TECHNISCHE UNIVERSITÄT WIEN
Vienna | Austria

Key Performance Indicators (KPIs) to assess asset performance and drive future developments and investments

Prof. Jörg Krampe
Institute for Water Quality and Resource Management, TU Wien

Content

- Introduction
- KPIs to asses WWTP capacity
- KPIs to asses WWTP performance
- KPIs to asses WWTP efficiency
- KPIs to asses WWTP operational standards (qualification, training, OHS…)
- Discussion

What are KPIs

- A **performance indicator** or **key performance indicator** (**KPI**) is a type of performance measurement. KPIs evaluate the success of an organization or of a particular activity….in which it engages.

- …choosing the right KPIs relies upon a good understanding of what is important to the organization

- …assessments often lead to the identification of potential improvements, so performance indicators are routinely associated with 'performance improvement' initiatives

wikipedia

Who might be using KPIs

- Governments/regulators
  - Environmental regulators
  - Economic regulators
- Owners/shareholders
  - WWTP operation
  - WWTP asset capacity
  - Sub-Contractor performance
- Funding agencies

Deciding on suitable KPIs

- Usually different stakeholders have different expectations into wastewater assets
- Discussing and agreeing on suitable performance indicators is an important stakeholder management process
- Well selected indicators are easy to measure and assess the performance of bigger parts of the asset
- It is usually required to define several indicators

Topics for todays discussion

- Discuss the importance of performance assessment

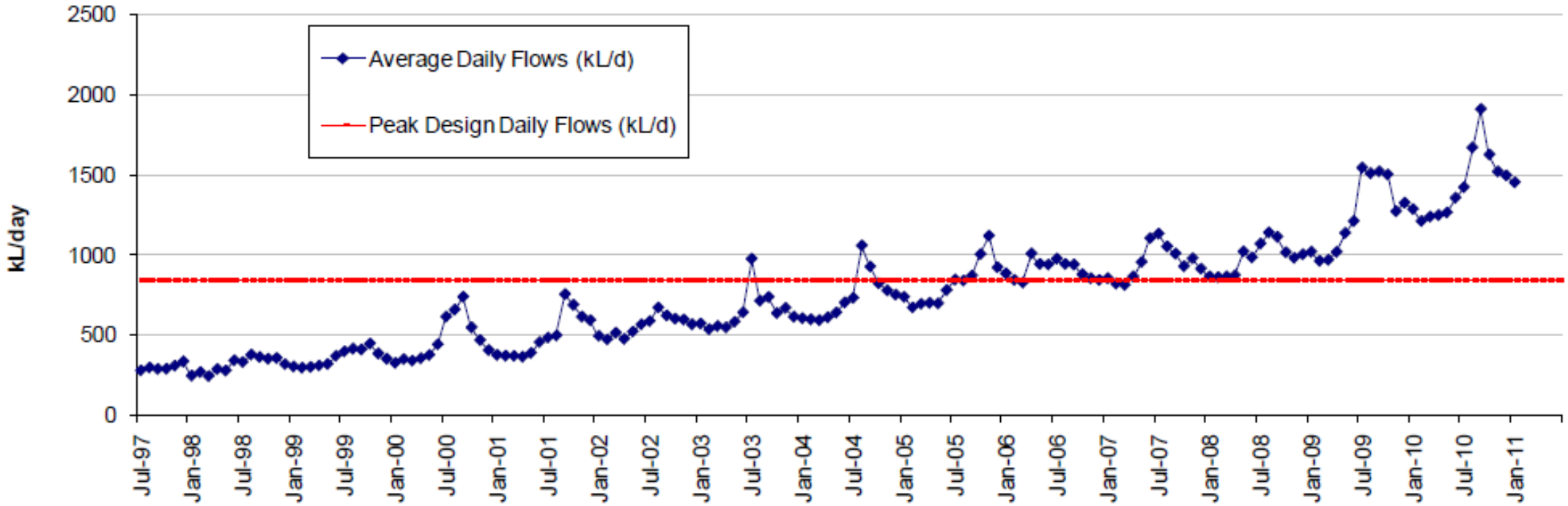
  In context with Norbert's presentation

- What are suitable indicators to achieve intended outcomes?
- KPIs drive behaviour, do we select the right KPIs without contradicting other targets?

