River conservation actions

AMBER National Workshop

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Improper urban stream engineering by contradicting flood defense purposes and environmental conservation

by Demetris ZARRIS
Civil Engineer– M.Sc., Ph.D. in Hydrology

The “Holy Grail” of Urban Streams’ Management

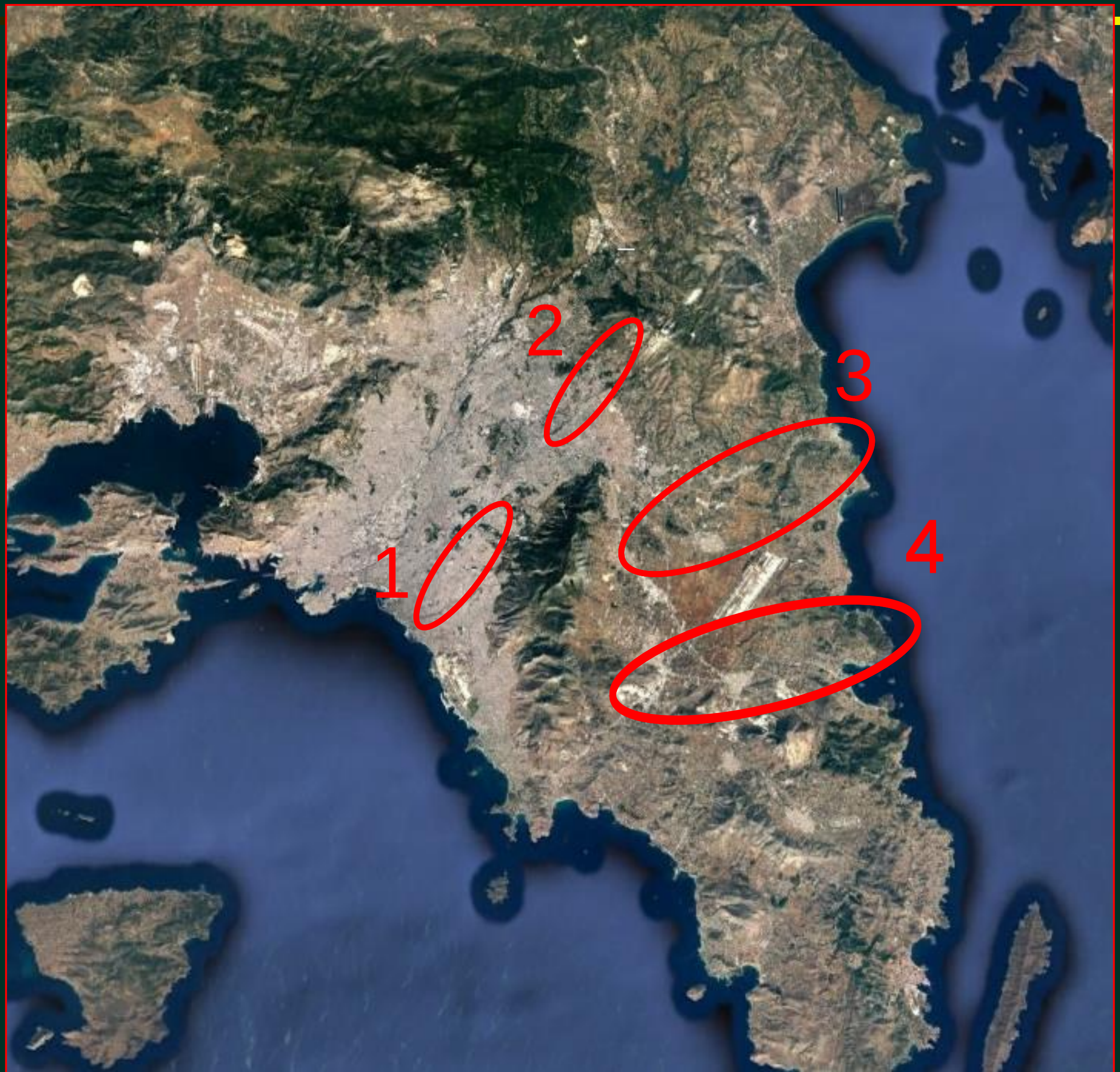
Urban Streams can be either:

