



**Passavant
Geiger**

Secondary Clarifier Optimization

Passavant® - hydrograv adapt system

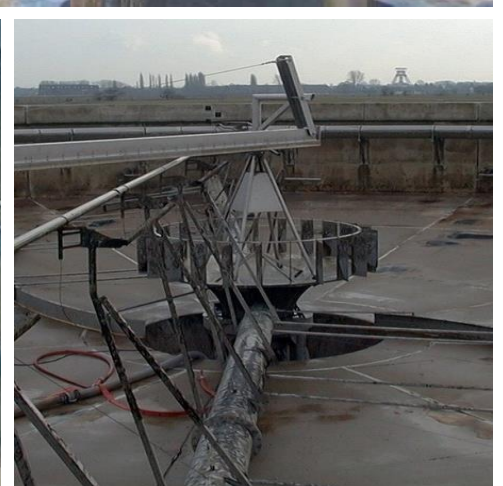
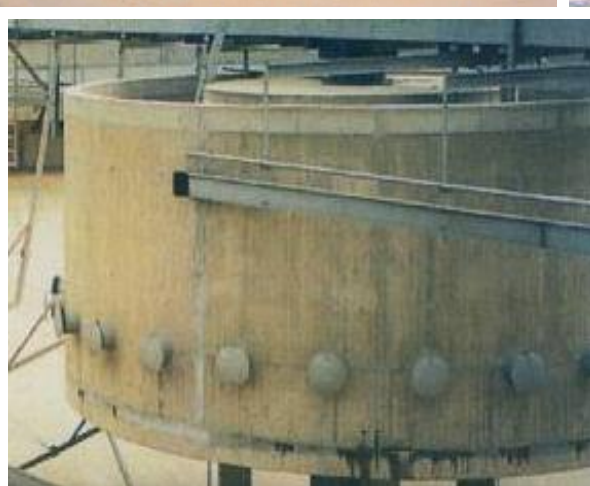
*Todd Latchaw – USA & Canada Sales Director
March 25th, 2024*

*Ref info: Dr. Martin Armbruster-hydrograv / Mario Benisch
PE/HDR*

Topic Outline

- Optimization & Introduction to new secondary clarifier inlet technology.
- Fixed inlet designs vs. Real time movable inlets
- Review basin hydraulic flow & velocity
- Benefit of sludge blanket filtration in secondary clarification
- Value of CFD modeling & control for capital savings
- Review Case Studies

Examples of fixed clarifier inlet



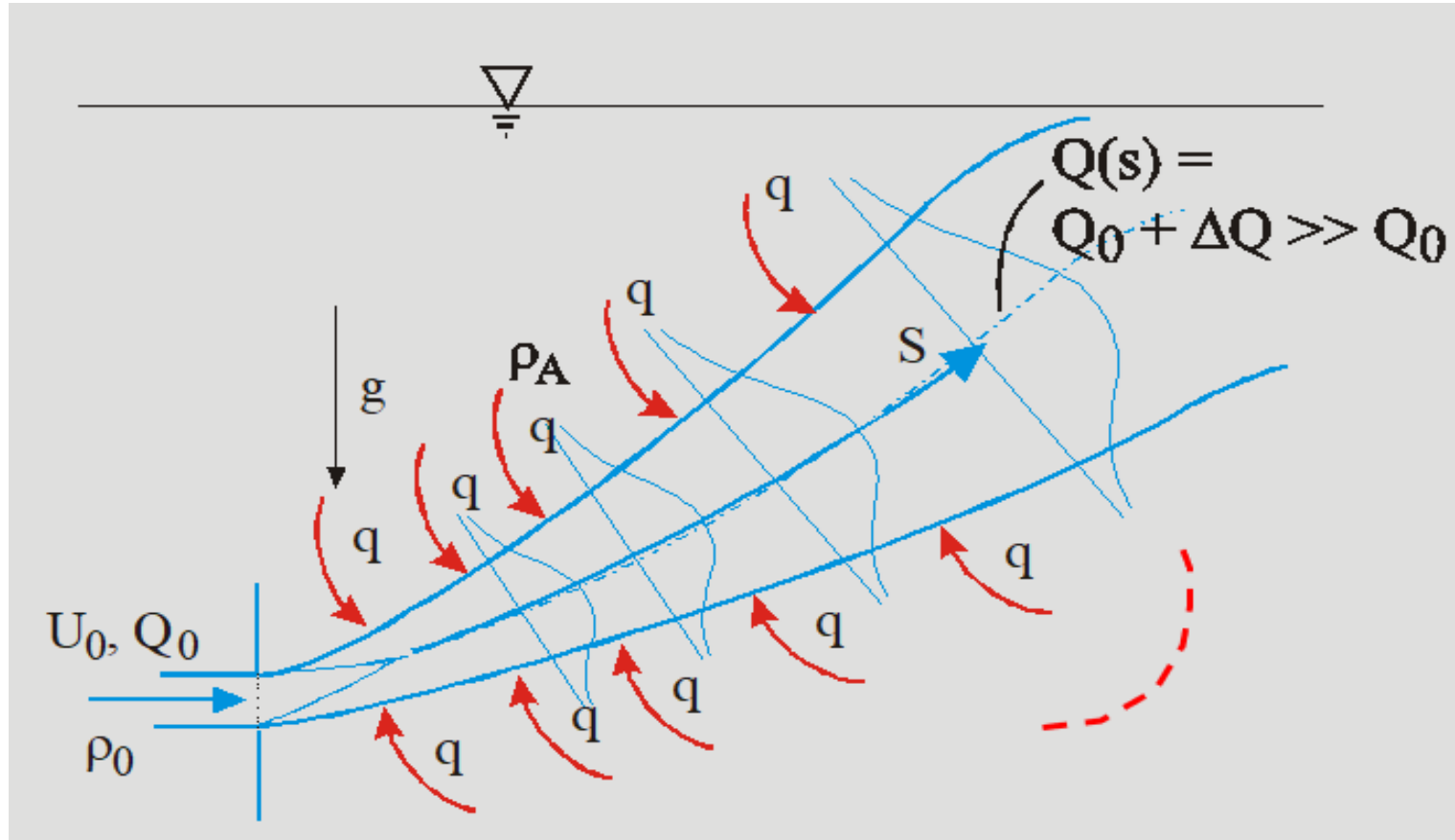
Fixed Inlet



Secondary Failure



Entrainment

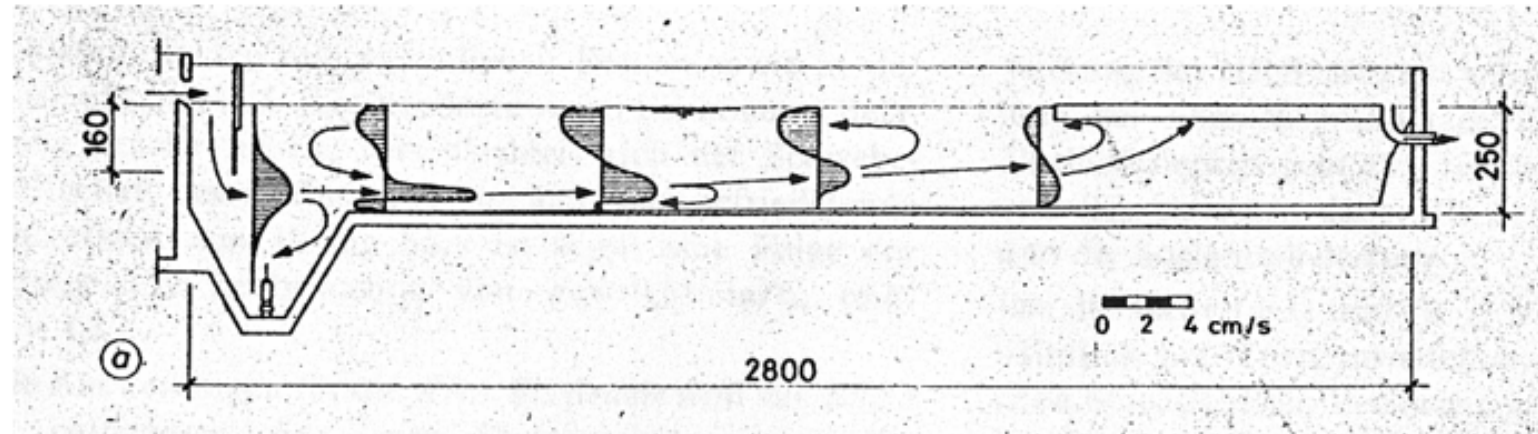


Entrainment Leads to
an Increased Internal
Recirculation

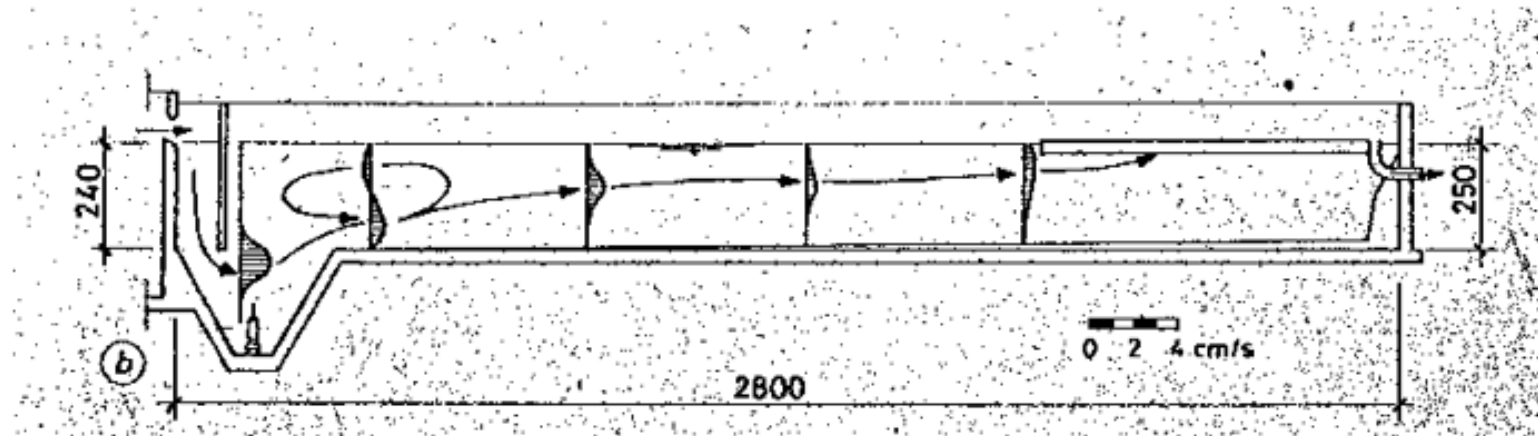
Volume not available
for Settling

(Source: M. Armbruster)

