UNECE Safety Guidelines and Good Practices for Tailings Management Facilities (TMFs) and a related TMF checklist methodology

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17 June 2019

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What risks do TMFs pose?

- Failures can release a tsunami-like wave of mine waste capable of killing and destroying everything in its path
- Damage or risk to human health, infrastructure and environmental resources and neighbouring countries
- Accidental water pollution and environmental degradation of transboundary watercourses / international lakes
- Significant costs for emergency response, clean-up, repairs, disruption of economic activity, claims for damages, and legal costs for governments and businesses
- Negative consequences for the social acceptance of mining

Past TMF accidents (overview)

- Brazil: Brumandinho (2019)
- Kazakhstan: Ridder (2016) → Transboundary effects
- Brazil: Bento Rodrigues (2015)
- Canada: Mount Polley (2014)
- Armenia: Kajaran (2013)
- Finland: Sotkamo (2012)
- Ukraine: Nikolaiev (2012/2011), Kalush (2005)
- Hungary: Kolontár (2010)
- Russia: Karamken (2009)
- Romania: Baia Mare (2000) → Transboundary effects

Brazil: Brumadinho, Minas Gerais (2019)

- Brumadinho dam failed at an iron ore mine in the South East of Brazil
- 186 deaths, at least 122 still missing

Source: https://www.youtube.com/watch?time_continue=8&v=lCoTcIMQ27k

Kazakhstan: Ridder (2016)

- Pollution from a zinc mine waste dump in Ridder, Kazakhstan spilled into the Ulba and Filippovka Rivers, flowing into Siberia → Transboundary water pollution

Source: https://siberiantimes.com/ecology/others/news/n0671-stinking-poisoned-water-flows-towards-siberia-from-mining-city-ridder-in-kazakhstan/

Canada: Mount Polley (2014)

24 million m^3 of mining waste released into nearby lakes and rivers

https://en.wikipedia.org/wiki/Mount_Polley_mine_disaster#/media/File:Mount_Polley_Mine_dam_breach_2014.jpg

Ukraine: Nikolaiev (2012/2011), Kalush (2005)

- Nikolaiev 2011: Nikolaiev Alumina plant tailings got dried and the wastes were released in the form of dry red dust
- Nikolaiev 2012: Red dust, melted ice and spring rains flushed all this multi-ton mass of red mud into the water of Bug river
- Kalush 2005: Several hundred kilograms of calcium hypochlorite were released into the Sivka River, causing massive fish death

