NO-DIG TECHNOLOGY AS A PREVENTION FOR ENVIRONMENTALLY HAZARDOUS LANDSLIDES

HIGH RIVERBANK STABILISATION AT ERCSI, HUNGARY

Case study for the

23rd NO-DIG INTERNATIONAL CONFERENCE AND EXHIBITION
19-21 September 2005 Rotterdam

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GENERAL GEOTECHNICAL INFORMATION ON THE LAND-SLIDE ENDANGERED AREAS IN HUNGARY AND THE MAIN REASONS OF THE LANDSLIDES HAPPENED LAST YEARS

- There were very intensive rainy periods in the years 1999-2000 and 2003-2004
- Large scale landslides occurred on the areas, where clay, silt, loessic and fine / medium sand layers had been settled in different geological periods in a light slope towards a creek or river creating a sandwich-like composite soil structure.
- Under normal conditions (at average rainfall) the groundwater outflow capacity of the permeable layers in the sandwich-like composite soil structures on these areas is equal or higher than the quantity of the streaming groundwater arrives from the background water collector areas.
- In this case the whole composite soil structure is in stable, positive balanced condition.
- In certain cases either the quantity of the streaming groundwater increases suddendly (e.g.: extreme rainfall, damage in the public utility lines, etc.), or the water outflow capacity of the permeable layers decreases dramatically. There is no more positive balance between the quantity of the streaming groundwater and the outflow capacity of the permeable layers.

RESULT: …..LANDSLIDES…..

Fig. No 1.

Medium water level at Danube, the outflow is free for the streaming groundwater, the riverbank slope is in stable condition

