Training within the framework of the project to improve the safety of mining facilities, including tailings, in Kazakhstan and Central Asia

(Kazakhstan) June 11-13, 2019

UNECE Convention on the Transboundary Effects of Industrial Accidents

Assistance Programme

The use of the checklist methodology to improve the safety of tailings for UNECE countries, including in Ukraine, Armenia and Georgia

Prof. D. Rudakov

National Technical University "Dnipro Polytechnic"

Dnipro, Ukraine

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Development of a methodology for improving the safety of tailings

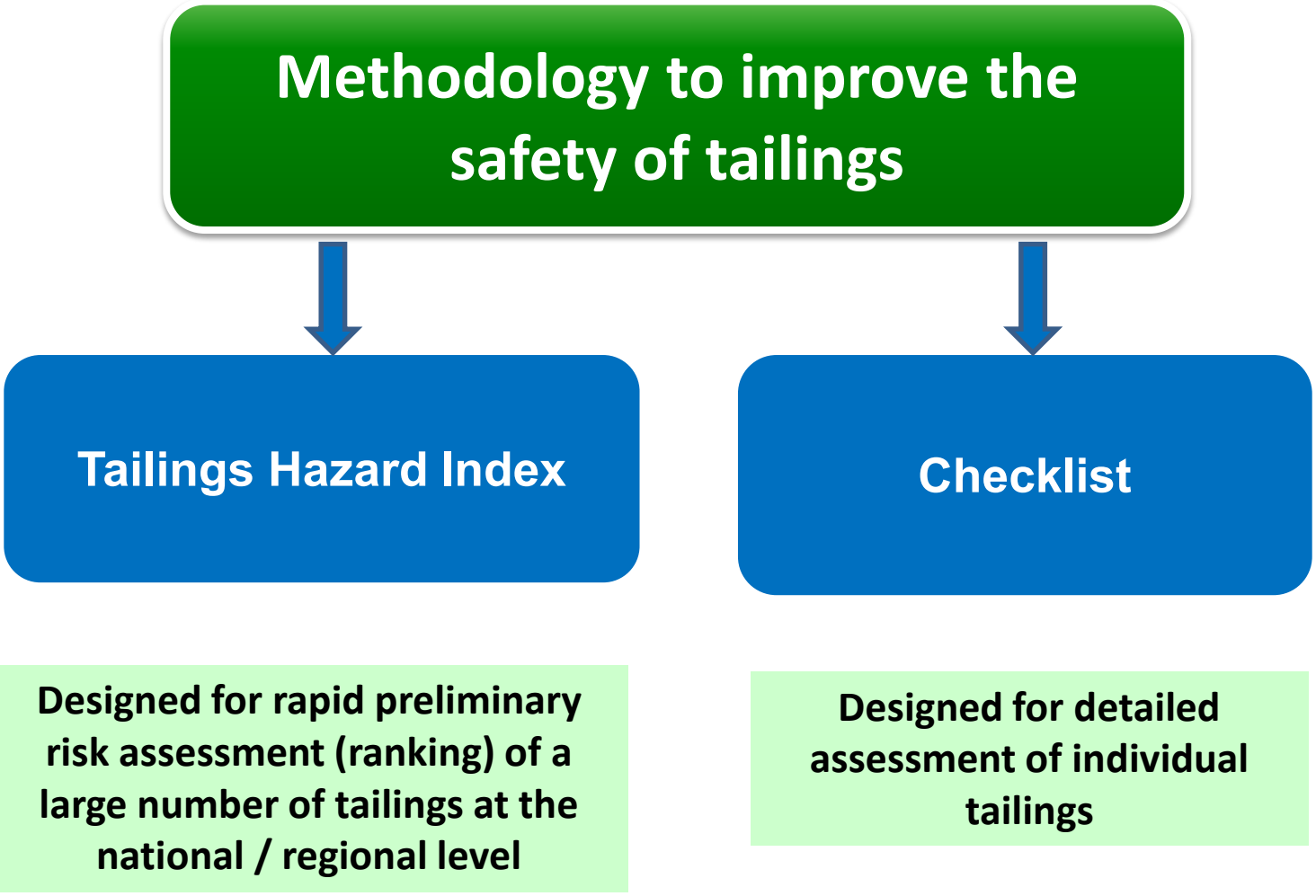
The methodology, including the tailings hazard index and a checklist, was developed by the Ukrainian team within

project of the Federal Agency of Germany on Environmental Protection "Improving the safety of industrial tailings on the example of Ukrainian objects" (2013-2015) with the participation of international experts

as a tool for the practical implementation of the UNECE Guidelines on Tailings Safety.

Projects to develop and implement a methodology for improving the safety of tailings

1. Improving the safety of industrial tailings on the example of Ukrainian facilities (UBA, 2013-2015).
2. Increase knowledge among students and teachers in tailing safety and its legislative review in Ukraine (UBA, 2016-2017).
3. Identification of emergency sites relating to tailings in the countries of the Danube River Basin (ICPDR, 2018-2019).
4. Assistance in improving the safety of tailings in Armenia and Georgia (UBA, 2017-2019).
5. Improving the safety of mining facilities, including tailings, in Kazakhstan and Central Asia (UNECE, 2018-2019).
6. Development of potential for improving the safety conditions of tailings in the Danube River Basin (UBA, 2019-2020).


