Mass transport of contamination released into surface water by landslide

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Aim

- Highlight a hazard not yet recognized
- Show possible implications

Göta älv river, SW Sweden

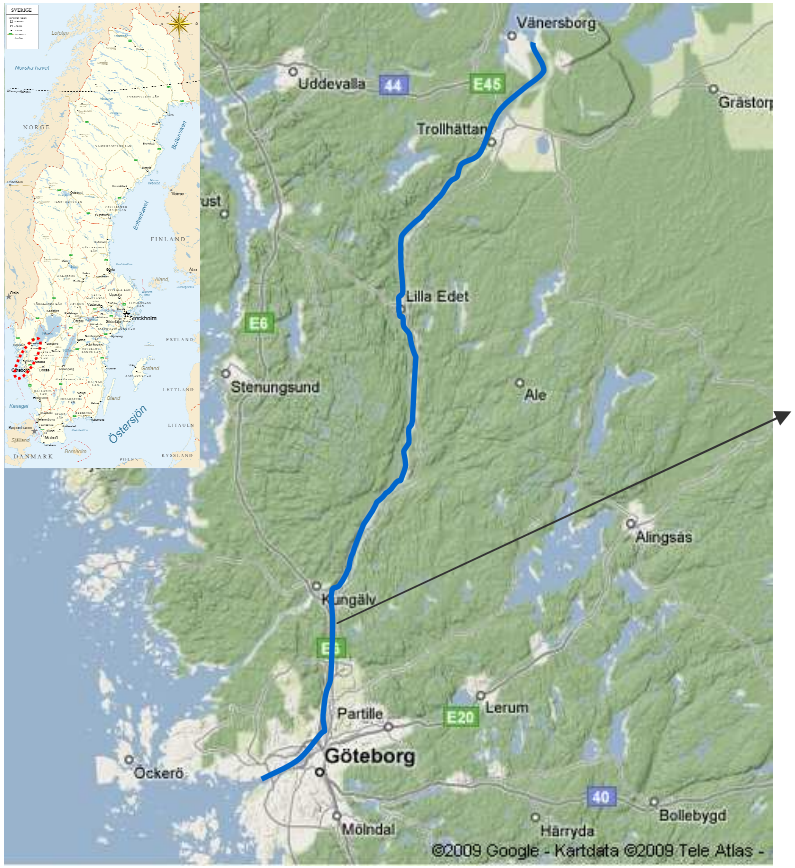

Photo: Gunnel Göransson

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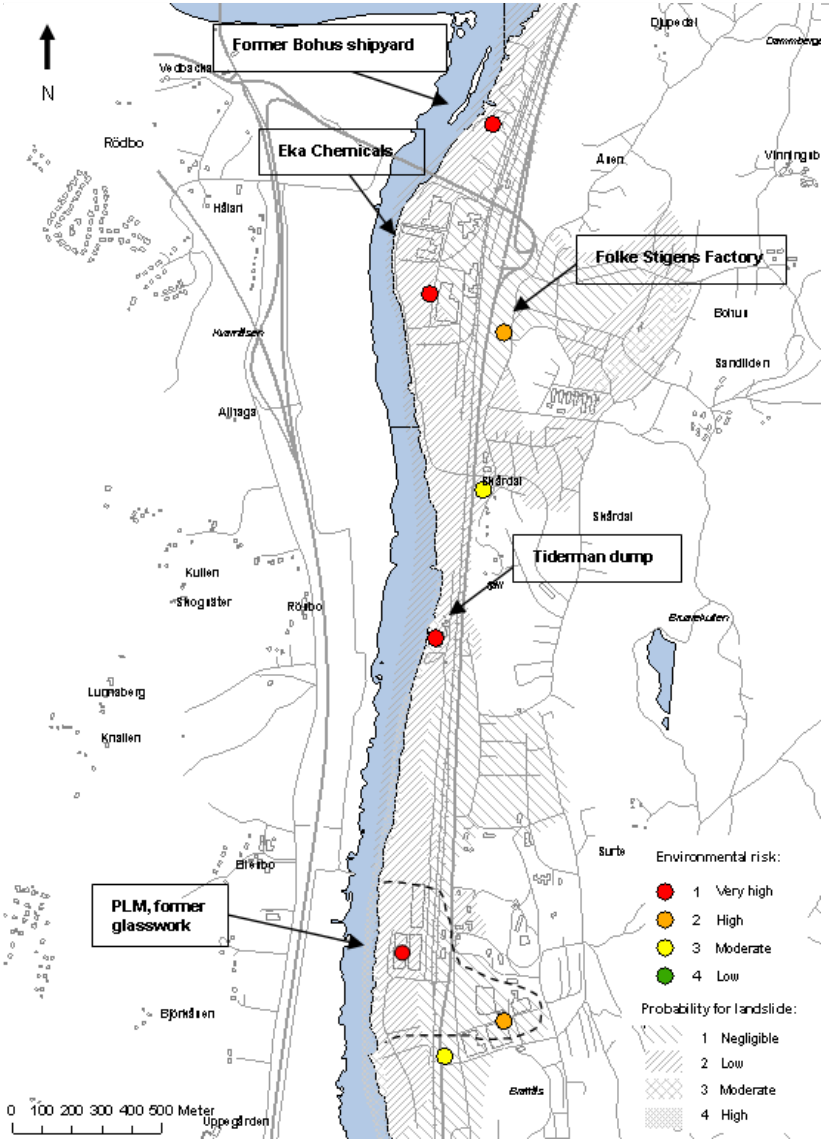


