

# Environmental regulation supporting the development of mine water management case Terrafame Mine



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31.8.2017, EELF 2017 Copenhagen



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# Object and task

The object of the research project is **to discern the role of environmental regulation in R&D** of mine water management during the mine lifecycle through case studies (in Finland)

1. Exploration
2. Mine development
- 3. Mine operation**
4. Closure



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The task of this case study is **to analyze how environmental regulation has affected the R&D of mine water management in Terrafame mine through the law enforcement**

**Environmental permits**

- 1. Regional State Environmental Agency**
- 2. Vaasa Administrative Court**
- 3. Supreme Administrative Court**

**Supervising permits**

**Centre for Economic Development, Transport and the Environment (ELY)**

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# Methodology

- qualitative empirical legal research
- case-study: investigating contemporary phenomenon within real-life context (Yin 1994)
- in-depth investigation, descriptive analysis:

## How environmental regulation has affected the R&D of mine water management in this case?

- Combining the innovation approach (focused in the final product) and the process approach (focused in the R&D process)



**to recognize effects of law enforcement on innovations of mine water management**



**to recognize the interactive mechanism between the law enforcement and the R&D process of the mine**

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# Ex post evaluation

“The evaluation of existing laws and regulations through ex post impact analysis is necessary to ensure that they are effective and efficient.” (OECD 2015)

1. **How the innovation goals of environmental regulation concerning the mine water management have been achieved in the case Terrafame? (innovation approach)**

 **Vedung’s side-effect model**

2. **How the effectiveness of environmental decisions has been built on the interaction between the enforcement authority/court and the mining company? (process approach)**

# Case Terrafame Mine

- A Finnish multi-metal mining company
- Products: Nickel (NiCoS) Ni 50%, Zinc (ZnS) Zn 60%, Copper (CuS)
- One of the largest known sulfide Ni/Zn – deposits in Europe



## Production methods:

1. Quarrying
  2. Crushing
  3. Agglomeration
  4. Bioheapleaching
  5. Metal production
- Outside operation
- Metal Factory

### Metal Production (2016)

Nickel	9 554 t (aim 30 000t)
Zinc	22 575 t

Total quarrying 14.2 Mt  
(the annual aim of  
ore production 18.0 Mt)

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## History of Terrafame Mine