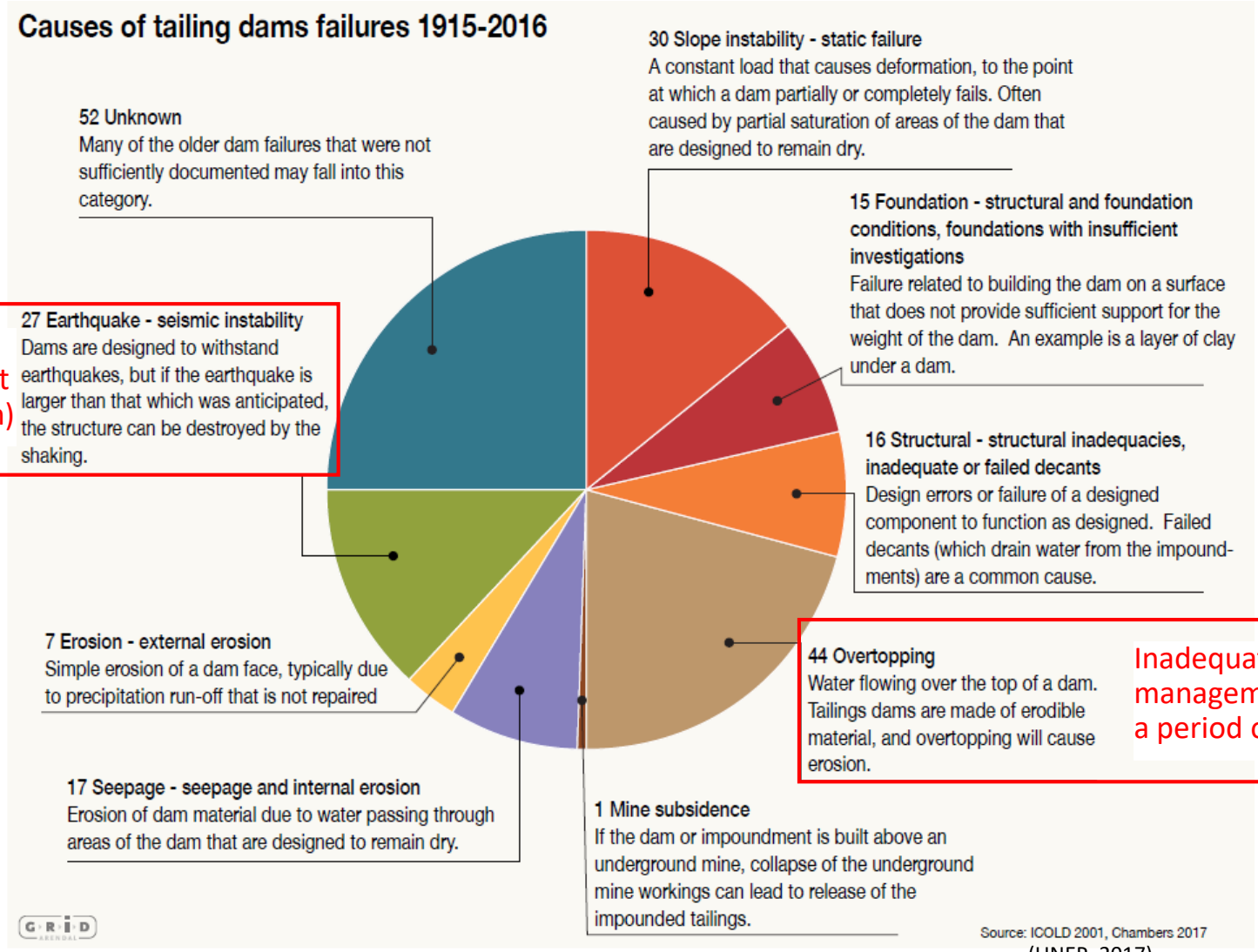
Source: www.umweltbundesamt.de/sites/default/files/medien/378/publikationen/doku_01_2016_annex_1_improving_the_safety_of_industrial_tailings_management_facilities.pdf

Romania: Baia Mare (2000)

- “The second Chernobyl”
- 100,000 m^3 of cyanide contaminated water released into the Someş River
- Affected countries: Romania, Hungary, Republic of North Macedonia → Transboundary effects
- Death of fish and wildlife, over 100 people hospitalized

Source: UNEP, 2017

Main causes of TMFs failures (1 / 2)



TMF design (management consideration)

Inadequate management over a period of time

(UNEP, 2017)

Main causes of TMFs failures (2 / 2)

- **Lack of management continuity** and **inadequate resourcing (especially financial)** for the facility (UNEP Report, 2017)
- **Poor management** combined with **inadequate commitment to safety** was the cause of most failures (ICOLD, 2001)
- **All failures were avoidable** (ICOLD, 2001)
- Climate change and extreme weather events: 25% of global and **35% of European TMF failures due to heavy rain (NATECH accidents)**

Mining industry needs to put safety first **=> zero-failure objective**

TMF failures can be prevented => life-cycle approach

UNECE Safety Guidelines for Tailings Management Facilities (TMFs)

- Intended to **limit the number of TMF accidents and the severity of their consequences** for human health and the environment
- Contain safety principles and recommendations for governments, authorities and TMF operators
- Cover technical and organizational aspects in relation to:
  - Pre-construction and construction
  - Operation and management
  - Facility inspections
  - Identification, assessment and management of abandoned sites
  - Emergency planning

