SEWERAGE BOARD OF LIMASSOL - AMATHUS (SBLA)

Madrid 28 & 29 January 2014

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Cyprus Water Characteristics

Location: Eastern Mediterranean, semi-arid region.

Classified (together with Malta) as one of the "water poor countries" in Europe, with the most acute water shortage (DGENV_COM July2007).

- **Water resources rely on the annual rainfall which is highly variable. They are scarce and expensive to exploit.**
- **Availability varies significantly from year to year and water demand and supply are rarely in balance condition.**
- **Statistical analysis of rainfall in Cyprus reveals a stepped drop in the early 70's, which persists, leading to 40% surface runoff reduction.**

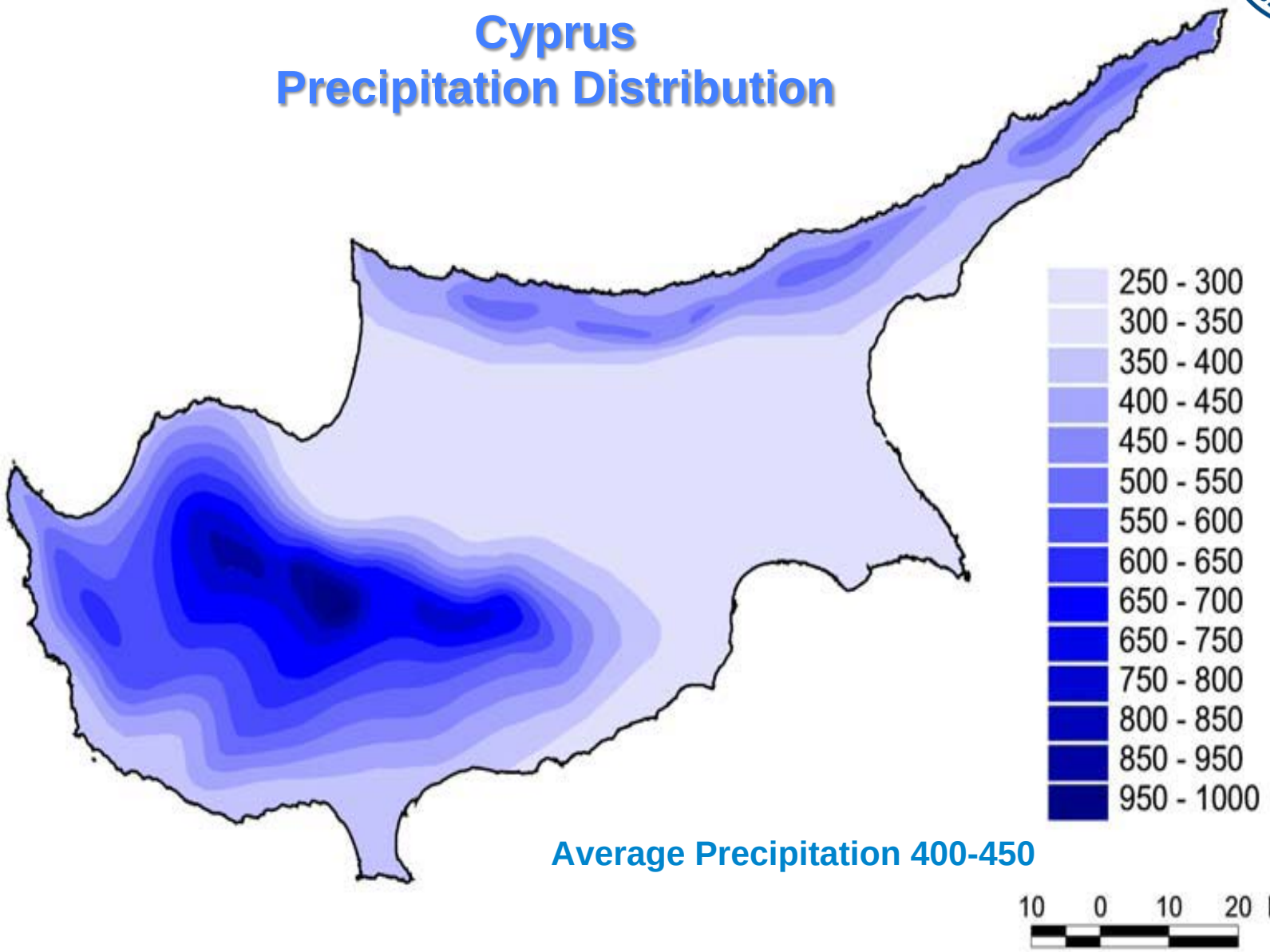
The climatic conditions along with the economic development and the increased water demand in all sectors of the society led to severe water scarcity

Challenges from the Public Authorities Perspective

Cyprus is: one of the countries facing the great impact from climate change in the Mediterranean.

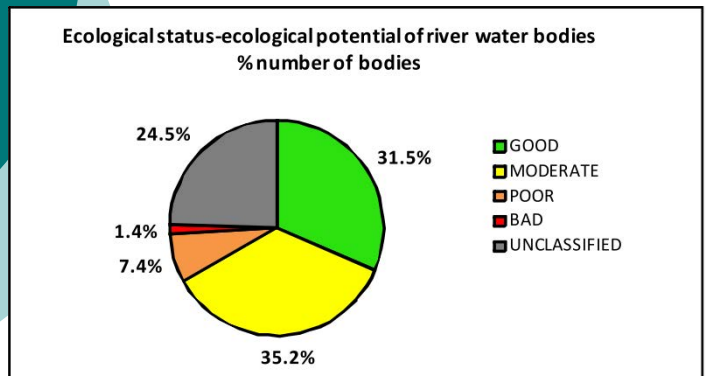
- Climate modification : Heat waves and high temperatures
- Unpredictable Heavy Storm events causing serious flooding events and environmental challenges mainly in the urban areas.
- Huge Investments needed for flood prevention infrastructure.