Contaminated sites at landslide risk?

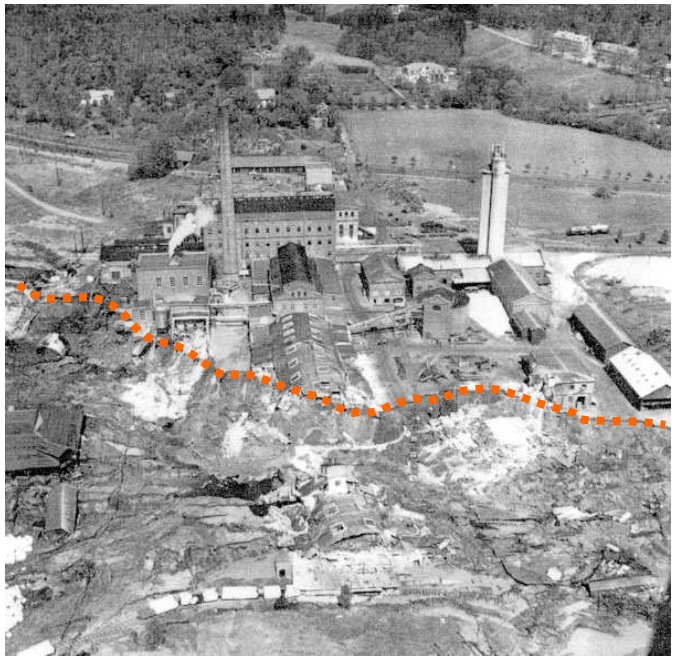
Of 31 potentially contaminated sites:
8 → moderate to high probability for landslide

