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Identification and dealing with sites with enhanced level of natural radioactivity

A PRACTICAL SIMPLE AMBIENT DOSE RATE MAPPING METHOD TO ASSESS THE AREA OF POCKETS CONTAINING ENHANCED CONCENTRATION ACTIVITIES OF NORM AT A LARGE SLAG AND ASHES DEPOSITION SITES

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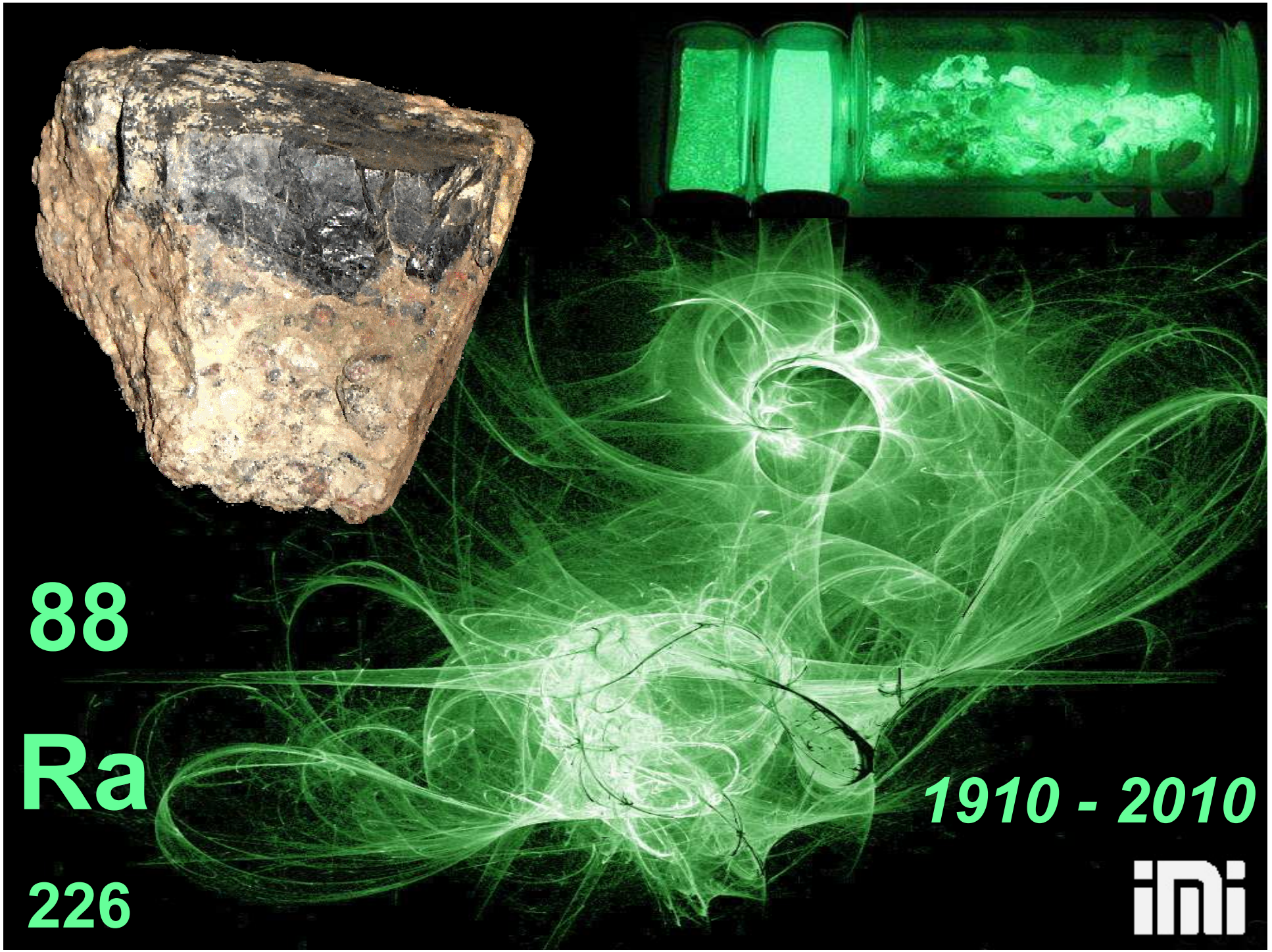
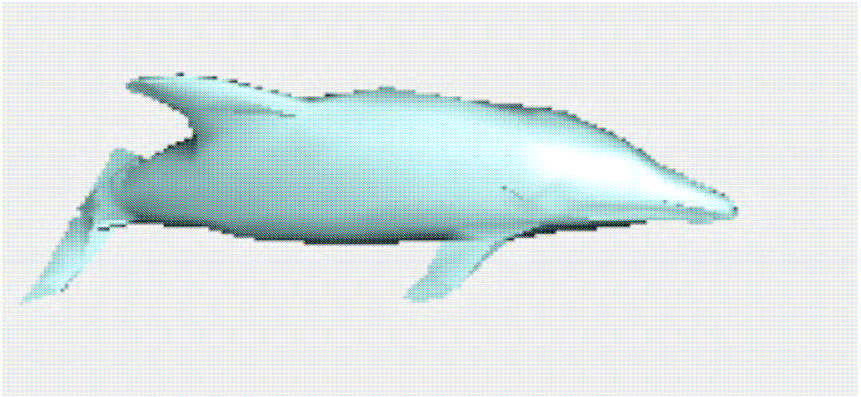
Characterisation, Conditioning and Remediation of NORM to be Reused in New Products and Associated Possible Public Member and Occupational Hazard

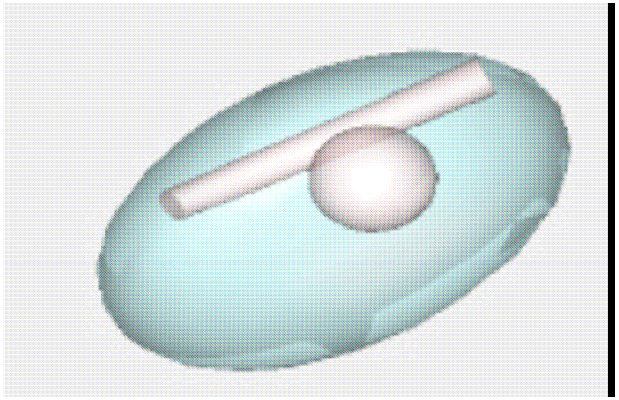
Knowledege about Hazardous waste, production, handling and it`s safe storage is a privilege of experts

Typical Public ignorance obout given matter results “sometimes” in a heavy conflicts


88
Ra
226
1910 - 2010

Physical **Internal and External** DOSE MODELS: **BIOTA CONCEPT**





If one assumes an infinite or semi-infinite volume with a uniform concentration $C(t)$ of a radionuclide at time t, then the absorbed dose to biota, D_b, can be expressed as:

$$D_b = d_b \cdot \int C(t)dt, \qquad (1)$$

where d_b denotes the time-independent dose coefficient for given type of exposure, $Gy \cdot s^{-1}$ per $Bq \cdot kg^{-1}$.

External exposure from an infinite source (air, water, and soil).

External exposure from contamination surfaces

Internal exposure of animals (inhalation)

Internal exposure of animals (ingestion)

Radium equivalent concept

$$Ra\ (eq) = A_{Ra} + 1.43 \cdot A_{Th} + 0.077 \cdot A_{K}$$

- radium equivalent in Bq/kg (becquerels per kilogram)

The radium equivalent [1] concept allows a single index or number to describe the gamma output from different mixtures of uranium (i.e., radium), thorium, and ^{40}K in a material.

External hazard index, H_{ex} >1

$$H_{ex} = \frac{A_{Ra}}{370} + \frac{A_{Th}}{259} + \frac{A_{K}}{4810} < 1$$

Internal hazard index, H_{in} >1

$$H_{\text{int}} = \frac{A_{Ra}}{185} + \frac{A_{Th}}{259} + \frac{A_{K}}{4810} < 1$$

[1] With the replacement of radium by other sources such as cesium-137 for exapmle, these sources have been described in terms of "radium equivalent" in order to facilitate use of the existing "institutional knowledge." Harold Johns and John Cunningham, in the Fourth Edition of *The Physics of Radiology* (Charles C. Thomas Publisher, 1983)

where
A_{Ra} is the activity of 226Ra (which is the same as that of 238U) in Bq/kg
A_{Th} is the activity of 232Th in Bq/kg, and
A_{K} is the activity of 40K in Bq/kg

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HEALTH RISK ASSESSMENT IN RESPECT TO RADIATION

All dose rates

-- measured --

(additionally calculated over the surface/volume samples activity concentrations)

are expected to be in the acceptable range
resulting in equivalent dose to a single public member

lower than 1 mSv per year added to a LBG

Health impact assessment to the public should be one of the key principles in the process of decision-making in physical planning and the construction of industrial, infrastructure and other facilities.

page20

It is absolutely necessary to integrate environmental health in the processes of strategic environmental and health assessment.

