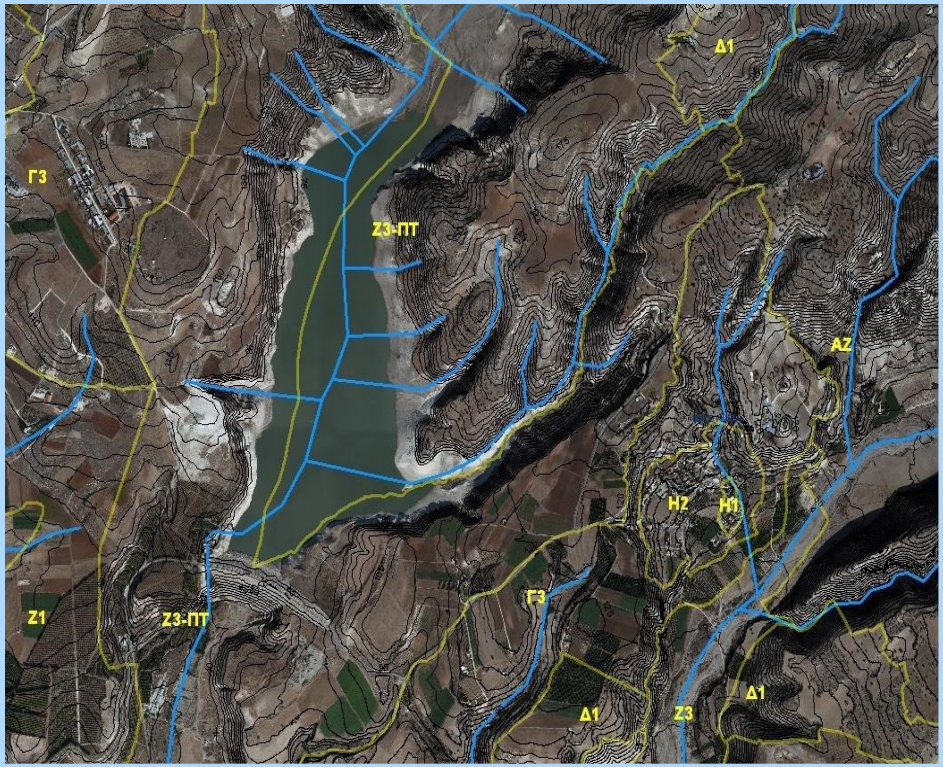


ΥΠΟΥΡΓΕΙΟ ΓΕΩΡΓΙΑΣ ΦΥΣΙΚΩΝ ΠΟΡΩΝ ΚΑΙ ΠΕΡΙΒΑΛΛΟΝΤΟΣ
ΤΜΗΜΑ ΑΝΑΠΤΥΞΕΩΣ ΥΔΑΤΩΝ
Υπηρεσία Υδρολογίας & Υδρογεωλογίας

Kostas Aristeidou WDD hydrologist
Msc Env. Eng. UIUC
Dipl. Civil. Eng. NTUA

GIS and remote sensing applications for water resources management at the Water Development Department of Cyprus.

Presentation Agenda

1. The use of GIS at the Water Development Department.
2. Basic GIS hydrologic functions and datasets
3. Recent GIS and remote sensing applications for Water Resources Management in WDD:

a. Delineation of Town Planning river protection zones.
b. Establishment of Drinking water reservoir protection zones
c. Implementation of the EU Floods Directive

The use of GIS at the Division of Hydrology & Hydrogeology

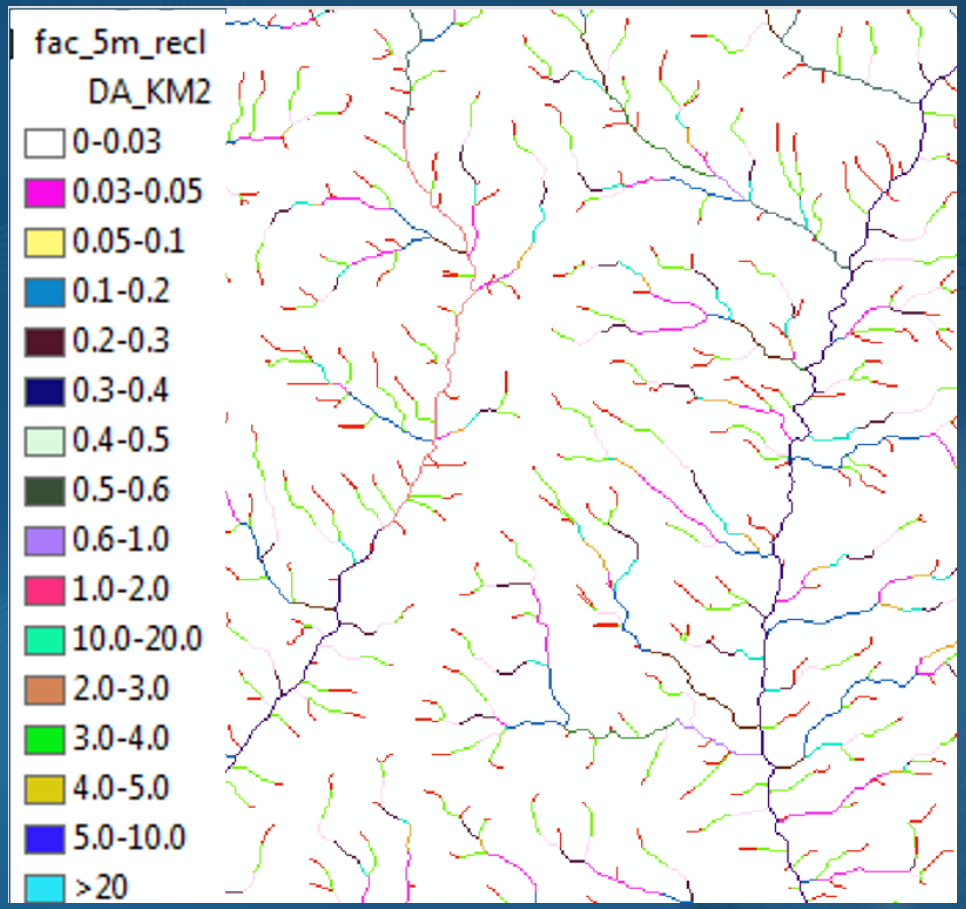
- Due to the nature of its workflow the Division of Hydrology & Hydrogeology of WDD has started using GIS a long time ago.
- 1998 – Use of Map info
- 2005 –Arcmap
- 2014 – ArcGIS server- EDAMS expansion to all WDD
- The many years of experience and the large volume of GIS data accumulated over the years have made GIS an essential tool, used on a daily basis to support almost all of the functions and workflows of the WDD.

Basic GIS hydrologic functions and datasets

- The most important GIS product for surface water resources management is the **Flow Accumulation Raster** which is derived from a DEM dataset.

- **The FAC shows the catchment size of each raster cell of the DEM.**

- **It is very useful because it gives direct information about the hydrographic network, watershed boundaries and catchment size at each location which are essential for water resources and flood risk management.**



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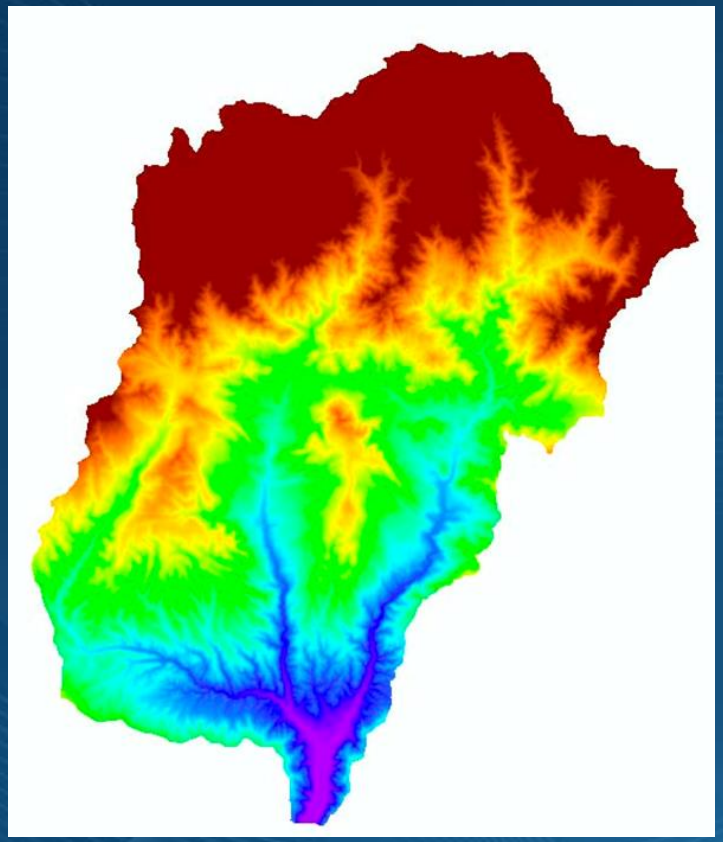
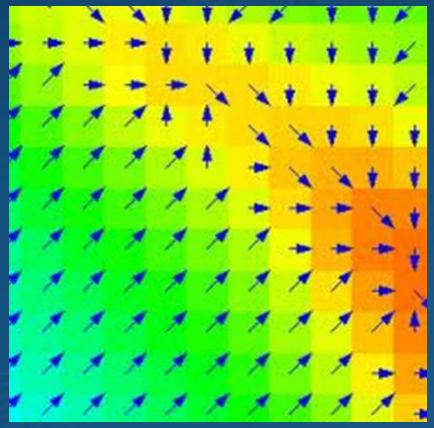
& Υδρονεωλογίας

Digital Elevation Model to Flow direction raster





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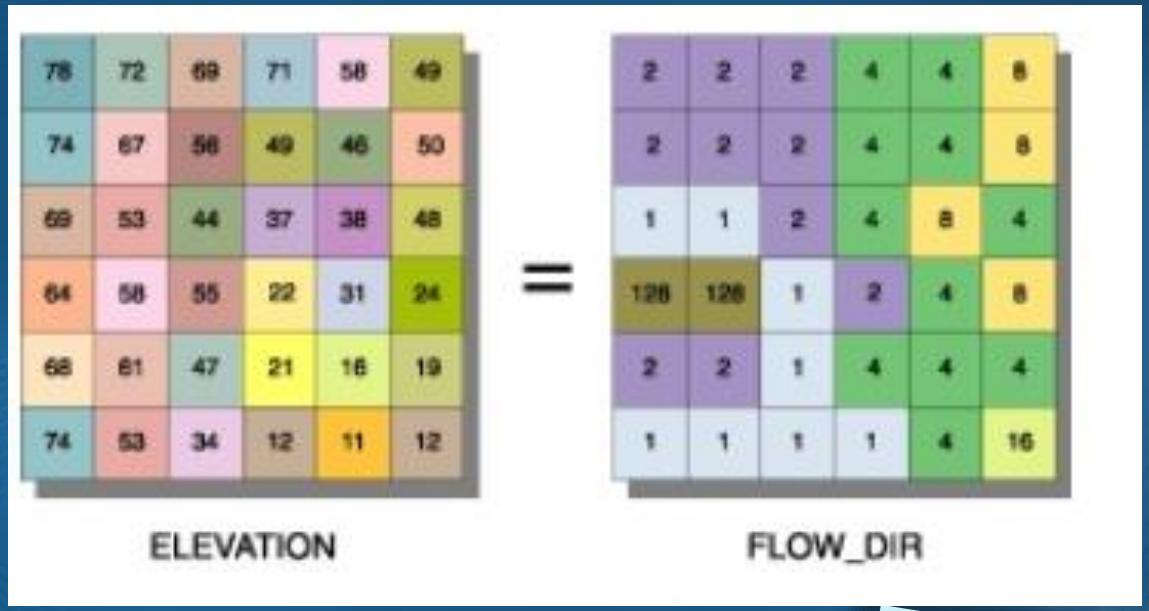
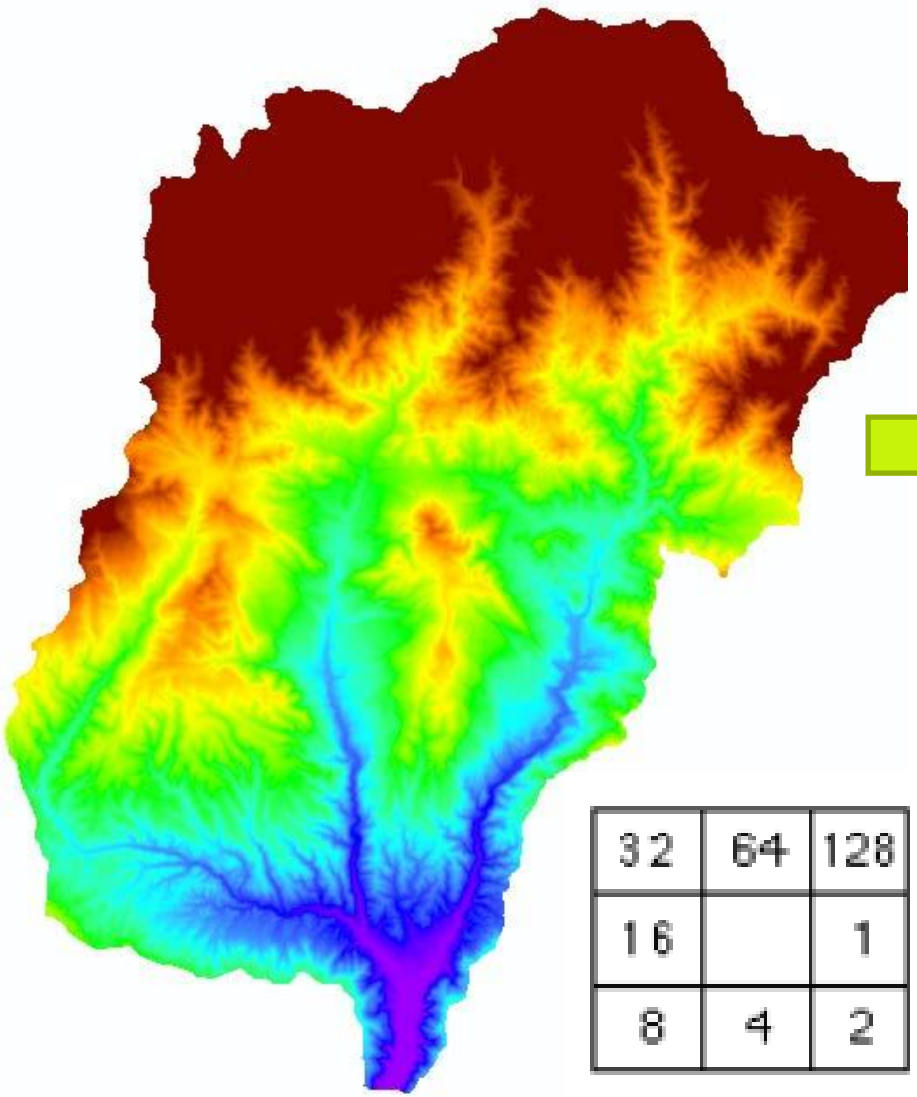
16		1
8	4	2



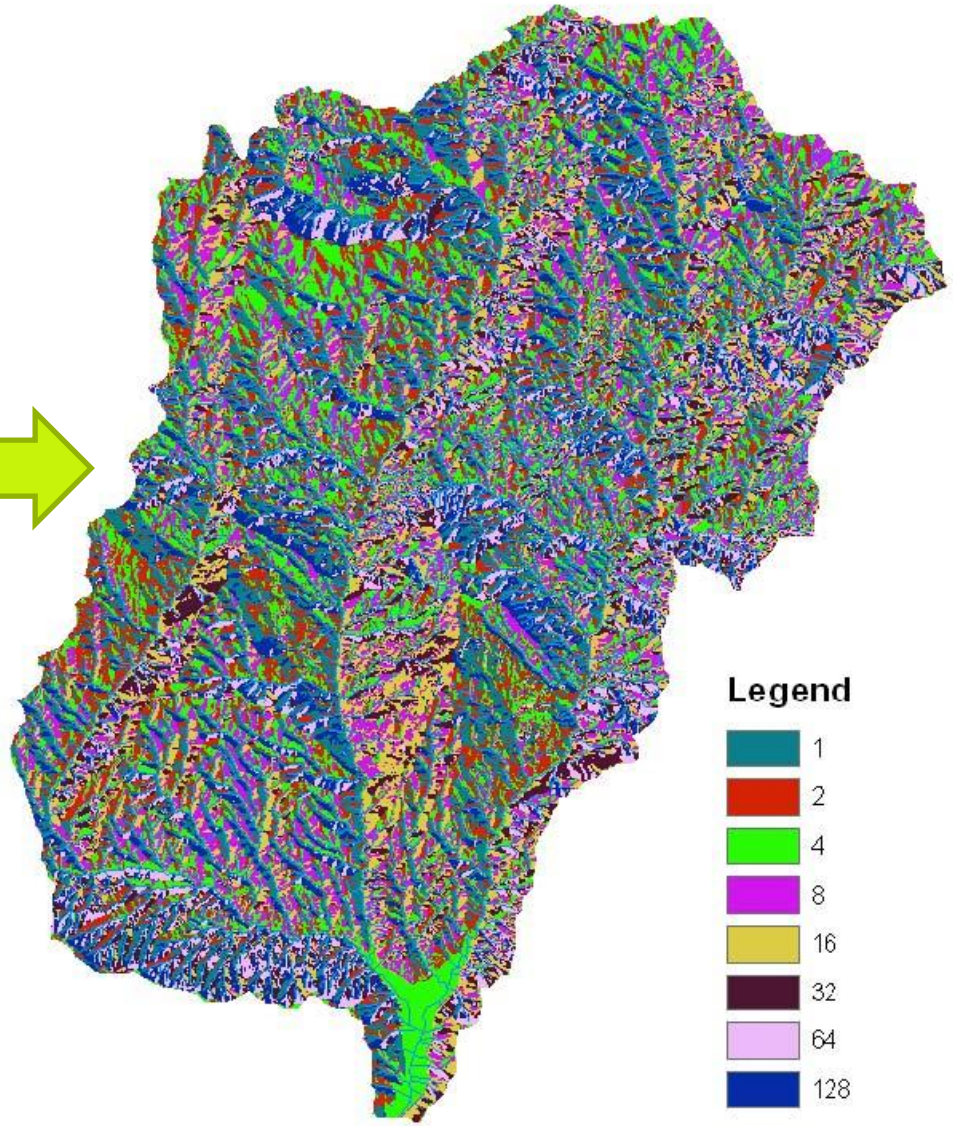
images from ArcGIS user manual

VisualBee

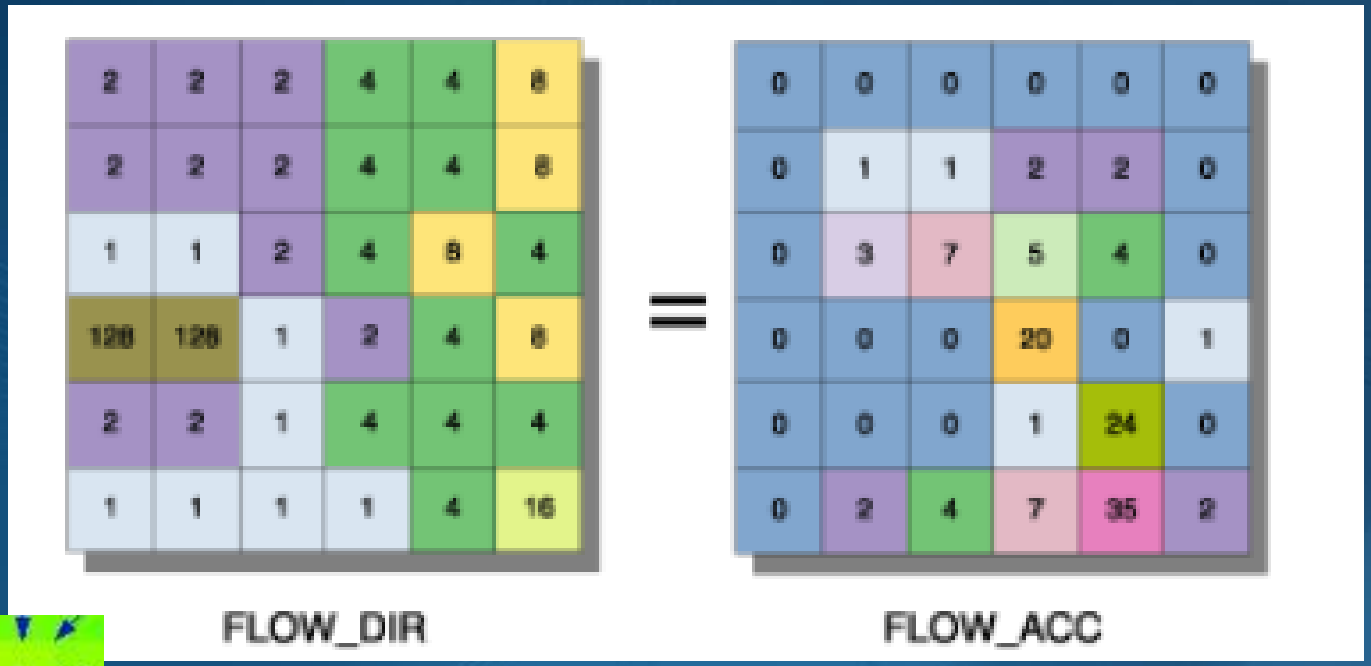
Digital Elevation Model to Flow Direction raster

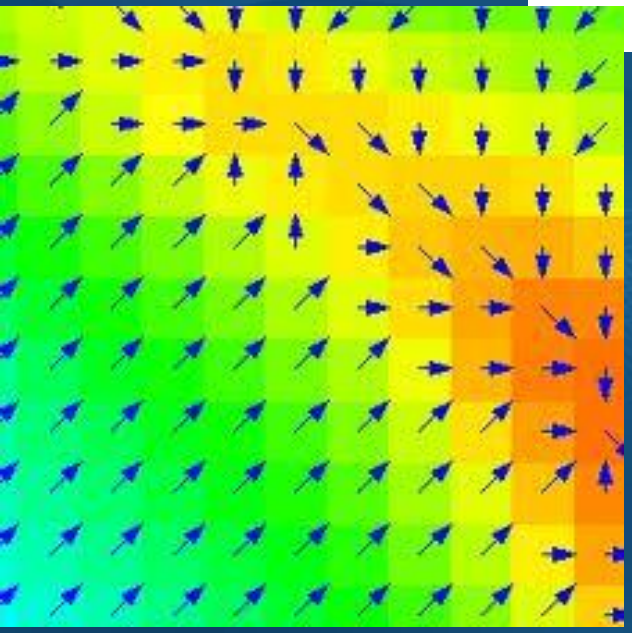


32	64	128
16		1
8	4	2



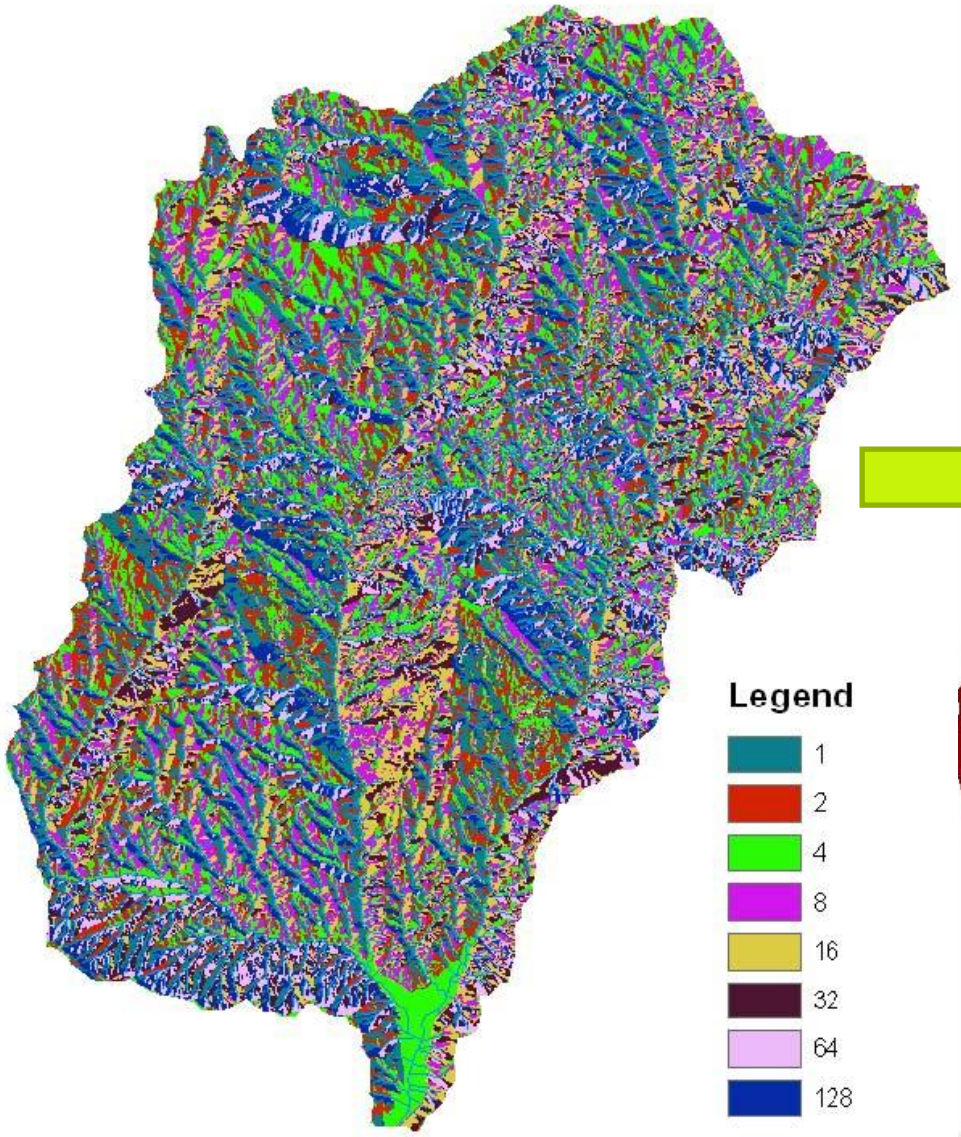
Flow Direction Raster to Flow Accumulation Raster