Key Recommendations for Competent Authorities

Competent authorities should…

- **Notify neighbouring countries**' authorities about TMFs that could cause transboundary effects
- Develop a **permitting/licensing system** for construction of TMFs
- **Verify, endorse, and supervise** TMF monitoring by operators
- **Develop external emergency plans** in the event of a TMF failure
- **Review internal and external emergency plans** with operators
- **Apply methodologies for risk identification** and assessment of closed, abandoned, or orphaned TMFs and **develop risk reduction measure**s
- **Ensure meaningful public participation and access to information**

Key Recommendations for Operators

TMF operators should…

- **Publish an operations and management plan** for all relevant stakeholders
- **Develop and implement internal emergency plans** and apply them
- **Notify competent authorities** of emergencies on site
- **Cooperate with competent authorities and local communities** in developing external emergency plans
- **Train personnel** in updated safety procedures, especially with regard to how to identify potentially harmful circumstances
- **Perform regular safety audits** based on international standards

TMFs Methodology

To support countries in the practical application of the guidelines, a related methodology was developed

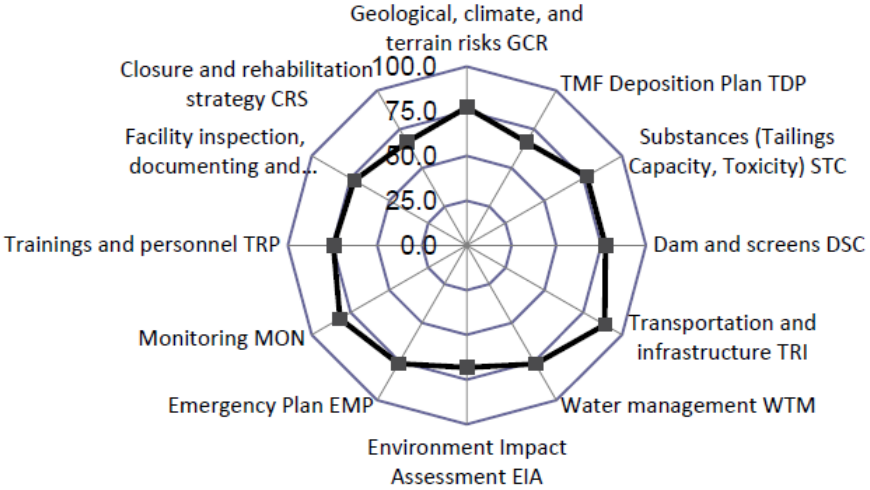
1. Tailings Hazard Index (THI)

- Ranking TMFs according to their hazard
- Basic data needed to determine it (volume, toxicity…)
- Provides overview of all TMFs and allows prioritization of work

2. TMF Checklist

- Questionnaire
- Evaluation Matrix for the TMF safety level
- Measure Catalogue

=> For detailed check at a TMF



1. Tailings hazard index (THI)

$$THI_{Basic} = THI_{Cap} + TXI_{Tox}$$

$$THI_{Ext} = THI_{Cap} + TXI_{Tox} + THI_{Man} + THI_{Loc} + THI_{Dam}$$

THI_{Basic}

- ***THI_{Cap}*** a degree of hazard / risk, related to a volume of materials in a TMF
- ***THI_{Tox}*** a degree of hazard / risk, related to toxicity of tailing materials

THI_{Ext}

- ***THI_{Man}*** a degree of hazard / risk, related to poor management
- ***THI_{Loc}*** a degree of hazard / risk, related to local geological and hydrological conditions
- ***THI_{Dam}*** a degree of hazard / risk of a dam failure related to its integrity faults

Диапазон ИОХ

Страна	ИОХ мин.	ИОХ макс.	Общий ИОХ
Армения	11.9	16.6	14.00
Грузия	12.2	16.5	14.00
Киргизия	11.5	15.9	13.38
Венгрия	8.0	12.9	10.80
Румыния	6.3	14.8	11.53
Сербия	11.3	16.3	14.13

Низкий уровень
5.5-9.4

Средний уровень
9.5-13.4

Высокий уровень
13.5-17.5

Диапазон ИОХ для международного уровня

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Map of TMFs

Низкий уровень

THI 9.4-5.5.