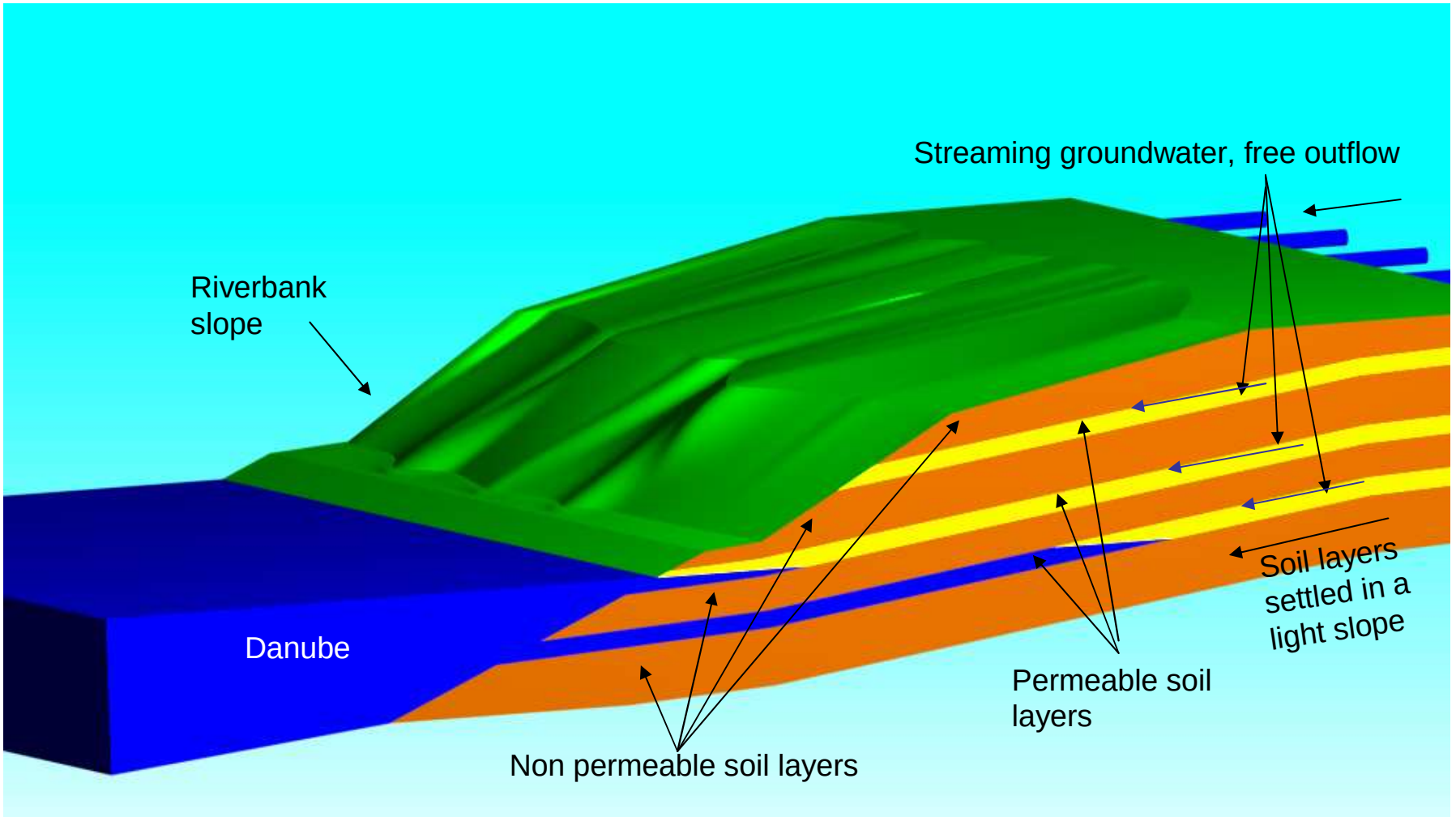


Fig. No. 2.

High tide, the permeable layers are in saturated condition, but the outflow is still free for the streaming groundwater

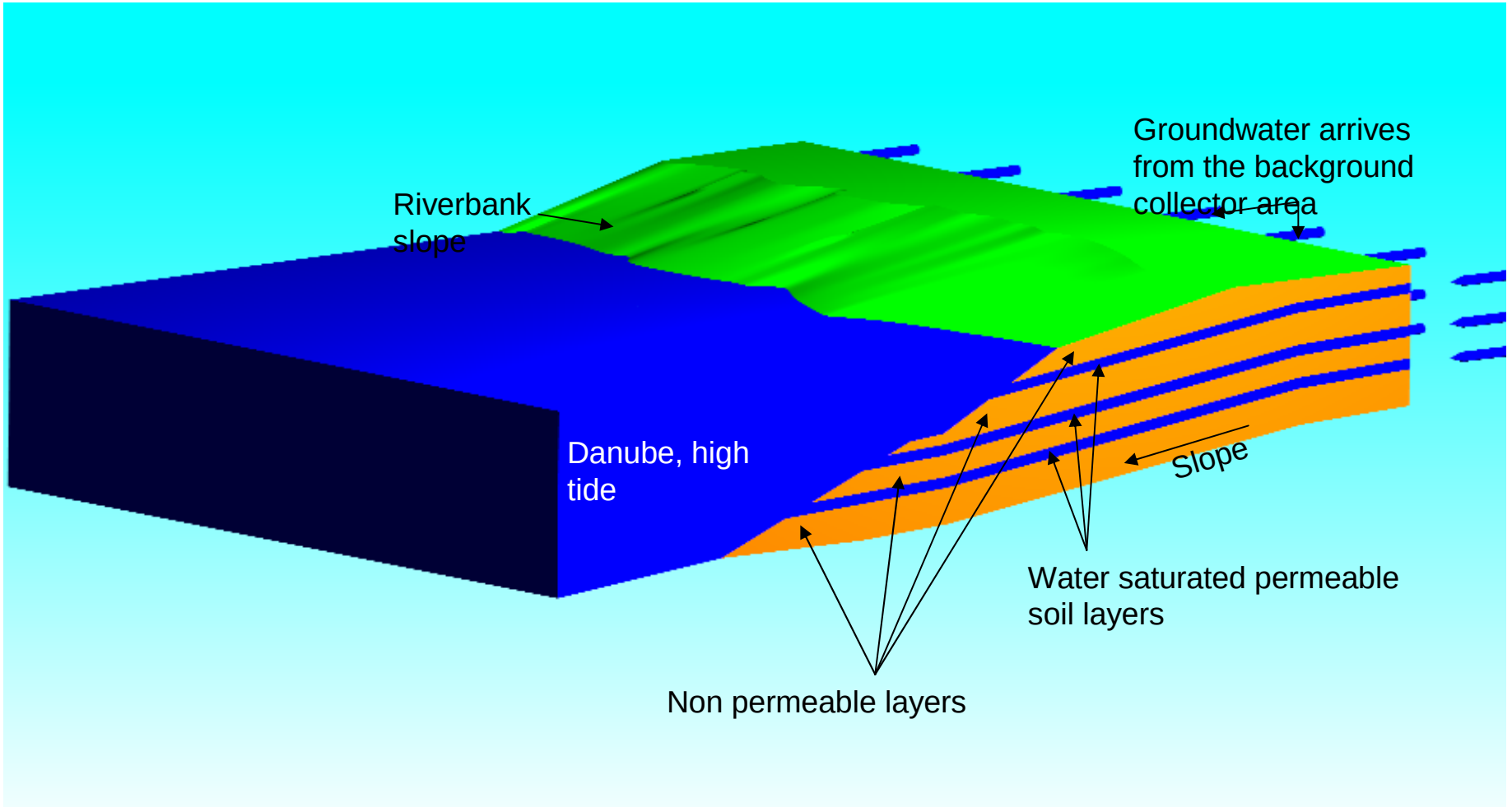


Fig. No. 3.

