily discharges (in m^3/s) per month for hydrometric station r2-8-3-10_Limnitis Saw Mill and 5% and 25% percentiles of the mean daily discharges of the entire sample.

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970-1971	0.000	0.058	0.130	0.110	0.200	0.610	0.645	0.230	0.057	0.006	0.006	0.005
1971-1972	0.009	0.025	0.120	0.092	0.180	0.230	0.155	0.140	0.046	0.003	0.002	0.001
1972-1973	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------
1973-1974	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------
1974-1975	0.029	0.042	0.220	0.450	2.350	0.730	0.295	0.220	0.240	0.160	0.100	0.076
1975-1976	0.061	0.096	0.150	1.050	0.900	0.980	0.780	0.400	0.230	0.160	0.120	0.095
1976-1977	0.080	0.091	0.270	0.510	0.585	0.810	0.600	0.310	0.170	0.088	0.062	0.068
1977-1978	0.071	0.074	0.290	3.000	2.000	0.880	0.675	0.360	0.185	0.100	0.072	0.070
1978-1979	0.073	0.096	0.190	0.660	0.480	0.380	0.260	0.150	0.170	0.070	0.040	0.039
1979-1980	0.050	0.079	0.320	1.250	0.930	1.400	0.600	0.260	0.120	0.062	0.049	0.038
1980-1981	0.043	0.061	0.090	0.990	2.425	0.940	0.445	0.400	0.225	0.051	0.029	0.025
1981-1982	0.036	0.083	0.110	0.230	0.375	0.700	0.265	0.110	0.056	0.019	0.003	0.002
1982-1983	0.024	0.050	0.078	0.300	1.075	1.000	0.510	0.270	0.155	0.048	0.012	0.010
1983-1984	0.032	0.079	0.150	0.320	0.640	0.460	0.495	0.200	0.063	0.021	0.014	0.011
1984-1985	0.010	0.120	0.160	0.480	0.945	0.650	0.250	0.110	0.038	0.010	0.007	0.008
1985-1986	0.029	0.058	0.063	0.300	0.385	0.160	0.085	0.054	0.010	0.007	0.007	0.006
1986-1987	0.008	0.044	0.044	0.770	0.460	3.100	0.535	0.250	0.097	0.036	0.015	0.016
1987-1988	0.022	0.065	0.140	0.260	1.200	2.500	0.540	0.200	0.088	0.025	0.020	0.017
1988-1989	0.034	0.083	0.380	1.200	0.435	0.260	0.145	0.056	0.027	0.013	0.015	0.015
1989-1990	0.019	0.078	0.078	0.091	0.295	0.400	0.170	0.050	0.011	0.004	0.003	0.003