Of these 8:
5 → high or very high environmental risk

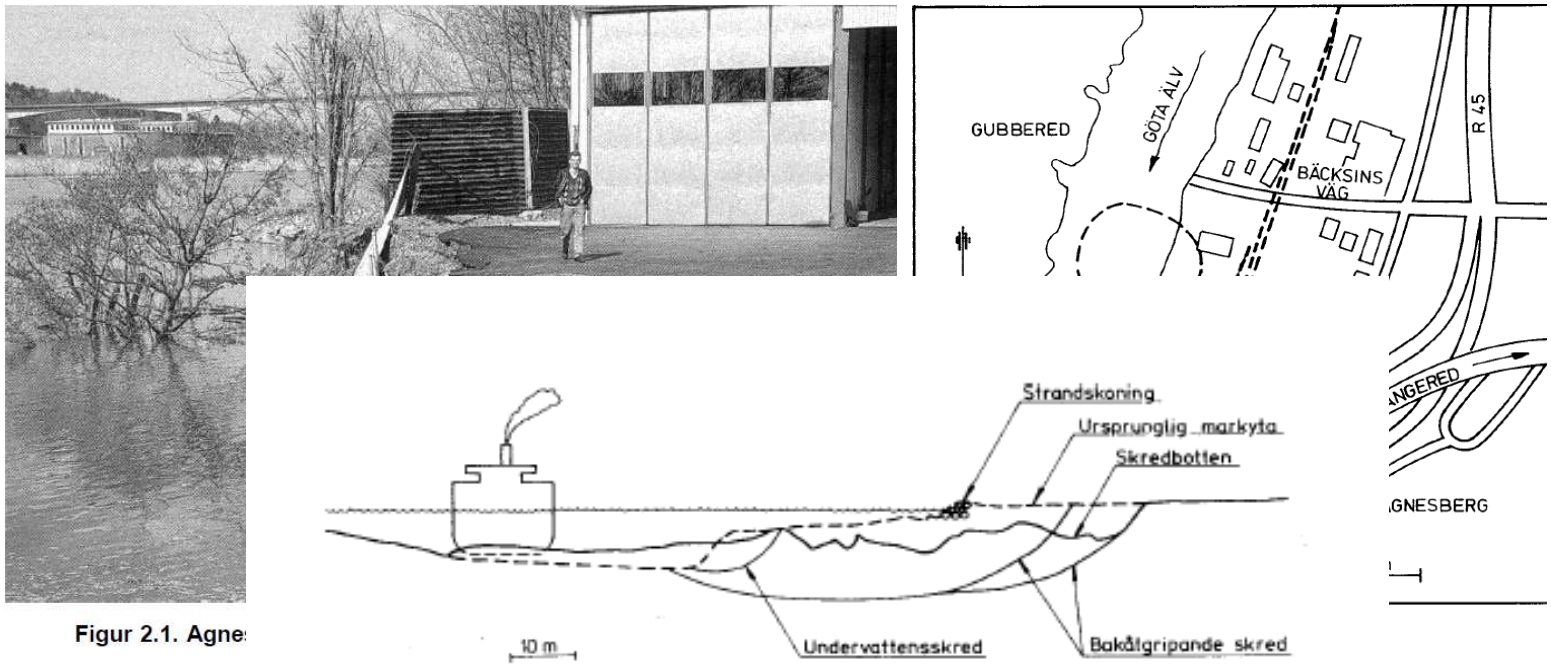
Göta älv river, SW Sweden

Göransson et al. (2009) *J Soils Sediments* **9**:33-45

1957 Göta landslide
Göta Sulphite industry (pulp mill)



1993 Agnesberg industrial site



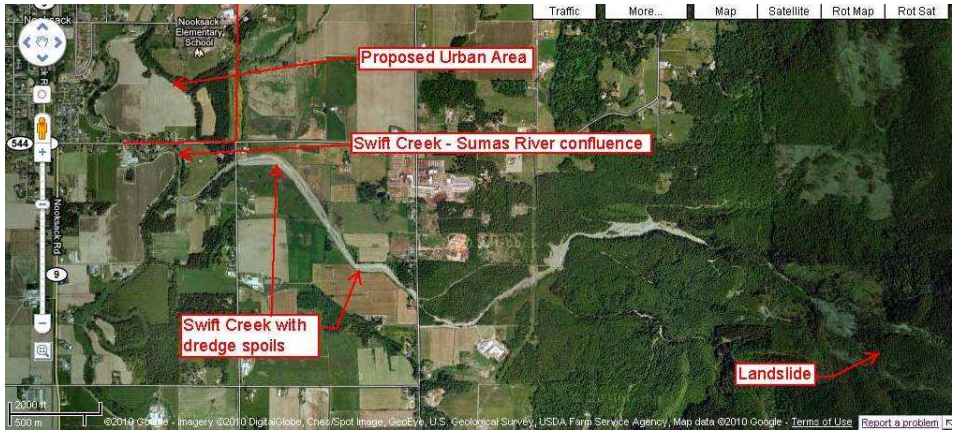
Figur 2.1. Agne

Figur 2.4. Förmodat skredförlopp.