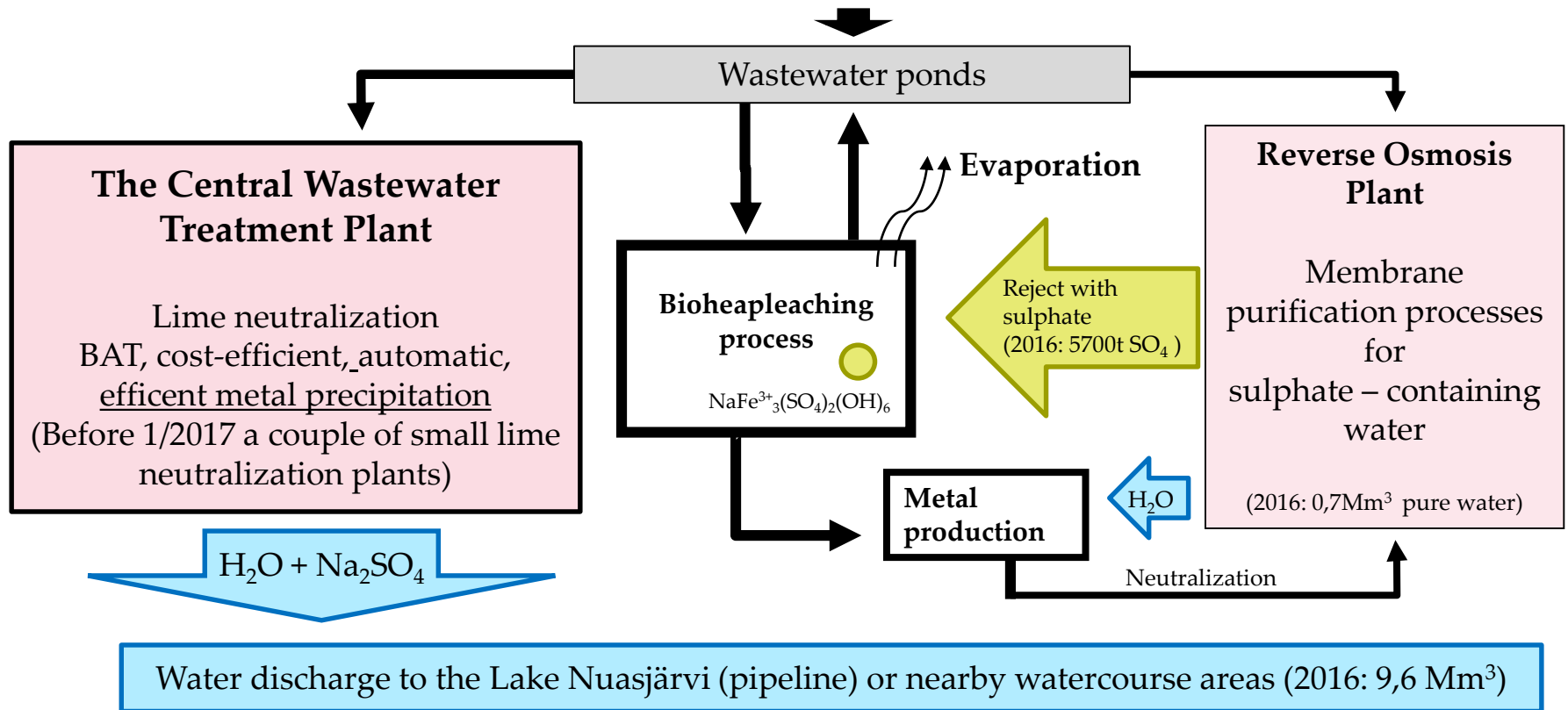
- The deposit of Talvivaara was originally found in 1977 by the Geological Survey of Finland (GTK). The sulfide nickel deposit was large but too poor for existing extractive technology
- The mining rights were obtained by Outokumpu Corp. and were sold to mining engineer Pekka Perä in 2003. The testing of bioheapleaching in Ni extraction from black-schist ore of Talvivaara deposit was started earlier and the results were promising
- The Talvivaara Mining Company was established in 2004. The company was listed on the London Stock Exchange in 2007. Environmental permit of the mine was obtained in 2007 and the mining was started in late 2008
- The problems of the Talvivaara Mining Company were cumulated in consequence of the **insufficient mine water management, problems in the ramp-up of the full-scale production, uncertainty of the funding and the fall of metal prices**. The situation degenerated into social conflict after a leak of mine waste water from a gypsum waste pond in late 2012. The company decided to file for bankruptcy in 2014. State-owned Terrafame Ltd acquired the operations and assets in August 2015