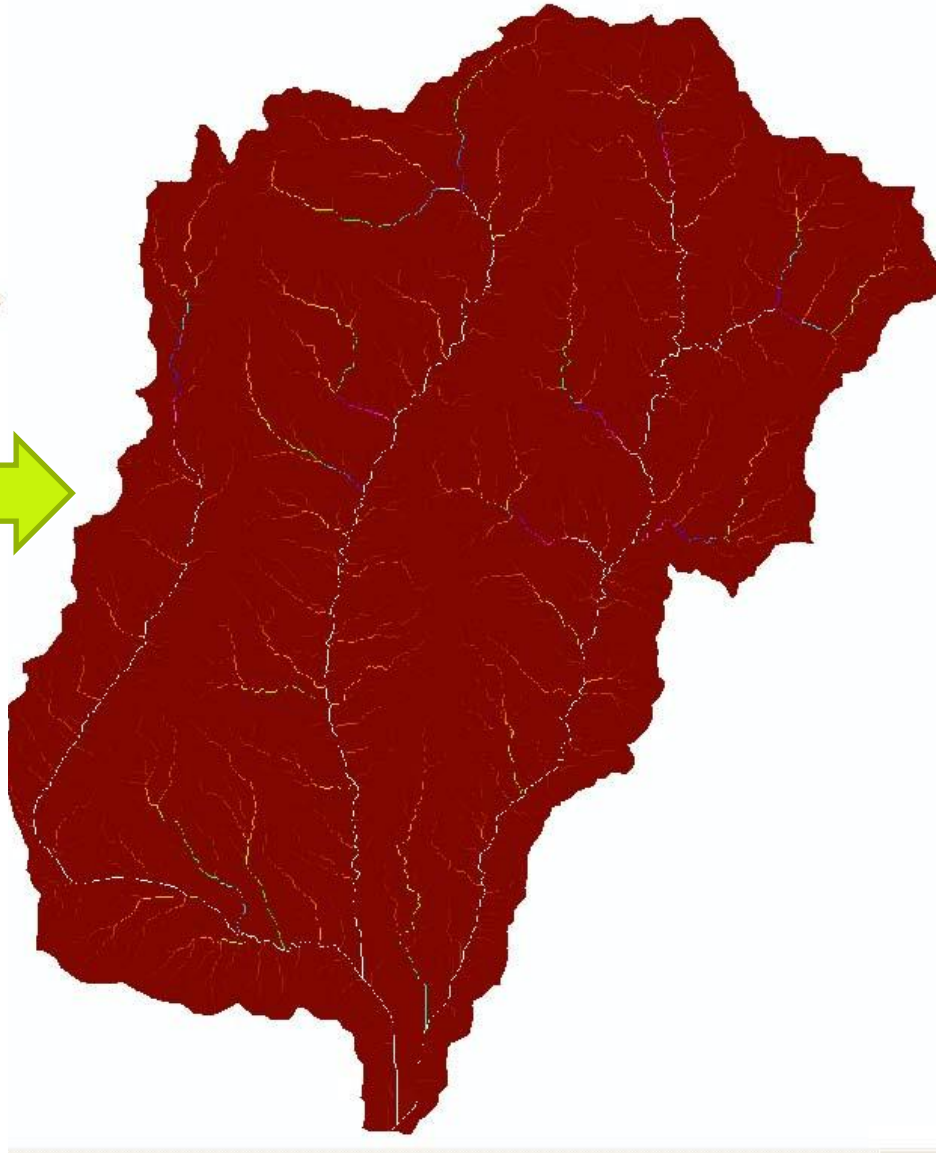




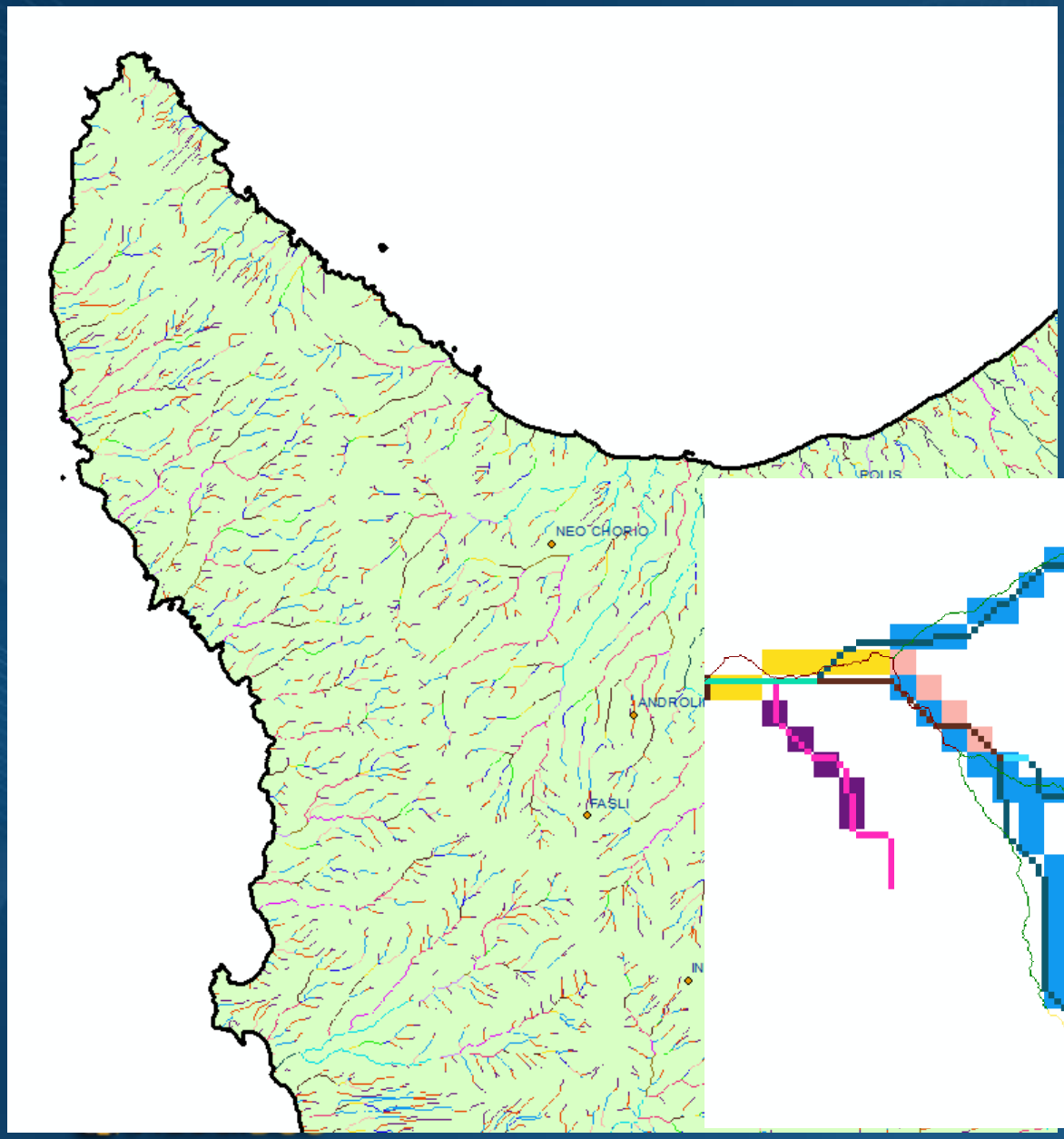
images from ArcGIS user manual

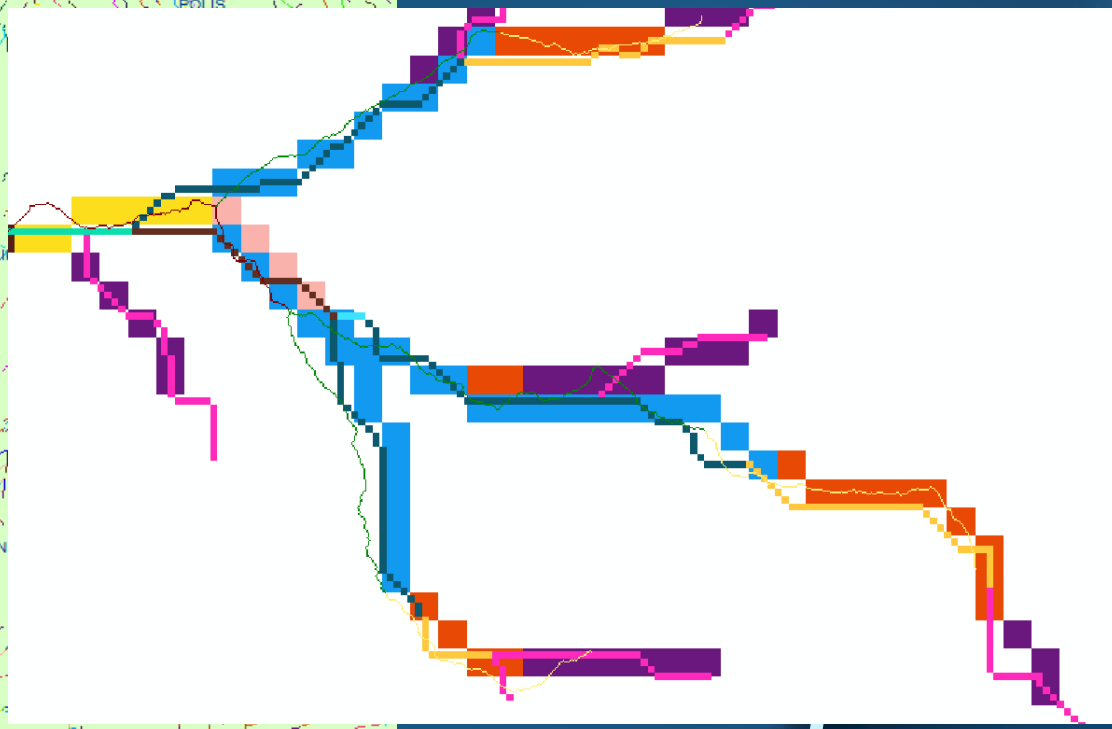
Flow Dir to Flow Accumulation





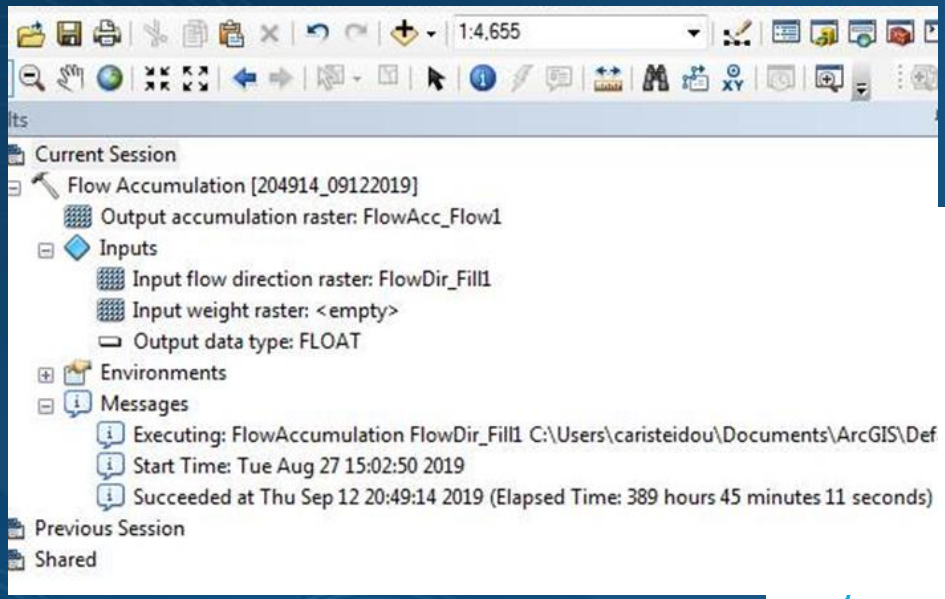
Flow Accumulation products at WDD

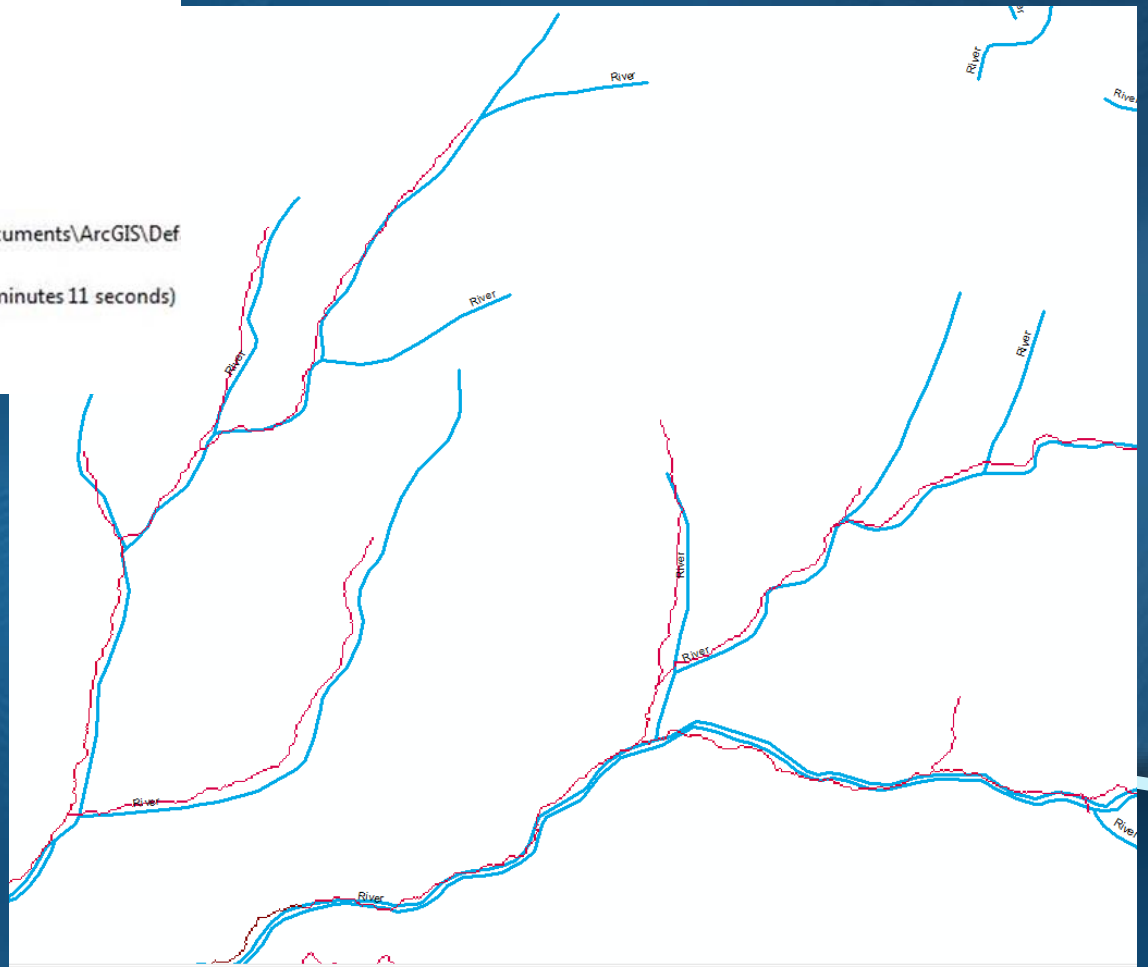




We have created three Flow Accumulation products with Country wide coverage for Cyprus from 20 m DEM, 5m DEM and 1 m DEMs.

2014 High accuracy LIDAR 1m DTM derived FAC.

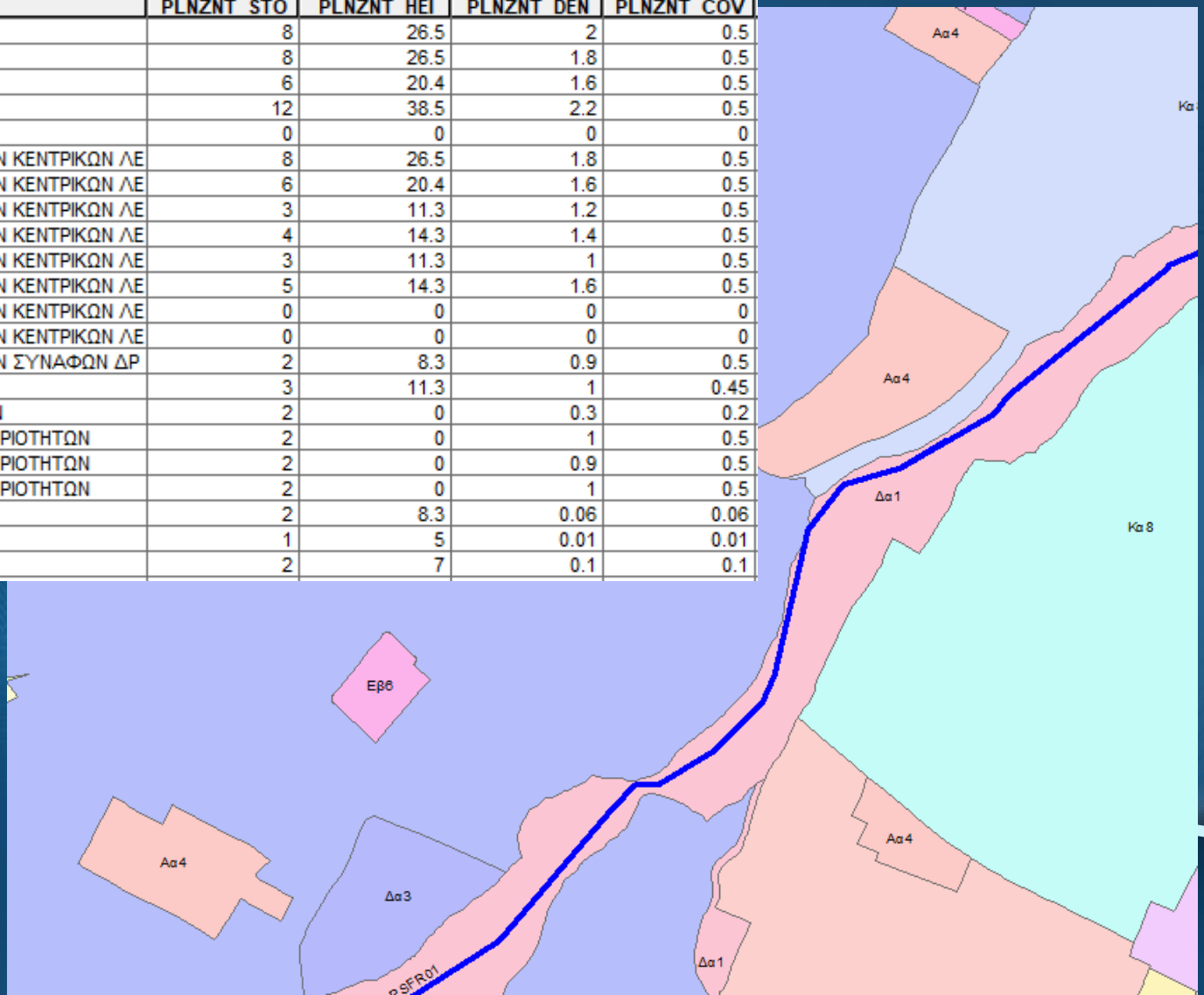




VisualBee

Delineation of Town Planning river protection zones.

RefName_1	PLNZNT_DES	PLNZNT_STO	PLNZNT_HEI	PLNZNT_DEN	PLNZNT_COV
Εα2	ΖΩΝΗ ΑΣΤΙΚΟΥ ΚΕΝΤΡΟΥ	8	26.5	2	0.5
Εα3	ΖΩΝΗ ΑΣΤΙΚΟΥ ΚΕΝΤΡΟΥ	8	26.5	1.8	0.5
Εα4	ΖΩΝΗ ΑΣΤΙΚΟΥ ΚΕΝΤΡΟΥ	6	20.4	1.6	0.5
Εα1	ΖΩΝΗ ΑΣΤΙΚΟΥ ΚΕΝΤΡΟΥ	12	38.5	2.2	0.5
Γ3-Η3	ΖΩΝΗ ΓΕΩΡΓΙΚΗ-ΟΙΚΙΣΤΙΚΗ	0	0	0	0
Εβ2	ΖΩΝΗ ΕΜΠΟΡΙΚΩΝ ΚΑΙ Α/Λ/ΛΩΝ ΚΕΝΤΡΙΚΩΝ ΛΕ	8	26.5	1.8	0.5
Εβ3	ΖΩΝΗ ΕΜΠΟΡΙΚΩΝ ΚΑΙ Α/Λ/ΛΩΝ ΚΕΝΤΡΙΚΩΝ ΛΕ	6	20.4	1.6	0.5
Εβ5	ΖΩΝΗ ΕΜΠΟΡΙΚΩΝ ΚΑΙ Α/Λ/ΛΩΝ ΚΕΝΤΡΙΚΩΝ ΛΕ	3	11.3	1.2	0.5
Εβ4	ΖΩΝΗ ΕΜΠΟΡΙΚΩΝ ΚΑΙ Α/Λ/ΛΩΝ ΚΕΝΤΡΙΚΩΝ ΛΕ	4	14.3	1.4	0.5
Εβ6	ΖΩΝΗ ΕΜΠΟΡΙΚΩΝ ΚΑΙ Α/Λ/ΛΩΝ ΚΕΝΤΡΙΚΩΝ ΛΕ	3	11.3	1	0.5
Εβ3α	ΖΩΝΗ ΕΜΠΟΡΙΚΩΝ ΚΑΙ Α/Λ/ΛΩΝ ΚΕΝΤΡΙΚΩΝ ΛΕ	5	14.3	1.6	0.5
Εβ	ΖΩΝΗ ΕΜΠΟΡΙΚΩΝ ΚΑΙ Α/Λ/ΛΩΝ ΚΕΝΤΡΙΚΩΝ ΛΕ	0	0	0	0
Εβ7α	ΖΩΝΗ ΕΜΠΟΡΙΚΩΝ ΚΑΙ Α/Λ/ΛΩΝ ΚΕΝΤΡΙΚΩΝ ΛΕ	0	0	0	0
ΕΜ	ΖΩΝΗ ΕΜΠΟΡΙΚΩΝ ΚΑΙ Α/Λ/ΛΩΝ ΣΥΝΑΦΩΝ ΔΡ	2	8.3	0.9	0.5
Κα7α	ΖΩΝΗ ΚΑΤΟΙΚΙΑΣ	3	11.3	1	0.45
Α	ΖΩΝΗ ΚΥΒΕΡΝΗΤΙΚΩΝ ΚΤΙΡΙΩΝ	2	0	0.3	0.2
Βε1	ΖΩΝΗ ΟΙΚΟΝΟΜΙΚΩΝ ΔΡΑΣΤΗΡΙΟΤΗΤΩΝ	2	0	1	0.5
ΒΕ2	ΖΩΝΗ ΟΙΚΟΝΟΜΙΚΩΝ ΔΡΑΣΤΗΡΙΟΤΗΤΩΝ	2	0	0.9	0.5
ΒΕ1	ΖΩΝΗ ΟΙΚΟΝΟΜΙΚΩΝ ΔΡΑΣΤΗΡΙΟΤΗΤΩΝ	2	0	1	0.5
Ζ1	ΖΩΝΗ ΠΡΟΣΤΑΣΙΑΣ	2	8.3	0.06	0.06
Ζ3	ΖΩΝΗ ΠΡΟΣΤΑΣΙΑΣ	1	5	0.01	0.01
Δα4	ΖΩΝΗ ΠΡΟΣΤΑΣΙΑΣ	2	7	0.1	0.1



VisualBee

Establishment of Town Planning river protection zones.

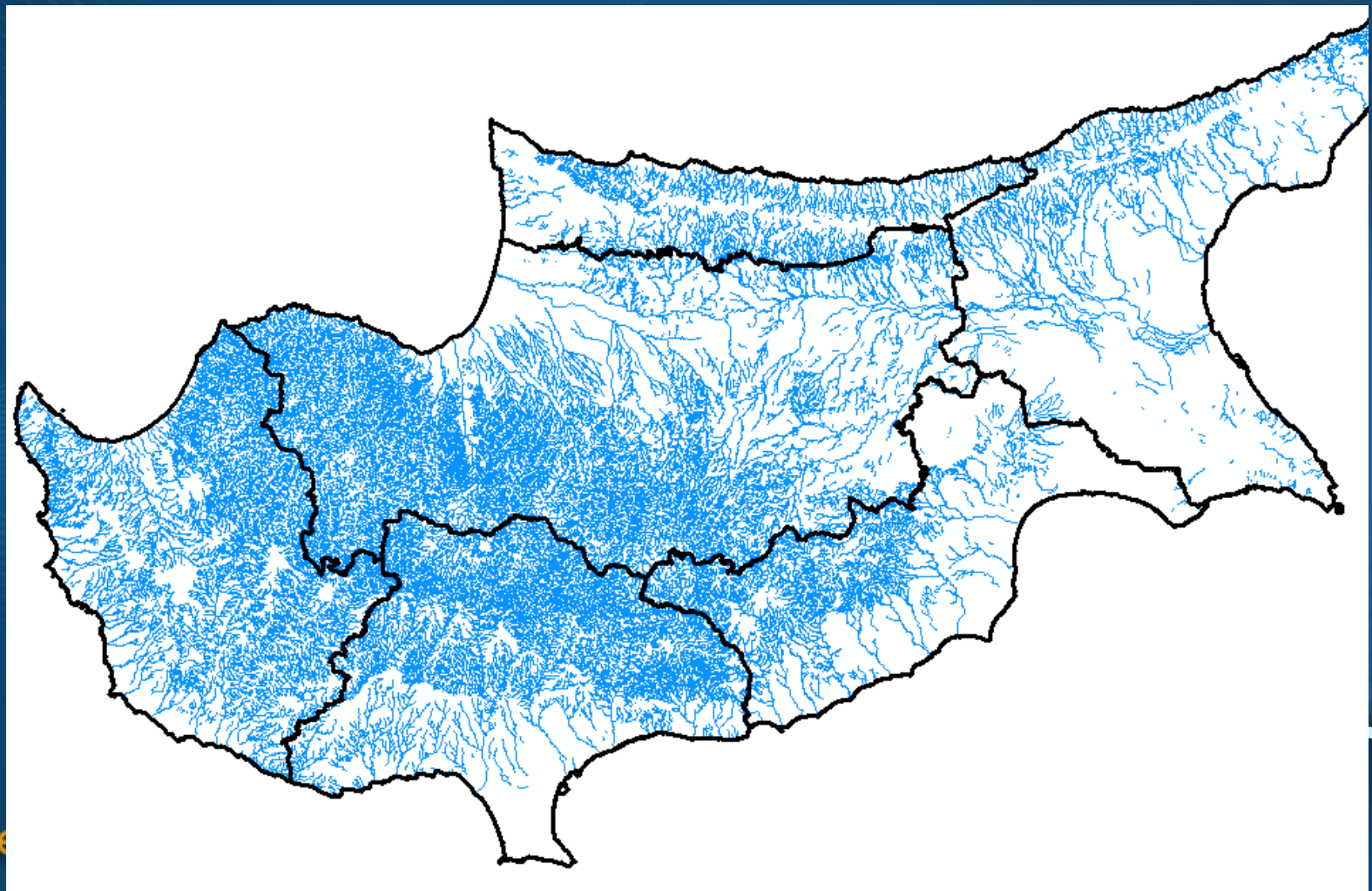
The goals for establishing the zones are :

a. Reduce flood risk exposure
b. Maintain flood plains for natural water retention and flood attenuation and flood protection of downstream areas.
c. Protection of river hydromorphology.
d. Protection of rivers from pollution and erosion
e. Protection of the wetlands and riparian ecosystems and forests.
f. Protection of the environment and scenery

Procedure for establishing the zones

Step 1.