Methodology to improve the safety of tailings
Tailings Hazard Index
Checklist
Designed for rapid preliminary risk assessment (ranking) of a large number of tailings at the national / regional level
Designed for detailed assessment of individual tailings

Conducting training on testing methodology for improving the safety of tailings

1. Improving the safety of industrial tailings on the example of Ukrainian facilities (UBA, 2013-2015).

2. Increase knowledge among students and teachers in tailing safety and its legislative review in Ukraine (UBA, 2016-2017).

3. Assistance in improving the safety of tailings in Armenia and Georgia (UBA, 2017-2019).

Application of the Checklist in Ukraine. 1. Tailing dump in Kalush

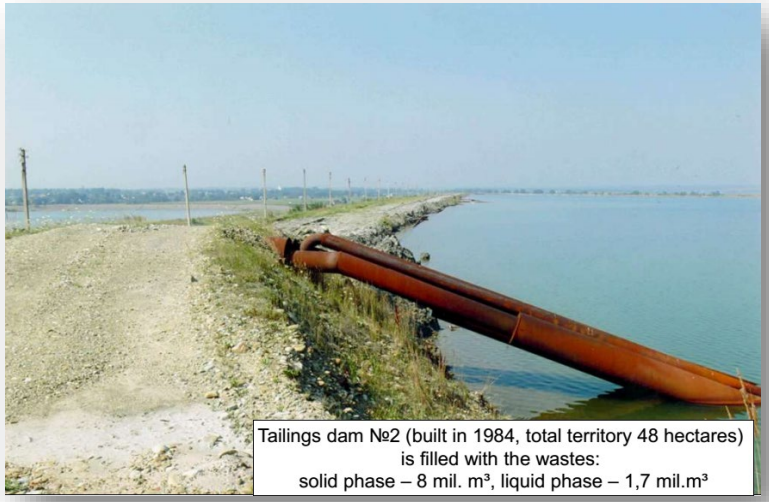
Evaluation in the framework of the first UBA project in Ukraine, 2014

Location: Ivano-Frankivsk region,
0.85 km from Kalush
Title: Tailing pond №2 GP “Potash Plant” LLC “Oriana”
Built in 1984
Materials: Potash Waste

Waste volume.
Solid phase 9 x106 m3
Liquid phase 1.7 × 106m3

Environmental hazard
Groundwater
The rivers in the basin of the river. Dniester

Application of the Checklist in Ukraine. 1. Tailing dump in Kalush



Tailing house No 2 in 2010

Tailing house No 2 in 2014

Saltwater seepage through dam

Application of the Checklist in Ukraine. 1. Tailing dump in Kalush

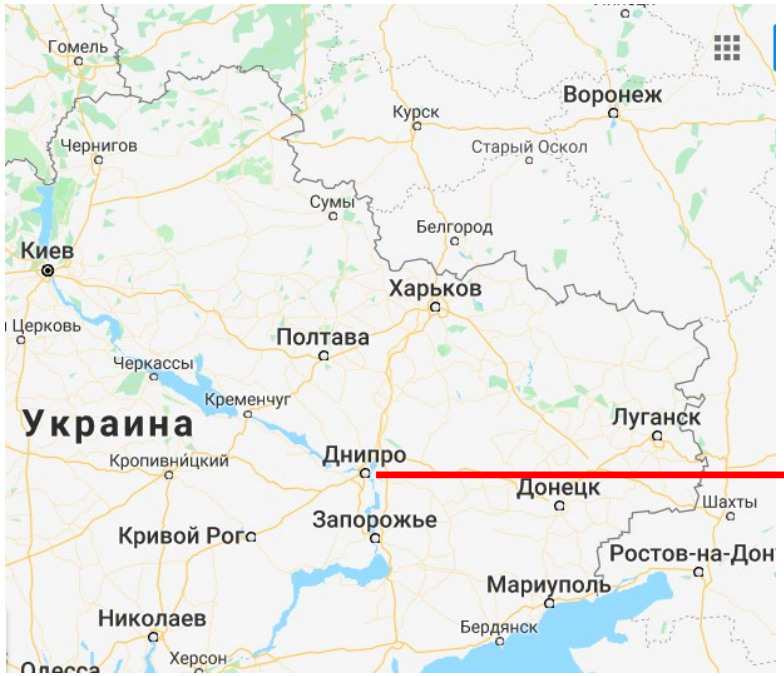
Overall rating

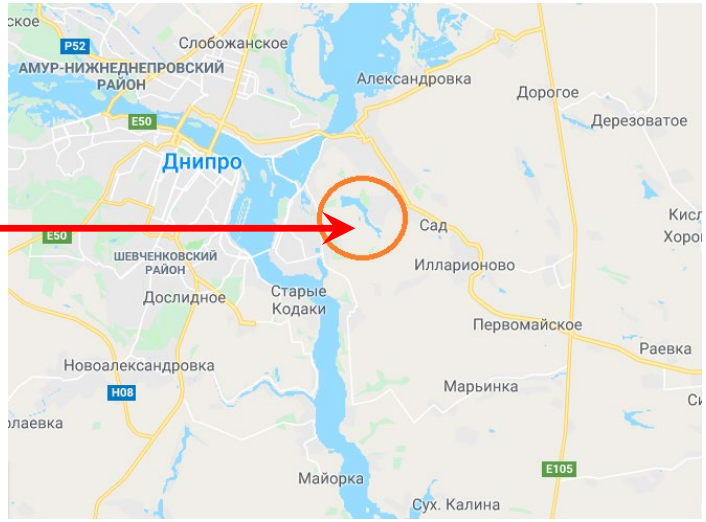
Veracity,	**58.2%**
Security Compliance	**51.7%**

Categorical assessment

Application of the Checklist in Ukraine. 2. Tailing dump in Dnepr

Evaluation in the framework of the UBA project “Increasing the level of knowledge among students and teachers on the safety of tailing storages and its legislative review in Ukraine” (2016-2017)





Title: Ash and Pit Drainage Prydniprovska TPP PJSC "DTEK Dniproenergo"
Waste volume: 15.75 million tons
Composition: sludge, coal burning waste
Built 1970

Application of the Checklist in Ukraine. 2. Tailing dump in Dnepr

Assessment participants: 4 groups of environmental students under the guidance of teachers from 4 universities, as well as the developers of the Checklist.

