

Management of water balance at Siilinjärvi mining area WaterSmart



Tekes

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Water balance at mining sites

- Aims:
 - Reliable estimates for the water balance (precipitation, runoff, evaporation) at mining sites: in ponds, tailing ponds, open pits, etc.
 - Estimates and forecasts for water level, pumping and discharge
- Solution:
 - Build a tool to estimate and simulate water balance in the area
 - WSFS (Watershed Simulation and Forecasting System, Vesistömallijärjestelmä) developed for Yara Siilinjärvi area

WSFS provides

- Real time simulation and forecasting of water balance
- Forecasting the need for pumping/outflow of storage ponds especially before rain/snow melt
 - To avoid overflow and dam breaks
- Estimating amount of discharge at channels and streams
- In planning phase of the sites: estimate water level and outflow in worst case scenarios
- Inputs for other systems:
 - E.g. Percolation for GTK's ground water model
- WSFS can be applied for simulations of:
 - Effect of climate change
 - Exceptional events (precipitation and temperature)

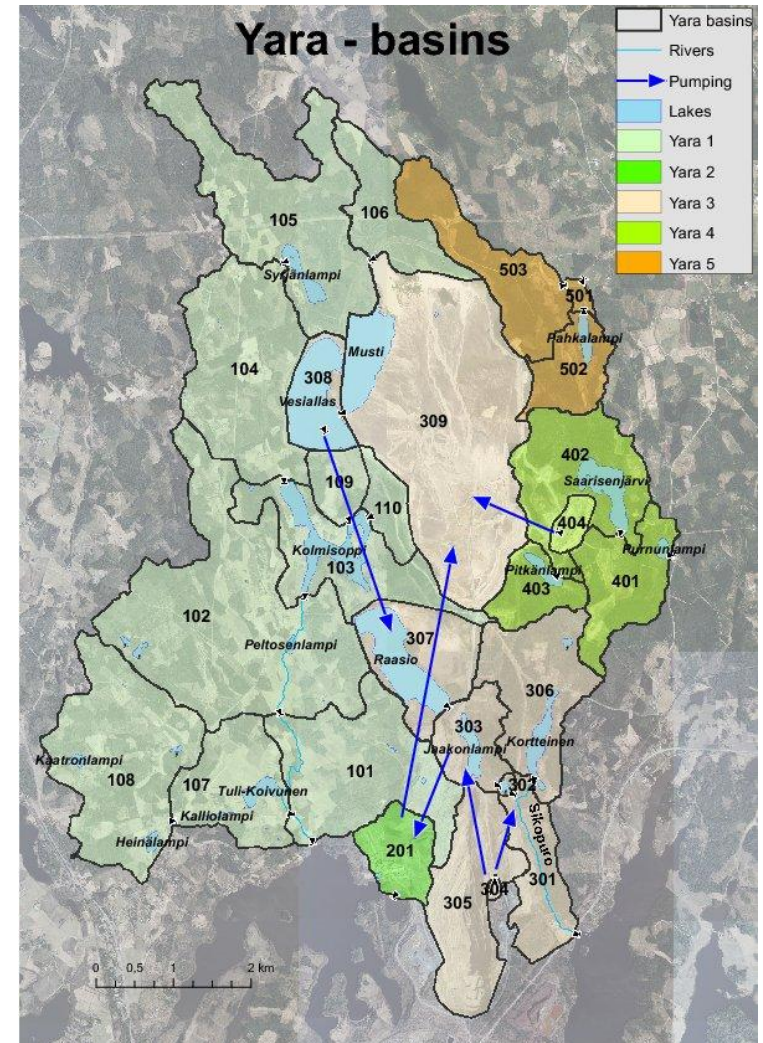


Inputs for the WSFS

- Weather observations and forecasts
 - From FMI, ECMWF
 - Real time weather forecast, weather radar observations
- Historical observations for calibration and long term forecasts
- Observations of water level, discharge and pumping, snow
 - Real time observations from mining site
- Outflowing and inflowing process waters given as input for the model
- Real time observations used in model updating
 - Improves forecast accuracy

