Basic characteristics of the Saidenbach Reservoir

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Introduction

The Saidenbach Reservoir was constructed between 1929 and 1933 by order of the city of Chemnitz and completed the drinking water reservoir system “Mittleres Erzgebirge”, which furthermore includes the reservoirs Einsiedel (built 1891 – 1894), Neunzehnhain I (built 1905 – 1908), and Neunzehnhain II (built 1911 – 1914) and the raw water pipeline system interconnecting the dams and the water work in Einsiedel near Chemnitz. It mainly serves to provide raw water for the supply of potable water for Chemnitz and its surroundings. It was the largest drinking water reservoir in Saxony until the commissioning of the Eibenstock dam in 1987. After a disastrous flood in the year 2002, extensive measures were implemented to improve flood protection of the Saxon reservoirs.

Like all surface waters in Saxony, the Saidenbach Reservoir is managed and operated by the Landestalsperrenverwaltung of the Free State of Saxony (LTV), which consists of five regional branches. The locally responsible branch is the Betrieb Freiberger Mulde/Zschopau with its head office in Lengefeld-Rauenstein.

First systematic limnological studies at the Saidenbach Reservoir were performed 1956 by students of the Abteilung Trink- und Abwasserbiologie of the Zoologisches Institut of the Karl-Marx-Universität Leipzig. After the foundation of the Hydrobiologisches Laboratorium Neunzehnhain in 1959, the reservoir was subject to numerous scientific projects and since 1975 until 2013 its physical, chemical and biological structures as well as its tributaries were regularly and continuously studied weekly or biweekly by the Neunzehnhain working groups of the Institut für Hydrobiologie of the Technische Universität Dresden and the Sächsische Akademie der Wissenschaften zu Leipzig in close collaboration with the LTV.

Structural details of the dam wall

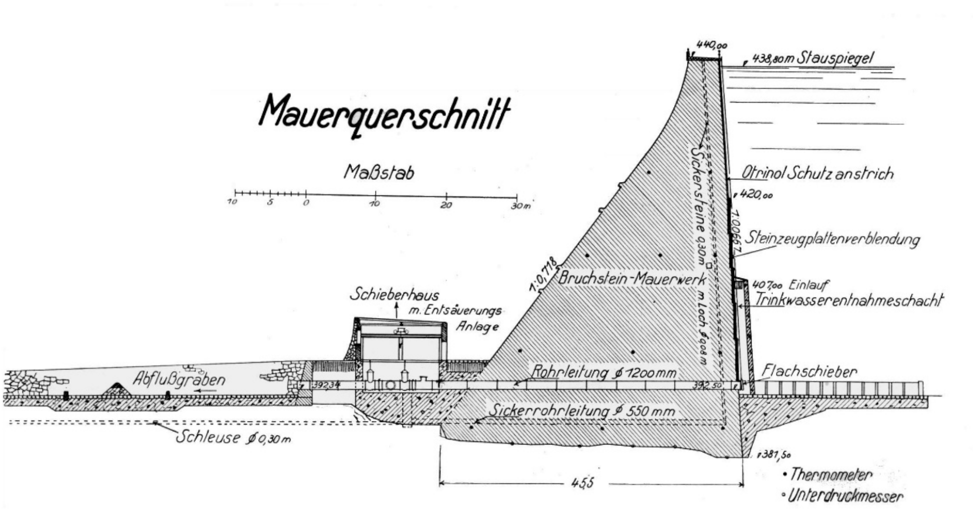


Figure 1: Cross section of the dam wall (Rat der Stadt Chemnitz, 1933)

- Gravity dam made of quarry stone brickwork
    - Wall crest: 440.00 m.a.sl
    - Highest fill level: 439.51 m.a.sl
    - Surface at full storage: 438.80 m.a.sl
    - Level of raw water intake: 407.00 m.a.sl.
    - Level of bottom outlet: 392.50 m.a.sl.

