From Traditional Flow Through to Modern Model 3 Farms - RAS

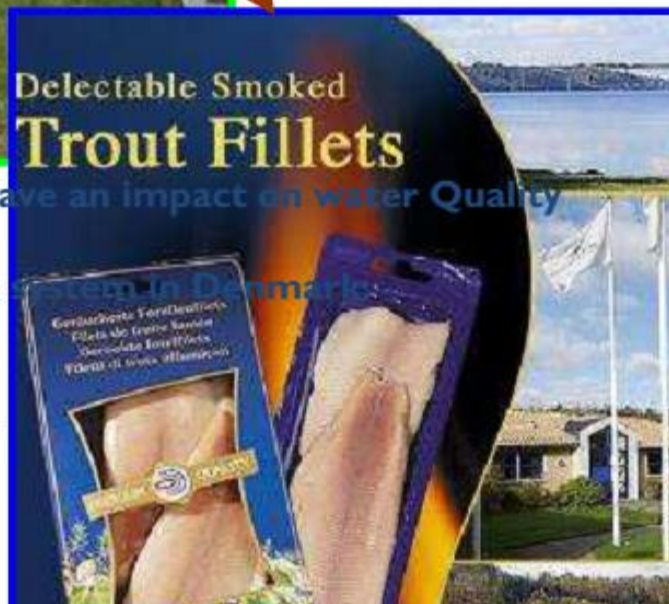
Anders Andreasen, BioFarm

Production of trout with less fresh water supply

Discharge of nutrients – Fish Feed have an impact on water Quality

Recirculated aquaculture system in Denmark

Increase Production
Avoid use of River water
(Specially in VHS areas)



15 locations (4 owners)

Seawater (brackish)

Production of rainbow trout, all female

Season only April - December

Total yearly production 12.000 tons


BioMar
North Sea
Max in Nor
16 million
smolt/yr
BioMar
Continental
Max in D
1500 ton
000 ton/yr
Max in DK
400 ton/yr
BioMar
Americas
Max in Chile
12 million
smolt/yr
Factory

- *trends in new technologies for fish farms - RAS*
- *starting out from a report from the Danish Ministry of the Environment*
- *trends in new technologies for future fish farms - FREA*

Dambrugsudvalget

(Udvalget vedr. dambrugserhvervets udviklingsmuligheder)

Rapport

Marts 2002

Ministeriet for Fødevarer, Landbrug og Fiskeri

Rules for fresh and sea water farms in the late 80'ties:

- Farmers were ready for investments
- Authorities very conservative

➔ *No development of the business for 10 years!*

In October 2000 a taskforce was established to evaluate the prospects for freshwater farms in Denmark.
Consideration should be given to:

- Possibilities for the wild fauna to pass fish farms
- ~~Regulation shall be based on discharge~~
- Establish 15 farms to document the impact of modern farming
- A code of conduct for best practice incl. legislations and training
- Financial support of investments
- Better possibilities for commercial financing
- More R&D in fish health and vaccines as well as in medicines an chemicals in freshwater fish farming

In January 2015: New Strategy for fresh and sea water farms

- Regulation is now partly based on discharge

➔ *Interesting Development of the business is ongoing!*

est farm type	Limiting parameter nitrogen (N)	Limiting parameter phosphorus (P)
1	158 tons / year	178 tons / year
1A	129 tons / year	178 tons / year
2	110 tons / year	145 tons / year
2A	110 tons / year	145 tons / year
3	125 tons / year	230 tons / year
3A	140 tons / year	230 tons / year

In January 2015: New Strategy for fresh and sea water farms

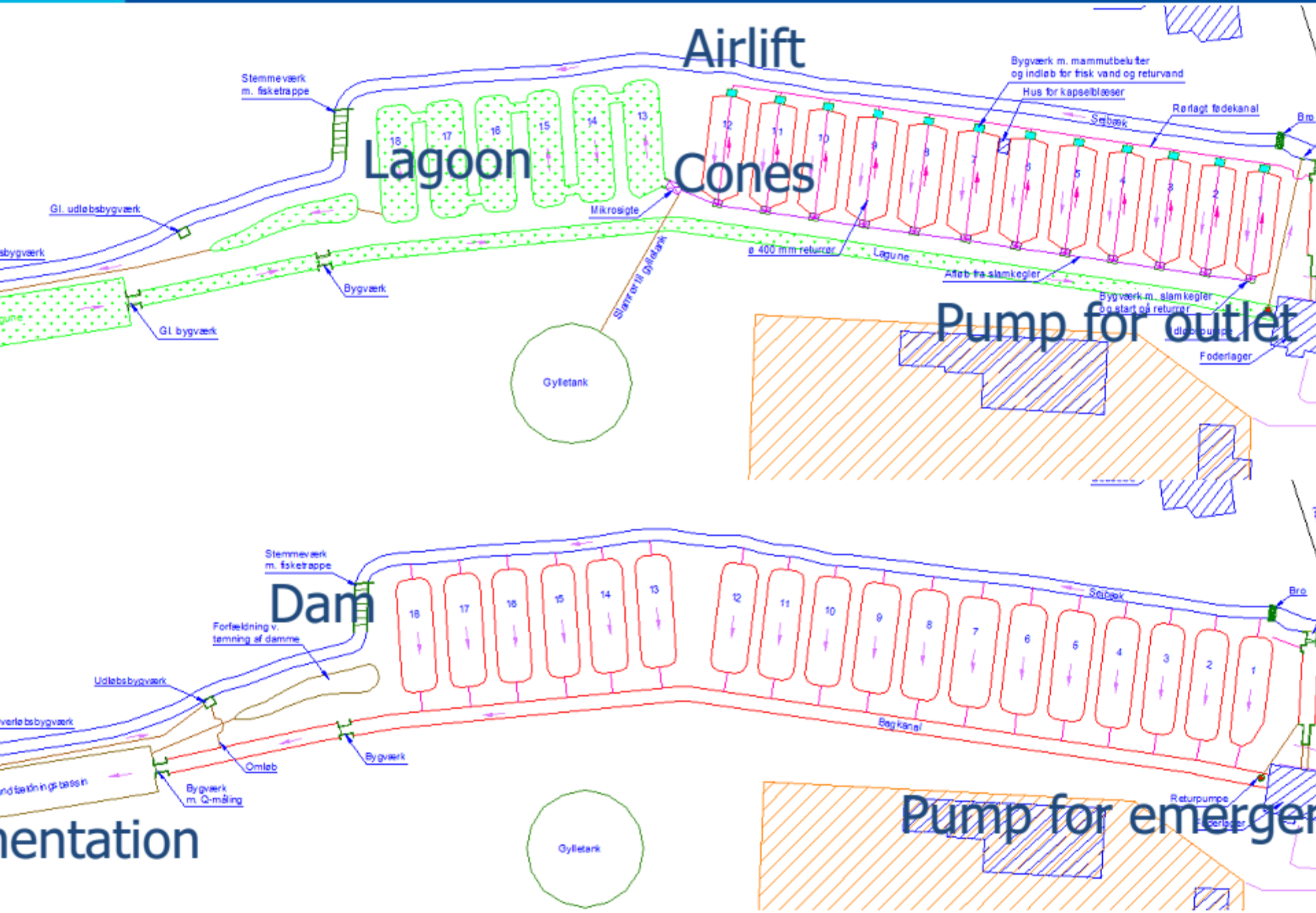
- Regulation of RAS are now based on discharge