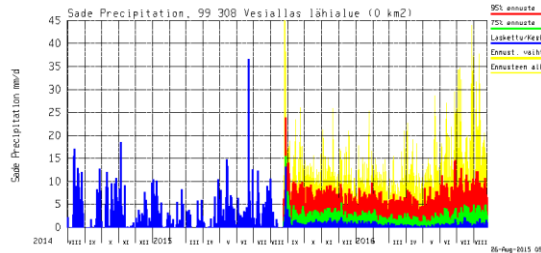
Water balance model for Siilinjärvi mining site

- Mining site divided into 27 water balance areas according to ponds
- Water balance components obtained for each area:
 - Precipitation
 - Evaporation
 - Snow
 - Soil moisture
 - Ground water storage
 - Runoff
- Water balance for ponds:
 - Inflow
 - Water surf. evaporation
 - Outflow
 - Water level

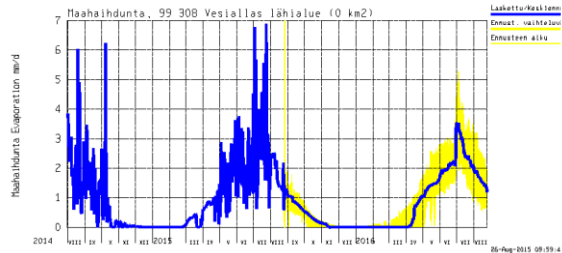


Results for each basin

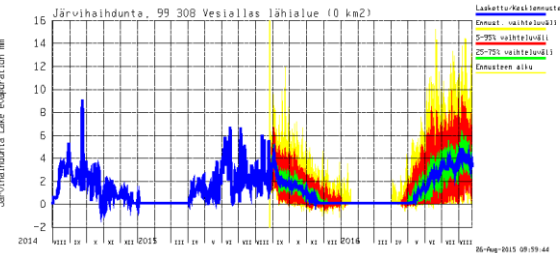
Precipitation



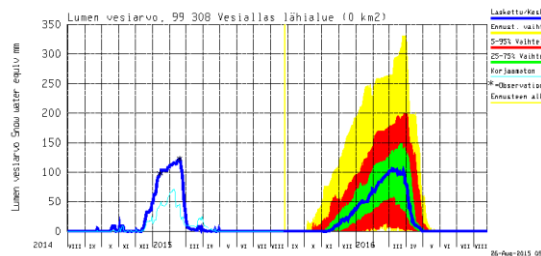
Evaporation



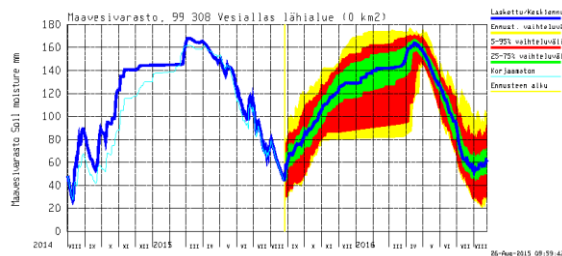
Lake evaporation



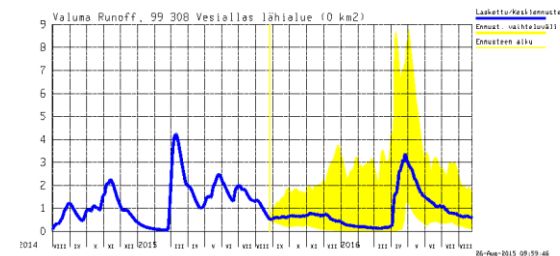