It is important to state that non radioactive harmful elements can cause much more intense environment pollution than radioactive ones.

Occupational Health impact assessment should also be incorporated in the same process

because of NEW type of working places beeing introduced

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Due to a desirable reconstruction of the fertilizer industrial facilities and remediation of existing industrial PG "waste",

main task of the environmental health services (and other responsible stakeholders) is to provide:

- **appropriate information and education of the XXX municipality population,**
- **to ensure a timely and accurate notification on possible *health hazards*,**
- **generate correct *risk perception*, (occupational , public)**
- **to provide public cooperation and understanding when introducing particular environment and health protection measures (if needed)**

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The key release or exposure vectors were as follows:

- **Air** (dust, particles and gas emission) + **teNORM** = **very low – low Risk (HLL)**
- Water/groundwater **very low - no abnormalities identified so far**
- Soil for agriculture purposes – **neglectable**
- Soil in natural park **very low – low risk for biodiversity**
- Surface waters **low – medium in case of geotechnical interference**
- Radon in ***occupational*** manners occurs **evident but low risk**

Radon has no direct or indirect risk potential for the public health situation

The occurring direct and indirect risk on public health can be stated as very low – low (HLL) according the risk matrix model.

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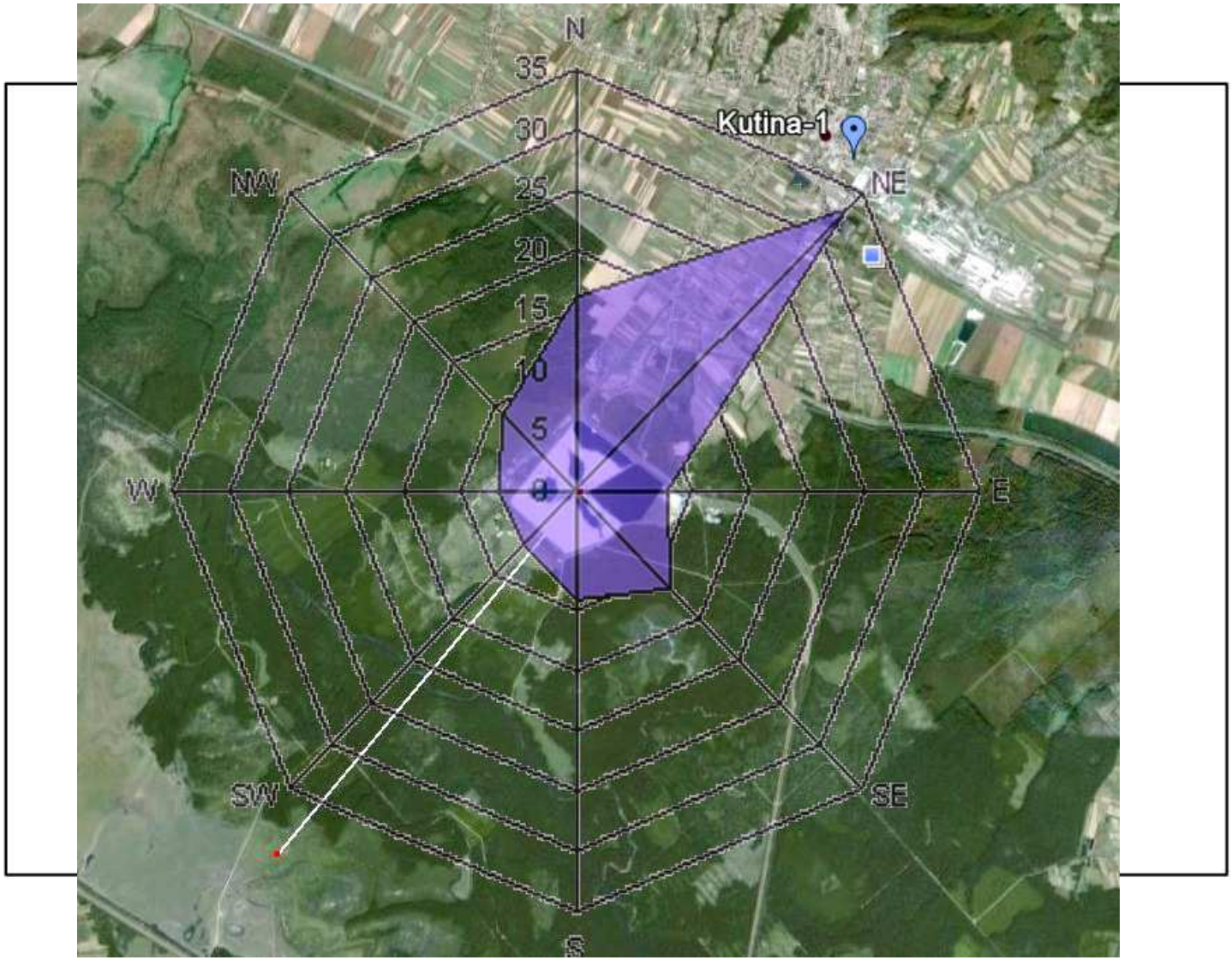
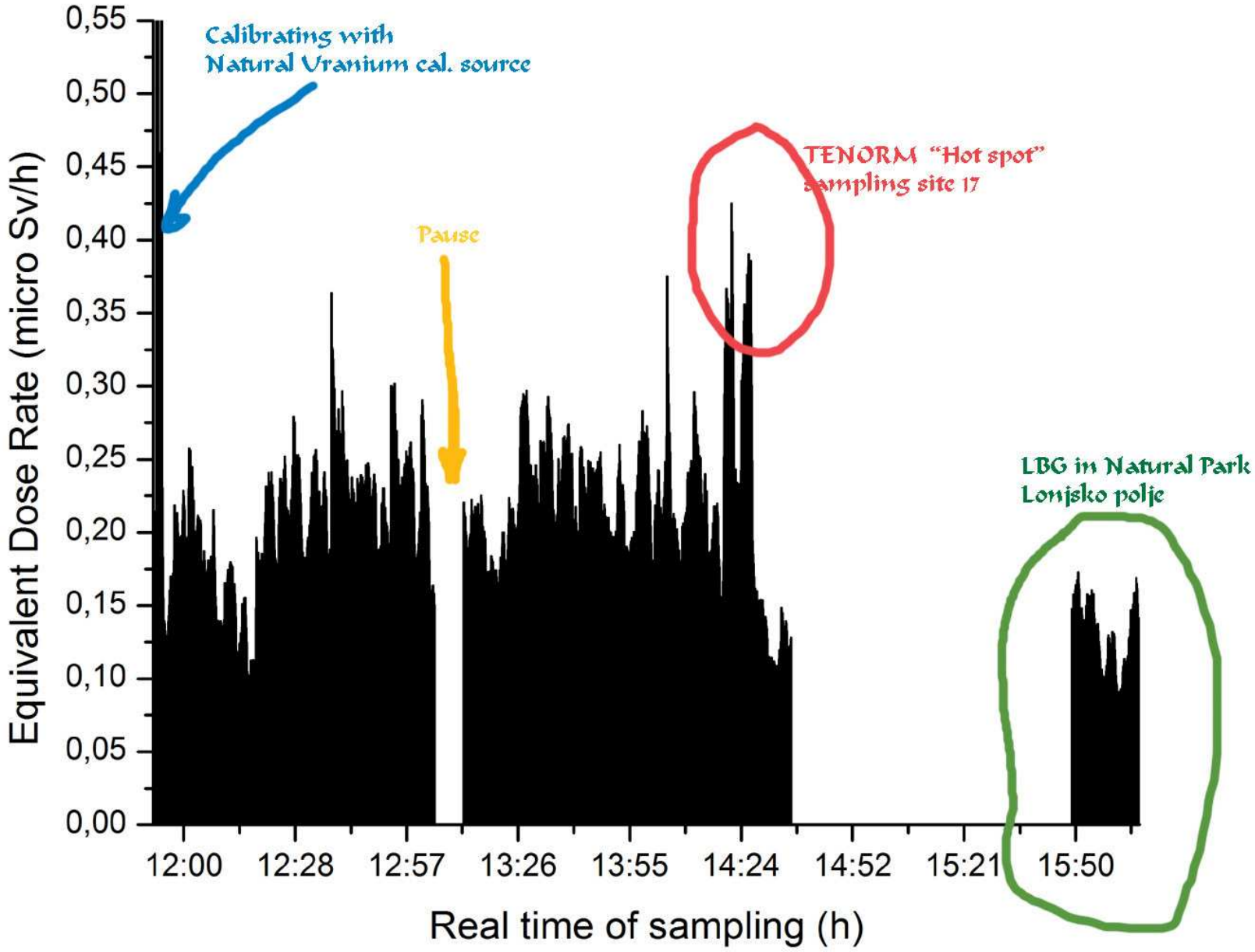
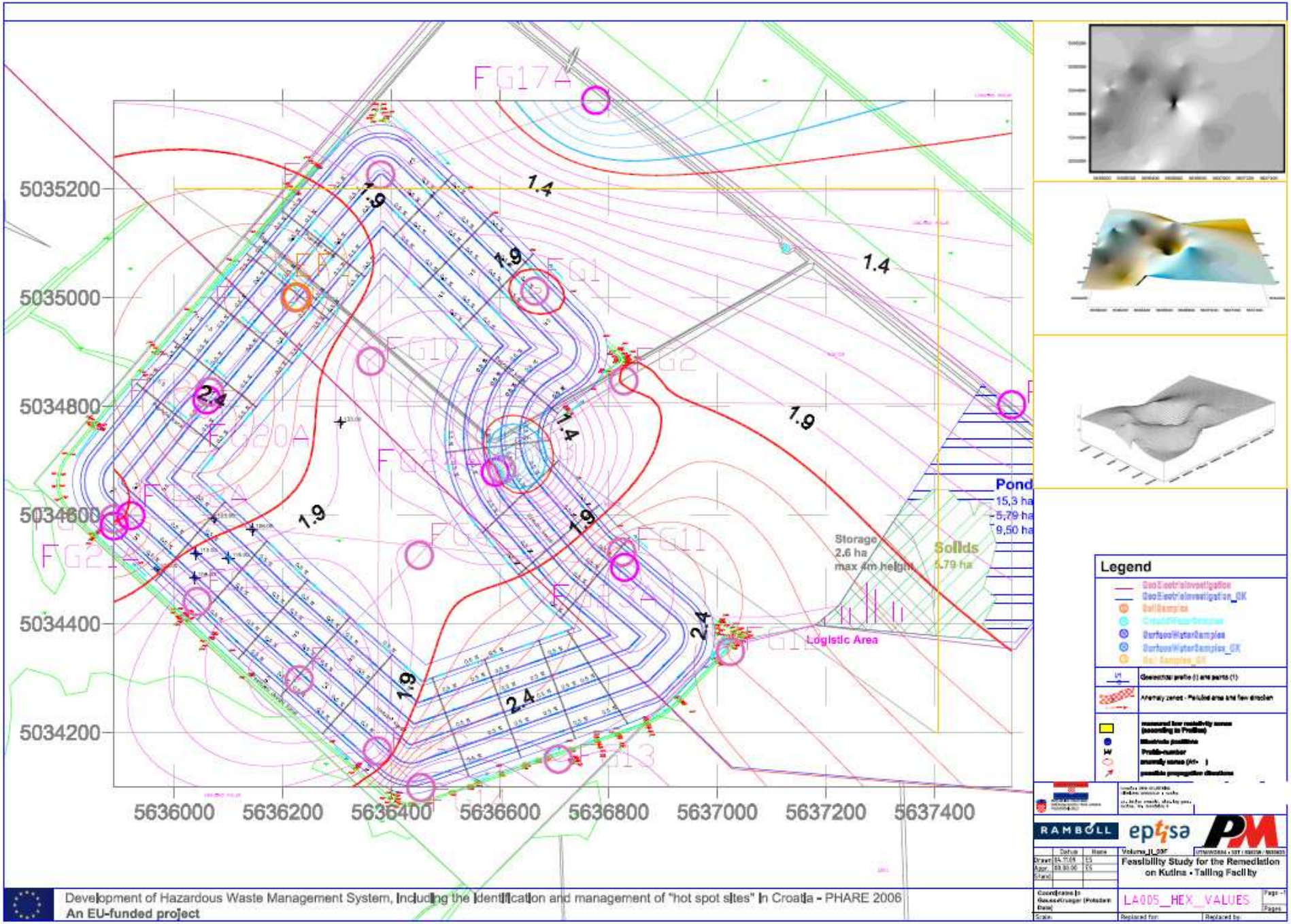
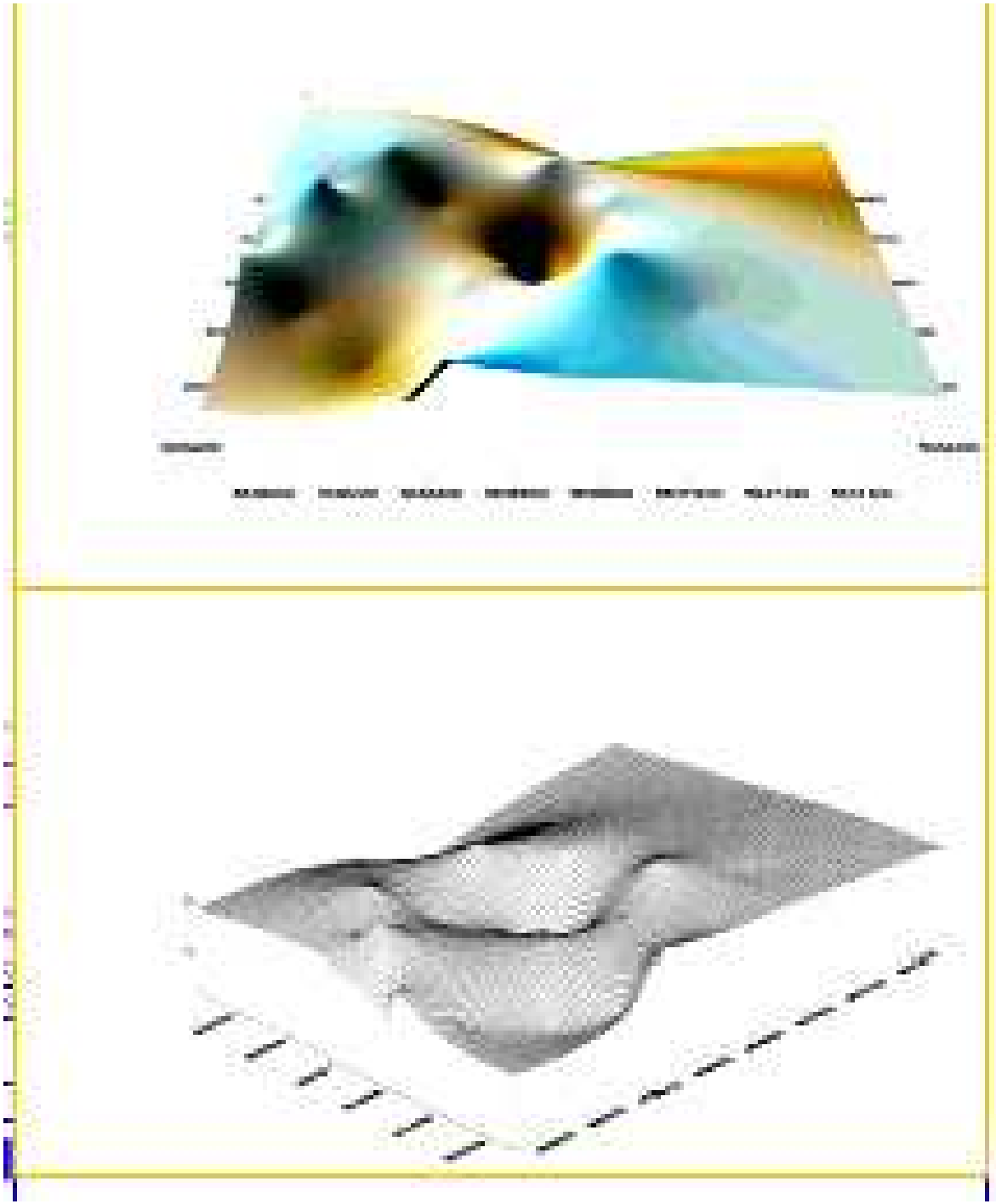