  e.g. low energy consumption vs effluent quality

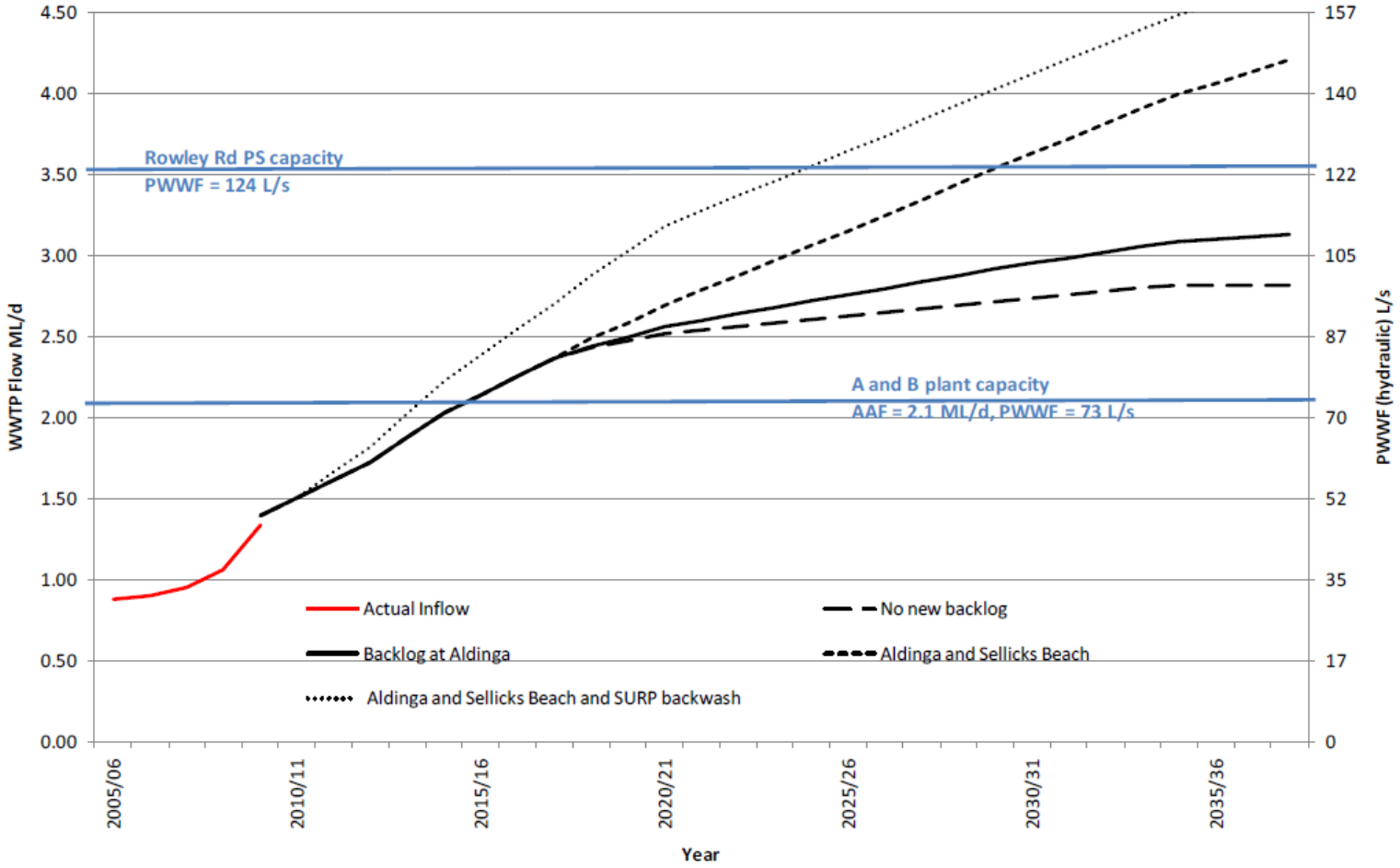
- Is it better to have many KPIs or to have fewer on a higher level?
- How often should KPIs be reported and to whom?