- Storm Drainage Sewers

Or / **And**

- Corridors of Biodiversity in Urban Environments

Urban Streams in Greater Athens with hard lining works



1. PIKRODAFNI R.: Gabions for 5km

2. PODONIFTIS R.: Concrete Lining for 770m

3. M. RAFINA R.: Gabions for 15km

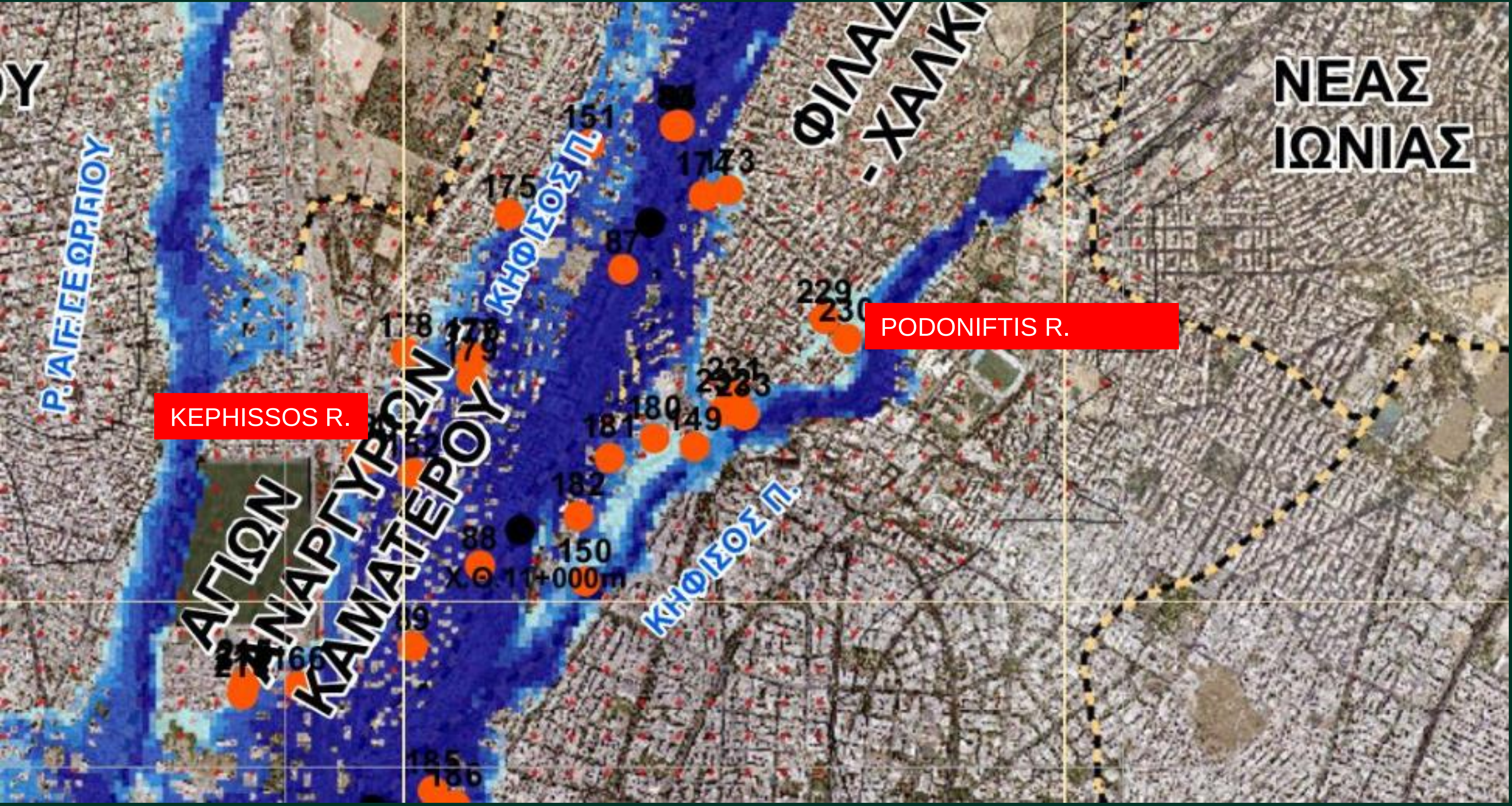
4. ERASINOS R.: Gabions for 10km

EXAMPLE OF NATURAL URBAN STREAM: NICOSIA: PEDIAIOS R.