N
35
30
25
20
15
10
5
0
Kutina-1
NE
E
SE
S
SW
W
NW


Calibrating with
Natural Uranium cal. source
Pause
TENORM "Hot spot"
sampling site 17
LBG in Natural Park
Lonjsko polje
Equivalent Dose Rate (micro Sv/h)
0,55
0,50
0,45
0,40
0,35
0,30
0,25
0,20
0,15
0,10
0,05
0,00
12:00
12:28
12:57
13:26
13:55
14:24
14:52
15:21
15:50
Real time of sampling (h)


5035200
5035000
5034800
5034600
5034400
5034200
5636000
5636200
5636400
5636600
5636800
5637000
5637200
5637400
1.4
1.9
2.4
Pond
15,3 ha
5,79 ha
9,50 ha
Storage
2.6 ha
max 4m height
Solids
5.79 ha
Logistic Area
Legend
RAMBOLL
eptisa
PM
Feasibility Study for the Remediation
on Kutina - Tailing Facility
LA005_HEX_VALUES
Development of Hazardous Waste Management System, Including the Identification and management of "hot spot sites" in Croatia - PHARE 2006
An EU-funded project



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Evident migration paths of hazardous substances (TENORM and chemicals) were found to be:

air,

through dust and airborne suspended particles dispersion and

surface water flows.

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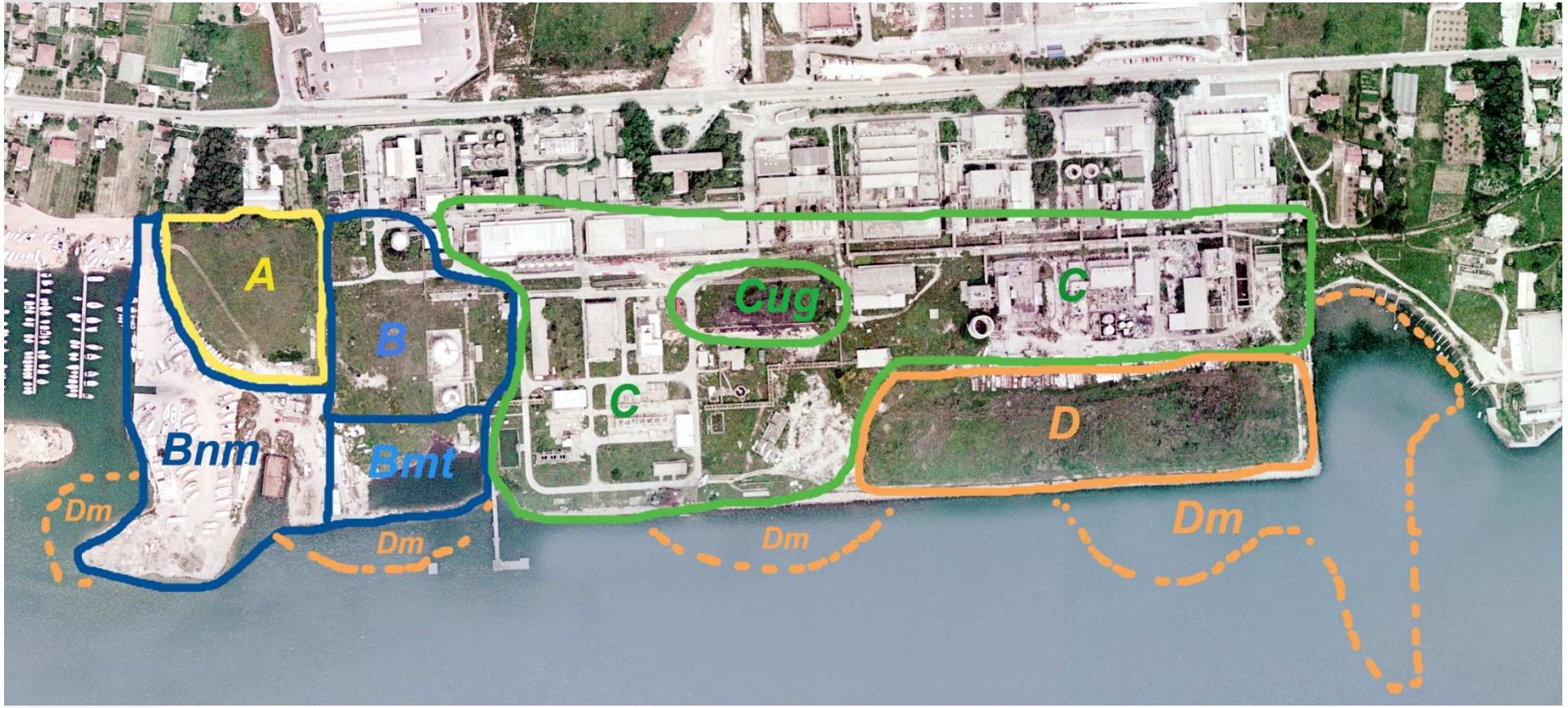
Capping and bioremediation via greening of open tailing facility surfaces will reduce the existing very low risk on dust/air – respiratory diseases to zero and will certainly enhance biodiversity.

The reuse of PG is possible and recommended but only under the professional supervision of total radionuclide activity content in final product (*monitoring*).
This depends, naturally, on the purpose and field of usage of this new product originating from PG.

The use of PG for other purposes such as the ones proposed and discussed in Task 2.1
Volume_I_00H – Market Analyses for the Reuse of produced Phosphoric Gypsum at Kutina **is to be conciliated with the EU, precisely with requirements given by Article 35 of Euratom Treaty regarding the teNORM radioactivity concentration content limits in a new product (originating from PG).**


A
B
Cug
C
C
D
Bnm
Bmt
Dm
Dm
Dm
Dm

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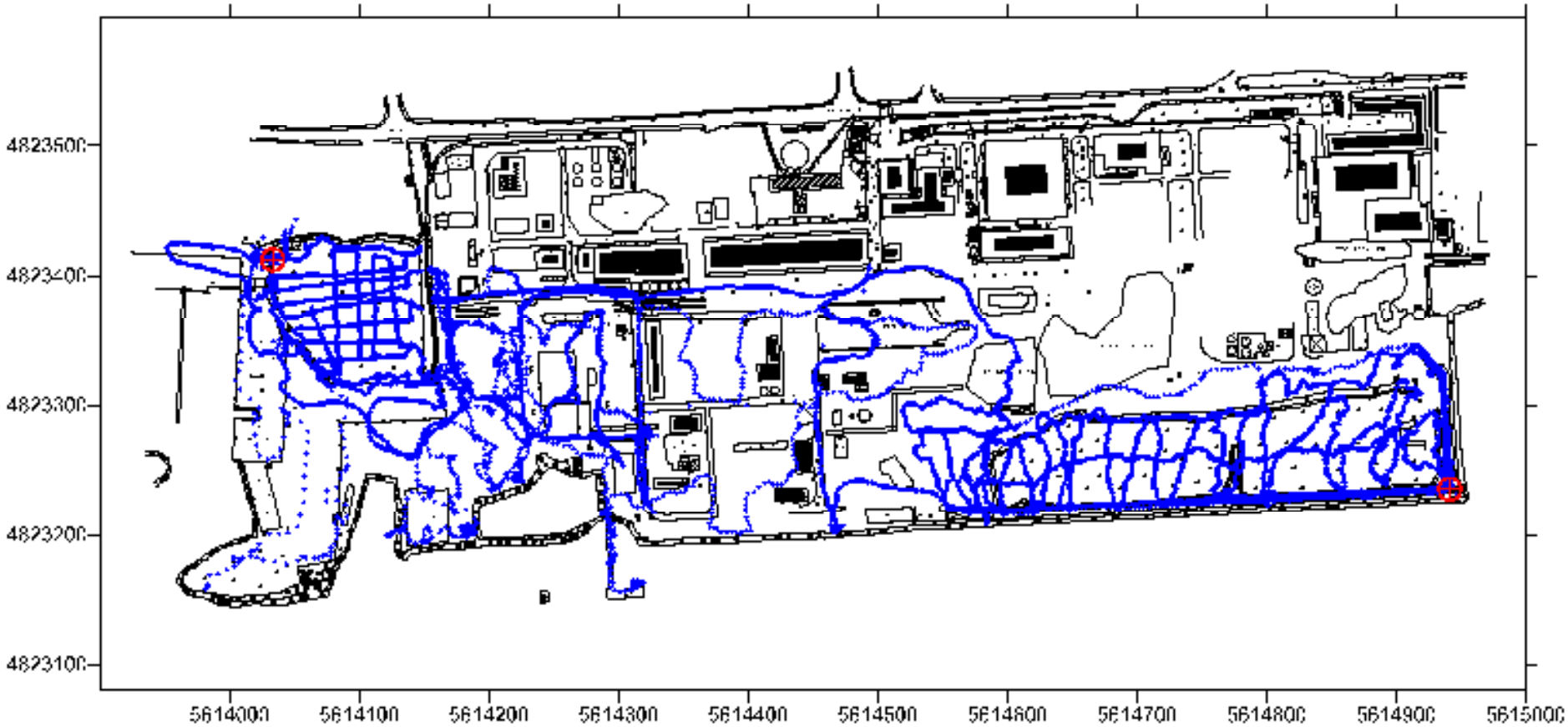