The assessment was conducted during two trainings (October and November 2016) with the participation of international and national experts..

Application of the Checklist in Ukraine. 2. Tailing dump in Dnepr

Overall rating

Veracity,	85.5%
Security Compliance	74.1%

Categorical assessment

Application of the Checklist in Ukraine. Legislative consolidation

- **A roadmap has been developed to implement Directive 2006/21 / EC through the UNECE Guidelines for the Safety of Tailing Pits within the framework of national legislation.**
- **At the Round Table with representatives of the competent authorities, the Methodology and interactive map of tailings sites were presented as a practical tool for the implementation of Directive 2006/21 / EC.**
- **The Ukrainian version of the methodology for tailing dumps is adapted for inspection bodies.**

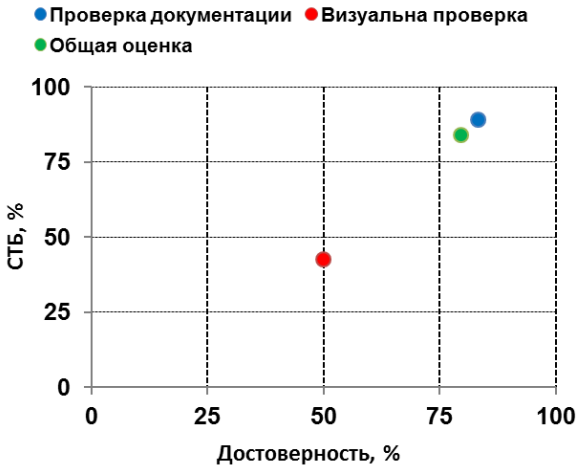
Training on the safety of tailings in Armenia. Location, participants.

Tailing dump "Nakhatak" Akhtala Mining Plant

Training in Tsakhkadzor
03-06.09.2018 included
Theoretical studies
Visit the tailings
Safety assessment and justification of measures.

Participants - representatives of the competent authorities of Armenia, Georgia, Kazakhstan, Kyrgyzstan, international experts, in total from 13 countries

Training on the safety of tailings in Armenia. Evaluation results



Overall assessment of one of the groups of participants

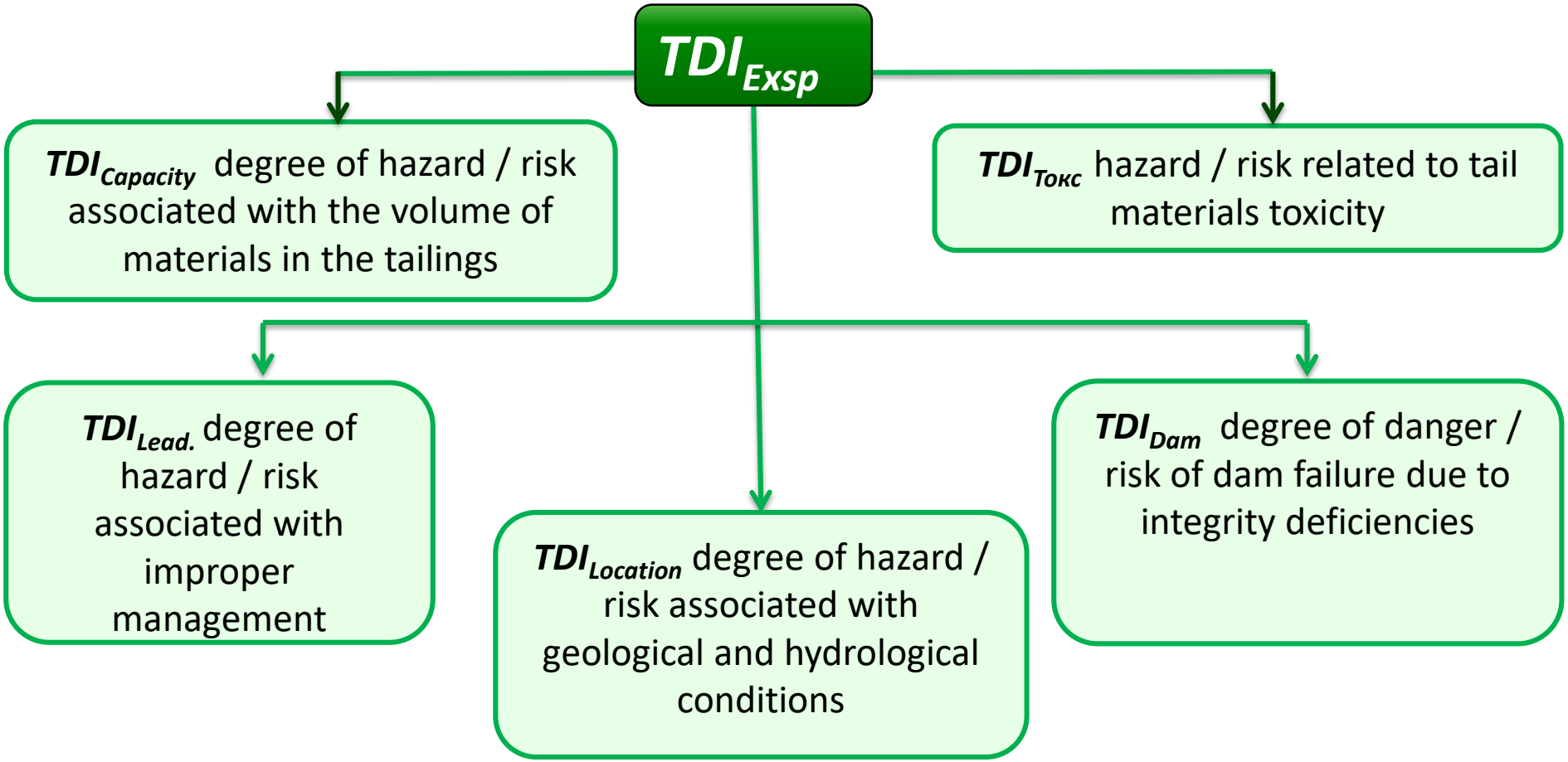
	Security Compliance, %	Veracity, %
Visual check	51.7	57.9
Documentation check	89.1	83.3
Overall rating	83.6	78.6