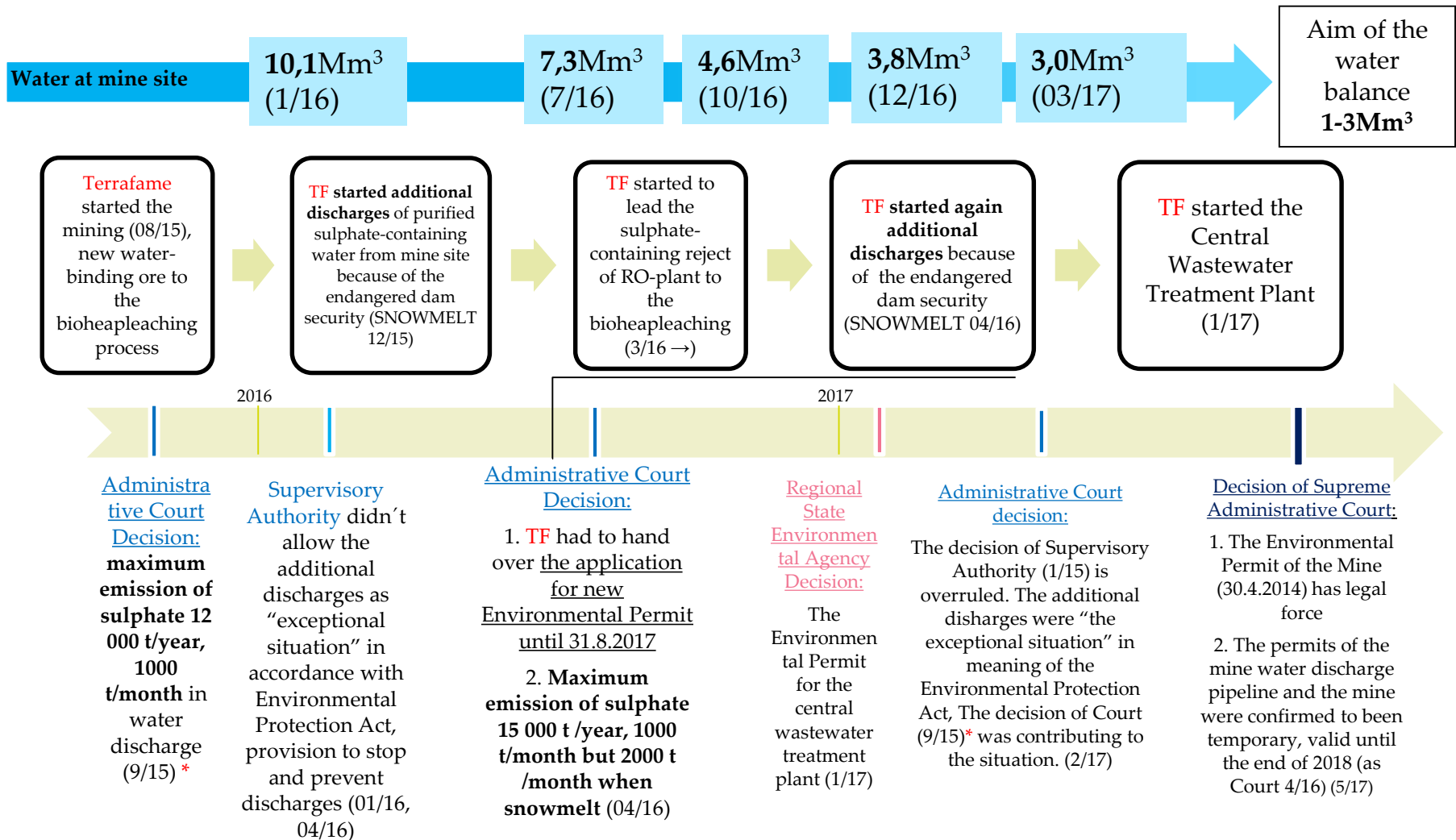
# Mine Wastewater Management System of Terrafame (Simplified)

- Closed water cycle in metal factory (from 2013), no wastewater
- The annual rain and snowmelt means **6-10 Mm<sup>3</sup> water** to the catchment area of the mine

