

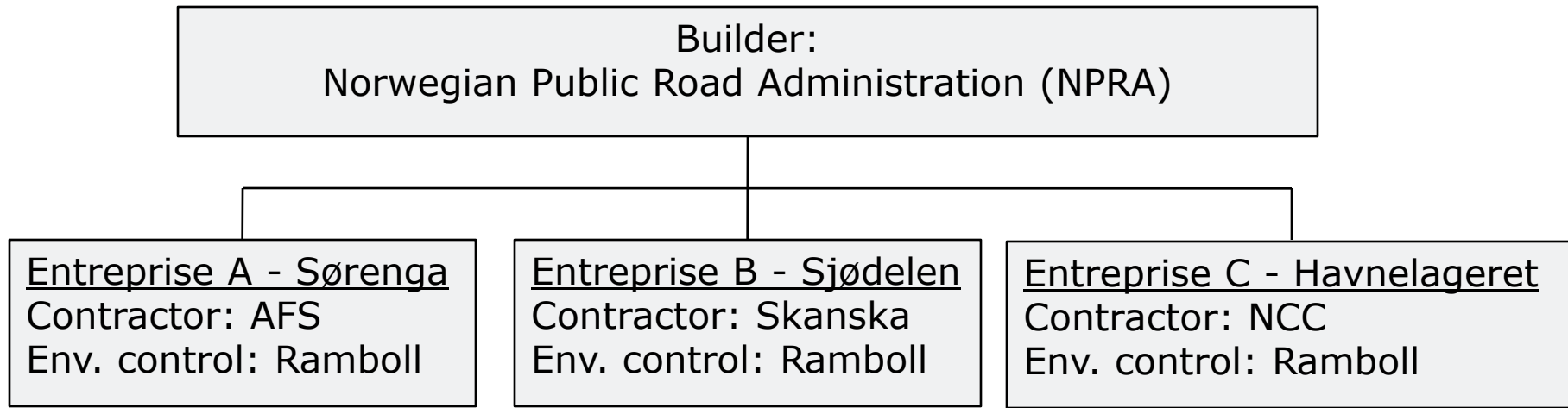
# The submerged tunnel project in the Oslo Harbour

## Environmental monitoring

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Environmental Department, Oslo



# Introduction



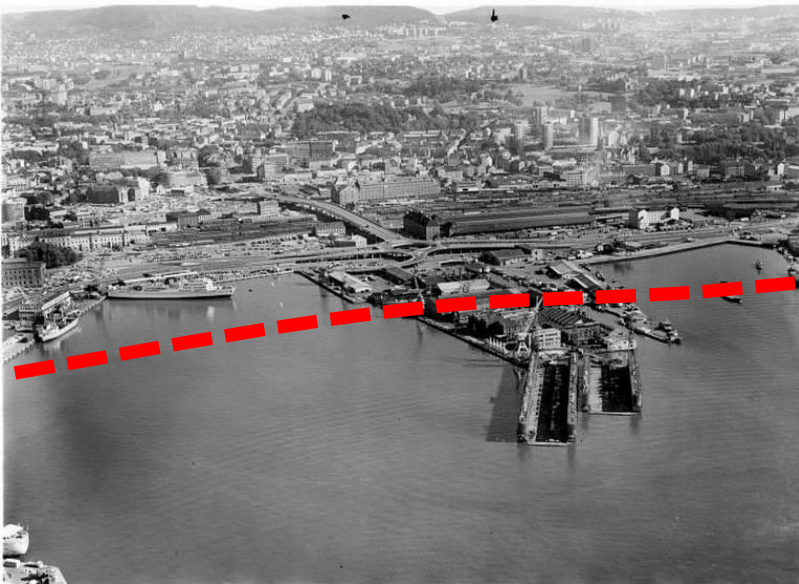
- NPR: Svein Røed, Turid Winther-Larsen, Marianne Aam Ness, Geir Sorte
- Ramboll: Arnt-Olav Håøya, Anne Fevang, Guro Thue Unsgård, Tom Tellefsen, Per Kristian Røhr, Michael Helgestad, Roger M. Konieczny, Fred Ytterdahl, Aud Helland, Tom Jahren, Kristine Bondo Pedersen, Jan Rukke, Per Samuelson, Malin Angervall