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1990-1991	0.007	0.028	0.052	0.079	0.130	0.140	0.087	0.016	0.007	0.002	0.002	0.001
1991-1992	0.001	0.020	0.830	0.550	1.700	0.820	0.365	0.200	0.093	0.032	0.016	0.013
1992-1993	0.010	0.039	0.650	0.600	0.990	0.830	0.275	0.160	0.047	0.018	0.012	0.013
1993-1994	0.010	0.053	0.090	0.100	0.630	0.380	0.130	0.051	0.013	0.004	0.002	0.001
1994-1995	0.016	0.135	0.410	0.530	0.350	0.250	0.170	0.094	0.018	0.004	0.003	0.003
1995-1996	0.012	0.056	0.063	0.130	0.240	0.440	0.195	0.060	0.012	0.004	0.001	0.001
1996-1997	0.006	0.037	0.100	0.067	0.101	0.110	0.205	0.055	0.016	0.006	0.002	0.001
1997-1998	0.002	0.019	0.078	0.081	0.120	0.100	0.190	0.072	0.005	0.000	0.000	0.000
1998-1999	0.001	0.010	0.320	0.380	0.910	0.330	0.360	0.110	0.050	0.010	0.001	0.001
1999-2000	0.003	0.021	0.042	0.120	0.360	0.260	0.185	0.140	0.012	0.001	0.000	0.000
2000-2001	0.001	0.002	0.120	0.160	0.240	0.280	0.120	0.051	0.001	0.000	0.000	0.000
2001-2002	0.000	0.003	0.520	1.000	0.615	0.480	0.465	0.170	0.039	0.022	0.043	0.001
2002-2003	0.002	0.015	0.120	1.000	2.200	1.800	0.580	0.180	0.093	0.022	0.015	0.015
2003-2004	0.017	0.028	0.100	1.700	1.900	0.450	0.185	0.110	0.026	0.012	0.011	0.011
2004-2005	0.013	0.017	0.084	0.098	0.395	0.280	0.225	0.066	0.016	0.000	0.000	0.000
2005-2006	0.001	0.094	0.065	0.250	0.330	0.360	0.145	0.050	0.019	0.000	0.000	0.000
2006-2007	0.000	0.044	0.042	0.069	0.311	0.175	0.096	0.213	0.043	0.001	0.000	0.000
2007-2008	0.001	0.001	0.140	0.072	0.300	0.170	0.069	0.022	0.000	0.000	0.000	0.000
2008-2009	0.000	0.001	0.013	0.070	1.198	0.990	0.470	0.180	0.044	0.001	0.000	0.000
2009-2010	0.000	0.050	0.200	1.105	1.118	0.520	0.231	0.036	0.010	0.000	0.000	0.000
2010-2011	0.000	0.002	0.060	0.072	0.306	0.436	0.246	0.099	0.016	0.001	0.000	0.000
2011-2012	0.000	0.003	0.046	2.014	1.766	1.515	0.388	0.140	0.050	0.011	0.002	0.001

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
2012-2013	0.003	0.072	0.660	0.458	0.440	0.281	0.212	0.170	0.044	0.002	0.000	0.000
2013-2014	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------
AVERAGE	0.019	0.050	0.193	0.579	0.824	0.686	0.314	0.150	0.066	0.026	0.017	0.014
ST. DEV.	0.022	0.036	0.192	0.624	0.664	0.641	0.187	0.102	0.070	0.040	0.028	0.024
COEFF. VAR.	1.206	0.713	0.992	1.079	0.805	0.935	0.595	0.683	1.066	1.526	1.627	1.656
5% PERCENTILE	0	0.001	0.042	0.062	0.12	0.12	0.08	0.022	0.001	0	0	0
25% PERCENTILE	0.001	0.019	0.07	0.11	0.3	0.27	0.15	0.063	0.01375	0.002	0.001	0.001

Table 32: Median values of mean daily discharges (in m^3/s) per month for hydrometric station r3-7-1-50_Peristerona near Panagia Bridge and 5% and 25% percentiles of the mean daily discharges of the entire sample.