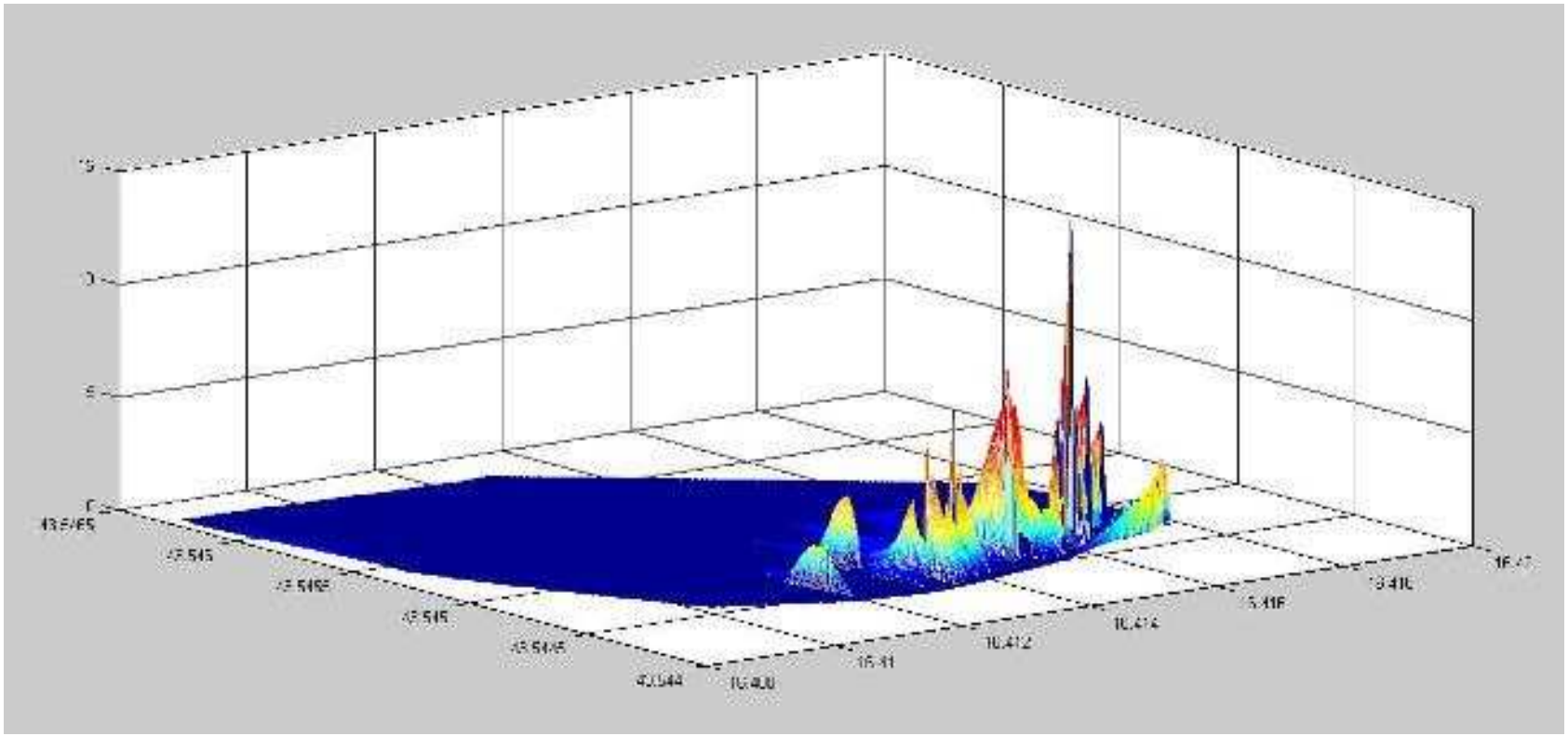

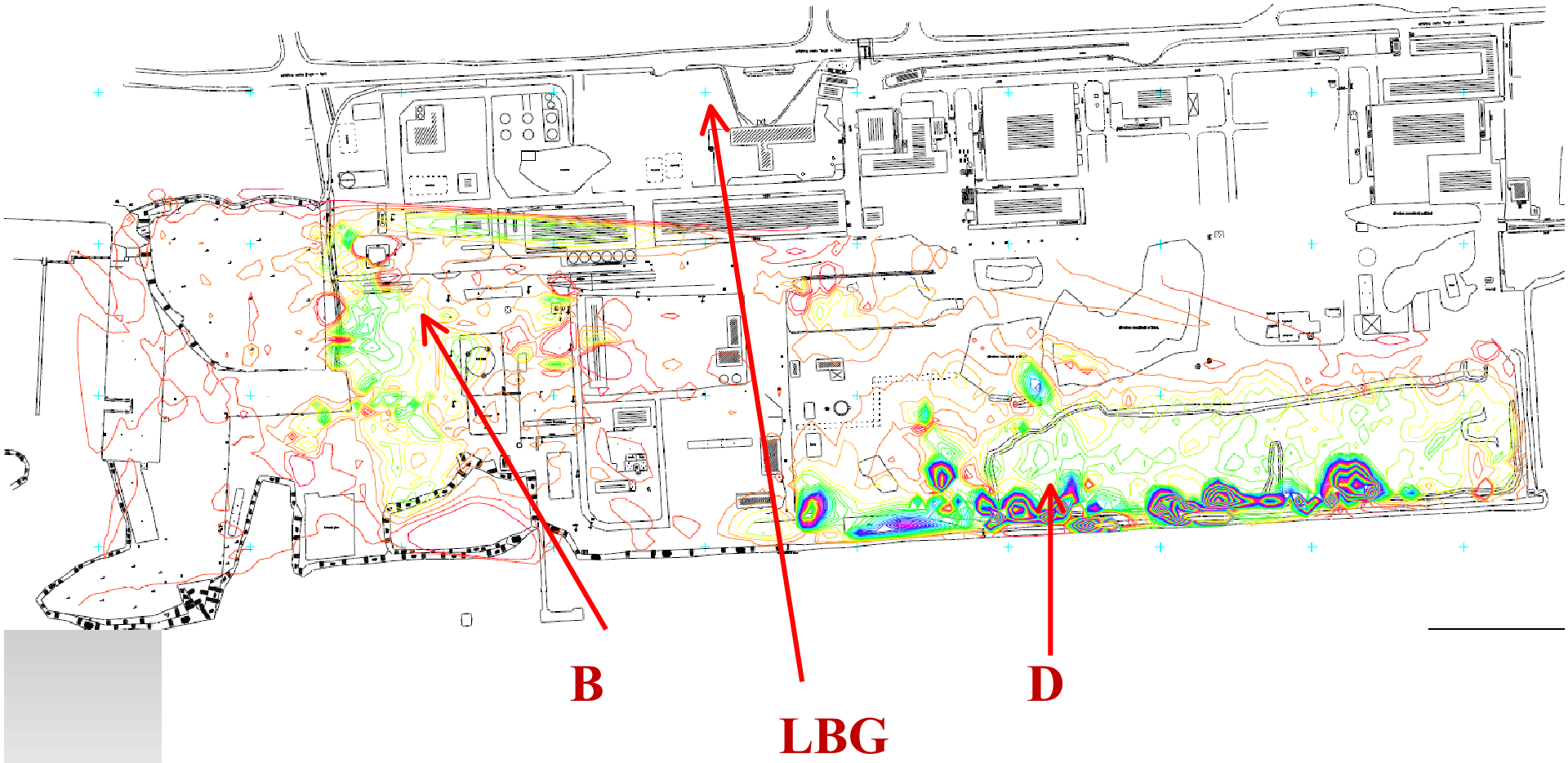
B
LBG
D

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$$A_{Ra}\ (\mathrm{Bq/kg}) = \frac{\text{Effective ambiental dose rate (nSv/h)}}{0{,}345\ \text{nSv/h po Bq/kg}}$$

$$Ra\ (eq) = A_{Ra} + 1.43 \cdot A_{Th} + 0.077 \cdot A_{K}$$

Ambiental dose rate at 1 m hight from soil level (nSv/h)	Activity concentration in soil (Bq/kg) , radionuclide ^{238}U	Activity concentration in soil (Bq/kg) , radionuclide ^{226}Ra
200	≈ 445	≈ 580
300	≈ 666	≈ 870
400	≈ 889	≈ 1159
500	≈ 1111	≈ 1449
639	**≈ 1420**	**≈ 1850**
800	≈ 1778	≈ 2318