Cyprus
Precipitation Distribution

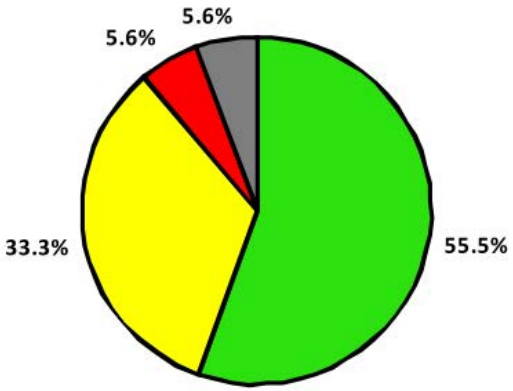


Average Precipitation 400-450

Water Quality



Ecological status/ ecological potential of lake water bodies
% number of bodies

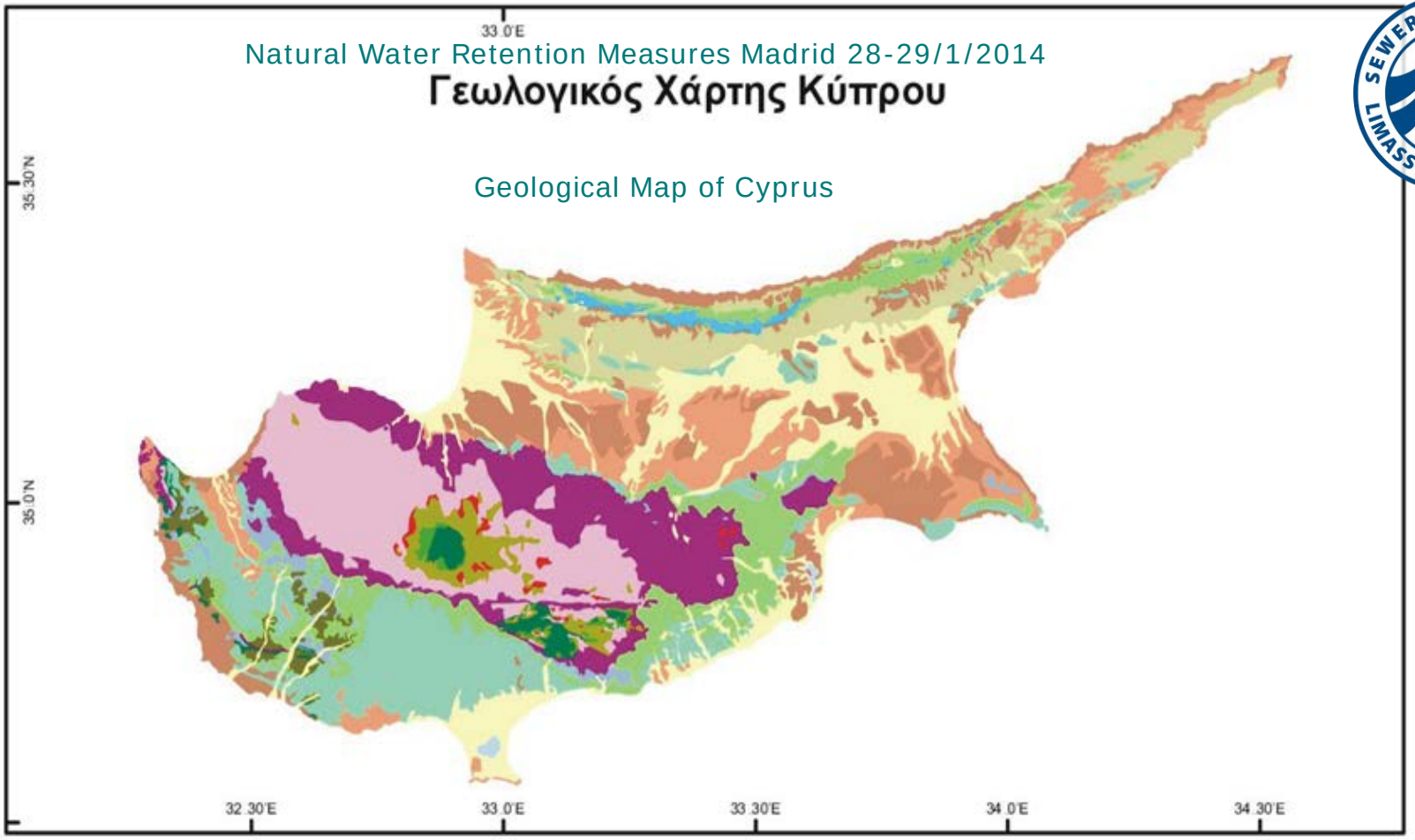


CTIC

CHALLENGES"

Γεωλογικός Χάρτης Κύπρου

Geological Map of Cyprus



LEGEND

ΙΖΗΜΑΤΩΔΕΙΣ ΣΧΗΜΑΤΙΣΜΟΙ

Αλλούβια - Κολλούβια	ΟΛΟΚΑΙΝΟ
Αποθέματα αναβαθμίδων, Fanglomerate	ΠΛΕΙΣΤΟΚΑΙΝΟ
Σχηματισμοί Άπαλος, Αθάλασσα, Κακκαριστα & Λευκωσία	ΠΛΙΟ-ΠΛΕΙΣΤΟΚΑΙΝΟ
Σχηματισμοί Καλαβάσος & Πακηνα	ΜΕΣΟ-ΑΝΩΤΕΡΟ ΜΕΙΟΚΑΙΝΟ
Σχηματισμός Κυθρεα	ΜΕΣΟ-ΑΝΩΤΕΡΟ ΜΕΙΟΚΑΙΝΟ
Σχηματισμοί Λευκαρα, Καλογρεα-Αρδανα & Λατηθος	ΜΑΙΣΤΡΙΧΤΙΟ-ΚΑΤΩΤΕΡΟ ΜΕΙΟΚΑΙΝΟ
Σχηματισμοί Καθικας, Μονή, Κανναβιου και Περαπεδη	ΚΑΜΠΑΝΙΟ-ΜΑΙΣΤΡΙΧΤΙΟ
Σχηματισμοί Χιλαριον, Συχαρι, Δικομο και Κανταρα	ΠΕΡΜΟ-ΛΙΘΑΝΘΡΑΚΟΦΟΡΟ ΩΣ ΚΑΤΩΤΕΡΟ ΚΡΗΤΙΔΙΚΟ
Σύμπλεγμα Μαμωνια	ΤΡΙΑΔΙΚΟ - ΚΑΤΩΤΕΡΟ ΚΤΗΡΙΔΙΚΟ

ΟΦΙΟΛΙΘΟΙ ΤΡΟΟΔΟΥ (Ανωτεροι Κρητιδικοί)

Ανώτερα, Κατώτερα Pillow Lavas& Βασαλτικό σύνολο	ΗΦΑΙΣΤΕΙΑΚΗ ΑΚΟΛΟΥΘΙΑ
Διαστρωμένες φλέβες (Διαβάσεις)	ΕΝΔΟΓΕΝΗ ΑΚΟΛΟΥΘΙΑ
Πλαγιογρανίτες	ΠΛΟΥΤΩΝΙΑ ΑΚΟΛΟΥΘΙΑ
Γάββροι	
Πυροξενίτες, Βερλίτες & Δουνίτες	
Χατζβουργίτες & Σερπεντινίτες	ΜΑΝΔΥΑΚΗ ΑΚΟΛΟΥΘΙΑ

Prepared by the Cyprus Geological Survey

SEWERAGE BOARD OF LIMASSOL - AMATHUS (SBLA)

OUR MISSION

Construction, Operation and Maintenance of the Central Sewerage and Drainage System of Greater Limassol Area, with the objectives of

- improving the quality of life,
- Environmental preservation and
- Upgrading of hygienic conditions in the area.

Planning

Long Term Planning Horizon

SBLA plans well in advance its programme of works, financing plan and tariff structure in order to avoid financial and liquidity difficulties. In particular, it prepares:

- Long term, medium term and short term feasibility studies and projections, up to the year 2030
- Long term Financial Projections (15-20 years)
- Rolling 5 year budgets and
- Annual budgets based on the long term and short term feasibility study

SEWERAGE AND DRAINAGE PROJECT

Construction in stages:

- **Phase A**: Construction started in 1992 Completed in 1995

  Cost: 70 million euro

- **Phase B1**: Construction started in 2000 Completed in 2004 Cost: 50 million euro

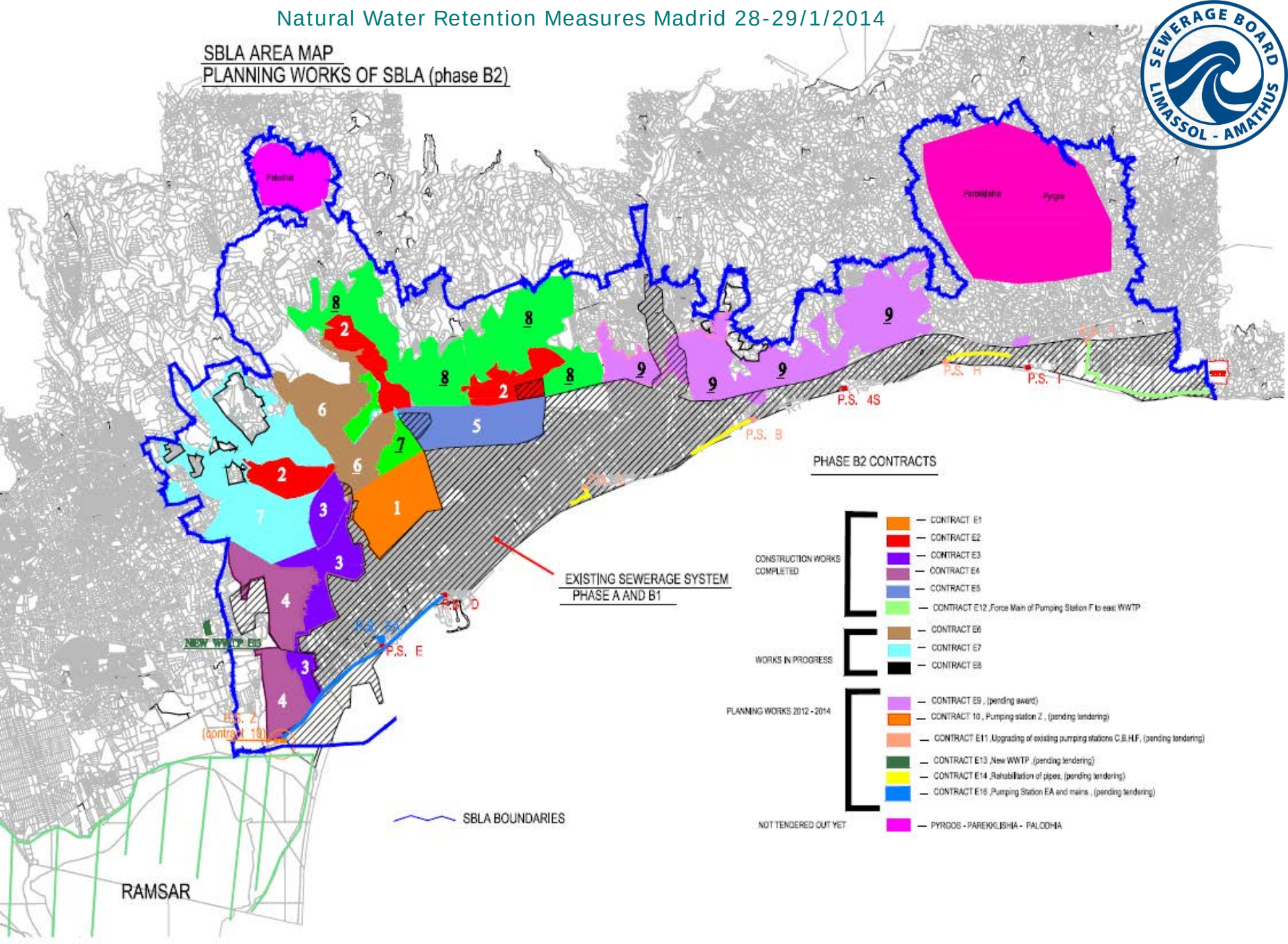
- **Phase B2**: Construction started in 2006