Flow based capacity indicators



Krampe, 2011

Flow based capacity indicators

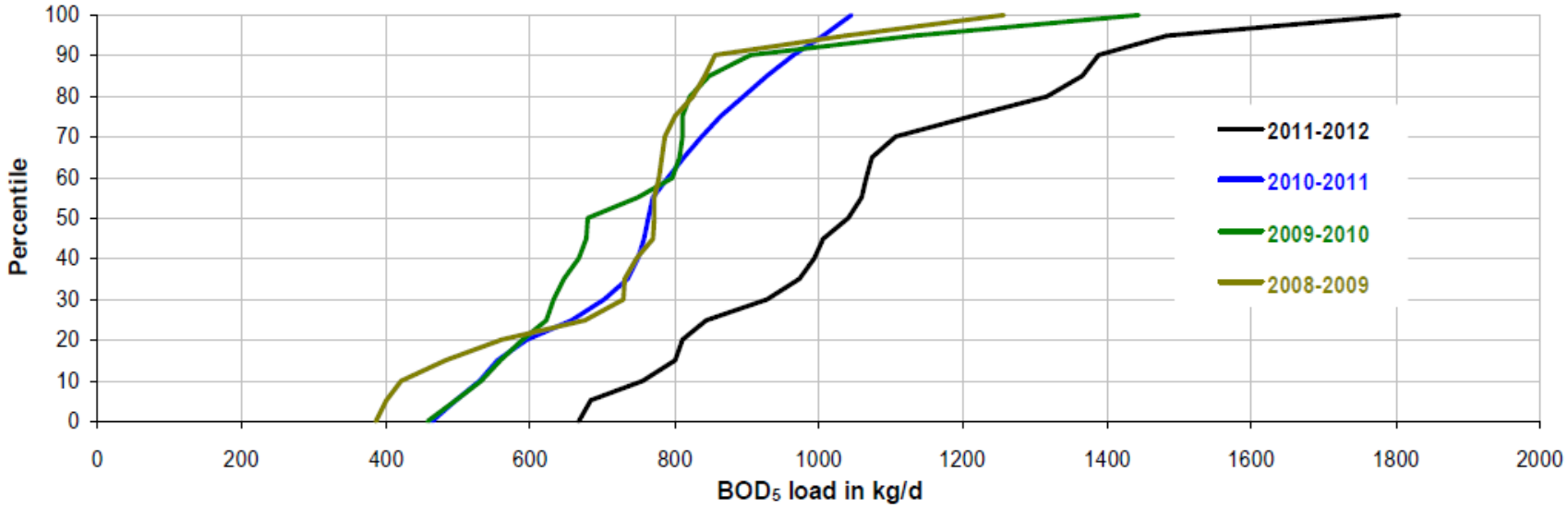


Krampe, 2011

Load based capacity indicators

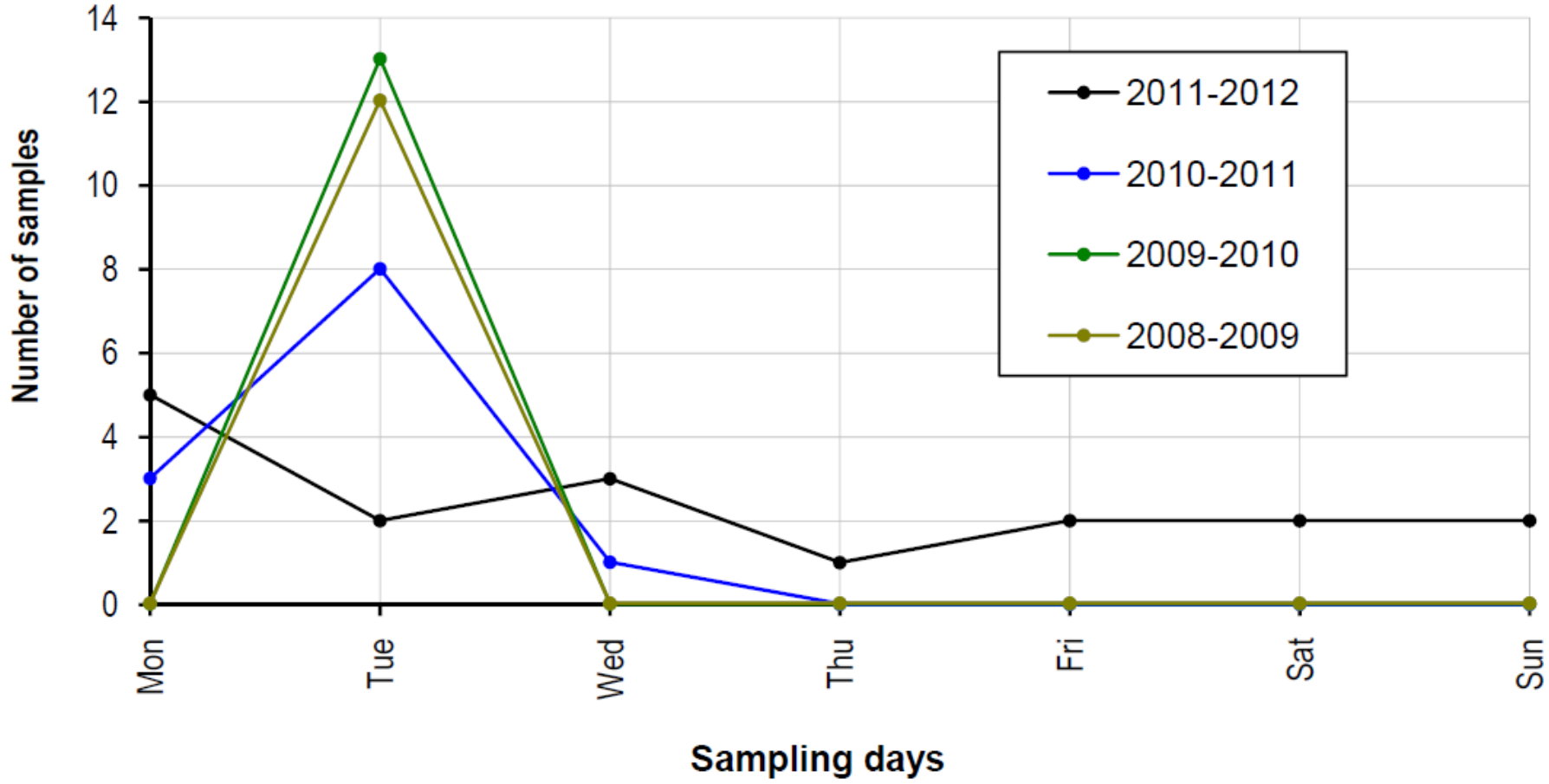
Krampe and Leak, 2012

Load based capacity indicators



	2008/2009	2009/2010	2010/2011	2011/2012	average of four years
BOD_5 in kg/d	772	680	764	1,040	**814**
P_{tot} in kg/d	32.3	30.5	30.1	38.8	**32.9**
TKN in kg/d	202	202	207	226	**209**
SS in kg/d	828	1,055	942	1,227	**1,013**