# Presentation - contents

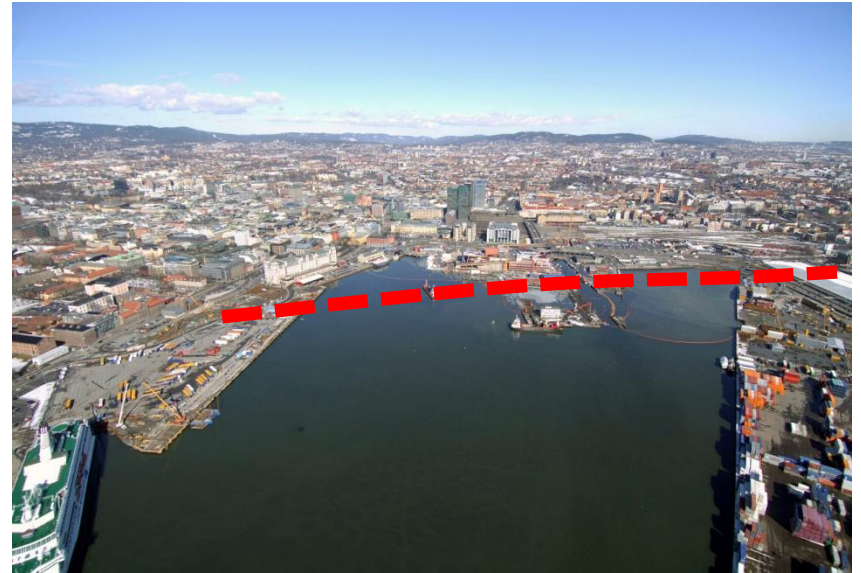
- Background
- Monitoring and control
- Results and experiences

