

# SWIM and Horizon 2020 Support Mechanism

Working for a Sustainable Mediterranean, Caring for our Future

## SWIM-H2020 SM Regional Activity EFH-TN-4

**“Assistance technique à l’élaboration d’un manuel national pour l’évaluation des matériaux de dragage”**

*Atelier de restitution et de présentation du manuel - Hôtel El Mouradi Africa - Tunis, 19 Décembre 2018*

## Application of guidelines on management of dredged material of the Kifissos River (Saronikos Gulf, Greece)

**Dr Vasilios KAPSIMALIS & Dr Ioanna SIOKOU**

This Project is funded by the European Union



# SWIM-H2020 SM - Regional Activity EFH-TN-4

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## 1. Legislative framework in Greece

### International (Global) level

- The London Convention (1972) and Protocol (1996 Amendments)  
(Depositary: IMO)
- The Barcelona Convention (1976) and Protocol (1995 Amendments)  
(Depositary: UNEP MAP)

Signatures and Ratifications of the Barcelona Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean and its Protocols as at 13 February 2018 (last notification received).

Contracting Parties	1976 Barcelona Convention - 1/				1976 Dumping Protocol - 2/		
	Signature	Ratification	Acceptance of 1995 Amendments	Entered into force	Signature	Ratification	Acceptance of 1995 Amendments
Greece	16.02.76	03.01.79	10.03.03	09.07.04	11.02.77	03.01.79	-

Accession = AC

Approval = AP

Succession = SUC

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## 1. Legislative framework in Greece

### European level

#### - Waste Framework Directive 2008/98/EC of 19 November 2008

The Directive excludes from its scope «***Sediments relocated inside of surface waters for the purpose of managing waters and waterways or of preventing floods or mitigating the effects of floods and droughts, or for land reclamation, shall be excluded from the scope of this Directive if it is proven that the sediments are non-hazardous***» (Article 2).

Therefore, hazardous sediments are considered as waste within the meaning of this directive.

#### - Water Framework Directive 2000/60 / EC of 23 October 2000 (normally within 1 nautical mile from the nearest shoreline)

The directive defines an objective of good chemical status, good ecological status, and non-degradation of the quality of water bodies. It establishes in this context a list of substances for which quality standards are set at Community level and defines chemicals that support biological quality.

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## 1. Legislative framework in Greece

### European level

#### - Marine Strategy Framework Directive 2008/56/CE of 17 June 2008 (normally beyond 1 nautical mile)

The directive sets the goal of achieving the good ecological status of marine environments by 2020 (see presentation in Appendix VIII of this report). This good ecological status is defined by 11 qualitative descriptors (see Annex I of the directive), many of which relate to the potential impacts of dredging activities, in particular:

- Descriptors 6: sea-floor integrity
- Descriptors 7: Hydrographical conditions
- Descriptors 8: Contaminants
- Descriptors 9: Health Issues
- Descriptors 11: Marine Energy

On the other hand, the question of sediment quality is included in the list of characteristics (Annex III, Table 1 of the Directive) and in the list of pressures and impacts (Annex III, Table 2 of the Directive).

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## 1. Legislative framework in Greece

### National (Greek) level

Ministerial Order No. 181051/2079/78 (FEK 1135 / B / 14.12.1978) - [On the list of substances for which disposal at sea is prohibited]

UNEP/MED POL: Guidelines for the Management of Dredged Material. MAP Technical Reports Series No. 129, UNEP, Athens 2000

(<https://wedocs.unep.org/bitstream/handle/20.500.11822/559/mts129.pdf?sequence=6&isAllowed=y> )

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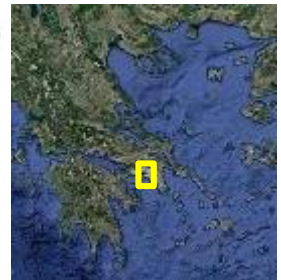
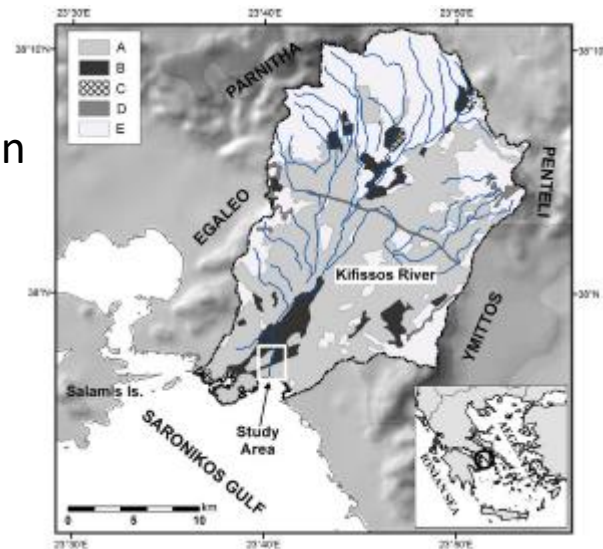
## 2. Need for dredging and disposal

The Kifissos River runs through the city of Athens and discharges into the Saronikos Gulf, where recreation, fishing and navigation activities take place.