Decide which rivers need to be protected with Town Planning Zone.

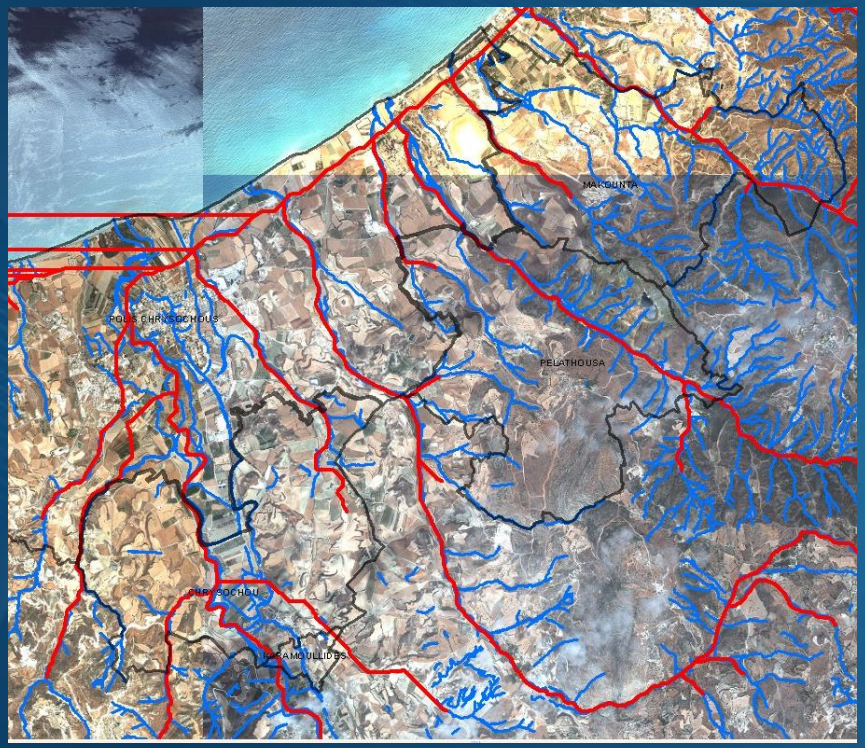


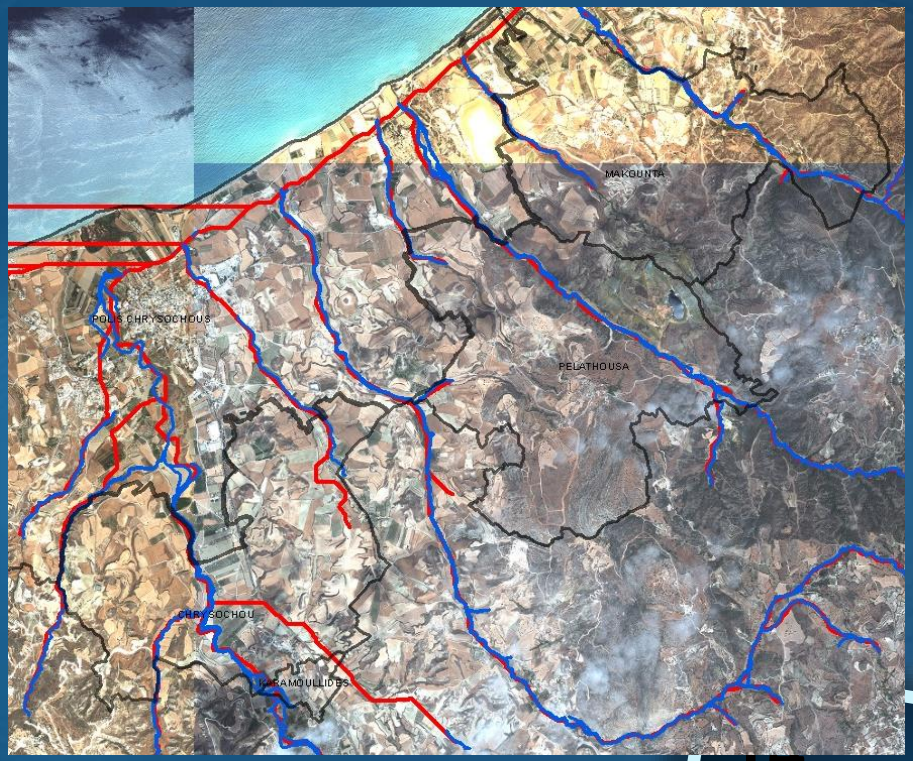
Procedure for establishing the zones

Step 1.

Catchment size is used as criterion for initial selection with threshold of 1 km2

Using FAC as guidance delete all cadastral rivers with smaller catchments.



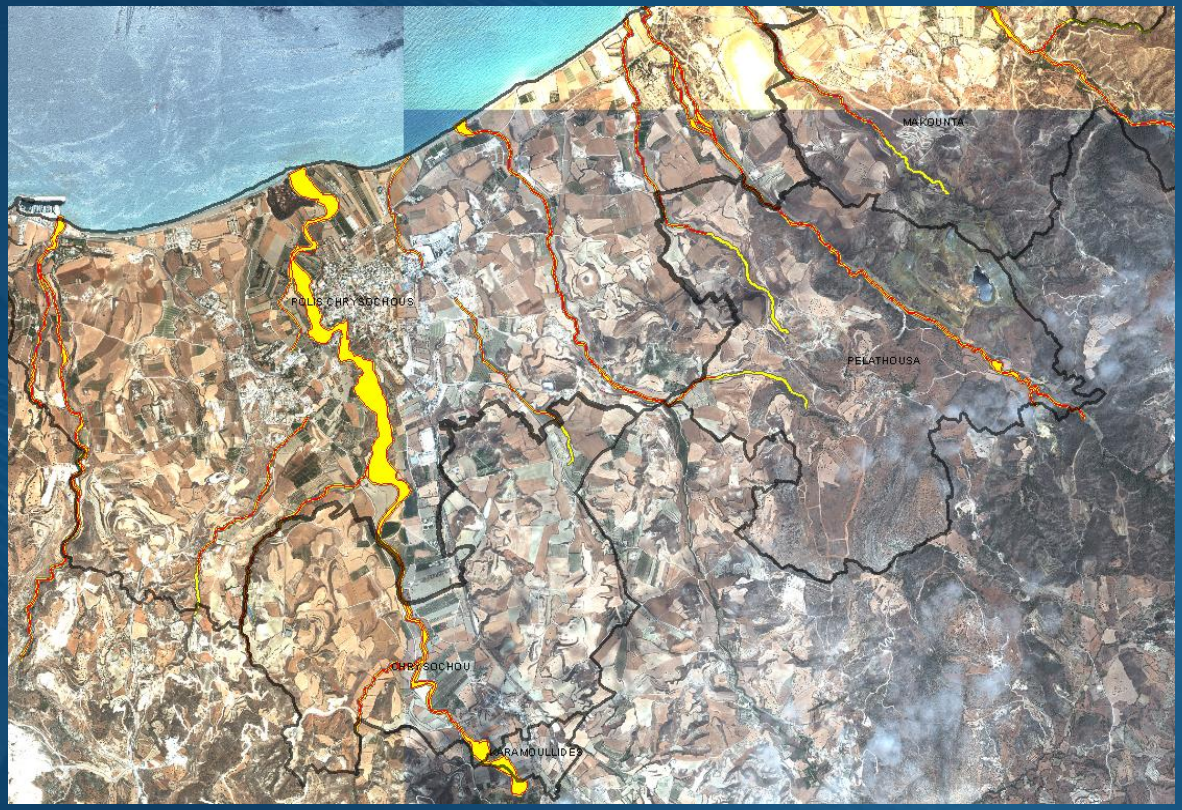


VisualBee

Procedure for establishing the zones

Step 2.

A buffer of 12.5 meters is applied on each side of registered stream bead. This is the minimum width of the TP protection zone.

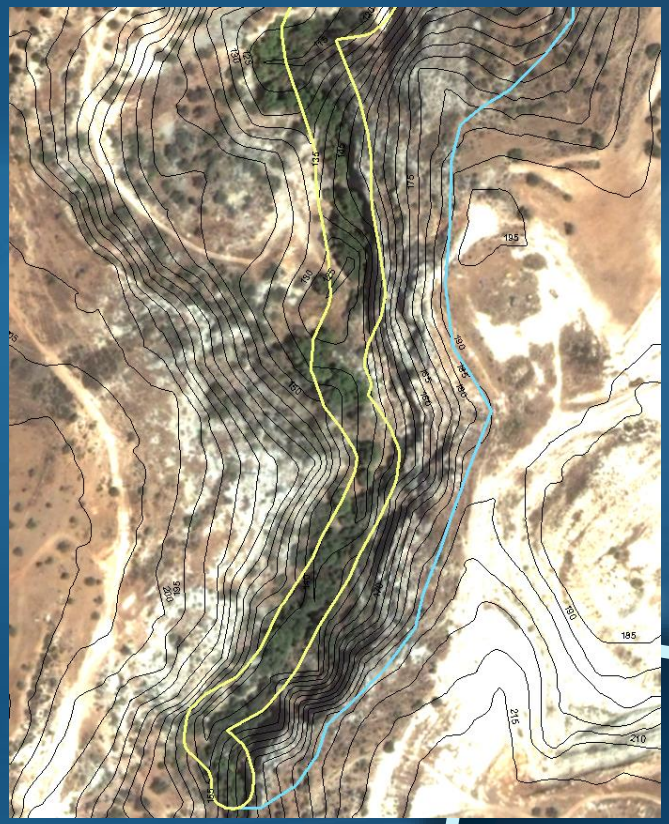


Procedure for establishing the zones

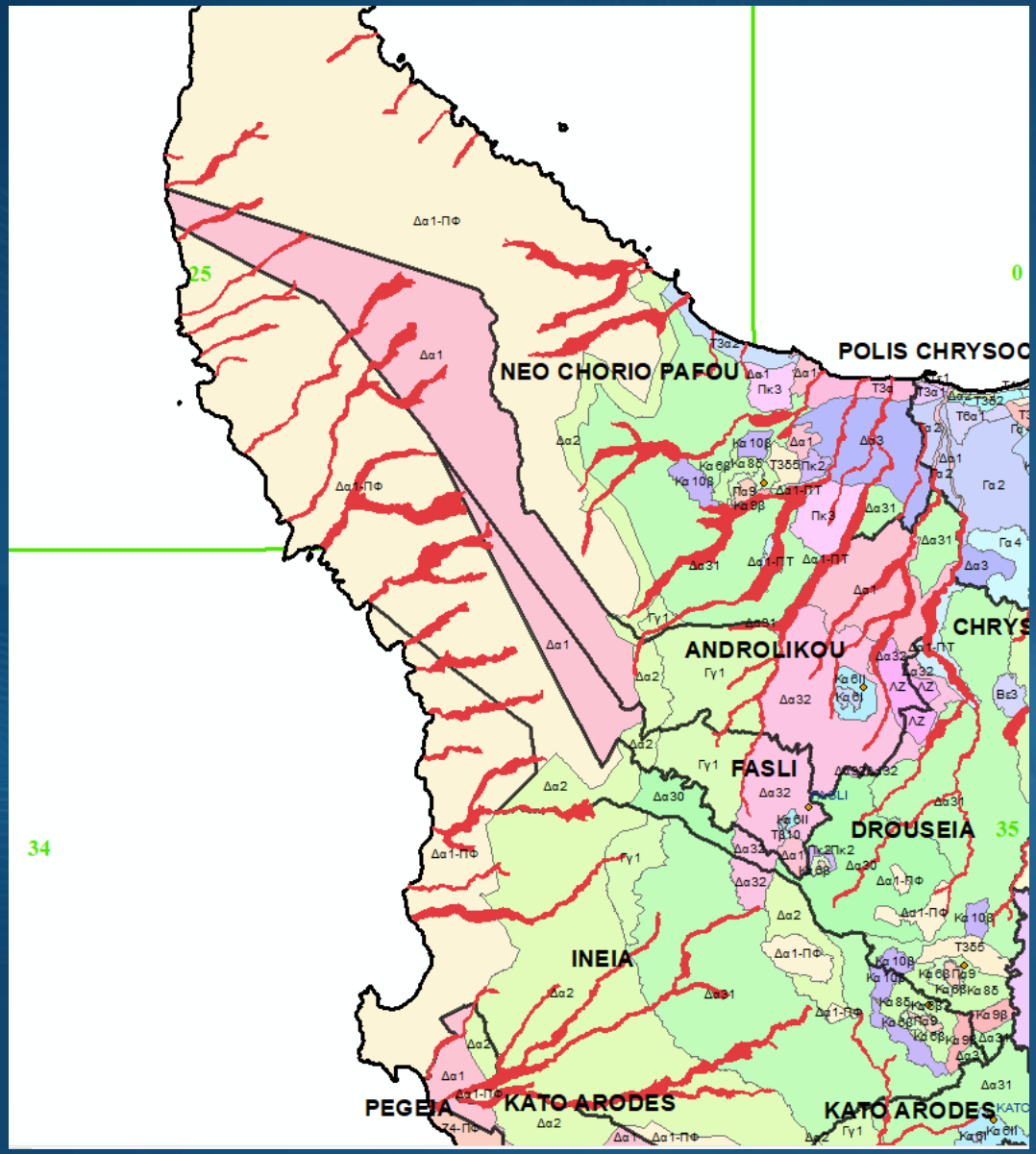
Step 3.

Adjust boundaries of zone manually in GIS using :

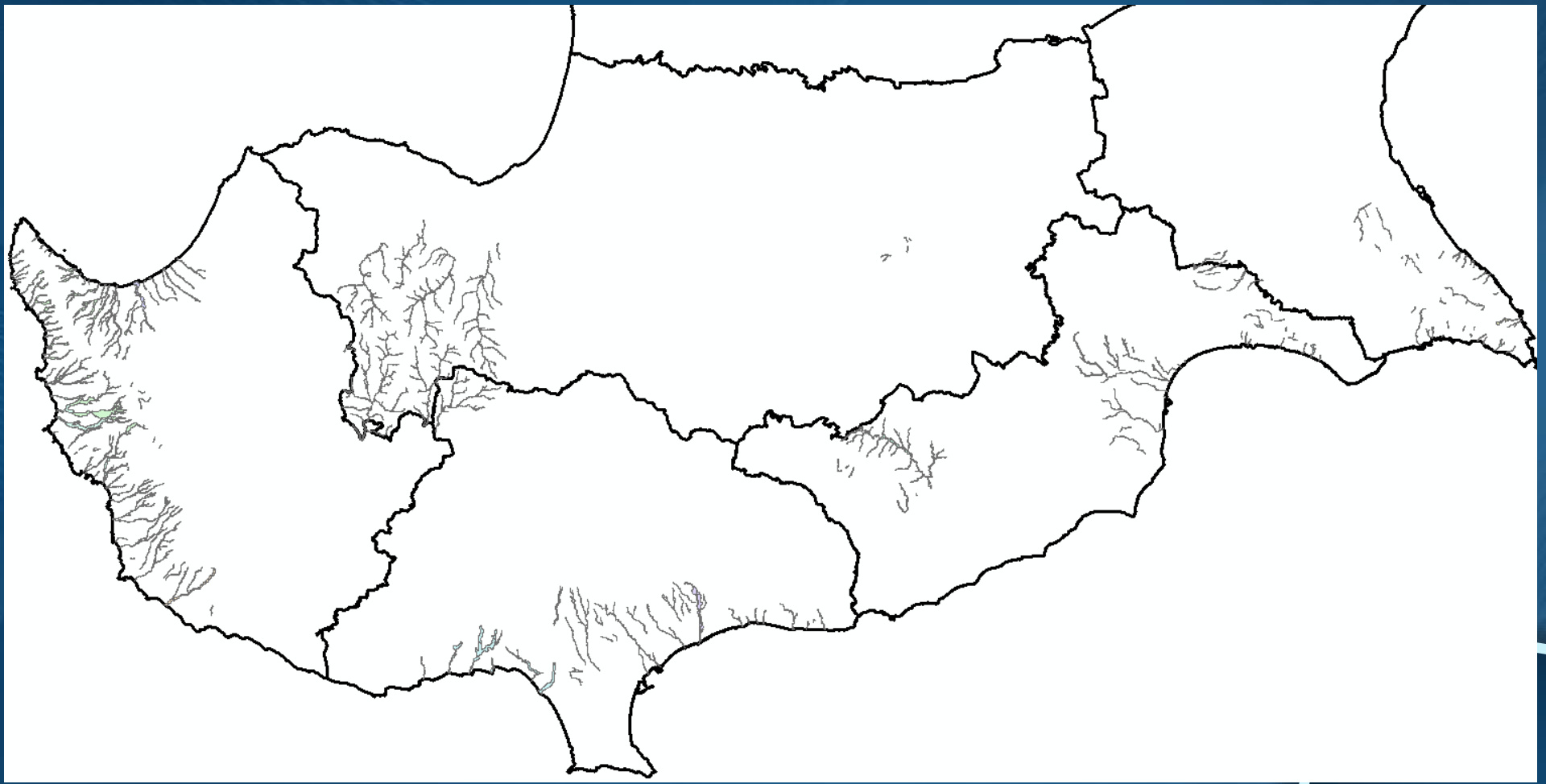
1. Flood maps (if exist in area)
2. Satellite images to identify riparian vegetation and river sediment and existing development such as roads or buildings.
3. Digital elevation models and contours to identify stream beds and floodplains
4. Other GIS layers



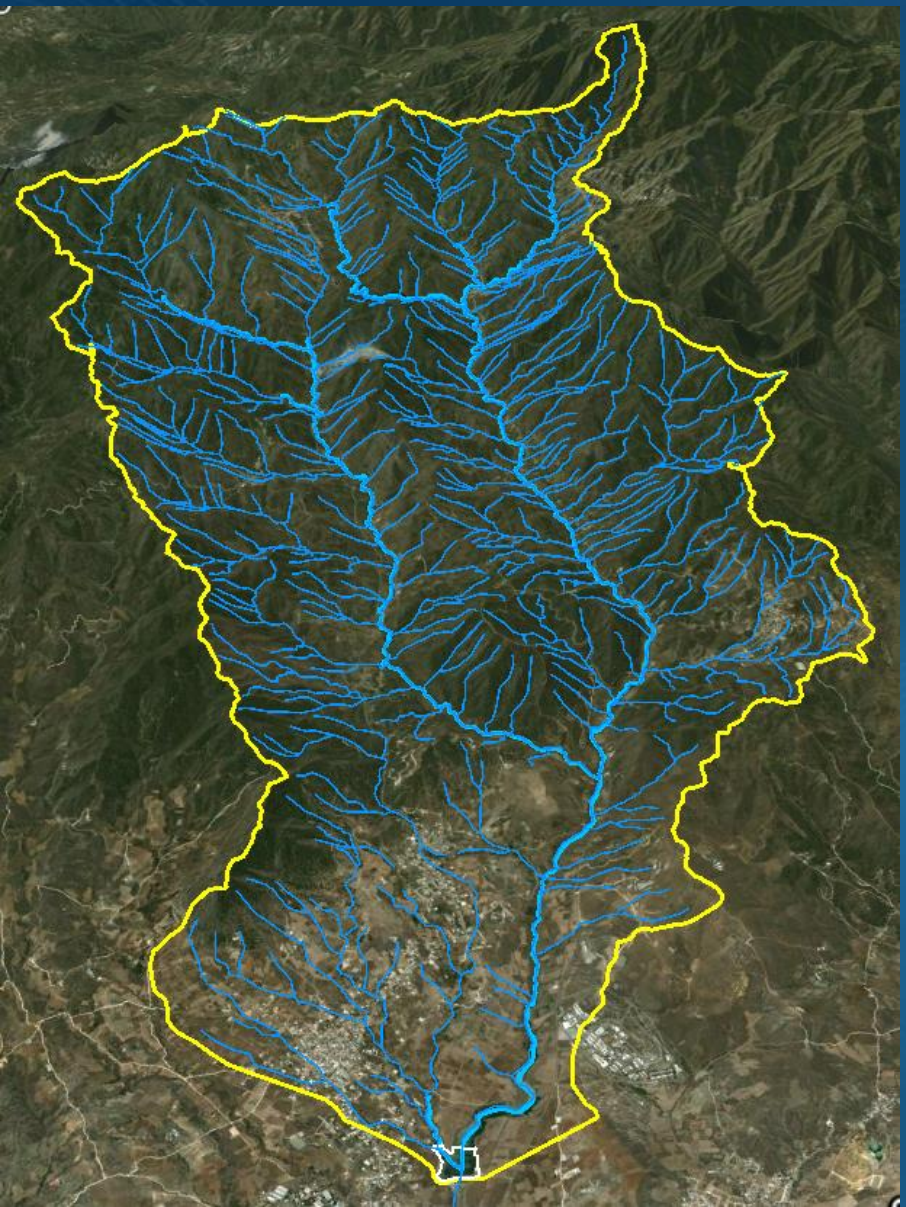
River protection zones Δα3 πroposals for Akamas Town Planning Zones



Proposed Town planning river protection zones ΔA3 so far.



Drinking water Reservoir protection Zones



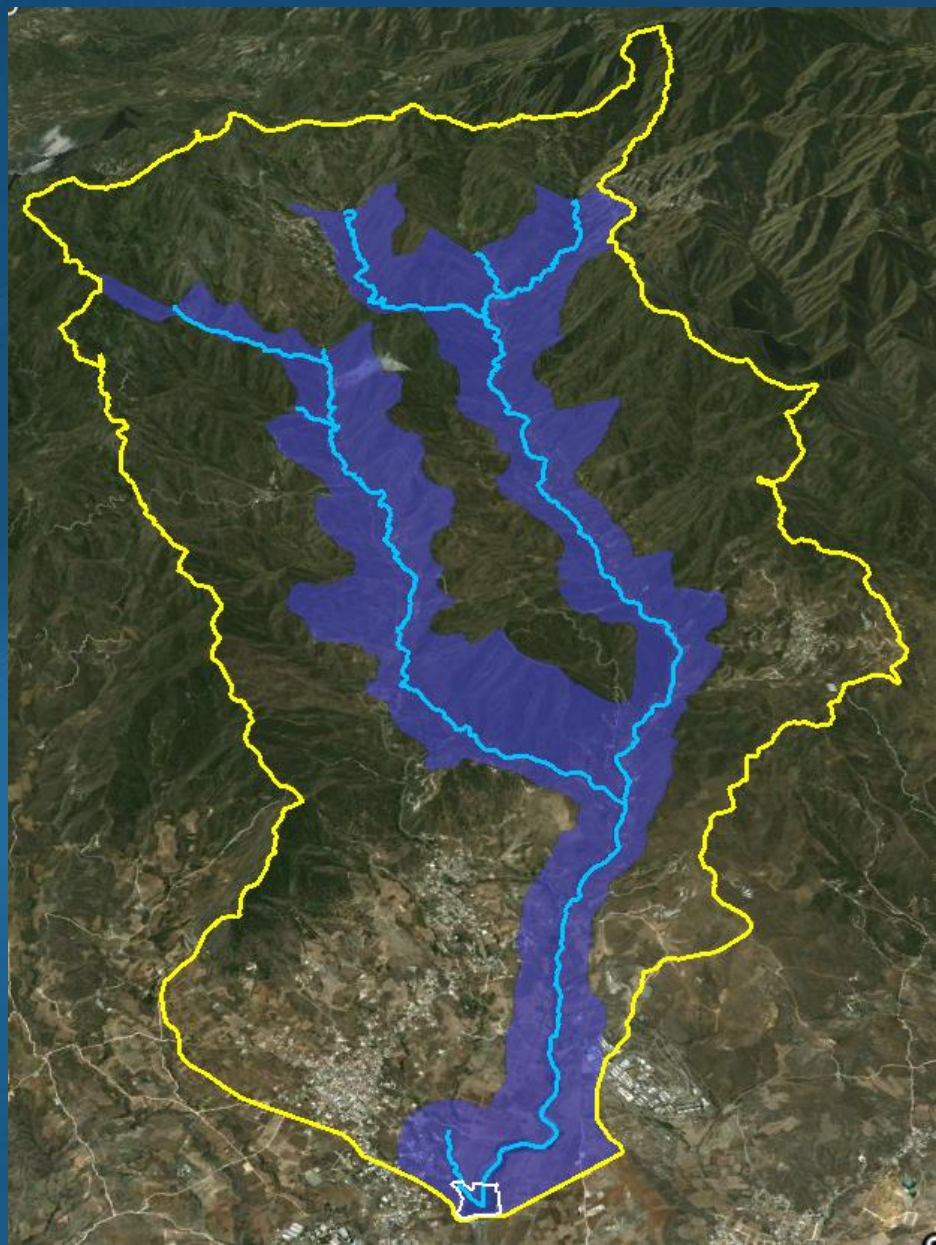
- The ideal protection zone of a reservoir is its whole catchment area.
- The most important areas within the catchment that need to be protected are the area around the reservoir where direct flow in the reservoir occurs and the areas around the main rivers that bring most of the volume of flow in the reservoir.

