

PFAS Remediation at Avinor Airports

Overview and Results

Agenda

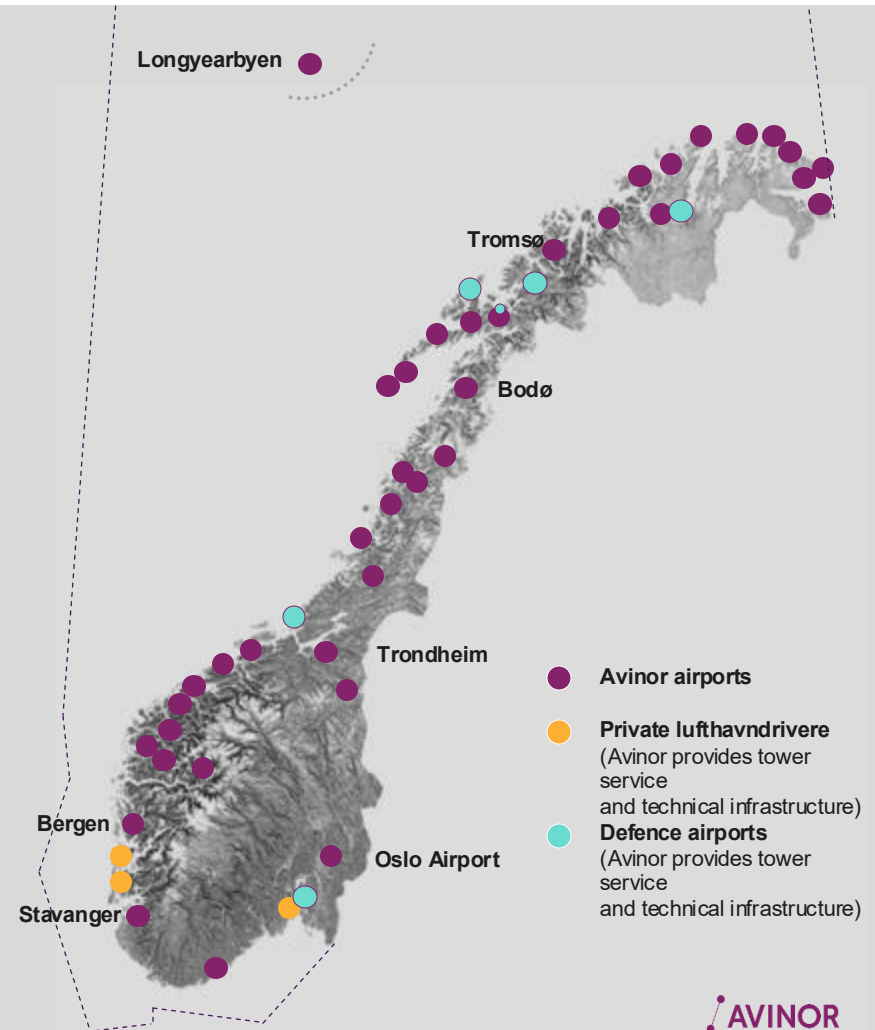
1. PFAS at Avinor airports
2. Costs and financial provisions
3. Remediation projects 2015–2025
4. Remediation results
 - Environmental objectives
 - Water quality monitoring
 - PFAS in sediment and biota



Firefighting training area
BØF (Brannøvingsfelt)

PFAS at Avinor airports

- Responsible for 43 airports and the air navigation service for civil and military aviation in Norway
- All airports have one or more locations that are contaminated with PFAS due to previous use of firefighting foam
- PFAS has been found in soil, groundwater, surface water, drinking water, recipients downstream the airports and in biota.
- In 2019, Avinor reviewed 59 active or closed firefighting training areas
- The Norwegian Environment Agency have a strong focus on these substances



Letter with orders from the Norwegian Environment Agency:

Supplementary soil sampling (10 airports)

- 2020-2022

Supplementary soil sampling (16 airports)

- 2024-2025

Investigate PFAS in drinking water (26 airports)

- 2020-2022

Investigate PFAS in biota (22 airports)

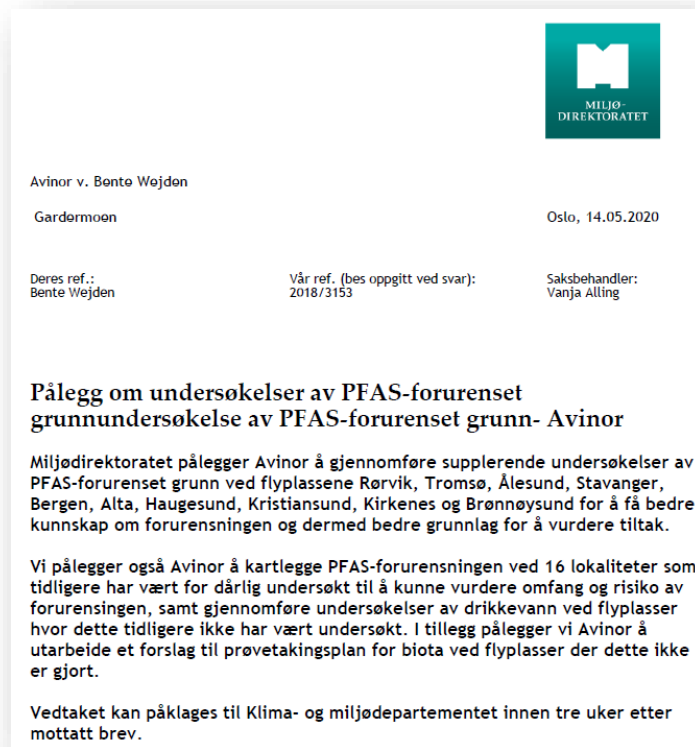
- 2022-2024

Action plans (13 airports)