Inventory and mapping of tailings

- Ukraine (2014-2017, 344 tailings).
- Armenia (2017-2019, 23 tailings).
- Georgia (2017-2019, 5 tailing dumps).
- Kyrgyzstan (2018-2019, 92 tailing dumps).
- Kazakhstan (2018-2019, 121 tailing).
- Danube basin countries (2018-2019, 309 tailings).

Tailings Danger Index (TDI)

$$TDI_{Exsp.} = TDI_{Capacity} + TDI_{Tox.} + TDI_{Exc.} + TDI_{Location} + TDI_{Dam}$$



Hazard Assessment of Tail Materials

$$TDI_{Capacity} = Log_{10}[V_t]$$

where V_t –volume of tail materials, м^3.

Examples.

For a large tailing dump with Vt = 10 million m³

$TDI_{Capacity} = 7$

For a small tailing dump with Vt = 0.01 million m³

$TDI_{Capacity} = 4$

Toxic Hazard Assessment

Minimum danger

Maximum danger

Classification		Value
(WGK)[1]	KO[2]	TDI_{Tox}
0	4	0
1	3	1
2	2	2
3	1	3

[1] WGK = Water hazard class; WGK = Wassergefährdungsklasse, classification of the German Federal Agency for Environmental Protection.

[2] KO = Hazard Class, classification according to SAUS 12.1.007-76 ССБТ

Assessment of hazard associated with tailing management

Data to determine $TDI_{Management}$	Size $TDI_{Management}$
Closed or reclaimed tailings	**0**
Active or abandoned tailing dump	**1**

Assessment of geological hazards. Seismicity

$$TDI_{Location} = TDI_{Seis} + TDI_{Flood}$$

Data to determine TDI_{Seis} Relative peak acceleration of soil aG with a repeatability period T_{ret}	Value TDI_{Seis}
≤0.1	0
>0.1	1

Data can be identified by a global seismic hazard map. http://gmo.gfz-potsdam.de/pub/download_data/download_data_frame.html