The Kifissos River is prone to pollution mainly due to its close proximity to different pollution sources, like wastewater discharge points, on-site sanitation systems for domestic and institutional sources, industrial effluent discharge spots, and solid-waste disposal sites.

The Greek Ministry of Environment, Spatial Planning and Public Works decided to fund an

## Environmental (clean up) Dredging



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## 2. Need for dredging and disposal

The question “**is dredging necessary ?**” was answered as following:



<b>Why?</b>	Contaminated sediment were accumulated in the lower route of the river <ul style="list-style-type: none"><li>• degradating the environmental quality of the surrounding areas (there was an increased risk to public health); and</li><li>• reducing the active cross section of the riverbed (there was no possibility of unimpeded water flow during floods)</li></ul>
<b>Where?</b>	In the lower route of the river from the mouth to 2 km upstream (the upland entrance of seawater)
<b>When?</b>	2008-2013 (dredging and dumping operations 2010-2012)
<b>How often?</b>	Once



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## 3. Characterisation of dredged material

### Physical characterisation

Quantity of dredged material :	700 000 m <sup>3</sup> or 1 100 000 tonnes
Method of dredging :	Mechanical dredging
Rough preliminary determination of sediment characteristics:	Consolidated clay Silt/Soft clay Mixture of sand/silt/soft clay

**Due to the significant presence of fine grained material (i.e., silt/soft clay) there is a need for sampling and further analyses of its physical properties**



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## 3. Characterisation of dredged material

### Sampling

**Twenty-six surface samples** (with their thickness ranging from 5 to 10 cm) were grabbed from the river bed at intervals of 100 m and upstream of the river mouth, with water depths during sampling procedure ranging from 3.2 to 0 m.

In addition, **seven sediment cores** (of 20–150 cm thickness each) were recovered from the river estuarine funnel, with water depths during sampling procedure varying from 3.9 to 7.3 m.



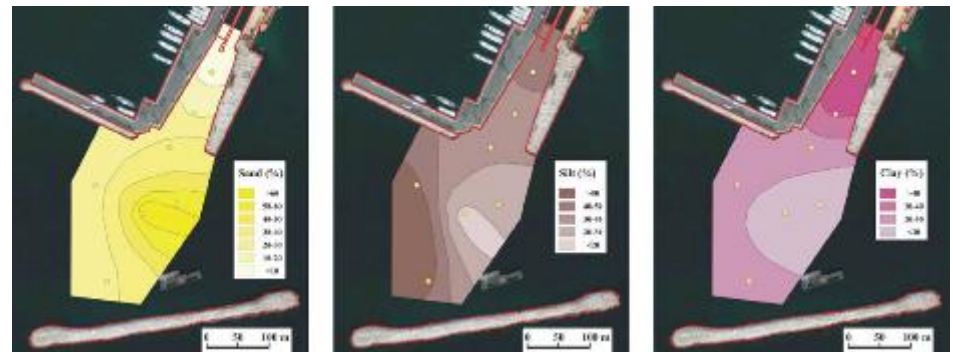
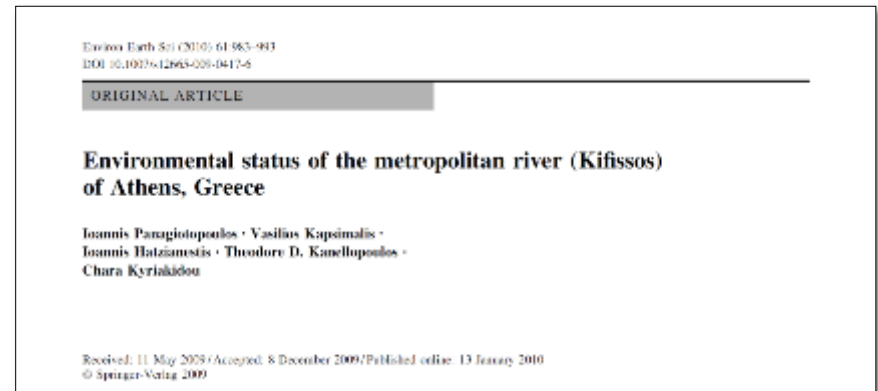
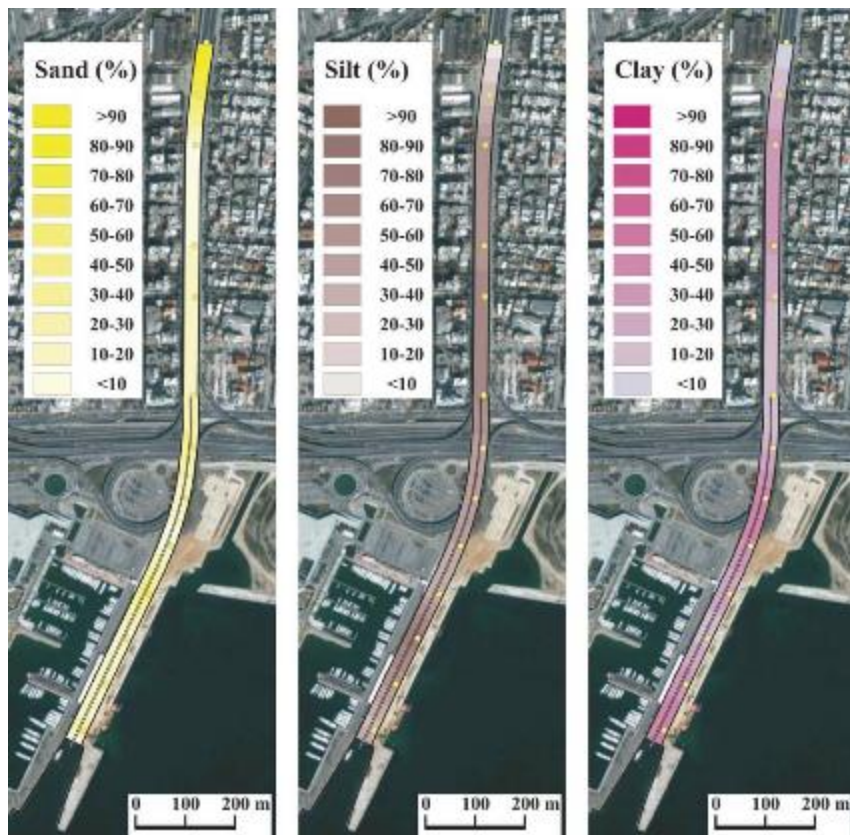
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## 3. Characterisation of dredged material