Source: SGI report 45

http://nwgeology.wordpress.com/the-fieldtrips/virtual-field-trip-to-the-swift-creek-landslide-whatcom-county/

Swift creek landslide, Suma River, USA Asbestos containing rock



http://washingtonlandscape.blogspot.com/2010_07_01_archive.html

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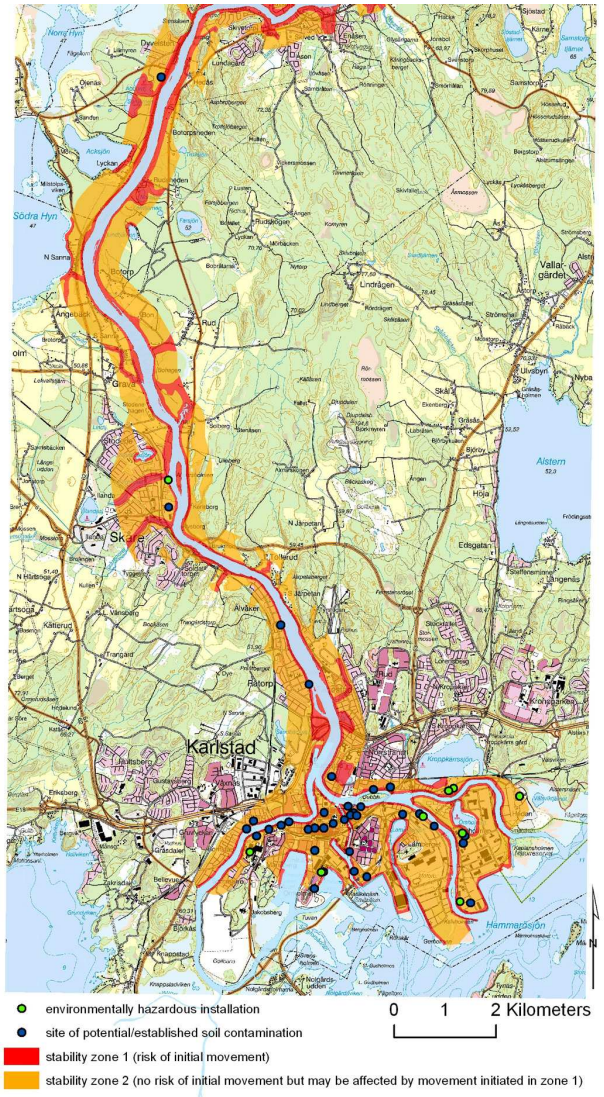
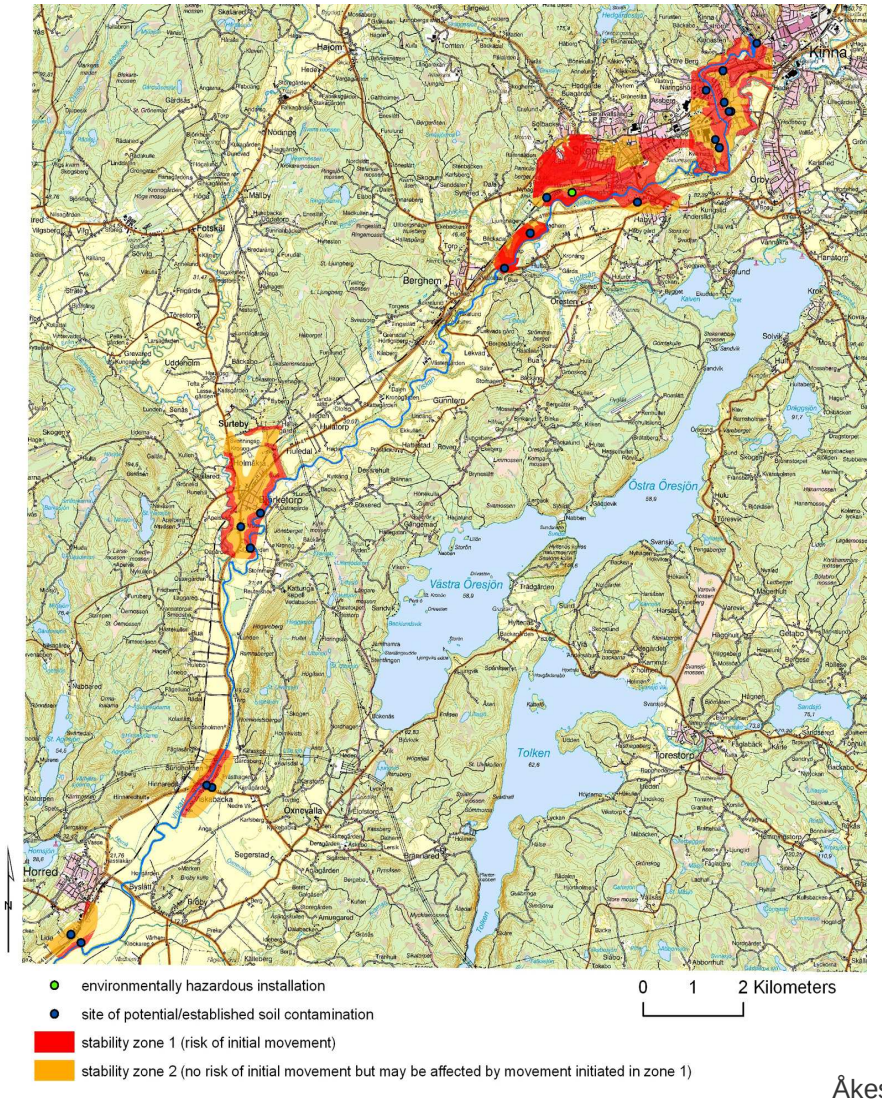
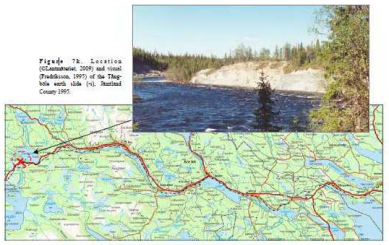