➔ *Interesting Development of the business is ongoing!*

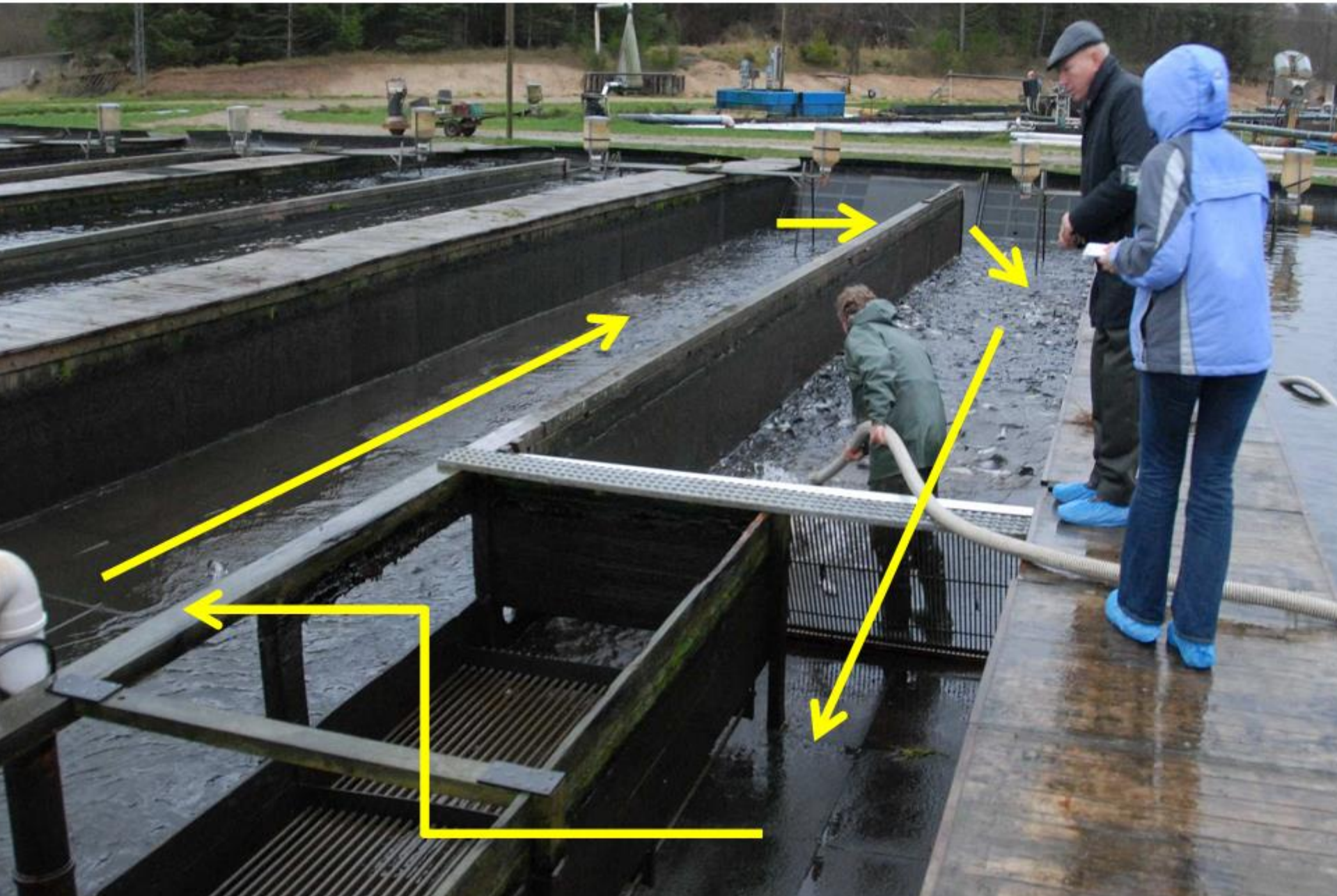
Fish farming in Recirculated Water
Production of trout with less fresh water supply

	Traditional earth ponds Re. Pump	Internal recirculating in channels	Model Farms with biofilter	Closed sy Indoo
n per year	100 tons	100 tons	100 tons	
day 15℃	384 kg feed	384 kg feed	320 kg feed	29
r	200 l/sec.	35 l/sec.		
ater			15 l/sec.	
er/day			4.055 l/kg feed	732
nsumption	350 kWh/day	180 kWh/day	250 kWh/day	750
Power	15 kWh	11 kWh	17 kWh	
t	2.500 dkk/t prod.	13.000 dkk/t prod.	18.000 dkk/t prod.	36.000 d
7,45	336 €/t prod.	1.745 €/t prod.	2.416 €/t prod.	4.832