FLOOD HAZARD ASSESSEMENT OF PRODONIFTIS R.
SCENARIO A΄: RETURN PERIOD 50 years

FLOOD HAZARD ASSESSEMENT OF PRODONIFTIS R.
SCENARIO B΄: RETURN PERIOD 100 years

FLOOD HAZARD ASSESSEMENT OF PRODONIFTIS R.
SCENARIO C΄: RETURN PERIOD 1000 years



PODONOFTIS R. IN FILADELFEIA MUNICIPALITY – Upstream of lined segment

PODONOFTIS R. IN FILADELFEIA MUNICIPALITY

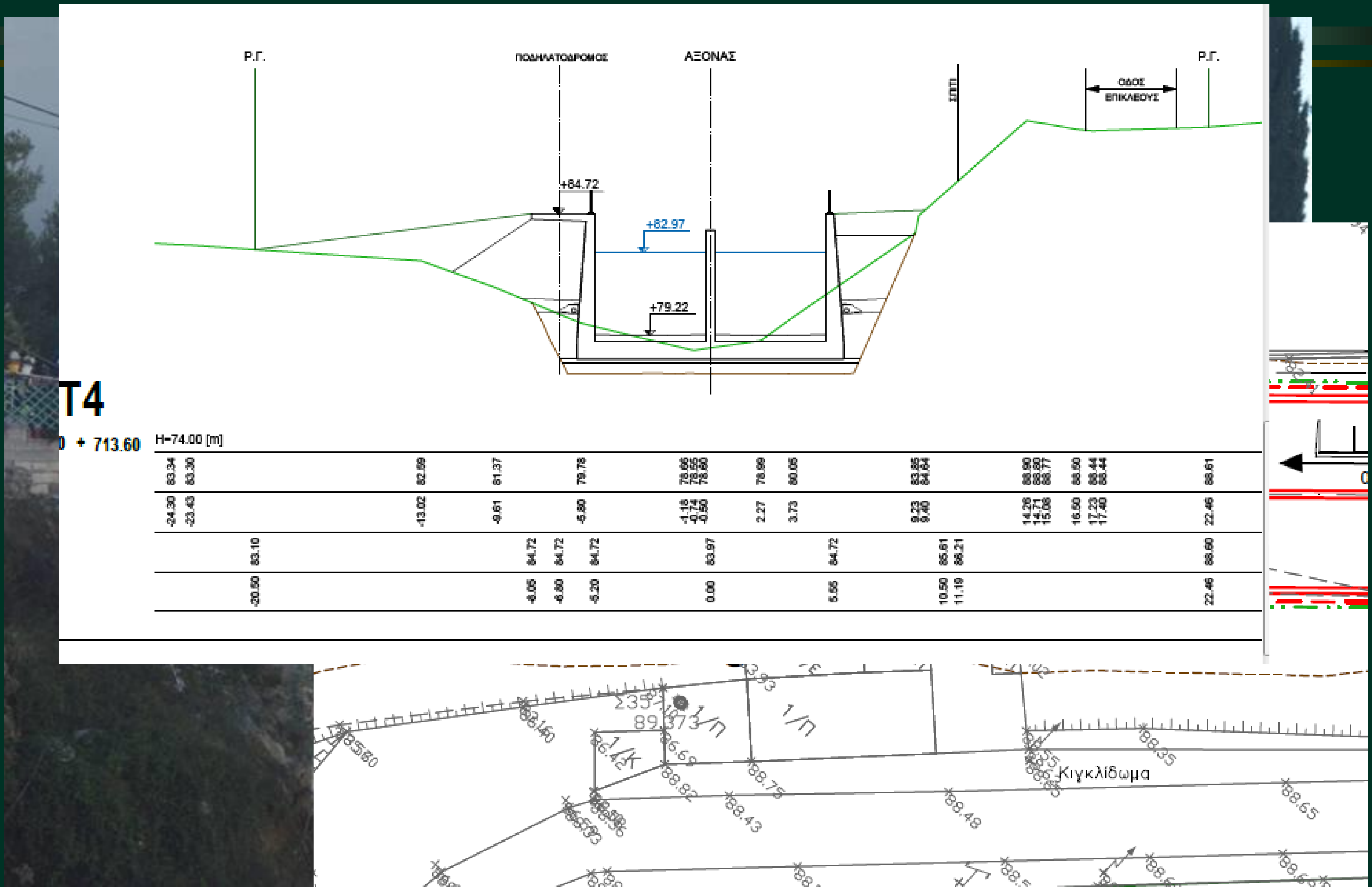
PODONOFTIS R. IN FILADELFEIA MUNICIPALITY (start of lined segment)

PODONOFTIS R. IN FILADELFEIA MUNICIPALITY

PODONOFTIS R. IN FILADELFEIA MUNICIPALITY (in the lined segment)