  Expected to be Completed in 2017

  Expected Cost: Over 400 million euro

PHASE B2- MAJOR OBJECTIVES

- Extension of Sewerage Network to cover the entire SBLA area to about 900 km
- Extension of main collectors and pumping Infrastructure (9 Pumping Stations)
- Extension & Upgrading of existing WWTP (in the east)
- Construction of a new WWTP in the west
- Construction of priority Storm Water Drainage & Flood Control Infrastructure and promotion of Sustainable Drainage Systems


SBLA AREA MAP
PLANNING WORKS OF SBLA (phase B2)
SEWERAGE BOARD LIMASSOL - AMATHUS
Paloma
Parekklisha
Pyrgos
P.S. 4S
P.S. H
P.S. I
P.S. B
P.S. D
P.S. 5A
P.S. E
P.S. 2
(contract 19)
NEW WWTP EIS
EXISTING SEWERAGE SYSTEM
PHASE A AND B1
SBLA BOUNDARIES
RAMSAR
PHASE B2 CONTRACTS
CONSTRUCTION WORKS COMPLETED
CONTRACT E1
CONTRACT E2
CONTRACT E3
CONTRACT E4
CONTRACT E5
CONTRACT E12 ,Force Main of Pumping Station F to east WWTP
WORKS IN PROGRESS
CONTRACT E6
CONTRACT E7
CONTRACT E8
PLANNING WORKS 2012 - 2014
CONTRACT E9 , (pending award)
CONTRACT 10 , Pumping station 2 , (pending tendering)
CONTRACT E11 ,Upgrading of existing pumping stations C,B,H,F, (pending tendering)
CONTRACT E13 ,New WWTP ,(pending tendering)
CONTRACT E14 ,Rehabilitation of pipes, (pending tendering)
CONTRACT E15 ,Pumping Station EA and mains , (pending tendering)
NOT TENDERED OUT YET
PYRGOS - PAREKKLISHIA - PALODHIA

Phase A: Commissioned in 1995

Phase B: Extension commissioned in 2007

Storm Water Drainage Scheme

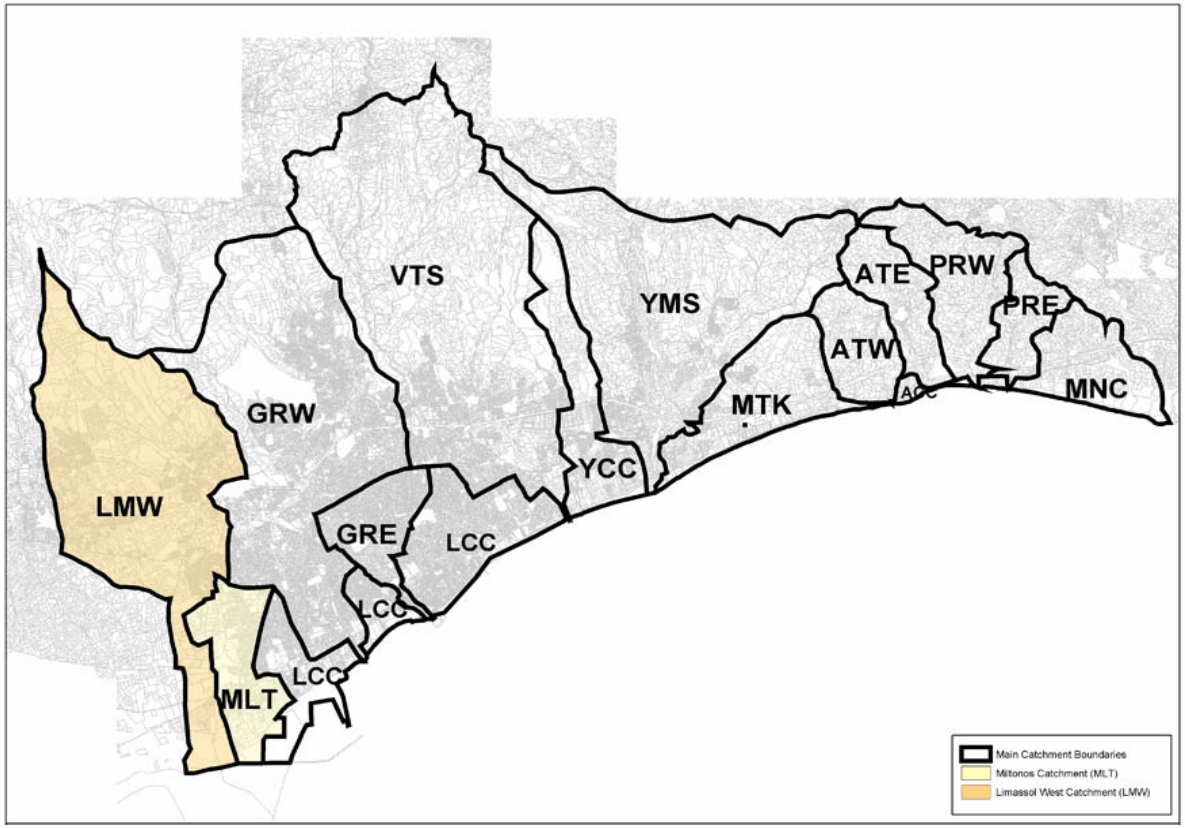
Master Plan 1995

Master Plan 2002

Sustainable Urban Drainage Systems 2007

Greater Limassol Catchment Areas

15 Catchment Areas



West: LMW,GRW

Central/West:

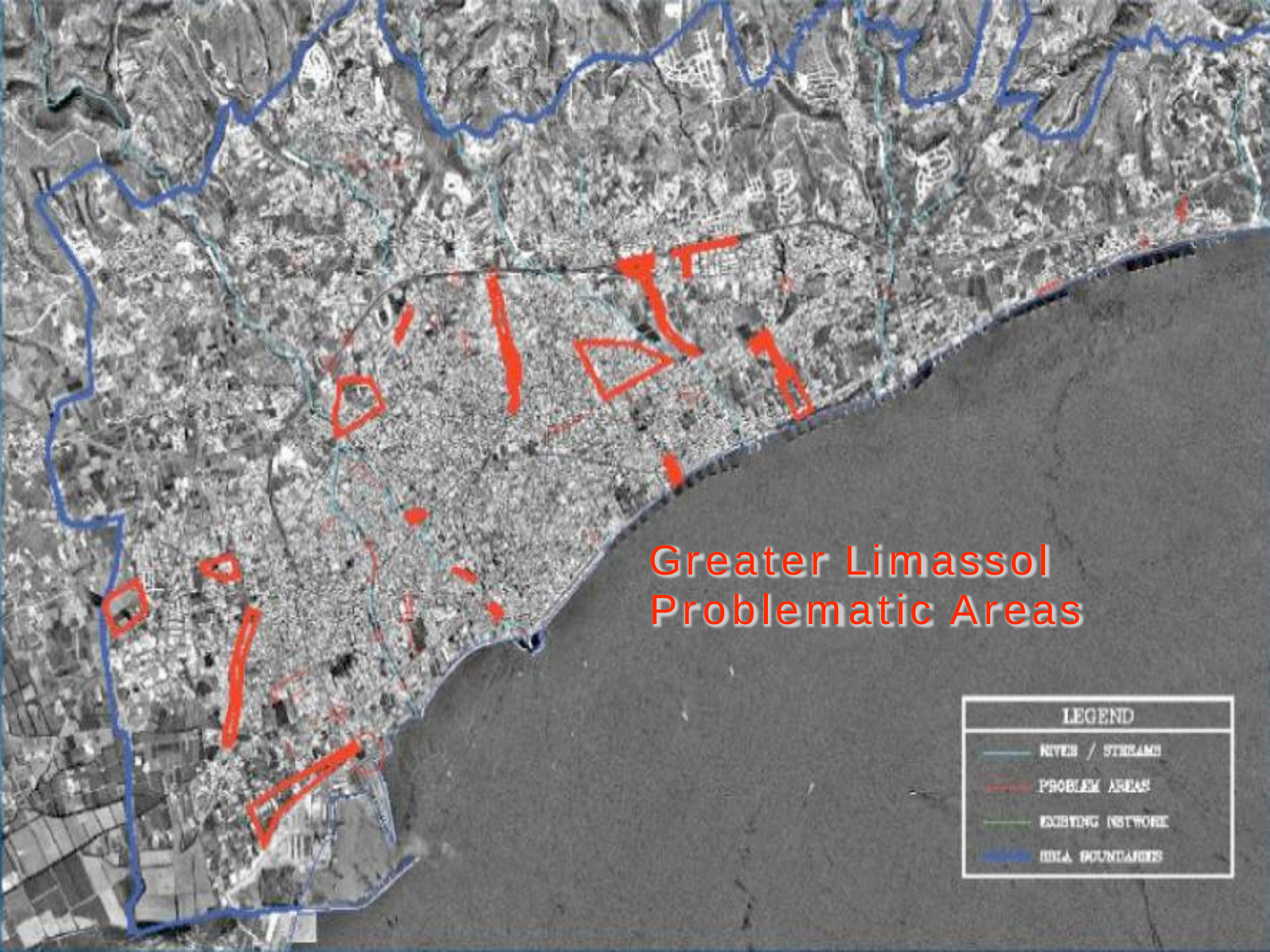
VTS,YCC

Central/ East:

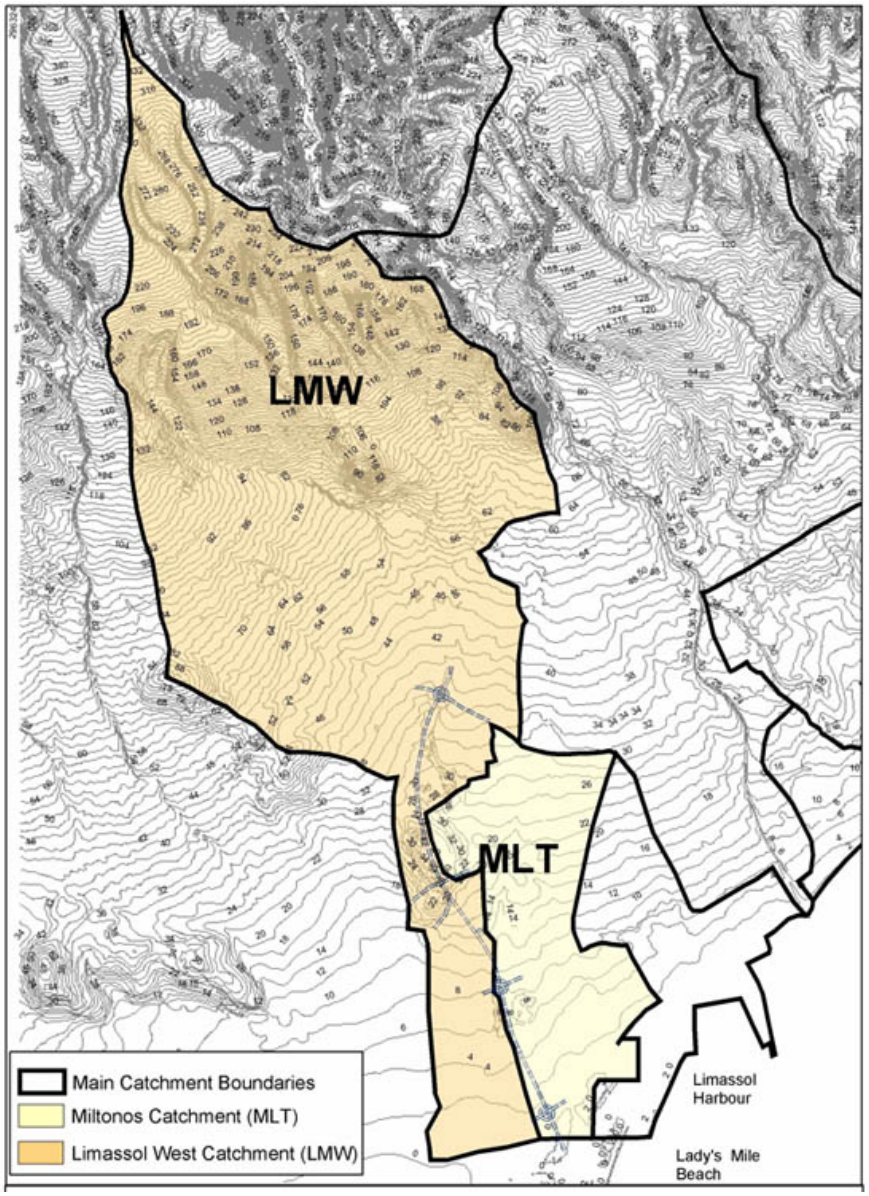
YMS, MTK.

East

Total Catchment area:13.000ha


Greater Limassol
Problematic Areas
LEGEND
RIVER / STREAMS
PROBLEM AREAS
EXISTING NETWORK
LOCAL BOUNDARIES

Limassol West Catchment Area

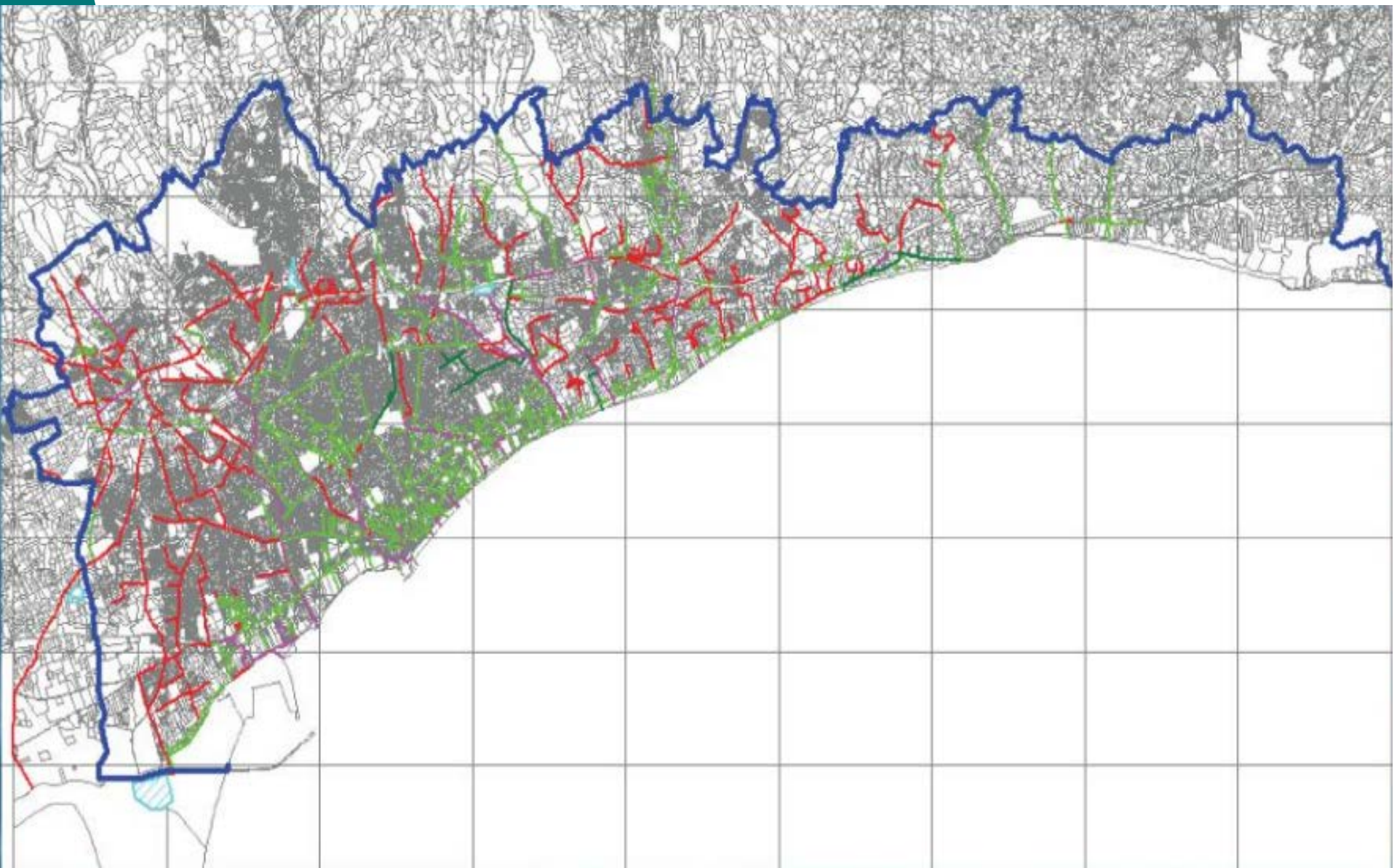


Catchment area:
1.887 ha

Future Strom flow
T_{25}= 95 m^3/s

Current 2014 flow
T_{25}=55.3m^3/s

Drainage Works Completed and in Progress



West Limassol Flood Control Project in progress

West Limassol Flood Control Project in progress

Storm Water Scheme Implementation Cost

PHASE	Implementation Plan	Investment in million Euro
PHASE A (SBLA PROJECTS)	1992-1995	3,0
PHASE B1 (SBLA PROJECTS)	2002-2005	16,0
PHASE B2 (SBLA PROJECTS)	2008-2013	32,0
PHASE B2 (GOVERNMENT PROJECTS)	2009-2013	30,0
PHASE B3 (SBLA PROJECTS)	2014-2017	18,0
RETENTION PONDS	2008-2018	13,0
TOTAL		**112,0**

Sustainable Urban Drainage Systems (SUDS)

An Environmental Approach

Sustainable Drainage Systems
Why do we need them?