After high tide. First slide at the riverside occurred by the wave erosion and the loss of passive resistant forces in the completely saturated soil layers (there were no riverside protection structures)

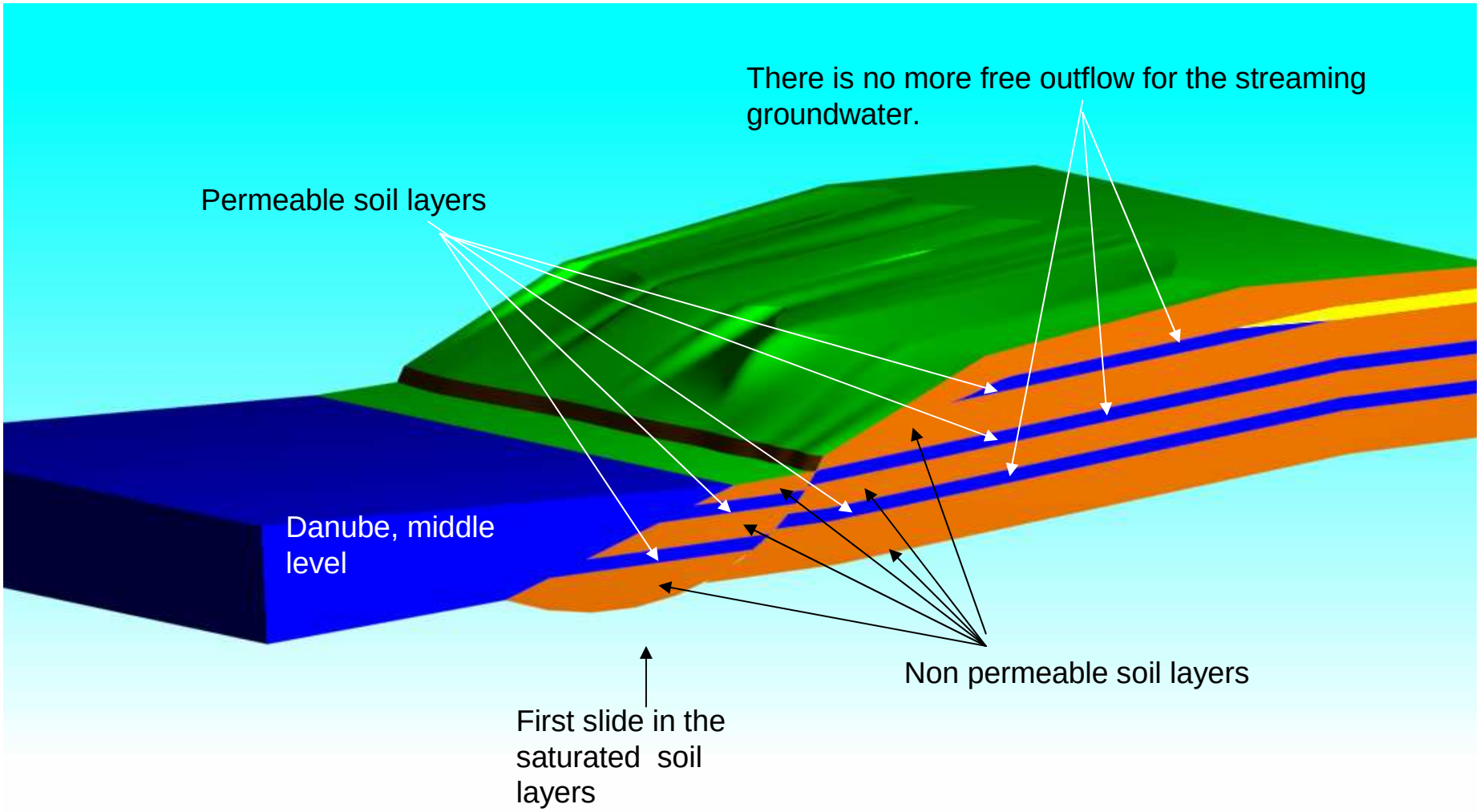


Fig. No. 4.

Next high tide. The piezometric pressure increases in the water saturated permeable soil layers because of the limited outflow.