- Since June 1988: depth variable raw water release from between 410 m.a.sl. and 423 m.a.sl. (infinitely depth adjustable tube installed in raw water shaft)
- Since March 2013: surface outlet structure operational that allows controlled “overflow” at flood control storage (see Fig. 2)

Figure 2: Surface outlet structure. Left: Vertically movable penstock allowing to adjust overflow level (blue line: flood control fill level); right: functional test at approximate maximum outflow capacity of the outlet (10 m³/s). Photos: LTV

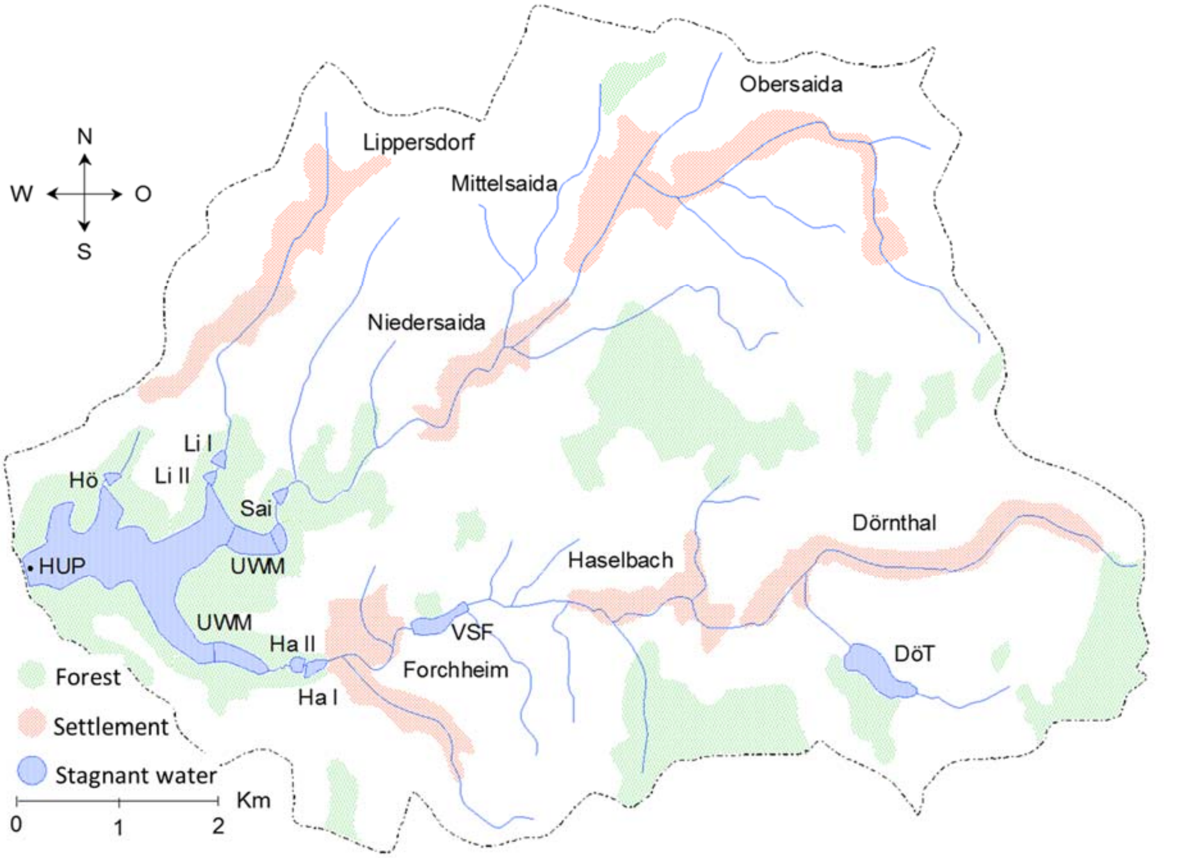
<u>The catchment area</u>

- Total Area: 60.7 km²
- Geology: hard rock, mainly red and grey gneiss; mostly brown soils and gley
- Altitudes h (KÖCK, 1982):
  - Highest point h_{max} = 708 m.a.sl. (Voigtsdorfer Höhe)
  - 17 % of the drainage basin h > 600 m.a.sl.
  - 63 % of the drainage basin 500 < h <= 600 m.a.sl.
  - 20 % of the drainage basin h <= 500 m.a.sl.
  - Lowest elevation h_0 = 438.8 m.a.sl. (surface of the fully filled reservoir)
  - Average altitude h_{mean} = 548 m.a.sl.
- Land use (REICHELT, Landestalsperrenverwaltung Sachsen, 2018, pers. comm.; underwent significant alterations since the 1960s, see also HORN et al., 2006):
  - 67.7 % agriculture (41.8 % arable land, 25.9 % grassland)
  - 23.3 % forest
  - 6.0 % settled area, roads etc.
  - 4.0 % waterbodies