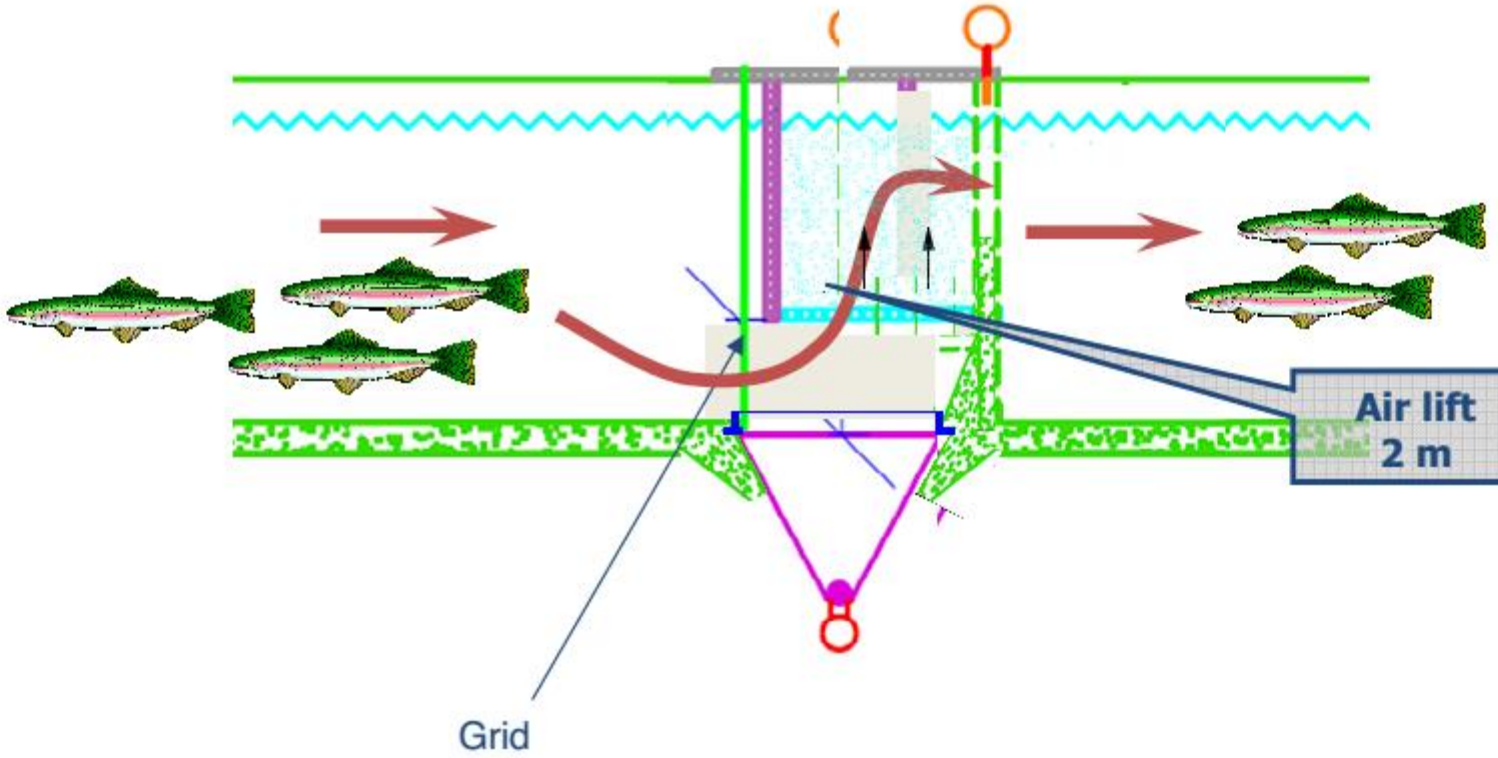




Airlift
Lagoon
Cones
Pump for outlet
Dam
Pump for emerger
Stemmeværk m. fisketrappe
Gl. udløbsbygværk
Bygværk
Gl. bygværk
Mikrosigte
Slamrør til gylletank
ø 400 mm returrør
Lagune
Afløb fra slamkegler
Bygværk m. slamkegler og start på returrør
Udløbspumpe
Fodertager
Gylletank
Bygværk m. mammutbeluftere og indløb for frisk vand og returvand
Hus for kapselblæser
Rørlagt fødekanal
Sobæk
Bro
Forfældning v. tømning af damme
Udløbsbygværk
Omløb
Bygværk m. Q-måling
Bagkanal
Returpumpe
Gylletank

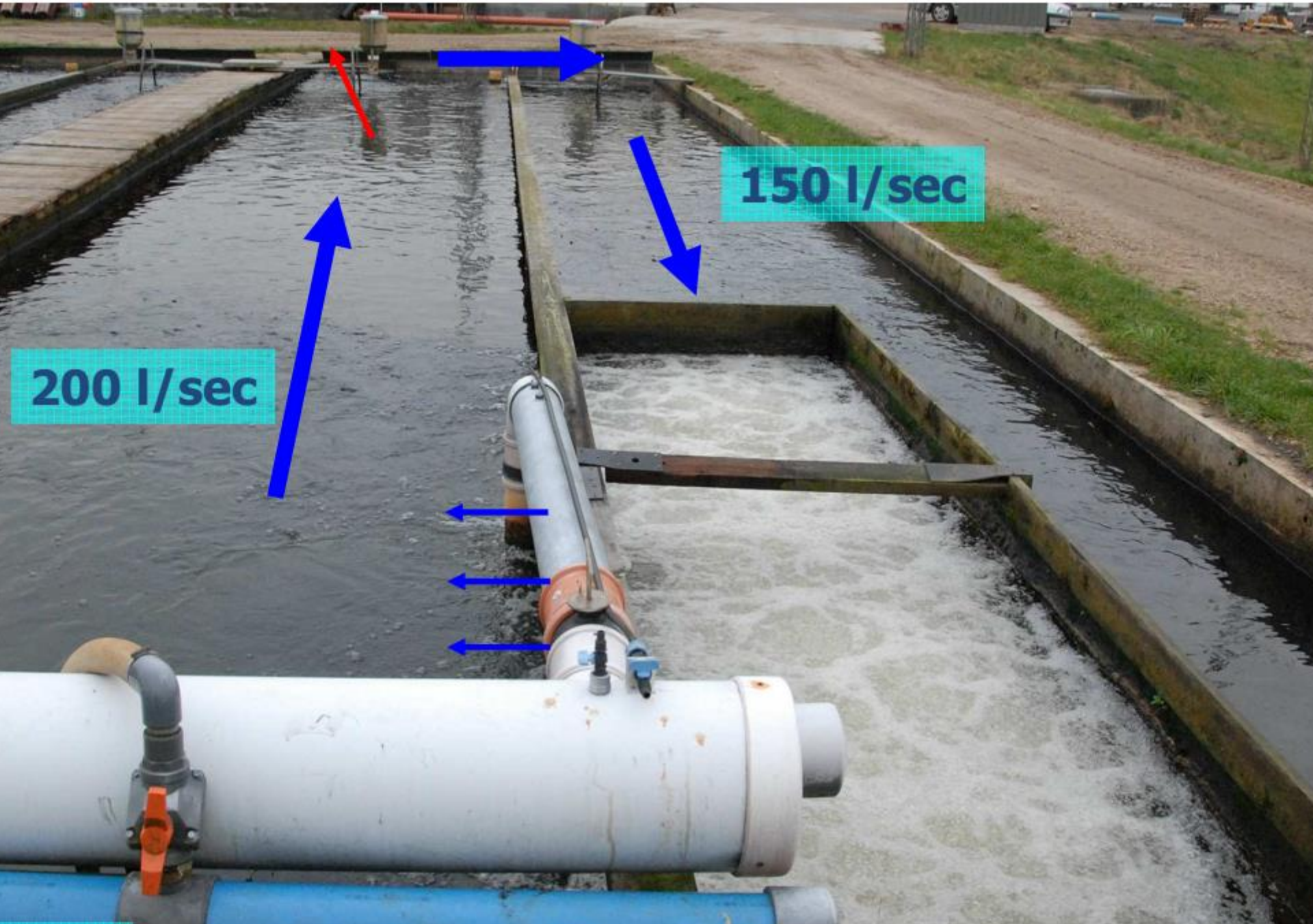

Cones
Airlift
Fish

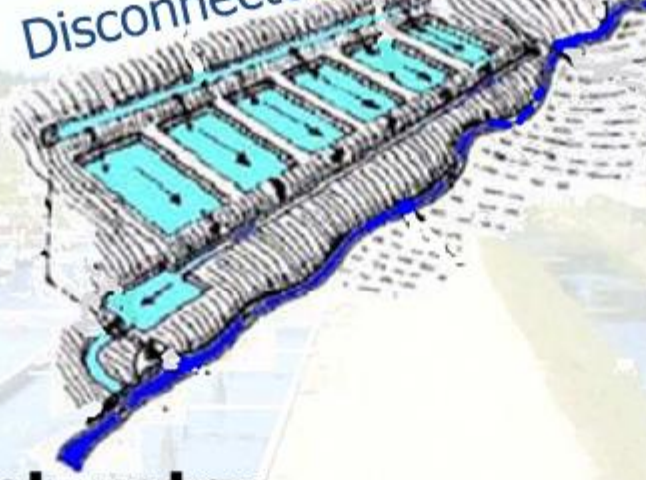


Airlift in 0,8 m dept



Low pressure airlift
High efficiency for degassing CO_2


150 l/sec
200 l/sec



farm layout with biofilter?