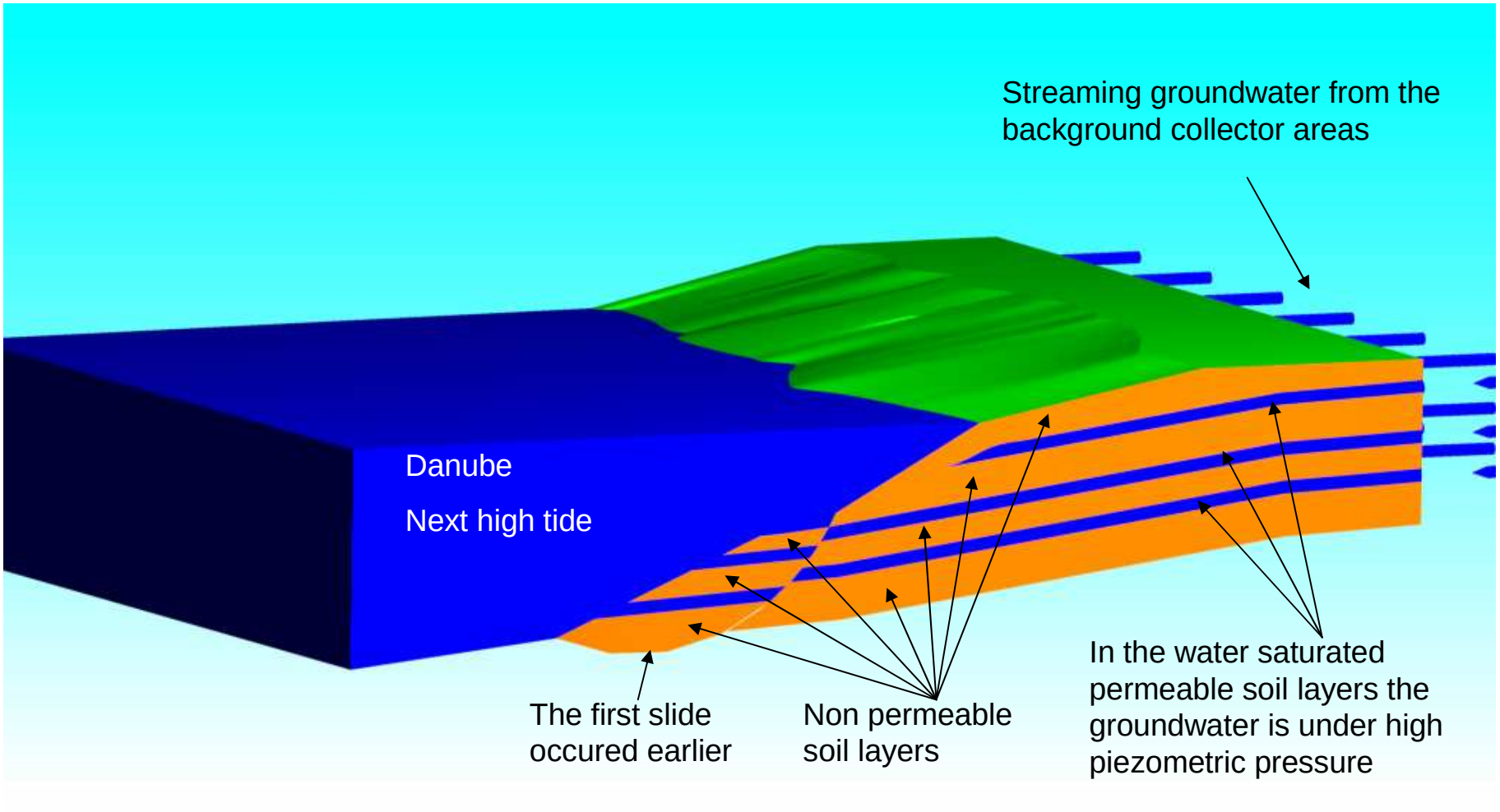
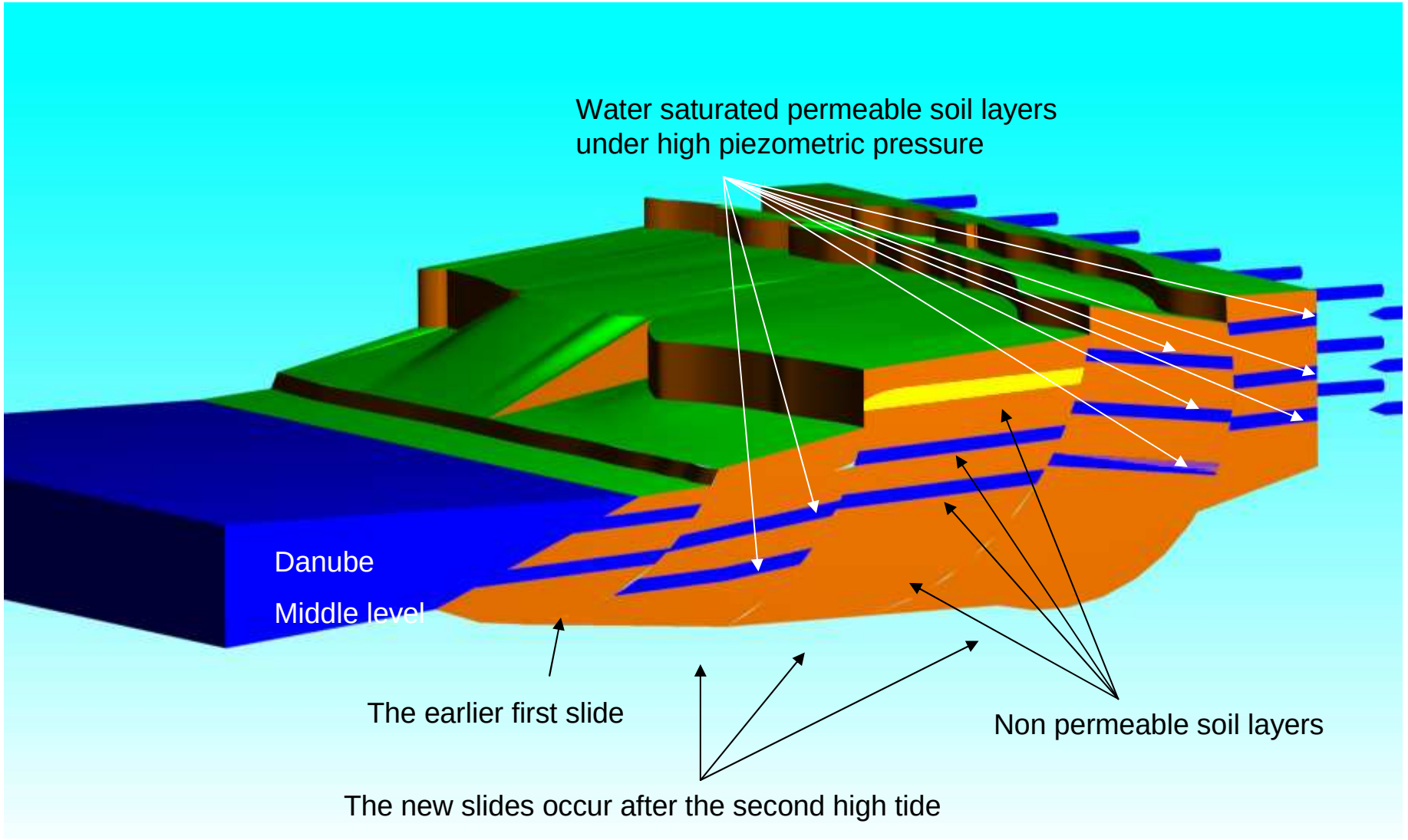