- Urbanization and Rapid Development
- Human intervention in the natural environment
- Continuous destruction of ecosystems and habitat
- Fast Urban Metabolism
- Inadequate infrastructure

- Increase of impermeable surfaces (asphalt and concrete)
- Increase of runoff
- Increase of groundwater extraction and reduction of replenishment of water reserves
- Increasing sea pollution
- Undermining natural water courses and rivers
- Increase of peak flow
- Increase in flooding events

Conventional Approach: Failure or a success?

Sustainable Urban Drainage Systems- SUDs What is all about?

SUDs consist of a series of measures, including administrative procedures construction techniques, environmental friendly and adaptation of practices, analogous to those found in nature, in order to manage and control surface water flows in a sustainable way, taking into account the long term objectives and needs of society and quality of water resources. It involves planning ahead before the stage of development, aiming at delaying flow, collection at source and avoiding accumulation of water quantities.

New Philosophy:

SUDs philosophy – quality and quantity with amenity and biodiversity benefits by using:

- The management train –

  Use of combination of SuDS techniques in series

- Source control –
- runoff managed as close as possible to where it falls as rain
- Sub-catchments –
- division into small areas with different drainage characteristics and land use

SUDS = a new Approach

The SUDS philosophy

- Reduce runoff rates
- Reduce additional runoff volumes and frequencies
- Encourage natural groundwater recharge
- Reduce pollution and protect quality of receiving waters
- Prevent direct discharge of spillage
- Reduce volume of surface waste runoff to sewers
- Contribute amenity and aesthetic value to development
- Provide habitat for wildlife and biodiversity

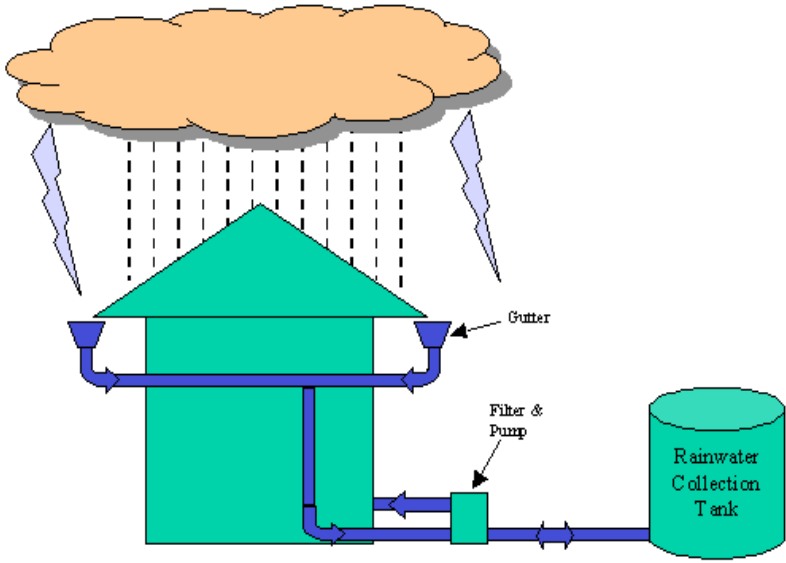
The Management Train

•Long Term Perspective-Prevention at the stage of development

• Source Control by managing runoff as close as possible to its source and as soon as possible when rain falls. Collect water at Source

•Site Control i.e dealing with runoff as close as possible to the site

• Regional Control use amenity spaces and SUDs at regional level before final disposal



Rainwater Collection Overview

Sustainable Urban Drainage System (SUDS) SUDS Techniques

SUDS are made up of various structures built to manage surface water runoff. They are used in conjunction with good management of the site, to prevent flooding and pollution. There are a number of general methods of control:

- Filter strips and swales
- Permeable surfaces and filter drains-Use less concrete and Asphalt
- Infiltration structures and devices
- Basins and Retention ponds
- Collection structures and devices for water reuse
- Storm Water Absorption Pits and Storage Techniques such as Sterns

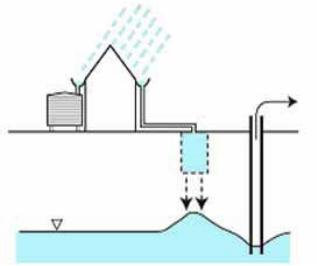
Prevention-Consider Prevailing Soil conditions, Hydrologic and Ground water Conditions

Sustainable Drainage Systems
Practical Implementation in Limassol

•**Application of the Law** - Stricter and consistent

•**Co-operation** - Closer co-operation between SBLA and the Local Authorities during the procedure of approval of Building Permits and new projects of land development.

•A series of conditions or restrictions are imposed on any new Building Permit and approval of land development, in order to use SUDs and to minimize overflow of rainwater into public roads, including the following:



•Construction of rainwater **absorption pits** in every new housing or commercial development, open areas, parking places, etc.

•Construction of rainwater **absorption pits on public roads and open areas.**

•Use of permeable materials where possible, in the construction of public passages, ancillary roads, etc.

•Avoid where ever is possible the use of cement in the construction of storm drainage systems, water canals, rivers or waterways.

Sustainable Urban Drainage Systems Practical Implementation in Limassol

•**Conversion** of **sewage absorption pits into rainwater absorption pits-** During implementation of the sewerage works, most of the existing **sewage absorption pits** are cleaned and converted to **rainwater absorption pits.** Soil conditions are considered before conversion. 30.000 absorption pits are expected to be converted by 2016.

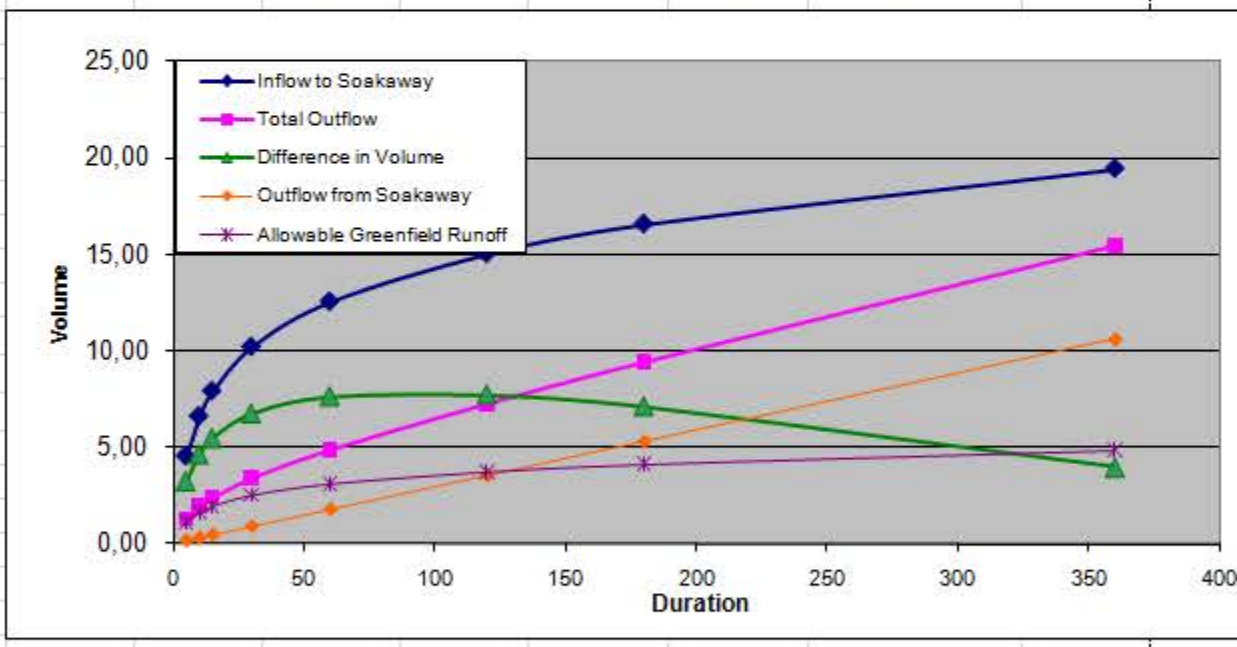
•**Adoption of a common policy of sustainable objectives** - introduction of common and standardized framework of building permit conditions, adoption of common specifications and common code of practice by all Local Authorities in Greater Limassol area.