- **Oxygen fluctuations in river water**
- **Too high temperatures in summer**
- **Water flow too low in summer**
- **High infective pressure from the inlet water**
- **Environmental limits on discharge- *Nitrogen removal***
- **Management (Higher labour efficiency 2-300T/person)**
  - **Daily on feeding and fish handling**
  - **Maintenance on ponds**

32 "Model farms" is in operation and produce 18.000 tonne fish

Overall focus on reducing production cost

FCR= 0.8

Oxygen combustion 50 kg

70 kg Carbon Dioxide

Feeding 100 kg

Particulate Waste

35 kg Oxygen consump

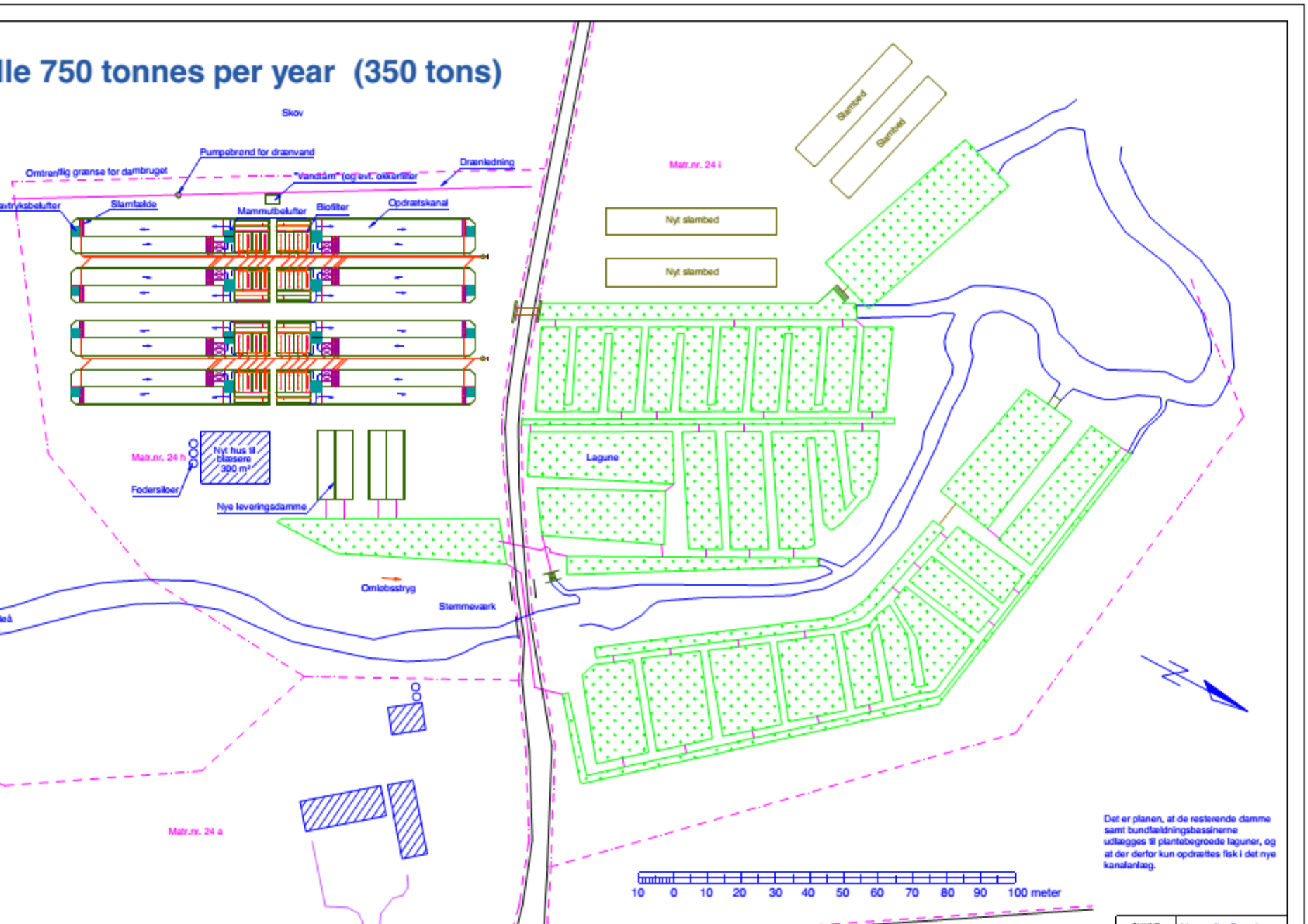
49 kg Carbon Dioxide

1.0 kg Nitrogen

Dissolved Waste

Nitrogen 3 kg

5-20 kg Alkalinity

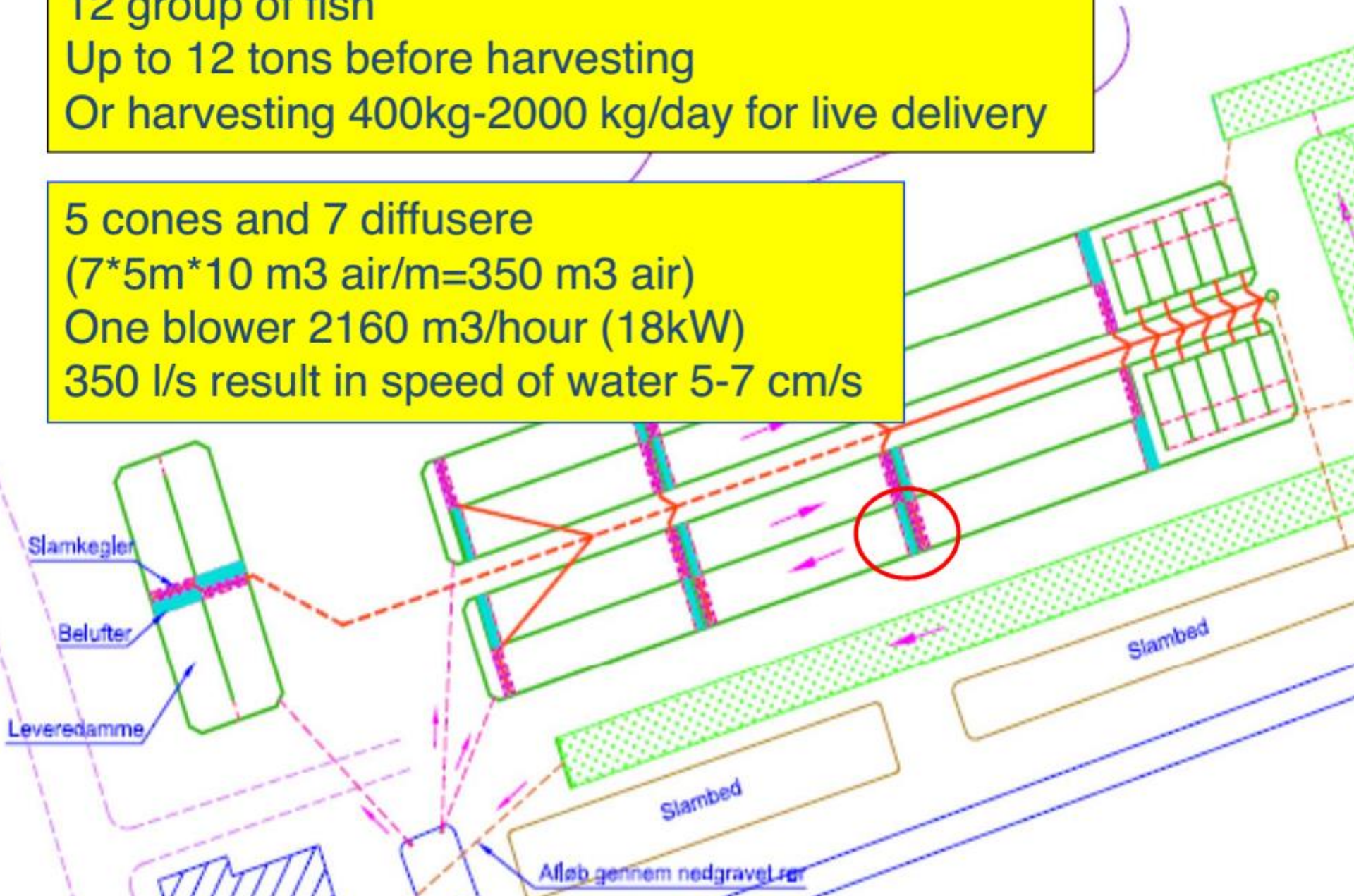