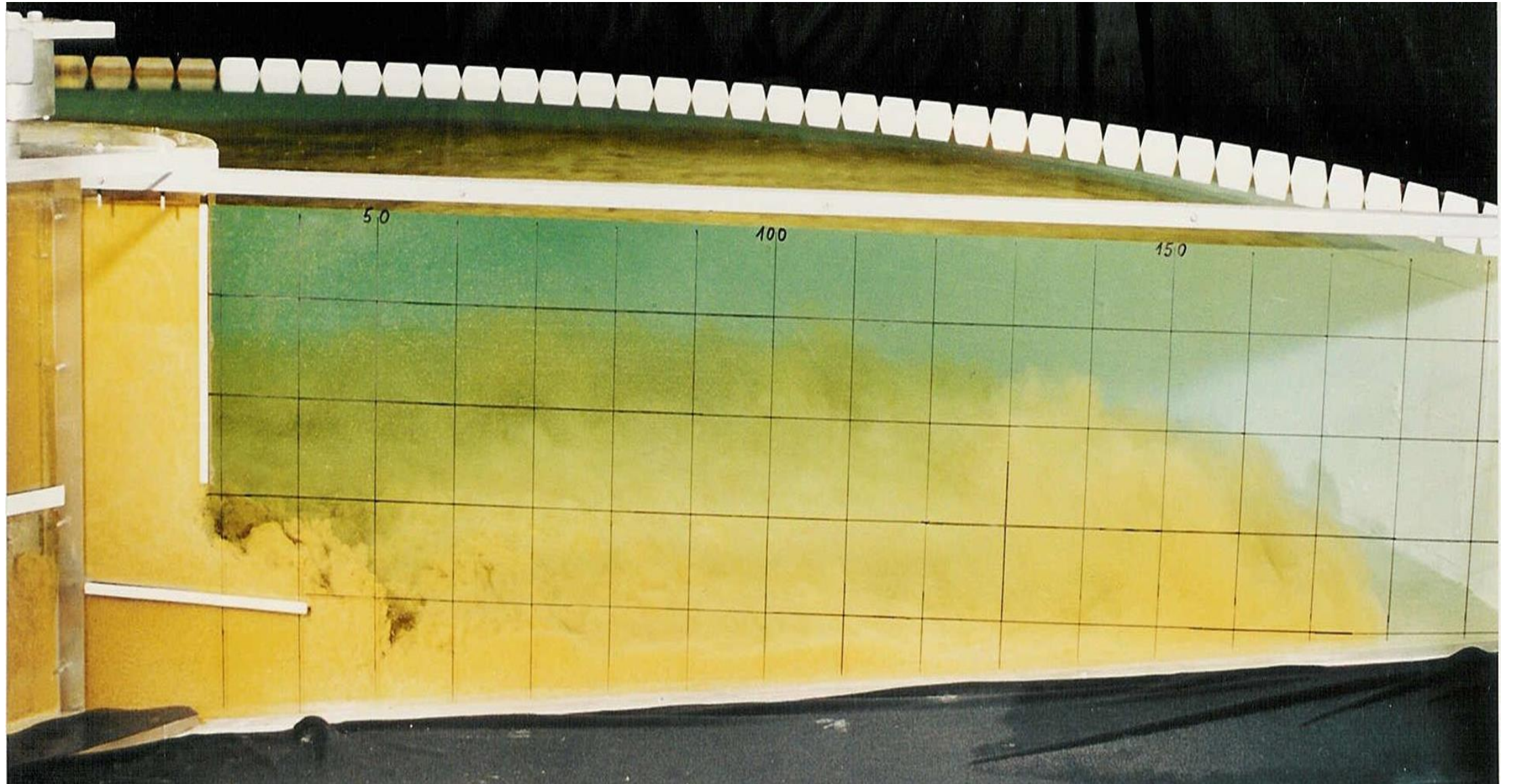
- Builds upon Prior work, Bretscher und Hager (1984)



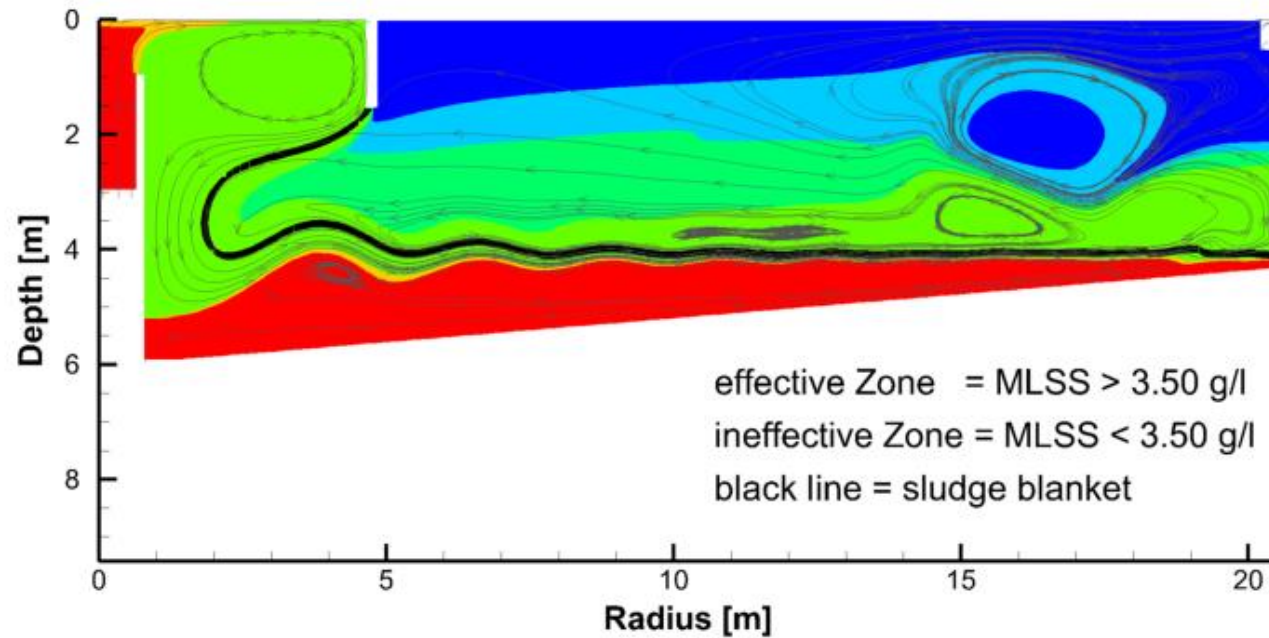
High Inlet Elevation



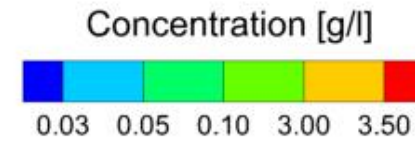
Low Inlet Elevation



Fixed EDI / Inlet

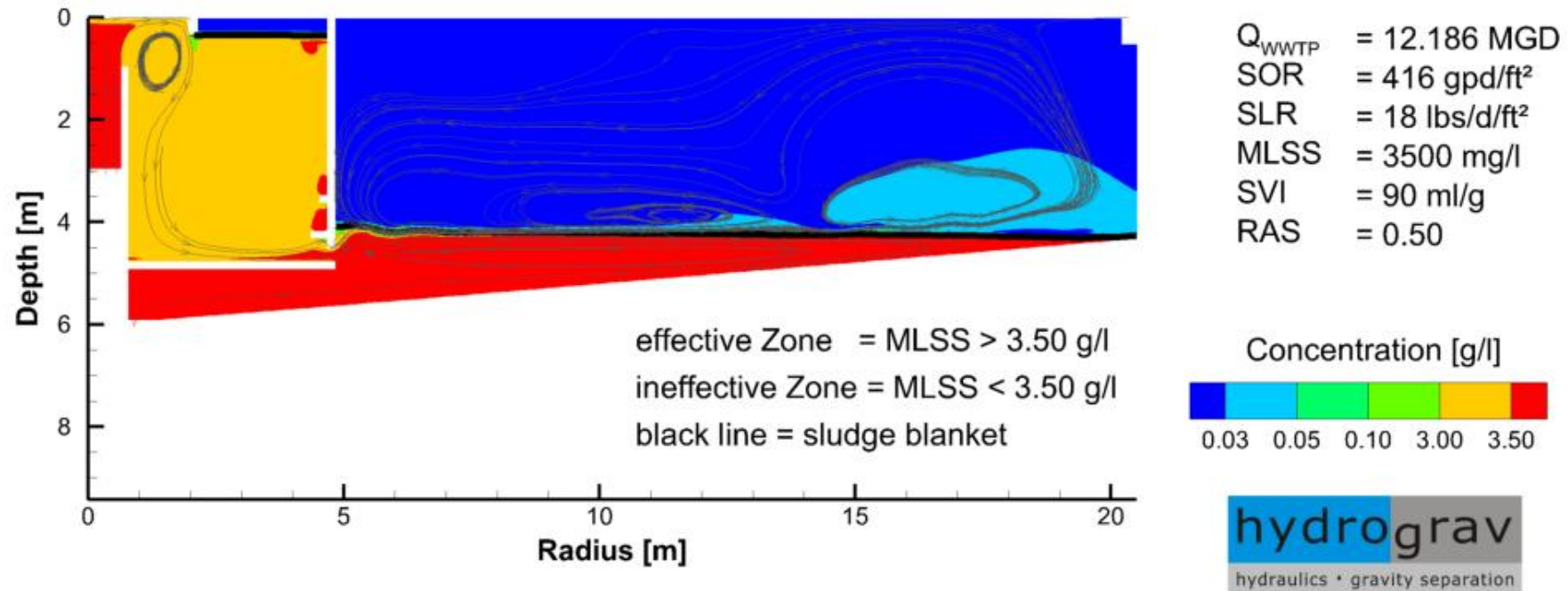


Q_{WWTP} = 12.186 MGD
SOR = 416 gpd/ft²
SLR = 18 lbs/d/ft²
MLSS = 3500 mg/l
SVI = 90 ml/g
RAS = 0.50