Åkesson, 2010

Key observations from some Swedish slides



Name (yr)	Type	Material	Size	Geography / Geology	Key observations
Tångböle (1995)	Earth slide/fall	Clay, silt	~200 000 m³	30-40 m high, steep, clayey-silty, forested river bank in sparsely populated region	- Widespread and long-term increases in levels of turbidity and rates of downstream sedimentation - Local hydrogeological disturbances including signs of **pollution**
Öd 1 (2002)	Earth fall	Silt/fine sand	~31 000 m³	40-45 m high, steep, silty, cultivated river bank in sparsely populated region	- Influence/-s) of ice on river upon time of movement - Major forces involved at time of movement - Long-term (permanent) damming and associated alterations of flow- and erosion patterns
Trossnäs (1996)	Rotational earth slide	Clay (sand, silt)	~100 000 m³	Clayey, forested, relatively flat stretch of river in a relatively developed and densely populated region	- Extensive up- and downstream damming - Rates of erosion and sediment transport - Downstream alterations in colour, temperature, visibility
Yara (2007)	Earth slide	Fills, clay	~1 200 m²	**Industrial site** within clayey harbour area in densely populated region	- Damming - Permanent shoreline displacement - Short- and long-term release of **contaminants** from displaced masses
Göta (1957)	Rotational earth slide	Clay	~370 000 m²	**Industrial site** along relatively steep, clayey river bank within densely populated area	- Evolution of movement - Extensive onshore soil subsidence and offshore damming - Up- and downstream surging
Agnes-berg (1993)	Rotational earth slide	Clay	~9 600 m²	**Industrial site** along seemingly flat, clayey river bank within densely populated area	- Importance of sub aquatic topography - Evolution of movement - Sediment transport capacity and processes