•**Regulatory Framework -** Updated and adapted in order to provide sustainable solutions to the storm water management issue in the entire urban area of Limassol.

•**Optimize the efficiency of all existing natural waterways and rivers** in the area and termination of any illegal developments and interventions in these rivers.

Excel Template-Absorption Pits

	A	B	C	D	E	F	G	H	I	J	K
1				Duration	Rainfall M10-D	Inflow to Soakaway		Outflow from Soakaway	Allowable outflow (1)	Total Outflow	Difference
2	**Plot/Development Details**			**minutes**	**(mm)**	**I (m^3)**	**As50**	**Os (m^3)**	**Og (m^3)**	**O=Os+Og (m^3)**	**I-O (m^3)**
3	Total Plot Area	500	m^2	5	11,40	4,56	26,376	0,15	1,14	1,29	3,27
4	Allowable Runoff (existing)	20	%	10	16,53	6,61	26,376	0,29	1,65	1,95	4,67
5				15	19,80	7,92	26,376	0,44	1,98	2,42	5,50
6	Built/Paved Area	400	m^2	30	25,52	10,21	26,376	0,88	2,55	3,43	6,77
7	Roads	0	m^2	60	31,38	12,55	26,376	1,77	3,14	4,90	7,65
8	Total	400	m^2	120	37,56	15,02	26,376	3,53	3,76	7,29	7,74
9				180	41,41	16,57	26,376	5,30	4,14	9,44	7,13
10	**Circular Soakaway Dimensions**			360	48,58	19,43	26,376	10,60	4,86	15,46	3,98
11	number of circular soakaways	1	m								
12	diameter	1,2	m								
13	effective depth	7	m								
14	f	0,0000186	m/s								
15	void ratio	1									
16											
17											
18											
19											
20	**Results**										
21	Max Storage	7,74	m^3								
22	Available Storage	7,91	m^3								
23	**Remaining Storage**	**-0,18**	m^3								
24											
25	**SUDS OK?**	YES									
26											
27	Time to Half Empty	2,24	hours								
28	**Time to Half Empty OK?**	YES									
29											



Sustainable Urban Drainage Systems- Practical Implementation in Limassol- Major SUDs Projects in Limassol

Limassol West – Sustainable Flood Prevention Project:

- Construction of flood prevention works along with major road works
- Box Culvert of about 6 km long
- Attenuation Pond
- Open Channel and storm water outflow from Attenuation Pond to “Akrotiri” salt lake
- “Akrotiri” Habitat Preservation - NATURA 2000

- Construction of 4 Storm Water Attenuation Ponds:
  - Agios Athanasios Attenuation Pond - 55.000 m3 - Central East Limassol
  - Agia Phyla underground Attenuation Pond, beneath school ground -17.000 m3 – Central Limassol
  - Polemidia Attenuation Pond along major road works project - 75.000 m3 – West Limassol
  - Makria Pond in Zakaki – 25.000m3 - South West Limassol
- Sustainable Enhancement of Capacity and Efficiency of Existing water courses and Rivers.

West Limassol Flood Control Project and SUDs Catchment area (LMW)