- Population (number of inhabitants):

Settlement	THIEL (2004)	Currently	Reference (last downloaded 2018-03-15)
Lippersdorf	800	687	https://www.pockau-lengefeld.de/lebendige-stadt/stadtportrait/pockau-lengefeld-in-zahlen.html
Forchheim	700	604	https://www.pockau-lengefeld.de/lebendige-stadt/stadtportrait/pockau-lengefeld-in-zahlen.html
Niedersaida	290	251	http://www.grosshartmannsdorf.de/cms/index.php?page=1161541092&f=1&i=1161541092
Mittelsaida	620	500	http://www.grosshartmannsdorf.de/cms/index.php?page=1161541092&f=1&i=1161541093
Dörnthal + Haselbach	1200	880	https://www.olbernhau.de/de/olbernhau-zahlen
Obersaida	360	280	http://www.grosshartmannsdorf.de/cms/index.php?page=1161541092&f=1&i=1161541095

- No treatment of household sewage before 1994, but faeces had to be collected in tanks or pits without drain-off; between 1994 and 2010 stepwise completion of a pipeline system for collection and pumping sewage out of the drainage area into a downstream treatment plant; current connection rate to the sanitation system is 96 %.

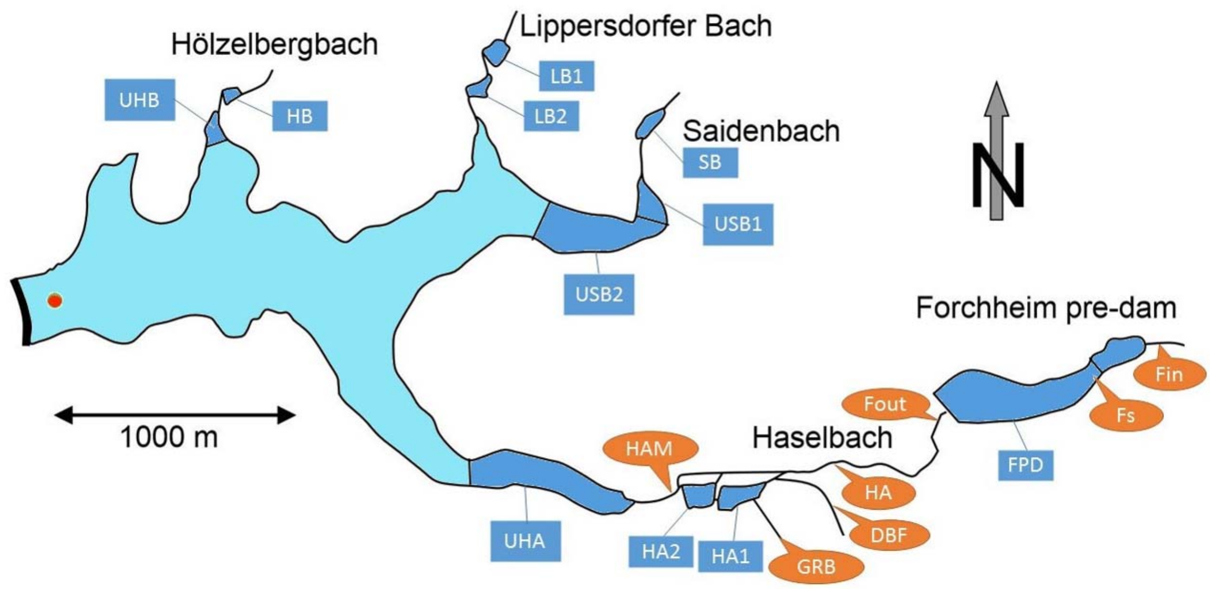


Drainage basin of the Saidenbach Reservoir (HUP = main sampling station; UMW = underwater dam; Hö = Hölzelbergbach; Li = Lippersdorfer Bach; Sai = Saidenbach; Ha = Haselbach; VSF = Forchheim pre-dam; DöT = Dörnthaler Teich; I = pre-dam 1, II = pre-dam 2); HORN et al. 2006.

