Design approach for Moving Bed Biofilm Reactor to achieving low effluent nutrient concentrations

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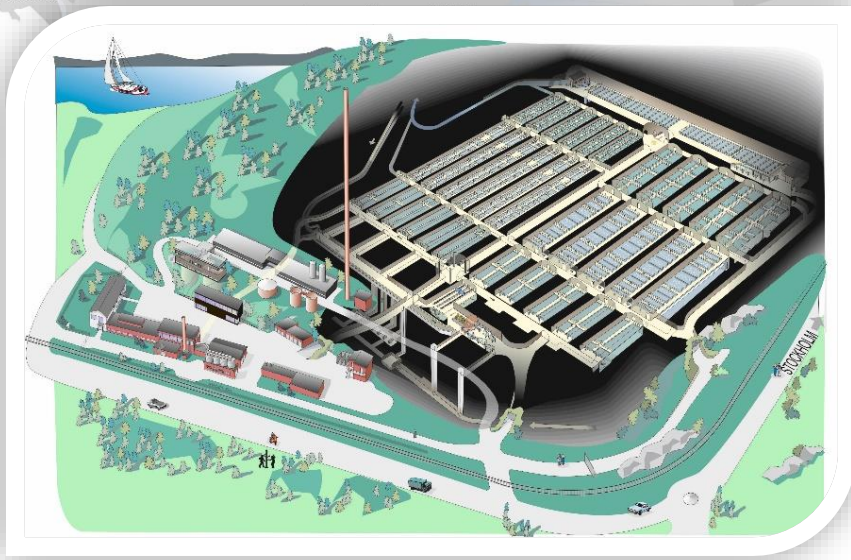
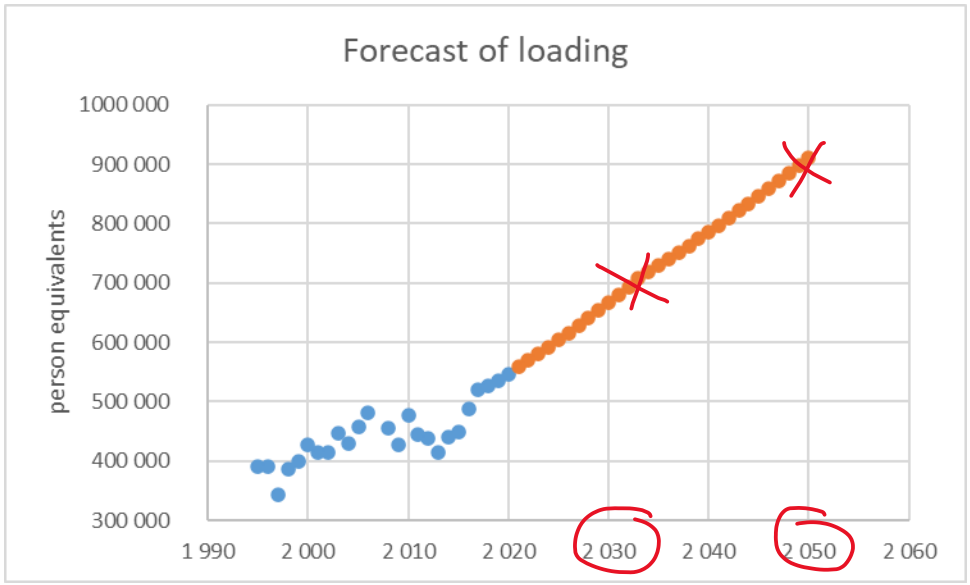
Special thanks to Peter Ek (Ramböll, Process expert)

Short facts about Käppala Association

- Facts about Käppala WWTP
  - *Third biggest plant in Sweden*
  - *576 000 pe*
  - *~ 60 Mm³/year wastewater (1,9 m³/s)*
  - *Treats Northern part of Stockholm area*
  - *Situated under ground*
  - *Activated sludge process*
  - *Nitrogen removal plant*



The future is here



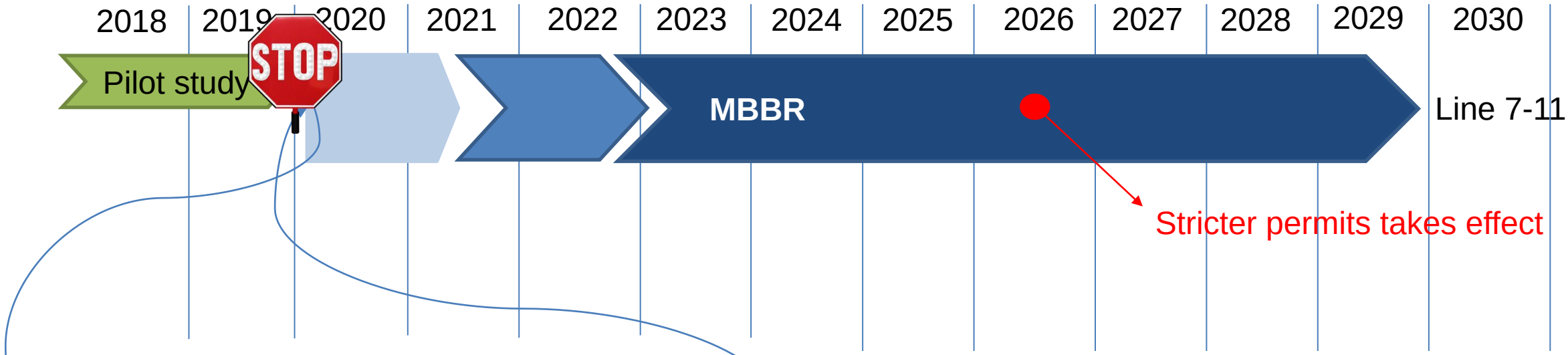
Quantity permits gives even stricter effluent concentration permit