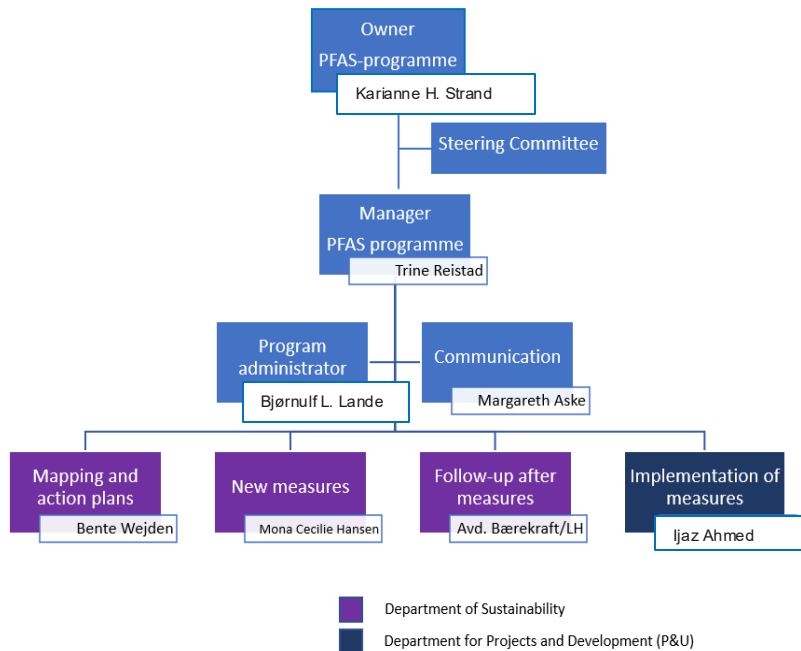
- 2021-2024 (still working)

Implement measures at 14 airports

- 2020-2027



The PFAS program



The objectives of the program

Respond to orders from Norwegian Environment Agency's

Contribute to the national goal of reducing emissions of these environmental chemicals

Investigate the possibility for more cost-effectively clean-up. Without this being at the expense of environmental impact

5 full-time positions dedicated to PFAS + consultants

Accounting provision - PFAS clean-up



The provision must reflect expected costs linked to clean-up in PFAS-contaminated locations



Updated every quarter based on the latest knowledge and documentation in the form of mapping, action plans, final orders, implemented measures etc..