Load based capacity indictors



Krampe, 2013

Load based capacity indicators

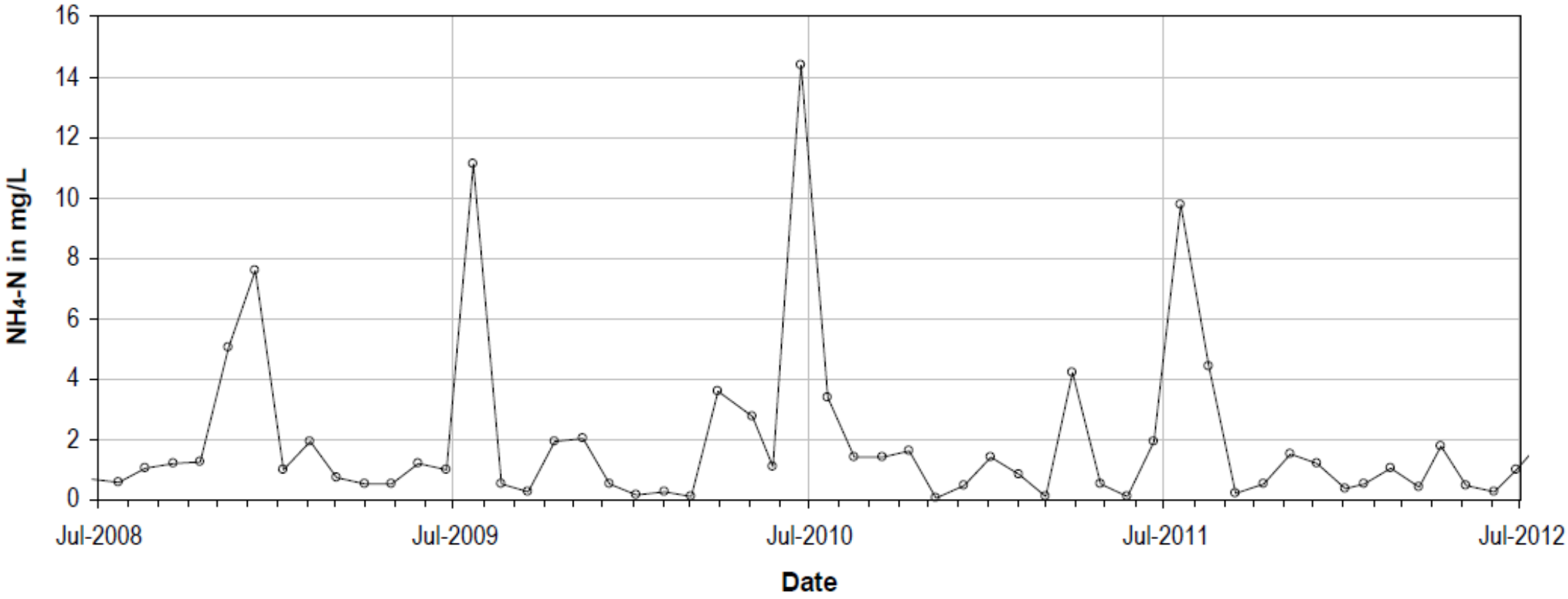
	average of four years	assumed load per PE in g/(PE d)	Resulting PE
AAF	2.82 ML/d	220 L/(PE d)	12,818
BOD_5	814 kg/d	60	13,567
P_{tot}	32.9 kg/d	2.5	13,160
TKN	209 kg/d	15	13,940
SS	1,013 kg/d	70	14,471

	Current (last four years)	Design[1)]	Spare capacity
AAF in ML/d	2.82	4.0	30%
PWWF (hydr.) in L/s	127	150	15%
BOD_5 in kg/d	814	1,000	19%
P_{tot} in kg/d	32.9		
TKN in kg/d	209		
SS in kg/d	1,013	1,200	16%