Fig. No. 5.

After quick come down of the second high tide the next slides occur



How could be prevented the dangerous situation, when the quantity of groundwater streaming in the permeable layers exceeds the outflow capacity of these layers? (This is the main reason of the landslides.)

There are two possibilities to recreate the positive balance:

Drastic minimization of the streaming groundwater in the permeable layers on the slide endangered areas .

(Minimize the infiltration on the background collector areas by levelling, grassing of the soil surface, forest plantation, construction and rehabilitation of the surface/subsurface rainwater collector systems, the sewer and freshwater pipelines.)

In case of very intensive and long rainy periods these above mentioned measures are not sufficient enough to prevent the landslides.

Significant increase in the outflow capacity of the permeable soil layers.

The combined application of the above mentioned two possibilities is the real solution !!!!!!!

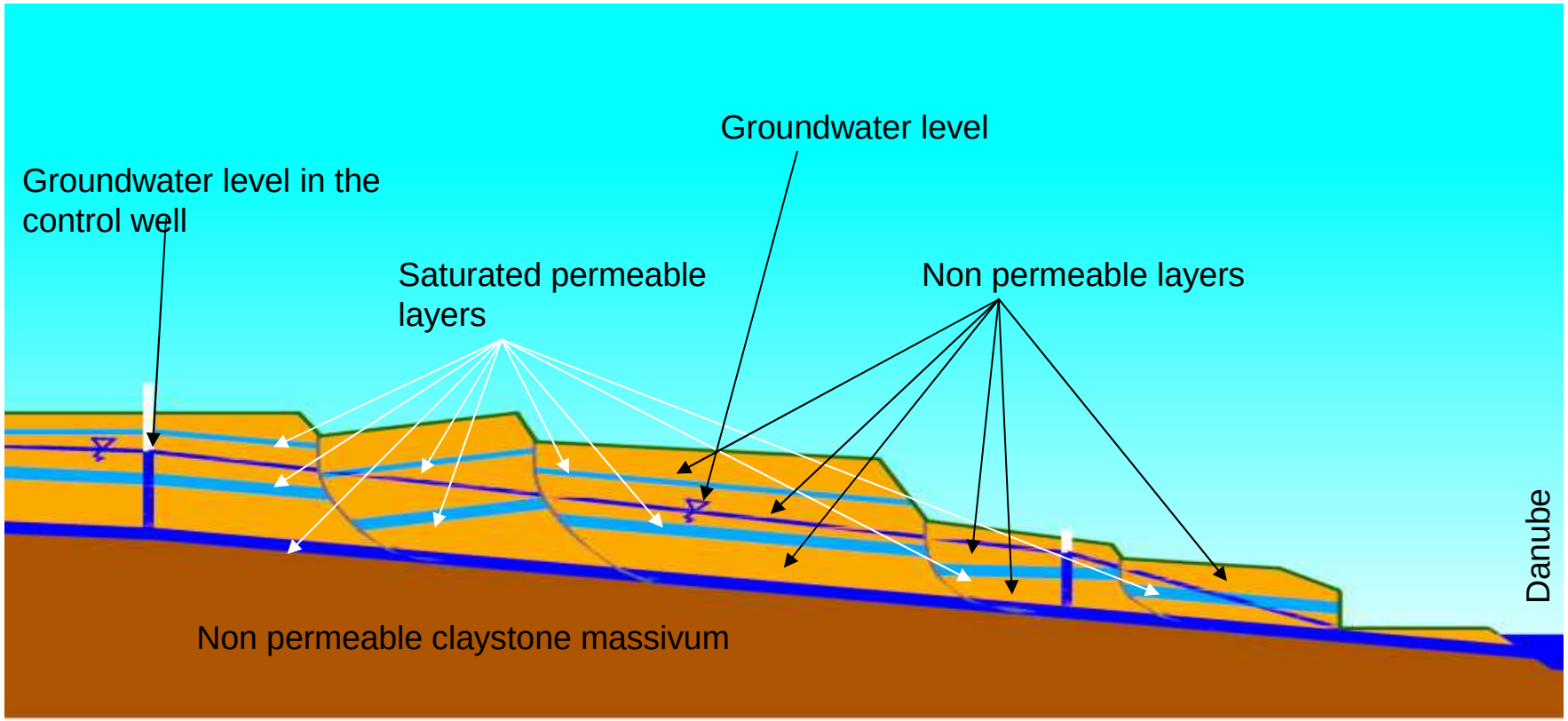