lle 750 tonnes per year (350 tons)
Skov
Pumpebrønd for drænvand
Omtrentlig grænse for dambruget
"Vandtårn" (og evt. okkerfilter
Drænledning
Slamfælde
Mammutbeluftere
Biofilter
Opdrætskanal
Matr.nr. 24 i
Slambed
Slambed
Nyt slambed
Nyt slambed
Lagune
Matr.nr. 24 h
Nyt hus til blæsere 300 m²
Fodersiloer
Nye leveringsdamme
Omløbsstryg
Stemmeværk
Matr.nr. 24 a
10 0 10 20 30 40 50 60 70 80 90 100 meter
Det er planen, at de resterende damme samt bundfældningsbassinerne udlægges til plantebegroede laguner, og at der derfor kun opdrættes fisk i det nye kanalanlæg.

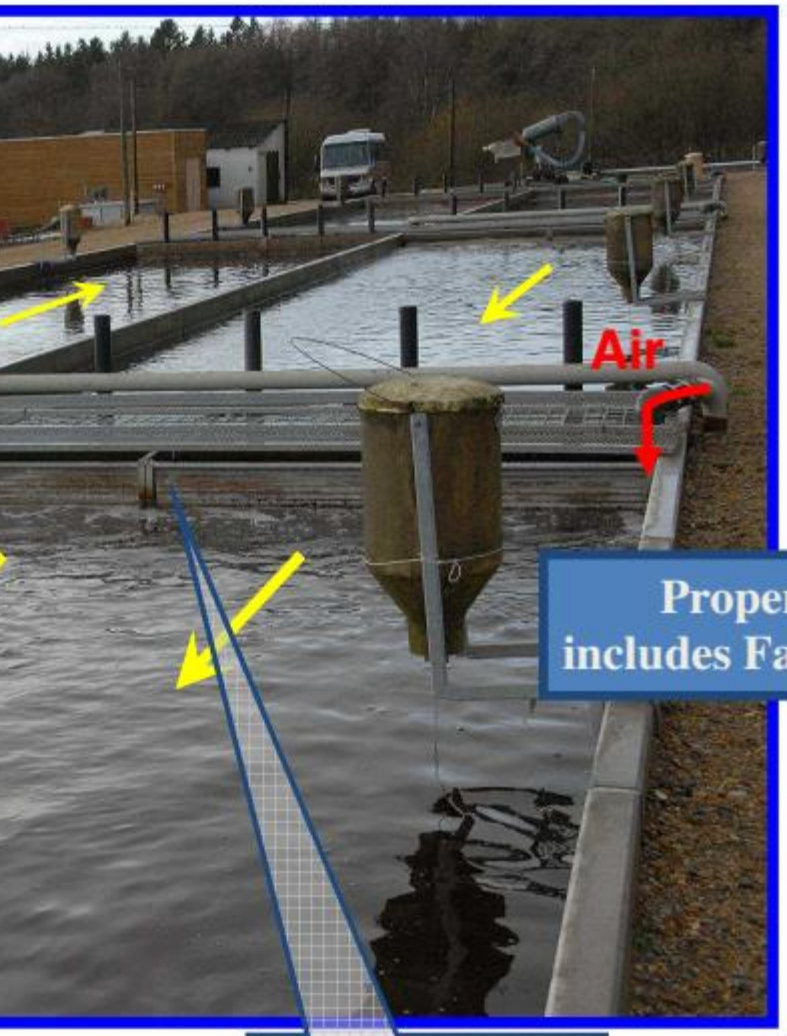
Hallundbæk 230

Example of new

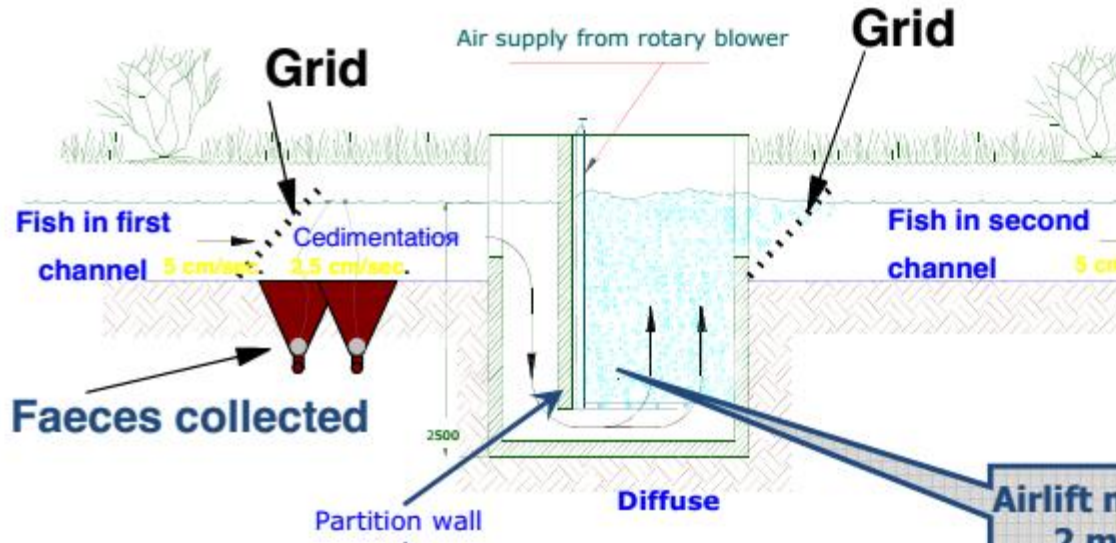
12 group of fish
Up to 12 tons before harvesting
Or harvesting 400kg-2000 kg/day for live delivery