[1)] based on original design without N removal

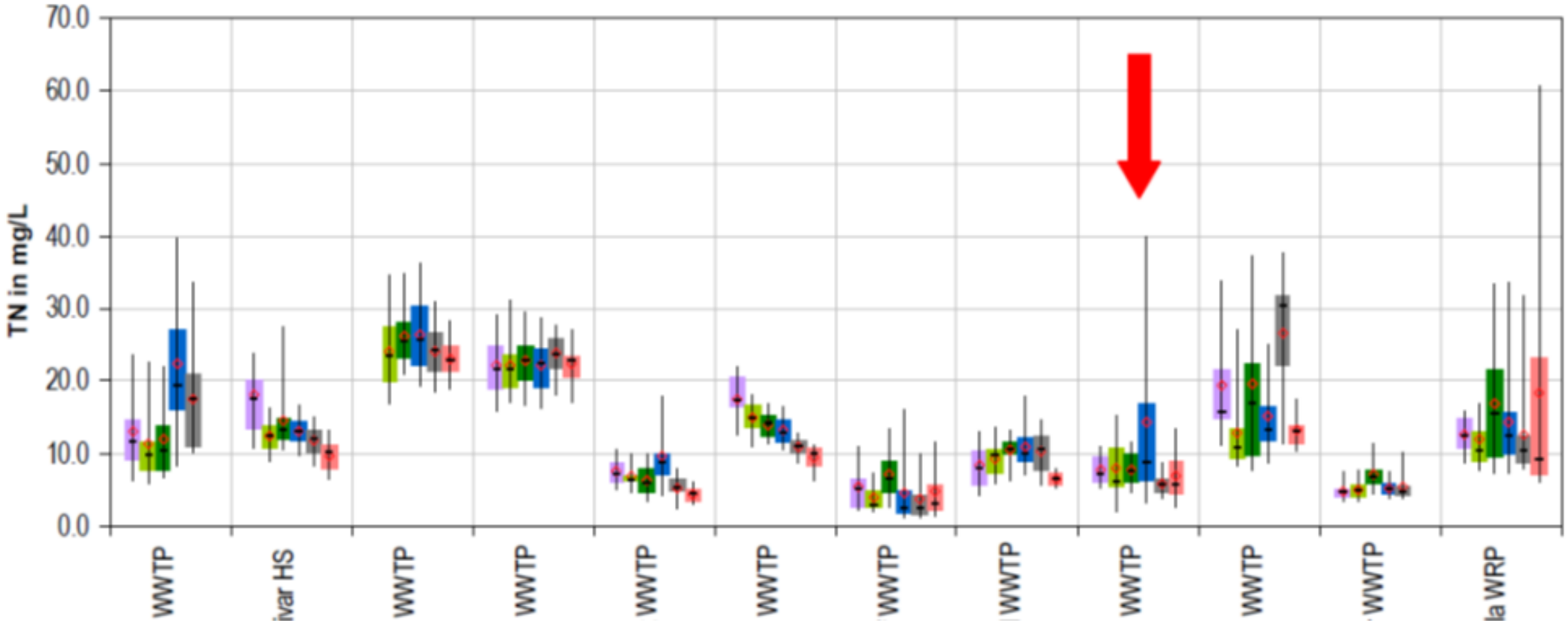
Krampe, 2013

Effluent quality perfomance indicator



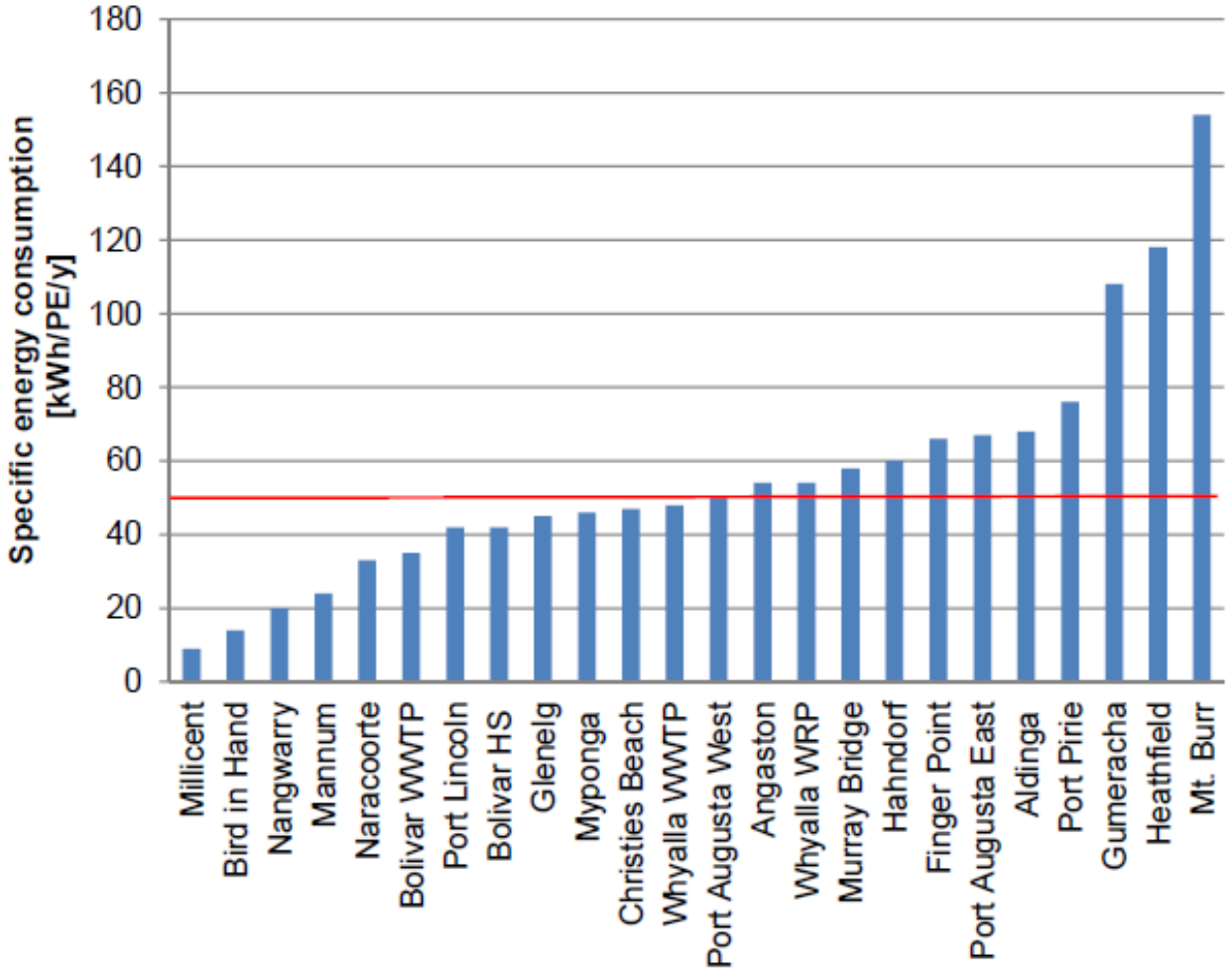
Krampe, 2013

Effluent quality perfomance indicator