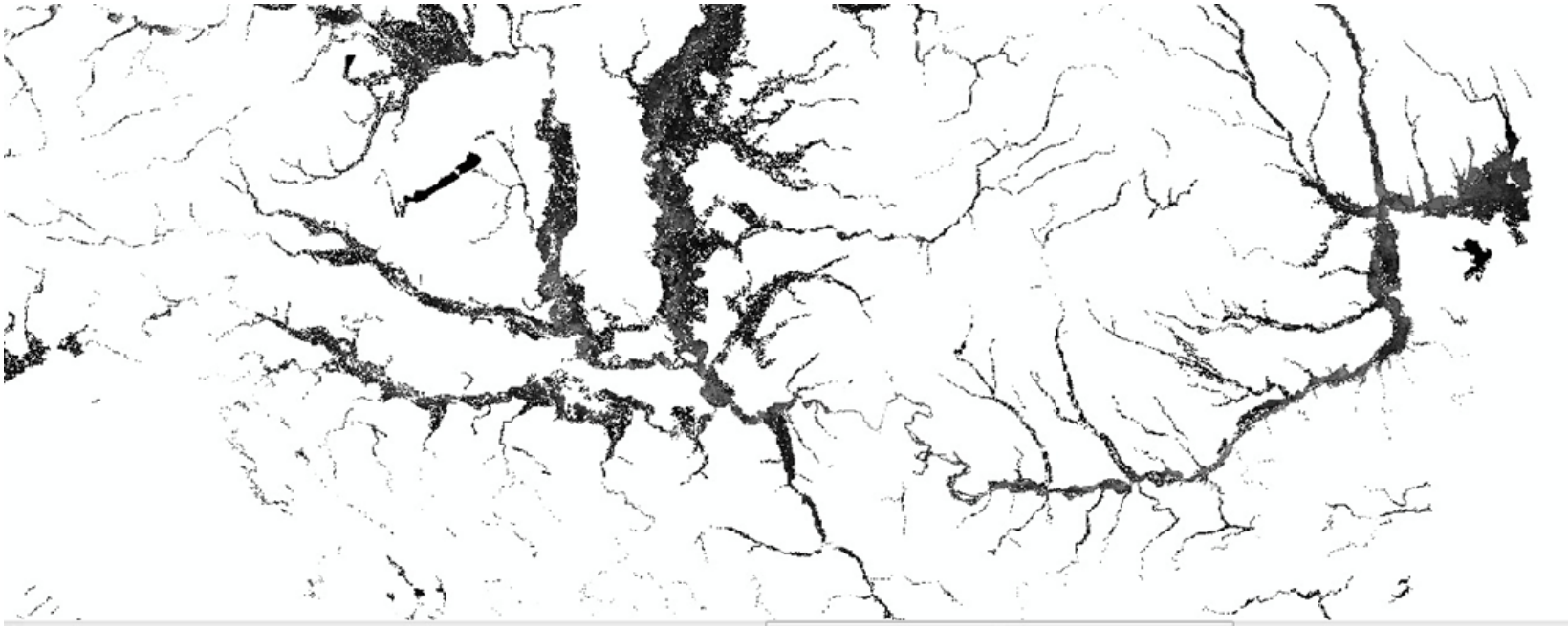
Flood hazard assessment

TDI_{Flood} determined by the parameter HQ_{500}, which quantifies the frequency of flooding with a recurrence period of 500 years (flooding with a probability of 1: 500).

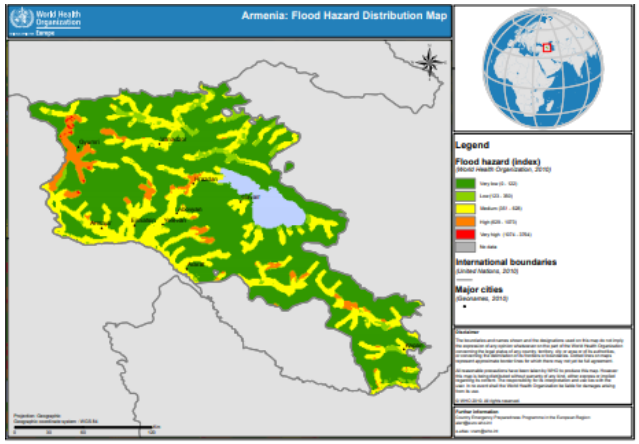
Data to determine TDI_{Flood}	Value TDI_{Flood}
Tailings location	
In the zone HQ_{500}	**1**
Out of zone HQ_{500}	**0**

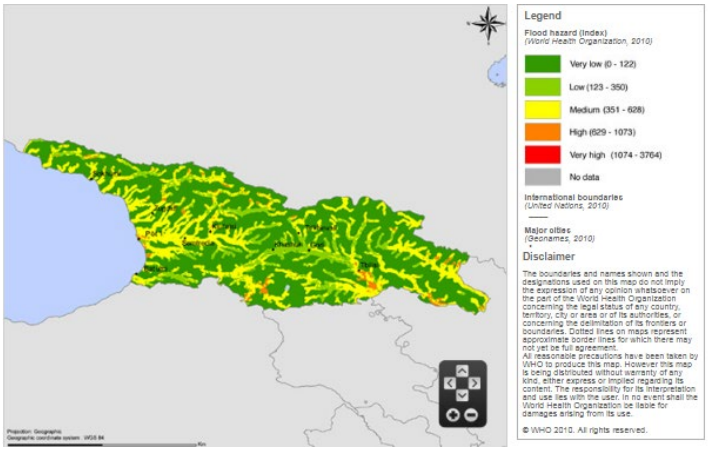
Flood hazard assessment. Map example

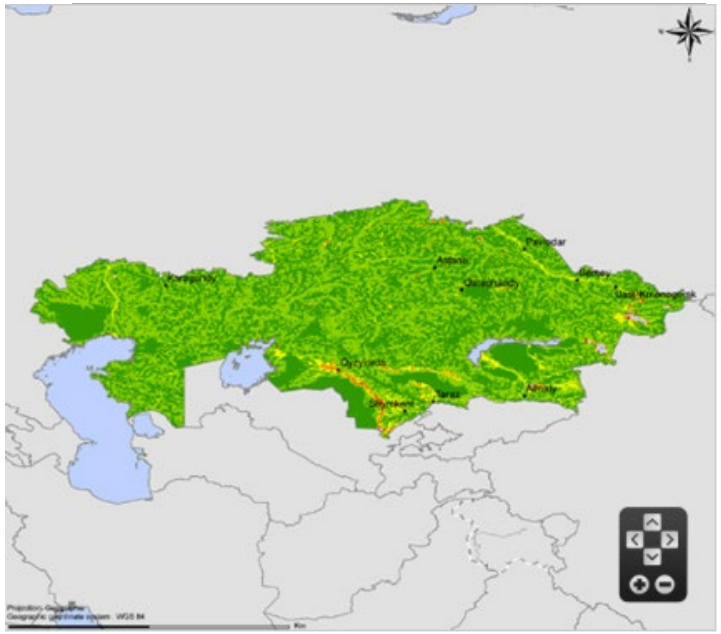
Fragment of a map of zones with a probability of flooding of 1: 500 in Europe in the basin of the r. Danube.
https://data.europa.eu/euodp/en/data/dataset/jrc-floods-floodmapeu_rp500y-tif