Snow water equivalent



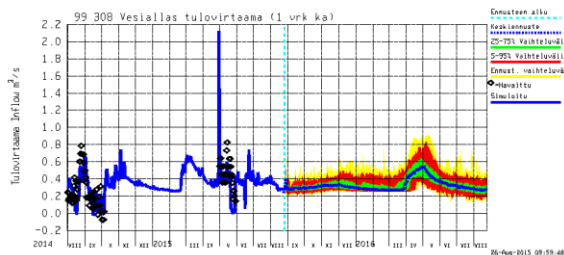
Soil moisture



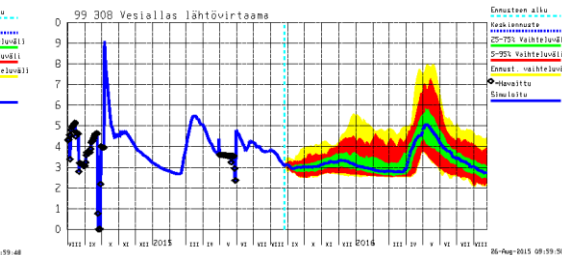
Runoff



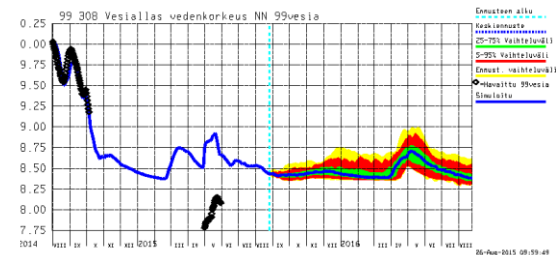
Inflow



Outflow

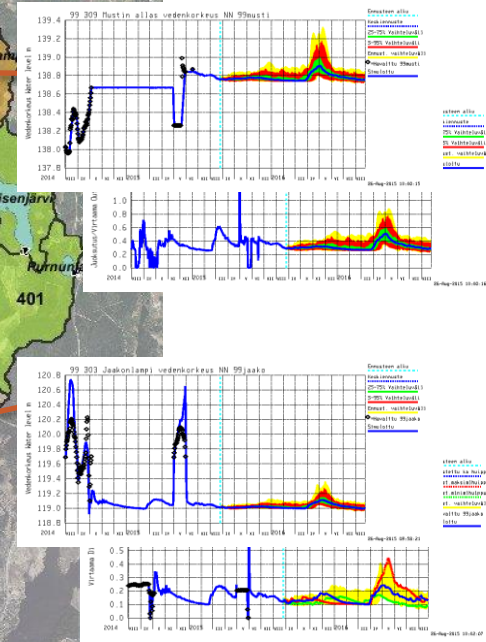
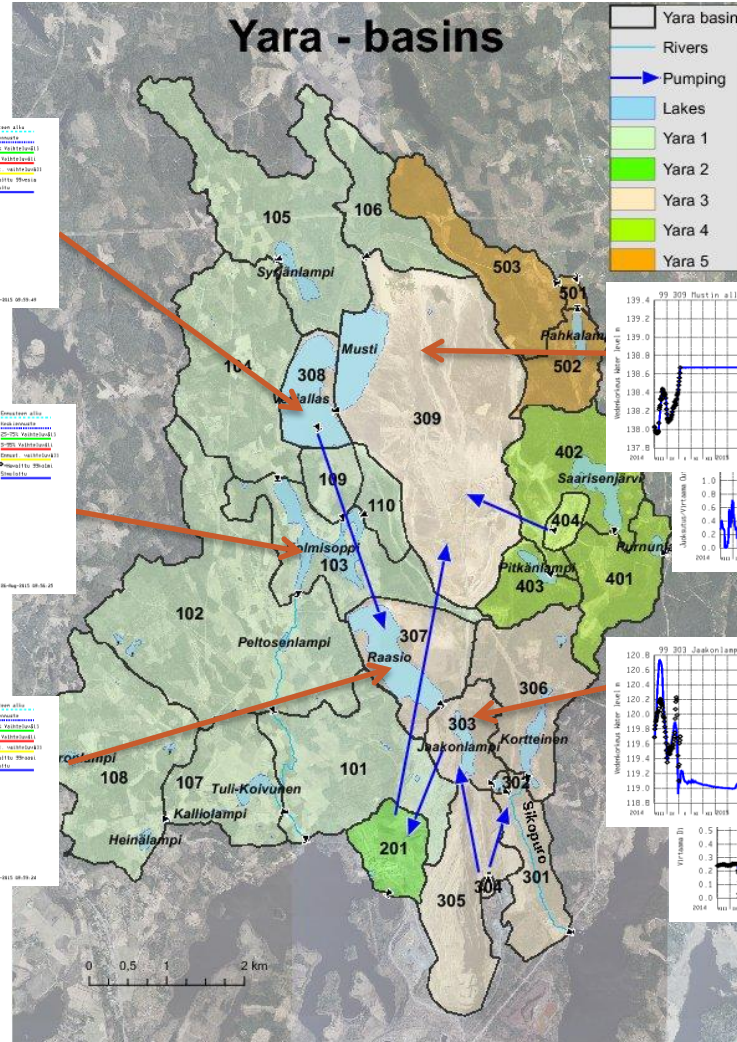
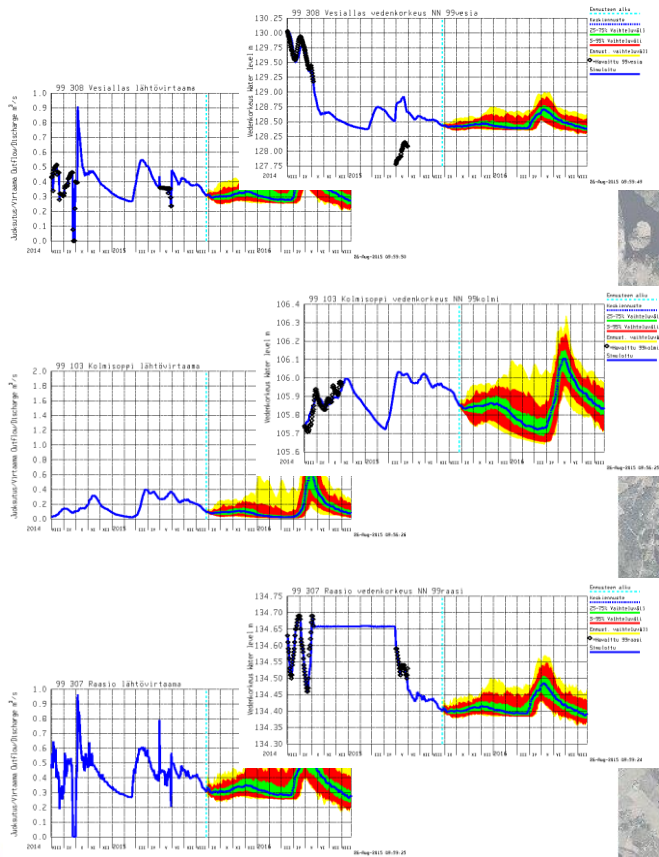