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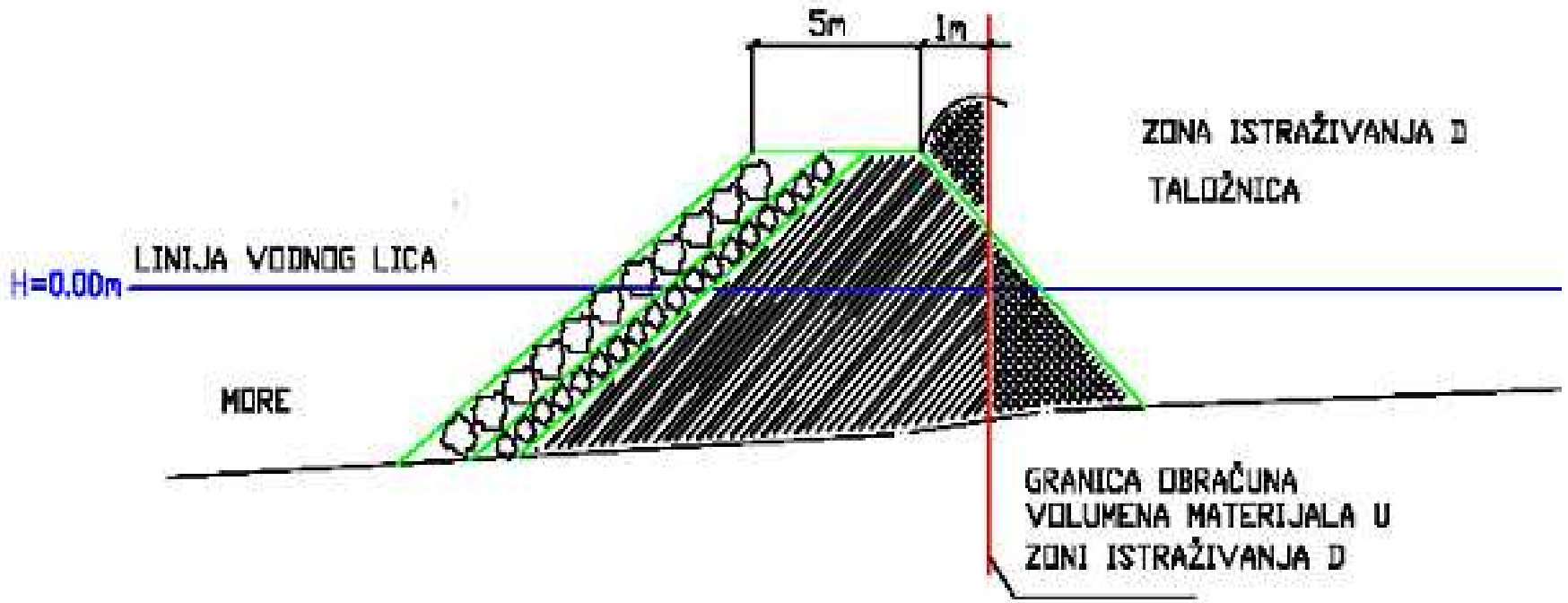
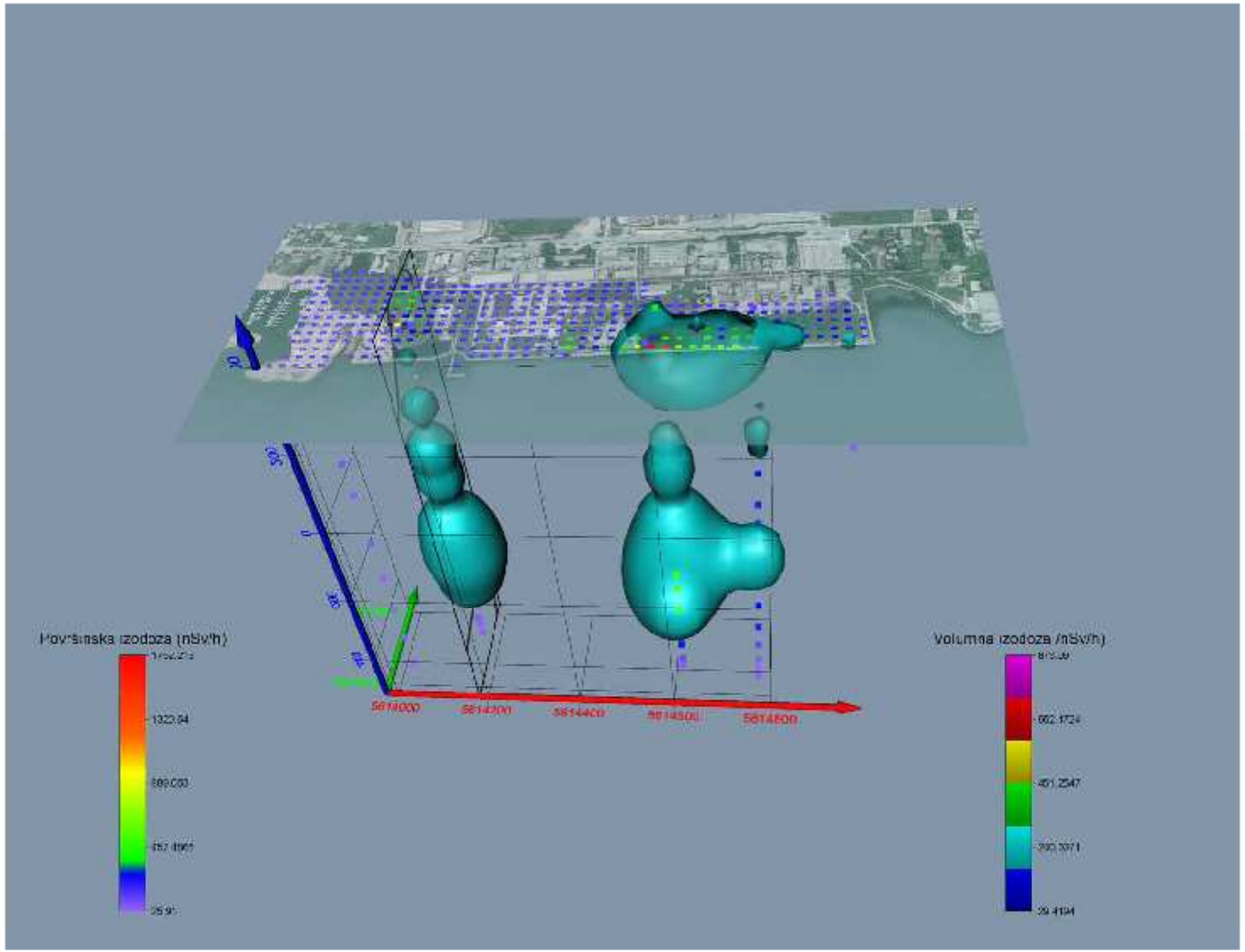
		Gauss-Krüger coordinates				Dose rate from integral		Dose rate-contributions U, Th, K i Cs to total dose rate			
location	mark	x	y	altitude	Research zone	nSv/h		nSv/h	Uranium series	Thorium series	K-40
Marina Kaštela	IG1	5613981,35	4823167,08	1,90	Bnm	**40,07**		37,498	15,109	18,184	4,108
Jugovinil	IG14	5614166,23	4823390,58	3,75	B	**550,694**		449,395	415,094	30,516	3,458
Jugovinil	IG15	5614225,37	4823397,13	3,53	B	**119,905**		91,334	53,827	32,313	4,443
Jugovinil	IG16	5614495,30	4823366,60	1,47	Cug	**291,361**		269,711	238,788	28,478	2,934
Jugovinil	IG18	5614931,20	4823325,79	3,48	D	**79,332**		47,434	26,804	16,001	4,569
Jugovinil	IG19	5614856,77	4823263,41	3,54	D	**557,131**		416,677	365,528	46,401	4,674
Jugovinil	IG20	5614793,33	4823271,66	4,01	D	**607,699**		475,226	409,251	60,606	5,911
Jugovinil	IG21	5614645,56	4823248,70	4,33	D	**535,031**		422,442	378,915	40,053	3,794
Jugovinil	IG24	5614619,07	4823218,68	3,95	D	**286,585**		291,792	265,026	23,920	2,578
Jugovinil	IG25	5614707,90	4823223,86	4,25	D	**278,646**		269,921	230,921	33,120	5,932
Kaštel Kambelovac	IG28	5612352,51	4823765,12	5,76	LBG	**68,479**		59,150	29,719	22,991	5,408