Catchment area: 1.887 ha

Future Strom flow T_{25}= 95 m^3/s

Current 2014 flow T_{25}=55.3m^3/s

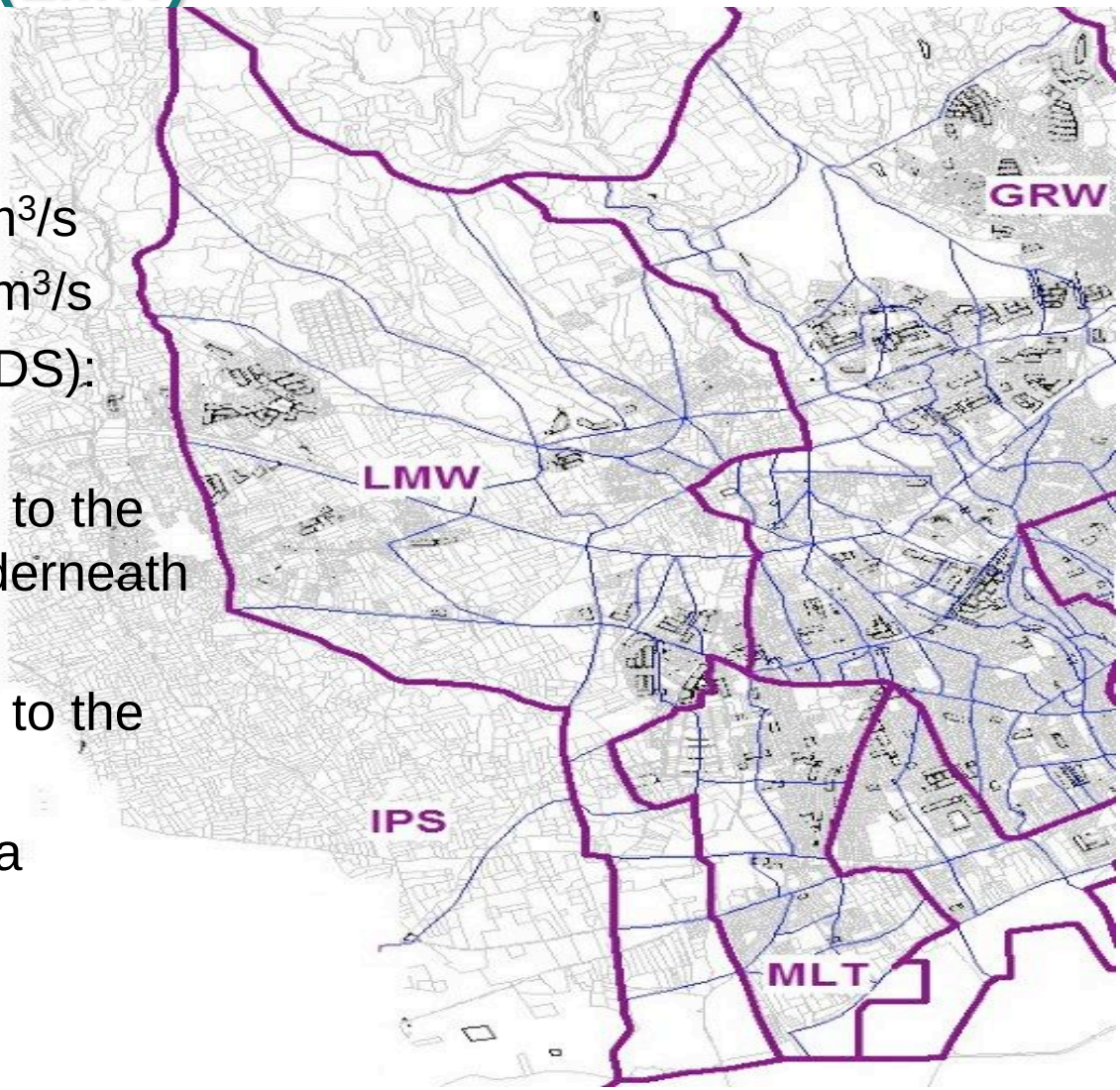
Total overflow retained (SUDS): 50%

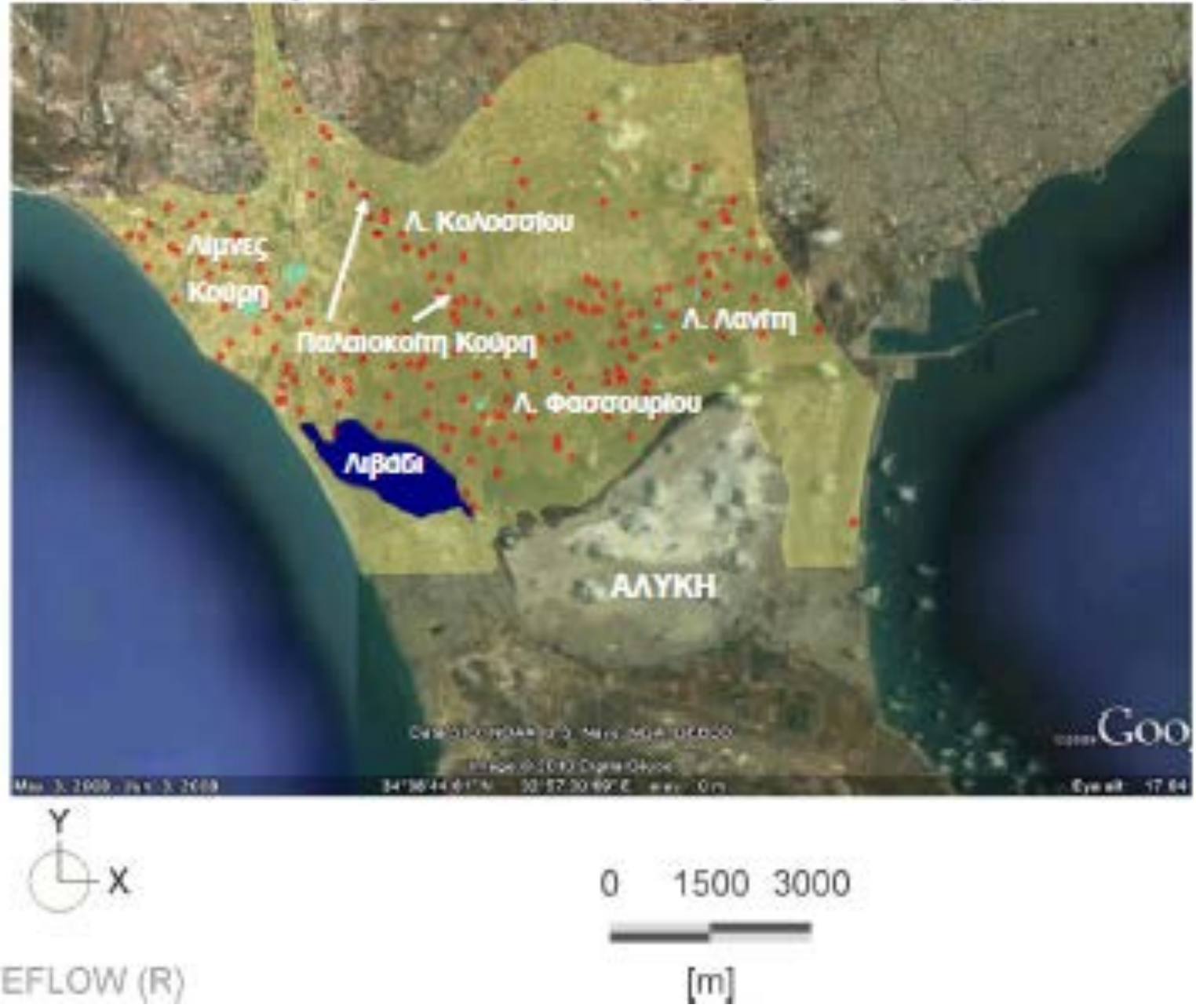
Total overflow down stream to the sea - via box culvert underneath road project= 35m3/sec.

Total overflow down stream to the salt lake= 3 m3/s

Retention pond area=3.5 ha

Pond capacity= 75,000 m3




Λ. Καλοσσίου
Λίμνες Κοθρη
Παλαιοκοίτη Κοθρη
Λ. Λαντη
Λ. Φασσουρίου
Λιβάδι
ΑΛΥΚΗ
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X
0 1500 3000
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FEFLOW (R)

West Limassol Flood Control Project Phase A and B Completed 2012

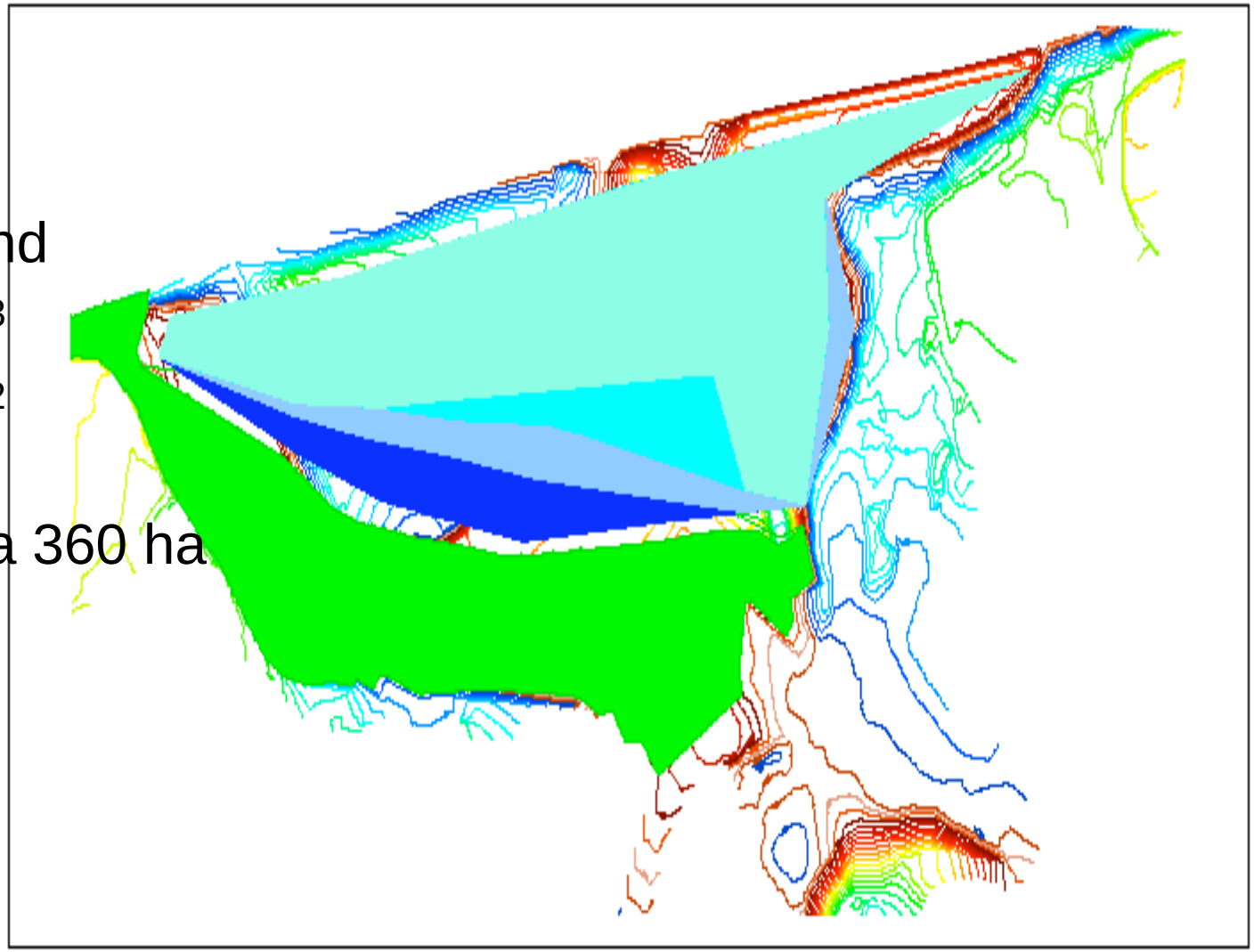
SUDs in Agios Athanasios
Central East Attenuation Pond

Attenuation Pond

Cap.:55,.000m^3

Area: 10,000m^2

Catchment area 360 ha



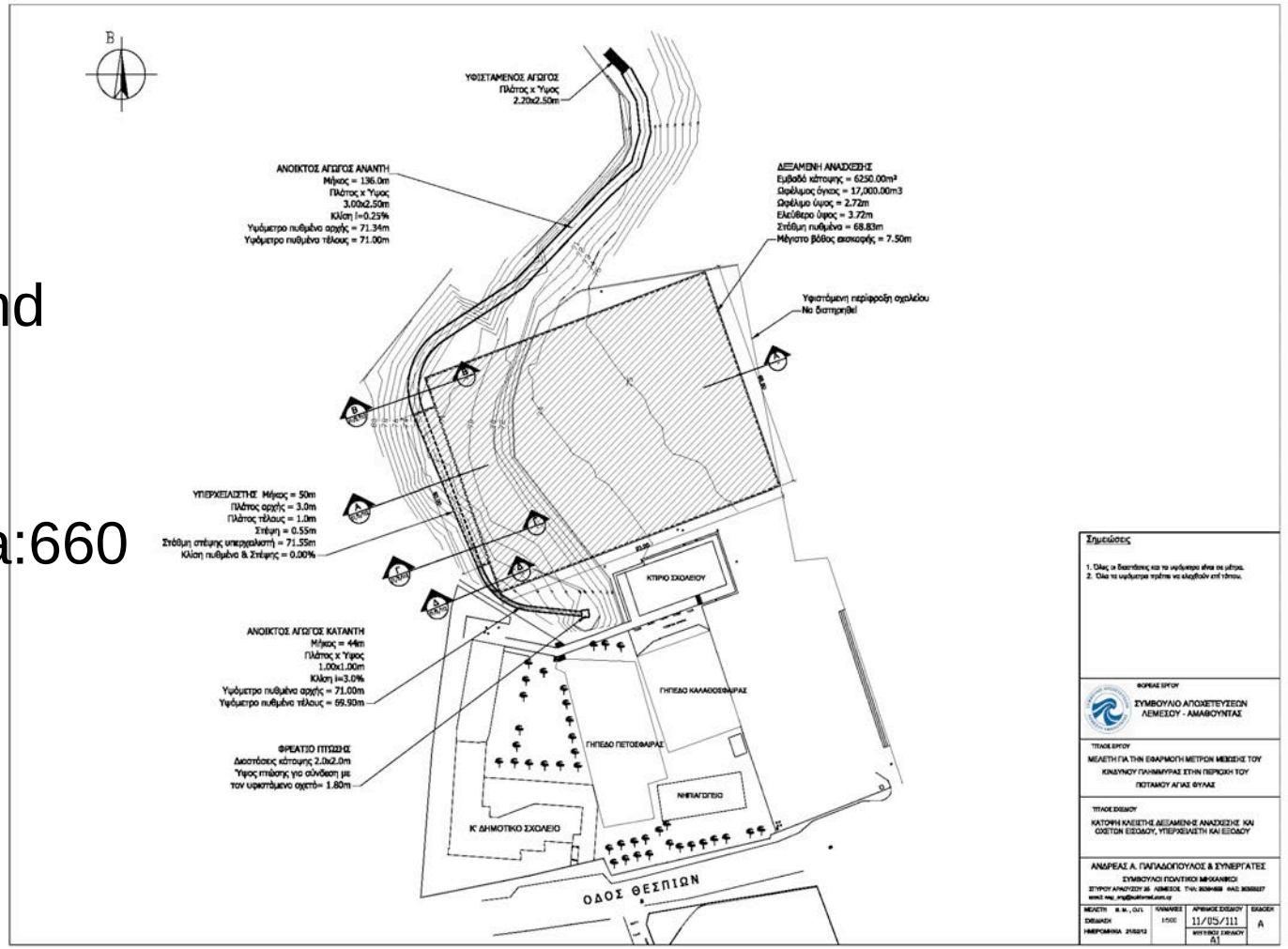
SUDs in Agia Phyla River
Limassol Central north Attenuation Pond