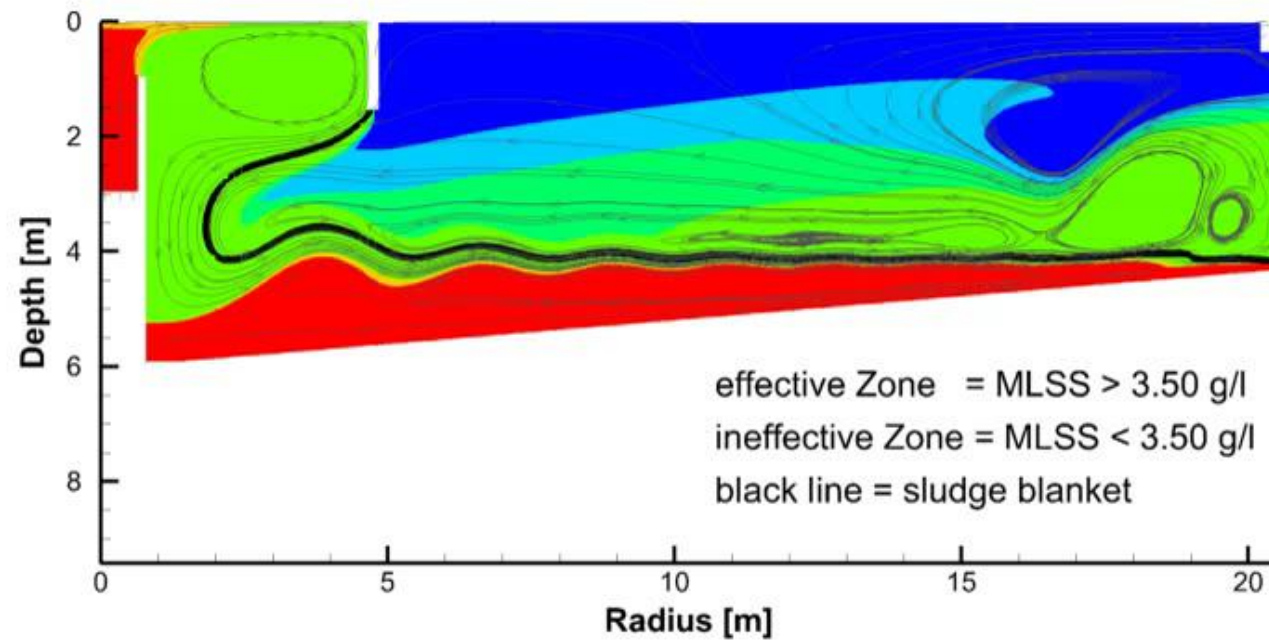


hydrograv
hydraulics • gravity separation

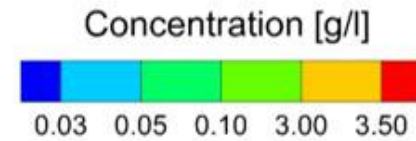
Passavant hydrograv adapt system



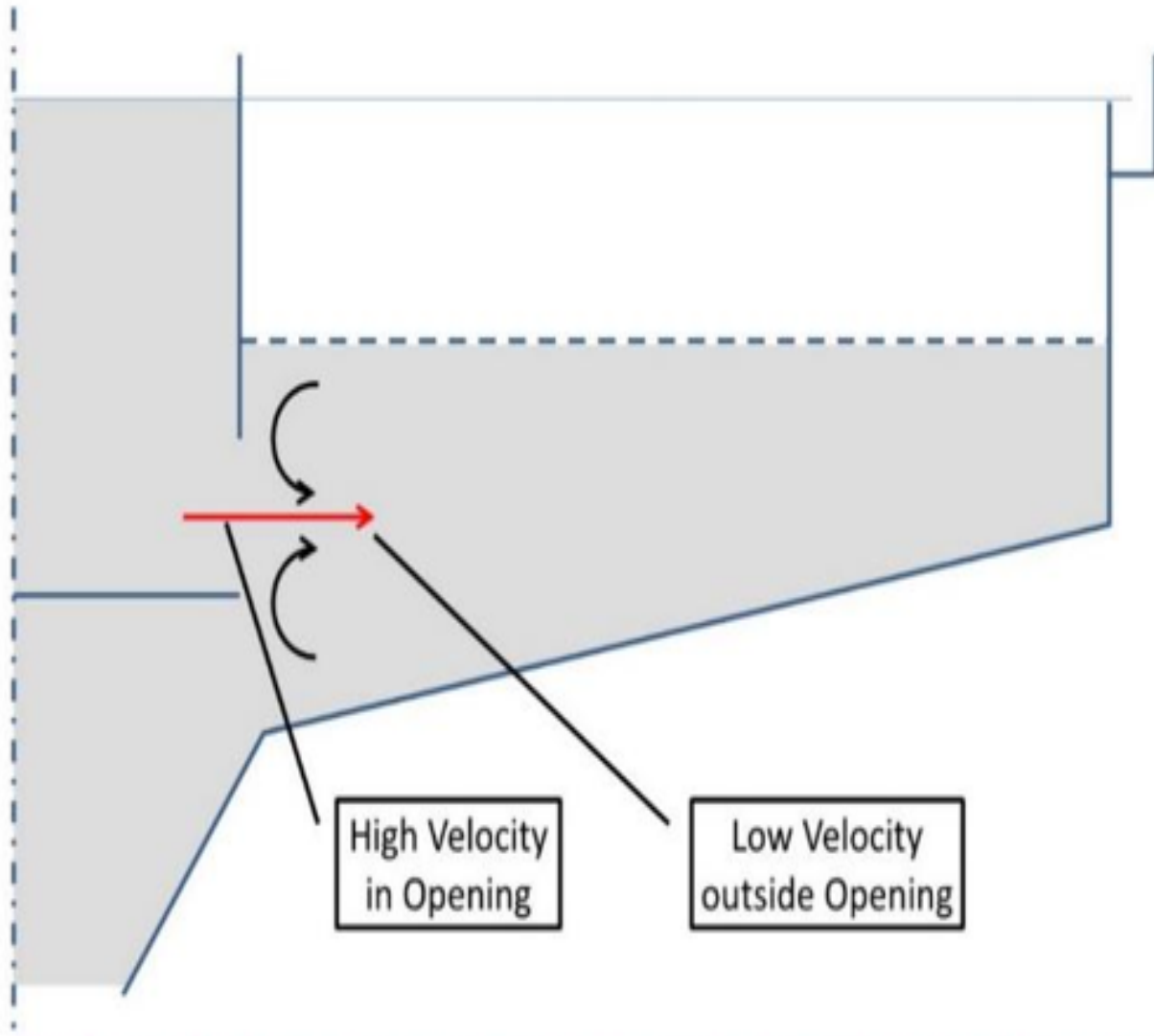
CFD Report on flow



Q_{WWTP} = 12.186 MGD
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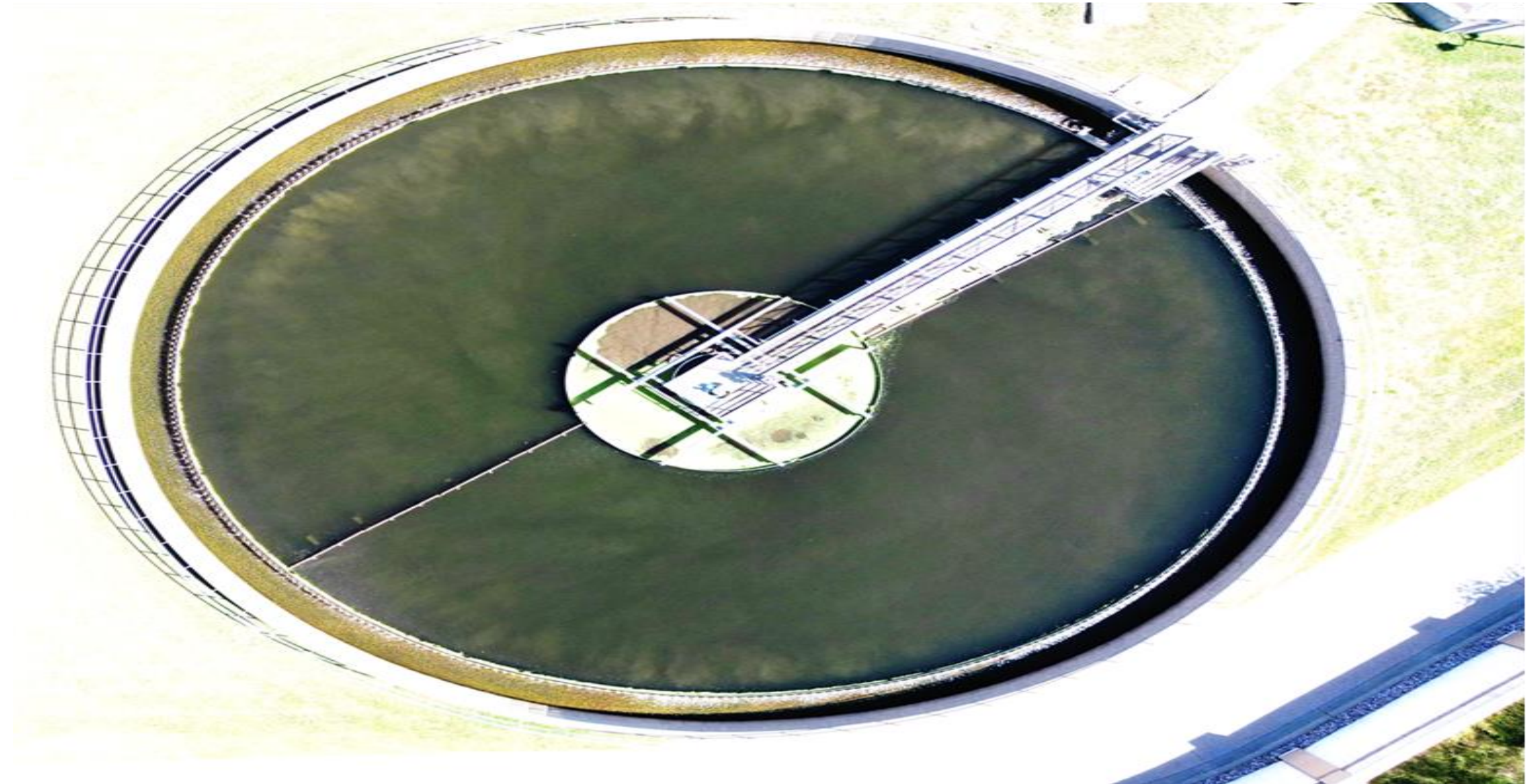
- Energy dissipation does not work well
- Static inlet performance varies with loading rate

Figure 3. "Venturi-Pump effect" from entrance into clarifier. Internal recirculation of solids will increase the solids loading and solids quantities between the inlet and outlet - causing the blanket to rise.

Original Image

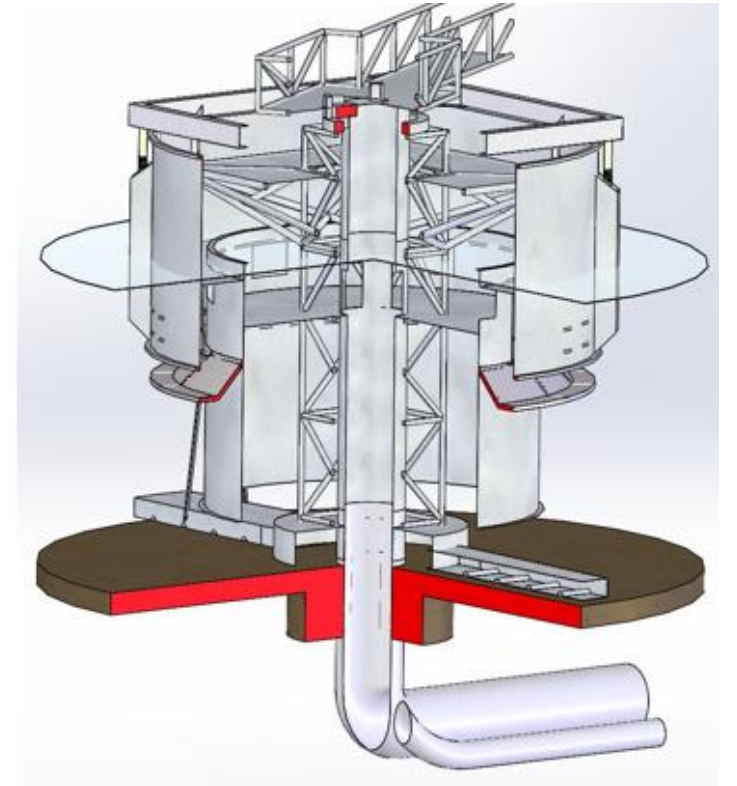
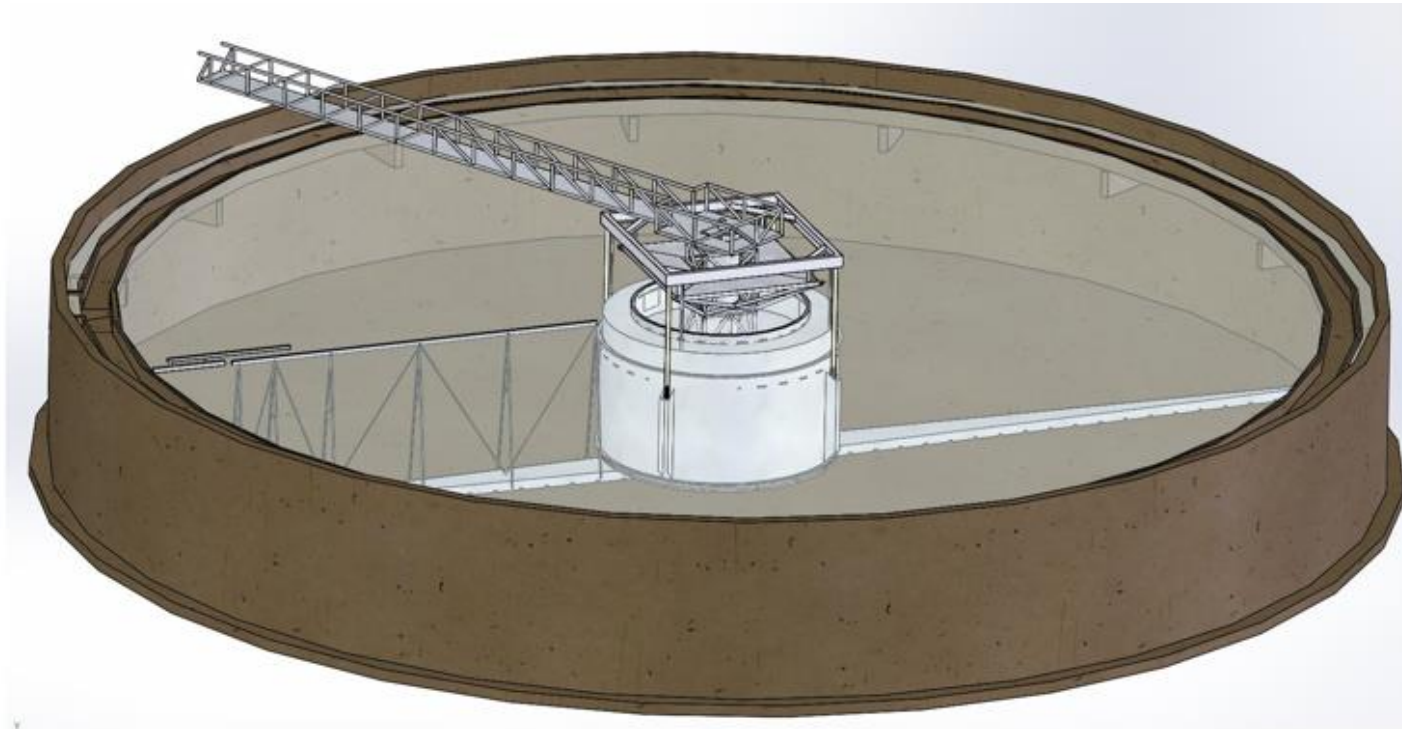