- Romania
- Hungary

Средний уровень

THI 13.4-9.5.xlsx

- Romania
- Hungary
- Armenia
- Kyrgyzstan
- Serbia
- Georgia

Высокий уровень

THI 17.5-13.5.xlsx

- Serbia
- Armenia
- Kyrgyzstan
- Romania
- Georgia

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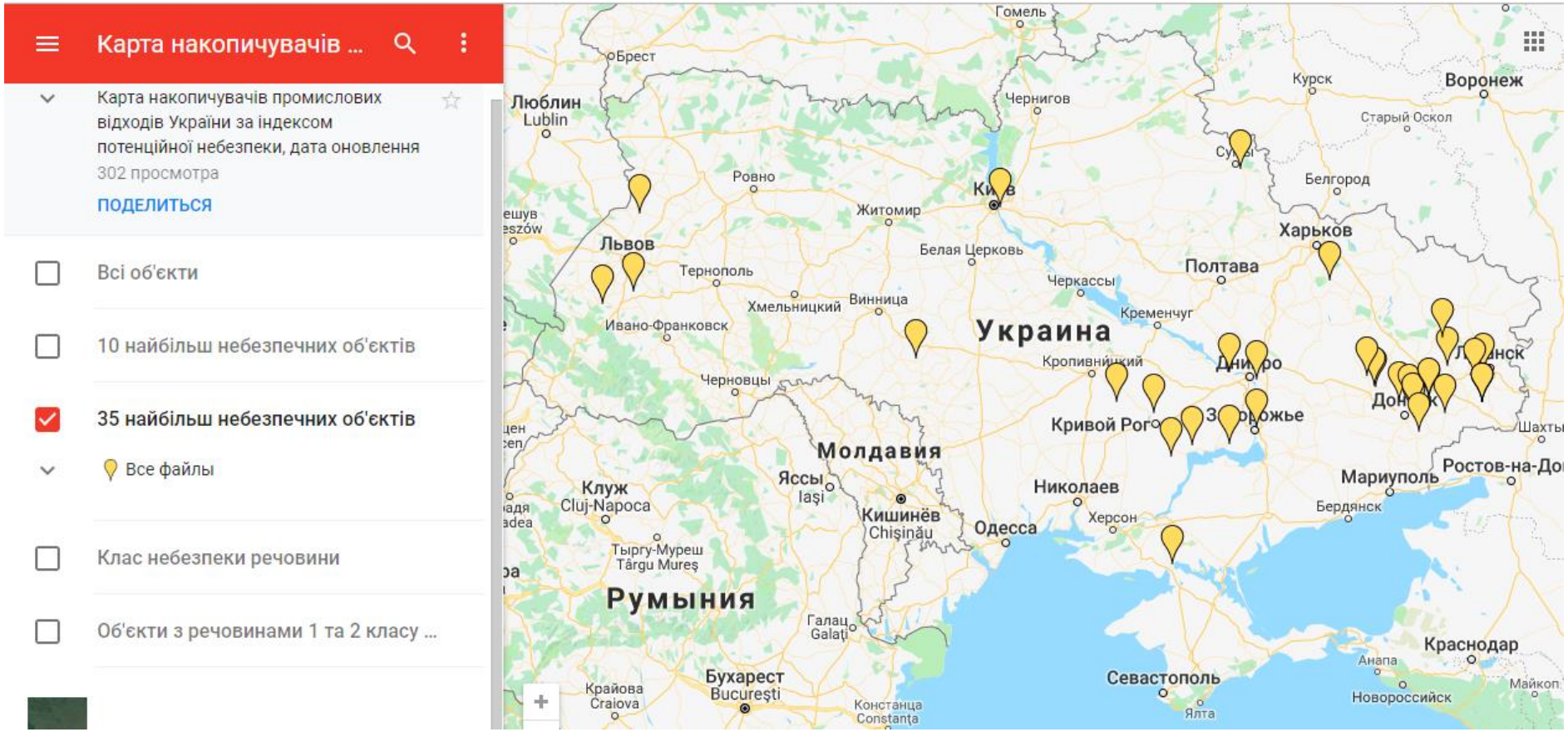
Application of tailing hazard indices in Ukraine