Attenuation Pond

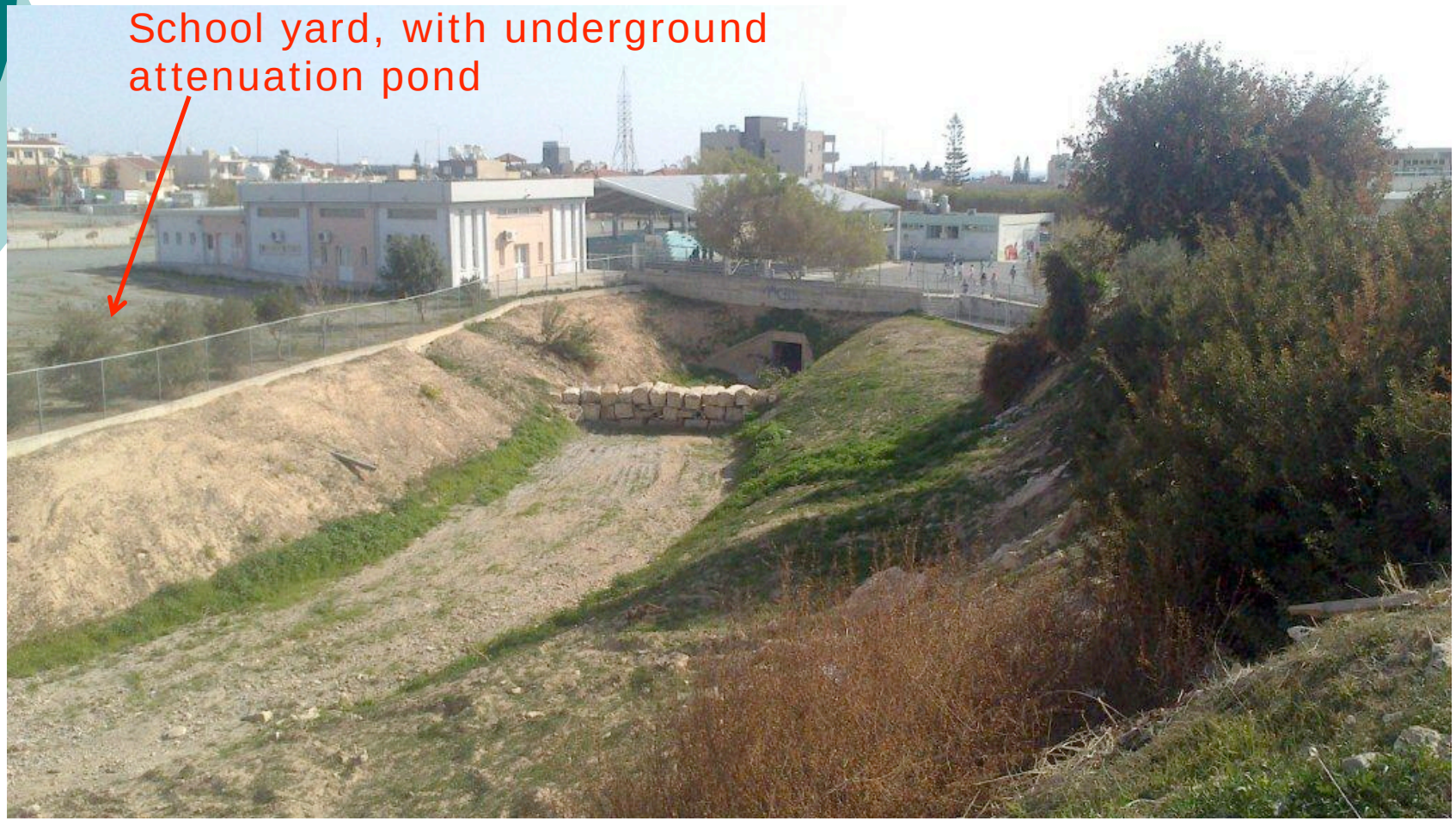
Cap.:17.000m^3

Area: 6.000m^2

Catchment area:660 ha



SUDs in Agia Phyla River
Limassol Central north Attenuation Pond



SUDs in **West Limassol Flood Control Project – Retention pond in progress**

Tendering Stage: 2014
Construction Start up: 2014
Contract Completion and Commissioning: 2017

West south Limassol
“Makria” Storm Water Retention Pond

SUDs in Dry River Limassol Downtown
Project in progress

Storm Water Canal - Use of Solid Removal Grids

SUDs in Ayia Phyla River

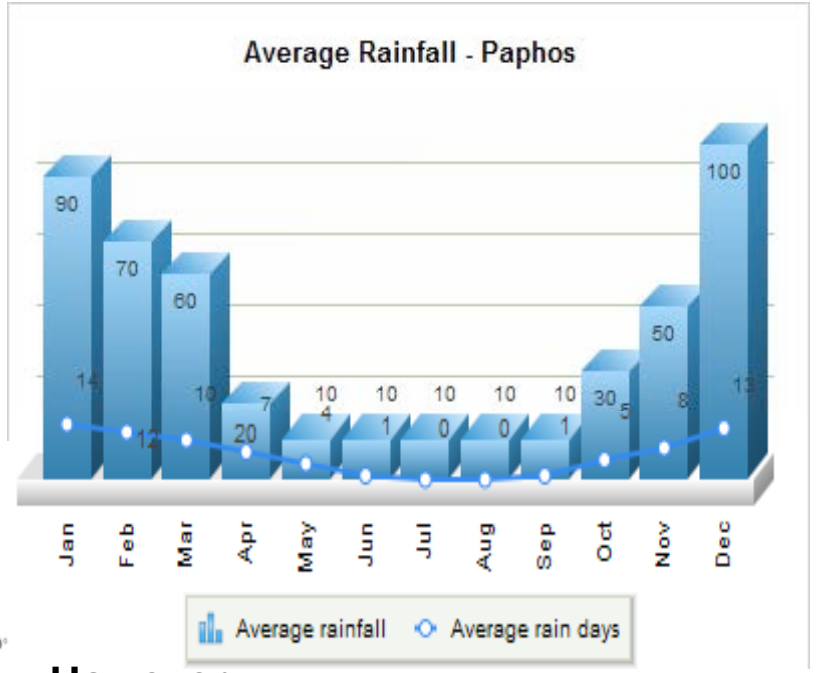
energy dissipation measures at the outlet (Use of Gabions)

Storm Water Outfall
- Use of Permeable Material

Should the Cyprus approach be different to other countries?

What is different?

- Different culture
- Different climate
- Different precipitation
- Different geology
- Different vegetation
- Different materials



However

Drivers are the same,
- flooding mainly in winter,
- water scarcity mainly in summer,
- significant water quality issues

Philosophy is the same
Concepts are the same

But Details are different

Summary

Key points

- Change in approach from conventional drainage to SUDs approach
- Management train / treatment train - New approach concentrates at managing rainfall that mimics natural drainage
- Source control – Collect at source, minimise impacts on quantity and quality of runoff
- Maximise amenity and biodiversity opportunities
- Subcatchments and runoff delay
- Storage Hierarchy
- SUDs can be used everywhere

Iacovos Papaiacovou
NWRM presentation 28 January 2014