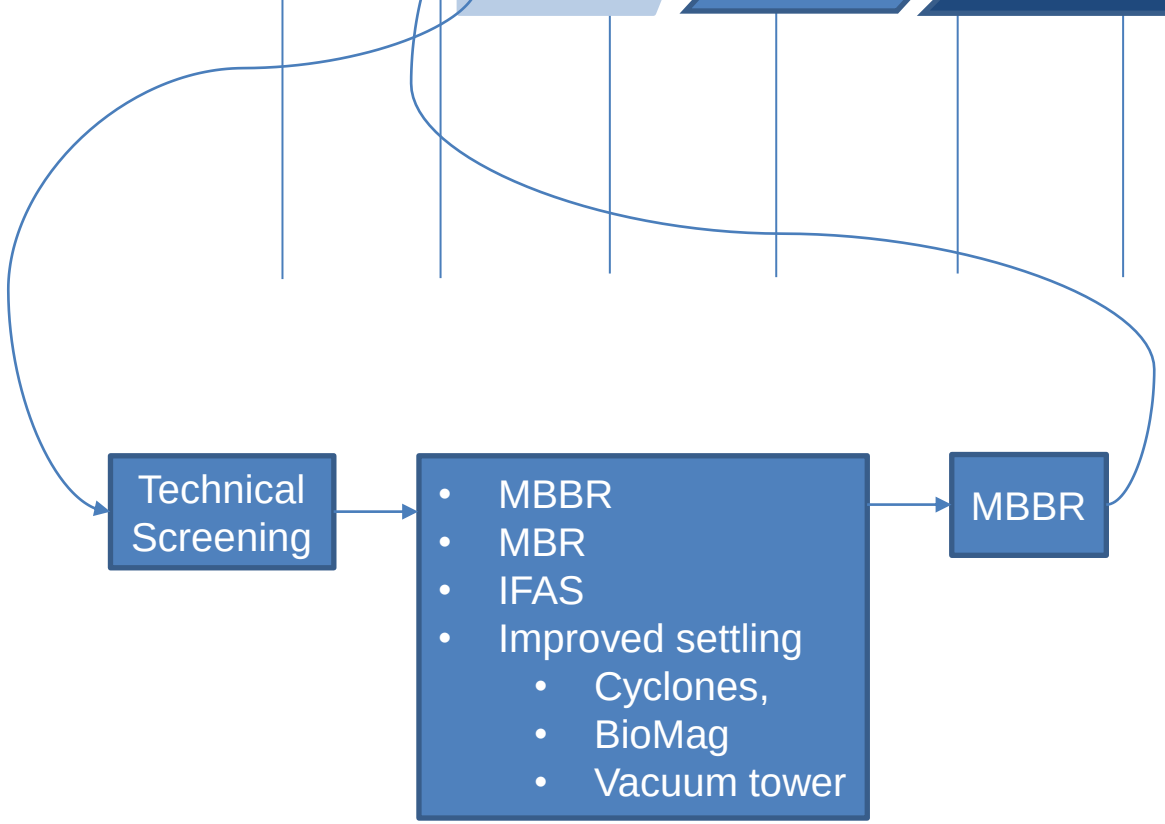
Parameter	Today	2026	2050 (production targe	Unit
Person equivalents	700 000	900 000	-	pe
$N_{tot,\ effluent}$	10	6	4,5	mg/l
$BOD_{7,\ effluent}$	8	6	4,0	mg/l
$P_{tot,\ effluent}$	0,3	0,20	0,12	mg/l