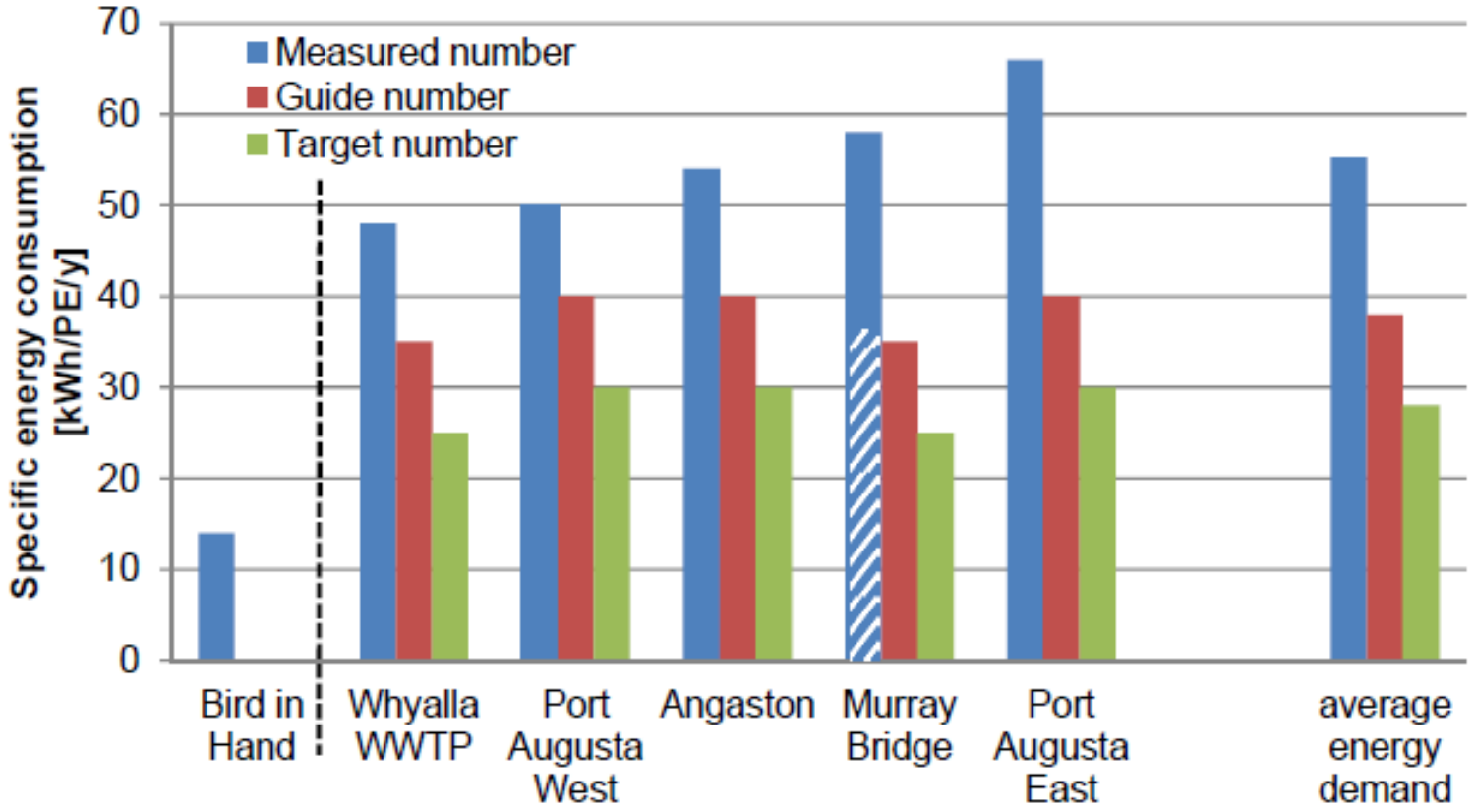
Krampe, 2013

Effenciency based performance indicators



Krampe and Trautvetter, 2012

Effenciency based performance indicators
Specific energy consumption - aerated lagoon plants