A. Definition of the protection zone extend

Then two questions need to be answered:

1. How do we define the most important river segments in the catchment that need to be protected?

2. What should be the width of the protection zone around the river segments that will be protected?



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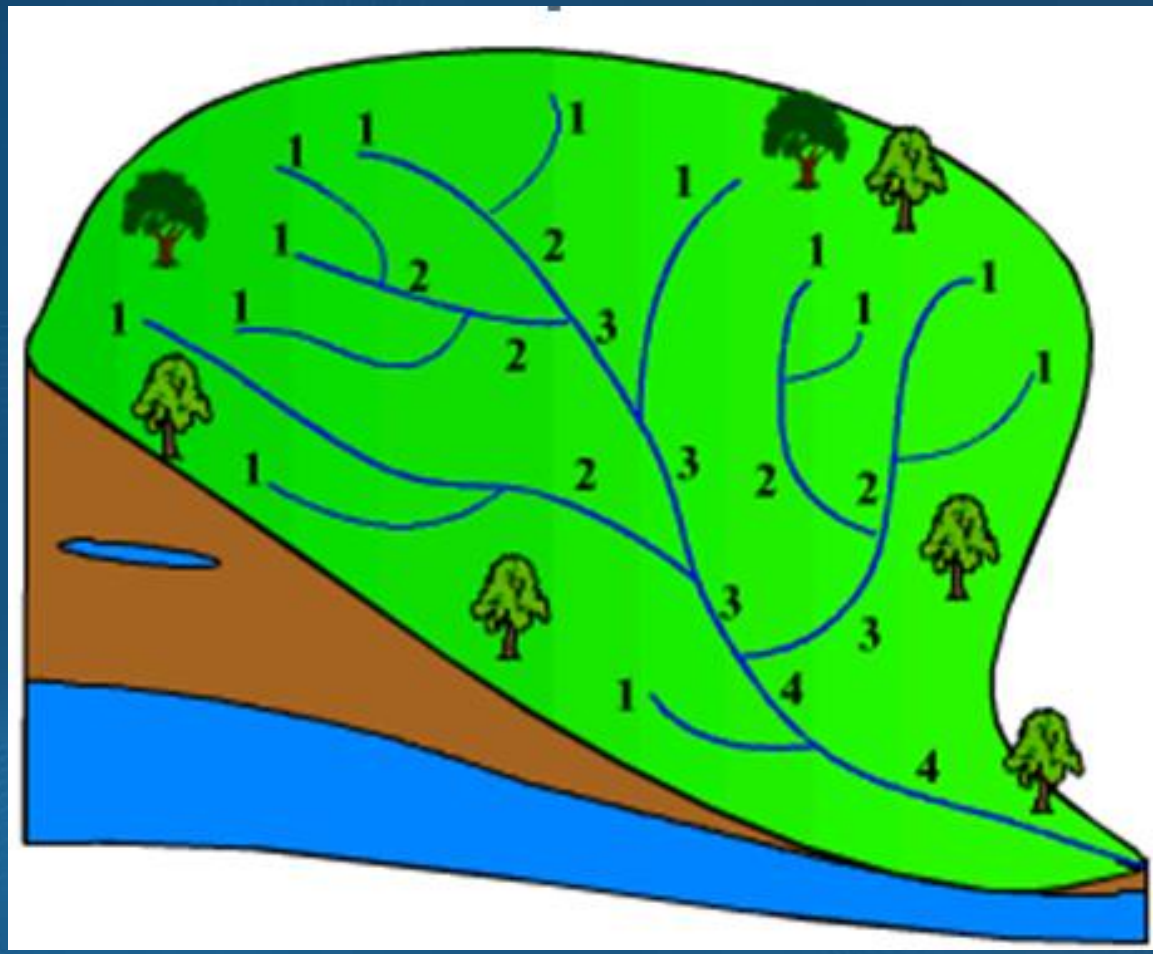
Question 1 : Definition of the significant river segments that need to be protected

Two methodologies explored:

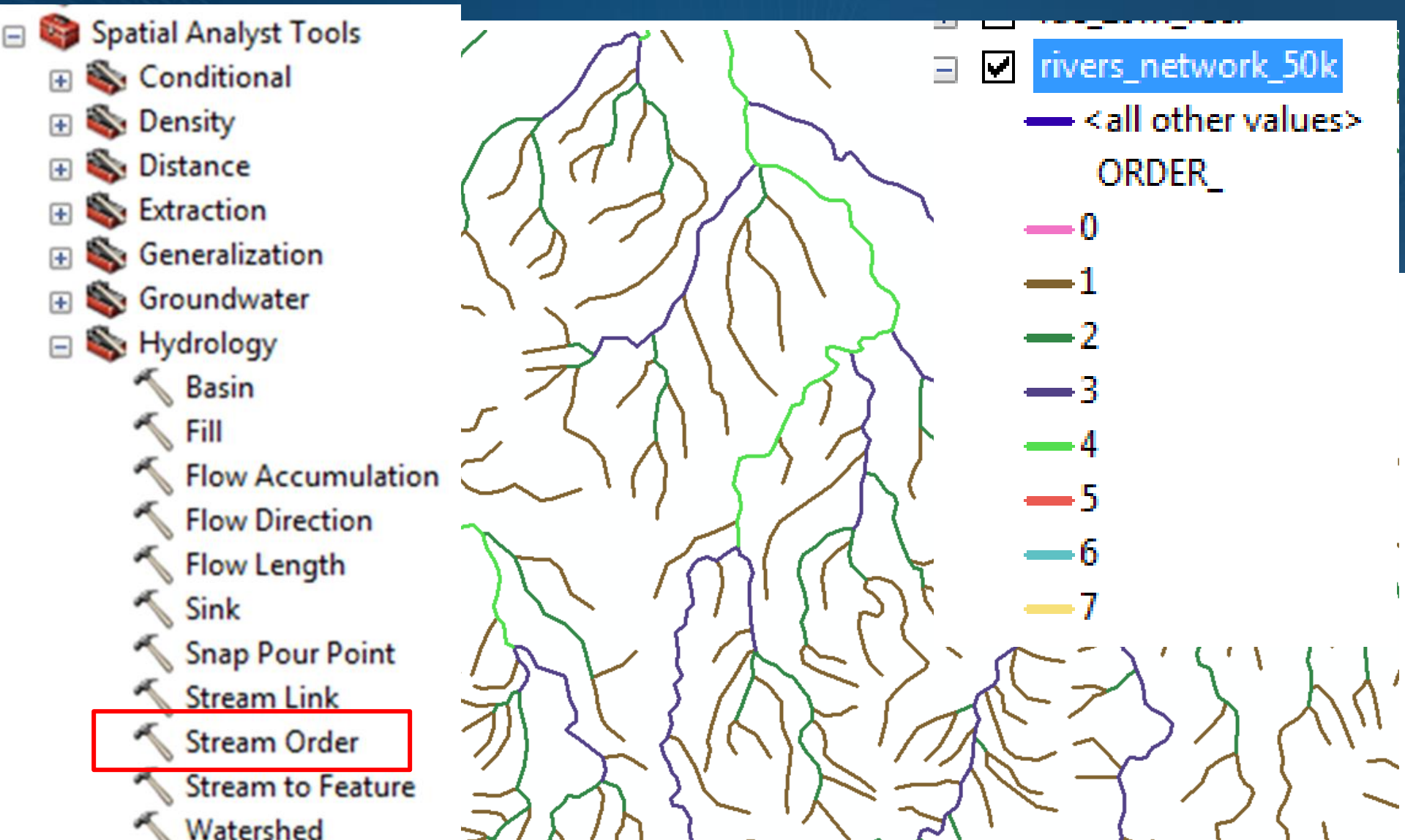
1. Using stream network classification (Strahler)

2. Using stream catchment area size.



1. Strahler stream network classification

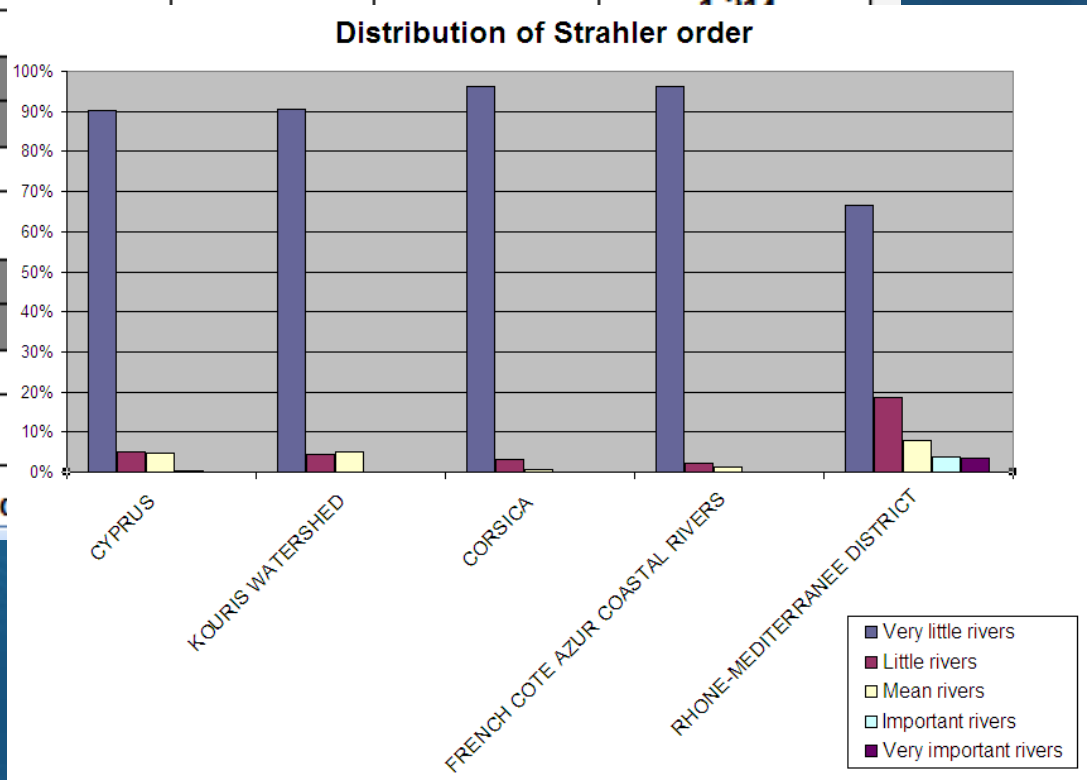
All the stream segments within the catchment areas of all reservoirs were classified using the Strahler method and Acgis tools and then a statistical analysis was performed.



Strahler Classification statistical analysis

	Very little rivers	Little rivers	Mean rivers	Important rivers	Very important rivers	Total length
	Stralher 0 to 3	Stralher 4	Stralher 5 to 6	Strahler 7	Strahler 8	Km
CYPRUS	17 947	994	917	32	0	19 889
	90.2%	5.0%	4.6%	0.2%	0.0%	
KOURIS	1 098	53	62	0	0	
	90.5%	4.4%				
CORSICA	12 263	388				
	96.2%	3.0%				
FRENCH COTE AZUR COASTAL RIVERS	15 205	365				
	96.3%	2.3%				
FRENCH COTE AZUR COASTAL BV	4 794	81				
	97.5%	1.6%				
RHONE-MEDITERRANEE DISTRICT	28 625	7 968				
	66.5%	18.5%				

Table 2: Strahler range



VisualBee

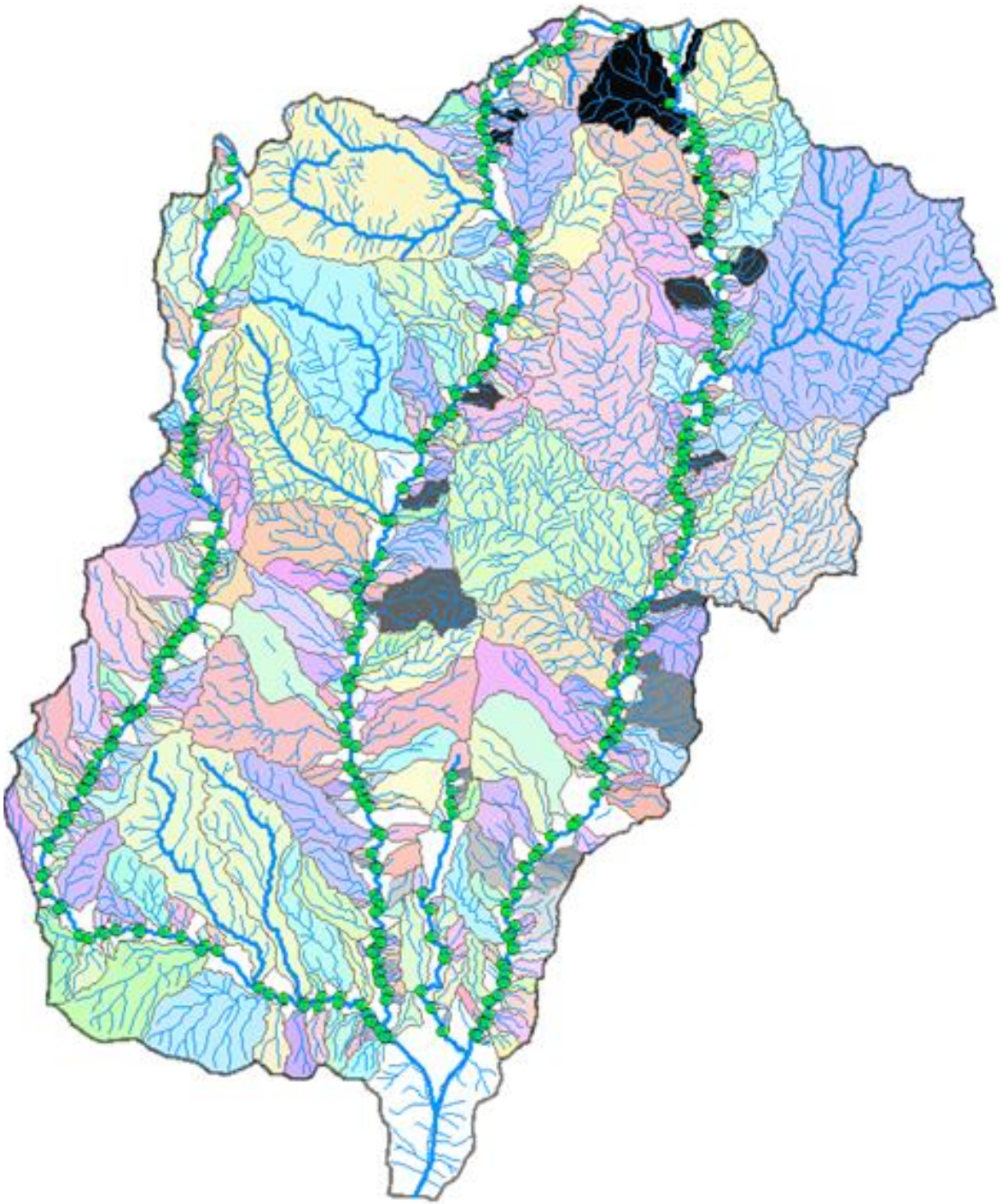
2 . Using stream catchment area size

The catchment size of main stream segments within the reservoir watersheds were calculated using the ArcHydro extension of ArcGIS and a statistical analysis was performed.

KOURIS (360 sub watersheds)

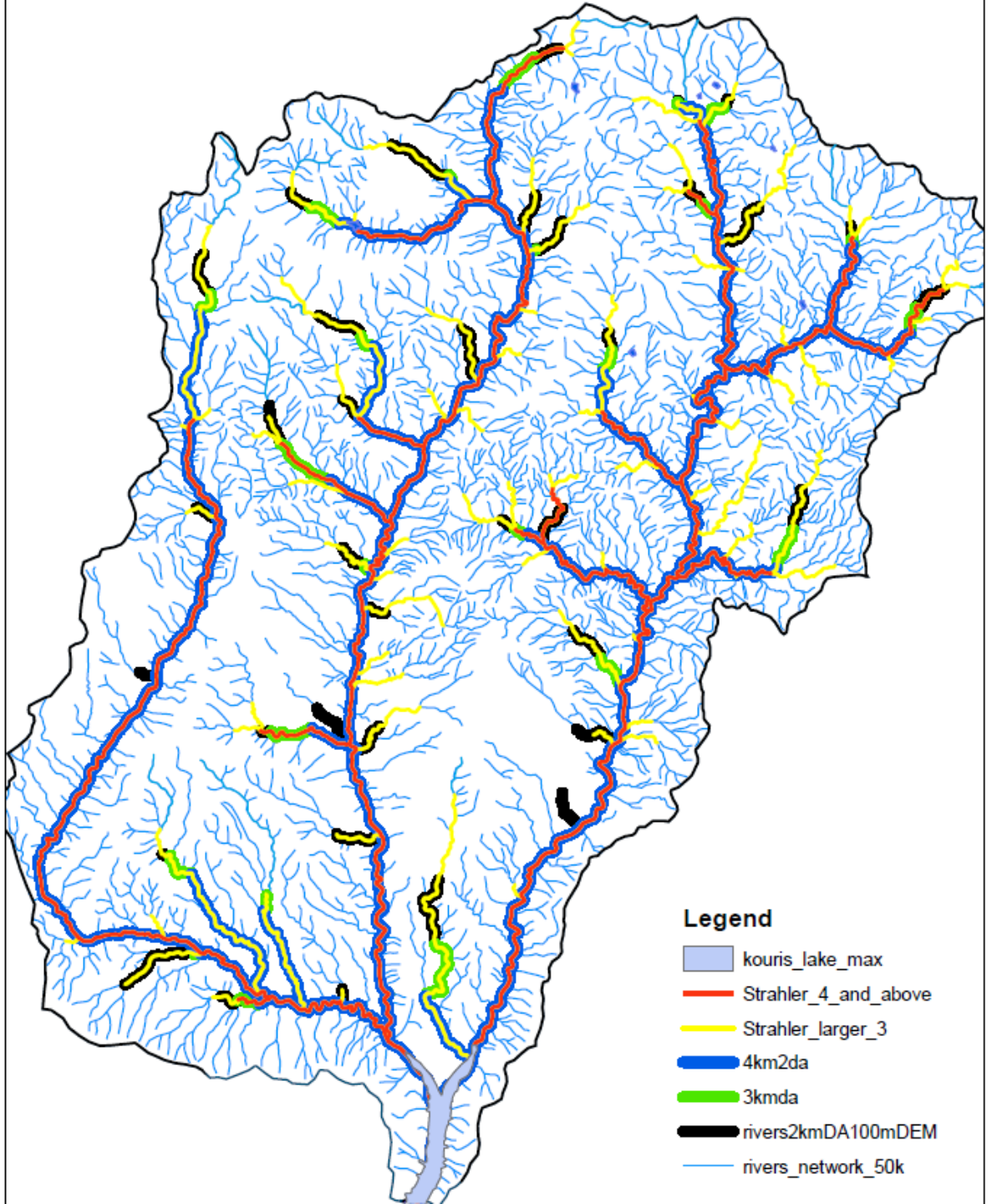
Percentile		Value (km²)
Maximum	100%	22.307
	99%	10.111
	95%	2.837
	90%	1.629
3rd Quartile	75%	0.556
Médian	50%	0.173
1st Quartile	25%	0.077
	10%	0.044
	5%	0.033
	1%	0.006
Minimum	0%	0.002

Percentile distribution of sub-watershed surfaces of first tributaries of Kouris



VisualBee

A comparison of the results of the two methods was performed and it was decided to include in the protection zone the stream segments with a cathment area size **≥ 3 km2** which also corresponded well with the Strahler classifications ≥ 4.

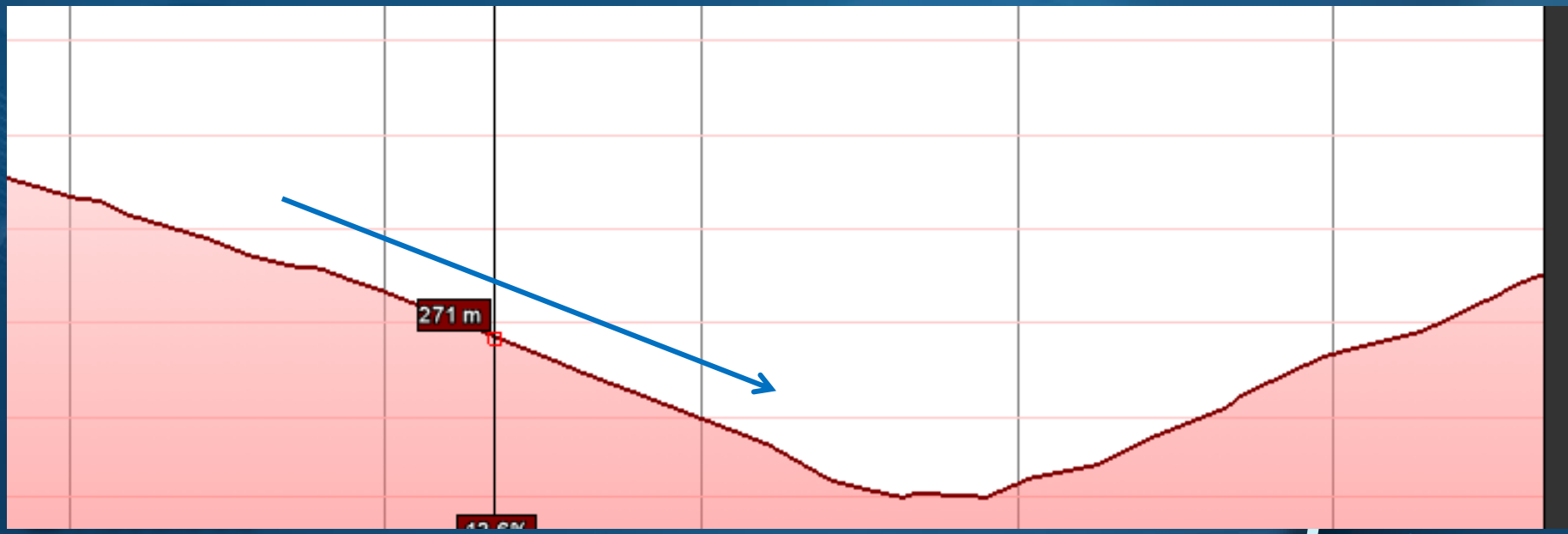


B. Zone Width definition and delineation

After a literature review the width of the protection zone was decided to be set proportional to the stream bank slope (Most common criterion used in many countries).

Slope is easily measurable parameter

The highest the slope the highest the erosion and the pollutant transport from the soil into the water and then into the stream



B. Zone Width definition and delineation

The final rules for the protection zone width were the following :

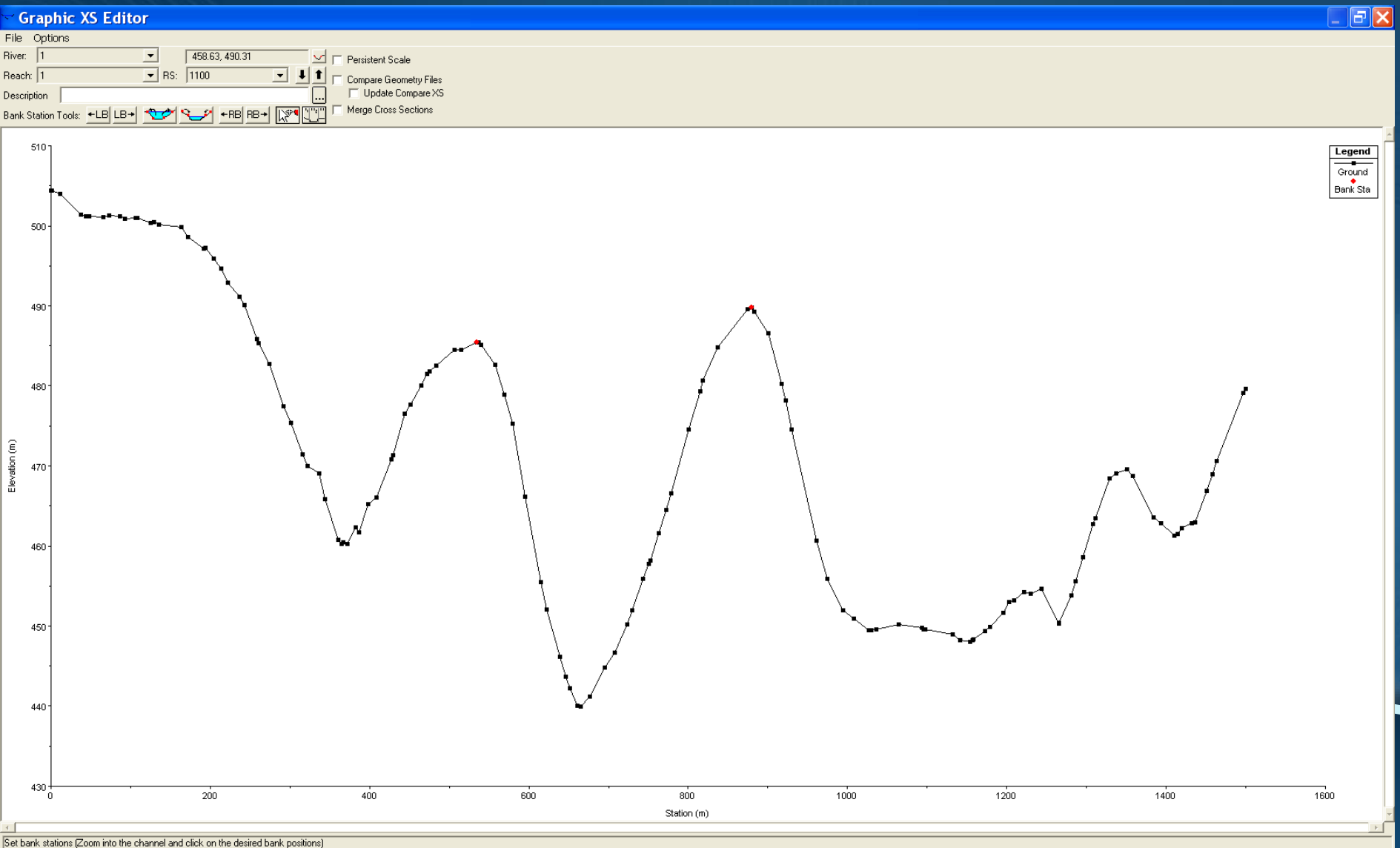
	Slope in %			
	< 3 %	3 - 10 %	10 - 20 %	> 20 %
Tributary buffer zone	is composed of a riparian protection zone whose width is			**Buffer zone extends as long as slope is > = 20% Until a buffer of 3 pixels of slope smaller than 20% is reached**
	100 m.	**200 m.**	**300 m.**	
Reservoir buffer zone	is composed of a riparian protection zone whose width is			
	300 m.			