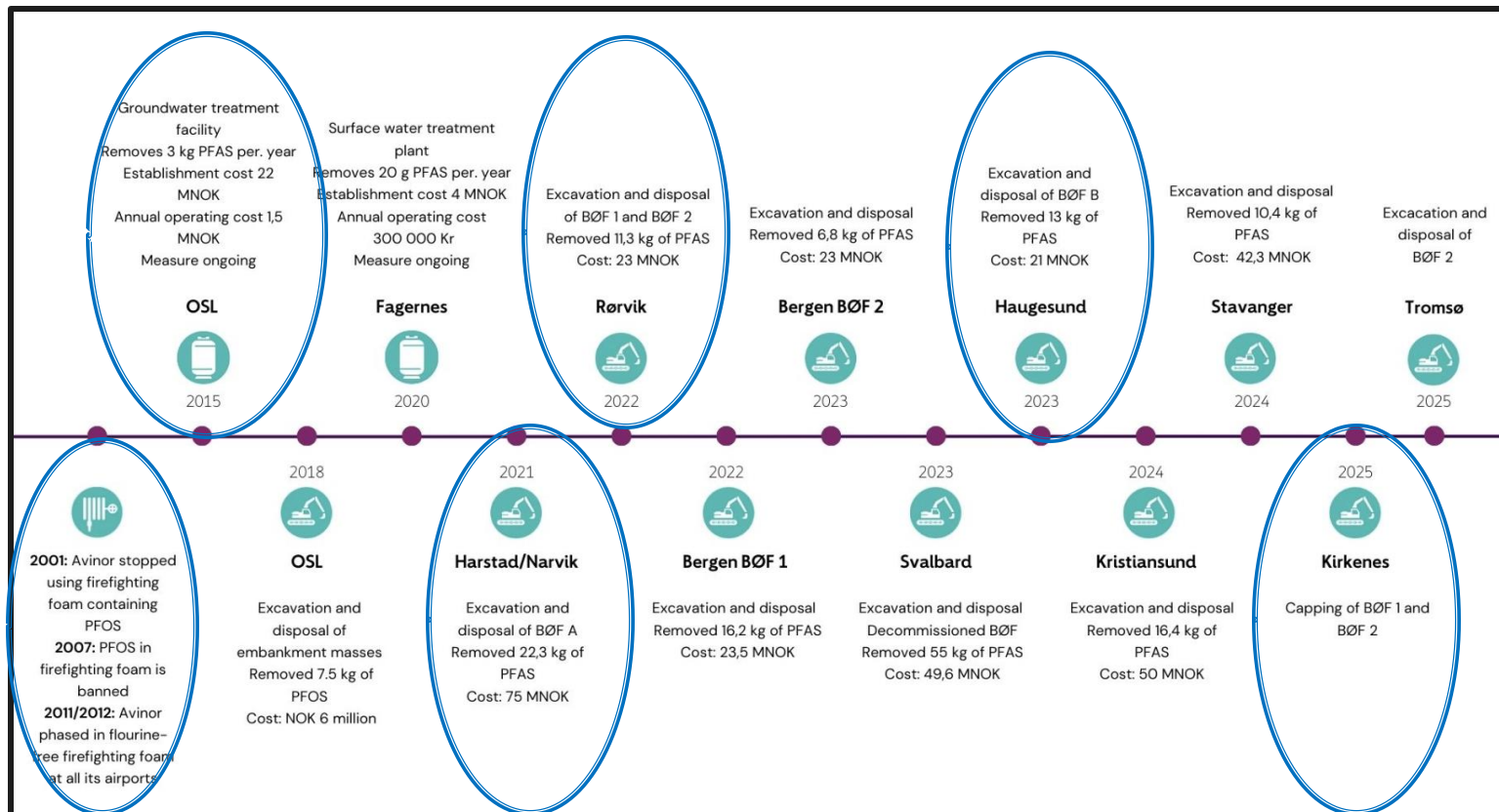


Updated in close dialogue with the accounting department and auditor

Accounting provision for clean-up - 127 million EUR

So far, Avinor has due to Q2 2026 used 69 million EUR on works related to PFAS

PFAS remediation 2015-2025

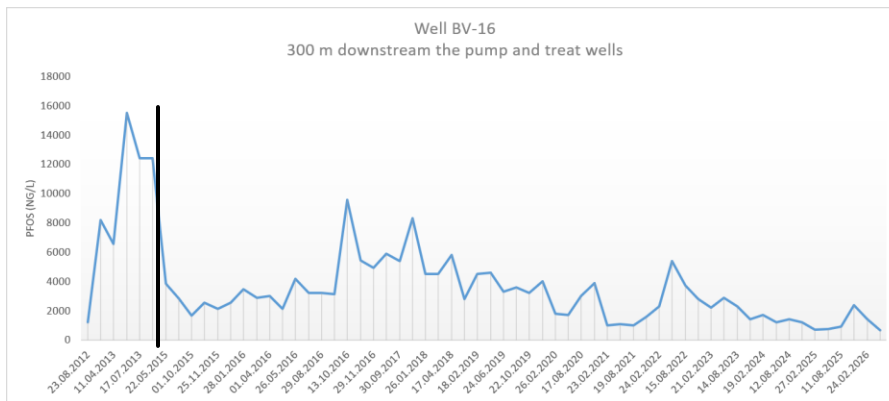
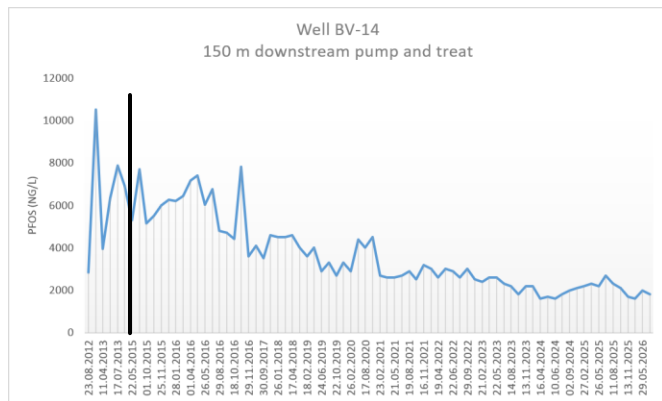
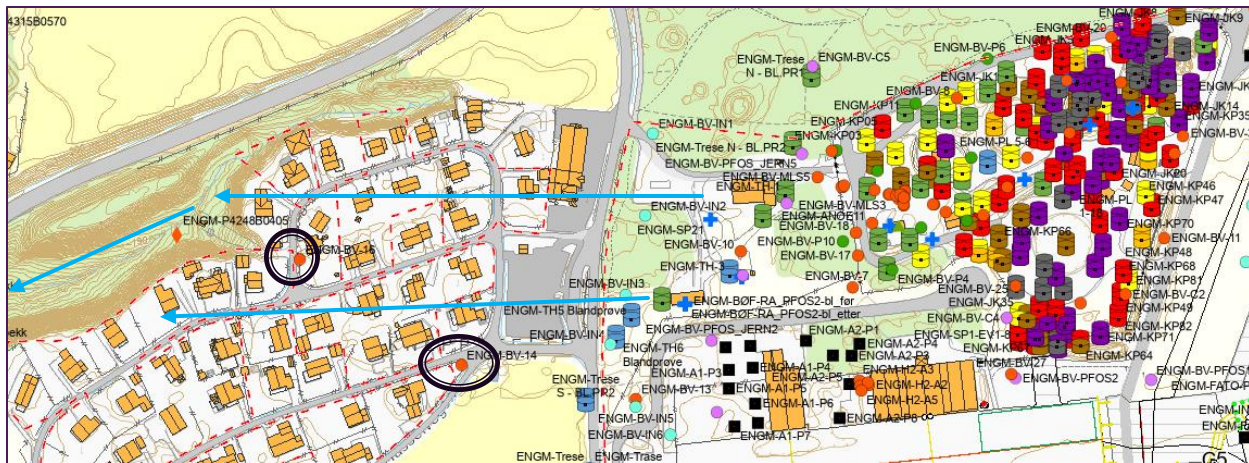