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970-1971	0.000	0.000	0.110	0.220	0.300	0.420	1.375	0.420	0.180	0.013	0.014	0.003
1971-1972	0.000	0.000	0.110	0.220	0.300	0.420	1.375	0.420	0.180	0.013	0.014	0.003
1972-1973	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------
1973-1974	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------
1974-1975	0.000	0.000	0.096	0.390	2.250	0.680	0.170	0.160	0.046	0.010	0.000	0.000
1975-1976	0.000	0.000	0.084	0.840	0.780	0.880	0.640	0.220	0.048	0.017	0.002	0.000
1976-1977	0.005	0.030	0.100	0.390	0.385	0.590	0.360	0.190	0.019	0.000	0.000	0.000
1977-1978	0.000	0.000	0.150	1.750	1.075	0.660	0.310	0.082	0.006	0.000	0.000	0.000
1978-1979	0.000	0.017	0.270	0.590	0.550	0.300	0.072	0.035	0.050	0.005	0.000	0.000
1979-1980	0.000	0.033	0.790	1.350	1.450	0.840	0.510	0.170	0.019	0.001	0.000	0.000
1980-1981	0.000	0.000	0.051	1.550	2.550	0.600	0.380	0.093	0.031	0.000	0.000	0.000
1981-1982	0.000	0.029	0.170	0.230	0.595	0.940	0.220	0.100	0.062	0.004	0.000	0.000
1982-1983	0.000	0.000	0.044	0.180	0.825	0.680	0.320	0.140	0.130	0.007	0.000	0.000
1983-1984	0.000	0.100	0.210	0.300	0.810	0.370	0.440	0.140	0.011	0.000	0.000	0.000
1984-1985	0.000	0.325	0.350	1.000	1.350	0.980	0.415	0.140	0.022	0.000	0.000	0.000
1985-1986	0.000	0.042	0.042	0.260	0.520	0.220	0.190	0.120	0.039	0.001	0.000	0.000
1986-1987	0.006	0.030	0.034	0.640	0.256	2.798	0.427	0.150	0.019	0.000	0.000	0.000
1987-1988	0.000	0.014	0.083	0.610	0.950	2.200	0.480	0.140	0.033	0.000	0.000	0.000
1988-1989	0.000	0.063	0.370	1.450	0.495	0.390	0.205	0.053	0.021	0.003	0.000	0.000
1989-1990	0.000	0.002	0.042	0.056	0.580	0.550	0.180	0.054	0.005	0.000	0.000	0.000

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1990-1991	0.000	0.000	0.000	0.056	0.140	0.350	0.125	0.015	0.003	0.000	0.000	0.000
1991-1992	0.000	0.000	1.100	0.610	2.500	0.760	0.360	0.240	0.099	0.031	0.011	0.003
1992-1993	0.001	0.002	1.250	1.000	2.000	1.050	0.360	0.250	0.088	0.010	0.000	0.000
1993-1994	0.000	0.000	0.039	0.250	1.150	0.800	0.270	0.130	0.014	0.000	0.000	0.000
1994-1995	0.026	0.110	0.800	0.640	0.445	0.250	0.150	0.079	0.006	0.000	0.000	0.000
1995-1996	0.000	0.000	0.037	0.190	0.530	0.470	0.275	0.054	0.006	0.000	0.000	0.000
1996-1997	0.000	0.000	0.160	0.110	0.130	0.180	0.335	0.075	0.025	0.000	0.000	0.000
1997-1998	0.000	0.006	0.150	0.160	0.135	0.110	0.135	0.039	0.006	0.000	0.000	0.000
1998-1999	0.000	0.000	0.170	0.610	0.670	0.250	0.145	0.031	0.105	0.022	0.001	0.000
1999-2000	0.000	0.000	0.012	0.042	0.150	0.250	0.150	0.140	0.011	0.000	0.000	0.000
2000-2001	0.000	0.000	0.650	0.660	0.420	0.470	0.220	0.084	0.005	0.000	0.000	0.000
2001-2002	0.000	0.000	0.940	2.900	0.785	0.540	0.580	0.300	0.390	0.260	0.015	0.003
2002-2003	0.016	0.036	0.176	0.490	0.858	1.655	0.634	0.187	0.133	0.023	0.000	0.000
2003-2004	0.000	0.000	0.234	2.008	1.605	0.228	0.126	0.076	0.070	0.007	0.000	0.000
2004-2005	0.000	0.042	0.400	0.518	0.897	0.622	0.423	0.200	0.187	0.000	0.000	0.000
2005-2006	0.000	0.116	0.073	0.187	0.358	0.300	0.199	0.069	0.010	0.008	0.000	0.000
2006-2007	0.000	0.099	0.047	0.075	0.700	0.410	0.227	0.425	0.150	0.023	0.000	0.000
2007-2008	0.000	0.000	0.148	0.047	0.208	0.127	0.023	0.008	0.000	0.000	0.000	0.000
2008-2009	0.000	0.000	0.000	0.059	0.810	0.440	0.295	0.124	0.012	0.002	0.000	0.000
2009-2010	0.016	0.089	0.490	0.903	1.150	0.696	0.279	0.098	0.031	0.010	0.000	0.000
2010-2011	0.000	0.000	0.109	0.115	0.557	0.712	0.590	0.270	0.040	0.005	0.000	0.000
2011-2012	0.000	0.043	0.060	2.779	2.200	1.635	0.475	0.280	0.057	0.003	0.000	0.000