Permeability and outflow capacity increase of the semi-permeable layers at land-slide endangered riverbanks by bored long-distance filter collector lines

The necessary steps:

- Detailed geotechnic survey to measure the position, the depth, the thickness of the subsurface soil layers and to detect the subsurface declinations.
- Taking samples from the subsurface soil layers for laboratory tests (granulometry, permeability, water content, cohesion, internal friction, etc.)
- Building a network of groundwater control wells.
- Detailed continuous control of the groundwater level on the area prior laying the filter collector line system.
- Design of the bored subsurface long-distance filter collector line system.
- Laying of special self-cleaning filter collector line system by horizontal directional drilling or horizontal thrustboring with reusable steel casing pipes.
- Monitoring the continuous lowering of the groundwater level.

Fig. No. 6.

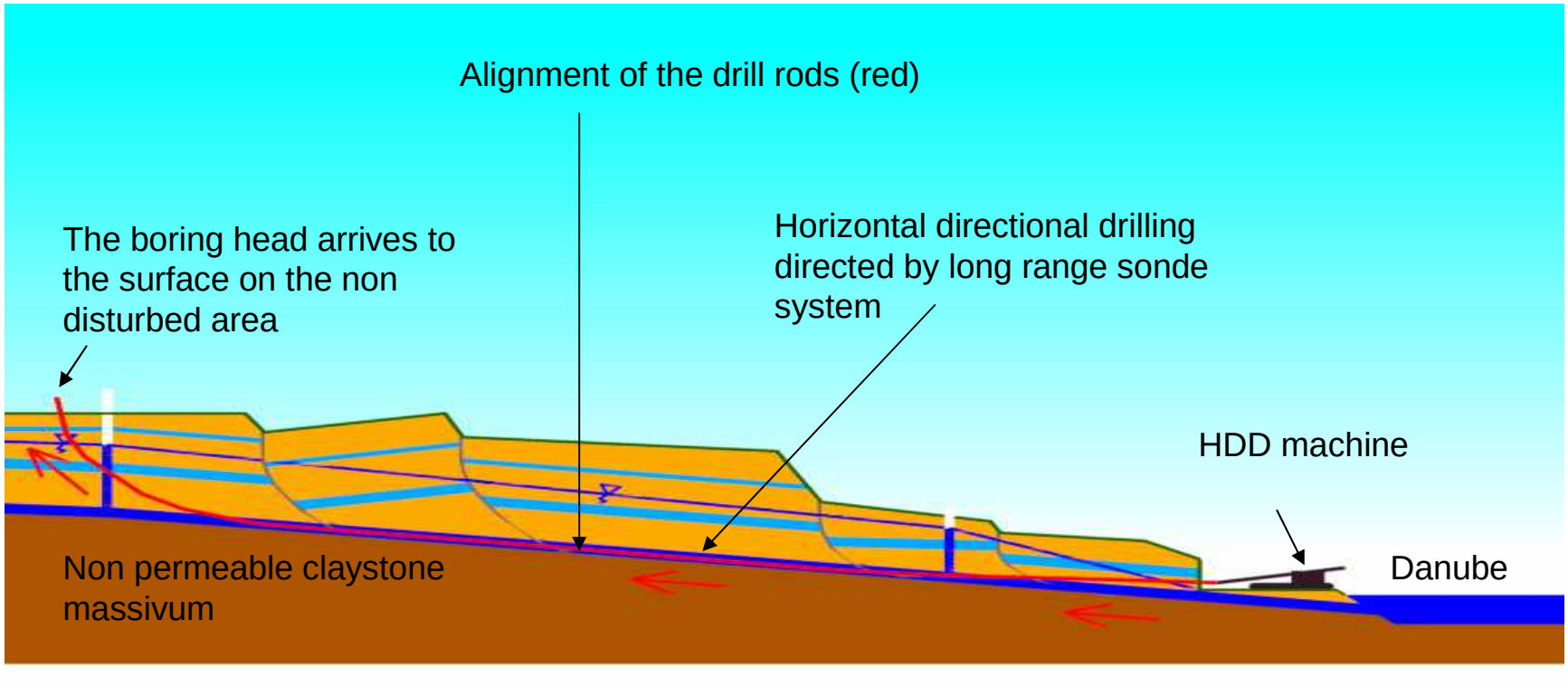
Typical cross section of the land-slide endangered riverbank at Ercsi/Hungary after the first land-slides.