### Physical characterisation

### Physical properties (e.g., grain size)



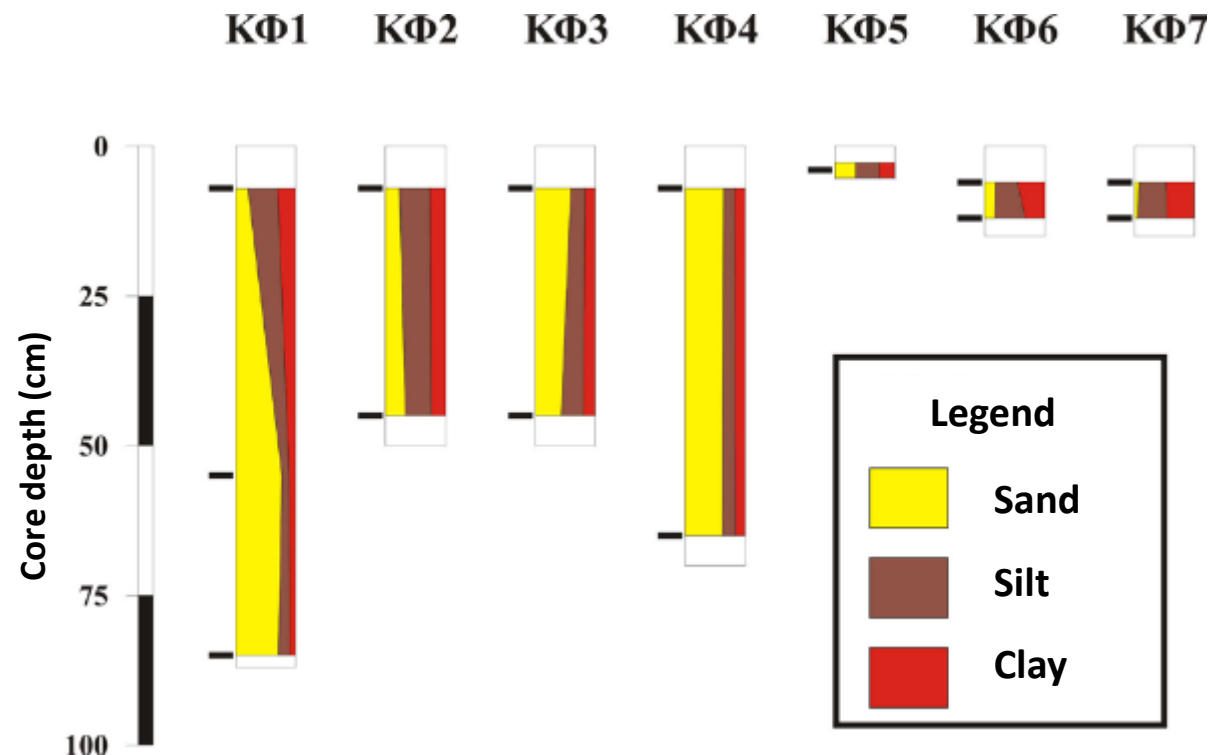
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## 3. Characterisation of dredged material

### Chemical characterisation

Existence of any information about chemical concentrations and properties of dredged material	No
Existence of any industrial and municipal waste discharges (past and present)	Yes