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
2012-2013	0.000	0.073	0.570	0.580	0.490	0.270	0.194	0.062	0.002	0.000	0.000	0.000
2013-2014	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------
AVERAGE	0.002	0.033	0.269	0.681	0.880	0.673	0.305	0.134	0.051	0.012	0.001	0.000
ST. DEV.	0.005	0.060	0.321	0.712	0.660	0.560	0.159	0.090	0.072	0.042	0.003	0.001
COEFF. VAR.	3.031	1.796	1.193	1.045	0.750	0.832	0.521	0.669	1.404	3.588	3.960	4.357
5% PERCENTILE	0.000	0.000	0.000	0.046	0.120	0.160	0.072	0.016	0.001	0.000	0.000	0.000
25% PERCENTILE	0.000	0.000	0.044	0.160	0.400	0.310	0.170	0.058	0.010	0.000	0.000	0.000

Table 33: Median values of mean daily discharges (in m^3/s) per month for hydrometric station r6-1-1-80_Agios Onoufrios near Kampia and 5% and 25% percentiles of the mean daily discharges of the entire sample.

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970-1971	0.000	0.000	0.016	0.044	0.165	0.063	0.230	0.039	0.008	0.000	0.000	0.000
1971-1972	0.000	0.000	0.037	0.015	0.087	0.110	0.029	0.027	0.005	0.000	0.000	0.000
1972-1973	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------
1973-1974	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------
1974-1975	0.000	0.000	0.050	0.098	0.340	0.086	0.005	0.030	0.003	0.000	0.000	0.000
1975-1976	0.000	0.000	0.024	0.150	0.130	0.150	0.130	0.022	0.003	0.000	0.000	0.000
1976-1977	0.000	0.002	0.014	0.056	0.037	0.071	0.013	0.002	0.000	0.000	0.000	0.000
1977-1978	0.000	0.000	0.030	0.130	0.087	0.044	0.012	0.000	0.000	0.000	0.000	0.000
1978-1979	0.000	0.000	0.030	0.068	0.069	0.042	0.011	0.001	0.000	0.000	0.000	0.000
1979-1980	0.000	0.001	0.090	0.140	0.170	0.075	0.035	0.005	0.000	0.000	0.000	0.000
1980-1981	0.000	0.000	0.000	0.180	0.285	0.060	0.030	0.002	0.000	0.000	0.000	0.000
1981-1982	0.000	0.000	0.013	0.008	0.045	0.071	0.008	0.002	0.004	0.000	0.000	0.000
1982-1983	0.000	0.000	0.000	0.046	0.065	0.069	0.021	0.004	0.000	0.000	0.000	0.000
1983-1984	0.000	0.005	0.026	0.028	0.047	0.020	0.019	0.001	0.000	0.000	0.000	0.000
1984-1985	0.000	0.032	0.029	0.120	0.093	0.091	0.026	0.002	0.000	0.000	0.000	0.000
1985-1986	0.000	0.002	0.000	0.023	0.066	0.022	0.014	0.015	0.003	0.000	0.000	0.000
1986-1987	0.000	0.000	0.000	0.027	0.009	0.089	0.019	0.006	0.000	0.000	0.000	0.000
1987-1988	0.000	0.000	0.000	0.110	0.140	0.200	0.026	0.001	0.000	0.000	0.000	0.000
1988-1989	0.000	0.006	0.039	0.190	0.059	0.026	0.006	0.000	0.000	0.000	0.000	0.000
1989-1990	0.000	0.000	0.000	0.003	0.102	0.061	0.011	0.001	0.000	0.000	0.000	0.000