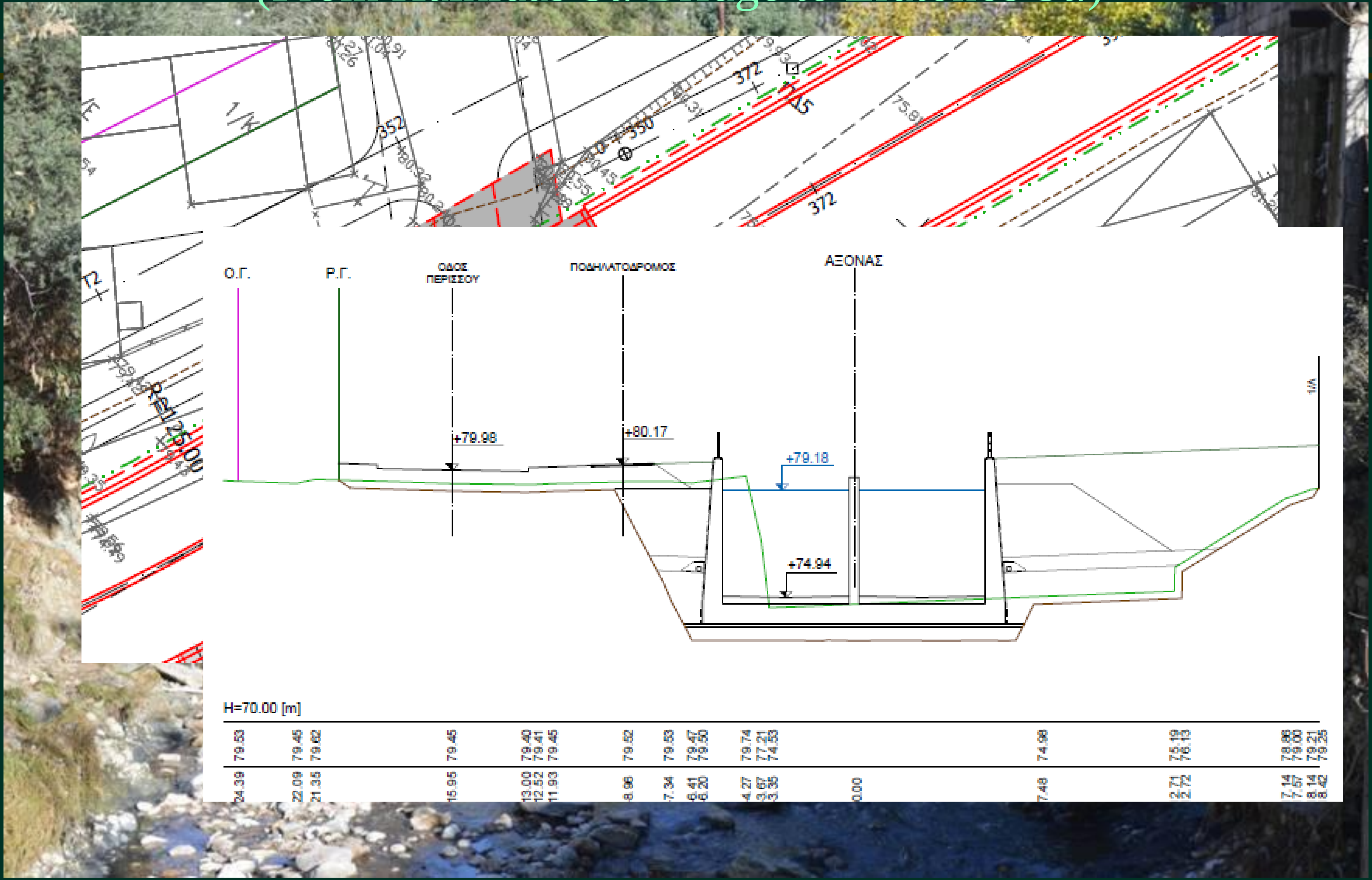
DESIGN STUDY: UPDATE – COMPLETIONS OF PODONIDTID R. LINING

(From Halkidas St. Bridge to Eratonos St.)



DESIGN STUDY: UPDATE – COMPLETIONS OF PODONIDTID R. LINING

(From Halkidas St. Bridge to Eratonos St.)



DESIGN STUDY: UPDATE – COMPLETIONS OF PODONIDTID R. LINING

(From Halkidas St. Bridge to Eratonos St.)

With the concrete lining of Podoniftis R. stream bed:

1. Flow- area Decreases.
2. Flow friction (resistance to flow) Decreases.
3. Flow velocity Increases.
4. Flow duration Decreases.
5. Flow kinetic energy Increases.