Oslo airport - Gardermoen



- Pre-remediation estimates:
 - 108 kg of PFOS
 - 32,000 m²
- 2015 – Pump-and-treat system
 - Approximately 2.4–3 kg of PFOS removed annually through water treatment
 - 2015–2026: 30 kg of PFOS removed
 - Groundwater pumping wells
 - Infiltration wells
- Cost: NOK 1.5 million/year + setup costs

ENGM – Water Quality Monitoring Results

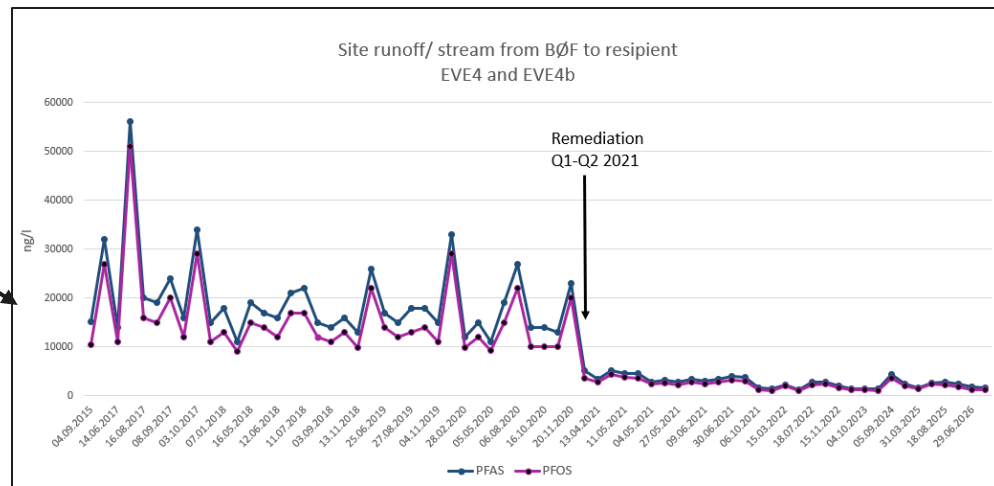
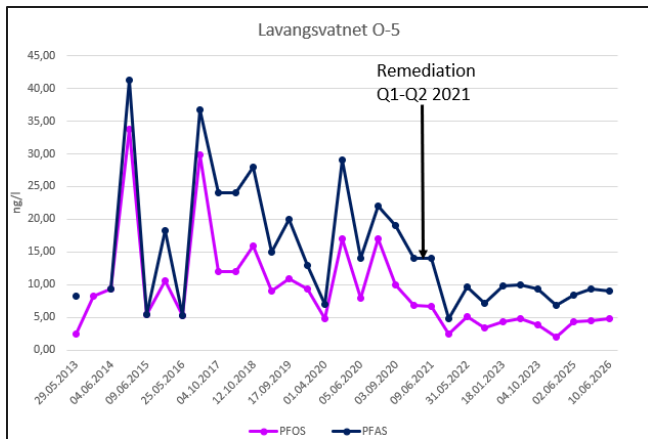




Harstad/Narvik - Evenes (BØF A)