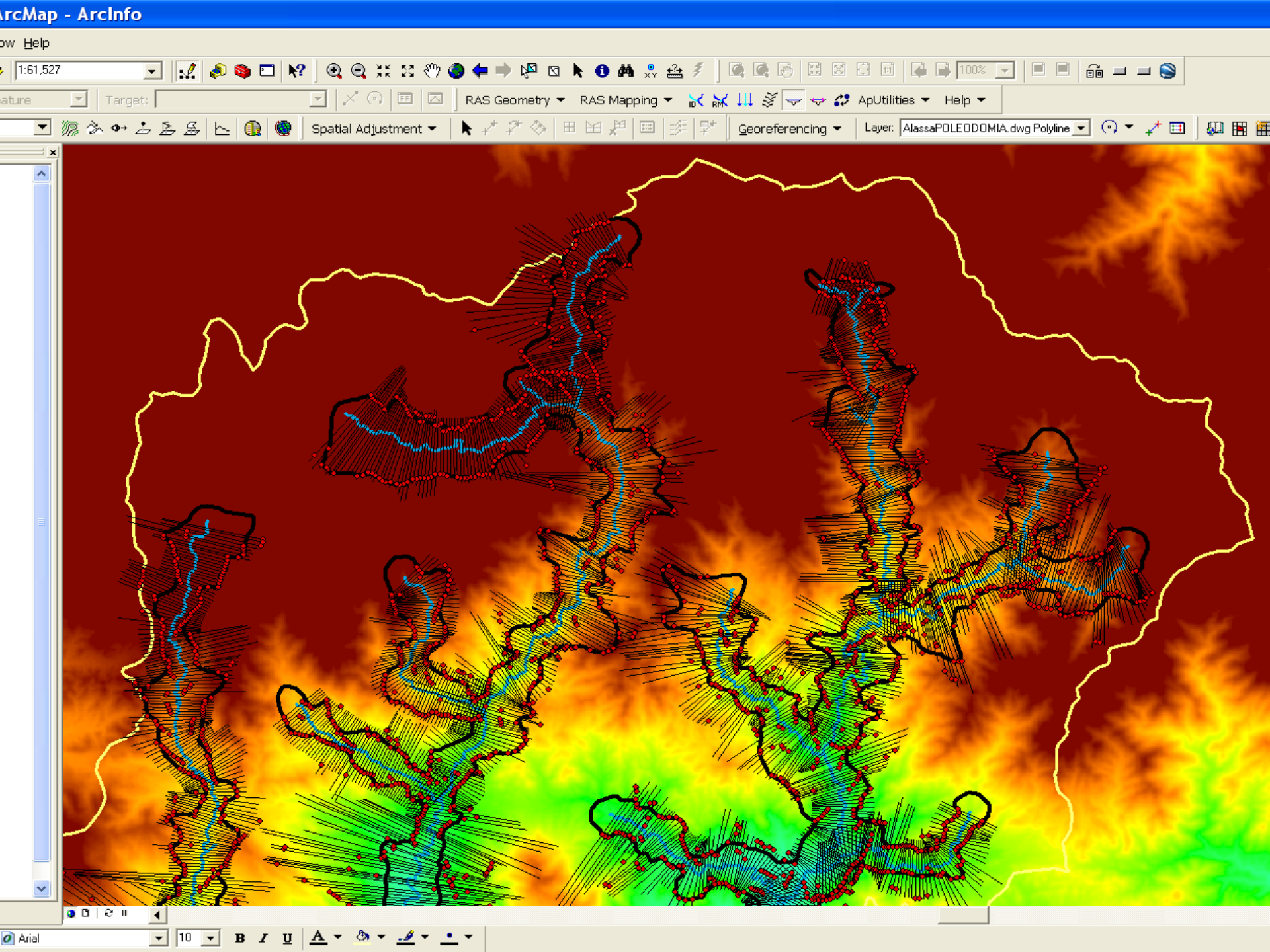
Table 9: Close Protection Zone final proposal

In any case, care will be taken to stop the extension of the buffer zone if a slope inversion is reached directing the flow away from the river or reservoir

Zone Boundary delineation using ArcGIS and Hec-RAS

Slope inversion point identification using HEC-RAS




ArcMap - ArcInfo
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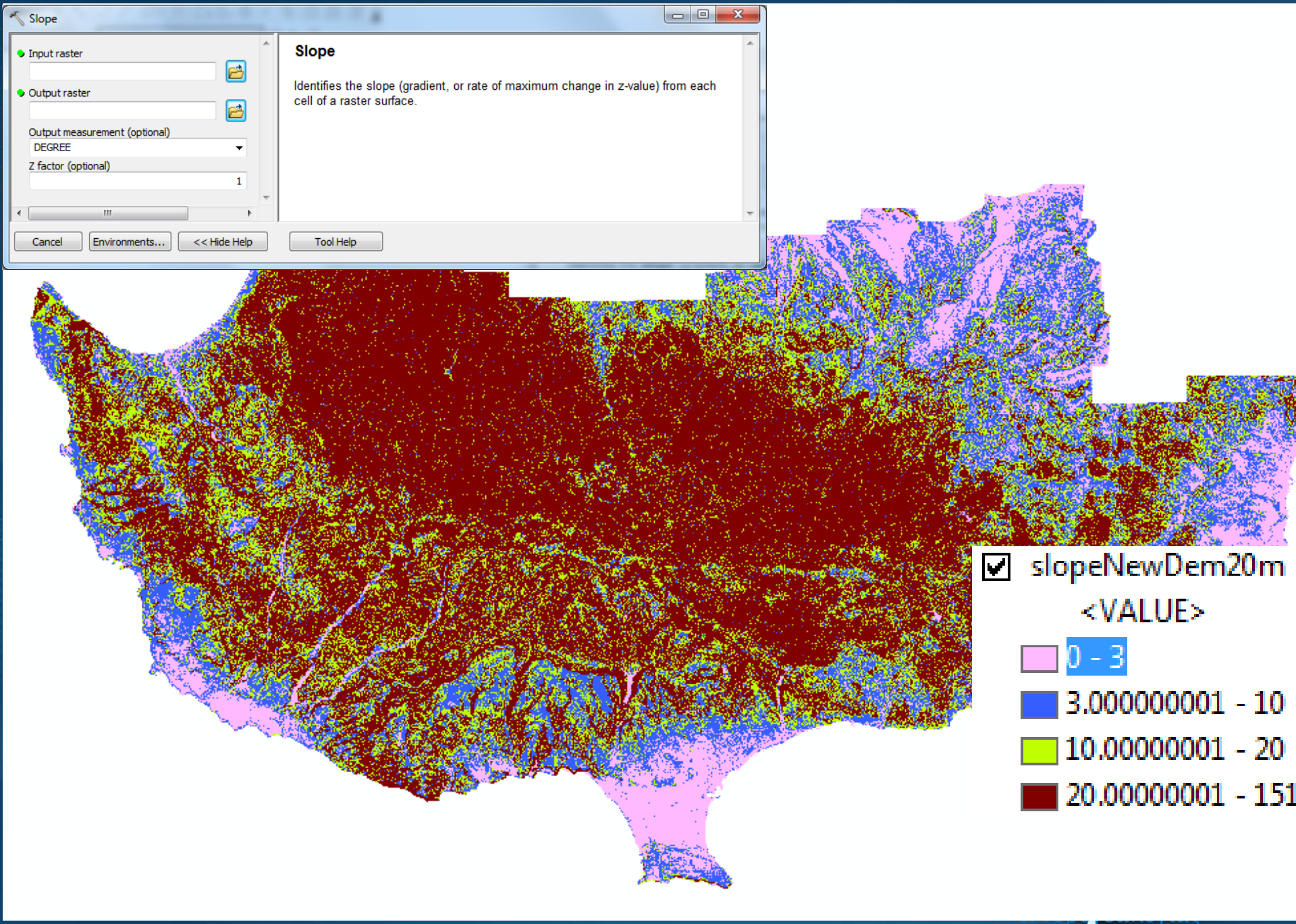
1:61,527
Target:
RAS Geometry
RAS Mapping
ApUtilities
Help
Spatial Adjustment
Georeferencing
Layer: AlassaPOLEODOMIA.dwg Polyline
Arial
10


Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2010 GeoEye
Image © 2010 DigitalGlobe


Slope
Input raster
Output raster
Output measurement (optional)
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Z factor (optional)
1
Slope
Identifies the slope (gradient, or rate of maximum change in z-value) from each cell of a raster surface.
Cancel
Environments...
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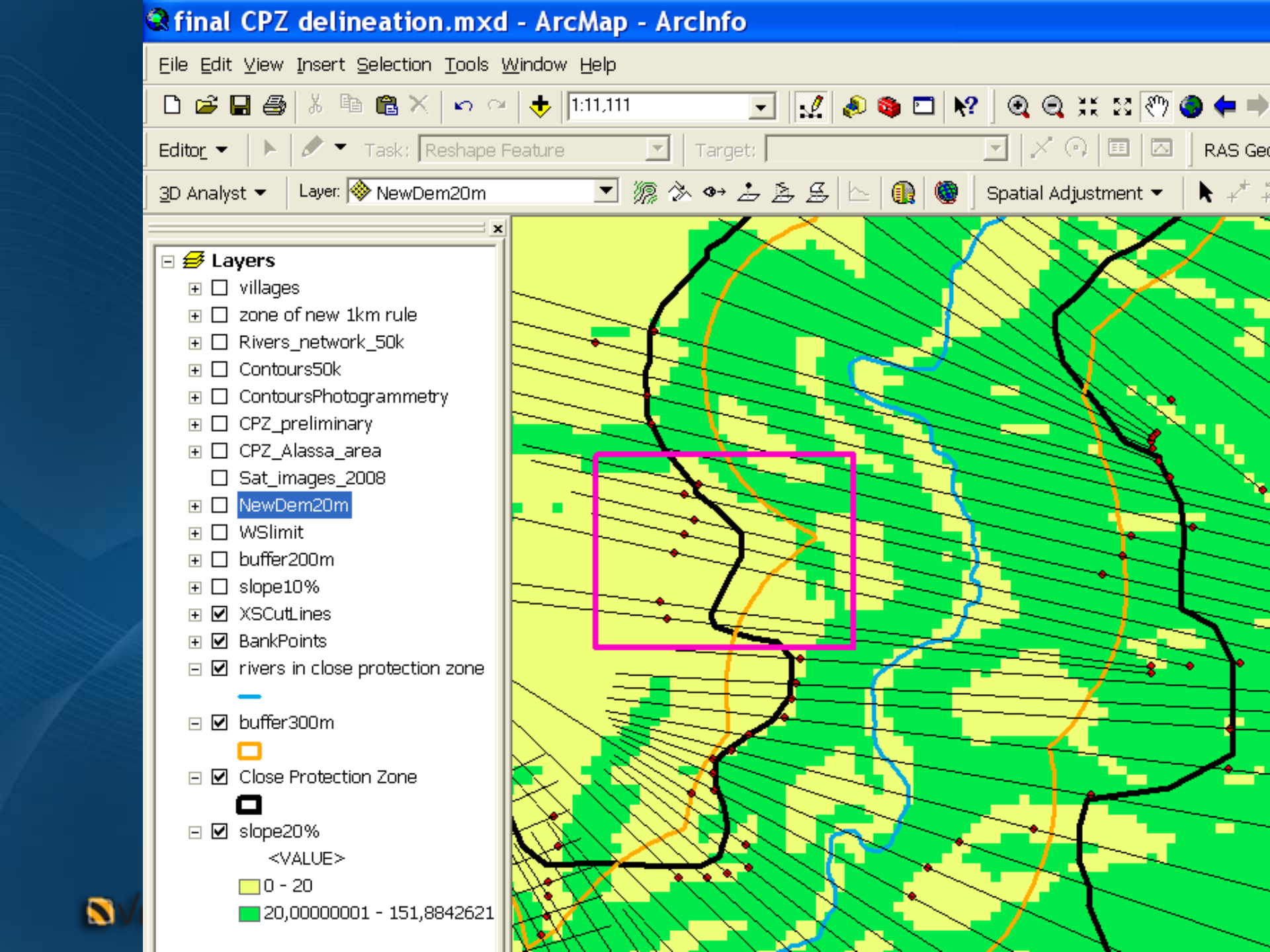
final CPZ delineation.mxd - ArcMap - ArcInfo
File Edit View Insert Selection Tools Window Help
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Editor
Task: Reshape Feature
Target:
3D Analyst
Layer: NewDem20m
Spatial Adjustment
Layers
villages
zone of new 1km rule
Rivers_network_50k
Contours50k
ContoursPhotogrammetry
CPZ_preliminary
CPZ_Alassa_area
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XSCutLines
BankPoints
rivers in close protection zone
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Close Protection Zone
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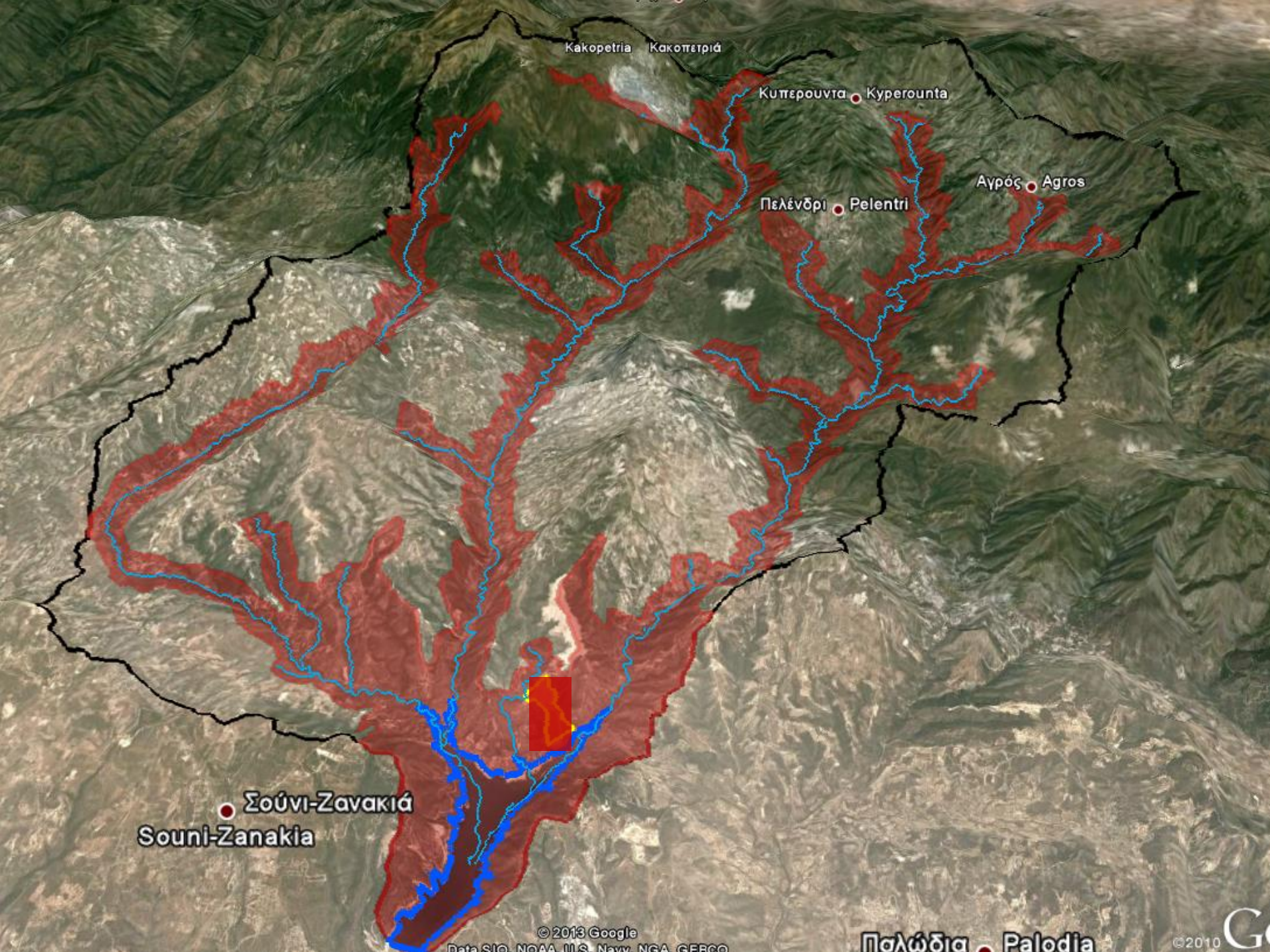
Reservoir protection Zones results

- The boundaries of the zones of the 13 drinking water reservoirs are shown below.


Kakopetria Κακοπετριά
Κυπερούντα Kyperounta
Αγρός Agros
Πελένδρι Pelentri
Σούνι-Ζανακιά
Souni-Zanakia
© 2013 Google
Παλώδια Palodia

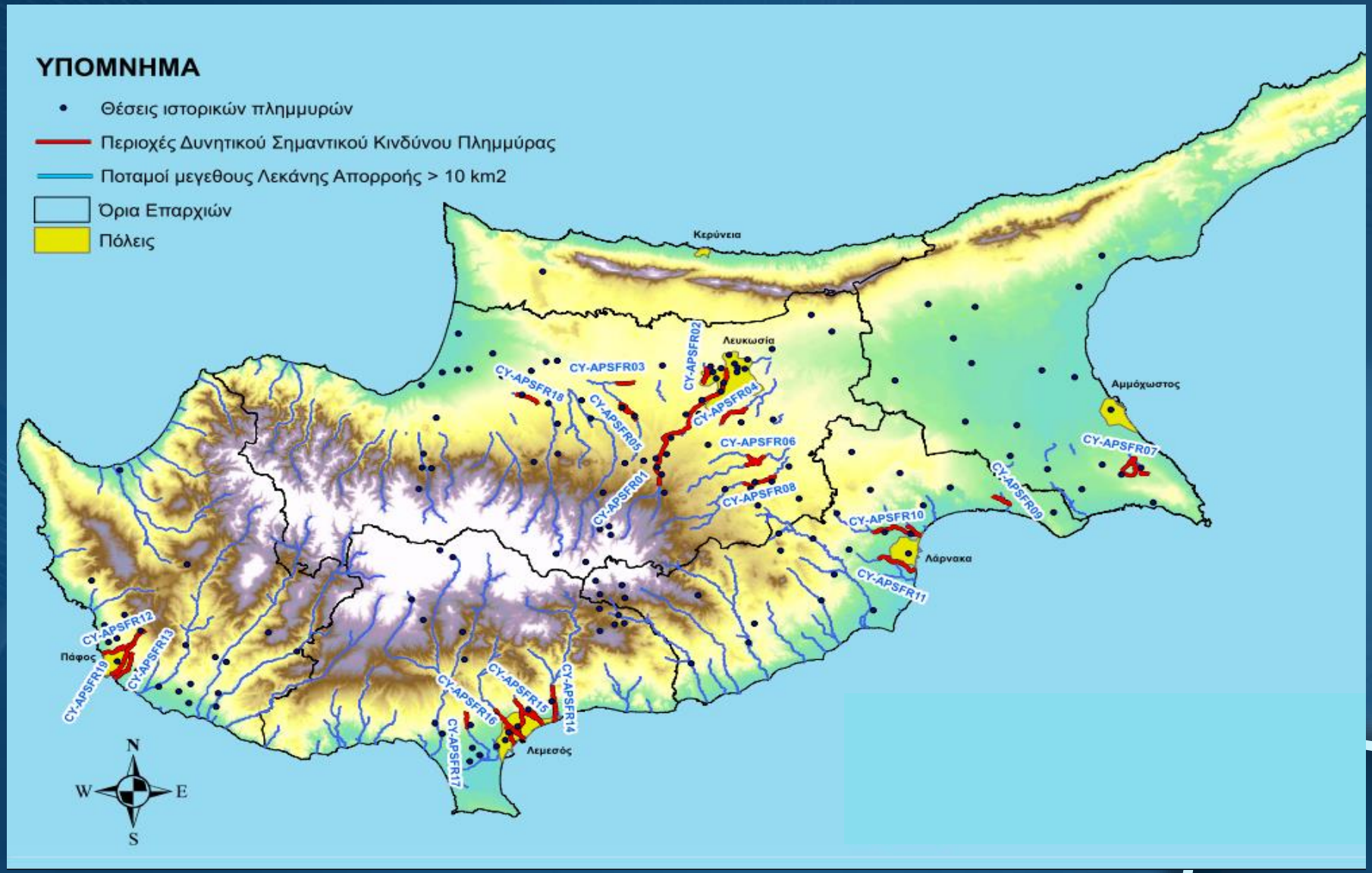
EU Flood Directive implementation

Identification of Areas of Potentially Significant Flood Risk

Preparation of Flood Hazard and Risk Maps for the APSFRs

Preparation of Flood Risk Management Plans

1st Cycle of implementation in Cyprus



Airborne LIDAR topographic survey

LiDAR survey specifications:

Flight altitude – 750-780 m AGL

Aircraft velocity - Maximum 140 knt.

Scan Angle - 20°

Average density of points - 1.0 points per m^2 (a point each 1 m^2)

Overlap between exposures – 25%

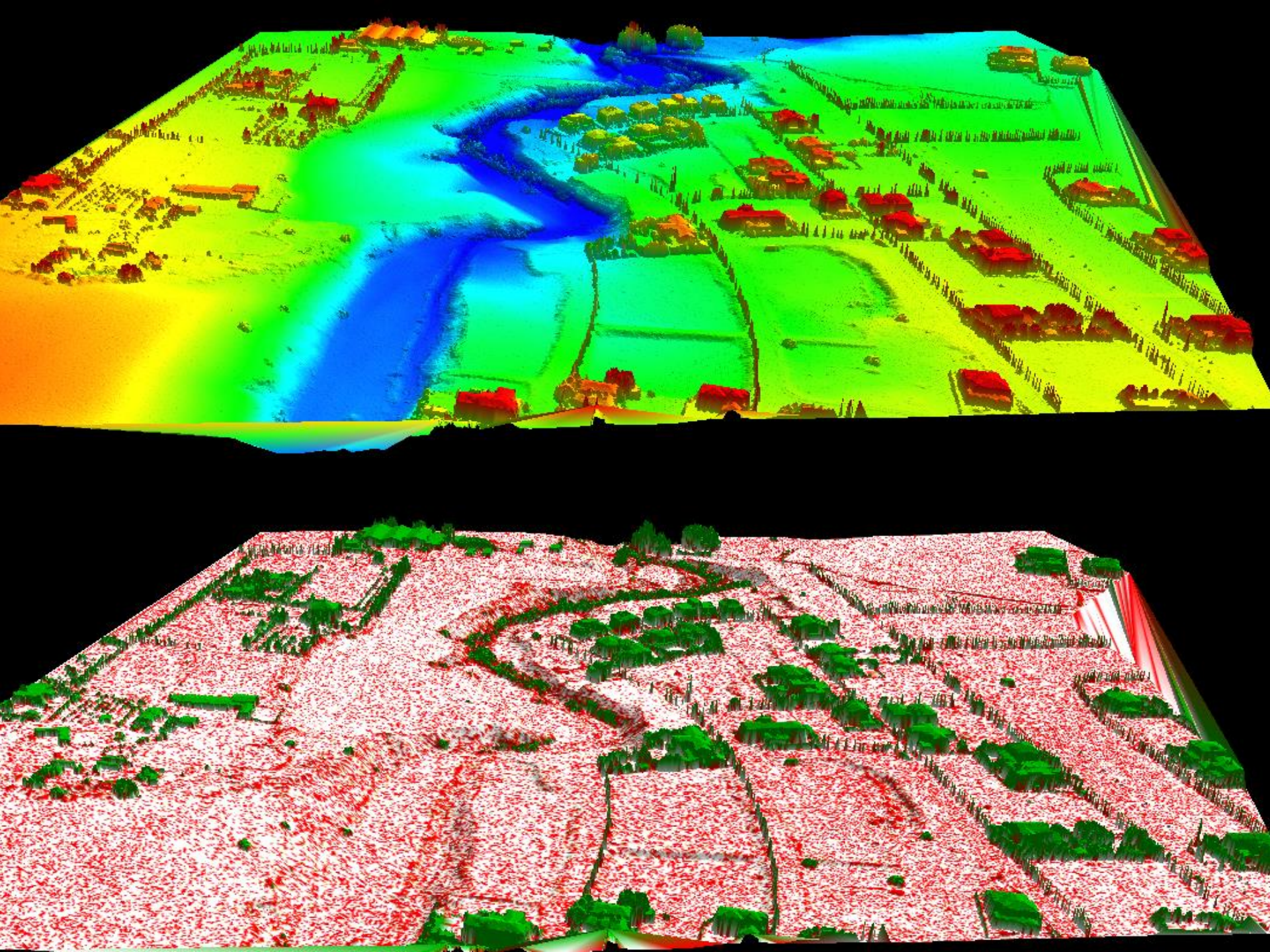
Data recording - first, second, third and last pulse, Intensity for each echo.