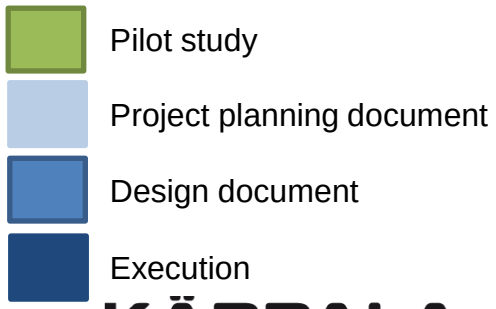
The Future WWTP

Water treatment	Today	2040	2050
Mechanical treatment (1 & 2)	Screening Grit chamber Primary clarifier	Screening Grit chamber Primary clarifier (+ chemical percipitation)	Screening Grit chamber Primary clarifier (+ chemical percipitation)
Biological treatment (3 & 4)	**CAS – Line 1-11 (3 &4)** Anaerobic Anoxic Oxic Deox Simultaneous percipitation	**CAS – Line 1-6 (4)** Anoxic (Pre DN) Oxic Deox Anox (Post DN) Simultaneous percipitation **MBBR – Line 7-11 (4)** Anoxic (Pre DN) Oxic Deox Anox (Post DN) Reox	**MBBR – Line 1-11 (3 & 4)** Anoxic (Pre DN) Oxic Deox Anox (Post DN) Reox
(5 & 6)	Secondary clarifier	Secondary clarifier + (chemical percipitation, MBBR)	Secondary clarifier + chemical percipitation
Filtration (7)	Sand filter + chemical percipitation	Sand filter + chemical percipitation	Sand filter + chemical percipitation

The Project Time Line







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The Design Approch, Challenges

- Challenges for the conceptual design
  - MBBR is a new process for us
    - *We are comfortable with AS*
  - Hard to find references
    - *10 meter deep reactors*
    - *Low effluent permits*
    - *Biological reaction rates*
  - Deadline, June 2026
    - *No time for pilot study*
    - *No time in the project, delivery needed in 6 months (including review and revision)*
- This drove us to strive for a fast method to find the process design

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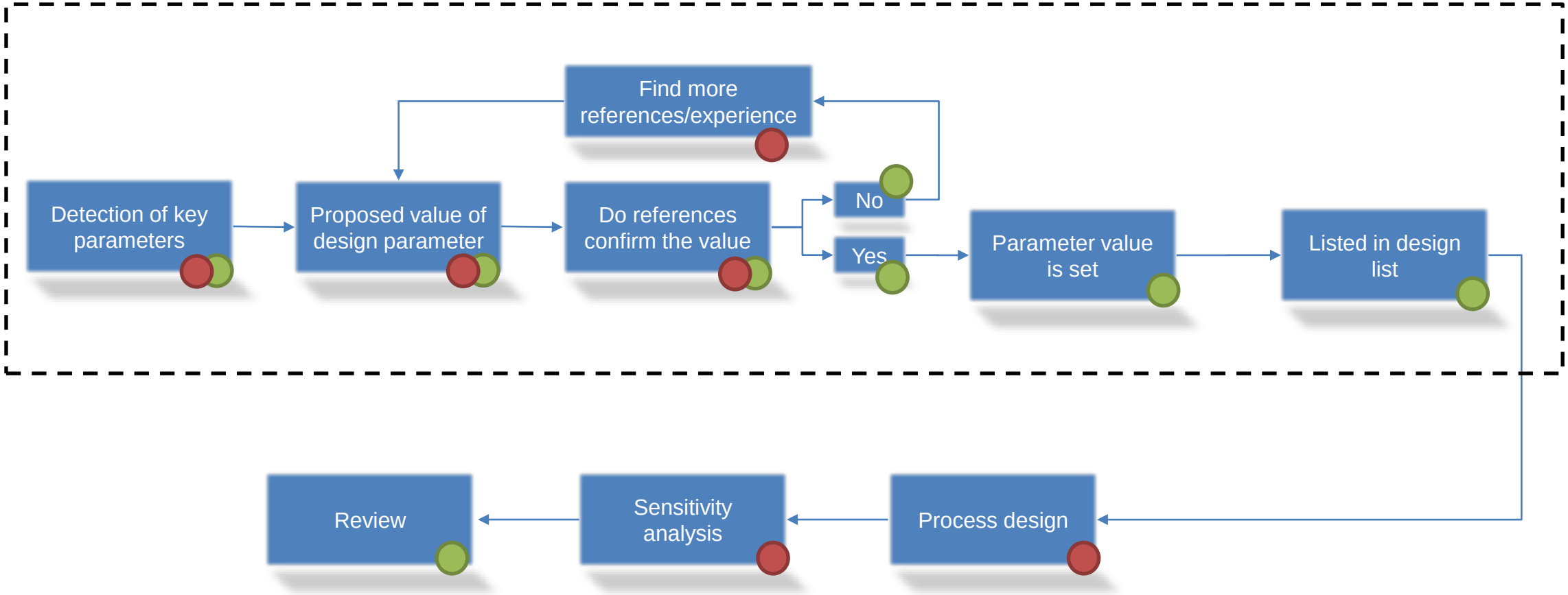
The Design Approach, Method



Consultant

Client

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The Design Approach, Key Factors

- Key factor for the design
  - Close cooperation with process consultant
  - Detect important design parameters to decide and make a list
  - Early (not changeble) decisions of important design parameters

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The Design Approch, Pros & Cons

- Pros
  - Time effective work
  - The final review didn’t contain any revolutionary remarks (only cosmetic things)
  - Great understanding of the new process and what’s behind the process parameters
  - “Reference data base” (a early beginning of)
- Cons
  - Takes a lot of time from customer
- Advice
  - Time limitation in this project is a bit frustrating. The method works fine when time is scarce. But I think this is a good method even if you have a lot of time since it gets you more involved in the design

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Thank you for listening!

Questions?