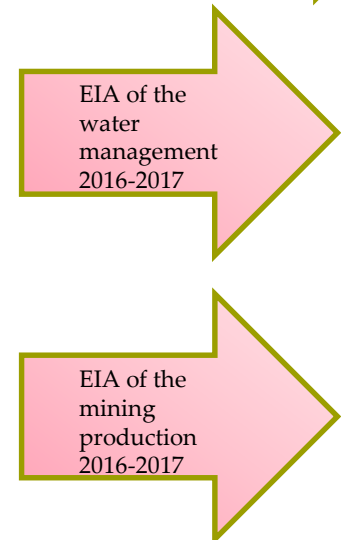
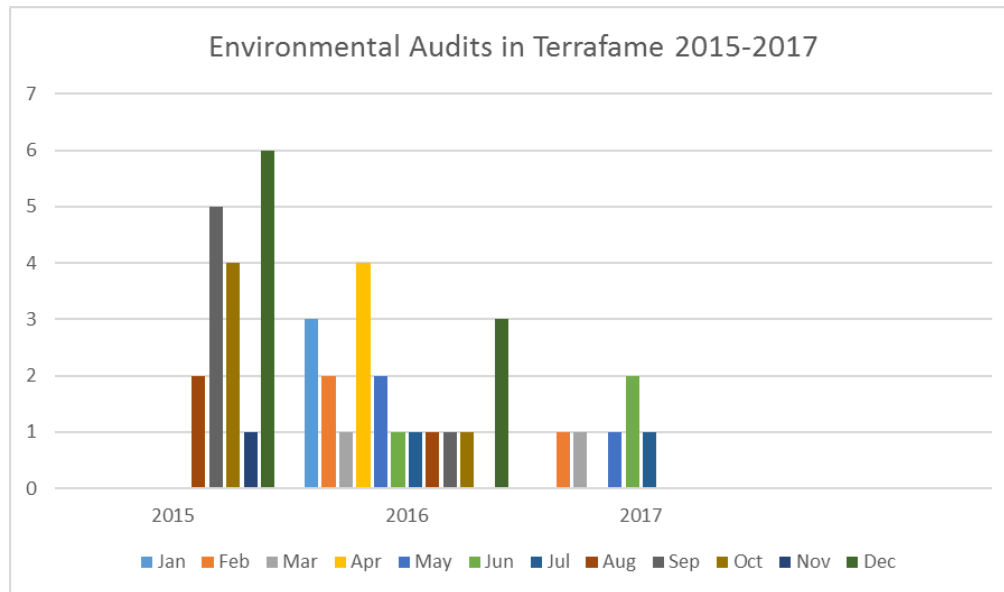
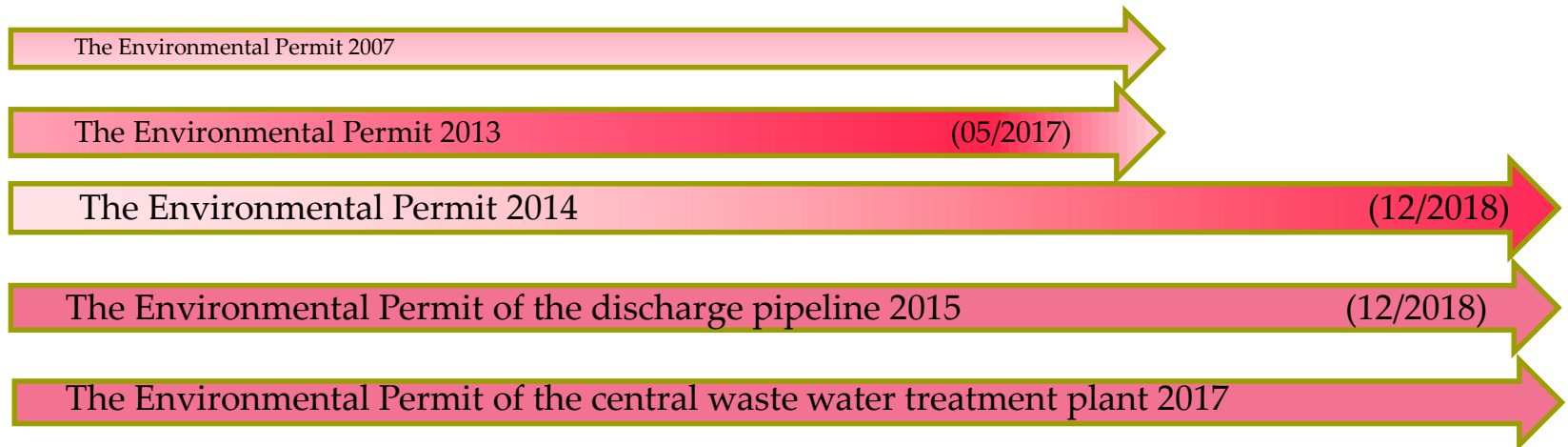
Water (rain and snowmelt) + outside mining operation + metal-containing soil = wastewater



# Mine water management and the law enforcement 08/2015-07/2017



## Mine water management and the law enforcement 08/2015-07/2017



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# Preliminary results of the study

The mine water management at Terrafame Mine depends on 1.) the water efficiency of the production process and 2.) the use of BAT – purification technology. The most of R&D is developing the process and produces process innovations. How has it affected the effectiveness of the law enforcement?

Relatively strict limits for sulphate emissions (water discharge) have affected the water management:

- negative side-effects: additional discharges in 2015-2016
- pressure for better water treatment instead of maximum use of discharge pipeline to achieve better water balance

**The impact problem:** the goal has been achieved through the development of the bioheapleaching process but because of the strict regulation or because of the efficient production ramp-up?



*Thank you!*

The research is funded by