# Background (1:5)

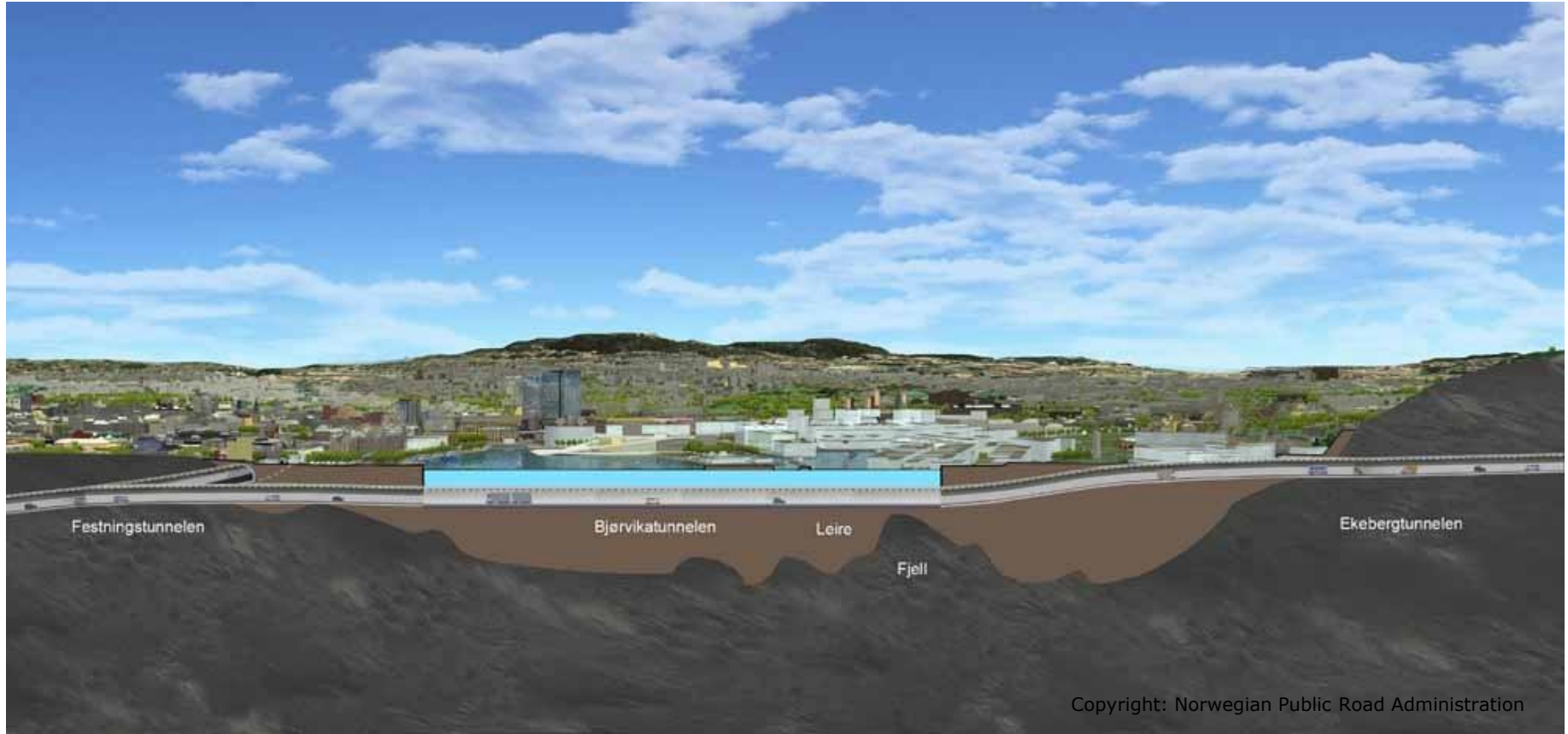
1971



2006



# Background (2:5)



# Background (3:5)



# Background (4:5)

- **Environmental authority - permit**

- Environmental impact preventive measures
  - On-line turbidity monitoring with an alarm system
  - Physical barrier (silt curtain)
- Environmental documentation of the preventive measures

# Background (5:5)

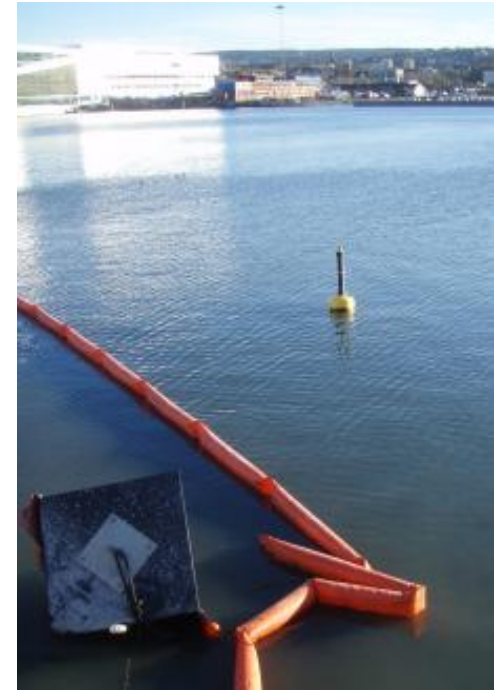