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1990-1991	0.000	0.000	0.000	0.000	0.031	0.075	0.017	0.000	0.000	0.000	0.000	0.000
1991-1992	0.000	0.000	0.170	0.093	0.580	0.130	0.030	0.016	0.005	0.000	0.000	0.000
1992-1993	0.000	0.000	0.140	0.120	0.290	0.130	0.023	0.025	0.004	0.000	0.000	0.000
1993-1994	0.000	0.000	0.000	0.019	0.180	0.120	0.019	0.004	0.000	0.000	0.000	0.000
1994-1995	0.000	0.010	0.086	0.063	0.033	0.020	0.012	0.000	0.000	0.000	0.000	0.000
1995-1996	0.000	0.000	0.000	0.022	0.089	0.047	0.020	0.000	0.000	0.000	0.000	0.000
1996-1997	0.000	0.000	0.016	0.009	0.018	0.013	0.023	0.000	0.000	0.000	0.000	0.000
1997-1998	0.000	0.000	0.018	0.030	0.013	0.005	0.005	0.000	0.000	0.000	0.000	0.000
1998-1999	0.000	0.000	0.003	0.040	0.055	0.009	0.008	0.000	0.000	0.000	0.000	0.000
1999-2000	0.000	0.000	0.000	0.000	0.014	0.025	0.008	0.005	0.000	0.000	0.000	0.000
2000-2001	0.000	0.000	0.150	0.120	0.047	0.033	0.012	0.001	0.000	0.000	0.000	0.000
2001-2002	0.000	0.000	0.260	0.420	0.115	0.068	0.049	0.015	0.000	0.000	0.000	0.000
2002-2003	0.000	0.000	0.029	0.082	0.200	0.280	0.050	0.010	0.003	0.000	0.000	0.000
2003-2004	0.000	0.000	0.022	0.320	0.300	0.040	0.015	0.003	0.000	0.000	0.000	0.000
2004-2005	0.000	0.000	0.009	0.047	0.039	0.011	0.004	0.000	0.003	0.000	0.000	0.000
2005-2006	0.000	0.011	0.006	0.028	0.037	0.030	0.011	0.001	0.000	0.000	0.000	0.000
2006-2007	0.003	0.010	0.003	0.003	0.075	0.034	0.014	0.010	0.003	0.000	0.000	0.000
2007-2008	0.000	0.000	0.006	0.003	0.008	0.006	0.000	0.000	0.000	0.000	0.000	0.000
2008-2009	0.000	0.000	0.000	0.006	0.061	0.029	0.012	0.000	0.000	0.000	0.000	0.000
2009-2010	0.000	0.003	0.024	0.054	0.129	0.034	0.006	0.000	0.000	0.000	0.000	0.000
2010-2011	0.000	0.000	0.003	0.011	0.044	0.040	0.024	0.003	0.000	0.000	0.000	0.000
2011-2012	0.000	0.008	0.005	0.268	0.153	0.082	0.011	0.002	0.000	0.000	0.000	0.000

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
2012-2013	0.000	0.008	0.051	0.027	0.027	0.006	0.003	0.000	0.000	0.000	0.000	0.000
2013-2014	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------
AVERAGE	0.000	0.002	0.035	0.081	0.110	0.063	0.019	0.005	0.001	0.000	0.000	0.000
ST. DEV.	0.000	0.006	0.056	0.093	0.116	0.057	0.021	0.008	0.001	0.000	0.000	0.000
COEFF. VAR.	6.245	2.342	1.636	1.146	1.055	0.903	1.107	1.556	1.902	N/A	N/A	N/A
5% PERCENTILE	0.000	0.000	0.000	0.001	0.009	0.006	0.002	0.000	0.000	0.000	0.000	0.000
25% PERCENTILE	0.000	0.000	0.000	0.012	0.035	0.023	0.008	0.000	0.000	0.000	0.000	0.000

Table 34: Median values of mean daily discharges (in m^3/s) per month for hydrometric station r8-9-5-40_Vassilikos near Lageia and 5% and 25% percentiles of the mean daily discharges of the entire sample.