**Need for further analyses of chemical properties of dredged material**

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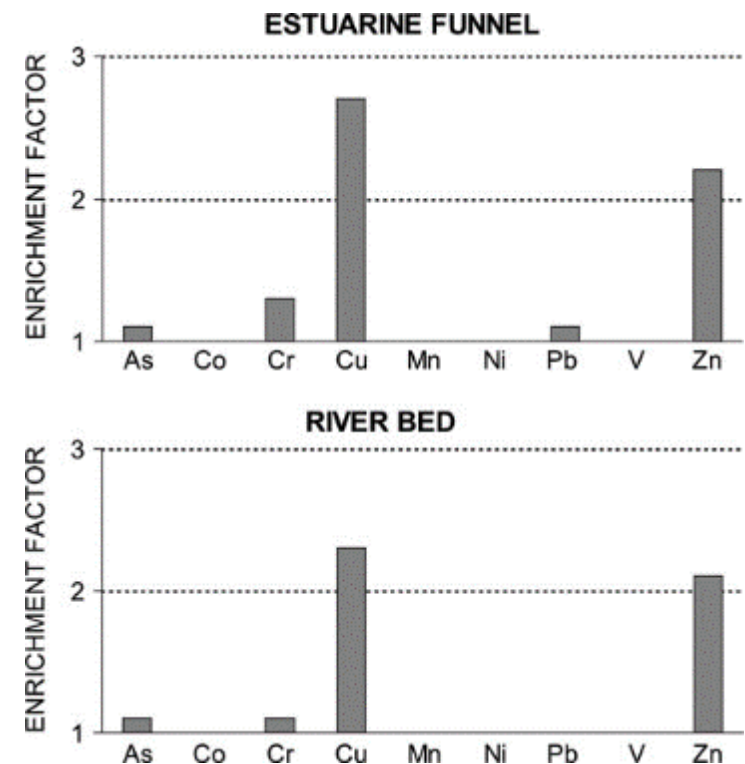
## 3. Characterisation of dredged material

### Chemical characterisation

### Chemical properties (inorganic contaminants)

- **Major elements** (Al, Ca, Fe, K, Mg, Na, P, Si, and Ti); and
- **Trace elements** (As, Ba, Br, Cd, Ce, Co, Cr, Cu, Ga, Hf, I, La, Mn, Mo, Nb, Nd, Ni, Pb, Rb, Sb, Sc, Sm, Sn, Sr, Te, Th, U, V, W, Y, Zn and Zr)

Analysis was carried out by a X-Ray Fluorescence (XRF) system (Philips PW-2400)





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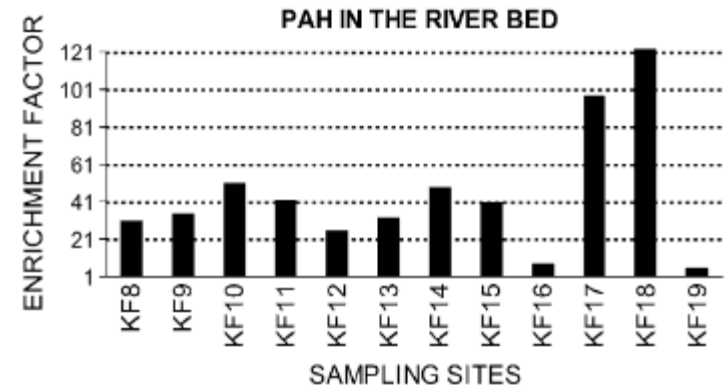
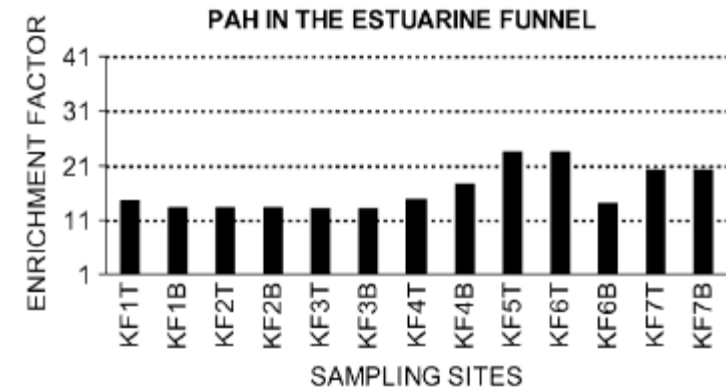
## 3. Characterisation of dredged material

### Chemical characterisation

#### Chemical properties (inorganic contaminants)

- **Polychlorobiphényles suivants (PCBs),**  
(congénères de PCB IUPAC numéros 28, 52, 101, 118, 138, 153 et 180);
- **Hydrocarbures aromatiques polycycliques (HAP)**  
( $\Sigma\text{HAP}_9$  est la somme des HAPs suivis: anthracène, benzo[a]anthracène, benzo[ghi]perylène, benzo[a]pyrène, chrysène, fluoranthène, indeno[1,2,3-cd]pyrène, pyrène, phénanthrène).