## ■ **Inspection plan**

- Prepared by the Norwegian Public Road Administration.
- Describing detailed procedures for monitoring and control.

# Monitoring and control (1:2)

## Continuous online turbidity monitoring.

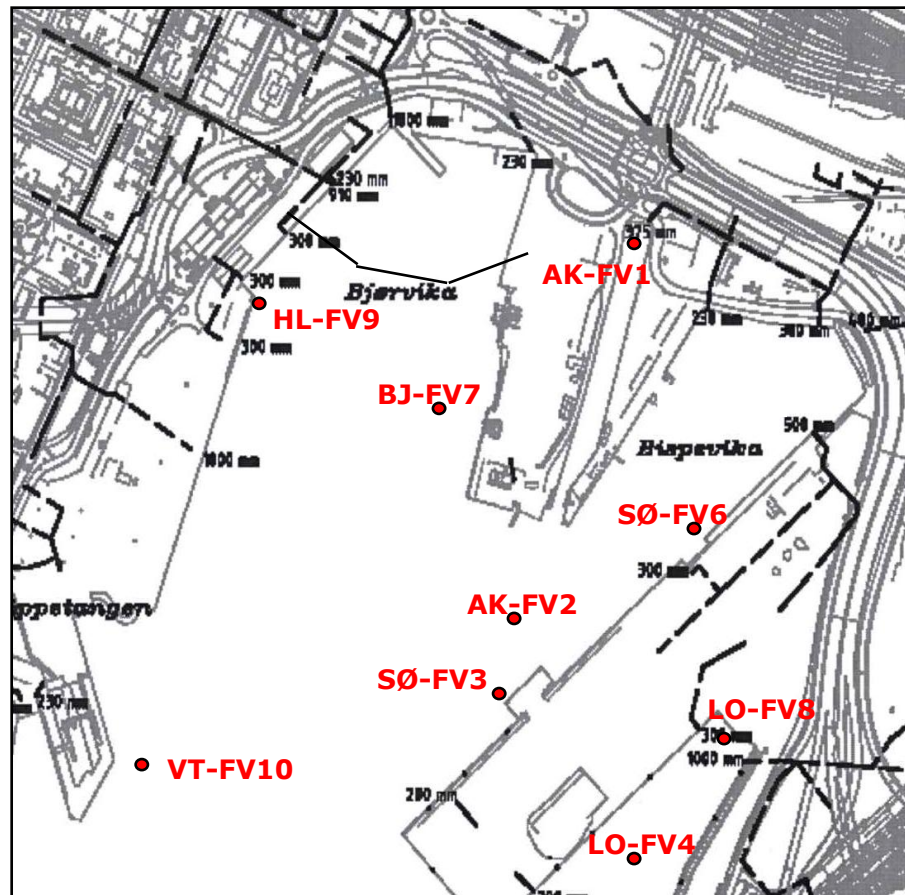
- Contractor (Skanska):
  - Performed the monitoring.
  - Maintenance of the equipment.
- Environmental control (Ramboll):
  - Control of stops when alarms.
  - Determining the effect of special events.