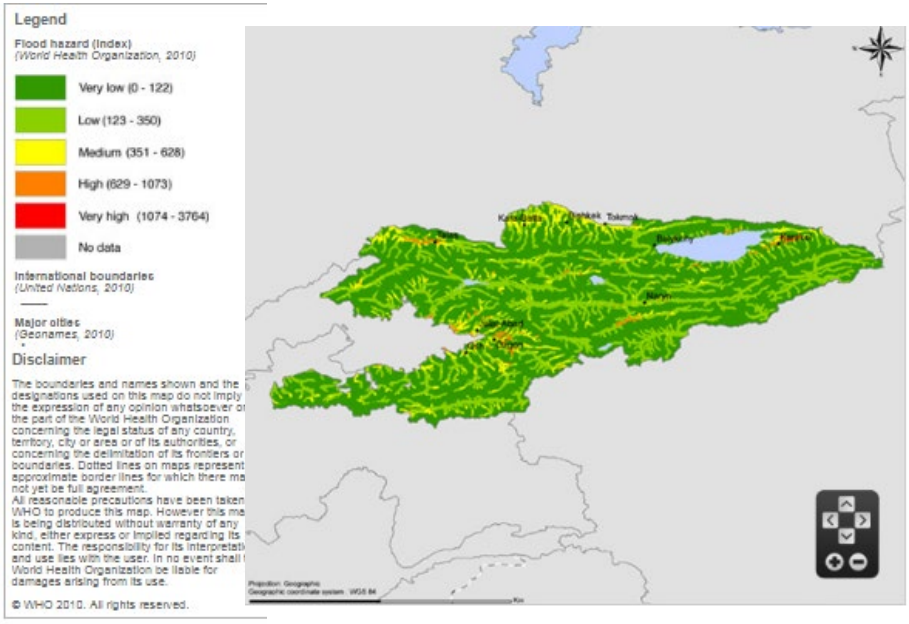


World Health Organization Atlas flood hazard maps









Estimation of the risk of dam failure

Recommended Calculation Method

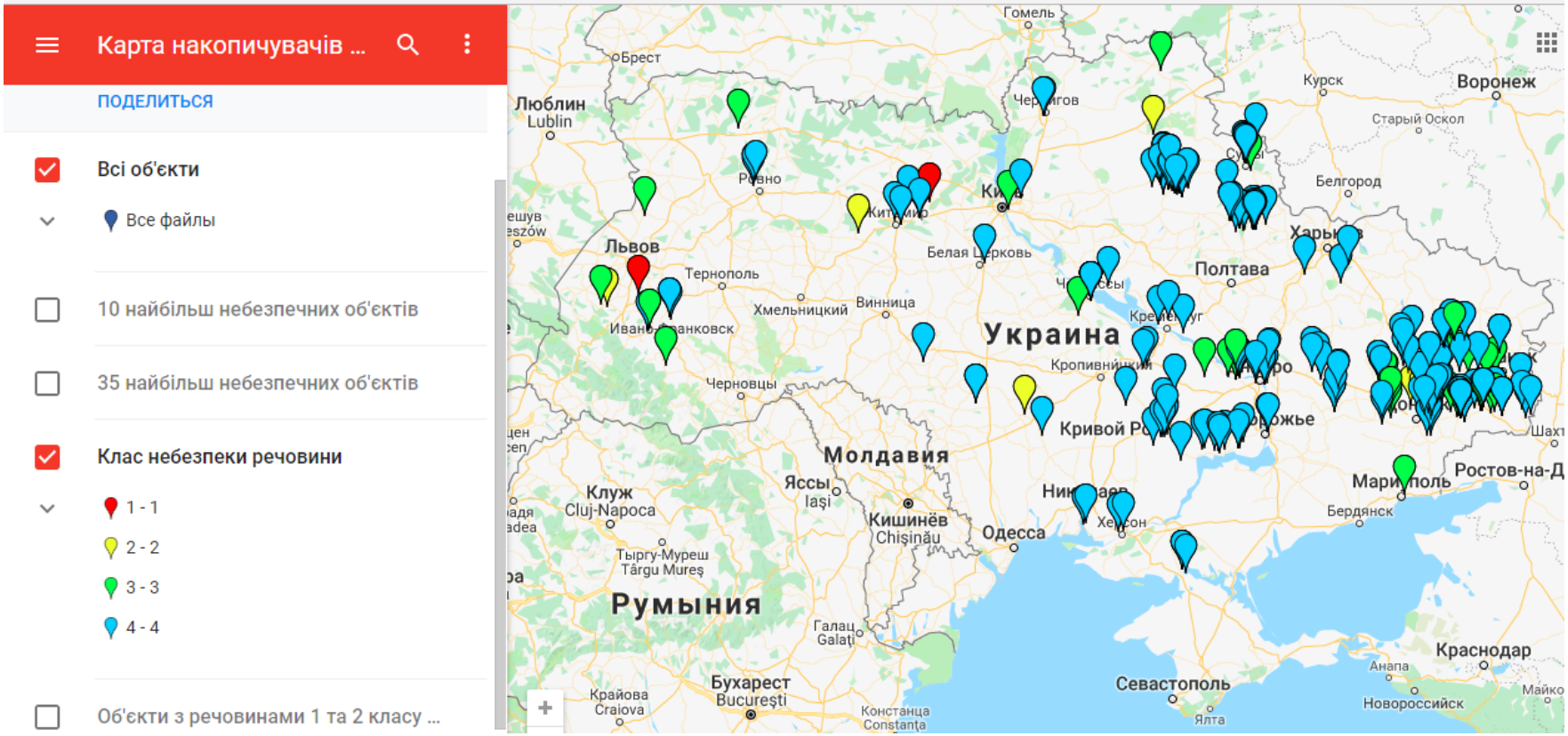
$$TDI_{Dam} = TDI_{Ky} + TDI_{Acs}$$

Range of slope stability factor K_y	Value TDI_{Ky}
$K_y > 1,35$	0
$K_y < 1,35$ or unknown	1