Analysis was carried out using carried out by gas chromatography–mass spectrometry (Hewlett Packard 6890 GC–MS).



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## 3. Characterisation of dredged material

### Sediment Quality Assessment (ERL/ERM & PEL/TEL)

#### Inorganic contaminants

Chemical	ERL (ppm)	ERM (ppm)	Present study (ppm) River bed/funnel (mean)
Copper	34	270	64/58
Zinc	150	410	202/166

#### Organic contaminants

Chemical	ERL (ng/g)	ERM (ng/g)	Present study (ng/g) River bed/funnel (mean)
Acenaphthene	16	500	32/5
Acenaphthylene	44	640	5/4
Anthracene	85	1,100	10/12
Fluorene	19	540	40/15
Dimethylnaphthalene	70	670	480/84
Napthalene	160	2,100	31/49
Phenanthrene	240	1,500	257/103
Benzo(a)anthracene	261	1,600	56/45
Benzo(a)pyrene	430	1,600	43/42
Chrysene	384	2,800	102/78
Dibenzo(a,h)anthracene	63	260	3/6
Fluoranthene	600	5,100	188/140
Pyrene	665	2,600	217/107



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## 3. Characterisation of dredged material

### Biological characterisation

The previous analysis of the material shows the presence of contaminants in quantities exceeding the upper reference threshold or of substances whose biological effects are not understood (?)	No
There is concern for the antagonistic or synergistic effects of more than one substance (?)	No
there is any doubt as to the exact composition or properties of the material, it is necessary to apply suitable biological test procedures (?)	No

**Analyses for the determination of biological properties of dredged material were not carried out since the physical and chemical characterisation *allows the assesement of the environmental impact on an adequate scientific basis***

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## 4. Contaminant source evaluation and control

The Greek Ministry of Environment, Spatial Planning and Public Works decided to fund:

- Flood protection works at the Kifissos bedside
- Removal of industries located within a zone of 100 meters from the river bed
- Regeneration on the river banks



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## 5. Evaluation of disposal options

### Options for material assessed to be intermediate contaminated (ERL/ERM)

**200 000 m<sup>3</sup>** of material enriched in Cu, Zn and PAHs (i.e., >ERL and <ERM) located in the lower river bed (between 0+300 and 0+900)

***In confined disposal facilities (CDF)***



### Options for material assessed to be not contaminated (ERL/ERM)

**500 000 m<sup>3</sup>** of material (i.e., <ERL) located in the river mouth and bed (from 0-300 to 0+300 and from 0+900 to 0+2000)

***Dumping at sea***

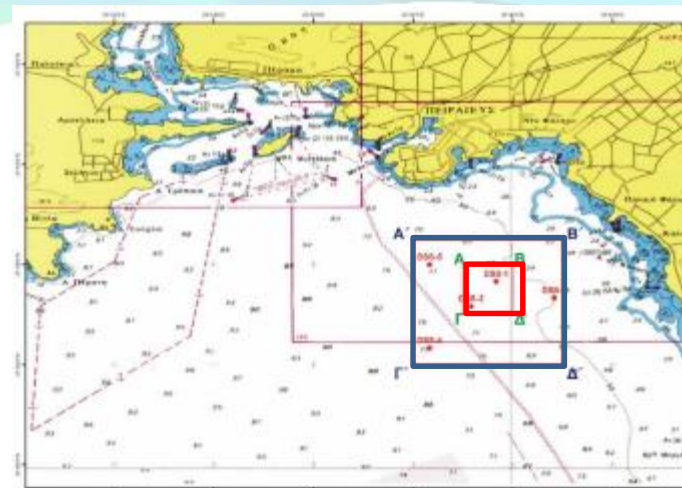
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## 6. Selection of dumping site

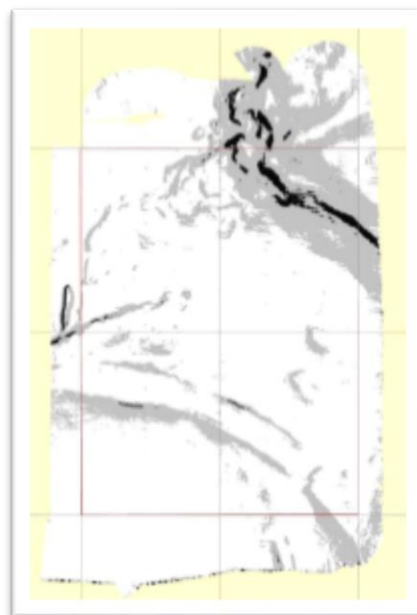
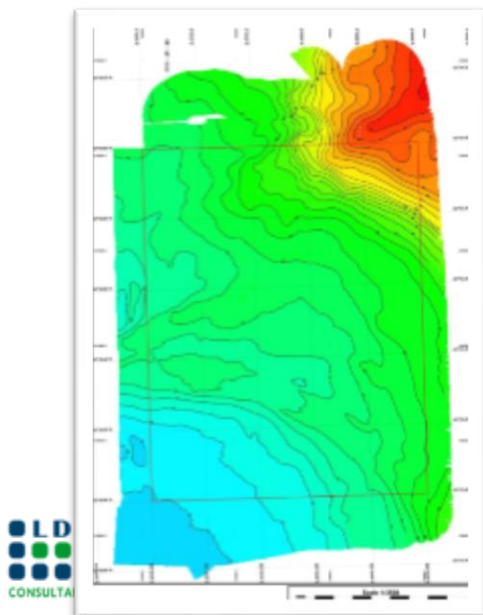
500 000 m<sup>3</sup> of uncontaminated material was decided to be placed in an *old dumping site*