# Monitoring and control (2:2)

## Chemical analysis of water and general inspections.

- 10 regular stations
- Additional stations established when needed
- Field measurements of turbidity

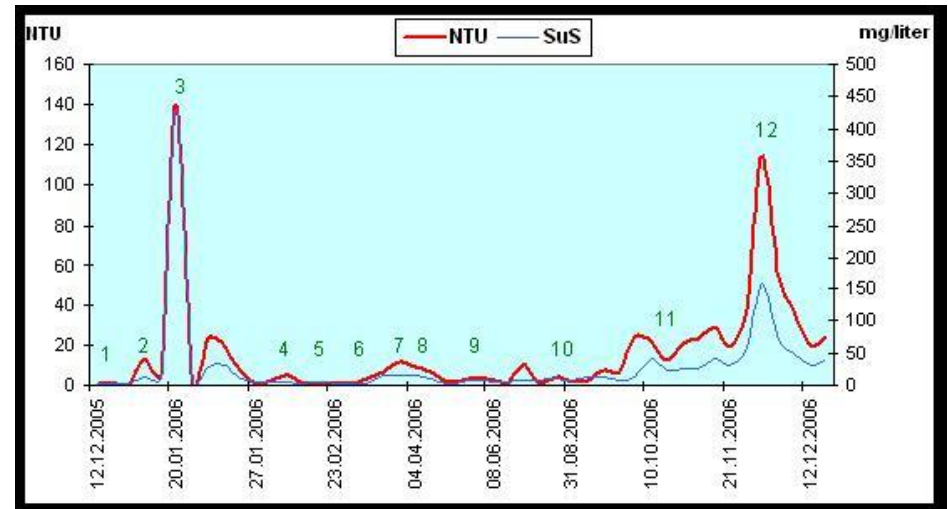


# Results and experiences (1:4)

Silt curtain – particles contained

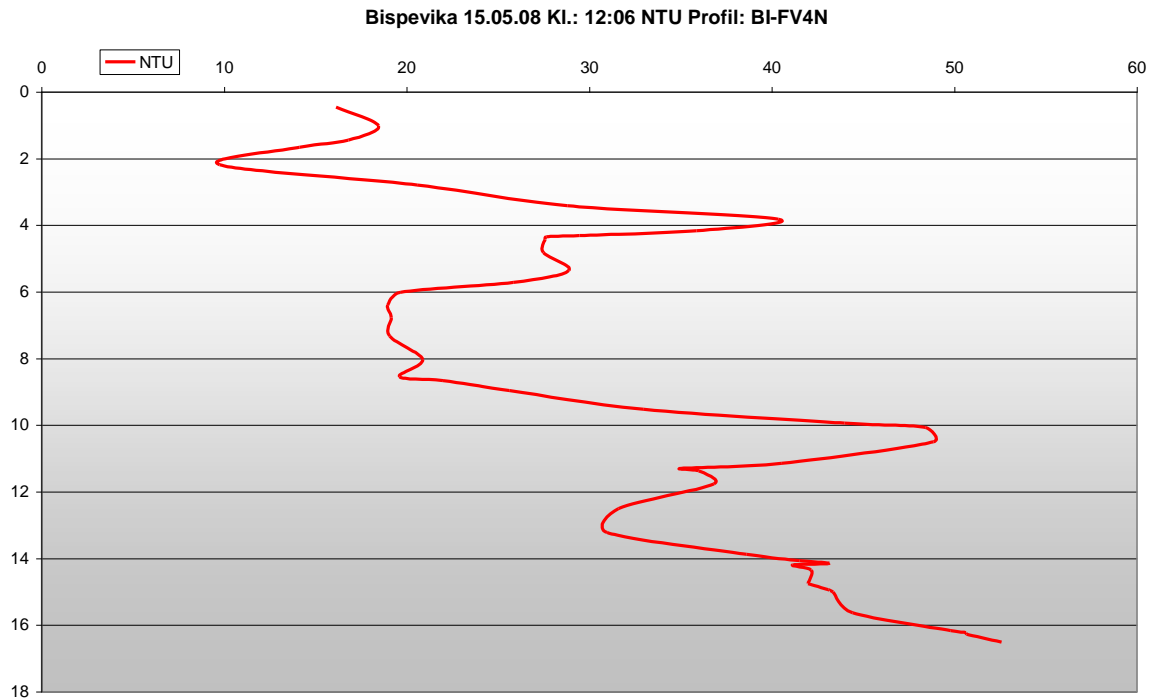


Turbidity and suspended solids

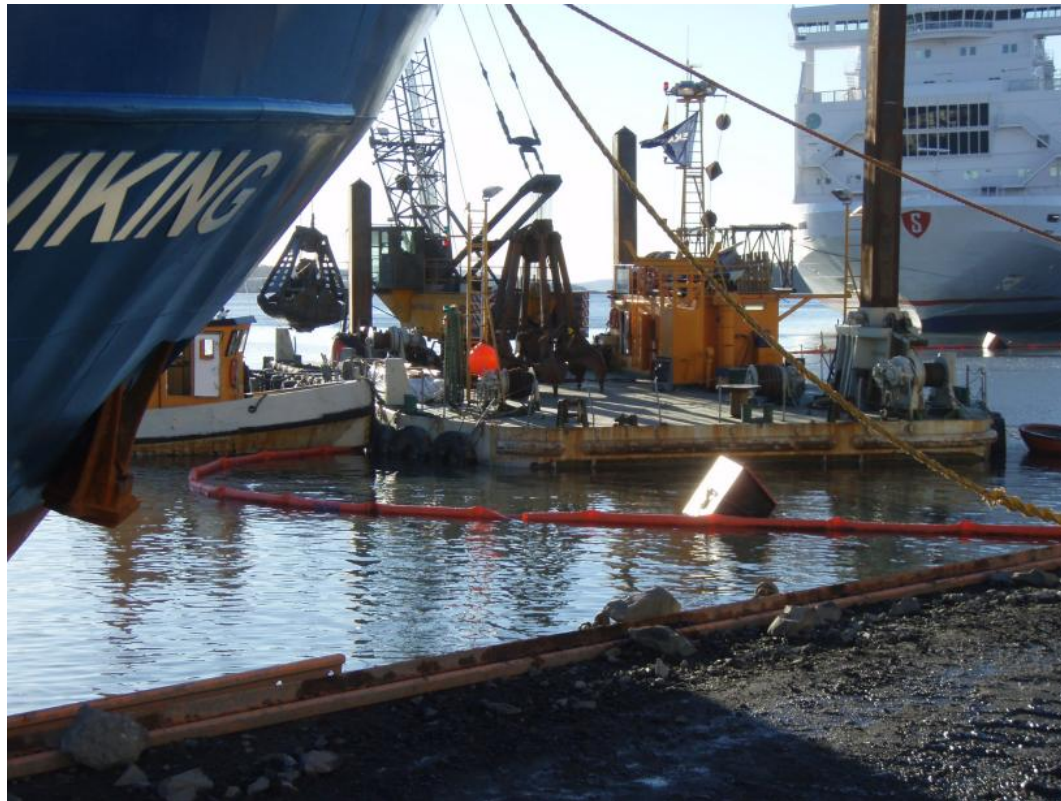


# Results and experiences (2:4)

## Profiling field measurements of turbidity



# Results and experiences (3:4)



## Results and experiences (4:4)

- The project have contributed to an increasing amount of particles locally. But not exceeding the permit outside of the construction area (50 – 100m).
- The on-line turbidity monitoring system have performed as expected.
- Siltcurtains prevents the spreading of particles, but their effect decrease in areas with high flow and/or when close to heavy machinery.