Enhanced

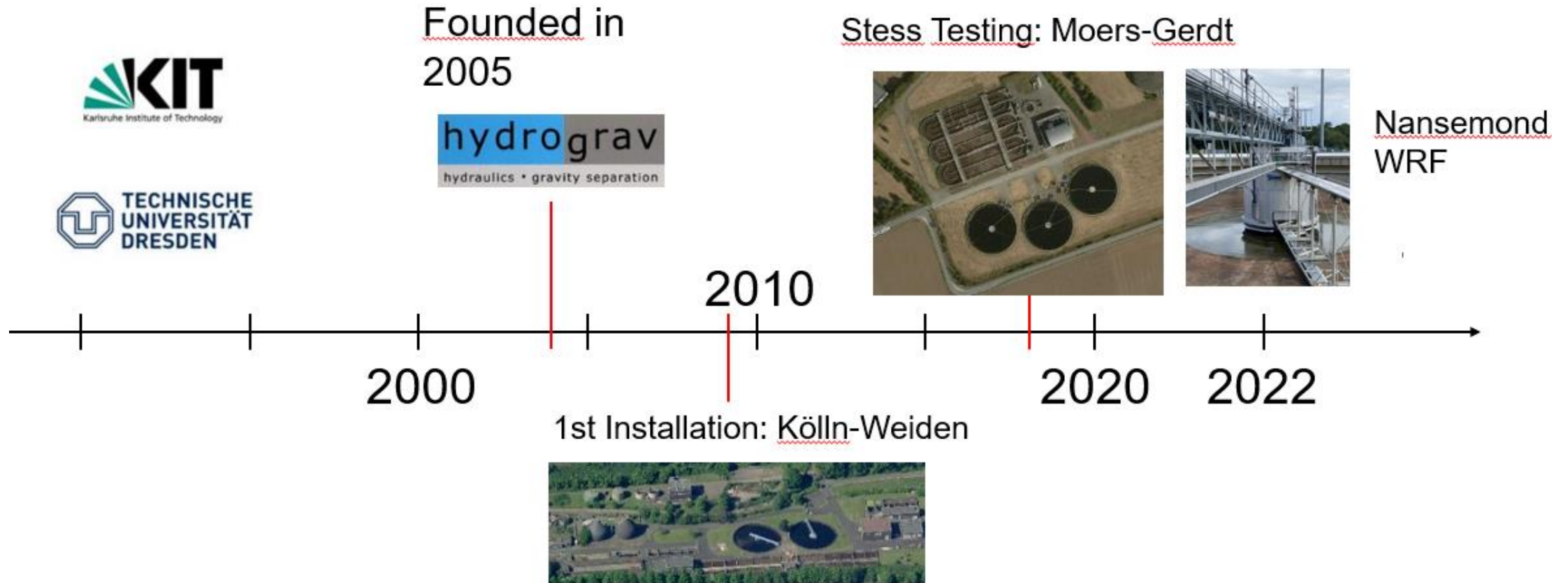


A variable-height inlet system for secondary clarifiers





History

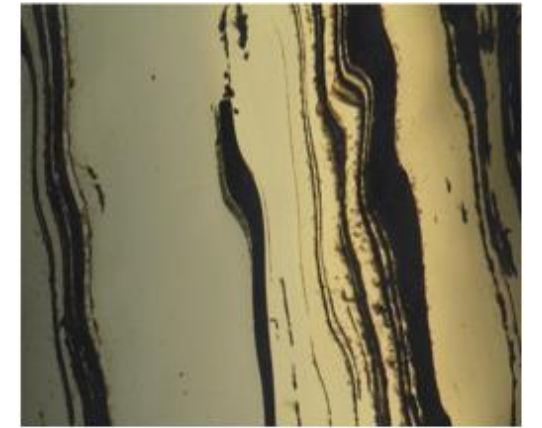
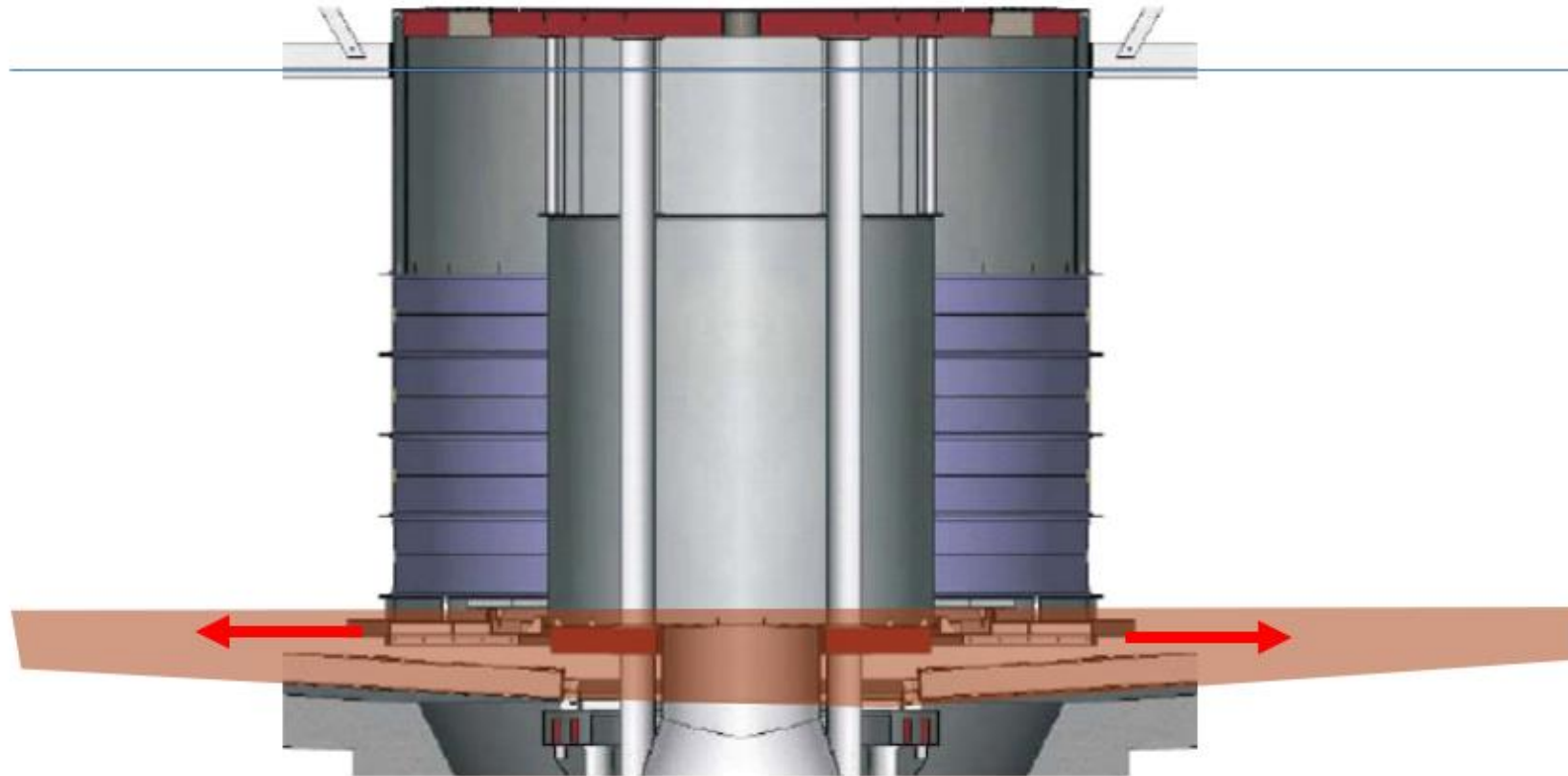


Optimization & Innovative Technology minimizing sludge discharge in secondary clarifiers