5 cones and 7 diffusere
(7*5m*10 m3 air/m=350 m3 air)
One blower 2160 m3/hour (18kW)
350 l/s result in speed of water 5-7 cm/s

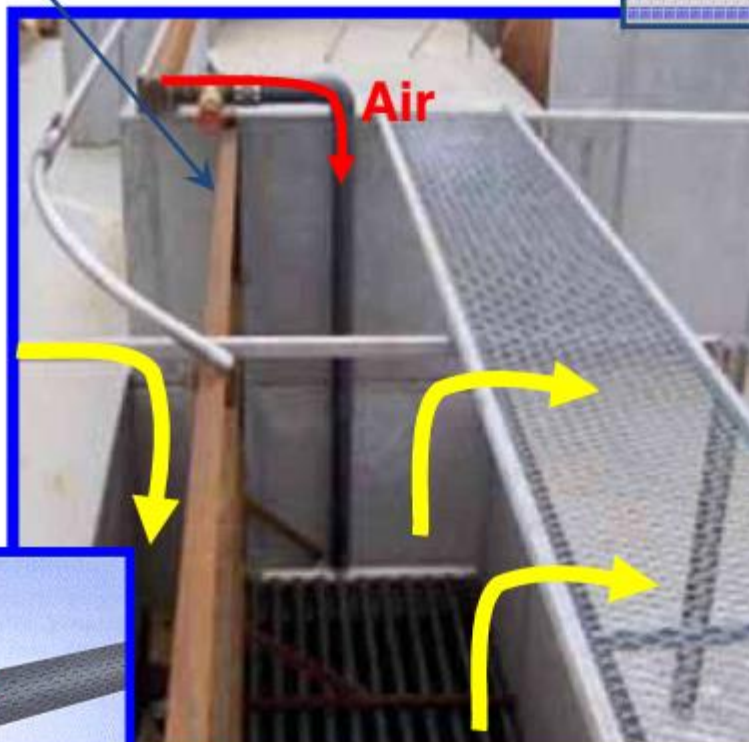


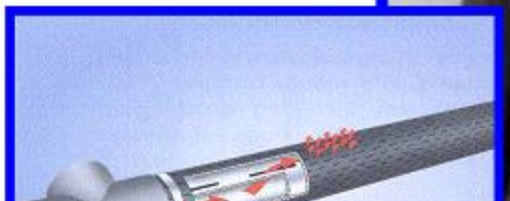


2-6 air lift
per circulation



Proper design
includes Faeces collector





Filter management techniques

Advantages and disadvantages

Solid and soluble waste

Grading
XXX = Good
XX = Average
X = Poor

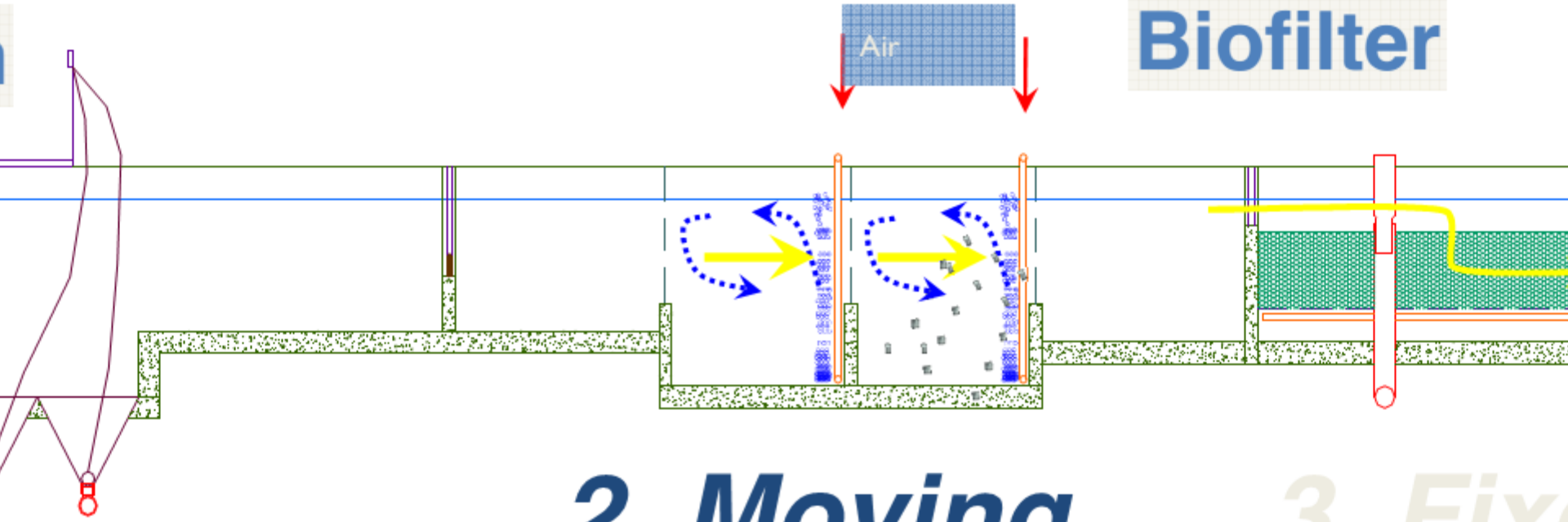
	Collectors Cones	Drumfilter Discfilter	Fixed filter LECA/plast
High Nitrification	X	X	XX
High Denitrification	X	X	XXX
Low cost of installation	XXX	XX	XX
High efficiency for small part.	X	XX	XXX
Low operational cost	XXX	X	XX
Low fresh water	XXX	XX	XX
Reliability clogging up	XXX	XX	X