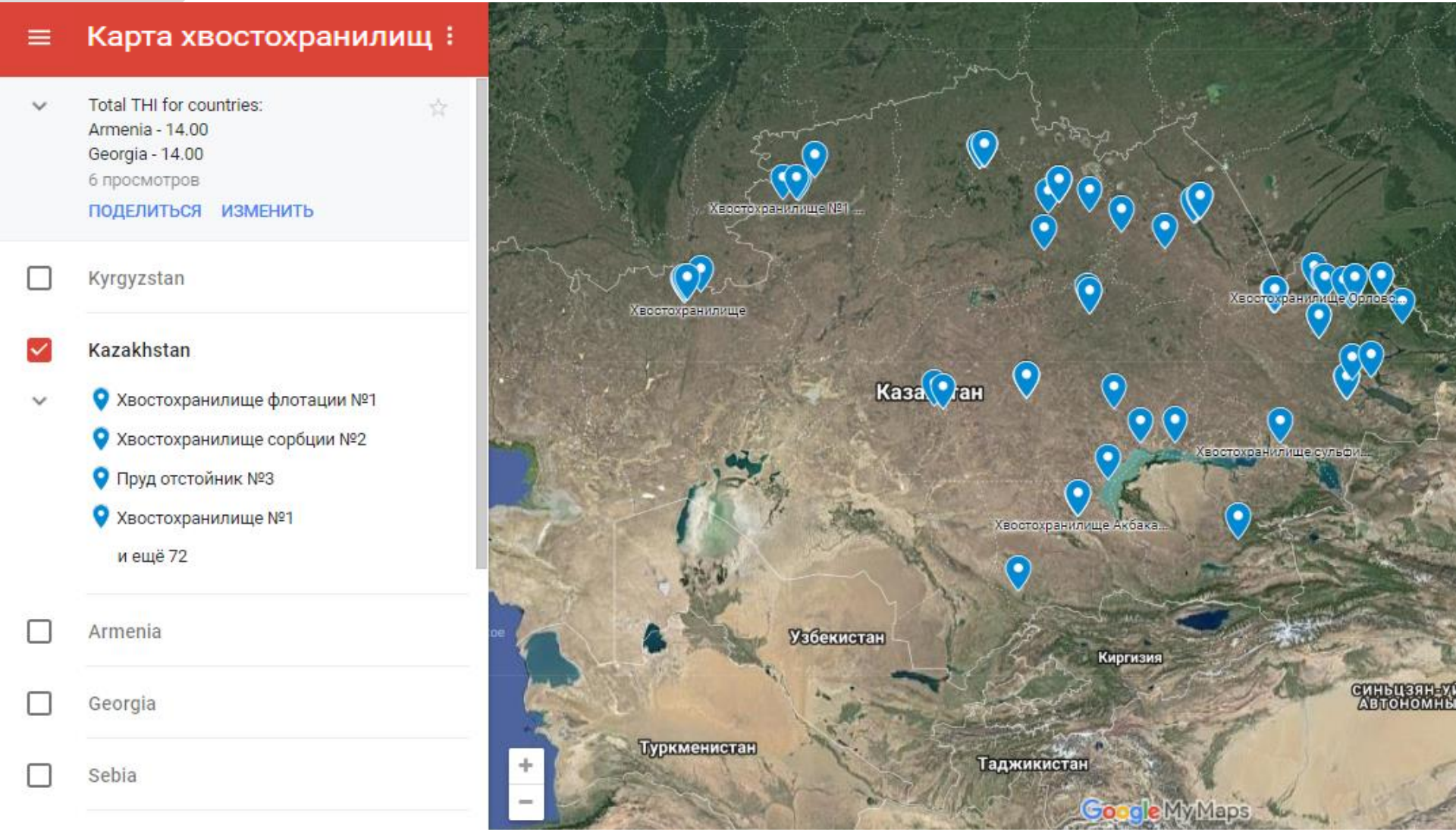
35 most hazardous TMFs



Начальная карта хвостохранилищ Казахстана (76 хвостохранилищ из 121)