2 major issues – 2 different load-dependent solutions

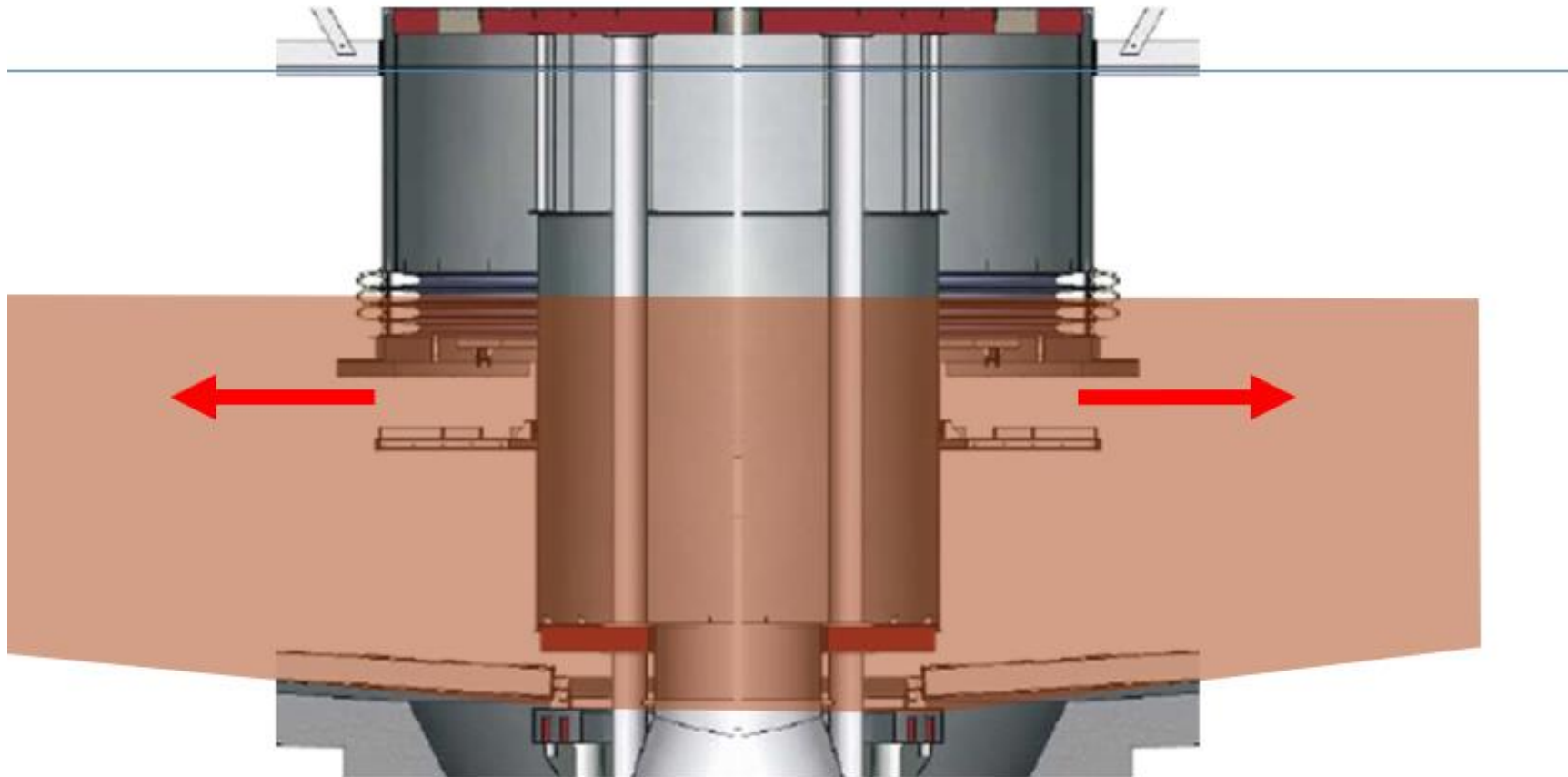
Best effluent qualities: inlet opening to be situated under the sludge blanket – in low loading situation directly at the floor:



Floc filtration inside clarifier. Regularly:
3 mg/l TSS and less 2 – 3 NTU

2 major issues – 2 different load-dependent solutions

Highest loading capacity: inlet opening still to be situated under the sludge blanket – but in high loading situation high in the tank



Minimized
ENTRAINMENT
Regularly:
**Up to 50 % load
capacity increase**

The Solution: Adaptive Inlet



Simply at any time the correct and optimal shape and elevation of the inlet opening!

Why Replace Fixed Inlet Devices with a Variable Machine?

It solves the **two major issues** of Secondary Clarifiers with Fixed Inlet Devices:

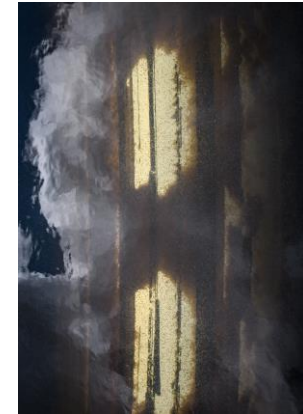
First, the reason for most **suspended solids** in the clear water discharge is fixed technology. This technology cannot respond to changing hydraulic conditions with an optimized design and always discharges the fresh sludge into the clear water - wasting it with suspended solids.

adapt systems, on the other hand, are designed to continuously adjust the inlet position. They consistently prevent the fresh sludge from coming into contact with the clear water. Therefore, it cannot be contaminated with suspended solids

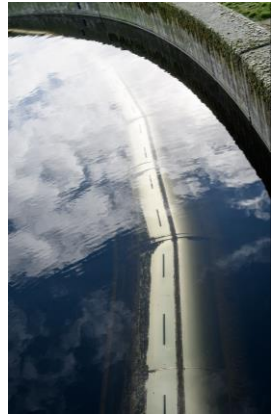
– **the clear water remains clear**

TSS @ Effluent Launder

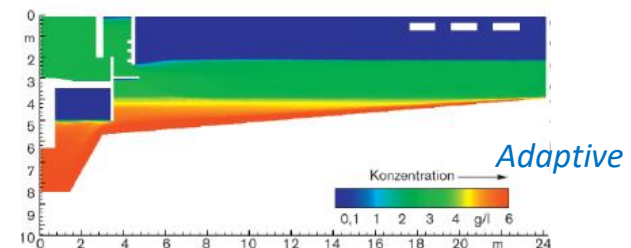
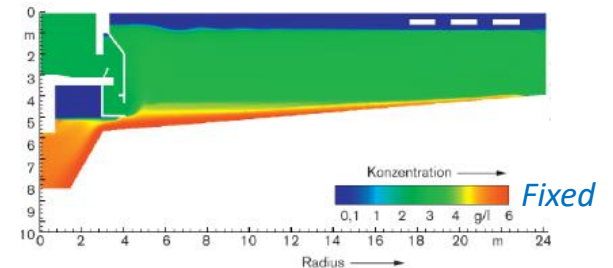
Fixed Inlet



Adaptive Inlet



Capacity at identical loading (CFD)



Why Replace Fixed Inlet Devices with a Variable Machine?

It solves the **two major issues** of Secondary Clarifiers with Fixed Inlet Devices:

Secondly, a fixed inlet technology is **never optimal in terms of hydraulic conditions**.

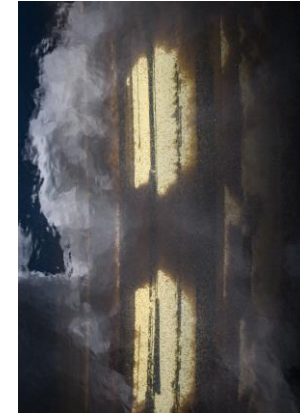
It re-suspends sludge that has already settled. This interferes with the settling process and thus **limits the hydraulic capacity** of the SST and the entire wastewater treatment plant.

adapt systems, on the other hand, adjust at their shape optimally to the current load. Together with their "McKinney baffle" - always in the right position in relation to the current loading – adapt **increases the possible loading** of the SST by up to 30% and some installed plants 50% - even more!

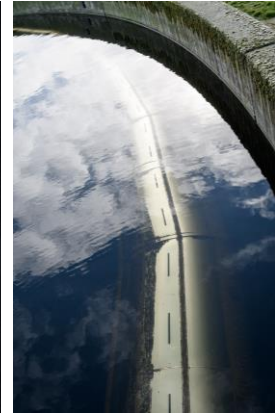
adapt - Lower Cost and Effort than Additional Clarifiers or Tertiary Treatment

TSS @ Effluent Launder

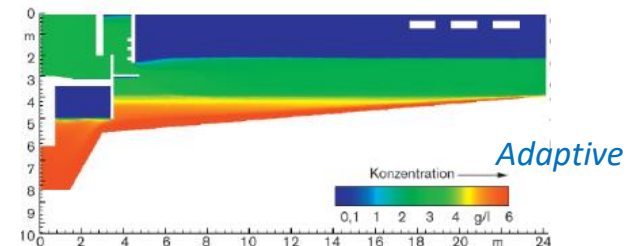
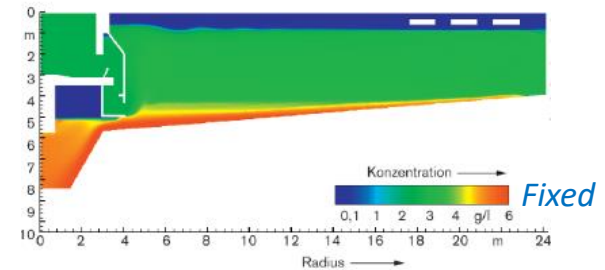
Fixed Inlet



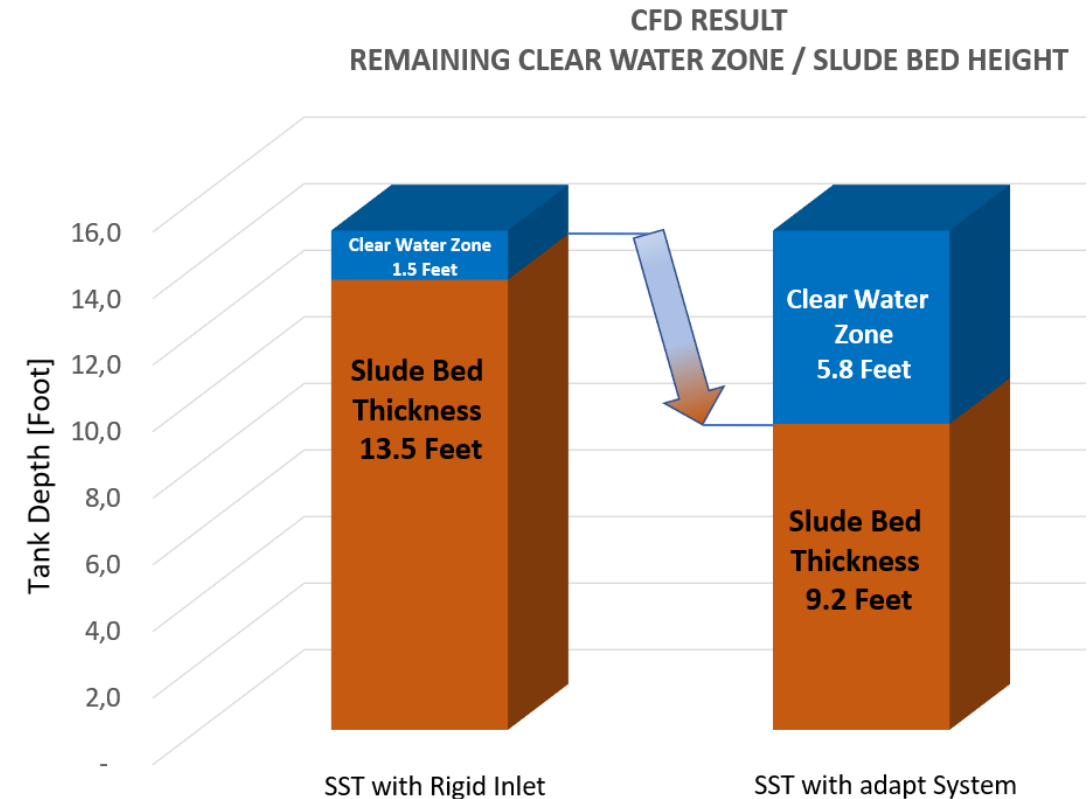
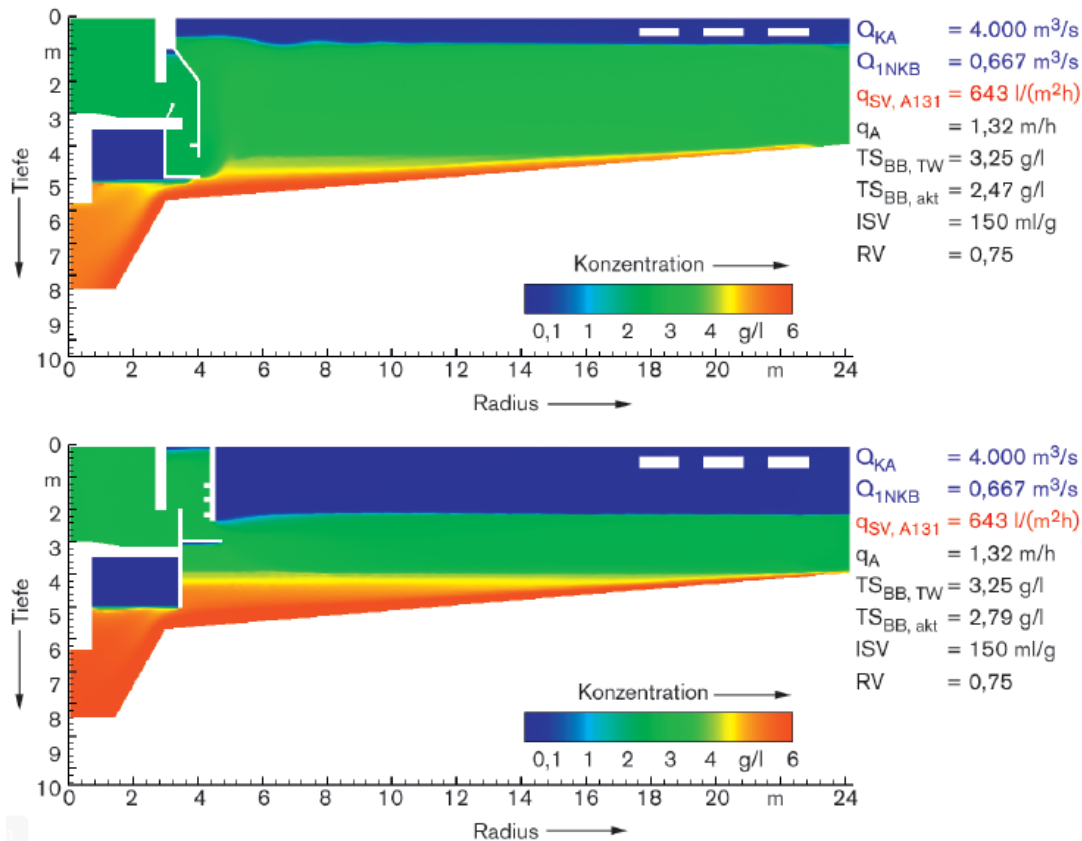
Adaptive Inlet