The site is located 3 nautical miles away from the nearest shoreline and its depth ranges from 55 to 76 m



Points	Latitude	Longitude
A	37°54'00"N	23°39'00"E
B	37°54'00"N	23°40'00"E
C	37°53'00"N	23°39'00"E
D	37°53'00"N	23°40'00"E

Size: 1 nm<sup>2</sup> (or 3.43 km<sup>2</sup>)  
Total capacity: 850,000 m<sup>3</sup>  
Used capacity: 250,000 m<sup>3</sup>  
Free capacity: 600,000 m<sup>3</sup>



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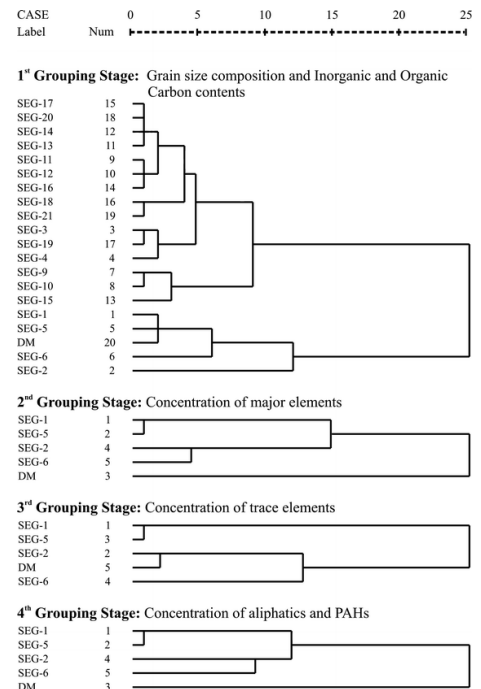
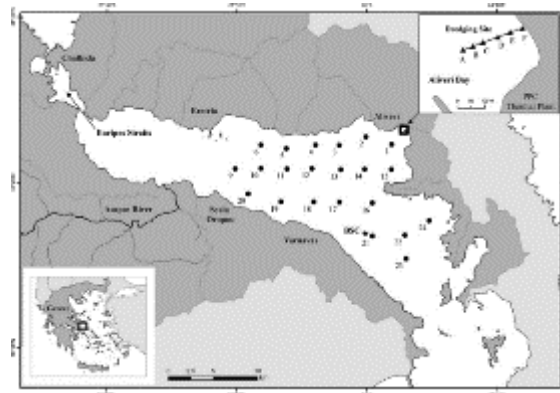
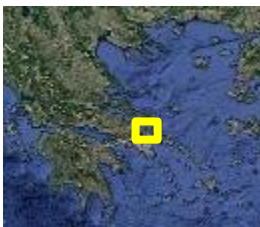
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## 6. Selection of dumping site

### Selection of a new site for sea disposal (the example of South Euboean Gulf)

Determination of

- the physical, chemical and biological characteristics of the seabed (e.g., topography, geochemistry, benthic biota);
- the physical, chemical and biological characteristics of the water column (e.g., hydrodynamics, dissolved oxygen, pelagic species); and
- proximity to human activities or areas of high ecological value



Cluster analysis for the successive classification criteria used: grain size composition and inorganic and organic carbon contents, major element concentration, trace element concentration, and hydrocarbon concentration



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## 6. Selection of dumping site