Improved by using ORBIT feed

2. Moving bed

3. Fixed be

. Cones

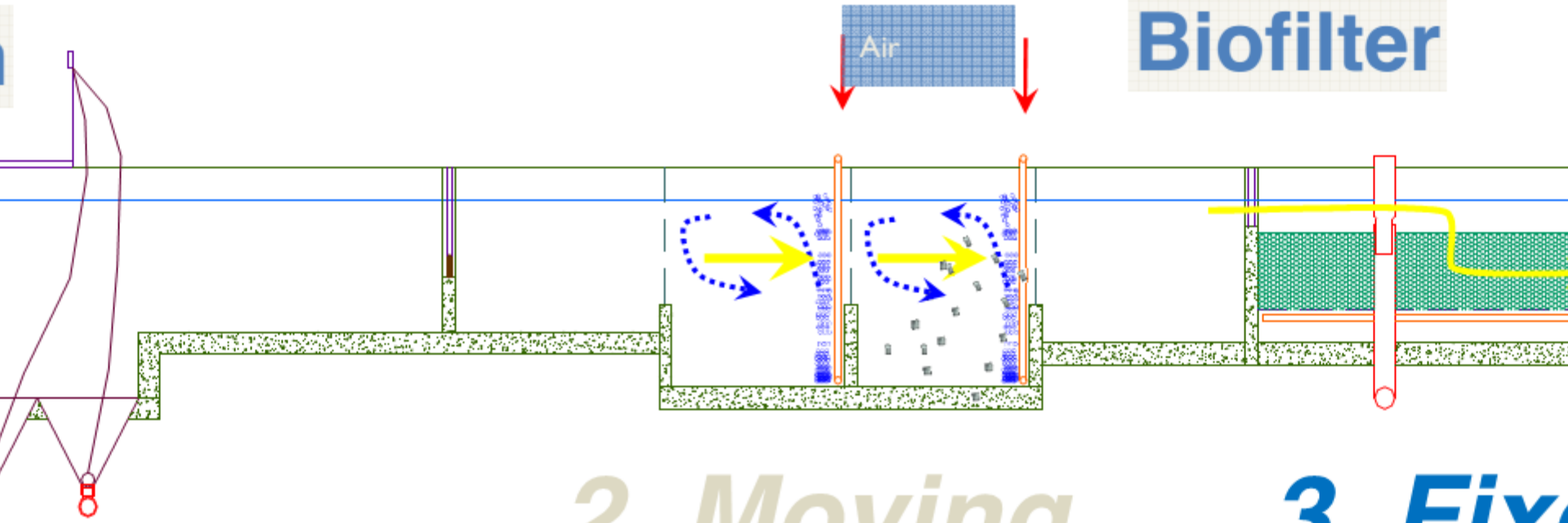


2. Moving Bed

Cones

3. Fix

Bed

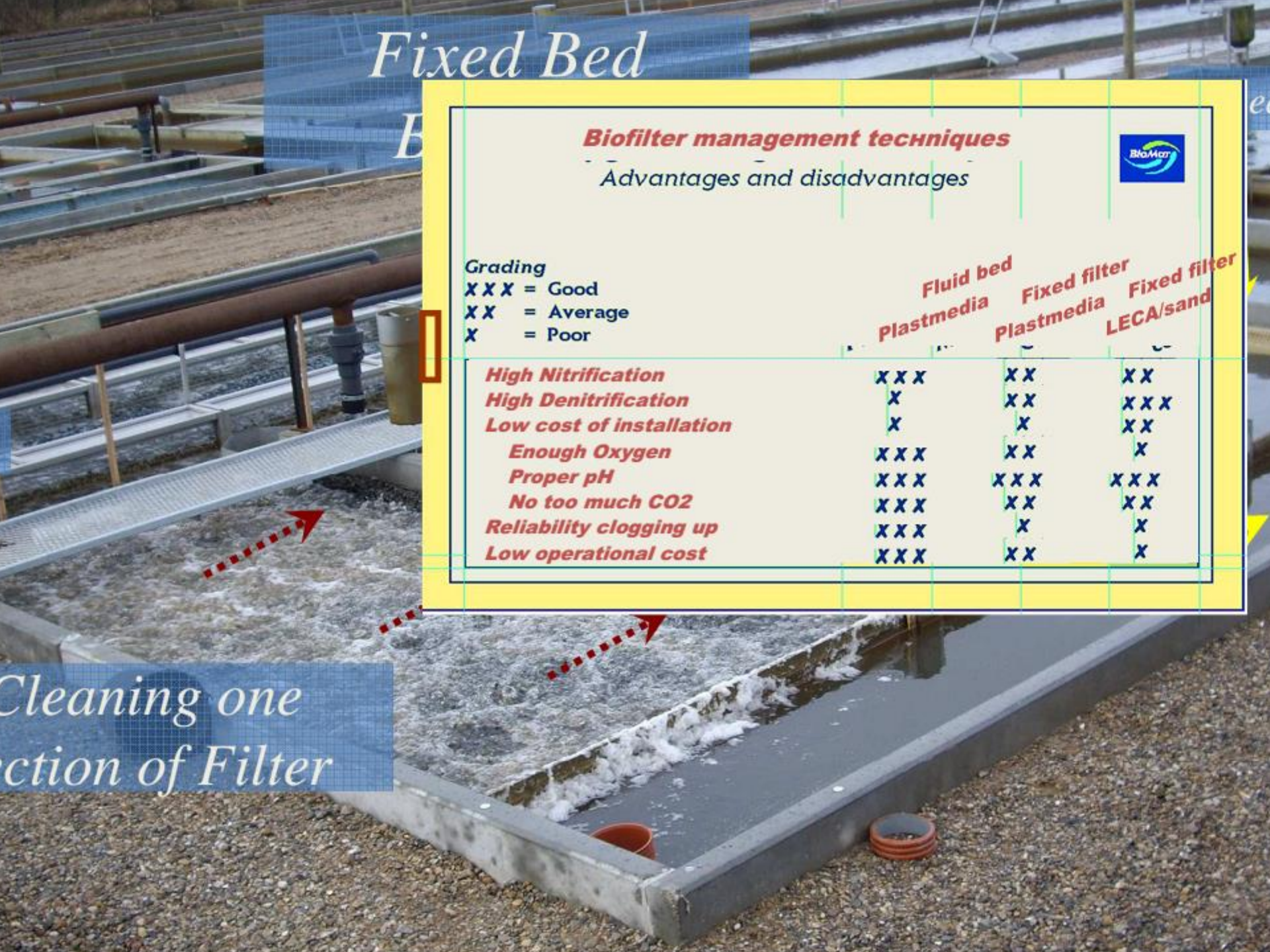


Biofilter

Cones

2. Moving Bed

3. Fixe Bed



Biofilter management techniques

Advantages and disadvantages

Grading
XXX = Good
XX = Average
X = Poor

	Fluid bed Plastmedia	Fixed filter Plastmedia	Fixed filter LECA/sand
High Nitrification	XXX	XX	XX
High Denitrification	X	XX	XXX
Low cost of installation	X	X	XX
Enough Oxygen	XXX	XX	X
Proper pH	XXX	XXX	XXX
No too much CO2	XXX	XX	XX
Reliability clogging up	XXX	X	X
Low operational cost	XXX	XX	X