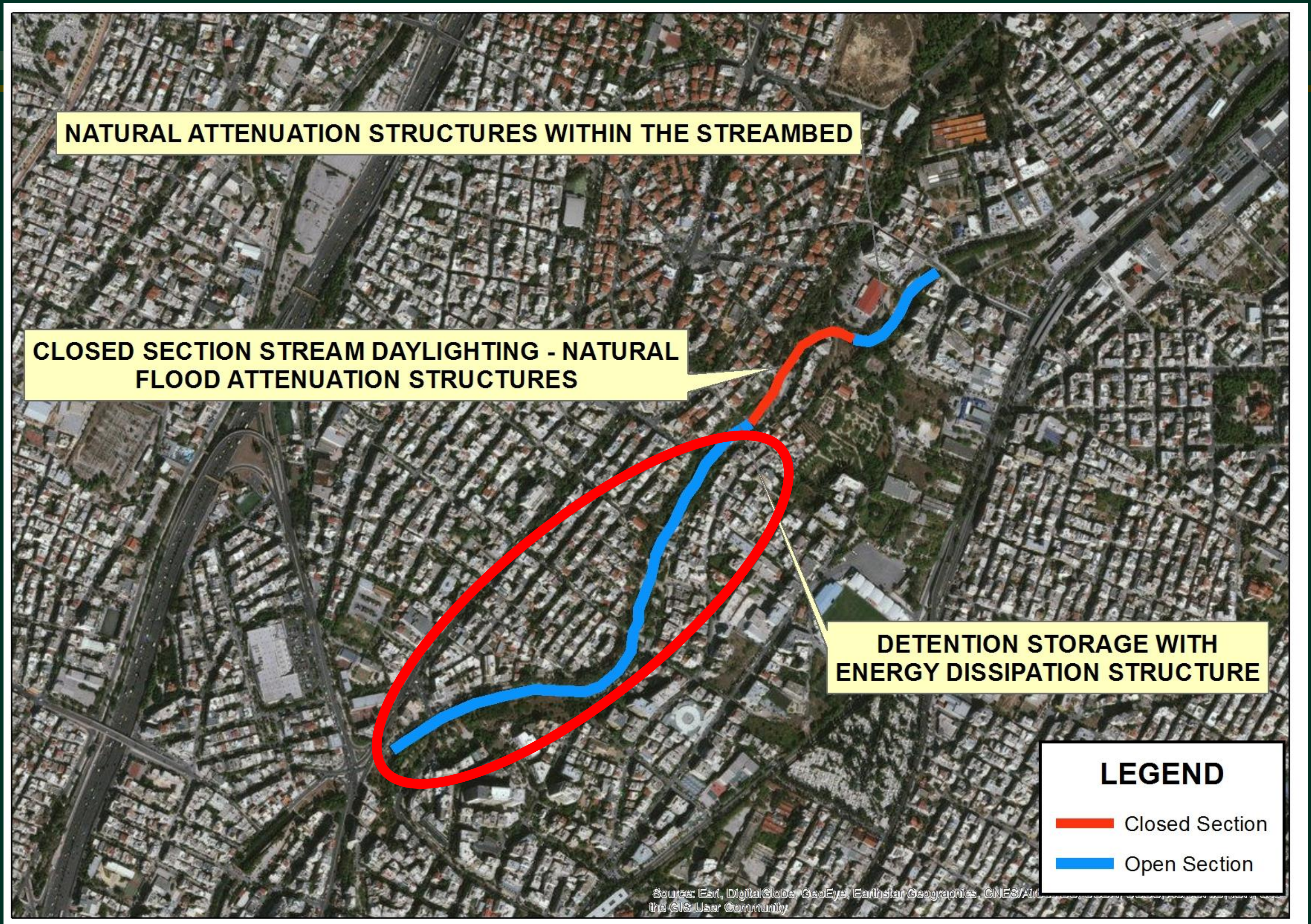
DESIGN STUDY: UPDATE – COMPLETIONS OF PODONIDTID R. LINING

(From Halkidas St. Bridge to Eratonos St.)

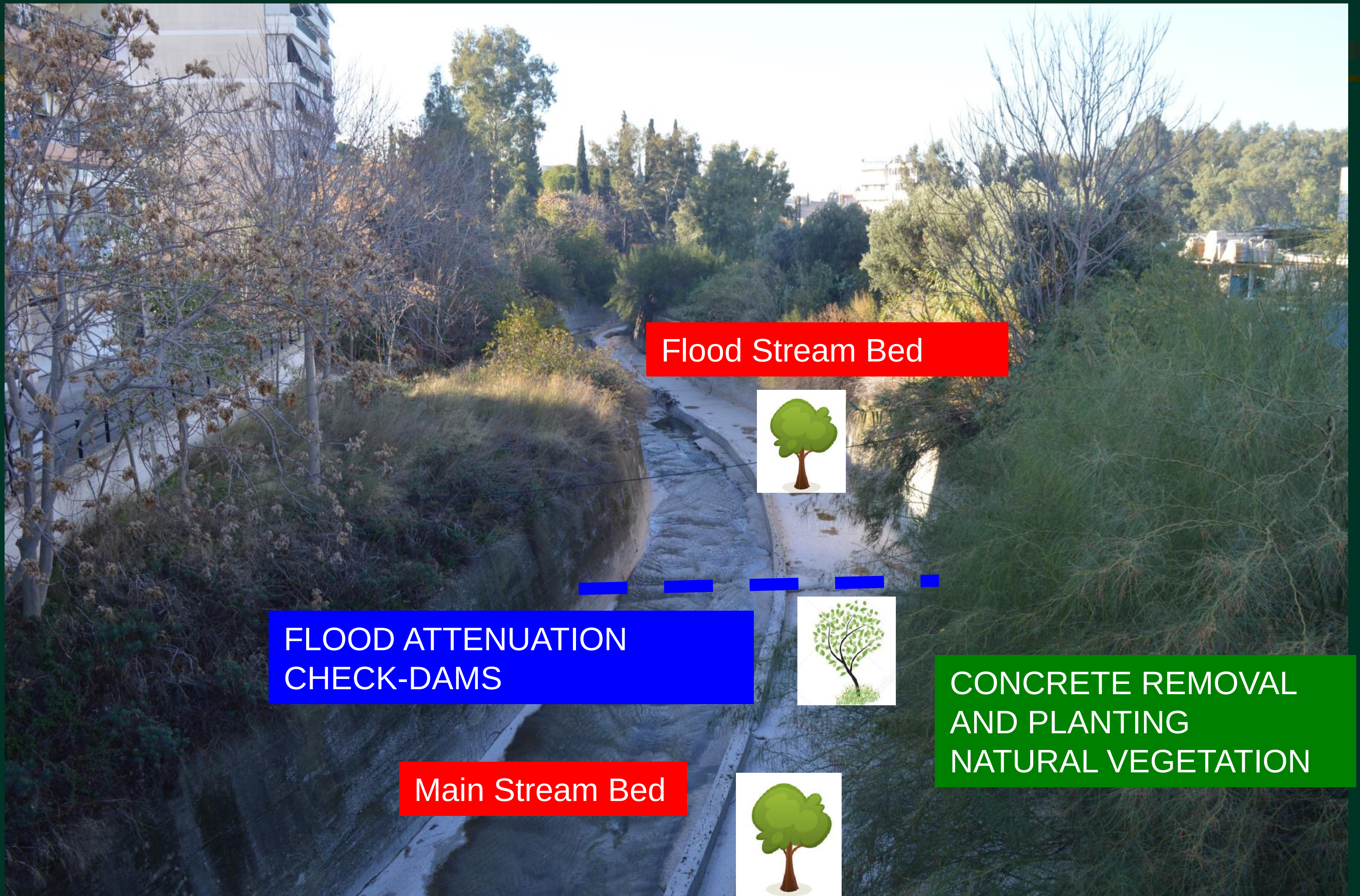
1. Flood Risk is increasingly propagating downstream under the dangerous mixture of all these flow characteristics alternation in contrast to more natural streambed configuration.