Capacity at identical loading (CFD)

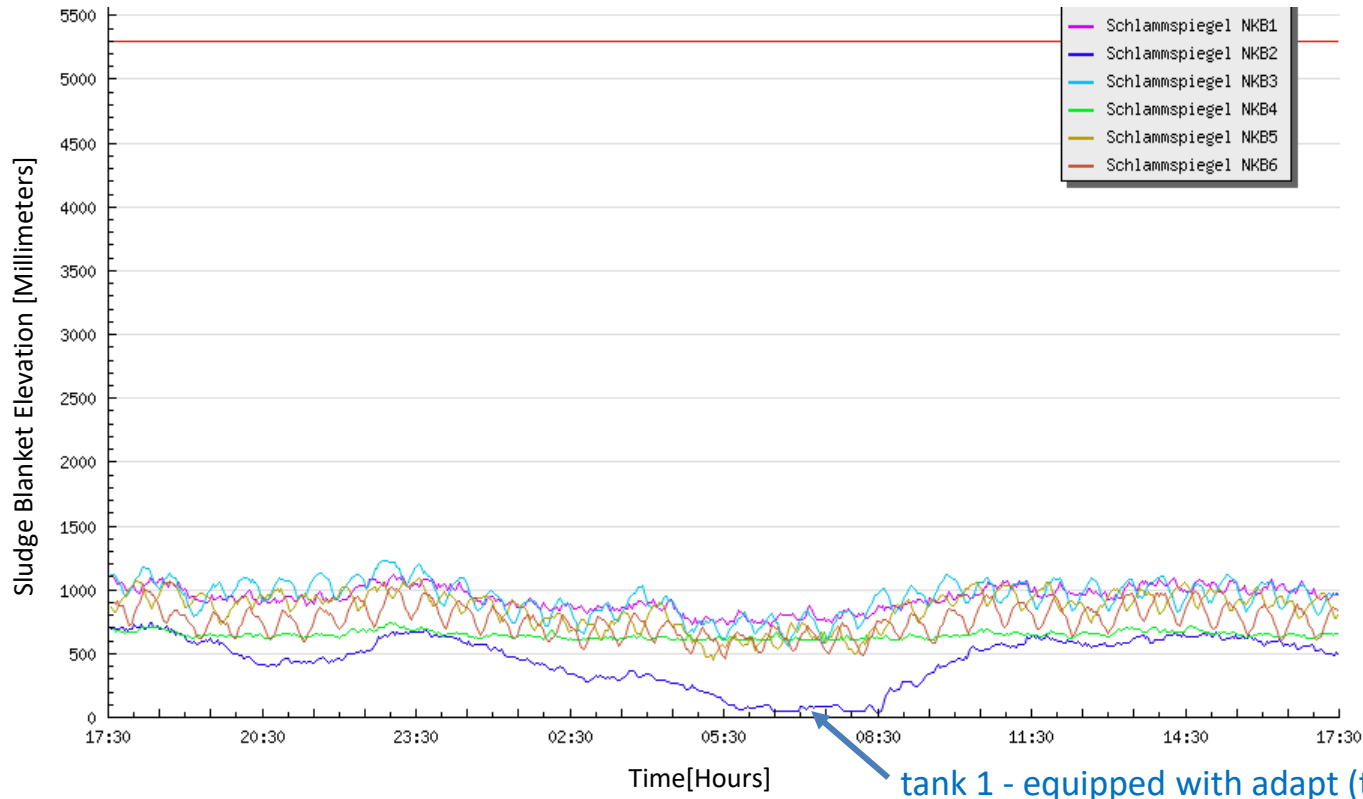


hydrograv tested the secondary sedimentation tanks in hundreds of CFD-simulations in actual low, medium and extreme load scenarios. Based on this best-fit geometries of the inlet system were derived for all loading situations. Those CFD examinations clearly show that the sludge blanket decreases as a result of the inlet being moved → The flexible adjustment of the geometry in response to changing loads strongly increases the capacity of the tanks!



- Also the on-site measurements confirm the drop of the sludge blanket (= higher capacity) with adapt:
- Minimized entrainment → adapt-tank has lowest **real** loading of all six settling tanks!
- Dresden, first adapt: immediately after installation the sludge level dropped!

Dresden - 24 hours measured sludge levels of SST 1 - 6; tank 1 (blue) at this time as the only one equipped with adapt

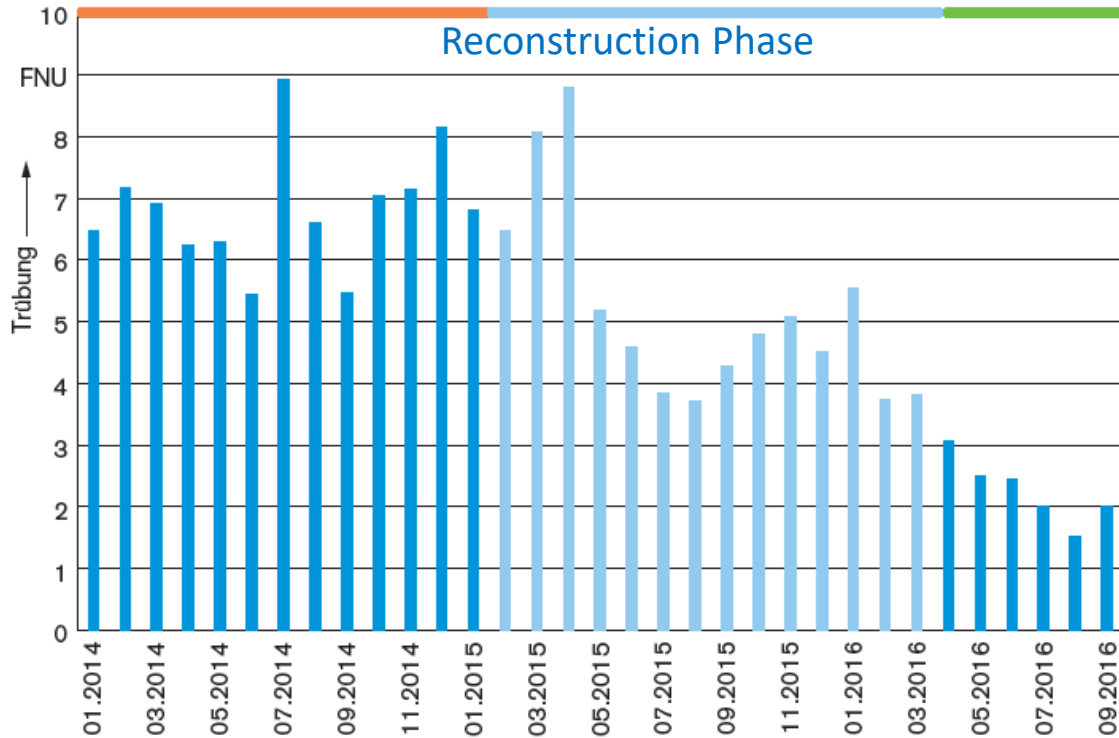


6 sludge blankets over 24 hours:
Dark blue: First tank with adapt in operation.
The other five SST still with fixed inlet



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The measurement also impressively proves the advantage with regard to effluent turbidity:
 Turbidity continued to drop as the conversion to adapt inlet systems progressed - at the end, when all six tanks were equipped with adapt, to a third with values below 2 FNU as a monthly average, as is often seen only with sand filters.