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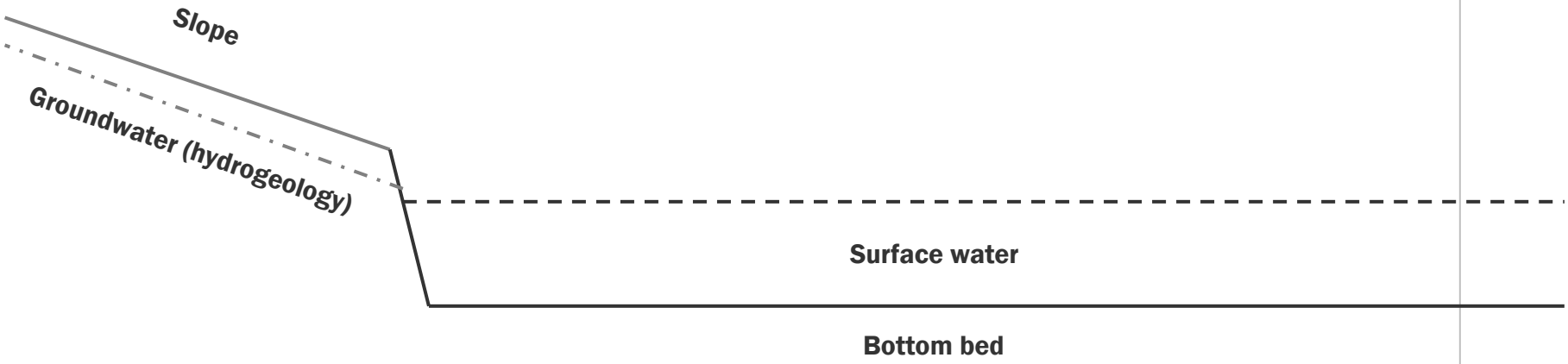

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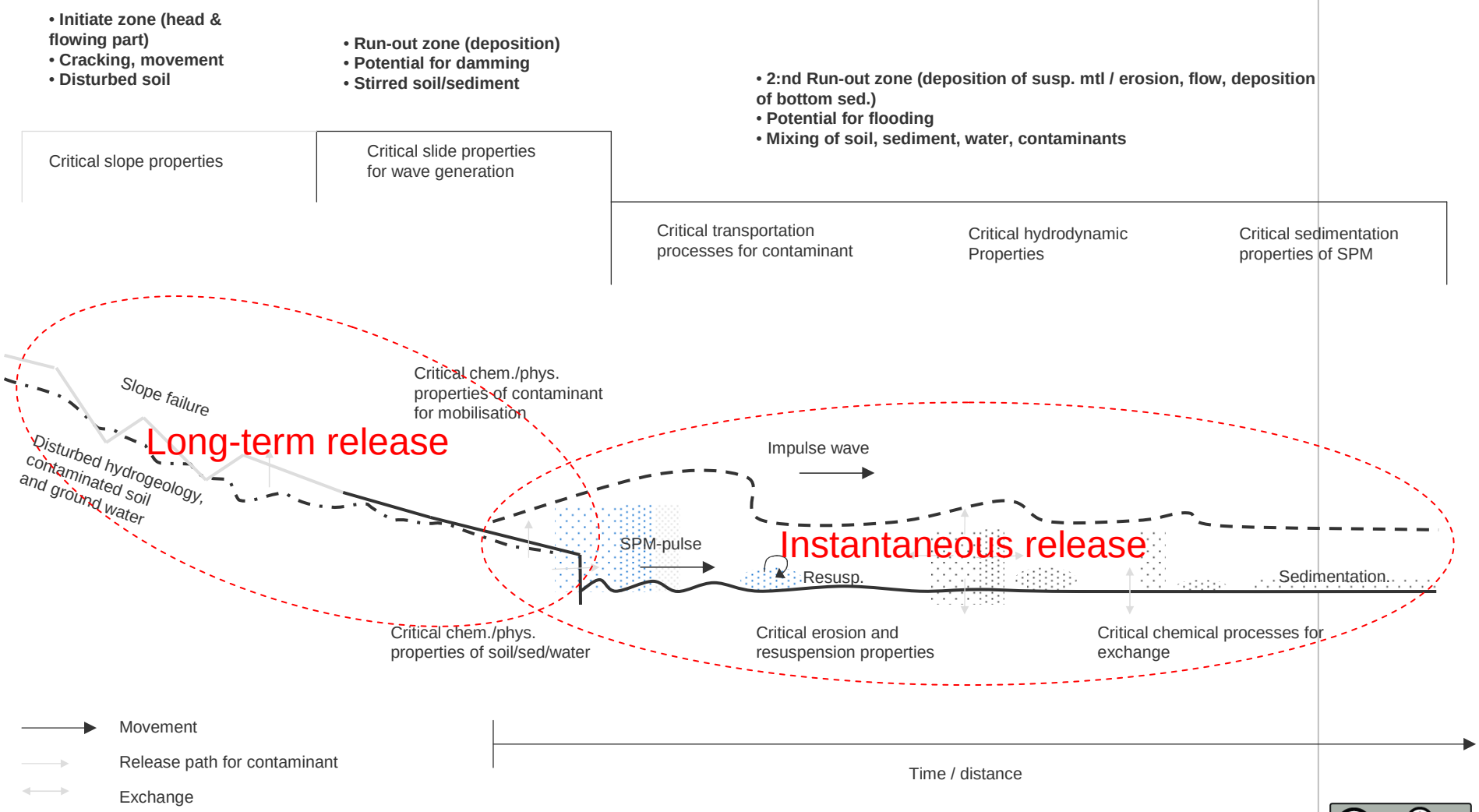