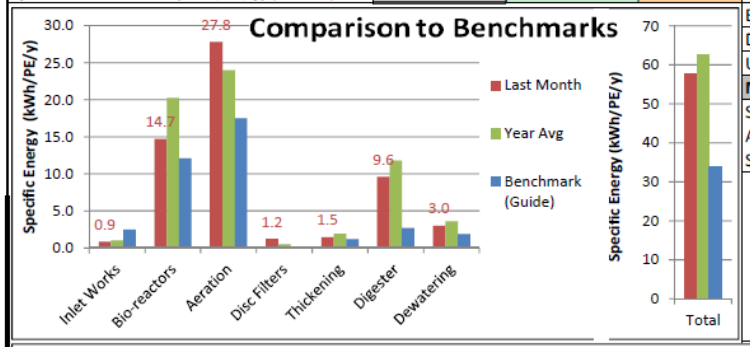
Krampe, 2013

Effenciency based performance indicators

Bird In Hand WWTP

Analysis Date	8-Oct-13		
Data Since	15-Feb-12		

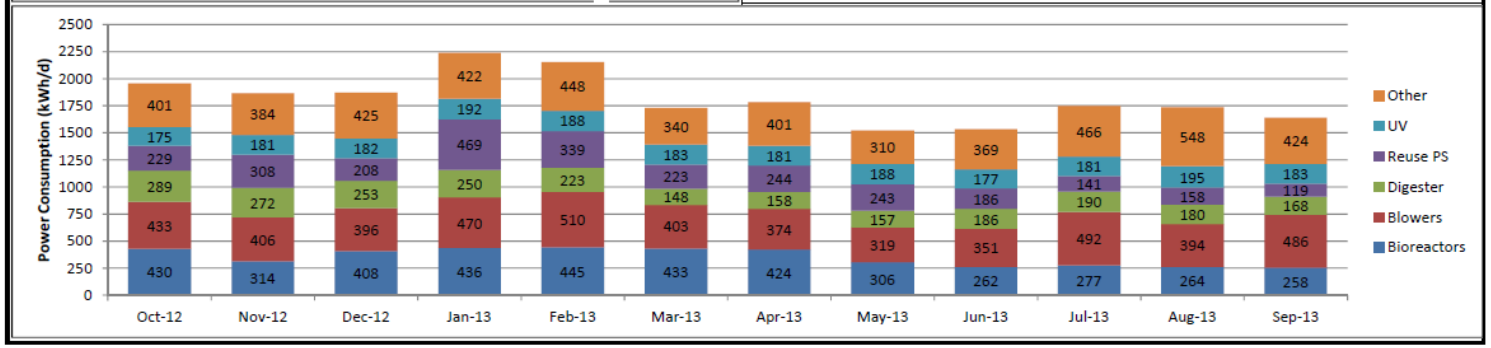
		Data Quality	Override
AAF (ML/d) (Year)	1.52	Good	
AAF (ML/d) (Month)	1.77	Good	
Median BOD (kg/d) (Year)	383	Manual Entry	
Persons Equivalent (Year)	6383	Calculated	
Total Power (kWh/d) (Year)	1815	Good	
Total Power (kWh/d) (Month)	1638	Good	
Benchmarkable Power (kWh/d) (Month)	1006	Good	
Sp Bchmrkble Power (kWh/PE/y) (Month)	58	Good	



Alerts	
Data overrides active	Total Plant, Inlet Works, Bioreactor, Blowers, Disc Filters, Thickening, Digester, Dewatering, Reuse PS,
More than 5% Power Increase	Blowers, Disc Filters, Thickening, Dewatering,
More than 5% Power Decrease	Inlet Works, Digester, UV Total, Reuse PS,

Digester Heating & Power Supply				
	Units	Last Month	Year Avg	comments
LPG Used	kg/d	40	45	
Biogas Used	kg/d	138	120	suspect data
% Biogas	Weight %	77%	73%	

Individual Unit Performance					
	Units	Last Month	Year Avg	Benchmark	SAW Avg
Blowers	Wh/m3/m	5.7	6	-	7.6
Digester Mixing	W/m3	1.6	2.6	2 - 3	2.8
UV	Wh/m3 inflow	103.1	121	30	118
Mixer Performance					
Selector Mixers	W/m3	5.3	13.6	2.5 - 4	
Anoxic Zone Mixers	W/m3	2.8	2.8	1.5 - 2	11.3
Swing Zone Mixers	W/m3	1.8	13.7	2.5 - 4	