1	Северо-Казахстанская область
10	Акмолинская область
4	Жамбылская область
7	Костанайская область
25	Восточно-Казахстанская область
8	Павлодарская область
15	Карагандинская область
6	Актюбинская область

Пример визуального отображения хвостохранилищ Казахстана на карте



2. Checklist

- **Group A: “Basic assessment"**
  - Preliminary and operational assessment of a TMF safety level to determine priorities for further detailed assessment
- **Group B : "Detailed assessment"**
  - Comprehensive and detailed assessment of a TMF safety level to determine the need to take actions
- **Group C: “Assessment of inactive sites“**
  - Assessment of an inactive TMF safety level to determine the need to take actions

Answer	Not applicable	Yes	Rather yes	Rather no	No
Value	-	3	2	1	0

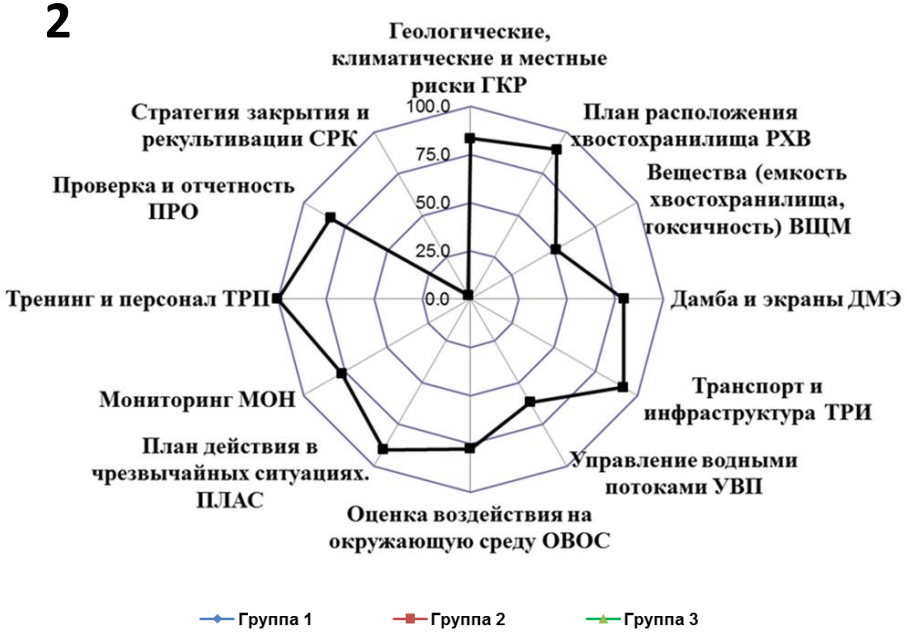
Example

#	Question	Recommendations (factors and parameters to be accounted for in answering the question)	Answer					Data source (reference to documents or photos as evidence)
			not applicable*	yes	rather yes	rather no	no	
Data recheck								
1	Does the design documentation correspond to the actual layout of the TMF elements?	Correspondence of charts and maps to actual layout of the TMF						

