LakeData.txt

This file contains lake properties for **outlet lakes** with specific data available. Properties defined here override the properties and generic parameters given in GeoData.txt and par.txt. If you want to use a generic parameter from par.txt for a particular lake in *LakeData.txt*, use -9999 as parameter value for that lake in *LakeData.txt*. Lake depth from GeoData.txt may also be kept by using -9999 for the value in *LakeData.txt*. Lake properties include physical characteristics, e.g. depth, and outlet rating curve, regulation routine parameters, and parameters concerning nutrient cycling within the lake. In *LakeData.txt*, two regulation regimes can be defined; constant flow and seasonally varying sinus-wave shaped flow. For more regulation options, use DamData.txt, which extends the regulation options provided here.

Outlet lakes in HYPE can cover a fraction of a subbasin or the whole subbasin. Large lake systems can be split into several subbasins themselves (lake basins), which allows for different properties in different lake basins. Outlet flows for such lakes are then defined in an additional entry in *LakeData.txt*, see variable and column `LdType` in table below. Smaller lakes that are not divided into lakebasins may have two outlets defined in LakeData.txt (see model description. These outlets are defined by `ldtype` 5 and 6 for the main outlet and the branch outlet. For these lakes only the downstream subid of the branch need to be given in BranchData.txt.

LakeData.txt is a tab-separated file located in the modeldir folder. Lakes and lake basins are listed row-wise. The first row contains a column header with variable names. Variable names are not case-sensitive (max. 10 characters, no spaces). Columns with headings unknown to HYPE are skipped while reading the file, but the column heading must not be longer than ten characters. Columns containing character strings, e.g. descriptive data, must not exceed a length of 100 characters. The columns may be in any order. A value must exist for all columns which cannot be alternatively defined in par.txt, see column description in table below.

Example snippet of a *LakeData.txt* file structure, showing an unregulated single basin lake, and a regulated lake with two lake basins:

```
LAKEDATAID LAKEID LDTYPE LAKE_DEPTH  AREA W0REF QPROD1 DATUM1 REGVOL RATE
EXP ...
         1      0      1        3.6  5000  7.67      0      0      0   40
2 ...
         0      1      2        7.2 34000 21.94   13.5    401    200  155
0.3 ...
         2      1      3        6.9  4000     0      0      0      0    0
0 ...
         3      1      4          5 30000     0      0      0      0    0
0 ...
       ...    ...    ...        ...   ...   ...    ...    ...    ...  ...
... ...
```

The table below describes all *LakeData.txt* columns read by HYPE.

Variable ID	Unit	Type	LdType	Description
`lakedataid`	-	*general*	*1/3/4/5*	lake/lake basin ID (integer), used to connect lakes/lake basins to subbasins in GeoData.txt (mandatory). Only main outlet of lake with two outlets have lakedataid. The second outlet should have lakedataid=0. Otherwise the lakedataid must be a unique positive integer.
`lakeid`	-	*general*	*2/3/4/5/6*	lake ID (integer), used to connect lake basins to multi-basin lakes and and outlets to same lake with two outlets. Unique positive integer, 0 for simple outlet lakes (`ldtype` = 1)
`ldtype`	-	*general*	*all*	code for lake data type, integer (mandatory): **1** - simple outlet lake **2** - multi-basin lake, i.e. covering several HYPE sub-basins, generic lake/outflow properties **3** - upstream lake basin of a multi-basin lake **4** - last/outlet lake basin of a multi-basin lake **5** - lake with two outlets, main outlet **6** - lake with two outlets, second outlet
`lake_depth`	*m*	*physical property*	*1/3/4/5*	water depth below threshold for outlet lake (mean depth), can also be defined in GeoData.txt (must be > 0). Not used for outlet 2 of lake with two outlets.
`area`	m^2	*physical property*	*1-5*	lake or lake basin area, used for multi-basin lakes and to check which fraction of the sub-basin is covered by the outlet lake for simple outlet lakes (compared with SLC class fraction in GeoData.txt), mandatory for `ldtype` = 2
`w0ref`	*m*	*general*	*1/2/5/6*	reference water level to be added to simulated water level before print out, for lake outflow threshold. This column has a different meaning for ldtype=6, where it is used as the relative difference to the threshold (w0ref) of outlet 1.
`rate`	-	*general/regulation*	*1/2/5/6*	parameter for specific rating curve of unregulated lakes or for spillway flow of regulated lakes above threshold (`w0ref`), equation $q = rate\ (w - w0)^{exp}$.
`exp`	-	*general/regulation*	*1/2/5/6*	parameter for specific rating curve of unregulated lakes or for spillway flow of regulated lakes above threshold (`w0ref`), equation $q = rate\ (w - w0)^{exp}$
`deltaw0`	*m*	*regulation*	*1/2/5/6*	difference in lake threshold for regulation with two rating curves (m). Determines the lake threshold for regulation period 2 (`w0=w0ref + deltaw0`), see `datum1` and `datum2`
`qprod1`	m^3/s	*regulation*	*1/2/5/6*	parameter for regulated olake, constant production flow down to lowest allowed waterstage for regulation period 1
`qprod2`	m^3/s	*regulation*	*1/2/5/6*	parameter for regulated olake, constant production flow down to lowest allowed waterstage for regulation period 2
`datum1`	-	*regulation*	*1/2/5/6*	parameter for regulated olake, start of regulation period 1 (if not defined only one period is used) (4 character month-day string *mmdd*)