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1983-1984	0.000	0.002	0.050	0.137	0.384	0.243	0.234	0.093	0.010	0.000	0.000	0.000
1984-1985	0.000	0.071	0.100	0.600	0.710	0.460	0.290	0.130	0.035	0.003	0.000	0.000
1985-1986	0.017	0.018	0.022	0.270	0.440	0.310	0.150	0.170	0.170	0.040	0.004	0.000
1986-1987	0.011	0.014	0.018	0.230	0.140	2.000	0.565	0.210	0.065	0.022	0.000	0.000
1987-1988	0.000	0.014	0.039	0.180	0.580	2.200	0.580	0.150	0.081	0.007	0.006	0.002
1988-1989	0.014	0.044	0.120	1.540	0.620	0.520	0.255	0.077	0.017	0.002	0.001	0.001
1989-1990	0.001	0.007	0.015	0.020	0.415	0.290	0.140	0.047	0.004	0.000	0.000	0.000
1990-1991	0.000	0.000	0.004	0.013	0.027	0.077	0.067	0.007	0.000	0.000	0.000	0.000
1991-1992	0.000	0.000	0.350	0.850	1.650	0.900	0.430	0.240	0.078	0.025	0.009	0.001
1992-1993	0.001	0.015	1.200	0.800	0.840	1.250	0.425	0.260	0.072	0.009	0.002	0.001
1993-1994	0.001	0.011	0.020	0.036	0.580	0.550	0.270	0.140	0.023	0.000	0.000	0.000
1994-1995	0.004	0.011	0.740	0.560	0.500	0.280	0.170	0.071	0.010	0.002	0.000	0.000
1995-1996	0.000	0.002	0.017	0.072	0.240	0.190	0.094	0.014	0.000	0.000	0.000	0.000
1996-1997	0.000	0.000	0.019	0.017	0.048	0.052	0.060	0.014	0.000	0.000	0.000	0.000
1997-1998	0.000	0.000	0.007	0.029	0.021	0.017	0.008	0.004	0.000	0.000	0.000	0.000
1998-1999	0.000	0.000	0.014	0.034	0.225	0.082	0.055	0.008	0.000	0.000	0.000	0.000
1999-2000	0.000	0.000	0.000	0.000	0.007	0.016	0.014	0.019	0.000	0.000	0.000	0.000
2000-2001	0.000	0.000	0.200	0.970	0.465	0.330	0.200	0.084	0.010	0.005	0.003	0.010
2001-2002	0.010	0.009	1.150	1.650	0.660	0.350	0.280	0.170	0.037	0.018	0.008	0.011
2002-2003	0.007	0.013	0.065	0.220	0.975	1.250	0.845	0.210	0.093	0.035	0.019	0.009