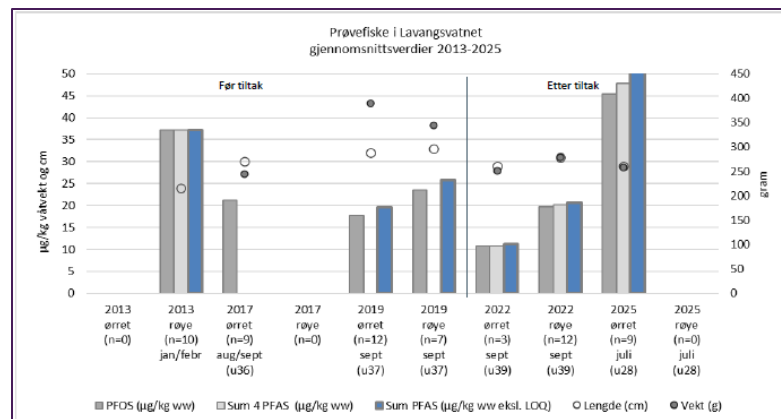
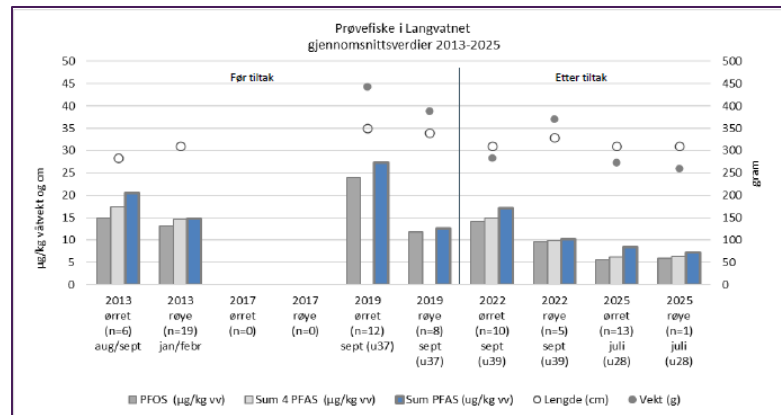
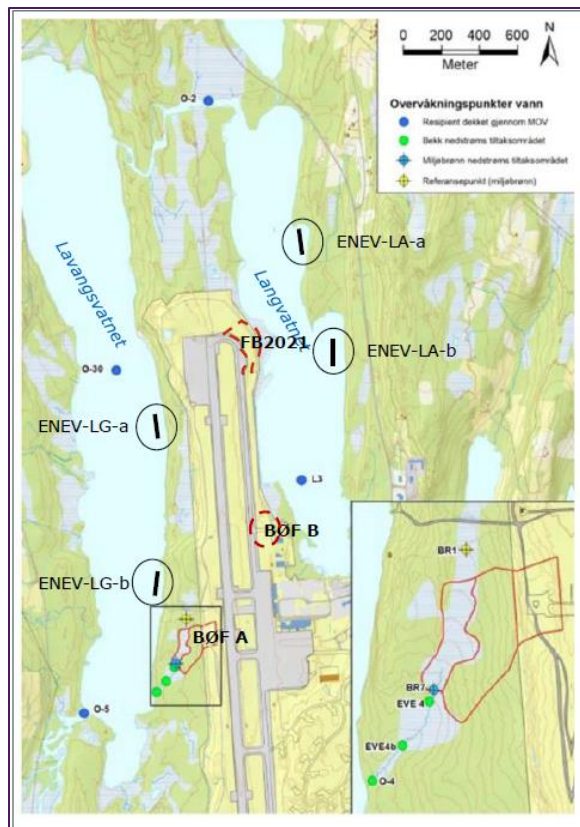
- Pre-remediation estimates :
 - 22.9 kg of PFAS
 - Annual PFAS leaching into Lavangsvatnet: 575 g
- Environmental objective:
 - Reduce PFAS leaching from BØF A by 95%
- 2021 excavation and disposal:
 - 22.3 kg of PFAS in 34,000 m³ of material
 - Soil and peat removed and replaced with clean donor peat
 - Contaminated material placed in a dedicated PFAS landfill cell
 - Site runoff and groundwater were treated
- Action thresholds: 100 µg/kg PFOS and 200 µg/kg ΣPFAS₂₆
- Cost: NOK 75 million

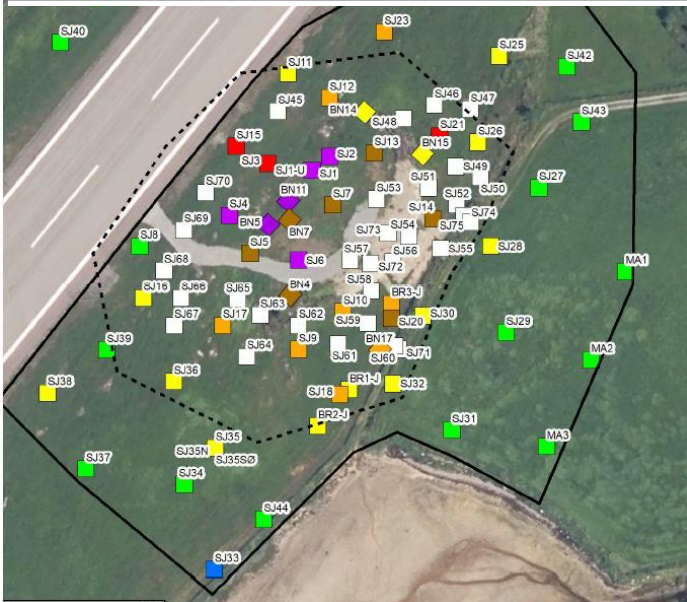
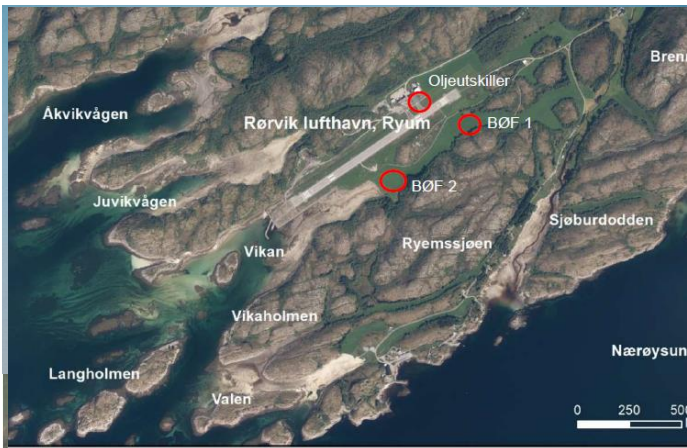
ENEV – Water Quality Monitoring Results