Elevation accuracy target – 0.15m

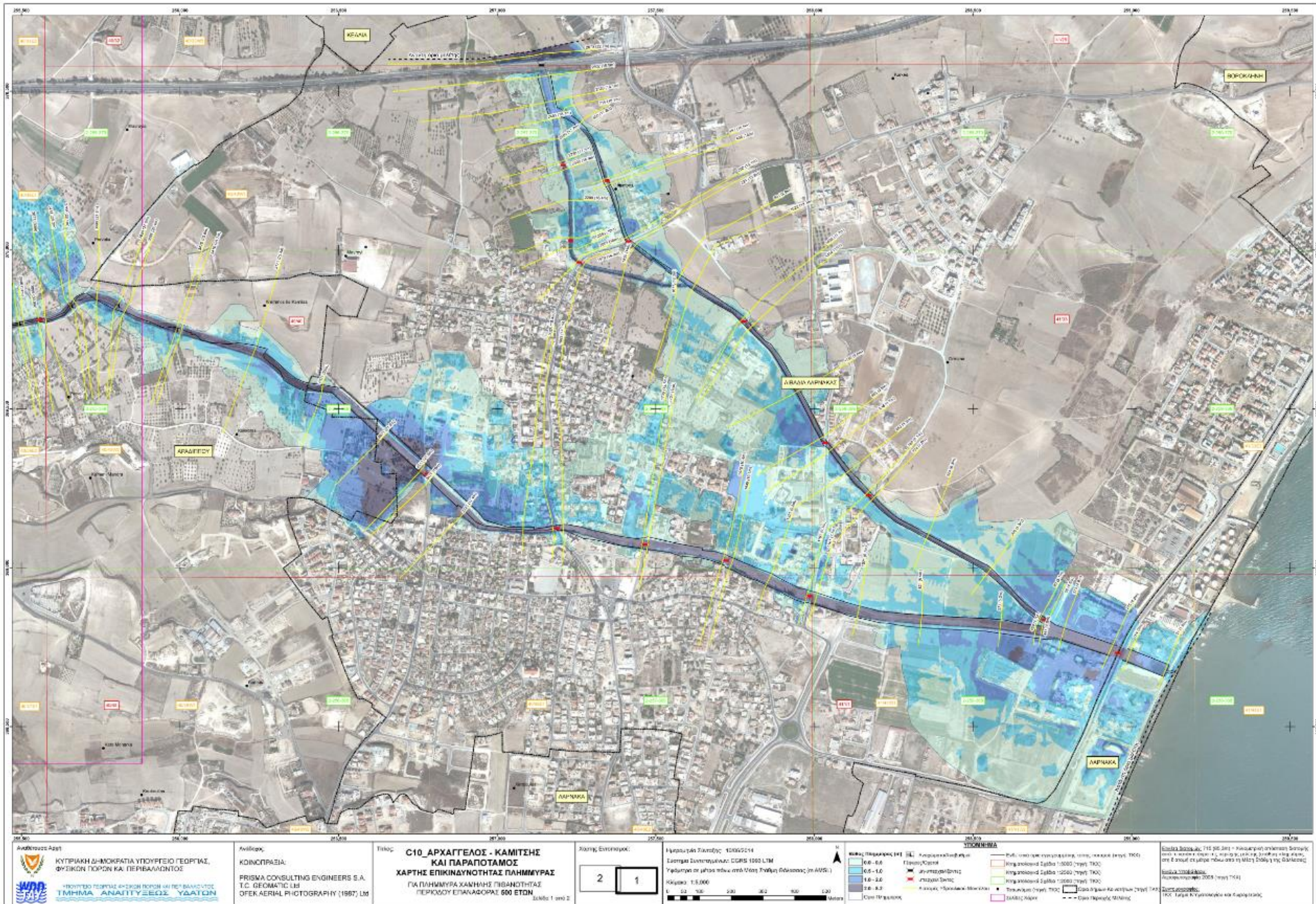
Position accuracy target – 0.4m

The LiDAR data strip width: 680m

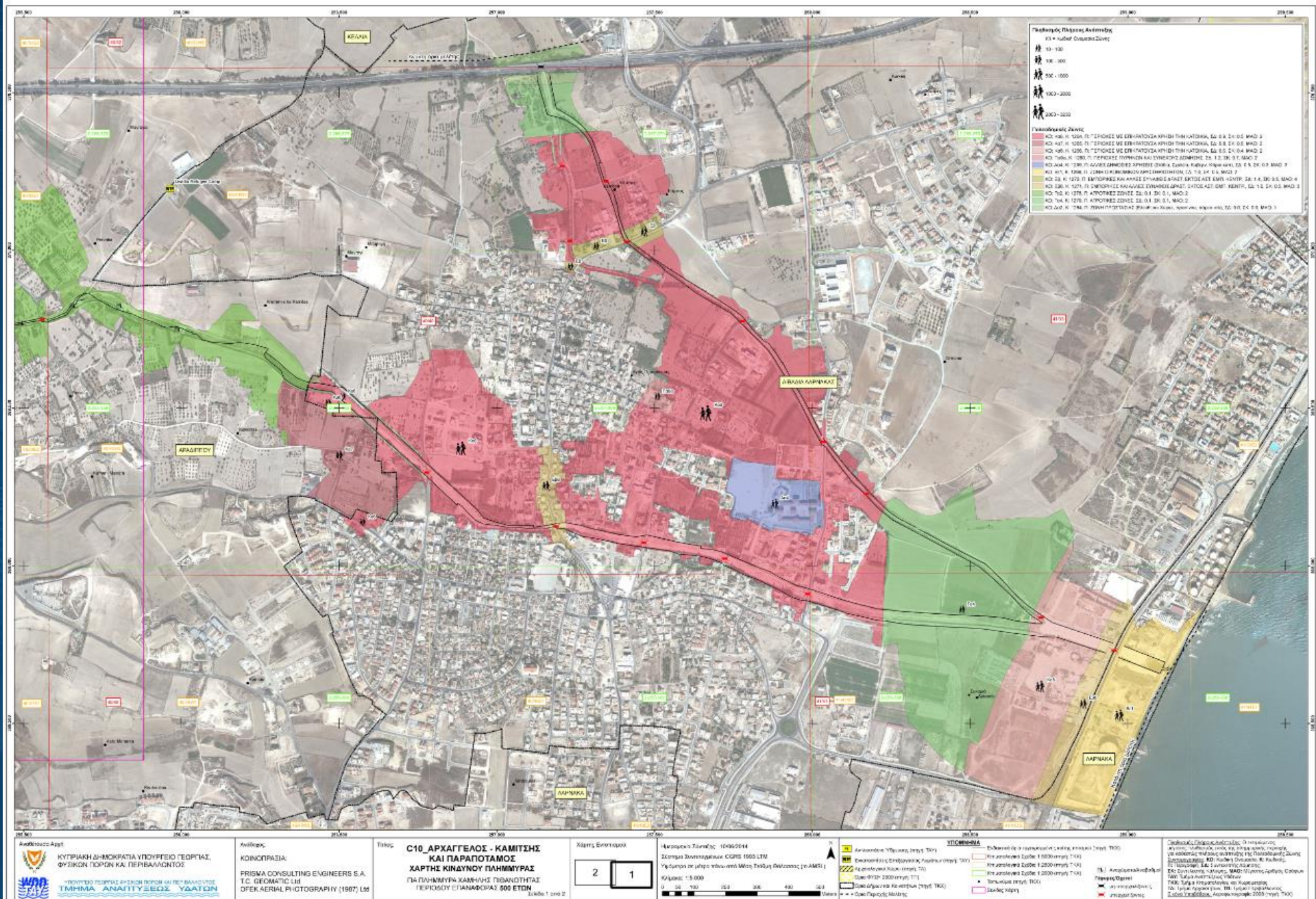
OFEK AERIAL PHOTO



Flood hazard depth map for each return period



Flood Risk Maps



Flood Risk Management Plan

The flood Risk Management plan Defines targets for managing flood risks and then measures on how to achieve these targets.

Cost of measures per flood risk management aspect

Flood Risk Management Aspect	Number of measures	Estimated cost (€)
Horizontal Measures		
Prevention	4	18 000
Protection	18	1 289 600
Preparedness	3	120 ,000
Recovery	3	36 000
Sub-Total	**28**	1 463 600
Specific Measures		
Prevention	0	0
Protection	8	17 733 800
Preparedness	2	0
Recovery	0	0
Sub-Total	**10**	17 733 800
TOTAL	**38**	19 197 400

2nd Preliminary Flood Risk Assessment and identification of Areas of Potentially Significant Flood Hazard.

Evaluation of all sources of flooding including :

1. Coastal floods
2. Fluvial (river) floods
3. Flash/ torrential floods
4. Pluvial/urban floods
5. Ground water floods
6. Artificially water bearing infrastructure floods

Coastal floods

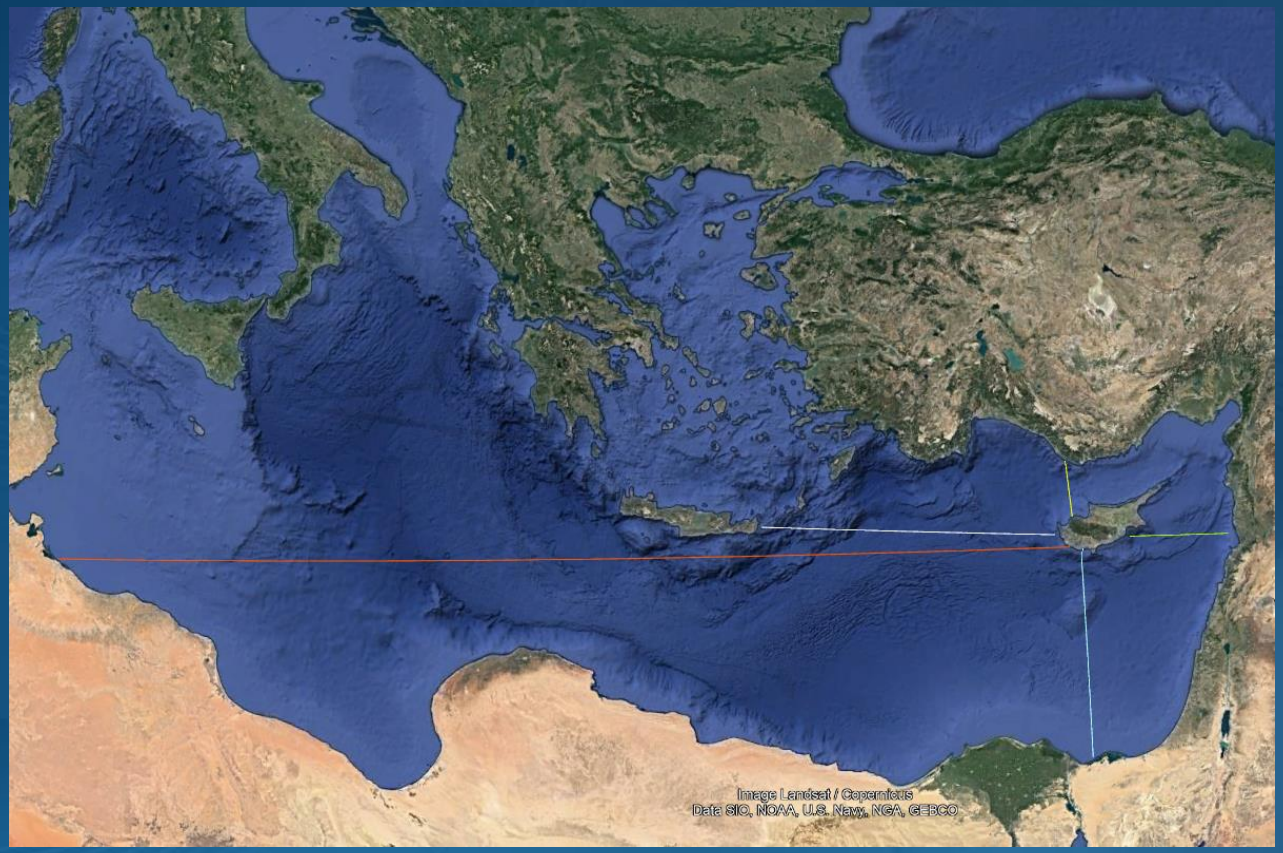
Coastal flooding is the result of a combination of :

1. Storm surge
2. Astronomical tide
3. Wind driven waves

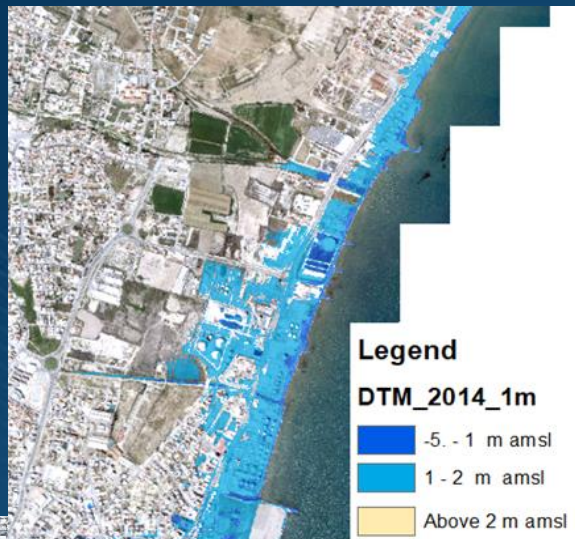
Storm surge and astronomical tide are small in the Mediterranean compared to open oceans.

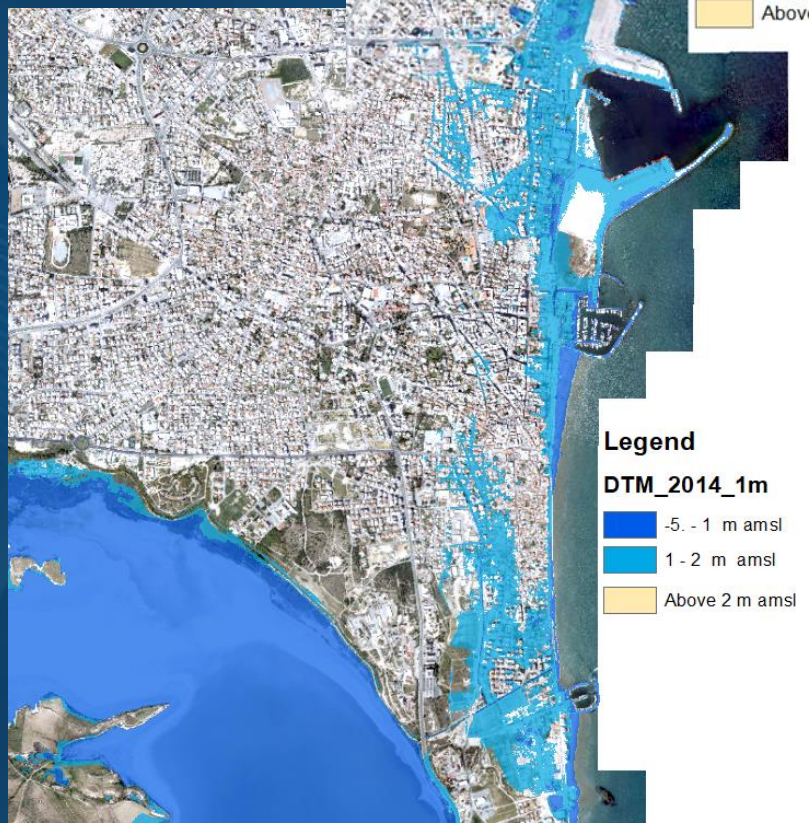
Height of wave is related to wind strength and Fetch.

Only west coast exposed to large Fetch

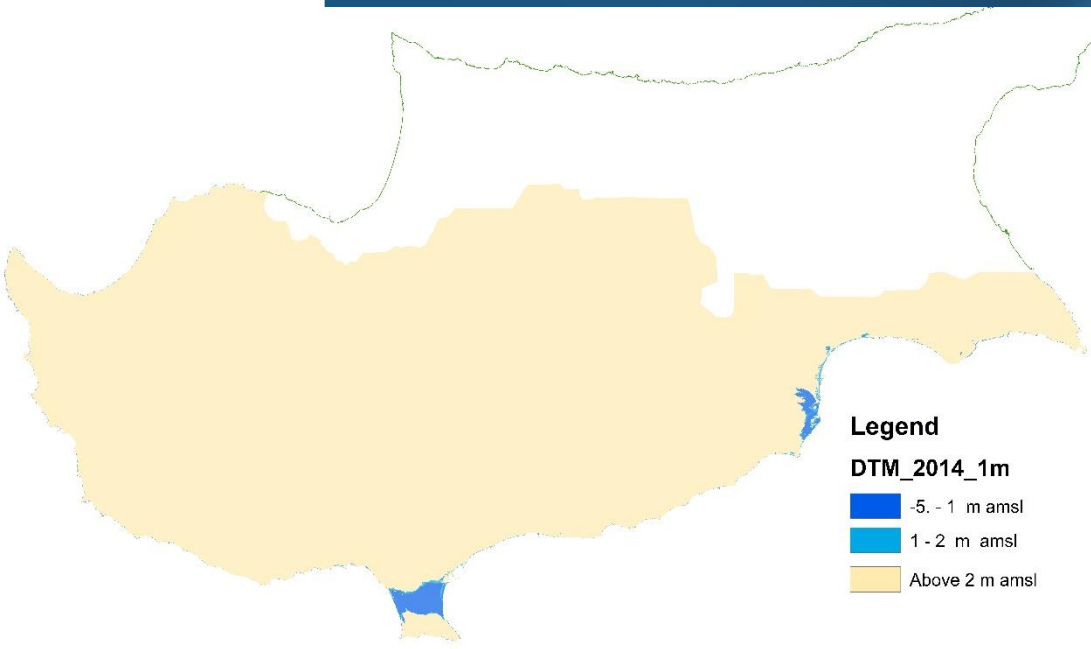


Coastal floods



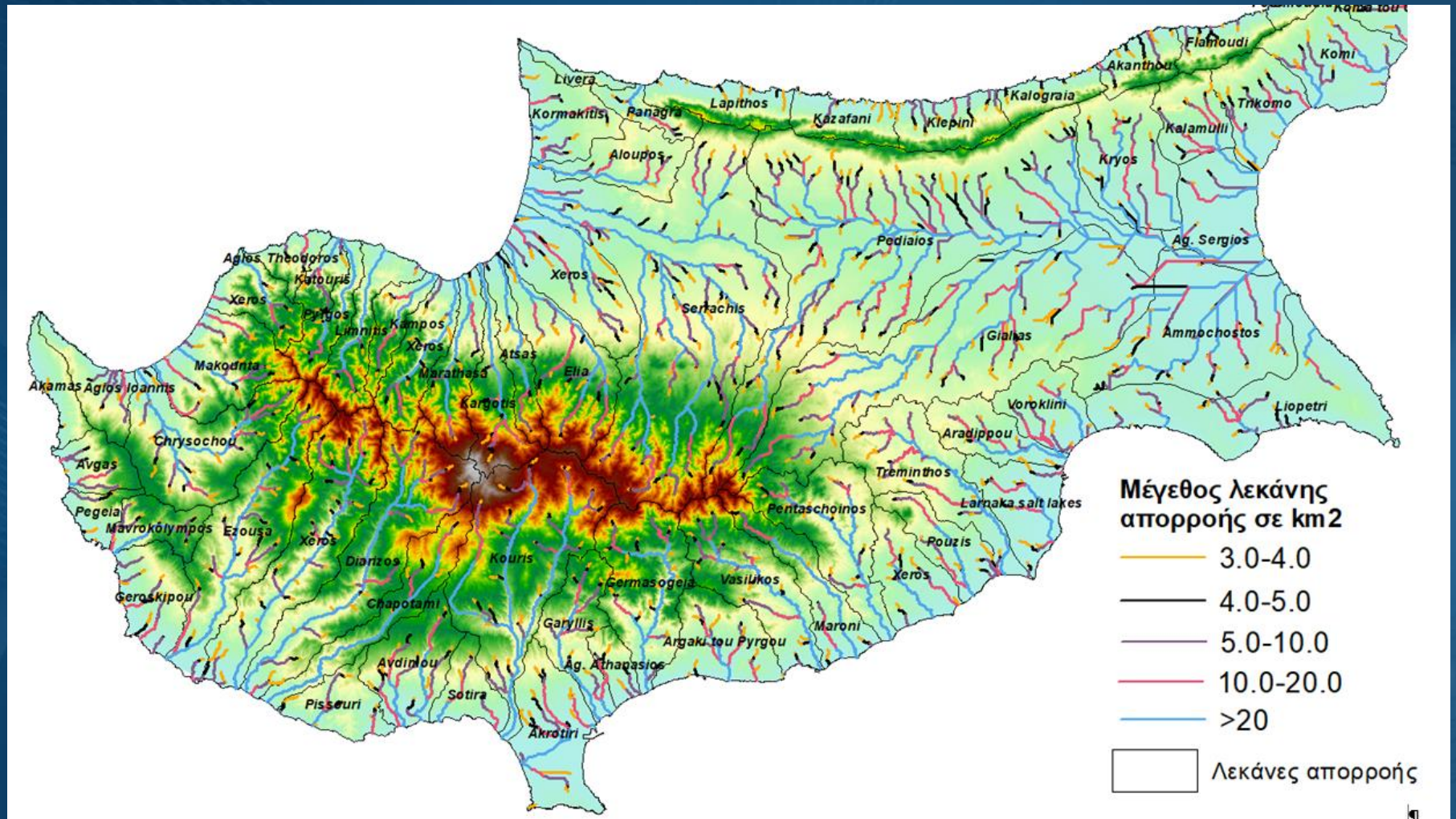


- Low elevation urban areas are in Larnaka not on the west coast.



Fluvial (river) floods

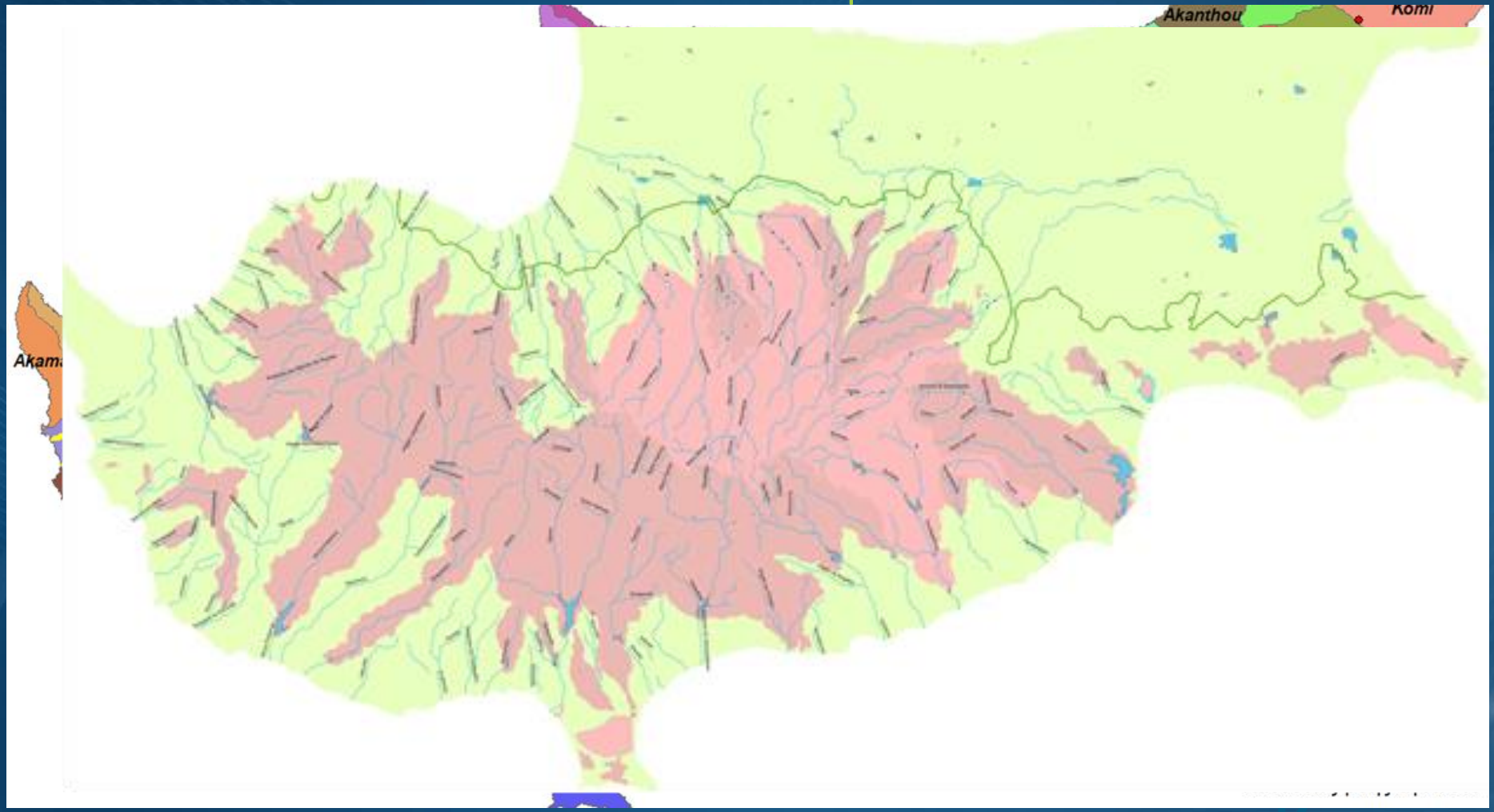
- Cyprus as a small island has small catchment sizes. Largest catchment Pediaios with 1700 km2 and 2nd largest Serachis 745 km2



Κατανομή·τμημάτων·ποταμών·και·υδατορεμάτων·με·βάση·το·μέγεθος·λεκάνης·απορροής·τους.·Πηγές·δεδομένων·:·ΤΑΥ,·ΤΚΧ¶

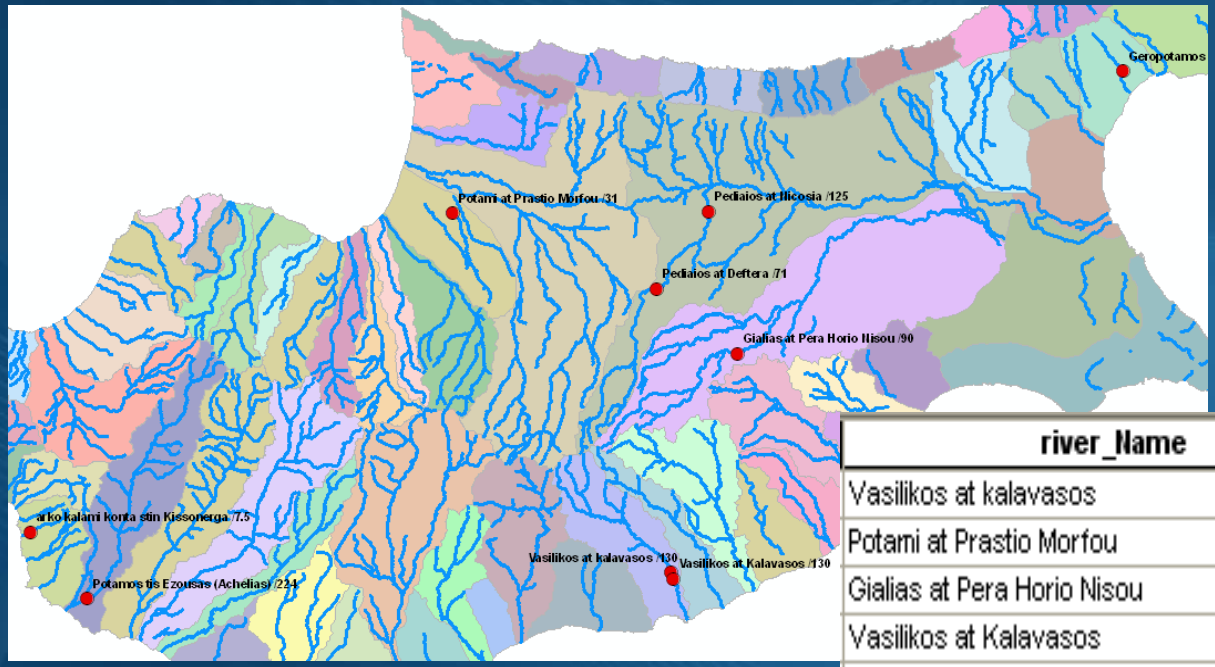
Fluvial (river) floods

- Due to semi arid climate and large number or reservoirs in most catchments, only mountain streams are perennial and downstream in urban areas almost all rivers become ephemeral.