The life of the tailings	Value TDI_{Acs}
≤ 30 years	0
> 30 years	1

Application of the tailings hazard index in Ukraine

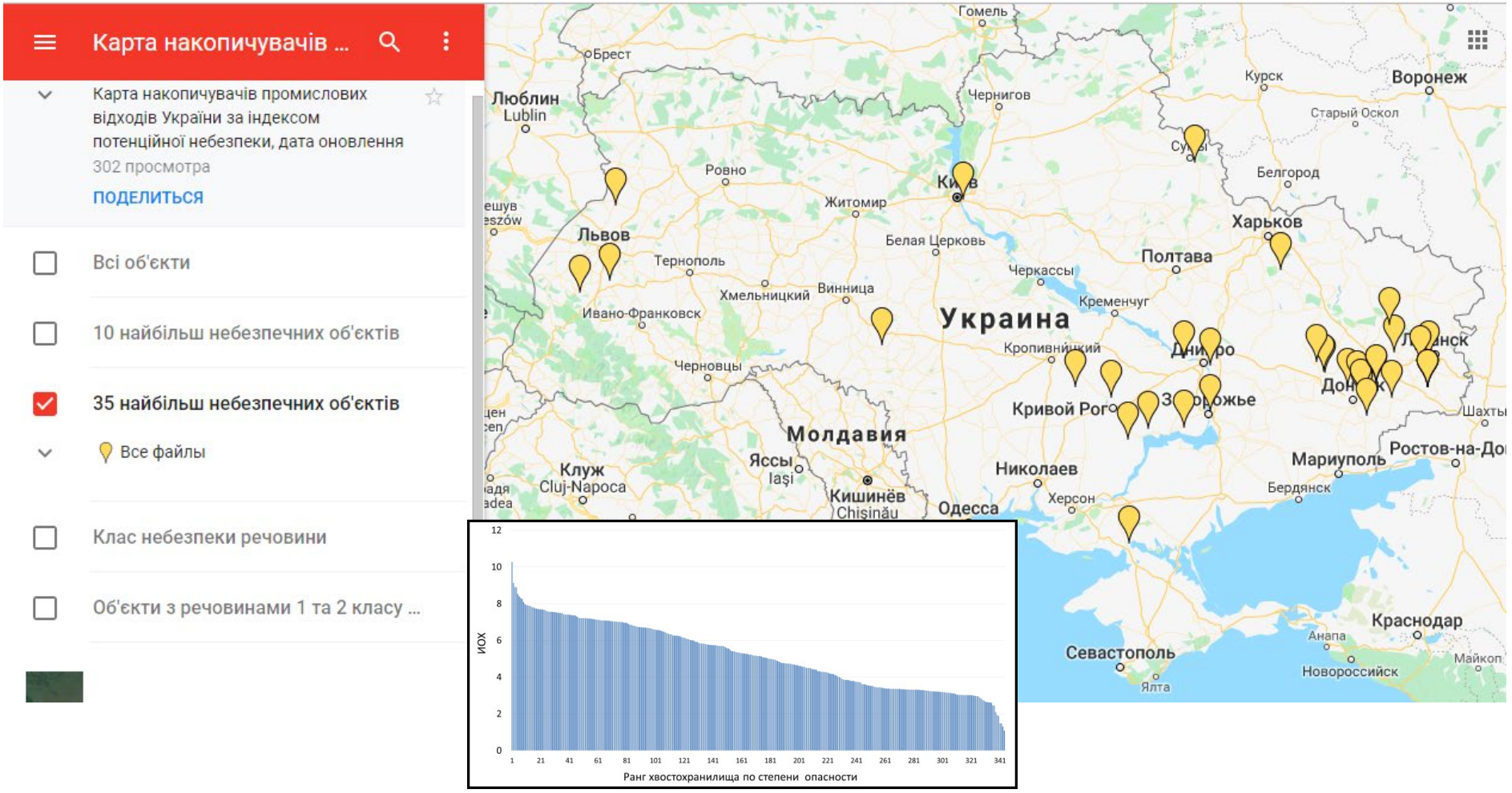
Map 344 of tailings, ranked by TDI, based on the volume of tailings and their toxicity, was built as part of the UBA project “Increasing the level of knowledge among students and teachers in tailing safety and its legislative review in Ukraine” (2016-2017)