REPER-SJEVER/ZAPAD
REPER_JUGISTOK
490 Bq/kg 670 Bq/kg 1100 Bq/kg 1550 Bq/kg 2000 Bq/kg
PODRUČJA KOJA SADRŽE REPER I ŠLJAKU NA „OKACLI ISTRAŽNIH RADOVA BIVŠE TVORNICE „UGOVINI"
PRIKAZ TŽEFCVA" S POVIŠENO KONCENTRACIJOM PRIRODNIH RADIONUKLIDA
OKOLIŠNO KRIVU „MAX KONCENTRACIJE AKTIVNOSTI (Pe/kg)
- PRIKAZANO 'AG 100's DOPRINOS Ra-226
Radiološki istražni radovi u Kaštelima
na okolišu bivše tvornice "Ugovini"
u ničnoj okolici
FOND ZA ZAŠT TU OKOLIŠA I ENERGETSKU UČINKOVITOST", KRAVER 908, ZAGREB
1 : 1500
Slika .


5m
1m
ZONA ISTRAŽIVANJA D
TALOŽNICA
H=0.00m
LINIJA VODNOG LICA
MORE
GRANICA OBRAČUNA
VOLUMENA MATERIJALA U
ZONI ISTRAŽIVANJA D


Površinska izodoza (nSv/h)
1322.84
889.003
457.4965
25.99
Volumna izodoza (nSv/h)
662.1724
451.2547
240.3371
29.4194
5814000
5814200
5814400
5814600
5814800

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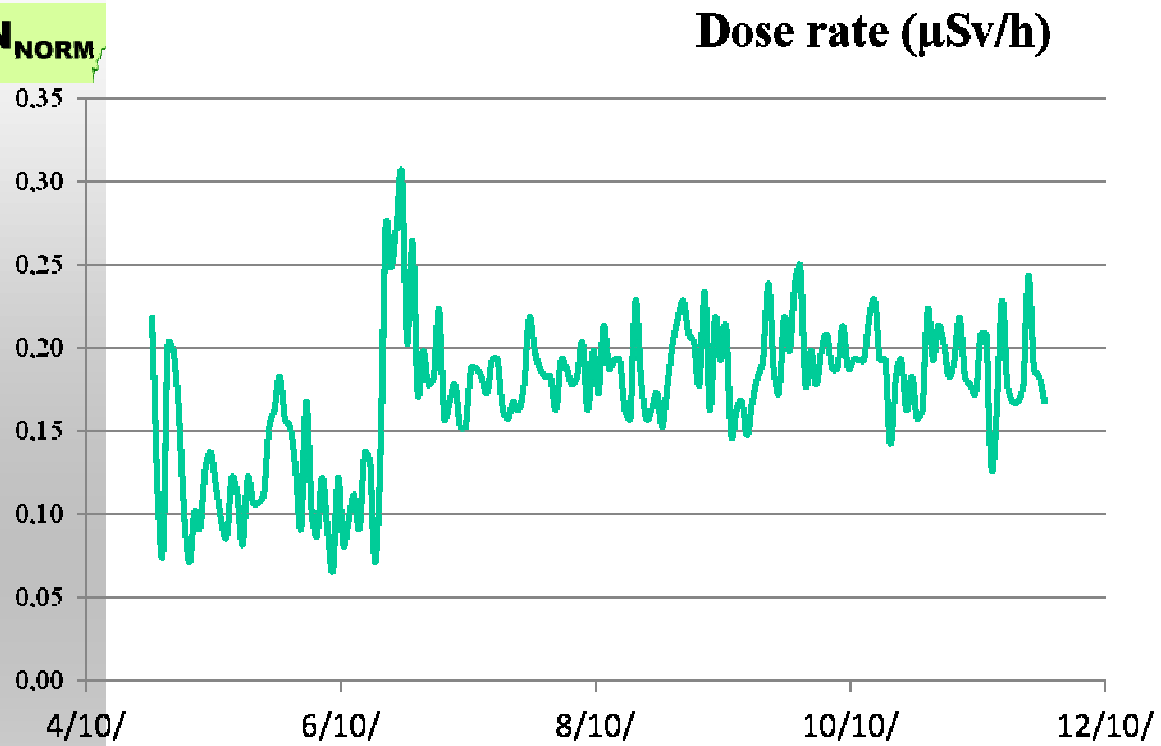
Summarized occupational dosimetric data for a case study

ID Code	name	(TLD) Hp(10) , µSv	duration
6181039	EK	806	7.7-12.10.
6181691	MK	1091	30.6.-12.10.
6181559	1-1	552	30.6.-7.10.
6181389	2-1	1132	2.7.-7.10.
6181190	3-1	1097	2.7.-7.10.
6181574	4-2	905	2.7.-7.10.
6181699	5-1	0	3. & 5. months
6181517	Ivica Prlić	**944**	**2.7.-29.9.**

_Dosimetric data for Project leader (IMI)



3 hours of occupational exposure in total during the while working on site

0,218274	µSv/h	Walking along D
0,116751	µSv/h	Walking along B
0,076142	µSv/h	LBG zone - walking
0,203046	µSv/h	again on D

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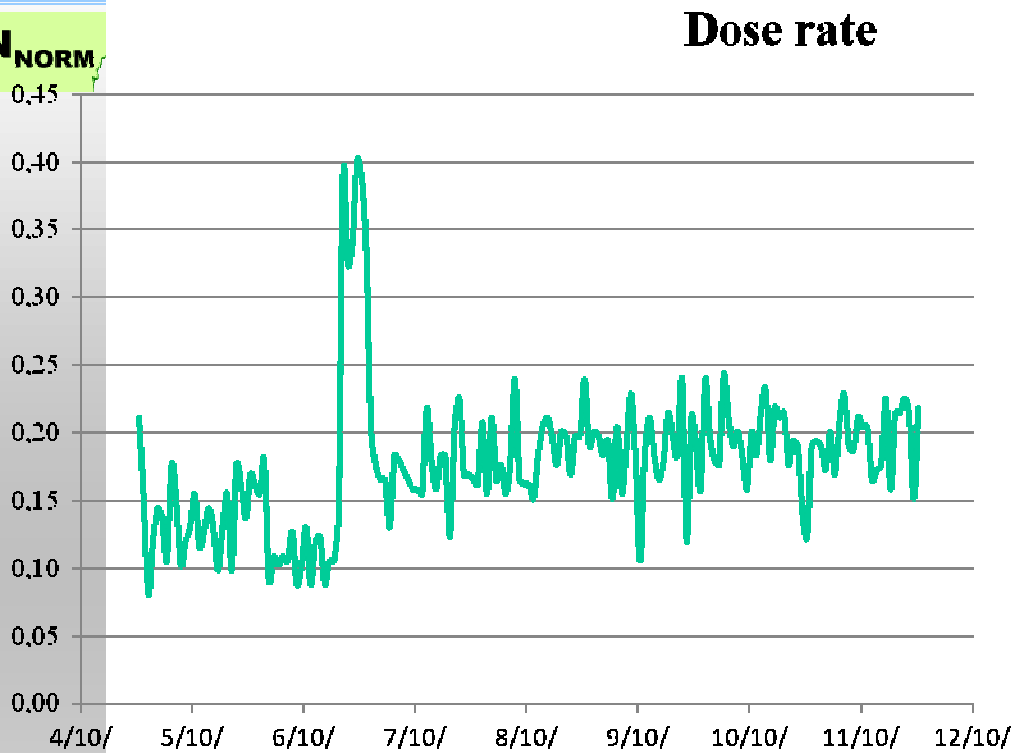
_Dosimetric data for supervisor