- Average hydrological key figures of the partial drainage basins of the main tributaries (WERNECKE, 1983)

	Area	Measured precipitation	Corrected precipitation	Evapo-transpiration	Runoff	Runoff
	km²	mm/a	mm/a	mm/a	mm/a	m³/s
Entire watershed	60.7	842.6	894.5	517.8	376.7	0.7251
Haselbach	26.8	847.4	931.9	511.3	420.6	0.3574
Saidenbach	22.4	825.7	823.9	500.2	323.7	0.2299
Lippersdorfer Bach	4.7	797.1	862.6	496.8	365.8	0.0545
Hölzelbergbach	0.763	825.6	854.7	494.6	360.1	0.0087
*Rest (* estimated)*	6.037		884.1*	495.0*	389.1*	0.0745*

Pre-dams and sampling stations:



Sketch of the reservoir with pre-dams ( ), sampling stations at the Haselbach inlet ( ) and the position of the main reservoir sampling station (●)

Pre-dam	Volume m³	Surface ha	Spillway level m.a.sl.	Crest level m.a.sl.	Dam hight m	Retention time d	Mean depth m
UHB*	1,850	0.15	431.00	?	4.54	?	1.23
HB	2,700	0.40	444.00	?	4.35	3.40	0.68
LB1	15,650	0.54	448.67	?	4.10	2.60	2.90
LB2	6,400	0.53	445.00	?	5.00	1.10	1.21
SB	19,200	1.30	442.50	?	6.90	0.70	1.48
USB1*	20,000	1.66	435.00	436.00	5.30	?	1.20
USB2*	135,100	4.37	430.50	431.50	10.44	?	3.09
HA1	23,900	1.67	443.00	?	5.50	0.35	1.43
HA2	18,300	1.56	441.00	?	4.95	0.27	1.17
UHA*	219,500	6.63	434.00	435.00	9.52	?	3.31
FPD	588,390	11.97	468.00	?	13.30	8.60	4.92

* Underwater basins (crest usually below reservoir surface depending on actual surface level)

- Geographic locations of the sampling stations at the inflows of Saidenbach Reservoir (sampling only upstream of the pre-dams until 1985, both up- and downstream of pre-dams since end of 1985):

Station	N. latitude	E. longitude	Note
HA	50.7260481	13.2652509	till 1985
Fin	50.7302282	13.2874703	since 1985
Fin	50.7299158	13.3016539	since 1985 when Fin inaccessible
Fs	50.7294642	13.2824171	since 1985 at bottom sill in FPD
Fout	50.7278920	13.2732707	since 1985
HA1in	50.7256270	13.2631856	
HA1out	50.7251380	13.2599562	
GRB	50.7247339	13.2621878	
HAM	50.7250327	13.2568771	
DBF	50.7257526	13.2658142	
SBin	50.7406105	13.2585400	
SBout	50.7389403	13.2558578	
LB1in	50.7429019	13.2478219	
LB1in	50.7511807	13.2465345	if LB1in inaccessible
LB1out	50.7422977	13.2466525	
LB2out	50.7405766	13.2457620	
HBin	50.7410790	13.2325763	
HBout	50.7409941	13.2313102	

<u>Morphometry of the Saidenbach Reservoir</u> (approximation according to JUNGE, 1966):

- Area A_z (ha):

$$A_z = A_0 \left(1 - \frac{z}{z_{max}}\right)^2$$

- Volume V_z (10^6 m³):

$$V_z = V_0 \left(1 - \frac{z}{z_{max}}\right)^3$$

with depth $z = h_0 - h$ (m), altitude h_0 = 438.8 m.a.sl. of the surface level, surface area $A_0 =$ 146.4 ha, volume $V_0 =$ 22.4 × 10^6 m³, and maximum depth z_{max} = 46 m of the fully filled reservoir.

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