2. Instead of «traditional» hard linings, a more flexible configuration is proposed taking advantage of storage capabilities in the upstream segment.

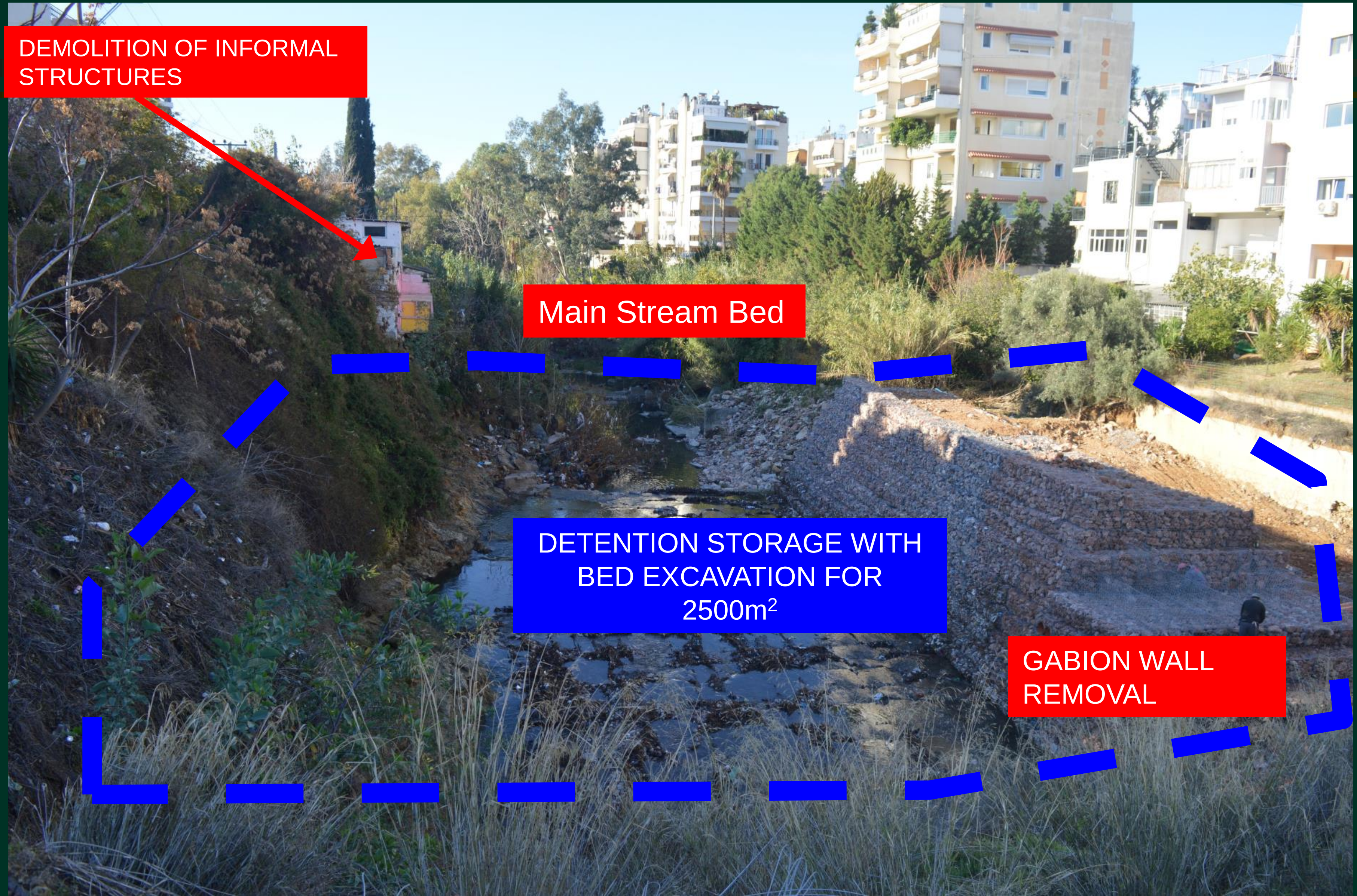
PROPOSAL FOR NATURAL FLOOD ATTENUATION IN PODONOFTIS STREAMBED



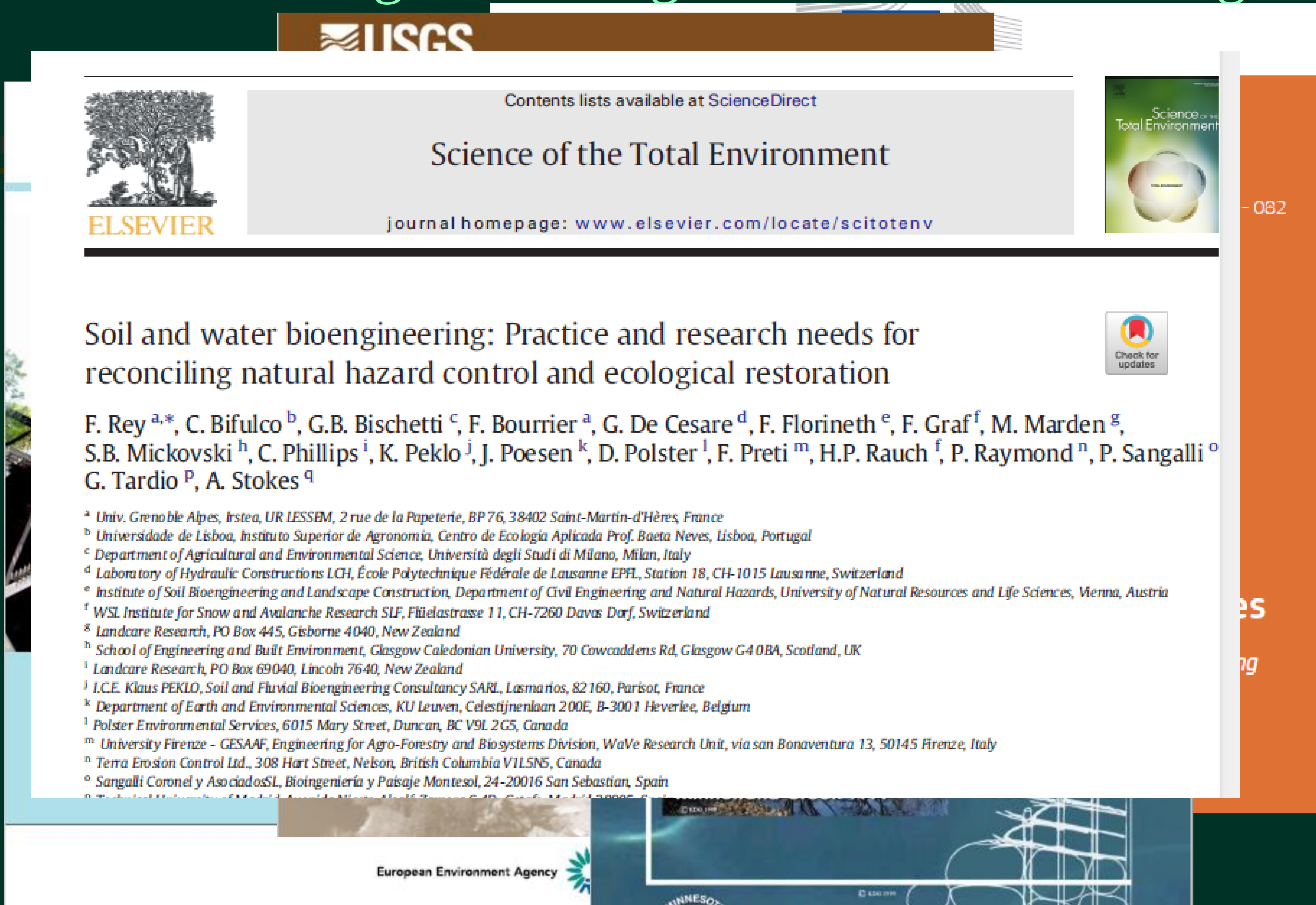
PROPOSAL FOR NATURAL FLOOD ATTENUATION IN PODONIFTIS STREAMBED



PROPOSAL FOR NATURAL FLOOD ATTENUATION IN PODONOFTIS STREAMBED



Tools Promoting Soft linings and Preventive Design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ELSEVIER

Soil and water bioengineering: Practice and research needs for reconciling natural hazard control and ecological restoration

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Hard Lining vs Soft Lining (bioengineering)