0,217439	µSv/h	Walking on D
0,155831	µSv/h	Walking on B
0,083351	µSv/h	LBG zone - walking
0,123215	µSv/h	again o n D

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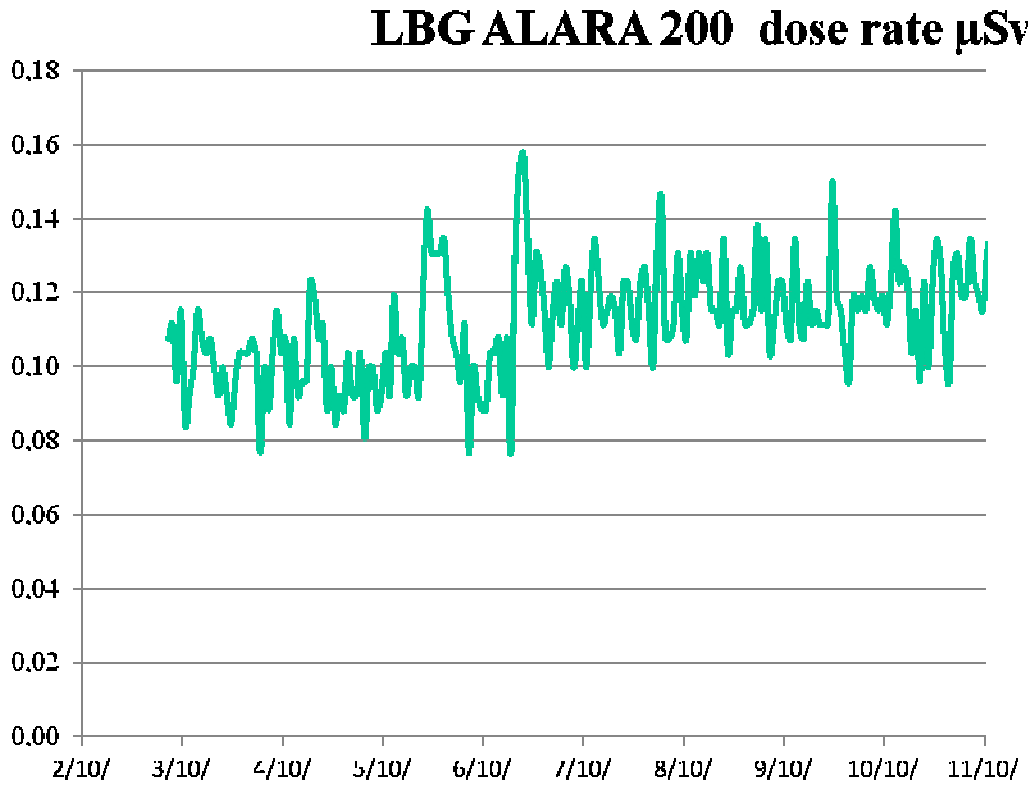

In total sampling 209 hours **0,112091** Dose rate in µSv/h

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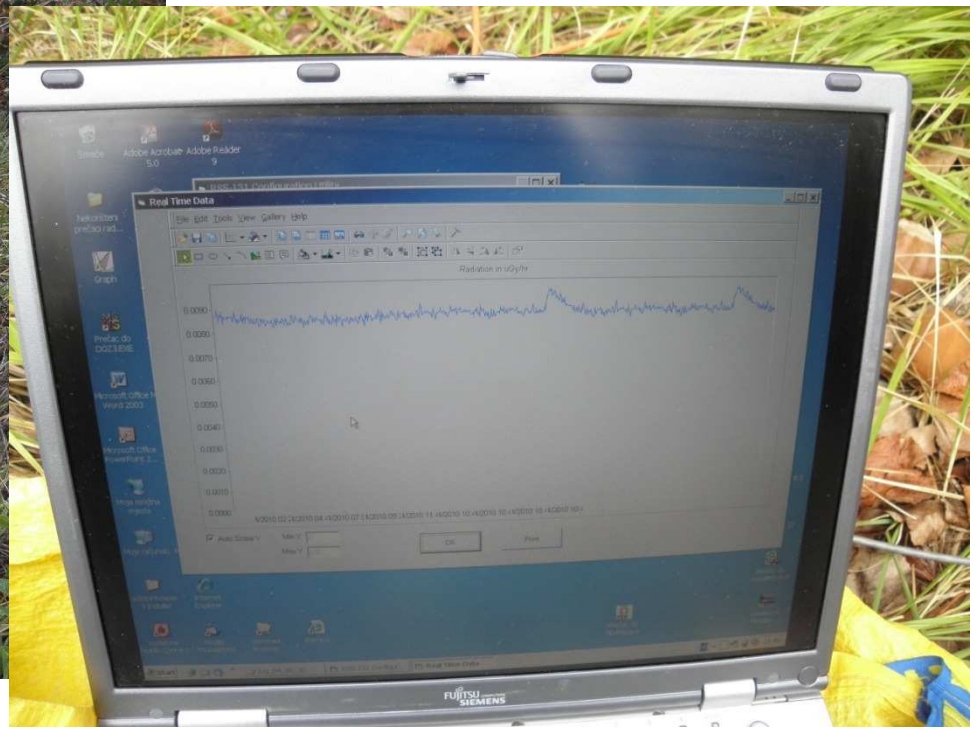

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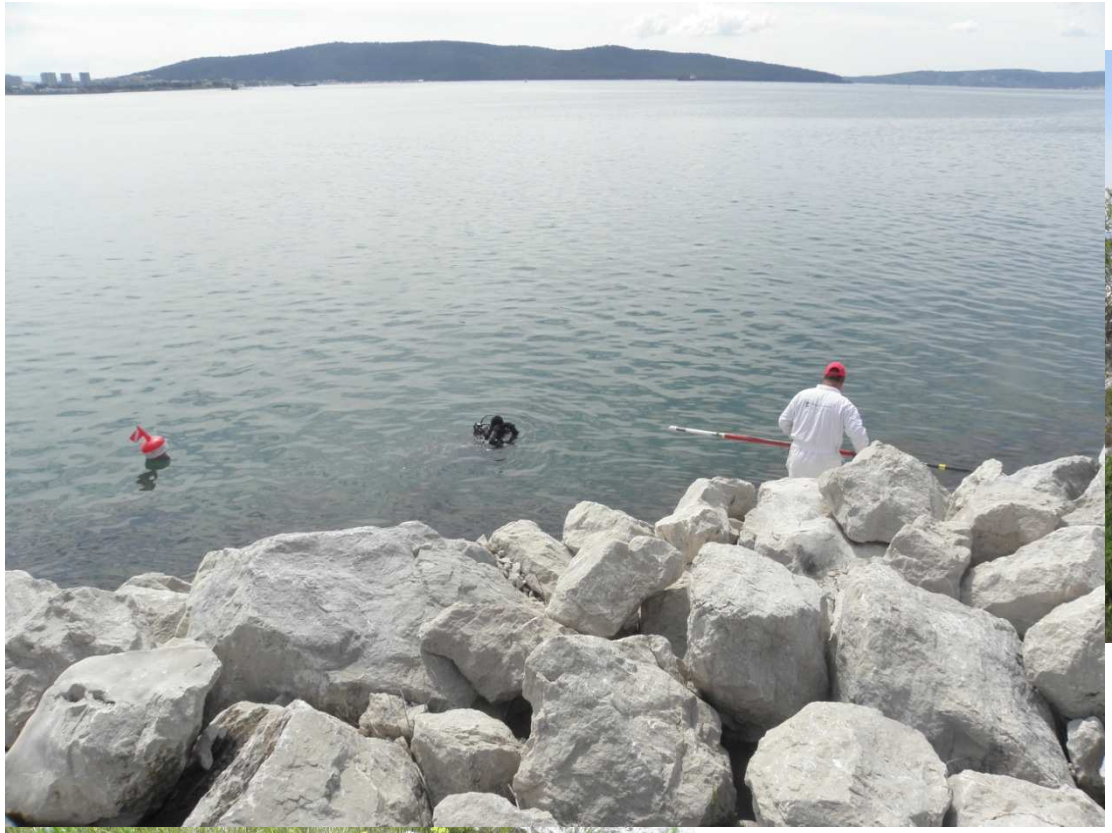

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beluga

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Greetings from CROATIA