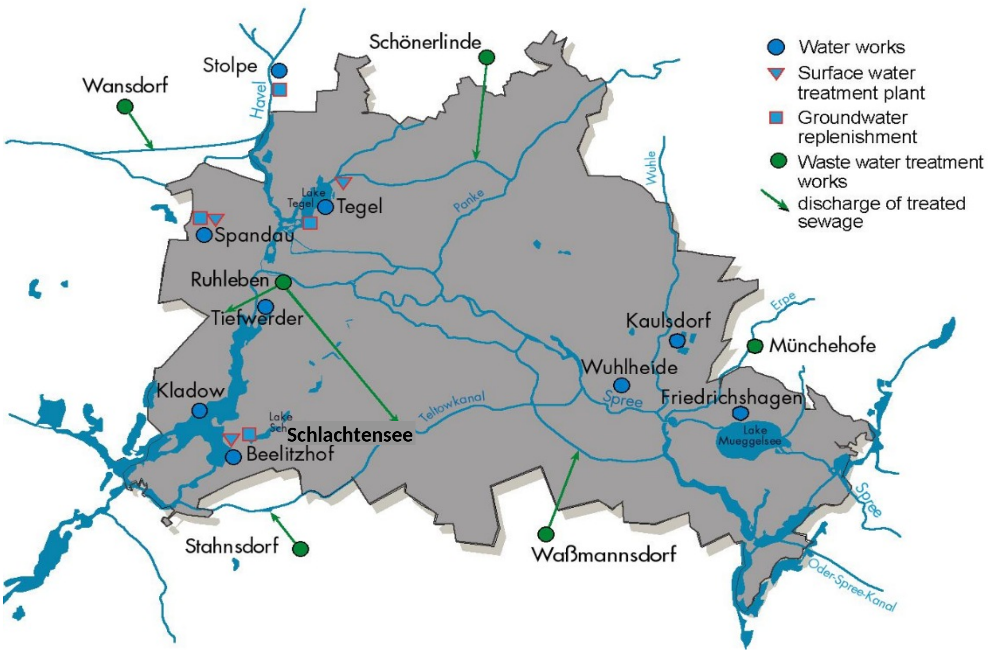
Features of Lake Tegel and background to the data

Ingrid Chorus and Anja Hoffman, October 2020

Lake Tegel

Lake Tegel is an urban lake located in a densely populated area in the northwest of Berlin. Along its north-western and south- eastern shores the land is partially forested. Two tributaries, the Nordgraben (which carries treated wastewater from the Schönerlinde treatment plant) and the Tegeler Fließ, confluence nearby and feed the lake at its north-eastern shore, while the River Havel is connected to the south-western end at two sites separated by the island Valentinswerder. The amount of Havel River water flowing into the lake depends on the discharge of the north-eastern tributaries and of the Havel River as well as on weather conditions (including wind direction and strength). Estimating this fraction of the total inflow is challenging: Model results by Schimmelpfennig et al. (2012) indicate a high variability of this Havel River water intrusion, amounting to 20 – 40% of the water in the lake's main basin and a water retention time of 50 – 100 days.



Water systems, water works and wastewater treatment plants in the Berlin region (from Schauser & Chorus, 2011). Note Lake Tegel in the north-west and Lake Müggelsee in the south-east, a lake that is also described in LakeBase.

Morphometric and hydrological characteristics of Lake Tegel

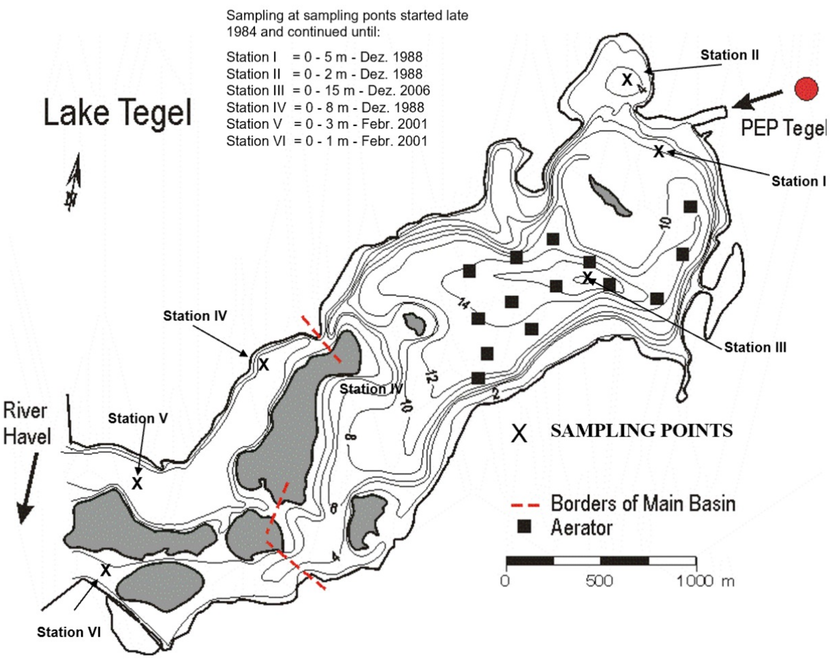
(from Chorus et al, in print 2020)

Surface area of main basin [km^2]	3.1
Total surface area [km^2]	4.0
Lake volume [10^6 m^3]	26.12
Maximum lake depth [m]	16
Mean lake depth [m]	7.6
Water retention time [d]	50 - 100

Lake Tegel is one of the city's major drinking water sources – supplying almost half a million of inhabitants with bank filtrate gained from production wells around the lake. A total of 8 well galleries abstract a mixture of groundwater and lake water, the latter is naturally filtered in the course of several weeks of travel time in the underground before it reaches the well. In total approximately 80% of the drinking water supply of waterwork Tegel derives from bank filtration and artificial groundwater recharge. Treatment of raw water is limited to aeration and rapid sand filtration, and microbiological quality test results show no need for disinfection of the drinking water.