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
2003-2004	0.024	0.026	0.072	1.850	2.300	0.900	0.320	0.160	0.058	0.010	0.009	0.012
2004-2005	0.009	0.016	0.038	0.180	0.415	0.210	0.110	0.045	0.028	0.003	0.002	0.002
2005-2006	0.005	0.016	0.021	0.024	0.055	0.051	0.032	0.017	0.002	0.000	0.000	0.000
2006-2007	0.004	0.032	0.017	0.022	0.100	0.073	0.050	0.023	0.003	0.000	0.000	0.000
2007-2008	0.000	0.002	0.006	0.006	0.026	0.012	0.004	0.001	0.000	0.000	0.000	0.000
2008-2009	0.000	0.004	0.004	0.008	0.230	0.220	0.285	0.085	0.025	0.004	0.000	0.000
2009-2010	0.019	0.053	0.430	0.390	0.955	0.550	0.240	0.087	0.058	0.038	0.002	0.000
2010-2011	0.005	0.006	0.047	0.062	0.175	0.350	0.270	0.120	0.021	0.002	0.000	0.000
2011-2012	0.001	0.012	0.020	0.490	1.350	0.980	0.390	0.190	0.061	0.032	0.003	0.002
2012-2013	0.013	0.040	0.186	0.320	0.250	0.167	0.103	0.048	0.006	0.000	0.000	0.000
2013-2014	0.022	0.015	0.020	0.020	0.026	0.020	0.009	0.004	0.000	0.000	0.000	0.000
AVERAGE	0.005	0.015	0.166	0.386	0.513	0.496	0.231	0.096	0.032	0.009	0.002	0.002
ST. DEV.	0.007	0.017	0.317	0.518	0.524	0.560	0.196	0.078	0.039	0.013	0.004	0.004
COEFF. VAR.	1.385	1.204	1.903	1.343	1.021	1.130	0.847	0.809	1.221	1.506	1.861	2.111
5% PERCENTILE	0.000	0.000	0.000	0.007	0.017	0.015	0.007	0.003	0.000	0.000	0.000	0.000
25% PERCENTILE	0.000	0.000	0.015	0.024	0.100	0.084	0.072	0.020	0.001	0.000	0.000	0.000

Table 35: Median values of mean daily discharges (in m^3/s) per month for hydrometric station r9-2-3-85_Germasogeia near Foinikaria and 5% and 25% percentiles of the mean daily discharges of the entire sample.

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970-1971	0.000	0.039	0.095	0.190	0.320	0.390	1.250	0.390	0.046	0.000	0.000	0.000
1971-1972	0.000	0.024	0.190	0.200	0.440	0.330	0.245	0.230	0.185	0.019	0.000	0.000
1972-1973	0.003	0.042	0.051	0.064	0.105	0.074	0.041	0.000	0.000	0.000	0.000	0.000
1973-1974	0.000	0.070	0.084	0.085	0.175	0.490	0.160	0.046	0.009	0.000	0.000	0.000
1974-1975	0.000	0.000	0.160	0.370	2.350	1.000	0.335	0.150	0.091	0.013	0.000	0.000
1975-1976	0.000	0.032	0.300	1.600	1.600	1.100	0.725	0.400	0.175	0.094	0.034	0.018
1976-1977	0.029	0.076	0.250	0.670	0.625	0.520	0.520	0.270	0.069	0.012	0.000	0.000
1977-1978	0.004	0.030	0.270	1.600	2.800	1.250	0.755	0.370	0.095	0.024	0.007	0.008
1978-1979	0.010	0.105	0.480	0.600	0.905	0.540	0.240	0.110	0.052	0.001	0.000	0.000
1979-1980	0.000	0.037	0.570	1.300	3.300	1.550	0.950	0.480	0.125	0.009	0.000	0.000
1980-1981	0.004	0.042	0.087	1.150	4.000	1.550	1.100	0.430	0.135	0.028	0.007	0.005
1981-1982	0.014	0.190	0.280	0.330	0.420	0.870	0.375	0.190	0.067	0.001	0.000	0.000
1982-1983	0.010	0.039	0.098	0.280	0.625	0.900	0.540	0.270	0.068	0.006	0.000	0.000
1983-1984	0.000	0.125	0.167	0.322	0.489	0.379	0.455	0.193	0.045	0.004	0.000	0.000
1984-1985	0.000	0.363	0.277	0.903	1.389	0.696	0.430	0.185	0.036	0.005	0.000	0.000
1985-1986	0.054	0.090	0.113	0.554	0.541	0.424	0.308	0.256	0.078	0.025	0.005	0.007
1986-1987	0.039	0.063	0.060	0.530	0.330	3.700	0.790	0.370	0.140	0.054	0.025	0.016
1987-1988	0.012	0.055	0.160	0.400	1.150	3.300	0.860	0.400	0.150	0.050	0.070	0.026
1988-1989	0.081	0.195	0.410	1.850	0.750	0.580	0.310	0.170	0.058	0.017	0.010	0.010
1989-1990	0.011	0.046	0.120	0.110	0.840	0.410	0.240	0.085	0.022	0.000	0.000	0.000