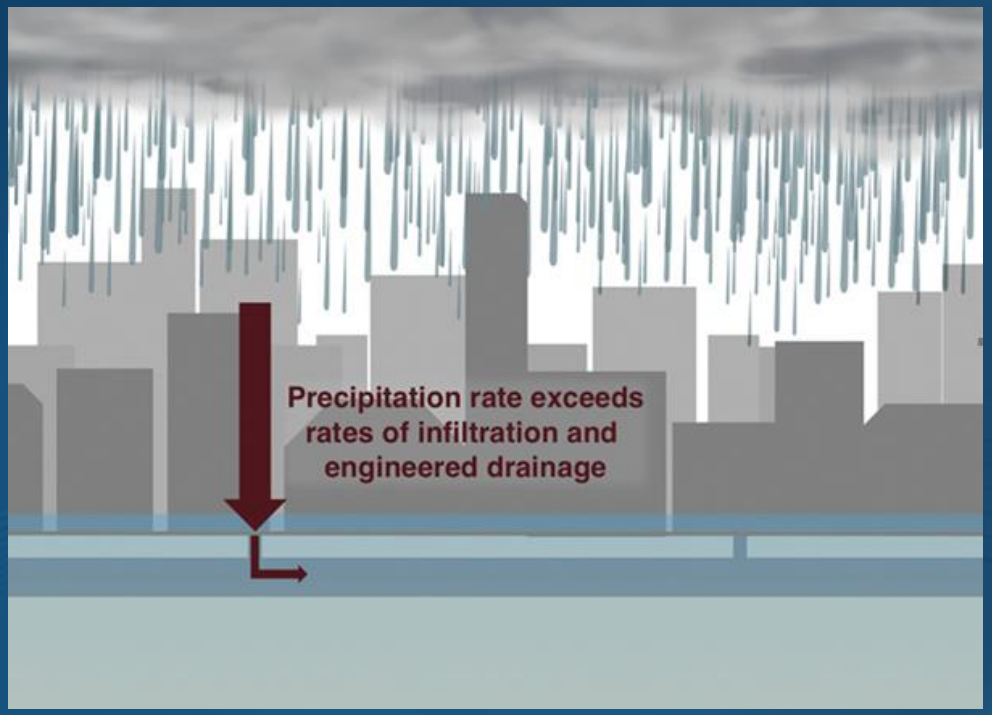
Flash floods

By analyzing the historical flood events that have caused the 35 fatalities in Cyprus it was determined that the smallest of the streams had a catchment size of 8 km2 while the average catchment size was 91 km2.

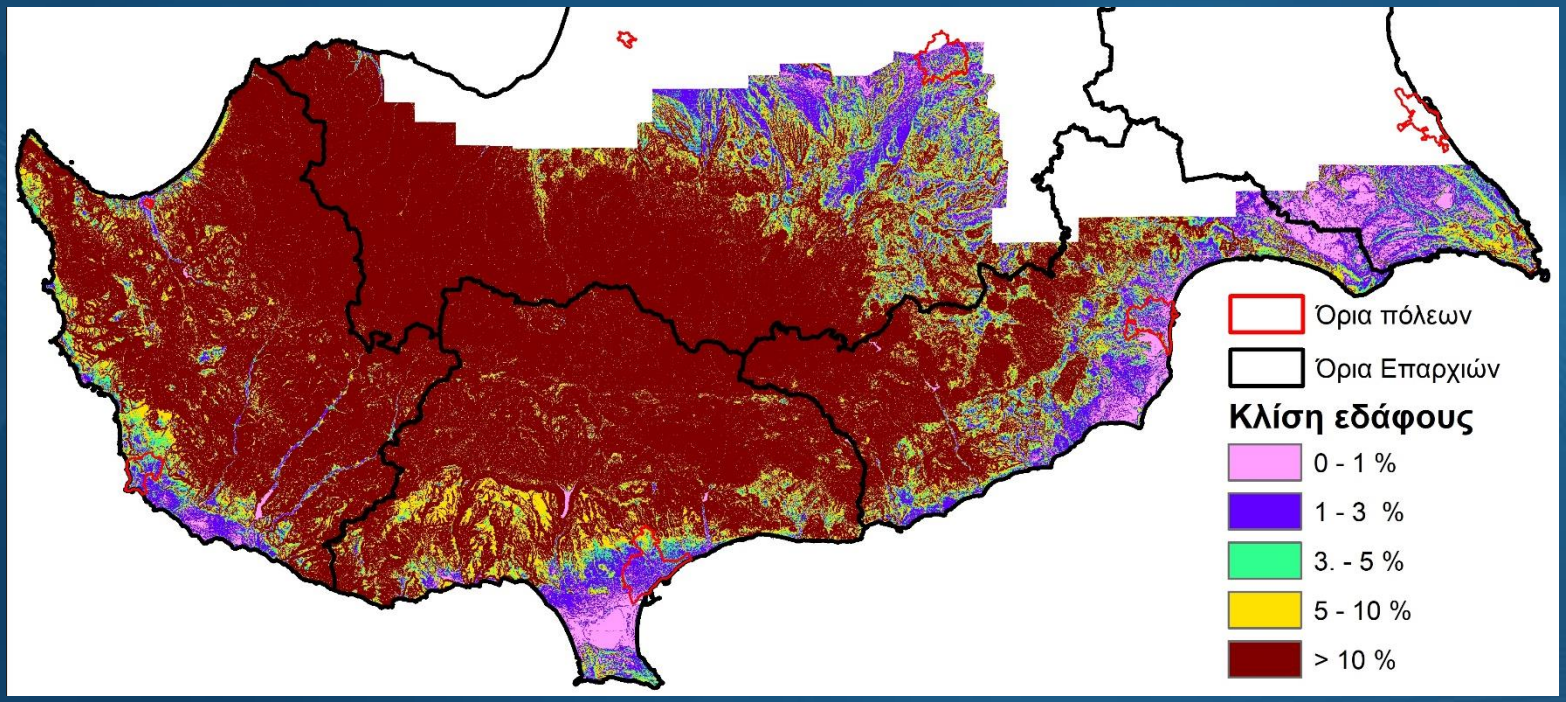


river_Name	DAsize	fatalities	date_
Vasilikos at kalavasos	130	2	11/12/1887
Potami at Prastio Morfou	31	5	11/12/1987
Gialias at Pera Horio Nisou	90	1	12/02/2003
Vasilikos at Kalavasos	130	2	1936
Potamos tis Ezousas (Achelias)	224	5	1936
Geropotamos at Agios Ilias	14	1	20/10/1897
Pediaios at Deftera	71	1	21/10/1918
Pediaios at Nicosia	125	18	29/10/1859
arko kalami konta stin Kissonerga	8	2	30/10/2006

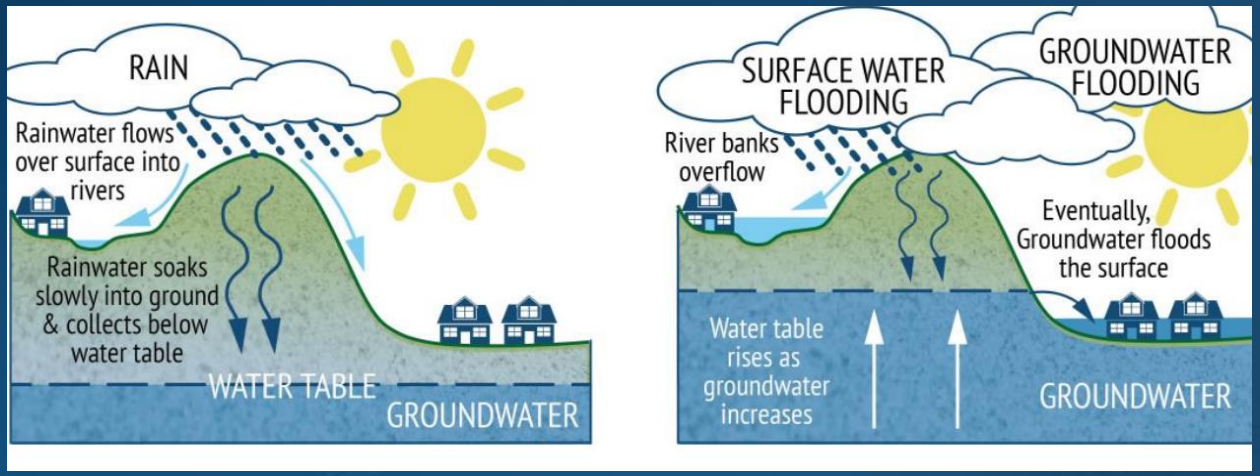
Pluvial (urban) floods



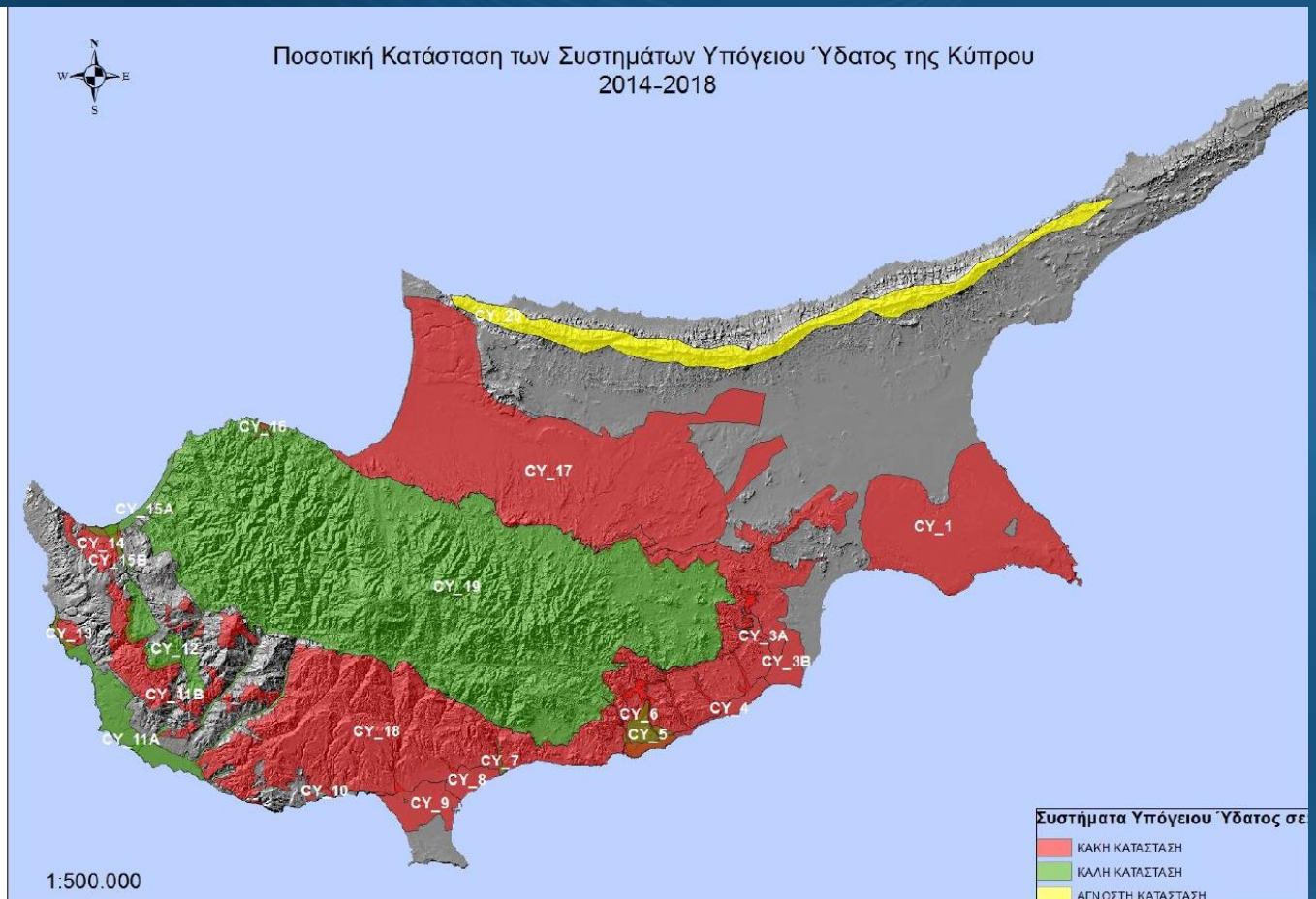
From: Willey online library



Ground water floods



https://www.geolsoc.org.uk/



Artificial water bearing infrastructure floods

There are 56 large dams in Cyprus registered in ICOLD (International Commission on Large Dams)

Flood risk from dam failures was assessed using :

Cullen Formula $HI_{(2)} = \frac{(V.S.H)^{0.2}p}{(10+(1.4\times10^{4}S)+SL)^{0.2}Sh^{1.5}}$	Where: H = height of dam L = distance to community(ies) at p = "length" of community at risk Sh = valley/floodplain shape factor
Thompson & Clark Formula $H.I = (V.H)^{0.2}\,\Sigma\,\frac{S_n{}^{0.2}.p_n}{(10+1.5\times10^{4}S_n+5L_n)^{0.2}.Sh_n{}^{1.5}}$	Where: V = capacity of reservoir S = average valley slope p = urban length along valley Sh = valley shape parameter

Artificial water bearing infrastructure floods

There are 56 large dams in Cyprus registered in ICOLD (International Commission on Large Dams)

No	Name	Height (m)	Capacity (m^3)	Slope (%)	Distance to community at risk (m)	Length of community at risk (m)	Shape Factor (Sh)	Cullen Formula		Thompson & Clark	
								Hazard Index	Rank	Hazard Index	Rank
32	Tamasos	33	2,800,000	0.010	1700	14000	150	**42.7**	**1**	**35625**	**1**
11	Polemidhia	45	3,400,000	0.010	3000	3500	200	**7.6**	**2**	**8808**	**3**
16	Yermasoyia	49	13,500,000	0.010	2000	3500	275	**6.4**	**3**	**12788**	**2**
9	Kiti (Tremithos)	22	1,614,000	0.005	2500	1000	140	**2.7**	**4**	**1698**	**7**
22	Asprokremmos	53	52,375,000	0.005	1500	700	200	**2.7**	**5**	**3145**	**5**
17	Lefkara	71	13,850,000	0.015	3000	700	180	**2.6**	**6**	**2769**	**6**
5	Lefka	35	368,000	0.005	6000	1000	150	**1.9**	**7**	**1164**	**13**
30	Arminou	45	4,300,000	0.012	1800	500	150	**1.8**	**8**	**1512**	**10**
23	Xyliatos	42	1,430,000	0.010	2200	500	130	**1.7**	**9**	**1110**	**14**
28	Kouris	110	115,000,000	0.010	3500	700	350	**1.6**	**10**	**4132**	**4**
24	Kalavasos	60	17,100,000	0.010	8000	500	200	**1.5**	**11**	**1515**	**9**
15	Pomos	38	860,000	0.010	3000	600	150	**1.5**	**12**	**1109**	**15**
18	Palekhori - Kambi	33	620,000	0.015	10000	500	120	**1.5**	**13**	**718**	**19**
14	Kalopanayiotis	40	363,000	0.015	11000	500	130	**1.2**	**14**	**658**	**21**
4	Trimiklini	33	340,000	0.010	1200	500	150	**1.0**	**15**	**893**	**16**
33	Kannaviou	75	18,000,000	0.010	2000	200	175	**0.8**	**16**	**843**	**18**
25	Dhypotamos	60	15,500,000	0.010	6000	500	300	**0.8**	**17**	**1573**	**8**
26	Evretou	70	24,000,000	0.015	2000	300	250	**0.8**	**18**	**1430**	**11**
12	Ayia Marina	33	298,000	0.015	2200	300	150	**0.6**	**20**	**502**	**23**
19	Akaki - Malounda	38	2,000,000	0.010	3500	200	150	**0.6**	**21**	**424**	**25**
1	Perapedhi	22	55,000	0.010	1500	500	150	**0.6**	**19**	**0**	**32**
3	Pyrgos	22	285,000	0.008	4000	400	175	**0.5**	**22**	**480**	**24**
29	Vizakia	37	1,690,000	0.005	2000	300	200	**0.5**	**23**	**596**	**22**
27	Akhna	16	6,800,000	0.005	6000	500	300	**0.5**	**24**	**892**	**17**
20	Arakapas	23	129,000	0.015	2000	500	300	**0.3**	**25**	**671**	**20**
13	Mavrokolymbos	45	2,180,000	0.015	2000	100	180	**0.2**	**26**	**270**	**27**
31	Tsakistra	23	100,000	0.015	20000	100	100	**0.2**	**27**	**81**	**30**
6	Athalassa	18	791,000	0.005	2500	1000	650	**0.2**	**28**	**1414**	**12**
10	Liopetri	18	340,000	0.005	4000	100	130	**0.2**	**29**	**109**	**29**
21	Ayii Vavatsinias	19	53,000	0.010	10000	100	100	**0.2**	**30**	**73**	**31**
8	Agros	26	99,000	0.020	2000	200	250	**0.1**	**31**	**276**	**26**
7	Argaka	41	990,000	0.005	3500	100	300	**0.1**	**32**	**163**	**28**
2	Kandou	15	34,000	0.005	3000	500	500	**0.1**	**33**	**0**	**32**

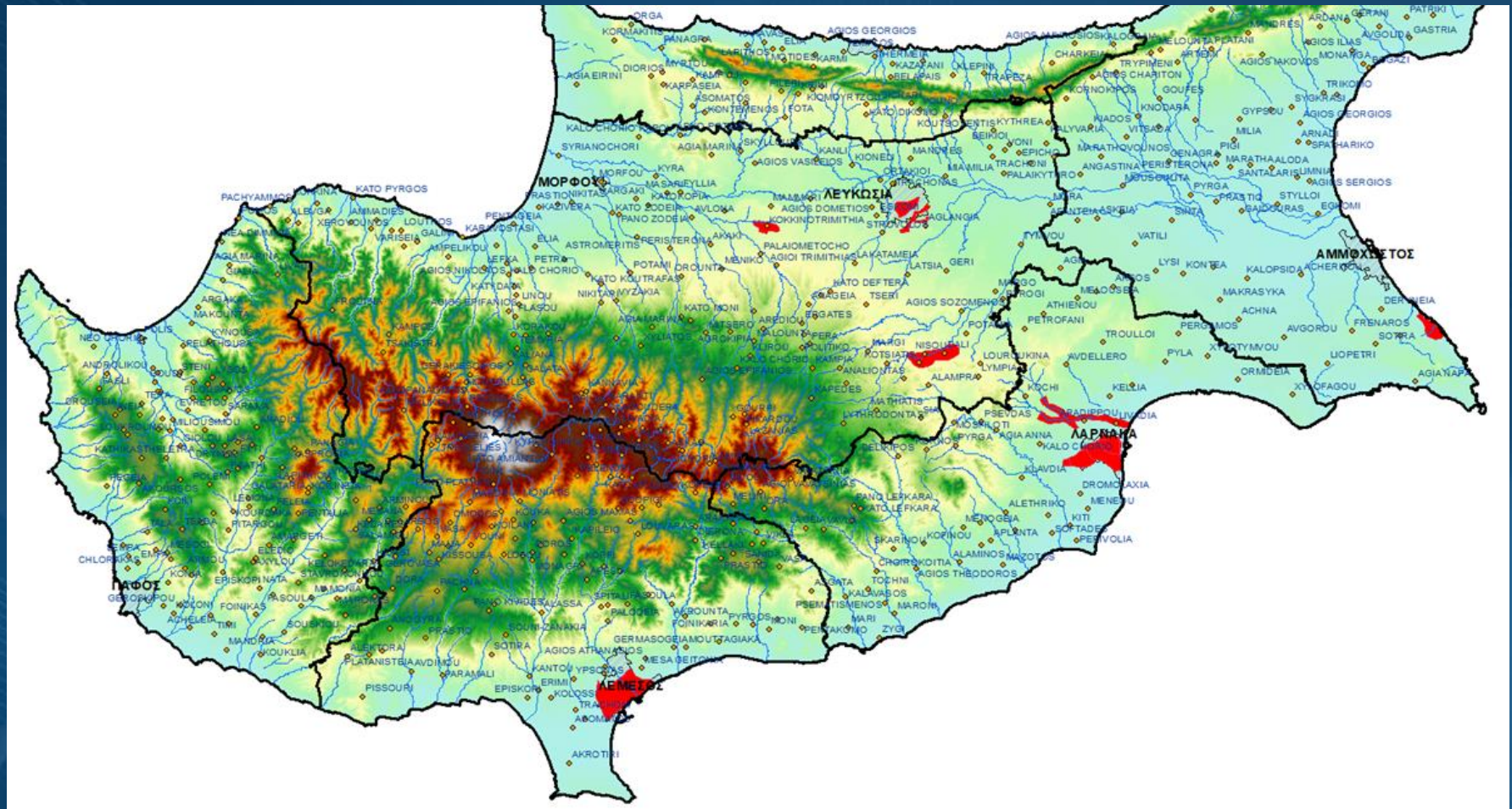
2nd Preliminary flood risk assessment and APSFR identification

Evaluation of significant flood events in the period 2011-2018

ΗΜΕΡΟΜΗΝΙΑ	ΟΝΟΜΑ ΠΕΡΙΟΧΗΣ	ΟΝΟΜΑ ΠΟΤΑΜΟΥ	Διάρκεια βροχοπτωσης	Ύψος βροχοπτωση	Ένταση βροχόπτωσης	Περίοδος Επαναφοράς	Μηχανισμός πλημμυρας***	Τύπος πλημμύρας**	Χαρακτηριστικά πλημμύρας***	Αποδέκτης Επίπτωσης					Σοβαρότητα Πλημμύρας**** (άθροισμα-τάξη)	
										Θύματα – (5)	Υγεία Ανθρώπινη - ρύπανση (4)	Οικονομία (3)	Μνημεία-Πολιτιστικά (2)	Περιβάλλον - ρύπανση (1)	Άθροισμα	Τάξη
13/06/2011	Πέρα Χωρίο Νήσου	Γιαλιάς	8	93	12.5	50	N	Π	F	1	1	3		1	19	Μέτρια
24/10/2012	Παλλουριώτισσα	Κατέβας	1	22.4	22.4	2	NB	Π	F	1	2	2			19	Μέτρια
09/05/2013	Παλλουριώτισσα	Κατέβας	1	25.6	25.6	2	NB	Π	F	1	2	2			19	Μέτρια
09/12/2014	Κοκκινοτριμιθιά	Μέρικας	6	87	14.5	50	N	Π	F		3	3		2	23	Μέτρια
13/12/2014	Λάρνακα (Πόλη)		24	114	4.75	200	N	Φ	O	1	3	3	1	1	29	Ψηλή
13/12/2014	Αραδίππου	Καλού Χωριού	24	52	2.2	5	N	Π	F	1	3	3	1	1	29	Ψηλή
26/10/2015	Αραδίππου	Αραδιπιώτης	NO DATA	NO DATA	NO DATA	NO DATA	N	Π	F	1	2	3			22	Μέτρια
01/11/2016	Αραδίππου	Καλού Χωριού	NO DATA	NO DATA	NO DATA	NO DATA	N	Π	F		2	3	1	1	20	Μέτρια
01/11/2016	Λάρνακα (Πόλη)		NO DATA	NO DATA	NO DATA	NO DATA	N	Φ	O		2	3	1	1	20	Μέτρια
16/02/2018	Λεμεσός (Πόλη)		1	60	60	150	N	Φ	O	1	2	3	2		26	Μέτρια
04/12/2018	Λευκωσία (Πόλη)		0.5	37.4	74.8	10	N	ΠΦ	F		2	3	1		19	Μέτρια
04/12/2018	Αγλαντζιά	Κατέβας	0.5	30.1	60.2	5	N	ΠΦ	F		2	3		2	19	Μέτρια
05/12/2018	Παραλίμνι		6	52.2	8.7	5	N	ΠΦ	F	1	1	3		1	19	Μέτρια