Water Resources Research

RESEARCH ARTICLE

10.1002/2015WR018227

Modeling the hydrological and mechanical effect of roots on shallow landslides

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Key Points:
- Root cohesion estimated using a FBM and branching topology model
- Assessment of hydrological and mechanical stability effects of roots for shrubs and trees
- The effects of root uptake can be more significant than the mechanical reinforcement

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Citation:
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Abstract This study proposes a new methodology for estimating the additional shear strength (or cohesion) exerted by vegetation roots on slope stability analysis within a coupled hydrological-stability model. The mechanical root cohesion is estimated within a Fiber Bundle Model framework that allows for the evaluation of the root strength as a function of stress-strain relationships of populations of fibers. The use of such model requires the knowledge of the root architecture. A branching topology model based on Leonardo's rule is developed, providing an estimation of the amount of roots and the distribution of diameters with depth. The proposed methodology has been implemented into an existing distributed hydrological-stability model able to simulate the dynamics of factor of safety as a function of soil moisture dynamics. The model also accounts for the hydrological effects of vegetation, which reduces soil water content via root water uptake, thus increasing the stability. The entire methodology has been tested in a synthetic hillslope with two configurations of vegetation type, i.e., trees and shrubs, which have been compared to a configuration without vegetation. The vegetation has been characterized using roots data of two mediterranean plant species. The results demonstrate the capabilities of the topological model in accurately reproducing the observed root structure of the analyzed species. For the environmental setting modeled, the effects of root uptake might be more significant than the mechanical reinforcement; the additional resistance depends strictly on the vegetation root depth. Finally, for the simulated climatic environment, landslides are seasonal,

Hard Lining vs Soft Lining

Plant Soil (2007) 294:169–183
DOI 10.1007/s11104-007-9244-2

Table 3 List of species and the potential of their root system to increase the erosion resistance of topsoils below the plant crown to concentrated flow erosion

Name of the species	Vegetation type	RSD (0–10 cm topsoil)	Erosion reducing potential
Avenula bromoides	Grass	$0.3.10^{-12}$	Very high
Juncus acutus	Reed	$2.72.10^{-8}$	Very high
Lygeum spartum	Grass	$2.41.10^{-7}$	Very high
Helictotrichon filifolium	Grass	$1.61.10^{-6}$	Very high
Plantago albicans	Herb	1.10^{-5}	Very high
Brachypodium retusum	Grass	8.10^{-4}	Very high
Anthyllis cytisoides	Shrub	$2.29.10^{-3}$	Very high
Piptatherum miliaceum	Grass	0.01	Very high
Tamarix canariensis	Tree	0.01	Very high
Stipa tenacissima	Grass	0.03	High
Retama sphaerocarpa	Shrub	0.03	High
Salsola genistoides	Shrub	0.03	High

Abstract Gully erosion is an important soil degradation process in Mediterranean environments. Revegetation strategies for erosion control rely in (RLD) and root diameters are measured for 26 typical Mediterranean plant species. RD values and root diameter distribution within the upper 0.10–0.90 m of

RSD = relative soil detachment rate for the 0.10 m thick topsoil below the plant crown (0 = very high erosion resistance, 1 = very low erosion resistance),

Hard Lining vs Soft Lining

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Stability Thresholds for

	24 – in. d_{50}	10.1	14 – 18	E
Soil Bioengineering	Wattles	0.2 – 1.0	3	C, I, J, N
	Reed fascine	0.6-1.25	5	E
	Coir roll	3 - 5	8	E, M, N
	Vegetated coir mat	4 - 8	9.5	E, M, N
	Live brush mattress (initial)	0.4 – 4.1	4	B, E, I
	Live brush mattress (grown)	3.90-8.2	12	B, C, E, I, N
	Brush layering (initial/grown)	0.4 – 6.25	12	E, I, N
	Live fascine	1.25-3.10	6 – 8	C, E, I, J
	Live willow stakes	2.10-3.10	3 – 10	E, N, O
Hard Surfacing	Gabions	10	14 – 19	D
	Concrete	12.5	>18	H

Designers of stabilization or restoration projects must ensure that the materials placed within the channel or on the banks will be stable for the full range of conditions expected during the design life of the project. Unfortunately, techniques to characterize stability thresholds are limited. Theoretical approaches do not

thresholds for the material forming the boundary of the channel are exceeded, erosion occurs. This technical note deals with the latter case of instability and distinguishes the presence or absence of erosion (threshold condition) from the magnitude of erosion (volume).

	Vegetated coir mat	4 - 8	9.5	E, M, N
	Live brush mattress (initial)	0.4 – 4.1	4	B, E, I
	Live brush mattress (grown)	3.90-8.2	12	B, C, E, I, N
	Brush layering (initial/grown)	0.4 – 6.25	12	E, I, N
	Live fascine	1.25-3.10	6 – 8	C, E, I, J
	Live willow stakes	2.10-3.10	3 – 10	E, N, O
Hard Surfacing	Gabions	10	14 – 19	D
	Concrete	12.5	>18	H

Sustainable Urban Storm Water Systems and Bioengineering Procedures

THANK YOU VERY MUCH FOR YOUR ATTENTION