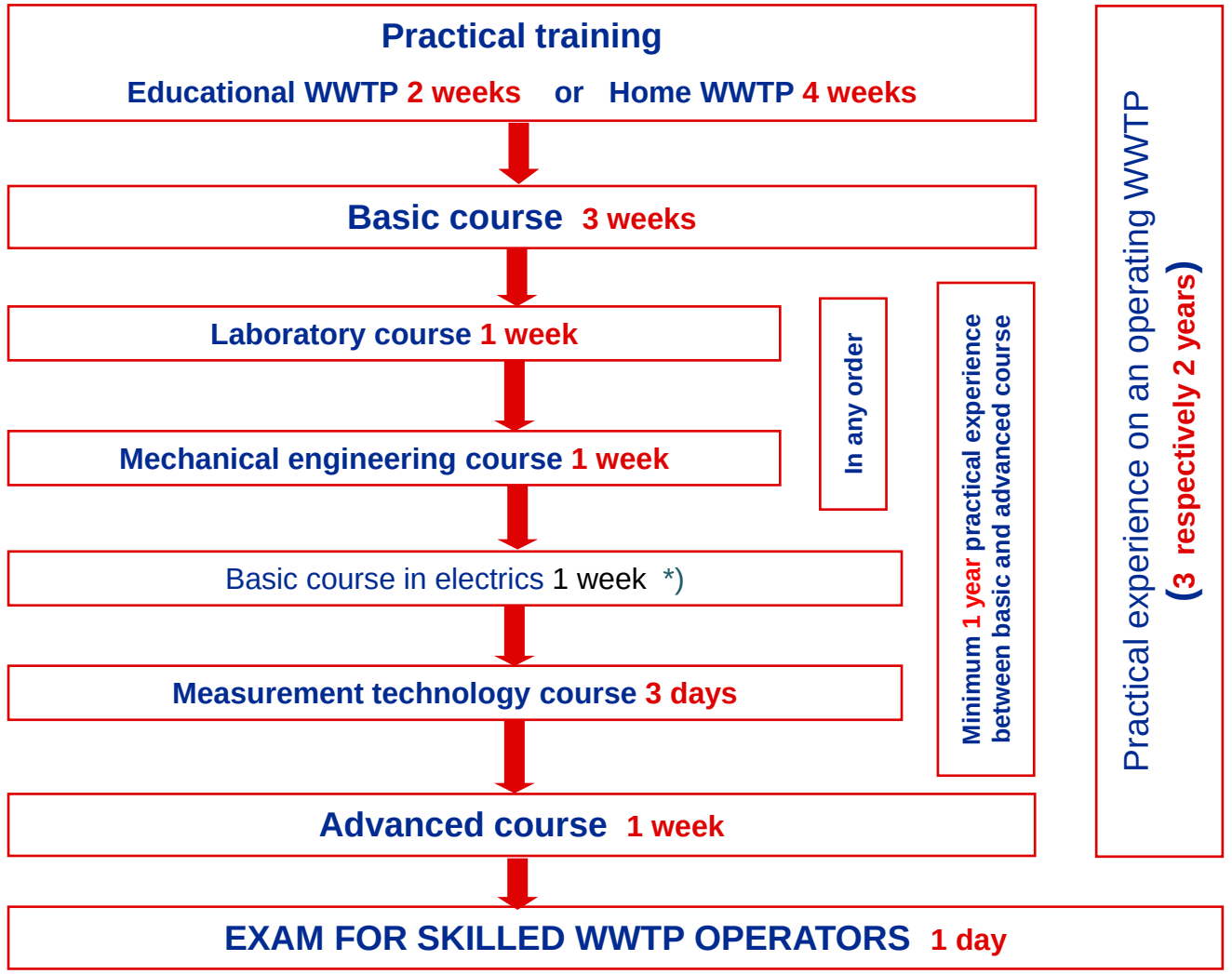


Steele et al., 2013

KPIs to asses WWTP operation standards

- Operator qualification
- Operator training
- Operator knowledge exchange
- Occupational Health and Safety targets (OHS)

Training of WWTP operator specialists according to ÖWAV guideline RB 15



*) for participants without electrical training

Krampe et al., 2015

Operator exchange

Personal lessons learnt

- KPIs – just do it!
- Start easy and take all level of stakeholders on board
- Link some KPIs to the design (capacity) to get an ideal about the remaining asset capacity and provide good data for future upgrades

Some suggestions for indicators

- Daily flow
- Volume of septic tank sludge accepted
- Solids, pH, C, N (and P) in the influent
- Solids, pH, C, N (and P) in the outlet
- Operational parameter depending on plant design (e.g. oxygen)
- Sludge produced and disposed
- Removal efficiency
- Energy consumed
- Chemicals consumed

Open Access references

- J. Krampe, M. Leak:
  Strategic planning approach for optimising investment at WWTPs
  Water Practice and Technology, (2012), 7 (2)
  https://doi.org/10.2166/wpt.2012.030

- J. Krampe:
  "*Energy benchmarking of South Australian WWTPs*";
  Water Science and Technology, (2013), **67** (9); S. 2059 – 2066
  https://doi.org/10.2166/wst.2013.090