Lake Tegel is intensively used for recreational activities, e.g. by sightseeing boats, motor boats and other watersports, including swimming.

Before the sewage treatment plant at Schönerlinde went into operation in 1986, sewage was treated on sewage farms ("Rieselfelder") by soil filtration. For decades, however, these were overloaded several-fold above their capacity, resulting in a high organic and phosphorus (P) load in the Nordgraben and extreme eutrophication of the lake. Oxygen depletion sometimes was so pronounced that anoxia extended from the bottom to 3 m below the lake surface, and massive cyanobacterial blooms caused Secchi disc readings typically less 0.5 m during summer. Due to the specific situation of West Berlin during the times of the "iron curtain", the city government aimed for a local solution and installed 15 aerators to counteract anoxia. These went into operation in 1979. Although they did not totally destratify the lake, they considerably weakened stratification, as temperature data given in LakeBase indicate.



Aerator installation merely targeted improving the oxygen supply. Thus, to minimize nutrient loads, the city government built a phosphorus elimination plant (PEP) at the confluence of the 2 northern tributaries shortly before they reach the lake (triangle in the map above). In parallel, negotiations with the government of the Democratic Republic of Germany led to the replacement of the sewage farms by a modern wastewater treatment plant at Schönerlinde, which also went into operation in 1986. However, as treated wastewater amounts to a major fraction of the discharge of the Nordgraben, the phosphorus concentrations of sewage treated with simultaneous P precipitation (≈ 500-1000 µg/L P) remained far too high to shift Lake Tegel to a lower trophic state. Treatment at the PEP involves precipitation, coagulation, flocculation, and in particular filtration, thus achieving effluent concentrations of about 20 µg/L P and exchanging the volume of Lake Tegel 2-3 times per year gradually “flushing” P out of the Lake. Inspite of this fairly substantial water exchange rate with “low P water” it took 10 years for TP-concentrations to decline from around 800 µg/l to 35-40 µg/L (summer mean). Consequently, in 1996 phytoplankton biomass and species composition shifted from dominance of cyanobacteria to a mixed composition at much lower levels of biomass. Trophic recovery continued for another 10 years, with summer TP concentrations of <20-30 µg/L in the mid 2000’s and submerged macrophytes returning to the lake.

Since the mid 2000’s, the lake has continued to develop towards a clearly mesotrophic state, with macrophyte coverage increasing and phytoplankton biomass decreasing. A reniewed slight increase of the P load since 2016 shows that the biocenosis responds immediately (Chorus et al, in print). While the trophic response to P loads and concentrations is paramount, other driving forces are gaining importance: in particular the invasion of the Quagga mussel as an important filter feeder as well as the trophic recovery of the Havel River, in which cyanobacterial blooms have been less pronounced in recent years. A concern for the future is that changes in hydraulic management and catchment management may well override the aim of trophic recovery.

Background to 35 years of data acquisition

To study the success of the measures described above, in 1985 the Berlin government contracted the Institute for Water-, Air- and Soil Hygiene" (in 1994 transferred to the German Environment Agency – Umweltbundesamt, UBA). In 1987 a research programme intensified this monitoring, including the periodic assessment of phytoplankton biovolume, and until the end of 2006, further research projects enriched the programme. Details are given in Chorus & Schauser, 2011, including references to publications about aspects of the lake's trophic recovery. Since 2007, the monitoring programme is being continued by the Berlin Senate Department for the Environment, Transport and Climate Protection and implemented by the Berlin-Brandenburg state laboratory (Landeslabor Berlin Brandenburg, LLBB).

Sampling started in autumn 1984 at 6 sampling points (shown as stations I – VI in the map above), and the full data are recorded in LakeBase. However, by the end of 1988 it turned out that the data of stations I – IV were very similar, and that station III at the deepest site of Lake Tegel represents the main basin very well (later hydrological modelling work confirmed that the main basin is quite homogeneous horizontally; see Schimmelpfennig et al. 2012 and references therein). Sampling of stations V and VI towards the Havel river was continued until early 2001 to determine the influence of the Havel River to the water quality of Lake Tegel.

Location of sampling points and aerators in Lake Tegel

Station	Depths sampled	Sampled from	Sampled until
I	0 – 5 m	March 1984	Dec. 1988
II	0 – 2 m	March 1984	Dec. 1988
III	0 – 15 m	March 1984	Dec. 2006 by UBA; ongoing by LLBB
IV	0 – 8 m	March 1984	Dec. 1988
V	0 – 3 m	March 1984	Feb. 2001
VI	0 – 1 m	March 1984	Feb. 2001

References

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