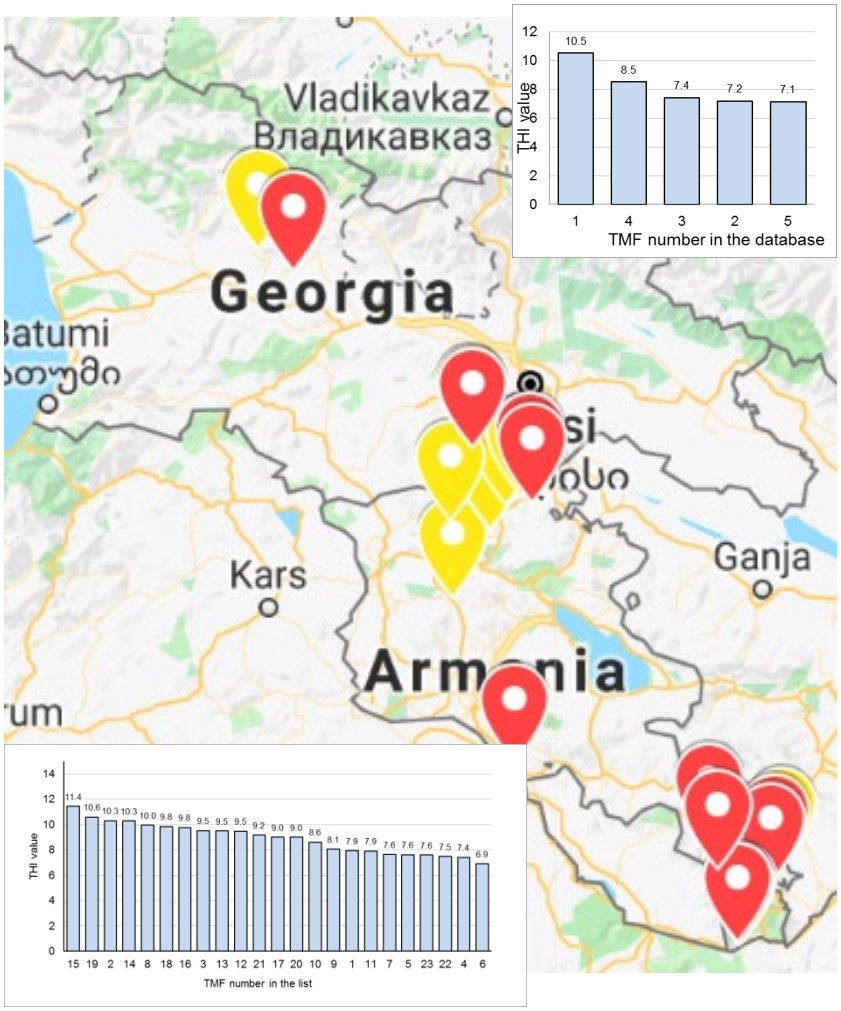
https://www.google.com/maps/d/viewer?amp%3Busp=sharing&mid=1RFomCn9uKponcHnFrK3XG997AEU&ll=48.749729913541%2C30.6949414062499 95&z=6

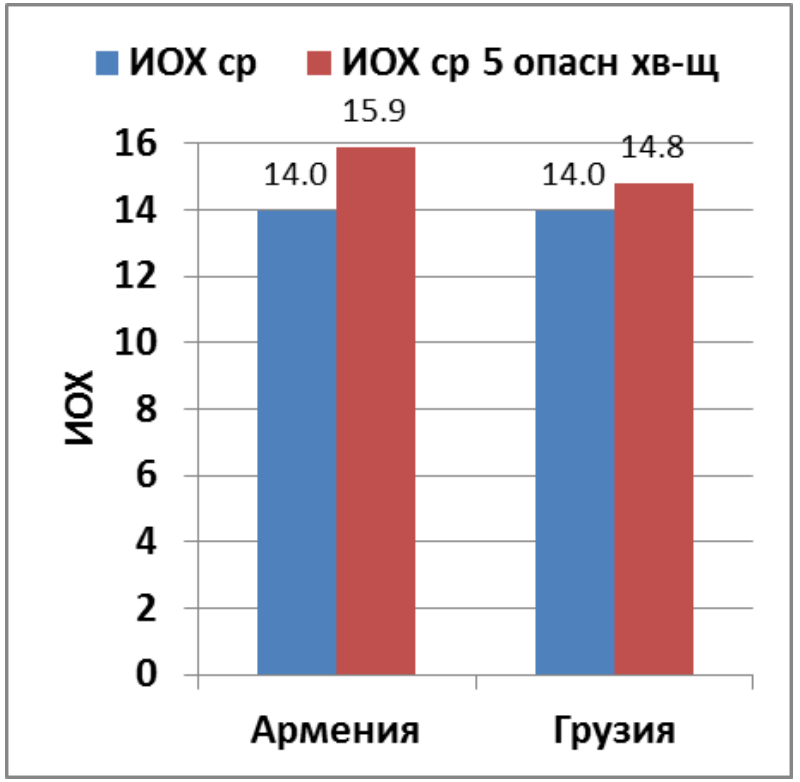
Application of the tailings hazard index in Ukraine

35 most dangerous tailings (10% of the total)



Inventory and mapping of tailings in Armenia and Georgia (in progress)





23 tailing dumps in Armenia, 5 tailing dumps in Georgia

Findings

- As part of the methodology for improving the safety of tailings, a method of ranking them according to the degree of danger has been developed, which makes it possible to give a preliminary assessment of a large number of objects.
- Within the framework of the projects of the Federal Office of Germany for Environmental Protection in Ukraine, a database of tailing dumps (344 objects) has been created, a checklist has been tested, and the methodology has been introduced at the legislative level.
- Within the framework of the project, the departments in Armenia and Georgia are completing inventory and mapping of tailings. The training was conducted on the application of the methodology; it is being consolidated at the legislative level.

Thank you for attention!