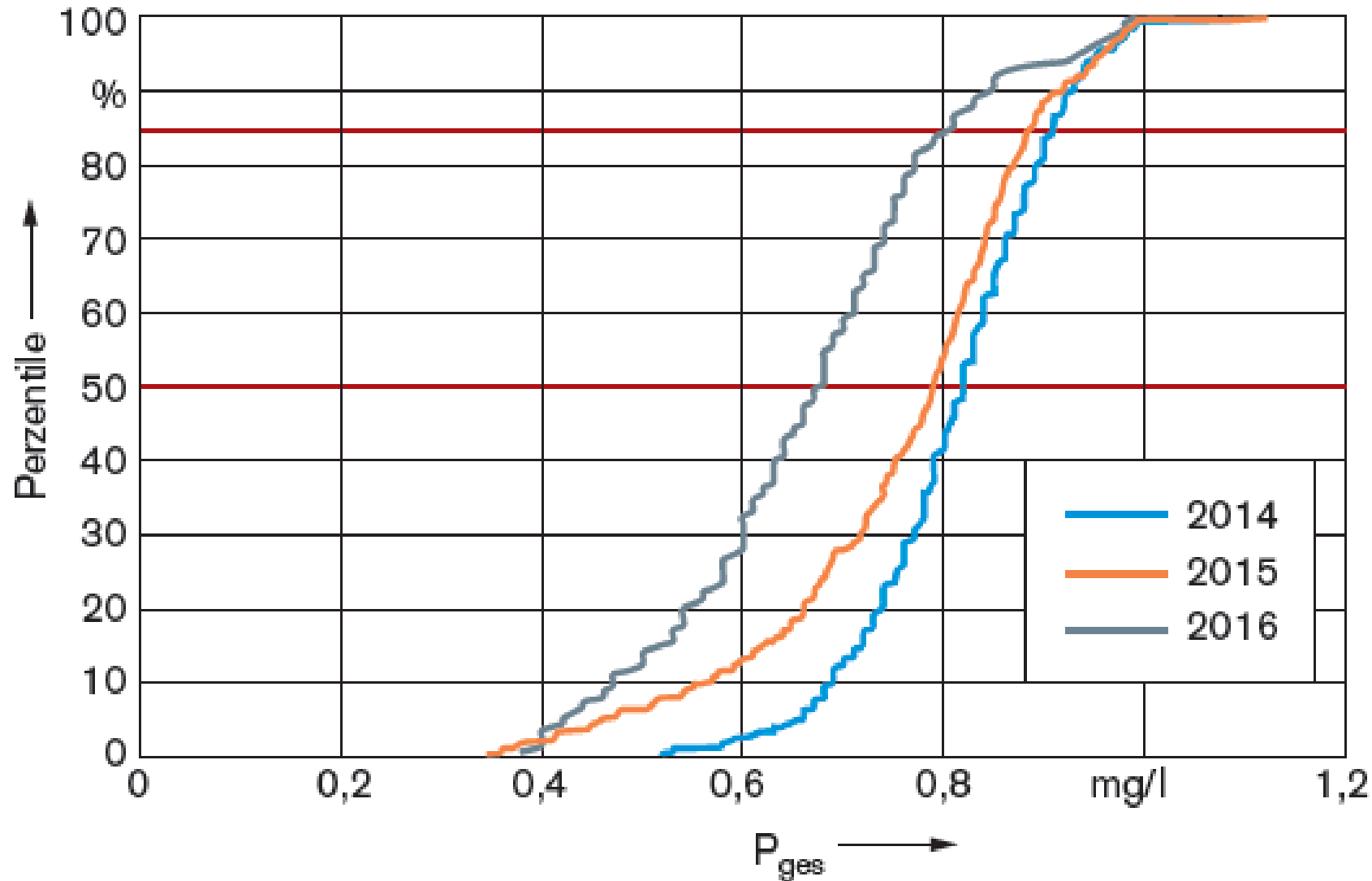
Also the view of the effluent launder of the Dresden SST showed the advantage of adapt very clearly – even in the sense of the word:



View into clarifier with fixed inlet.

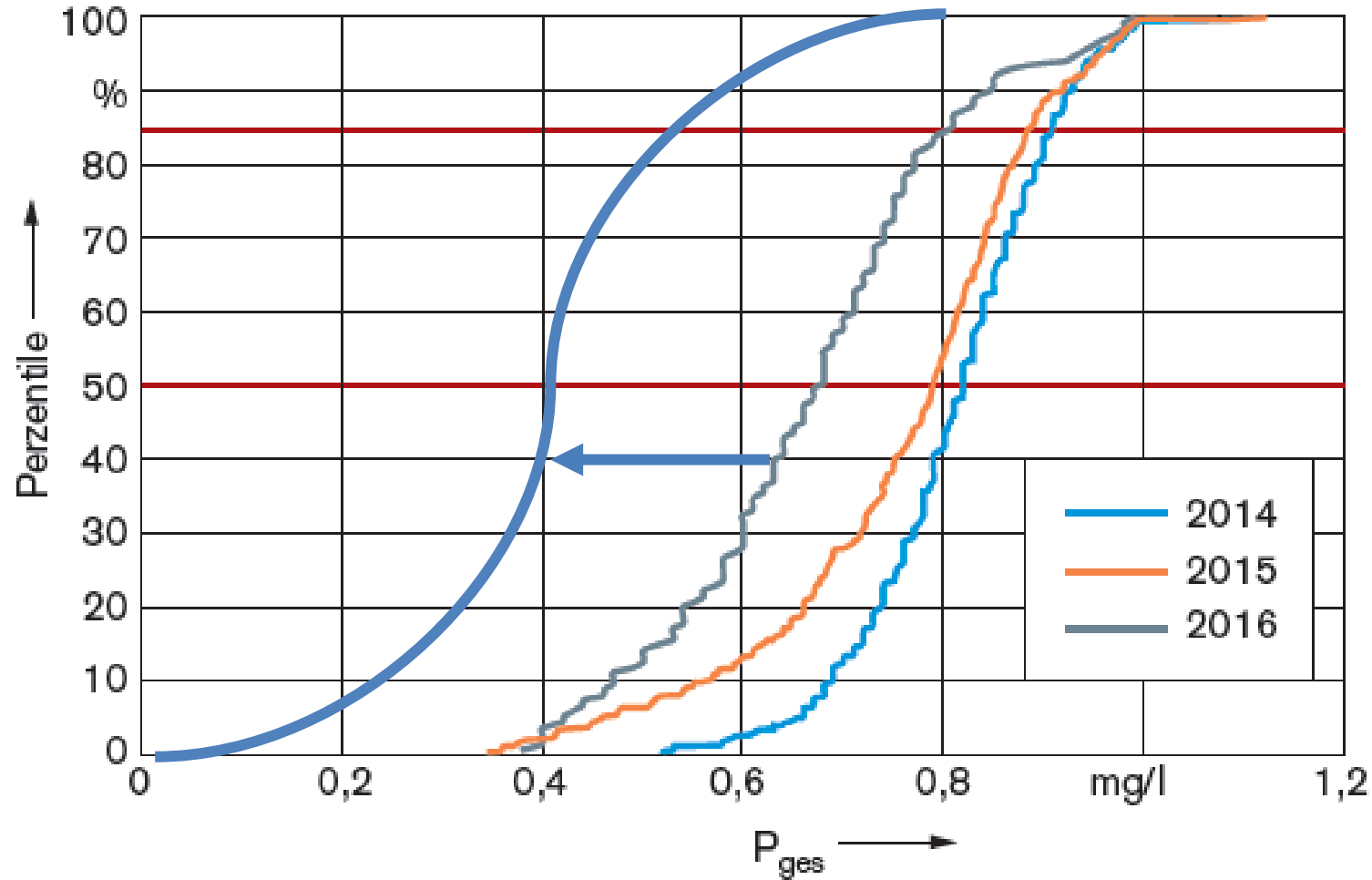


At the same time: view into the first secondary clarifier of the plant retrofitted with adapt.



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Phosphorous could now be further reduced just by precipitation