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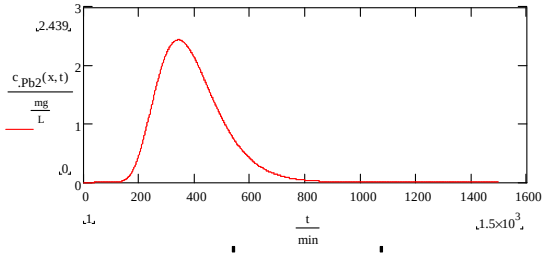
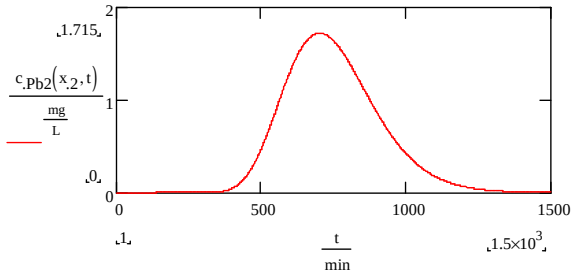
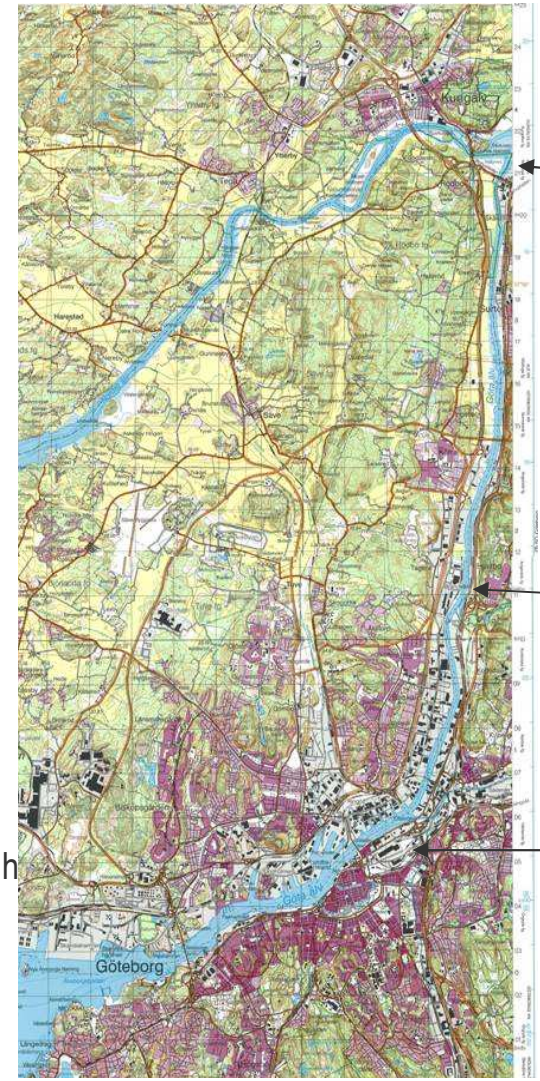
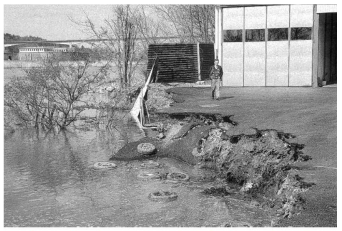