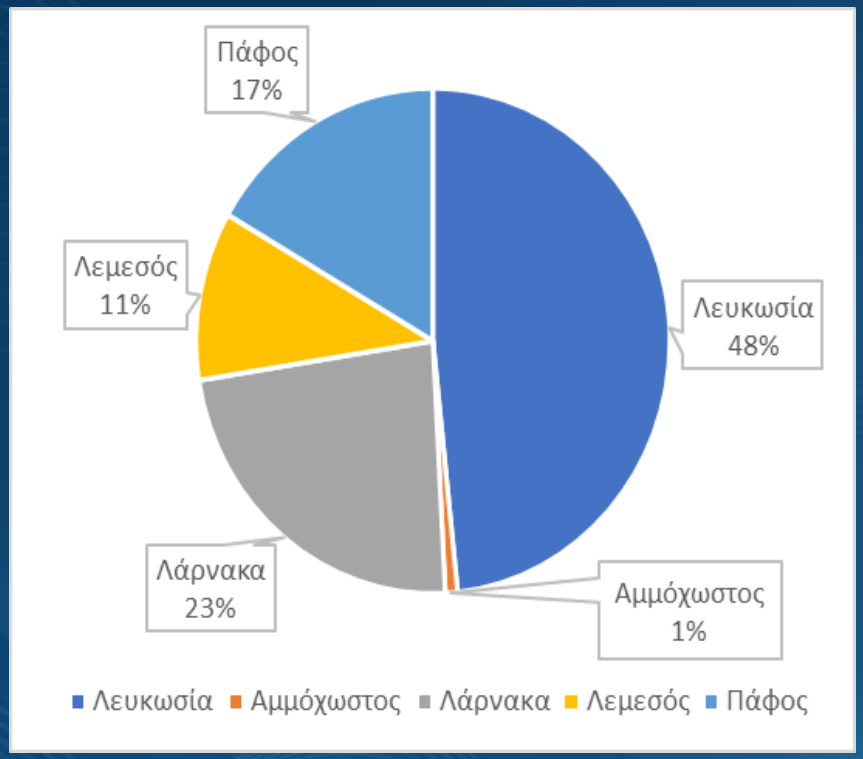
Πλημμυρικά·γεγονότα·μέτριας·και·ψηλής·σοβαρότητας·περιόδου·2011-2018¶

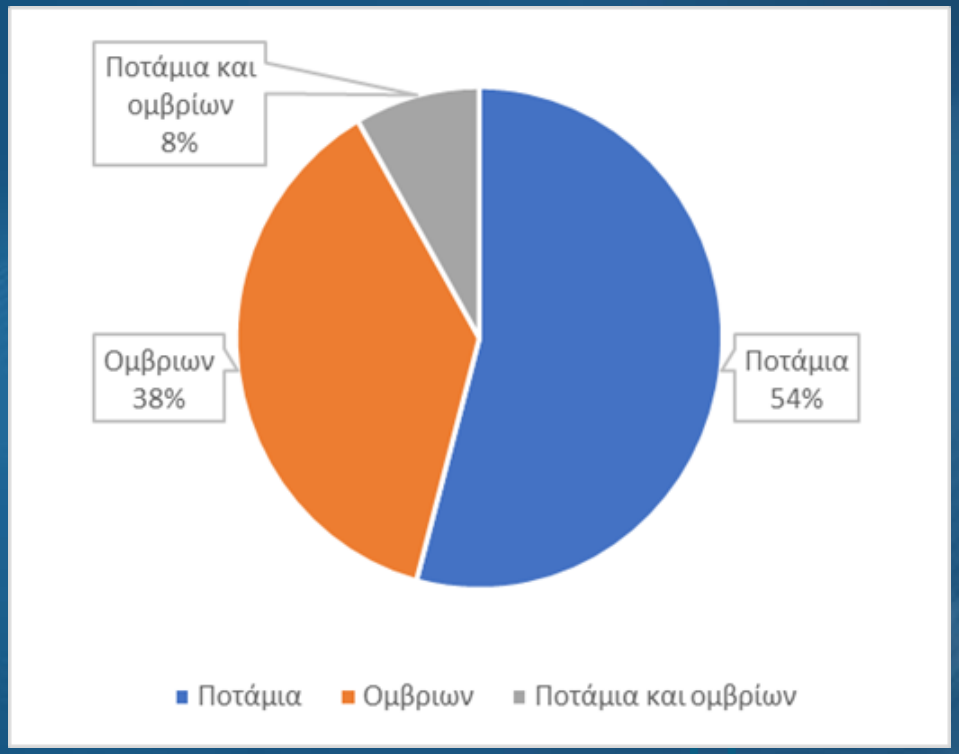
2nd Preliminary flood risk assessment and APSFR identification



Πλημμύρες·με·σημαντικές·συνέπειες·(κόκκινο)·που·συνέβησαν·την·περίοδο·2011-2018¶
Πηγές·δεδομένων·:·ΤΑΥ,·ΤΚΧ¶

2nd Preliminary flood risk assessment and APSFR identification





Methodology for identifying APSFR's

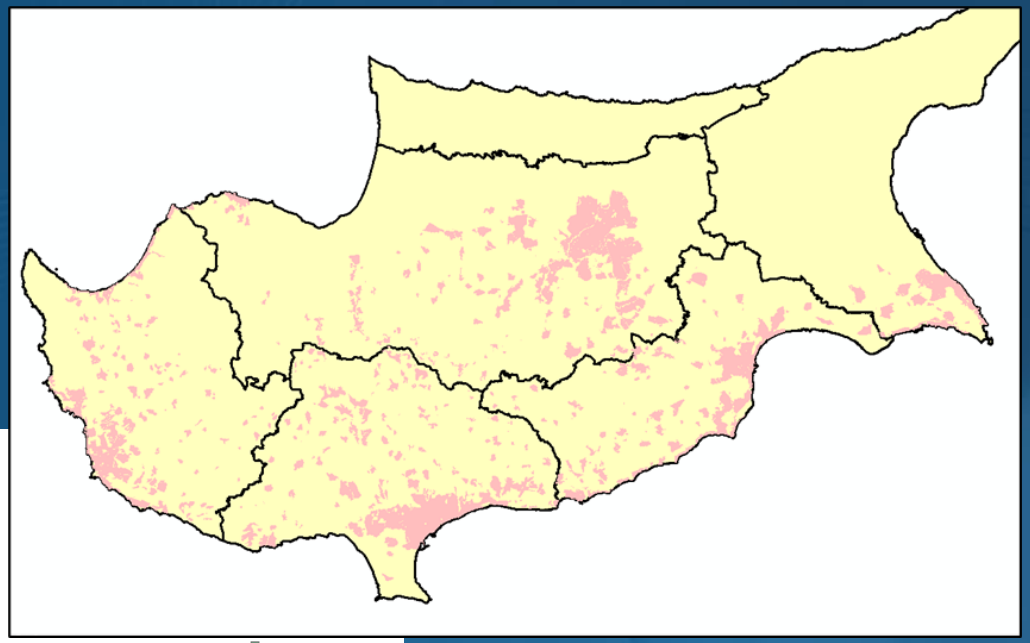
- The number or rivers that can cause Flooding is very large but the severity of problems that these rivers can cause is proportional to the peak flow, volume of water and velocity of water they can carry during extreme storm events.

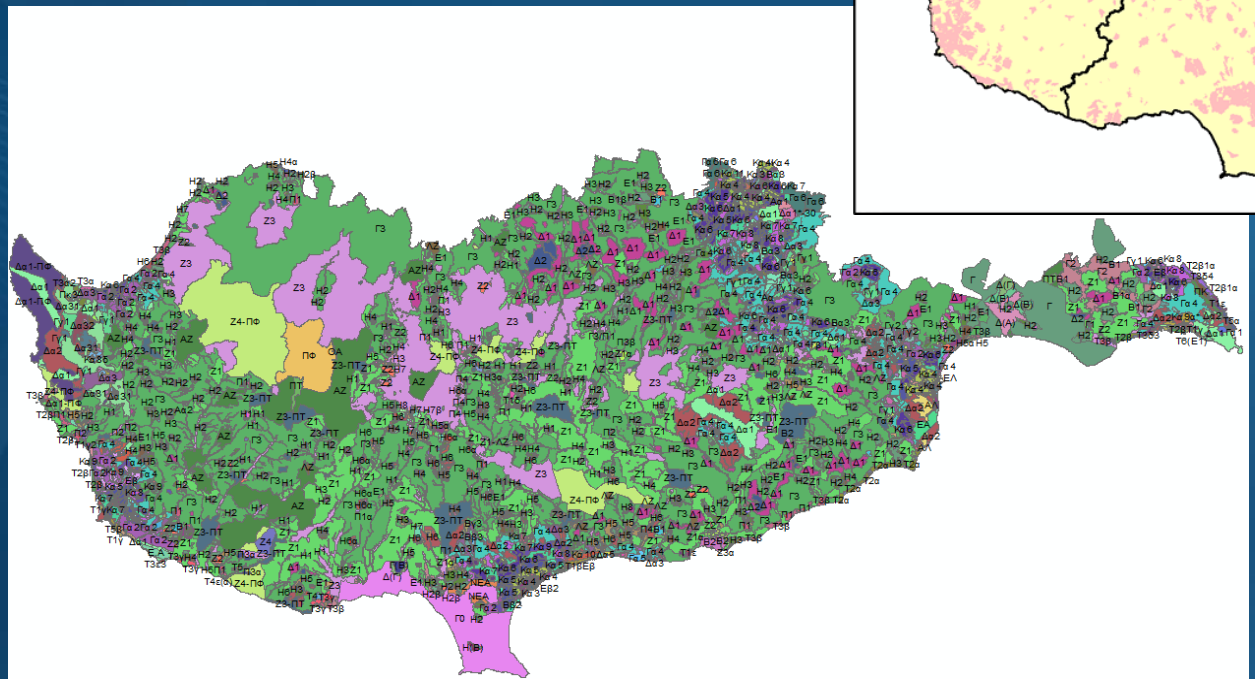
- An indicator for the volume of water and peak flow a stream can carry is it catchment area size.

- From historical floods experience the threshold of catchment size of significant floods was defined at 5 km2

Methodology for identifying APSFR's

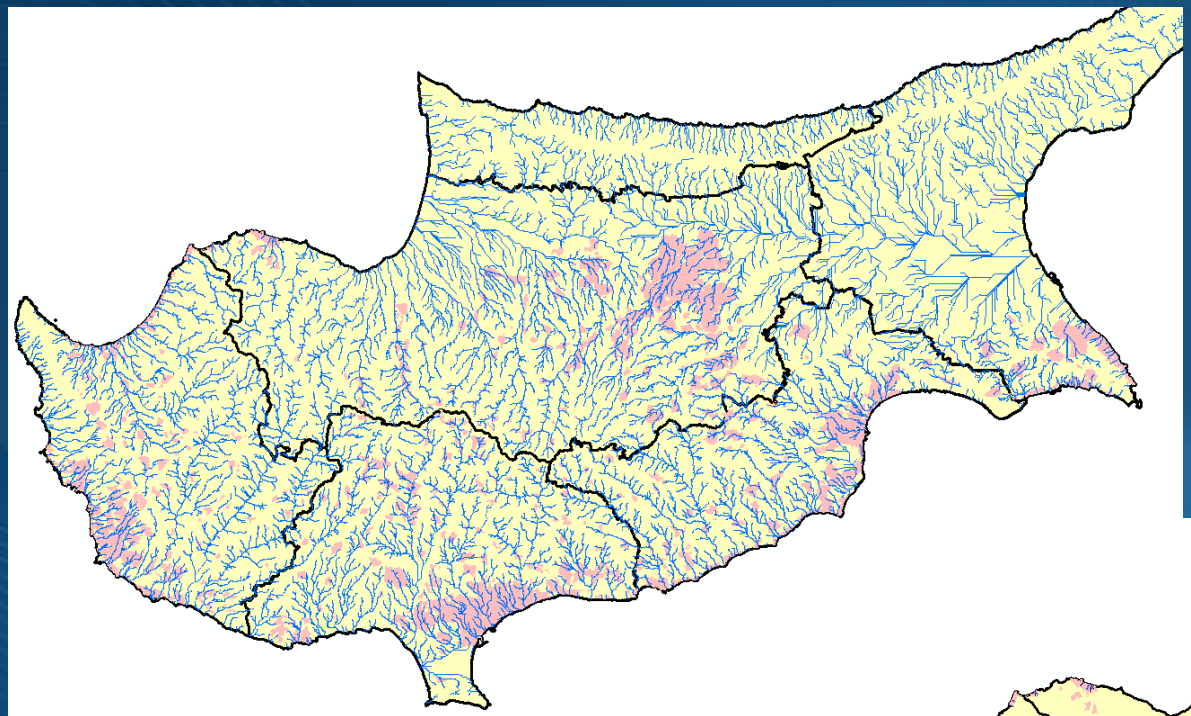
Step 1- Development zones are isolated from the Town Planning zoning.

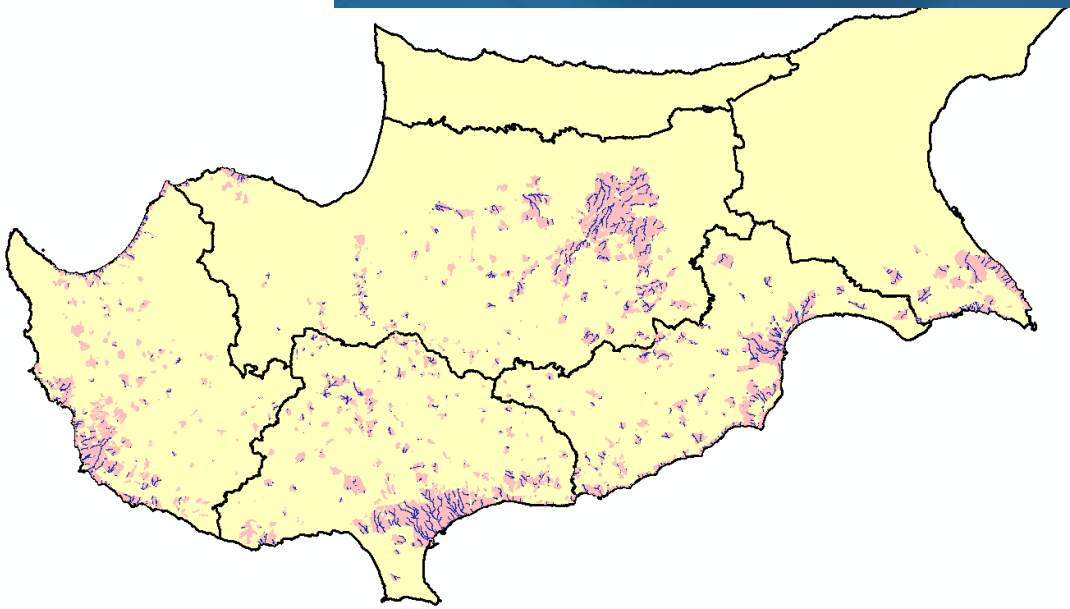




Methodology for identifying APSFR's

Step 2 Select only rivers that are located in development areas



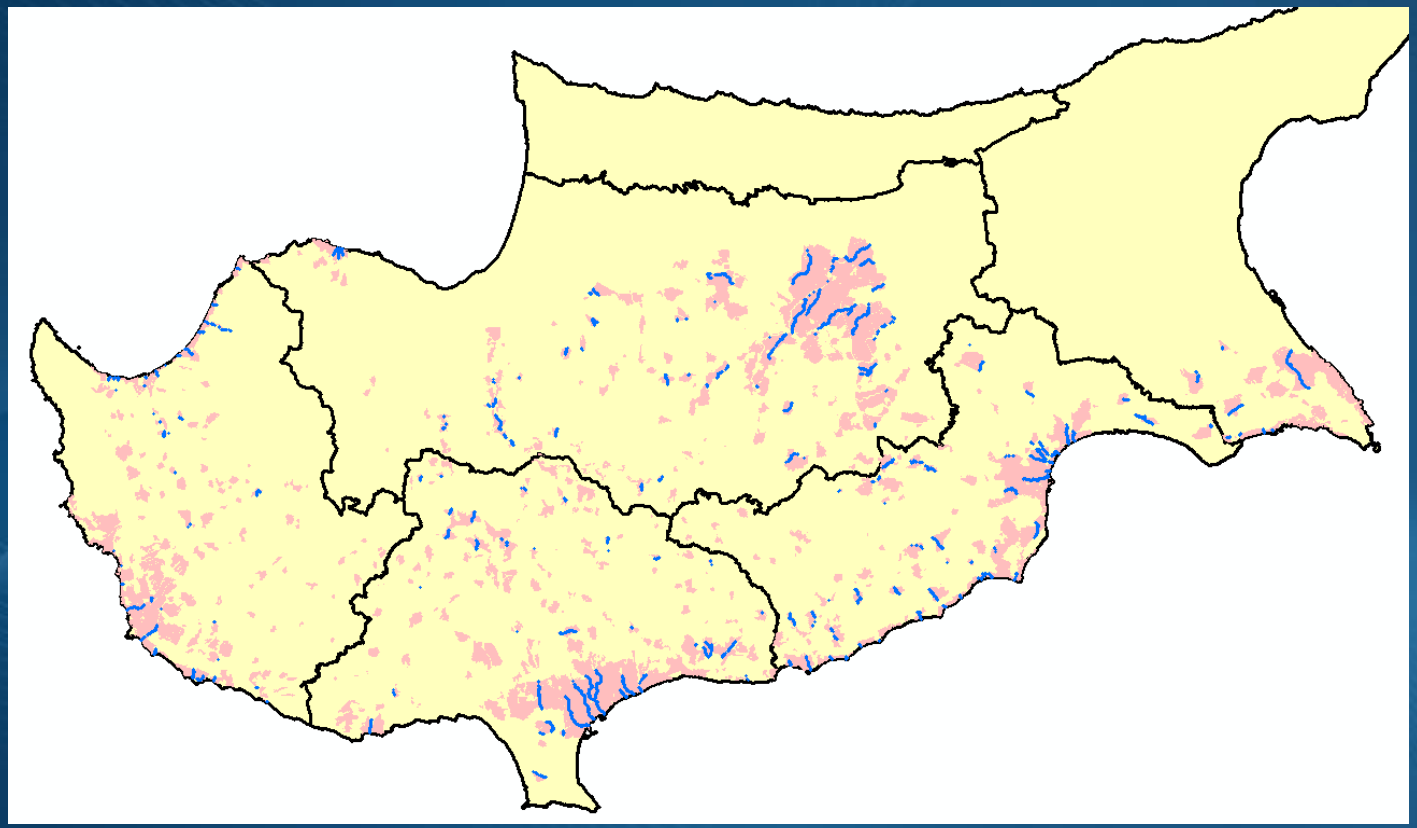


VisualBee

Methodology for identifying APSFR's

Step 3

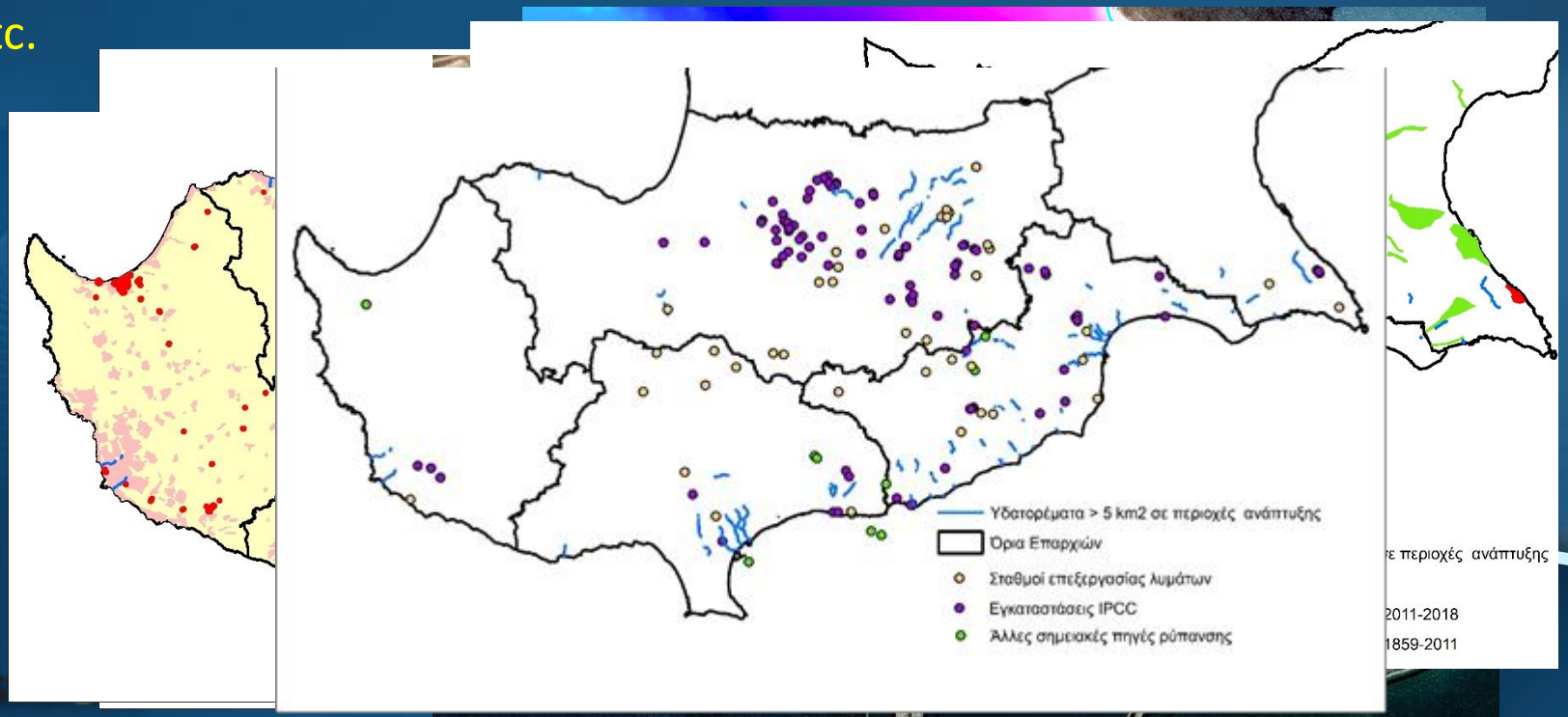
Select only rivers that have a catchment larger than 5 km2



Step 4

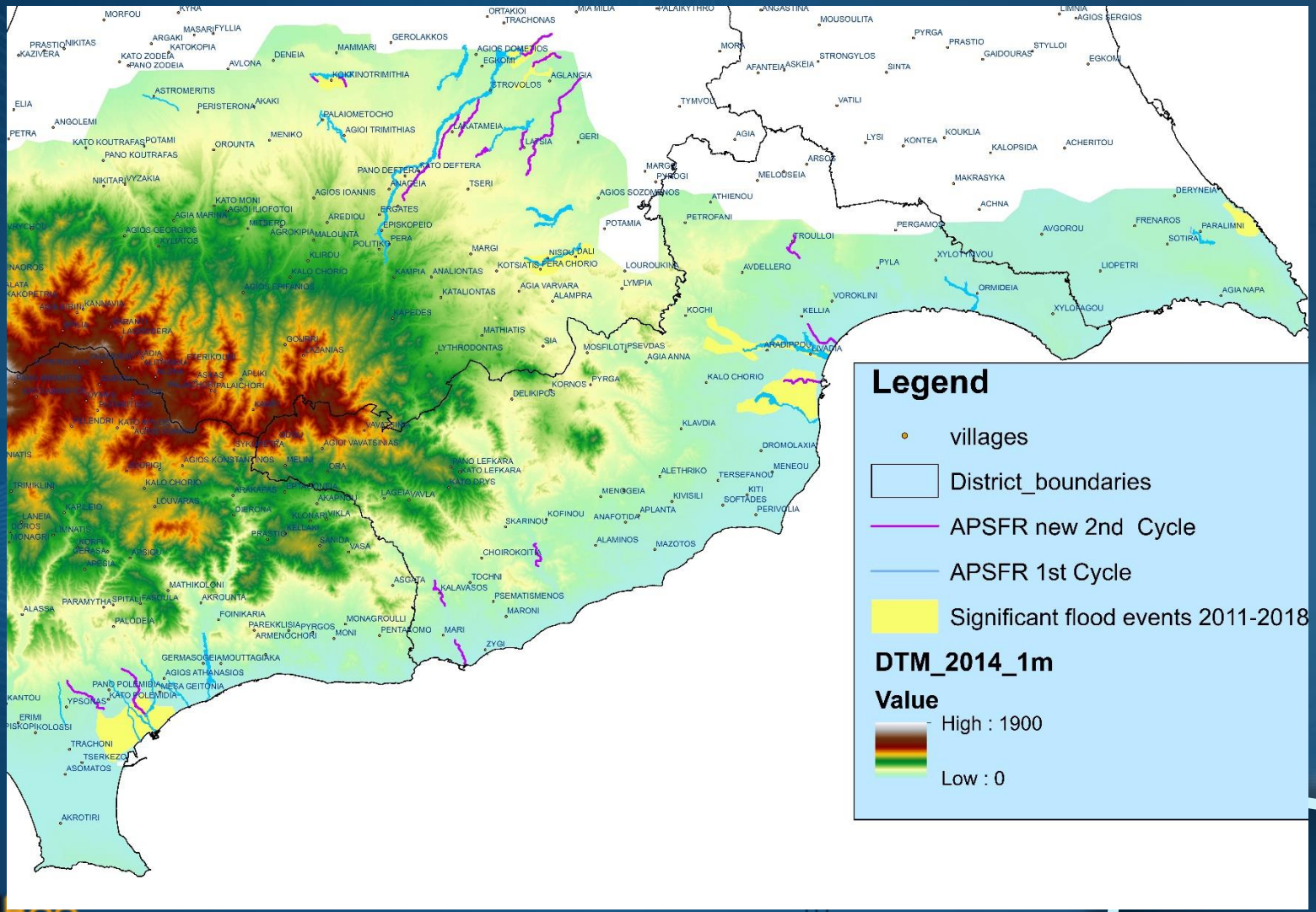
The stream segments are evaluated one by one to decide whether the specific river segment should be included in the Potentially Significant Flood Risk Areas using :

1. Field visit and evaluation
2. Historical floods in area
3. Topography
4. Level of existing development using Sat images
5. Other GIS data such as critical infrasture, cultural heritage, pollution sources etc.



Final APSFRs

19 Areas were identinfied as APSFRS bringing the total number of APSFRS to 38



Conclusions

- Today the use of GIS is essential for increased productivity and effectiveness in the sector of Water and Environmental management.
- The availability of satisfactory GIS data is required in order to exploit the potential of GIS.


Thank you for your attention
Questions;
Kanaviou reservoir