### Selection of a new site for sea disposal

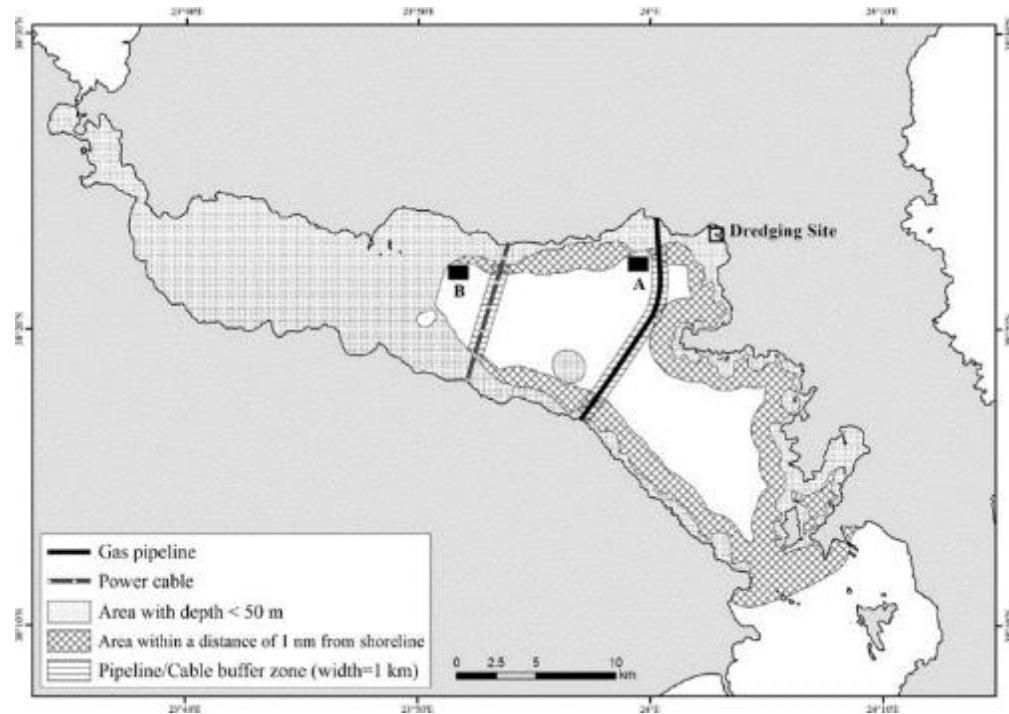
A complete description of the method presented in...

Environ Monit Assess (2013) 185:10549–10072  
DOI 10.1007/s10653-013-9312-2

#### A screening procedure for selecting the most suitable dredged material placement site at the sea. The case of the South Euboean Gulf, Greece

V. Kapsimalis · I. P. Panagiotopoulos · I. Hatzianestis ·  
T. D. Kanellopoulos · C. Tsangaris · E. Kaberi · H. Kontogiannis ·  
G. Roussakis · C. Kyriakidou · G. A. Hatiris

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## 7. Definition of an EIA and a Monitoring Programme

### Assessment of Environmental Impact (AEI)

The AEI carried out for the expected effects of the disposal option highlighted the followings:

#### ***Physical Impact:***

Fine grained material will increase the concentration of the suspended solids in the dumping site and its surroundings

#### ***Chemical Impact:***

A part of heavy metals and organic compounds contained in the dredged material will be realized in the water column during discharge

#### ***Biological Impact:***

The physical and chemical impact will cause a change in the composition, biodiversity and abundance of benthic communities



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## 7. Definition of an EIA and a Monitoring Programme

### Monitoring Programme

Determination of physical characteristics  
*prior and after* dumping operations

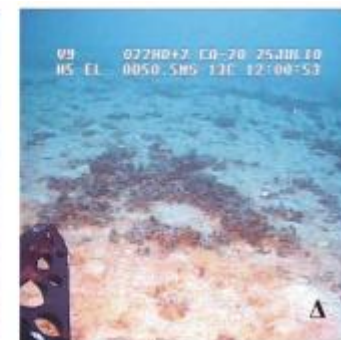
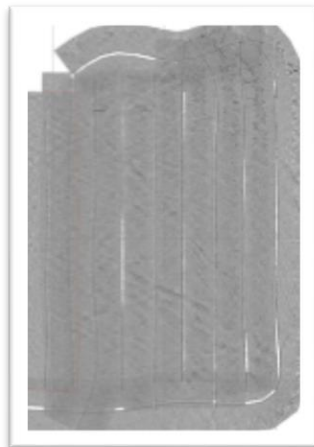
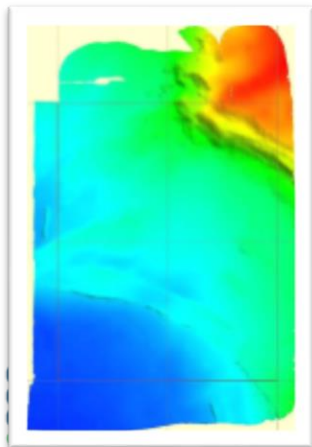
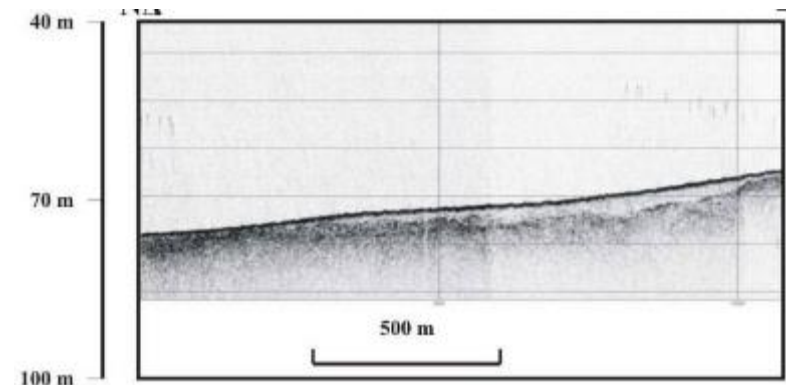
#### *Seabed prospection*