Variable ID	Unit	Type	LdType	Description
datum2	-	*regulation*	*1/2/5/6*	parameter for regulated olake, start of regulation period 2 (4 character month-day string *mmdd*)
qamp	-	*regulation*	*1/2/5/6*	parameter for regulated olake, seasonally varying flow in regulated volume. Variation defined in form of a sinus wave with this amplitude (as fraction of current qprod: 0-1), where the minimum of the sinus wave occurs for day number qpha
qpha	-	*regulation*	*1/2/5/6*	parameter for regulated olake, seasonally varying flow below the threshold. Default is qpha = 102.
regvol	10^6 m^3	*regulation*	*1/2/5/6*	regulation volume for general regulation routine. Determines lowest water stage for production flow (*wmin*). (must be less than lake depth * lake area)
wamp	*m*	*regulation*	*1/2/5/6*	regulation amplitude. Usually larger than water depth given by regvol. Used for scaling computed water stage variation (below threshold) similar to variation of observations. Set to -9999 for not to use.
maxQprod	m^3/s	*regulation*	*5/6*	maximum allowed production flow. Usually larger than daily production flow. Will reduce the number of spill occations and the spill flow. Only used for lakes with 2 outlets.
minflow	-	*regulation*	*5/6*	flag for minimum allowed flow. If set to one, the actual minimum flow will be determined by production flow parameters. Only used for lakes with 2 outlets.
obsflow	-	*regulation*	*6*	flag for using wanted water transfer flow for second outlet, 0=no (default), 1=yes. Only used for lakes with 2 outlets.
limqprod	-	*regulation*	*1/3/4/5*	water level below which there is reduced production flow from a dam (fraction of regulating volume), the flow reduction is linear to *wmin* (lowest water stage for production flow). Can also be defined in par.txt
prodpp	*m/d*	*nutrient cycling*	*1/3/4/5*	parameter for internal load of Part-P
prodsp	*m/d*	*nutrient cycling*	*1/3/4/5*	parameter for internal load of SRP (m/d)
Qmean	*mm/y*	*physical property*	*1/3/4/5*	initial value for calculation of mean flow, can also be defined in par.txt
tpmean	*mg/l*	*nutrient cycling*	*1/3/4/5*	mean concentration of total P, used for production if P is not simulated. Also used as initial value of particulate P concentration in lakes. Can also be defined in par.txt
tnmean	*mg/l*	*nutrient cycling*	*1/3/4/5*	mean concentration of total N (mg/l), used as initial value N concentration in lakes. Can also be defined in par.txt
tocmean	*mg/l*	*nutrient cycling*	*1/3/4/5*	mean concentration of TOC (mg/l), used as initial value of TOC concentration in lakes. Can also be defined in par.txt
sedon	*m/d*	*nutrient cycling*	*1/3/4/5*	sedimentation rate for ON in lakes. Can also be defined in par.txt
sedpp	*m/d*	*nutrient cycling*	*1/3/4/5*	sedimentation rate for PP in lakes. Can also be defined in par.txt

Variable ID	Unit	Type	LdType	Description
sedoc	*m/d*	*nutrient cycling*	*1/3/4/5*	sedimentation rate for OC in lakes. Can also be defined in par.txt
wprodn	*kg/(m^3 d)*	*nutrient cycling*	*1/3/4/5*	production/degradation in water for N. Can also be defined in par.txt
wprodp	*kg/(m^3 d)*	*nutrient cycling*	*1/3/4/5*	production/degradation in water for P. Can also be defined in par.txt
wprodc	*kg/(m^3 d)*	*nutrient cycling*	*1/3/4/5*	production/degradation in water for C. Can also be defined in par.txt.
denitwl	*kg/(m^2 d)*	*nutrient cycling*	*1/3/4/5*	parameter for denitrification in lakes. Can also be defined in par.txt
deeplake	-	*physical property*	*1/3/4/5*	fraction of the lake's initial volume which is considered as slow (SLP), between 0 and 1. 0 means that the lake is not divided into a slow and a fast part. Can also be defined in par.txt
fastlake	-	*physical property*	*1/3/4/5*	parameter determining the fraction of lake outflow from the different lake parts (FLP, SLP). Varies between 0 (default, no outflow from FLP) to 1 (outflow fractions proportional to FLP and SLP volumes). Can also be defined in par.txt
t2mix	-	*physical property*	*1/3/4/5*	switch for using mixed lake T2 temperature on outflow of lake (0/1). Can also be defined in par.txt