ter Treatment System

Fish Tank

filters: Sometimes- 60 micron

ters: 5 kg feed/m^3 biofilter

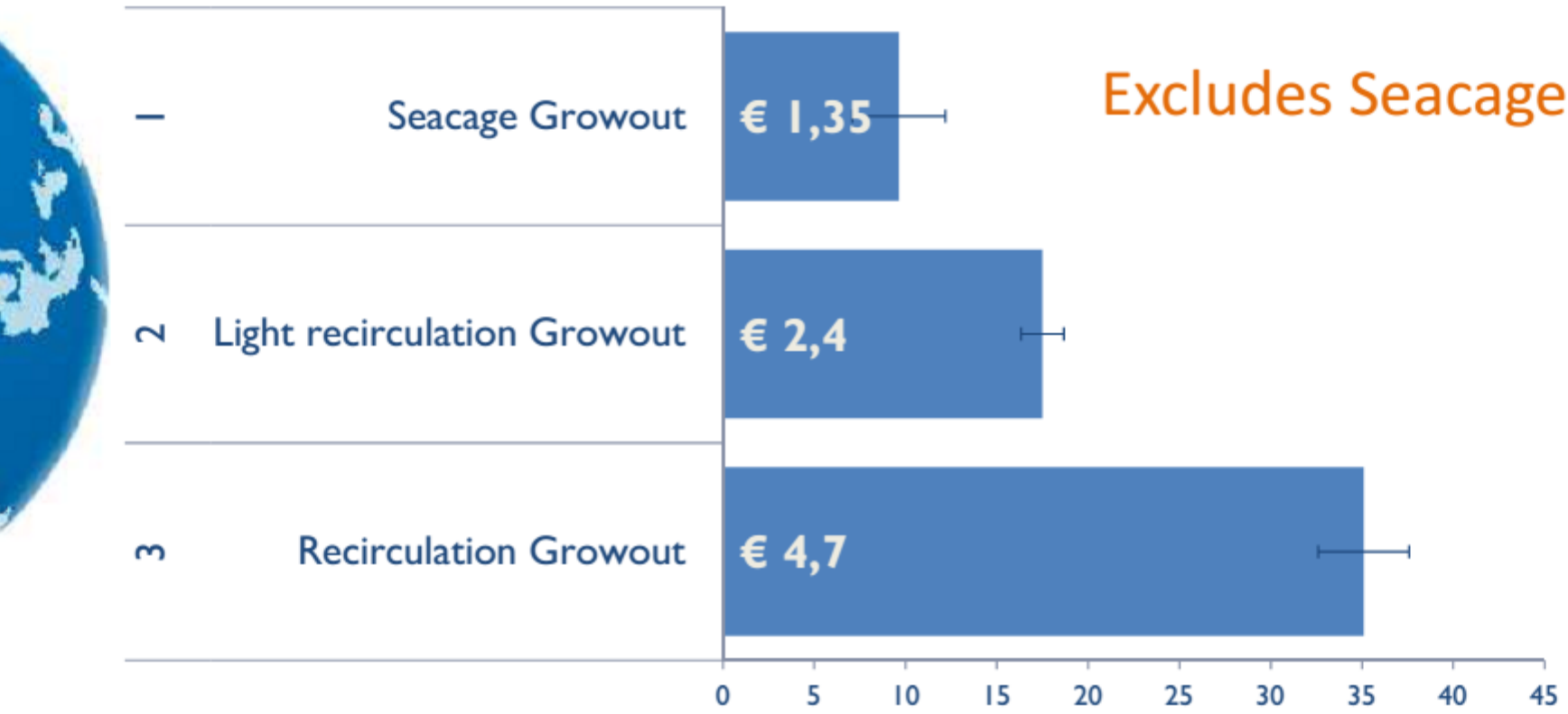
ion: <2 g CO_2 removed /m^3 flow

Fish Tank 1-3 exchange per hou

Fish density <80 kg/m3

New Water 0.5 m3/hr/ton proc

(Euro/kg annual production)



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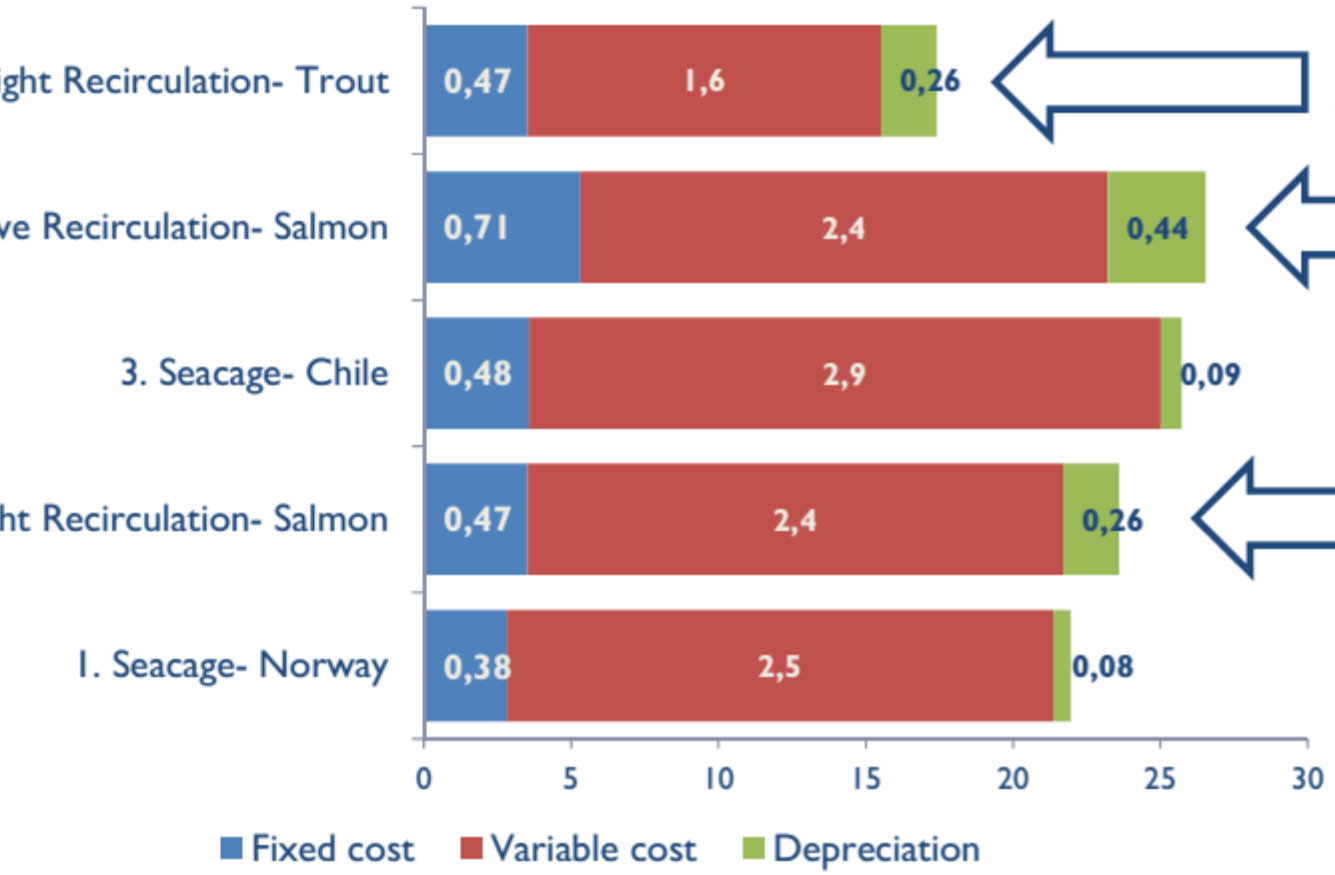

2,4 €/kg Danish trout

3,5 €/kg Da
salmon

3,2 €/kg theo
for salmon in
Danish Light
recirculation
system

- Fixed costs high for Recirculation- energy, cooling, maintenance
- Variable costs lower for Recirculation- lower FCR, mortality, better oxyg
- Depreciation high for Recirculation

Greater Intensity means greater management skill!

Profitability in light and Intensive Recirculation s very sensitive to:

- Production output
- Feed conversion
- Marketability

Demand professional management of fish, feed and market

Nearly 50 % (18.000 tons) of the Danish Trout is produced in recirculated water. One indoor farm for 1000 tons/year is under construction.

Development is driven by the demand form Authority and the empery work among farmers to find low cost technology and simple and handworks inspired solution.

Cost efficiently and “keep it simple” are main keyword