Water level



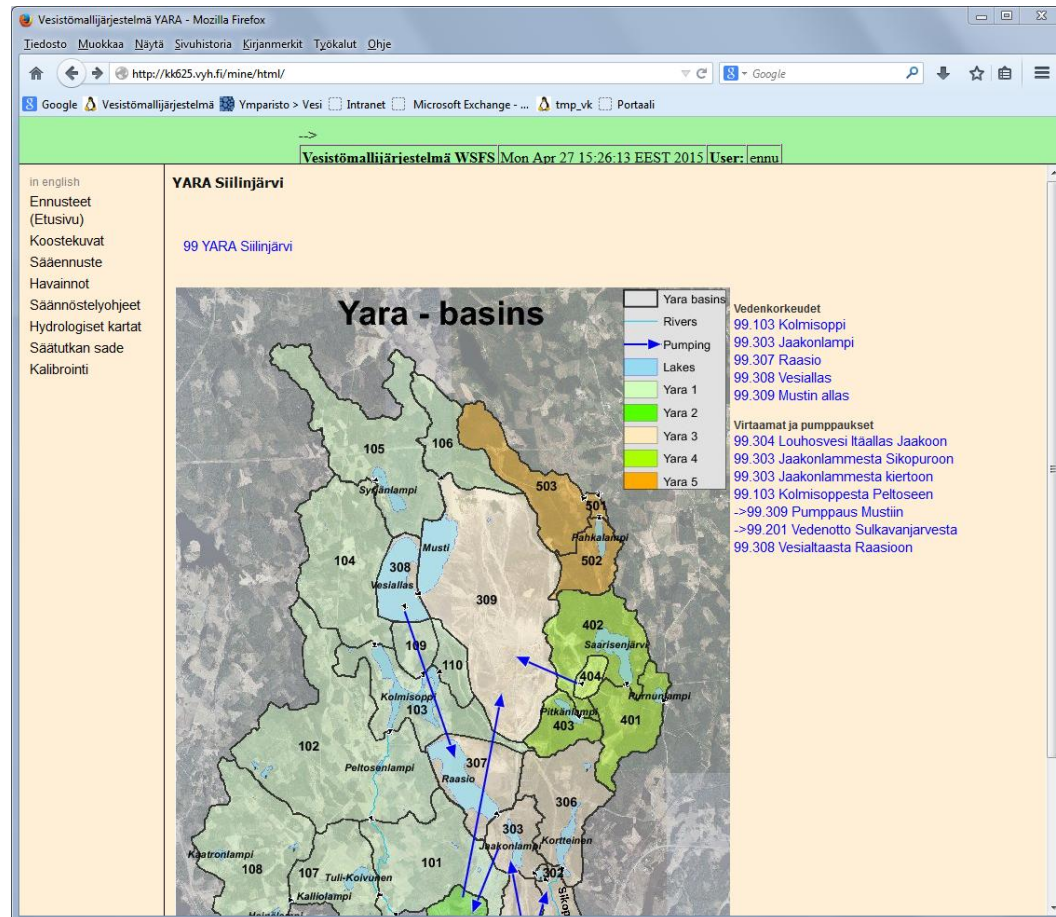
Siilinjärvi mining site

Water level and outflow for each pond



WSFS user interface

- www-based interface (local access or certificate required)