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1990-1991	0.000	0.000	0.019	0.059	0.125	0.250	0.082	0.010	0.000	0.000	0.000	0.000
1991-1992	0.000	0.000	0.800	1.000	1.650	0.900	0.565	0.340	0.190	0.071	0.027	0.002
1992-1993	0.003	0.073	1.600	0.790	1.075	1.300	0.590	0.340	0.130	0.039	0.012	0.000
1993-1994	0.001	0.033	0.065	0.180	1.025	0.860	0.380	0.180	0.055	0.000	0.000	0.000
1994-1995	0.013	0.140	0.920	1.000	0.830	0.500	0.330	0.180	0.044	0.016	0.000	0.000
1995-1996	0.010	0.041	0.091	0.240	0.320	0.350	0.200	0.096	0.016	0.000	0.000	0.000
1996-1997	0.000	0.008	0.140	0.084	0.180	0.170	0.270	0.120	0.020	0.000	0.000	0.000
1997-1998	0.010	0.049	0.170	0.160	0.093	0.100	0.085	0.049	0.000	0.000	0.000	0.000
1998-1999	0.000	0.000	0.130	0.180	0.435	0.250	0.185	0.048	0.040	0.000	0.000	0.000
1999-2000	0.000	0.000	0.025	0.038	0.065	0.125	0.091	0.093	0.000	0.000	0.000	0.000
2000-2001	0.000	0.000	0.200	0.740	0.400	0.390	0.220	0.130	0.000	0.000	0.000	0.000
2001-2002	0.000	0.015	1.250	1.250	0.915	0.670	0.445	0.250	0.053	0.004	0.000	0.000
2002-2003	0.031	0.021	0.309	0.413	1.182	1.643	1.065	0.416	0.141	0.057	0.000	0.003
2003-2004	0.013	0.039	0.159	2.531	1.956	0.867	0.541	0.257	0.132	0.038	0.021	0.012
2004-2005	0.018	0.090	0.284	0.676	0.846	0.614	0.274	0.099	0.054	0.000	0.000	0.000
2005-2006	0.000	0.042	0.088	0.090	0.230	0.167	0.080	0.040	0.000	0.000	0.000	0.000
2006-2007	0.000	0.000	0.000	0.064	0.241	0.221	0.113	0.060	0.002	0.000	0.000	0.000
2007-2008	0.000	0.000	0.045	0.060	0.074	0.072	0.024	0.000	0.000	0.000	0.000	0.000
2008-2009	0.000	0.000	0.000	0.088	0.862	0.632	0.696	0.252	0.056	0.004	0.000	0.000
2009-2010	0.084	0.107	0.610	0.900	1.324	0.764	0.328	0.140	0.055	0.017	0.002	0.000
AVERAGE	0.013	0.059	0.297	0.642	0.998	0.823	0.430	0.206	0.066	0.016	0.006	0.003

	OCT	NOE	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
ST. DEV.	0.021	0.073	0.353	0.593	0.916	0.784	0.286	0.133	0.055	0.023	0.014	0.006
COEFF. VAR.	1.694	1.233	1.186	0.923	0.918	0.953	0.665	0.643	0.822	1.431	2.294	2.102
5% PERCENTILE	0.000	0.000	0.000	0.056	0.083	0.090	0.055	0.002	0.000	0.000	0.000	0.000
25% PERCENTILE	0.000	0.007	0.078	0.140	0.320	0.322	0.199	0.084	0.013	0.000	0.000	0.000