- 91 % reduction in PFOS concentrations (EVE4b)

ENEV – PFAS levels in fish

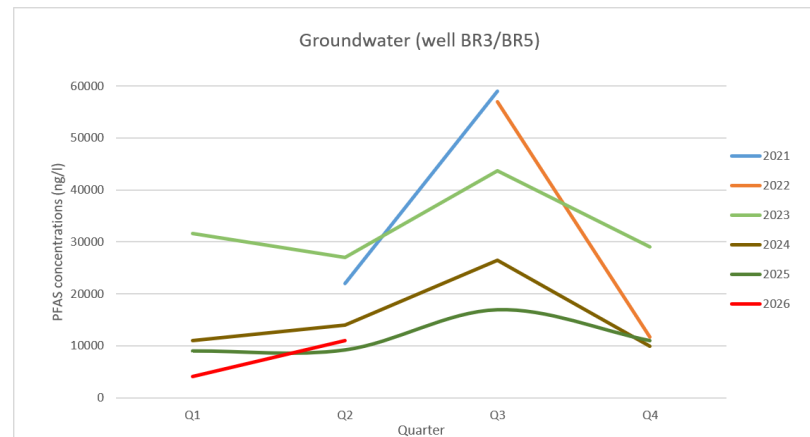
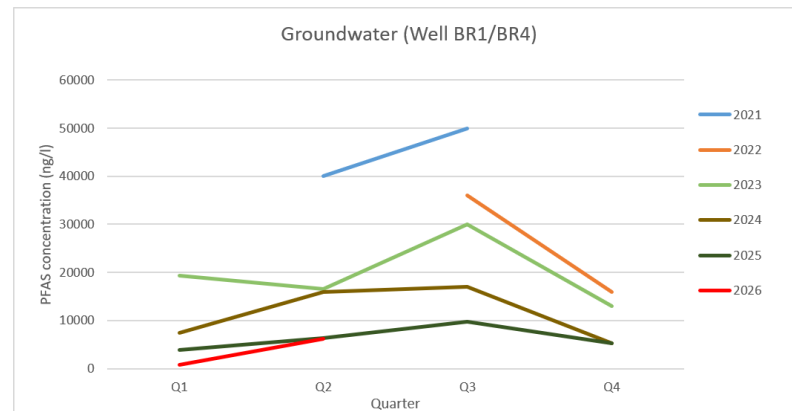




Rørvik Airport – Ryum (BØF 1 & 2)

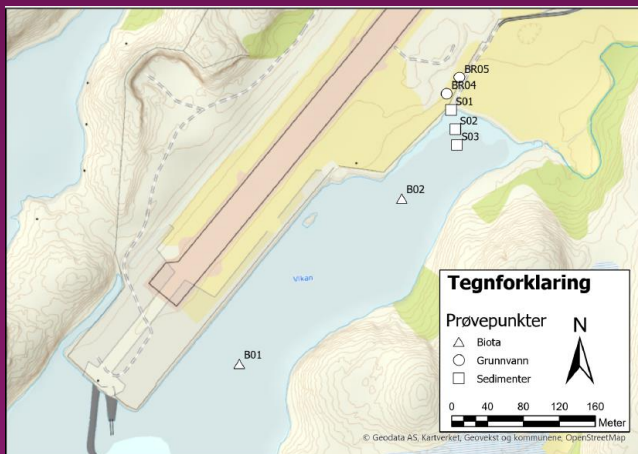
- Pre-remediation estimates :
 - BØF 1: 11.6 kg PFAS
 - BØF 2: 1.5 kg PFAS
 - Annual PFAS leaching into the fjord: 360 g
- 2022 excavation and disposal:
 - 0.1 kg and 11.2 kg PFAS (4 565 m³)
 - Contaminated soil was placed in a dedicated PFAS landfill cell
 - Site runoff and groundwater were treated
- Action threshold: 500 µg/kg ΣPFAS
- Cost: NOK 23 million
- Environmental objectives:
 - Remove 85% of PFAS from soil in the BØF 1 and BØF 2 areas
 - Reduce PFAS leaching from BØF 1 by 90%

ENRM – Water quality monitoring



- 75-94 % reduction in PFAS₃₅ concentrations in monitoring station P4, BR4 and BR5
- 2-3 years to see significant reductions in groundwater