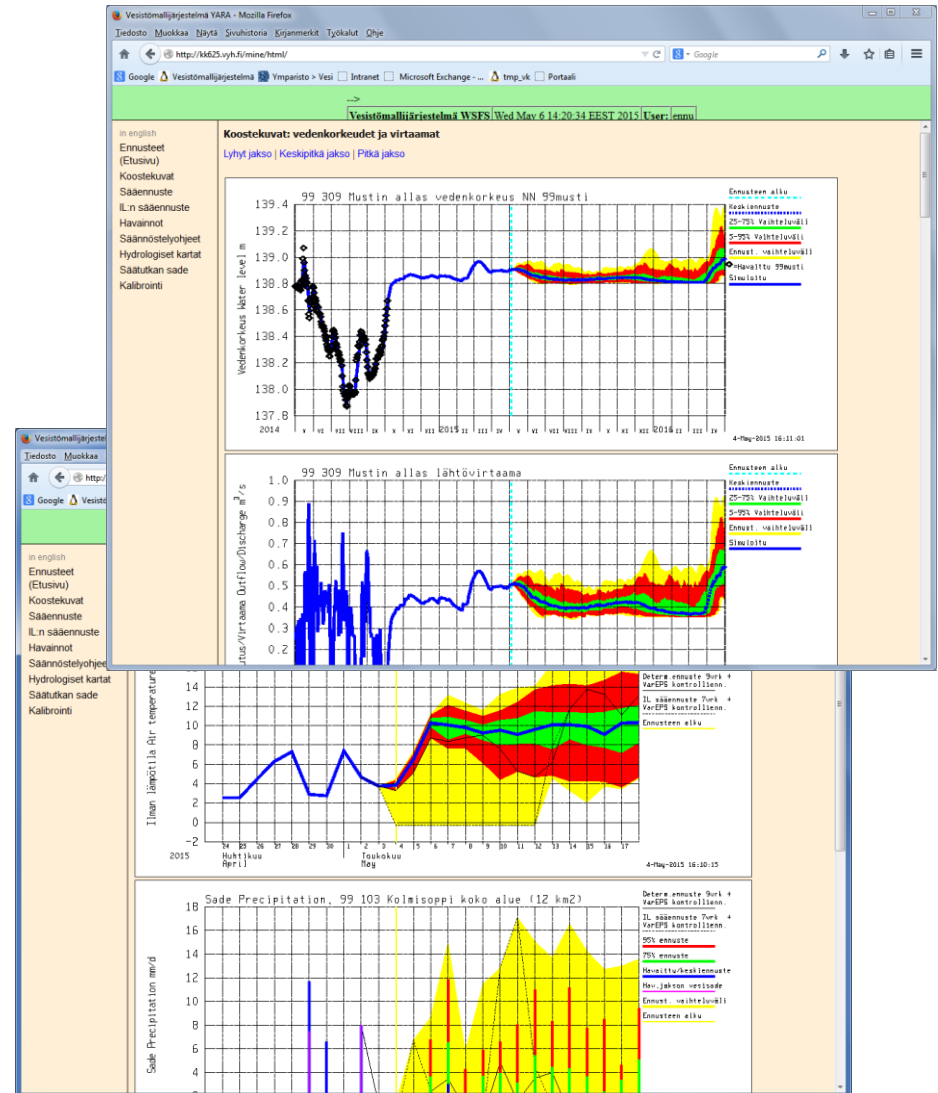
WSFS user interface

www-user interface for:

- Viewing forecast images and reports
 - Images by basins/ponds
 - Weather observations and forecasts
- Entering observations (water level, discharge, snow,...)
- Real time planning of pond outflows
 - Regulation schedules
 - Water level and outflow/pumping plans

WSFS user interface

- Simulation results for each basin
 - View by basin
 - Summary view of water level and discharge
- Weather observations and forecasts
 - Temperature, precipitation



WSFS user interface

- Entering observations (water level, outflow/pumping)

The left screenshot shows the 'Havainnot / Observations' page. It features a sidebar with navigation options: Ennusteet (Etuusivu), Koostekuvat, Sääennuste, IL:n sääennuste, Havainnot, Säännöstelyohjeet, Hydrologiset kartat, Säätätkan sade, and Kalibrointi. The main content area lists observation types: Vedenkorkeus, Virtaama/pumppaukset, Haihdunta / Haihdunta-asema, Lumilinjamittaukset, Muut lumimittaukset, Pinta veden lämpötila, and Lämpötila. Below this is a table for 'Water level' observations:

Station ID	Station Name	Status
99103	Kolmisoppi	●
99303	Jaakonlampi	●
99307	Raasio	●
99308	Vesiallas	●
99309	Mustin_allas	●

The right screenshot shows the 'Vesiallas vedenkorkeus N60' page. It includes a table for entering observations:

Year	Month	Day	Data	Period	Actions
2014	10	6	129.18	1 days	Save
2014	10	5		1 days	Remove
2014	10	6		1 days	Mark as missing

Below the table is a 'Show last: 20 values Show' button and a table of saved data:

Year	Month	Day	Register I	Register II
2014	10	5	99vesia.w????	129.18
2014	10	4		129.22
2014	10	3		129.27
2014	10	2		129.32
2014	10	1		129.37
2014	9	30		129.41
2014	9	29		129.45
2014	9	28		129.44
2014	9	27		129.43
2014	9	26		129.41
2014	9	25		129.40
2014	9	24		129.39
2014	9	23		129.40
2014	9	22		129.44
2014	9	21		129.46
2014	9	20		129.50
2014	9	19		129.53

WSFS user interface

- Regulation schedules
- Outflow planning

in english

- Ennusteet (Etusivu)
- Koostekuvat
- Sääennuste
- IL:n sääennuste
- Havainnot
- Säännöstelyohjeet
- Hydrologiset kartat
- Säätökan sade
- Kalibrointi

Juoksutusennusteet	Sääennuste	Reg
Jaakonlampi		
Raasio		
Vesiallas		
Mustin allas		
Jaakonlampi kiertovesi		
Louhosvesi Jaakonlampeen		
Louhosvesi Itäallas Sikopuroon		
Louhosvesi Itäallas		

Juoksutusennusteissa määritellään altaan juoksutus kuutiome...

Jos juoksutusennustetta ei ole määritelty, niin silloin käytetään vedenkorkeuden perusteella.

in english

Ennusteet (Etusivu)

Koostekuvat

Sääennuste

IL:n sääennuste

Havainnot

Säännöstelyohjeet

Hydrologiset kartat

Säätökan sade

Kalibrointi

vv	kk	pp	arvo
2015	5	25	0.20
2015	5	24	0.20
2015	5	23	0.40
2015	5	22	0.40
2015	5	21	0.40
2015	5	20	0.50
2015	5	19	0.50
2015	5	18	0.50

Viimeisin muutos on tehty 18.05.2015 15:57 tunnuskella ennu osoitteesta 192.168.13.252.

Vesiallas säännöstelyohje

Päätä aikaväli: Talleta taulukko

		Juoksutus				Liik. sarakke	
		0.00	0.50	0.70	1.00	4.00	
kk	pp	Vedenkorkeus					
1	1	128.00	130.35	130.40	131.30	131.50	-999.99
2	15	-999.99	130.35	130.40	-999.99	-999.99	-999.99
4	1	128.00	128.70	129.90	131.30	131.50	-999.99
6	1	128.00	128.70	129.90	131.30	131.50	-999.99
10	1	128.00	128.70	129.90	131.30	131.50	-999.99
		Liik. rivi					
		-999.99	-999.99	-999.99	-999.99	-999.99	

Kopio taulukko varmuuskopiksi: Päätä viimein varmuuskopio

Taulukon käyttöohje

Kuva säännöstelyohjeen juoksutuksista

Vesiallas säännöstelyohje

Vedenkorkeus m

0.00
0.50
0.70
1.00
4.00

I II III IV V VI VII VIII IX X XI XII

11.05.2015 14:30:12

Main usage of interface

- Viewing results via map
- Entering pumping, regulation schedules and discharge plans
- Entering observations (water level, discharge, snow, etc.)
- Viewing weather observations (precipitation, temperature, snow, etc.) and forecasts

Requirements for reliable forecasts

- Real time observations of pumping and water level
- Regulation schedules
- Can be entered via www-interface
- Accurate data enable real time forecasting and planning of water level/discharge

WSFS WaterSmart - Further work

- Updating model to be included: automatical updating of water balance (precipitation, temperature) to observations
- Automatization of the system (operational 24/7 if required)
- Delivering data automatically
- Fine tuning of the user interface

- Transport of metals and other substances
- Lake evaporation (water colour and surface temperature)
- Soil moisture simulation with soil types

- More:
 - End-user feedback required: How end-users would like to use system and what kind of needs they have

WSFS in general

- WSFS (Watershed Simulation and Modelling System, Vesistömallijärjestelmä)
- A system which simulates several hydrological and other quantities:
 - Water level
 - Discharge
 - Evaporation
 - Snow
 - Runoff
 - Ground water
 - Soil moisture