Bathymetry (multibeam echo sounder)

Surface morphology (side scan sonar)

Underwater videos and photos (ROV)

Subsurface sediments (Sub bottom profiler)



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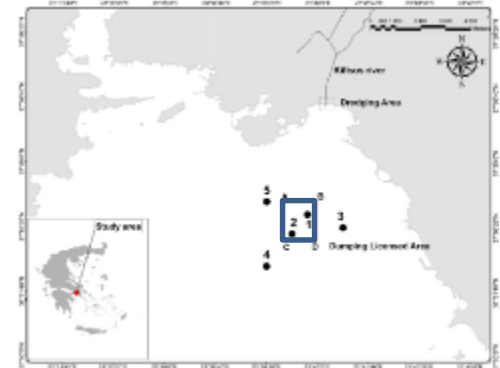
## 7. Definition d'une EIE et d'un Programme de Surveillance

### Monitoring Programme

Determination of physical, chemical and biological characteristics  
*prior, during and after* dumping operations

#### *Seabed sampling*

Collection of surface sediment (grab sampler)



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## 7. Définition d'une EIE et d'un Programme de Surveillance

### Monitoring Programme

**Determination of physical, chemical and biological characteristics prior, during and after dumping**

#### *Sediment (laboratory) analyses*

- Grain size (sieves and particle size analyser)
- Percent solids (dry matter)
- Density/specific gravity
- Organic matter (as total organic carbon)
- Geochemical composition (major and minor elements)
- Concentration of organic compounds (aliphatic hydrocarbons, PAHs, PCBs DDTs)
- Cascade leaching tests (CLTs) in heavy metals, PAHs and PCBs
- Acute toxicity (Mictotox)
- Benthic communities (BENTIX)



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## 7. Définition d'une EIE et d'un Programme de Surveillance

### Monitoring Programme

Determination of physical, chemical and biological characteristics prior, during and after dumping

#### *Seawater in situ measurements and sampling*

- Seawater circulation - (**ADCP**)
- Measurement of salinity, temperature, turbidity, dissolved oxygen saturation - (**CTD probes**)
- Collection of water samples (surface, middle and base of column) - (**Niskin bottles**)
- pH - (**pH-meter**)
- Total Organic Carbon
- Plankton - (**plankton net**)
- Biomarkers in caged mussels - (**mooring**)





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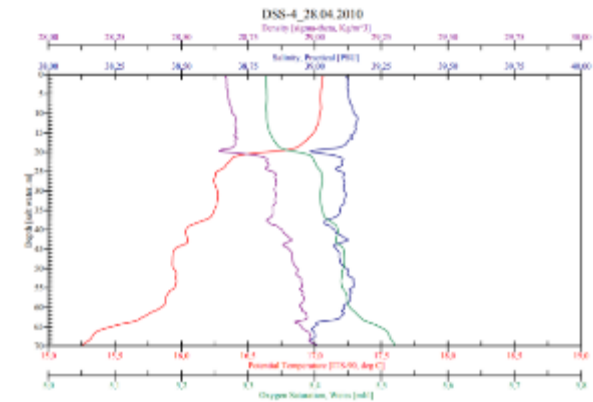
## 7. Définition d'une EIE et d'un Programme de Surveillance

### Monitoring Programme

Determination of physical, chemical and biological characteristics prior, during and after dumping

#### *Seawater (laboratory) analysis*

- Particulate Suspended Matter (PSM)
- Nutrients
- DO
- Total Organic Carbon
- Heavy metals in water
- Heavy metals in PSM
- Hydrocarbons, PAHs, PCBs, DDTs
- Hydrocarbons, PAHs, PCBs, DDTs in PSM
- Phytoplankton
- Zooplankton
- Heavy metals and PAHs in mussels



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## 8. Issue of permits

The ***special permit*** for the dumping in Saronikos Gulf was issued by the local station of ***Coast Guard*** after having been approved by the Ministry of Environment, Spatial Planning and Public Works the

- Assessment Environmental Impact; and
- Monitoring Programme

Two of the specific condition of the permit were:

- solid waste contained within the dredged material should be separated and managed on land; and
- disposal vessels should be equipped with accurate positioning systems referring to the permitting authority the coordinates of the discharge site

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## 9. Implement project and monitor compliance

Dredging and dumping operations were carried out from July 2010 to May 2012

The frequency of field monitoring was one survey per month





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## 9. Implement project and monitor compliance

### *Results of the monitoring:*



### *Conclusion:*

Dumping of Kifissos River dredged material did not cause unexpected effects; therefore, **the permit did not need to be modified or revoked**

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“Assistance technique à l’élaboration d’un manuel national pour l’évaluation des matériaux de dragage”

## 10. Notification

After the cessation of dumping operations the permitting authority forwarded the final report to:

- Ministry of Environment, Spatial Planning and Public Works; and
- UNEP/Mediterranean Action Plan (MAP) of their monitoring activities

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## Merci pour votre attention!