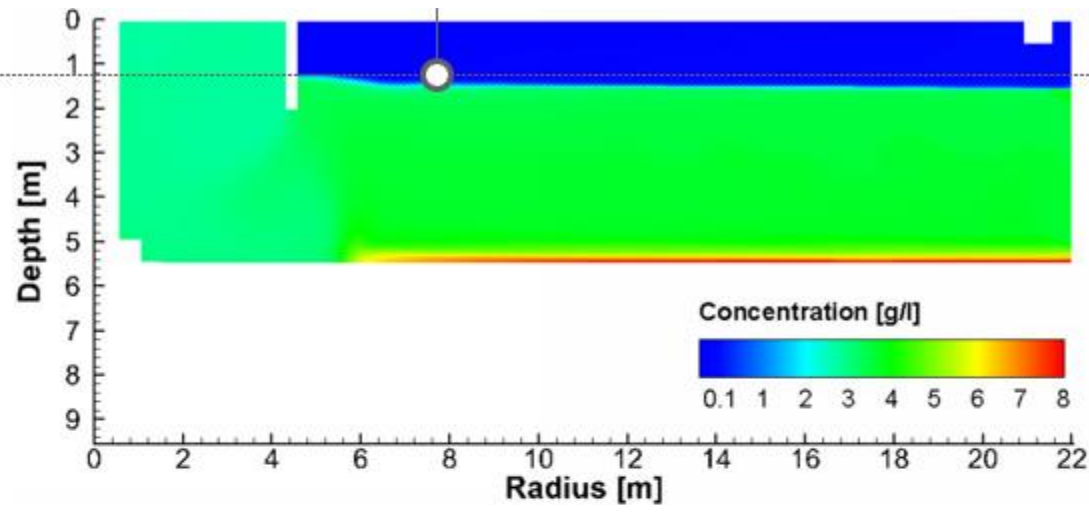




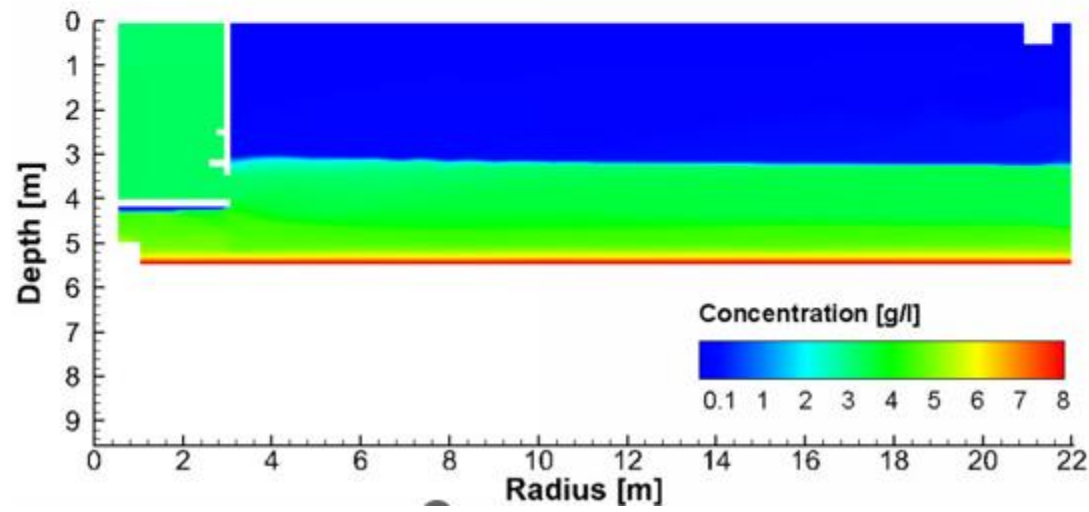
Dresden-Kaditz WWTP



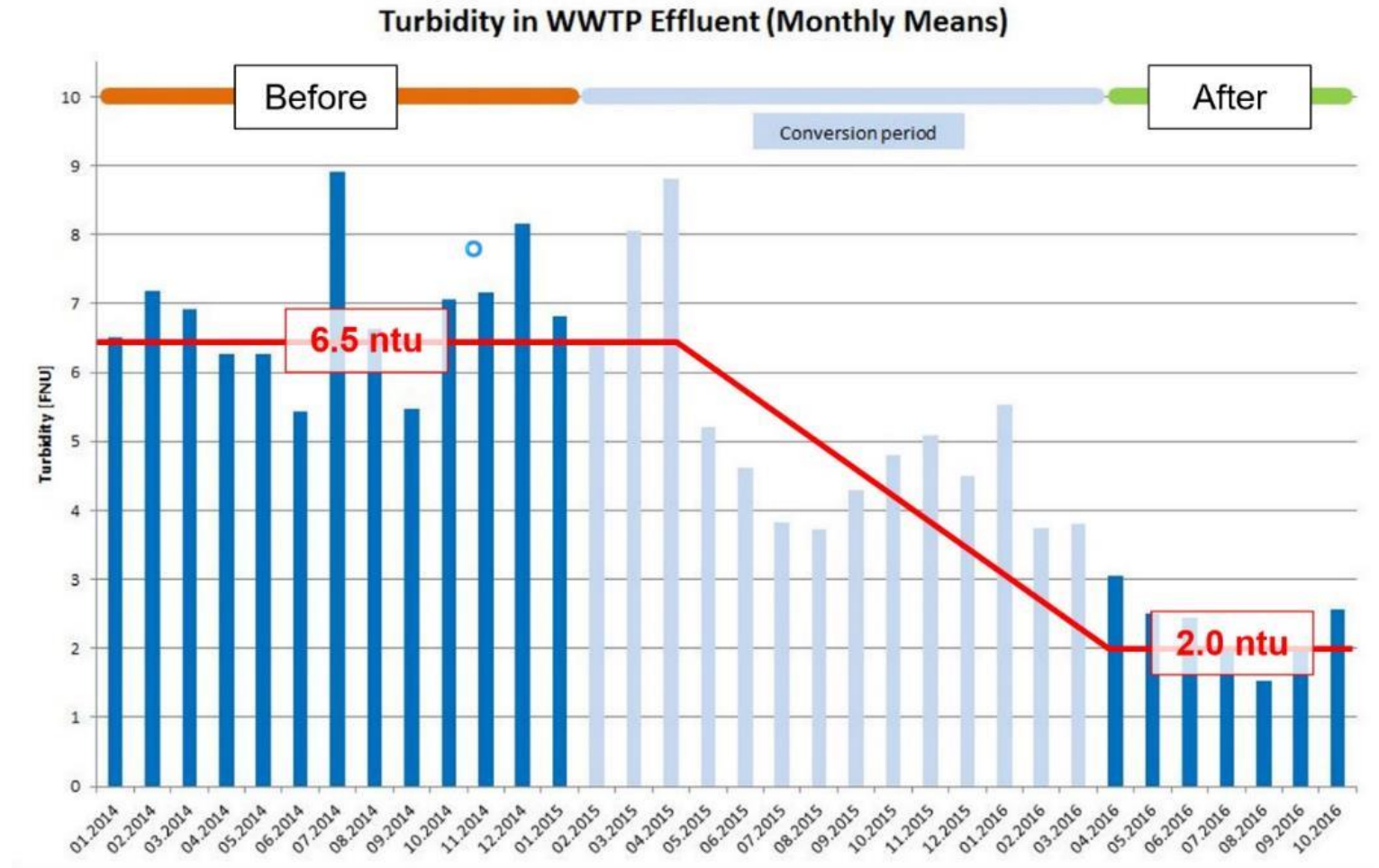
Conventional



Adaptive



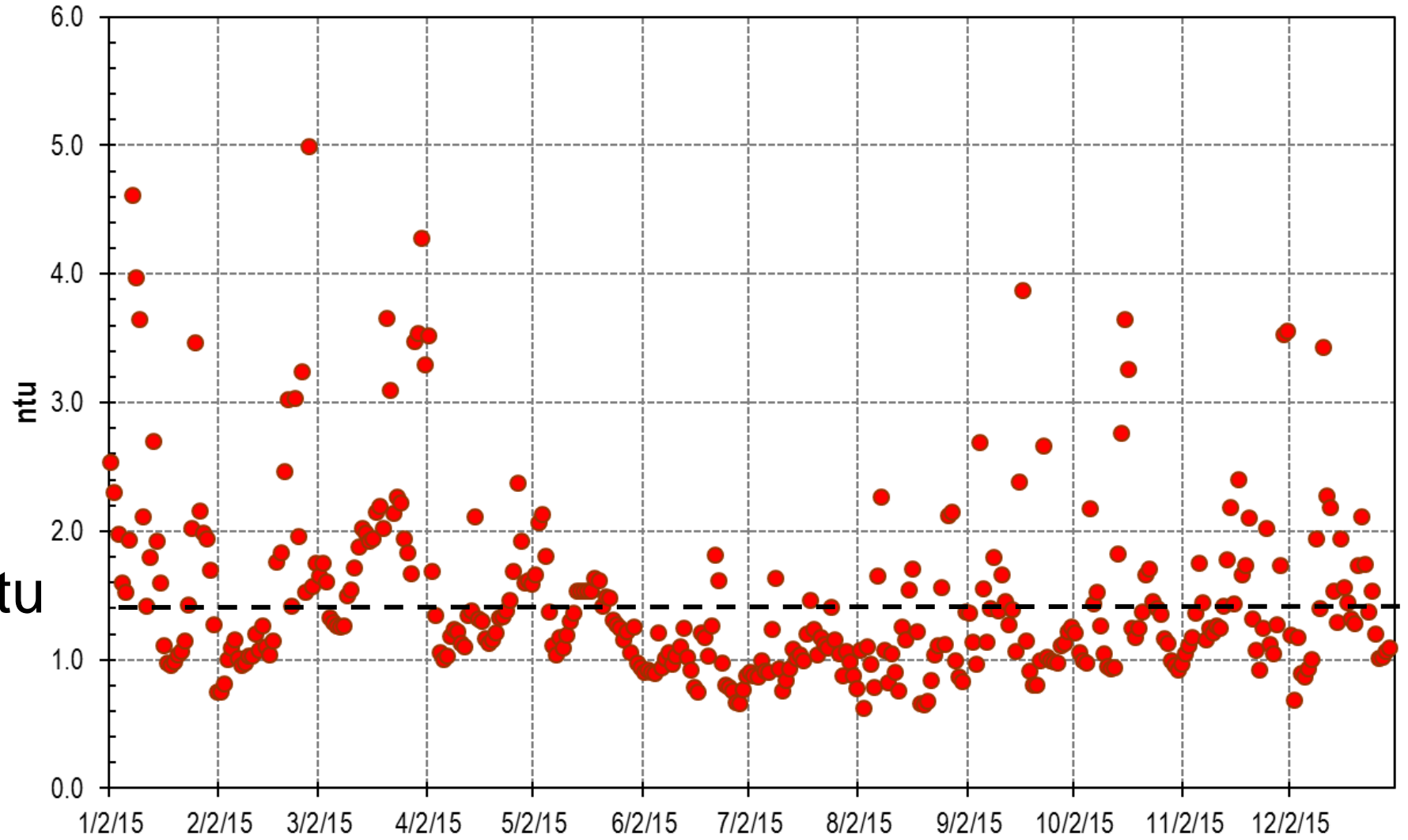
- 800,000 PE
- 6 x 150 ft diameter SCL



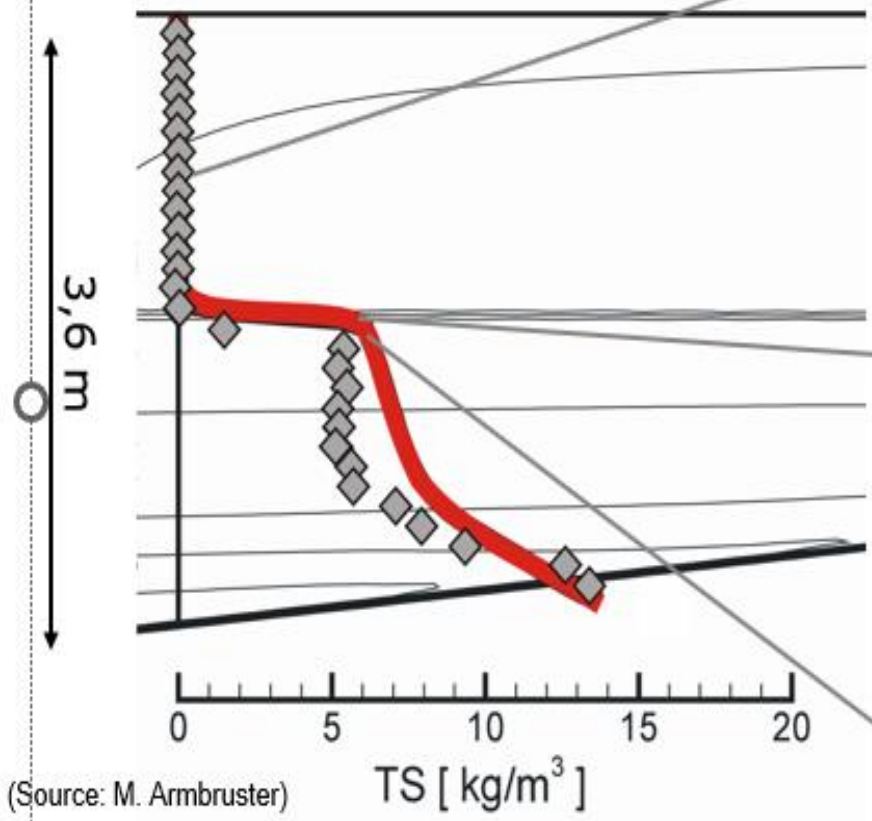
Source:
Hydrograv

X

Ave Turbidity: 1.5 ntu

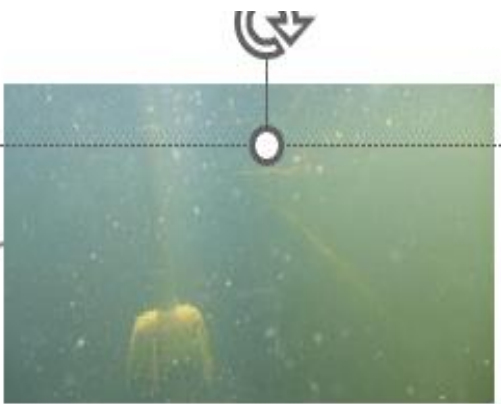


Sludge Profile

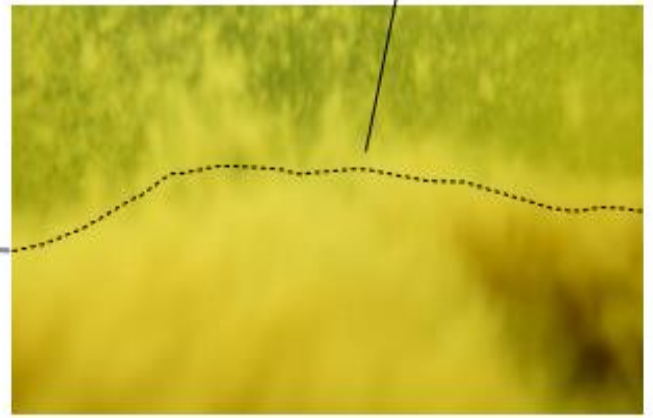


(Source: M. Arnbruster)

Concentrations



Tops of Sludge Blanket



2'

Summary

- **Adaptive inlet**

- Insures ideal hydraulic conditions
- Minimize internal flow circulation
- Process capacity gains up to 50%
- Re-use of capital assets

- **Blanket filtration**

- Enhanced Treatment Capacity
- Captures Smaller Particles
- Produces low effluent TSS & OP
- Reduces O&M - Down Stream Tertiary Treatment
- Effluent with $< 2 - 3$ NTU
- Water Reuse opportunity

Thank you for your time



Key Benefits:

- Enhanced treatment capacity
- Avoid filtration efforts
- Avoid extra load of backwash water
- Lower whole-life cost
- Lower carbon
- Re-uses existing assets

Thank you for your kind attention!

Questions?



Passavant



Geiger



Noggerath

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