Freshwater intake (10 km):
Time peak: ca 6 h
Time pulse passage: ca 12 h
Cons. peak: 2,4 mg/l



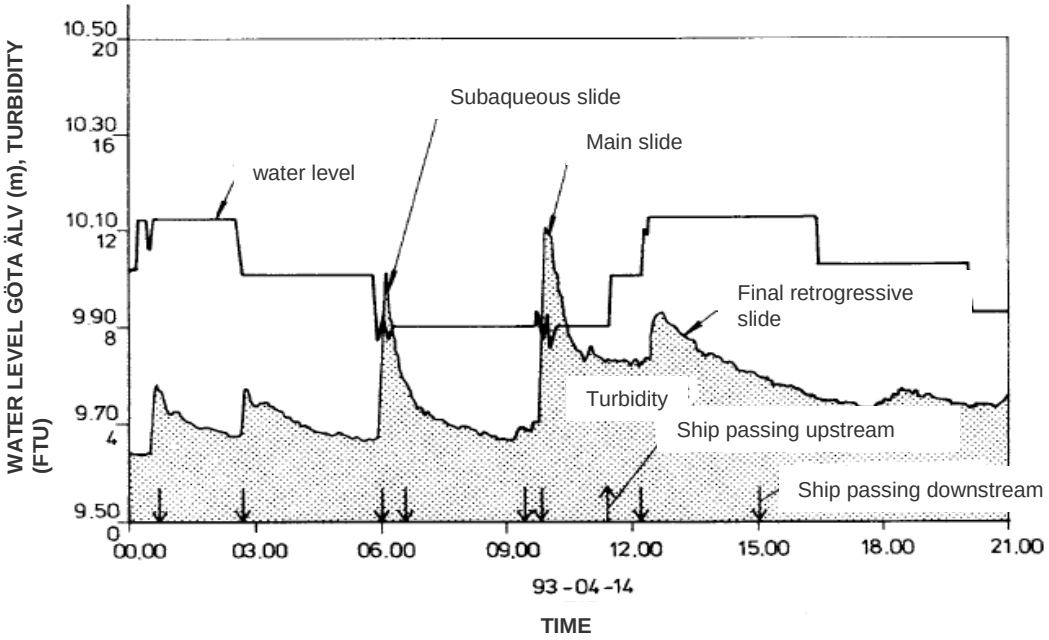
Göteborg C (20 km):
Time peak: ca 11,5 h
Time pulse passage: ca 16 h
Cons. peak: 1,7 mg/l

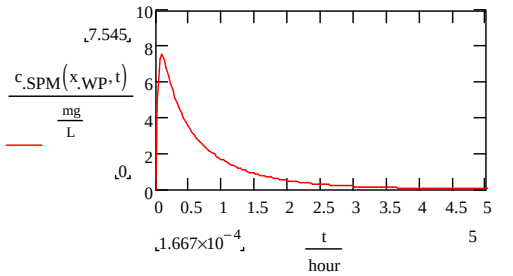


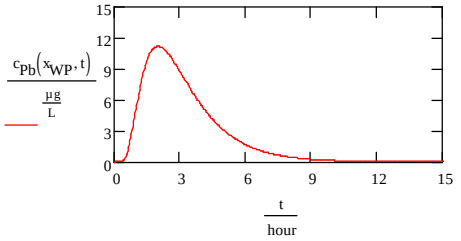


Figur 2.1. Agnesbergsskredet 1993-04-14. (Foto: Sven Liedberg, CTH)

Agnesberg industrial site







Source: SGI report 45

Deviation from ADE

• Deposition occurs and its velocity depends on sediment concentration. This may give a skewed concentration distribution (long tail).

• There is a reversible or irreversible sediment exchange with e.g. stagnant or slow moving water masses. If the exchange is irreversible (depending on concentration gradient), it gives strong effect and a skewed tail.

In progress

• In cases where the hydrodynamic dispersion is very limited, the above mentions processes give a strong impact on the shape of the distribution.

In summary

- Most likely not only a Swedish phenomena …
- Has large impact on sediment dynamics
- May have large impact on water quality
- Needs to bee included in river basin management and risk assessments

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