Примеры категориальной оценки

1

2



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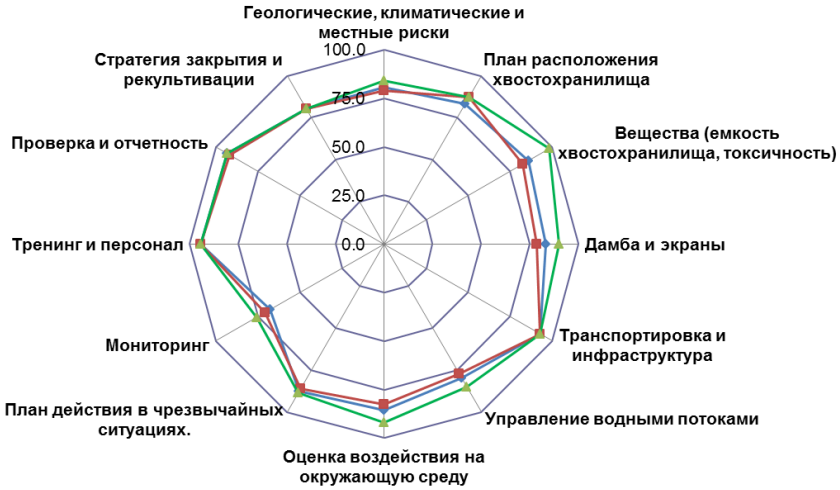

1. Хвостохранилище возле г. Калуш (Украина)
2. Хвостохранилище возле г. Днепр (Украина)
3. Хвостохранилище возле г. Ахтала (Армения)

Measure catalogue example

Problem to be solved	Measures prescribed	Priority
	CLOSURE AND REHABILITATION, ABANDONED TMF	
The TMF closure plan is absent or insufficient	31A. Develop an action and monitoring plan for TMF closure	Short-term
	31B. Amend the TMF closure plan according to applicable requirements	Short-term
	31C. Develop the plan of landscaping and restoration of water resources during TMF closure	Short-term
	31D. Study the feasibility of using tailings materials as secondary raw	Short-term
	31E. Reassess the preservation and further monitoring stages using Factor of safety set by national regulations/requirements	Mid-term
	31F. Develop the schedule and regulations of accomplishing the engineering measures for mitigating the after-effects of TMF operation	Short-term
	31G. Include monitoring procedures into the closure and rehabilitation plans	Short-term
Long-term stability of the TMF is not ensured after closure	33A. Develop a long-term strategy and action plan for rehabilitation of the TMF site	Mid-term
Reclamation and landscaping plans are absent or incomplete	34A. Establish the cause of non-implementing the plan for TMF reclamation and landscaping, revise this plan	Long-term
	34B. Elaborate technical measures for rehabilitation of the TMF using suitable topsoil	Long-term
	34.C. Elaborate technical measures for phyto-rehabilitation of the TMF site	Long-term
Protective measures for mitigation of TMF after-effects are not applied	35A. Develop/Implement the measures ensuring TMF stability after closure	Long-term
	35B. Develop/implement the schedule and network to monitor the environment during and after TMF rehabilitation	Long-term
	35.C. Employ the technologies that minimize the volume and toxicity of tailings materials with maximum extraction of useful components	Long-term
	35.D. Employ biological methods of TMF remediation including phytoremediation, life barrier of perennial trees etc. if applicable	Long-term
The TMF is abandoned and not maintained properly	36A. Assign a competent body or find a company responsible for maintenance and care of the TMF	Short-term

UNECE on-site training at a TMF in Altyntau-Kokshetau (KAZ, 11-13 Jun 2019)

https://www.unece.org/info/media/news/environment/2019/unece-launches-project-to-support-safe-management-of-mining-waste-in-tajikistan-and-other-central-asian-countries/doc.html

Next steps

UNECE projects in Kazakhstan and Tajikistan

- Finalize the mapping in Kazakhstan
- Develop ToRs for the establishment of the inter-institutional working group on tailings safety and water management in Kazakhstan
- Prepare inventory and map for Tajikistan
- Subregional Workshop: 20-21 Nov 2019 in Almaty (Kazakhstan) at the Centre for Emergency Situations and Disaster Risk Reduction
- On-site training in Tajikistan in summer 2020

Other projects under the UNECE Industrial Accidents Convention

- Final project workshop under Caucasian TMF project: 16-20 Sep 2019 in Batumi (Georgia)
- Possible project in Kyrgyzstan as of 2020, with the financial support from Germany

Thank you for your attention!

For more information please visit:

- www.unece.org/env/teia

Or contact:

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