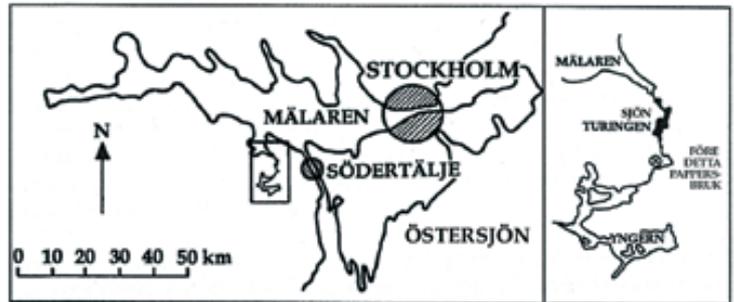




# Turingen

## Project Information

Bottom sediments in Lake Turingen in the municipality of Nykvarn, Sweden are contaminated with mercury released between 1946 and 1966 from a paper mill located upriver in the town of Nykvarn. Although use of mercury was discontinued in 1966, secondary releases still occur from the 350 to 400 kg of mercury that had accumulated in river sediments and in 225,000 m<sup>3</sup> of sediments in the 100 ha lake. This causes dislocations in the ecosystem of the lake and has rendered fish unfit for human consumption. As well, the ongoing releases pose a threat to the exchange of aquatic species between Lake Mälaren downstream and the nationally unique Lake Yngern upstream of Lake Turingen. Finally, if nothing is done, the situation implies a threat to nearby areas of Lake Mälaren, Sweden's third largest lake and the main source of drinking water for the city of Stockholm.



### Objectives and goals

**Isolation of 90 to 95% of mercury contaminated sediments from the aquatic environment**

<p style="text-align: center;"><i>in order to ...</i></p> <ul style="list-style-type: none"> <li>• Reduce mercury concentrations in fish to a level which does not inhibit human consumption</li> <li>• Hinder transport of contaminants from Lake Turingen to Lake Mälaren</li> <li>• Enable an unimpeded exchange of genetic material between Lake Yngern and Lake Mälaren, thereby ensuring biological diversity in the aquatic system</li> <li>• Allow greater freedom to use Lake Turingen for recreational purposes</li> </ul>	<p style="text-align: center;"><i>by undertaking remedial actions that ...</i></p> <ul style="list-style-type: none"> <li>• Stop resuspension of mercury contaminated sediments which leads to elevated levels of mercury in fish and other species</li> <li>• Construct durable barriers between mercury contaminated sediments and the aquatic system</li> <li>• Create a new, healthy lake bottom that can be rapidly recolonized by bottom fauna</li> </ul>
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Project activities have been organized into three parts: river remediation, lake remediation and long-term monitoring. Sweden's Department of the Environment, the Swedish Environmental Protection Agency, the European Union's Life-Environment fund, the environmental fund of the Stockholm County Health Authority, and the municipality of Södertälje have financed the remedial work.

Relocation of river channels	Reference measurements	Dredging and disposal near river mouth	Gel capping of transport and accumulation bottoms	Verification of results
1995	1996 - 1998	1999   2000	2001   2002	2003 ...
<b>Part I</b>		<b>Part II</b>		<b>Part III</b>
River remediation		Lake remediation		Monitoring

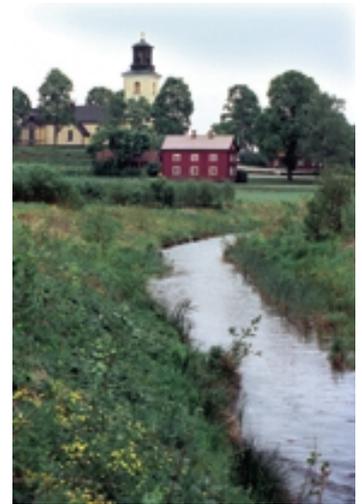
## Remedial actions

Remedial works in the river were carried out during 1995. The work entailed construction of new channels to lead flow past two reservoirs filled with contaminated sediments. This effort has significantly reduced the amount of mercury in circulation upriver of the lake.

The lake is being remediated in two stages. Work done during Stage 1 (1999-2000) included:



- Dredging of sediments from the final reaches of the river channel, from an area just outside the mouth of the river, and from shallow areas near the mouth of the river,
  - Redepositing of dredge spoils underwater along the shoreline and capping with a geotextile and clean geological materials, thus creating a new area of land, and
  - Underwater capping of 4 ha lake bottom near the river mouth with a geotextile and a two-layer barrier of clean geological materials.
- All work was performed within the confines of protective geotextile silt-screens, which isolated the active work area from the rest of the lake.



Stage 2 of lake remediation, which is being carried out during 2001-2002, entails capping of 80 ha lake bottoms at water depths greater than 2 me-

ters (accumulation and transport bottoms) with a gel-like artificial sediment. The thickness of the cap will vary between 3 and 6 centimeters. After a few years, natural sediment will overly the cap and there should be no problems for bottom-dwelling organisms to recolonize it.

The cover consists of a modified aluminum hydroxide precipitate. This "Cover method", which was invented by two Swedes and is being installed by the Swedish company Vattenresurs AB, is the only one of its kind in the world.

An extensive environmental monitoring program is being used for supervision and evaluation of all project activities. Among other things, the monitoring program encompasses



During the summer of 1999, Vattenresurs performed a pilot scale test

sampling, measurement and chemical analysis of water, sediment, and biota (zooplankton, bottom fauna and several species of fish). To date, the program has been able to verify that remedial activities have not had a negative impact on the environment. However, it will take several years following completion of Stage 2 before the biological variables being measured are able to verify that the project has met its objectives.