PFAS Levels in Sediment and Clams



Station	2021	2024	2026	Change from 2021 to 2026
PFOS $\mu\text{g/kg DW}$				
S1	100	42	37,5	- 63 %
S2	41	5,9	20,5	- 50 %
S3	32	6,1	2,3	- 93 %
PFOA $\mu\text{g/kg DW}$				
S1	1,4	0,54	0,33	- 76 %
S2	0,56	0,063	0,31	- 45 %
S3	0,85	0,074	0,023	- 97 %
Σ PFAS ₃₅ $\mu\text{g/kg DW}$				
S1	120	49	42,5	- 65 %
S2	54	7,8	24	- 56 %
S3	50	7,6	2,1	- 96 %

Station	2021	2024	Change from 2021 to 2024
PFOS ($\mu\text{g/kg ww}$)			
B01	0,7	1,8	174 %
B02	41	6,3	190 %
Σ PFAS ₂₆ ($\mu\text{g/kg ww}$)			
B01	0,7	2,0	201 %
B02	2,3	7,0	201 %

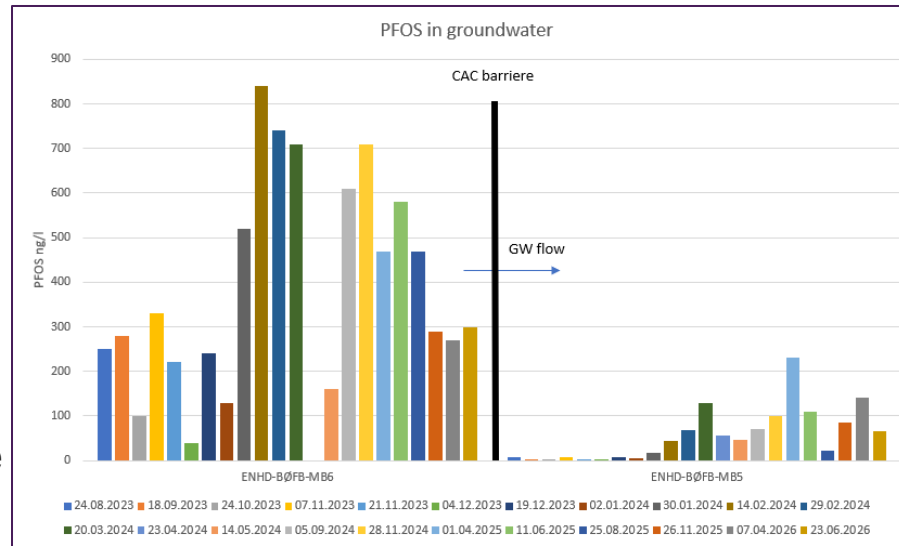


Haugesund Airport, Karmøy – BØF B

- Site characterization and conceptual site model (BØF B):
 - 13.3 kg of PFAS in soil at the hotspot
 - Annual PFAS leaching into Visnesbukta: 115 g
- 2023 excavation and disposal:
 - 13 kg of PFAS removed with 4,100 m³ of soil
 - Soil placed in a dedicated landfill for PFAS-contaminated material
 - Dewatering water treated with activated carbon (0.049 kg)
- Action threshold: 150 µg/kg ΣPFAS
- Cost: NOK 22.9 million
- Environmental objectives:
 - PFAS concentrations in Visnesbukta meet environmental quality class II (AA-EQS)
 - PFAS concentrations in resident species are reduced to levels comparable with reference areas

Mitigation measures: Barrier to reduce PFAS leaching

- Collodial activated carbon (CAC) barrier (SourceStop)
- Downstream the excavation area
- Bedrock
- Dimensions: 10 m long × 3–5 m wide



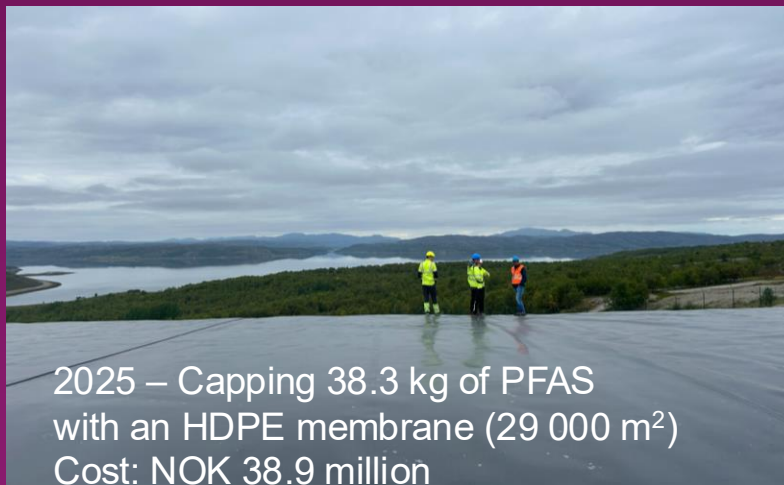
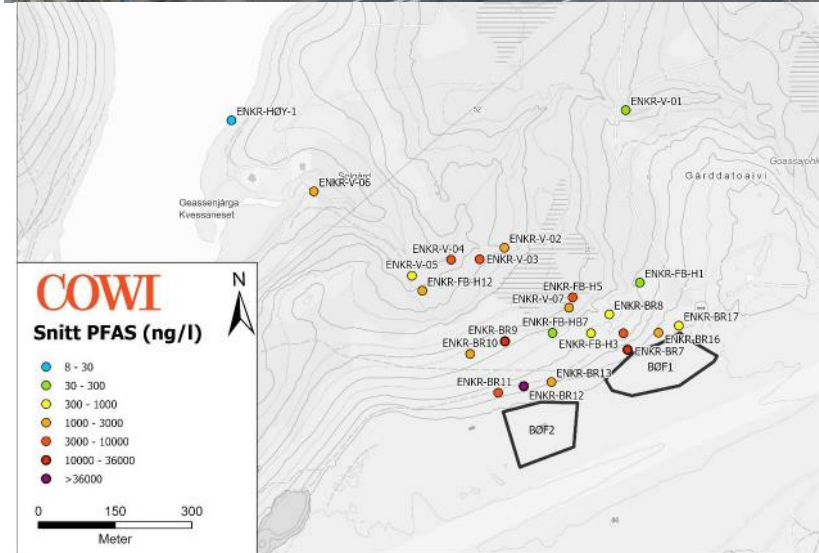
	Reduction of PFAS mass flux %			
	2023	2024	2025	2026
ΣPFAS ₃₅	93	84	67	59
PFOS	97	89	74	63
PFHxS	98	90	69	69
PFHxA	99	84	74	70
PFPeA	97	78	49	22
PFBA	74	2	0	0