The positions of the soil layers, the sliding surfaces and the groundwater level according to the geotechnic survey and groundwater monitoring after the slides occured in early 2000.

Fig. No. 7.

Horizontal directional drilling in the lowest permeable soil layer



Applying the long range sonde direction system it is possible to follow the slope of the permeable layers detected by the detailed geotechnic survey earlier.

Fig. No. 8.

Laying the special self-cleaning filter pipes by backpulling the drill rods

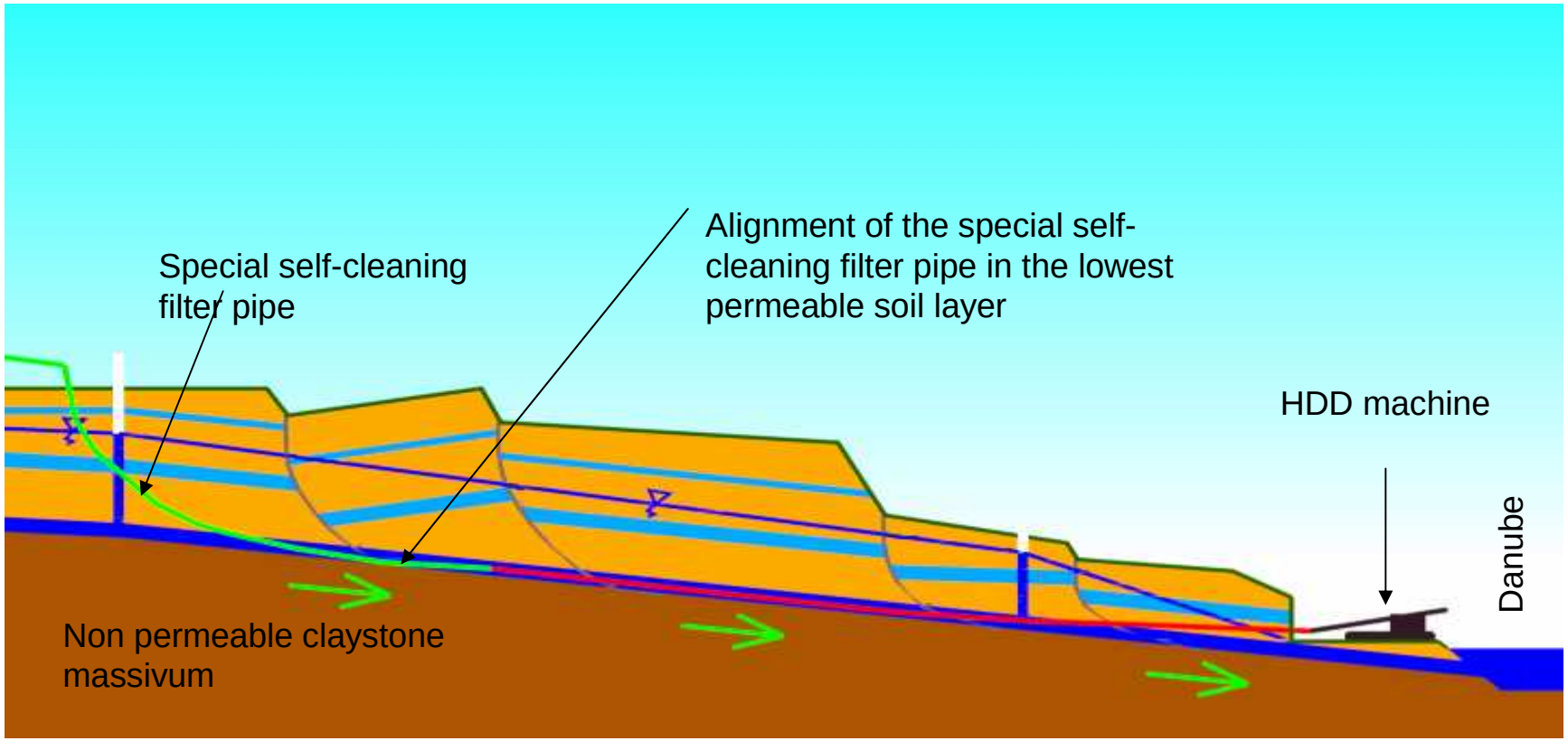
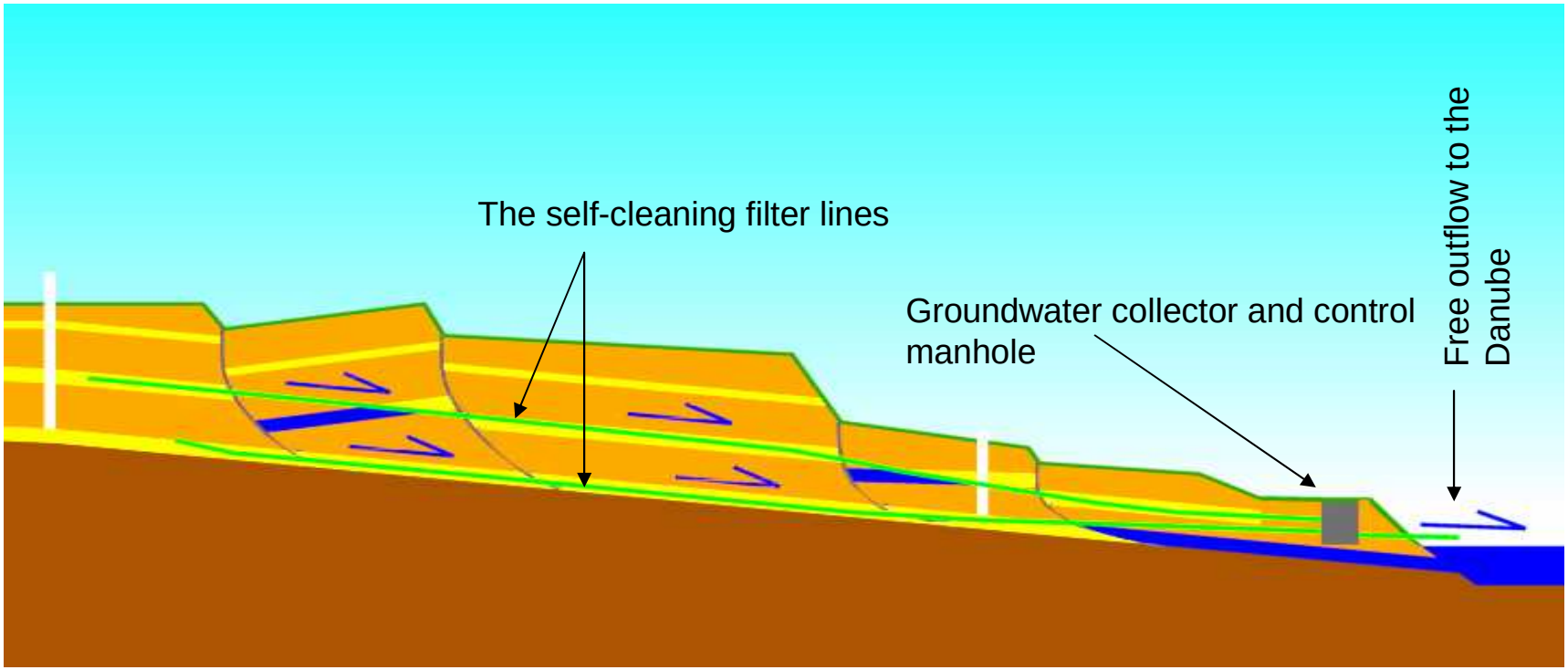


Fig. No. 9.

The multi-level special filter line system laid by horizontal directional drilling



By the application of this multi-level filter line system on the whole riverbank area - endangered with land-sliding earlier –the water saturated permeable layers became pactically dry (except of the lowest permeable layer) and the piezometric pressure in these layers ceased. There are no more reasons for land-slides, the whole area is in a stable position now.

We will show now a short film report on the riverbank stabilisation works at Ercsi/Hungary.

Thanks for your kind attention

Questions, remarks?

For additional informations please contact us directly:

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