Kirkenes Airport – Høybuktnmoen (BØF 1 and BØF 2)

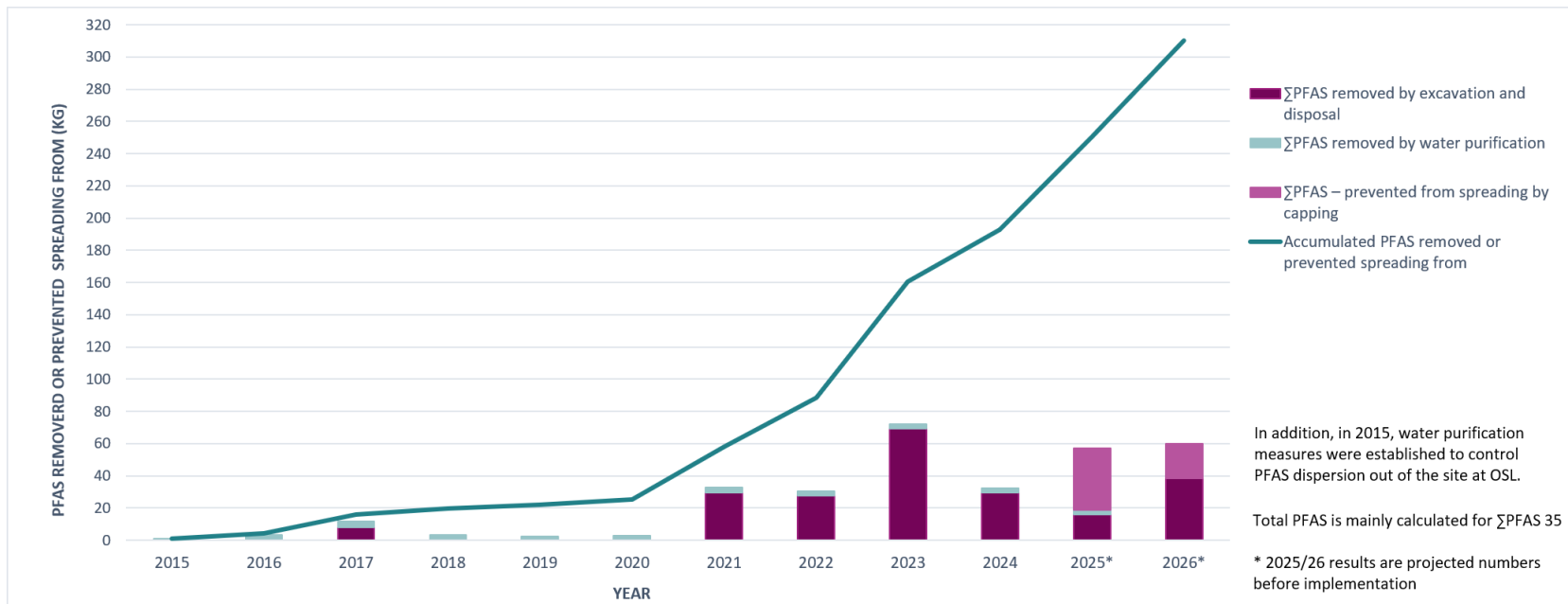
Pre-remediation estimates:

- BØF1: 18 kg PFAS in 240,000 m³
- BØF2: 23 kg PFAS in 50,000 m³
- A deep unsaturated zone
- Approximately 1 kg of $\sum\text{PFAS}_{35}$ leached out each year



2025 – Capping 38.3 kg of PFAS
with an HDPE membrane (29 000 m²)
Cost: NOK 38.9 million

PFAS removed or reduced leaching from



Thank you for your
attention



Further reading: Avinor.no [PFAS/PFOS report](#)