Wetland treatment

use of contructed wetlands to upgrade effluent quality

23rd October 2008, 17.00 – 17.20

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Research & Engineering
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Wetland treatment

- Biology of polluted water
- Wetland treatment
  - for raw sewage
  - for treated waste water to upgrade existing stp's
- The value of waste water
  - It used to be drinking water, take the waste out and use it!

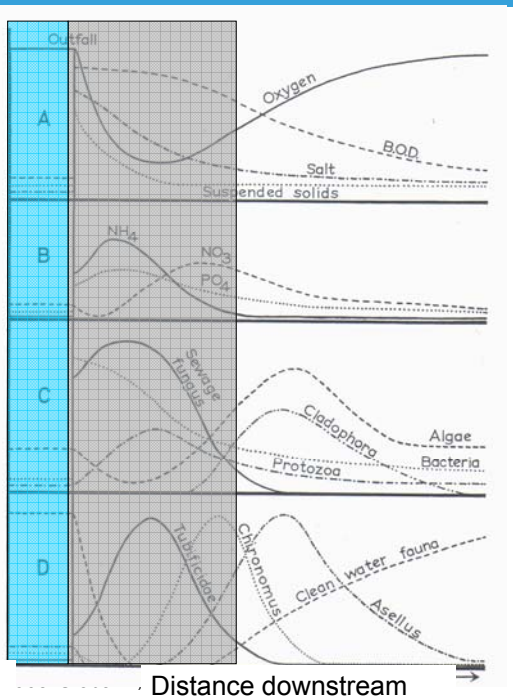
Influence of a discharge on a river

A: fysical - biochemical

B: chemical

C: micro-organisms

D: “larger”organisms



Based on Hynes, 1960 The biology of polluted waters

Development of simple waste water treatment methods

General rule of life…..

- It is easy to come upon a complicated solution
- But: difficult to come upon a simple solution

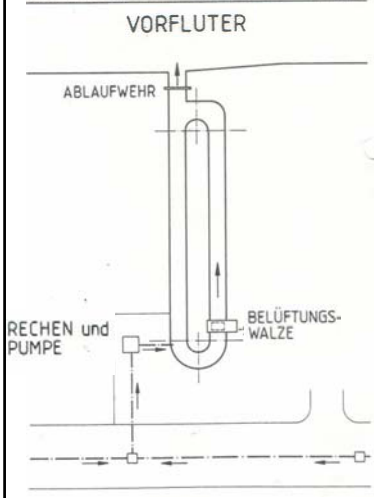
Pasveer 1957:
Simple waste water treatment:

- Just aeration of treated waste water can already improve a local situation: less oxygen consumption in the surface water
- Using a simple aerated system discontinuously enables sludge to grow: a huge improvement in effluent quality

Pasveer 1954: *Werkrapport betreffende proeven, genomen met een beluchtingsinstallatie voor het rioolvocht aan de Dobbe-weg te Voorschoten gedurende het tijdvak 14 juli – 1 october 1954*

Voorschoten, The Netherlands

Bild 1: Urform des Oxydationsgrabens. Voorschoten bei Den Haag. Einfacher Durchlaufbetrieb.



Source: Kees van Loohuizen – Afvalwaterzuivering in Nederland

- simple
- still modern
- excellent effluent

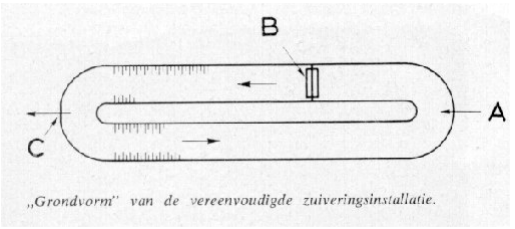
Ca 1955

0.05 kg BOD per kg d.s. per day

Bron: Kees van Loohuizen – Afvalwaterzuivering in Nederland

Oxidation ditch

Dutch development A. Pasveer 1909 - 2001



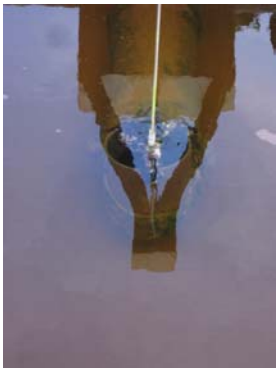
Firstly: “search for simplified treatment”

Only after 1960 “*Oxidation ditch”*

‘t Horntje, Texel

‘t Horntje, Texel

‘t Horntje, Texel



Begin of effluent discharge

End of effluent discharge

Dismantled in 2007

Results 1991 – 1993 (mg/l)

BOD	2.8
COD	42

NH_4	1.0
NO_3	1.8
N-TOT	4.9

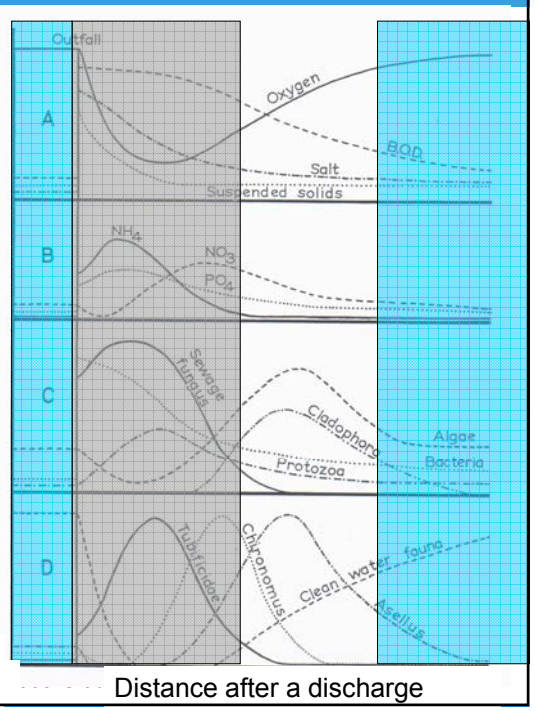
Influence of a discharge on a river

A: fysical - biochemical

B: chemical

C: micro-organisms

D: “larger” organisms



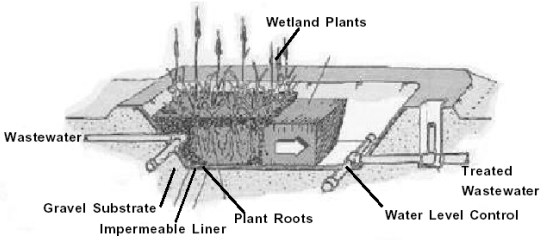
Based on Hynes, 1960 The biology of polluted waters

Wetlands??

- When is he going to talk about wetlands??

Constructed wetlands

- A good way to treat sewage



- But only up to 2000 p.e. (max. 50.000 p.e.)
  - Size
  - Efficiency
  - Sensitive to C-loading (blockage of filter, growth of sludge)
  - Cost

Sources:

Gianotti, M., Water reclamation & phyto-technologies

ww.epa.gov/wetlands

Turon, 2006 “Decision support system subsurface wetlands

Wetlands to upgrade existing plants

A – to improve a bad functioning plant

B- to improve effluent quality

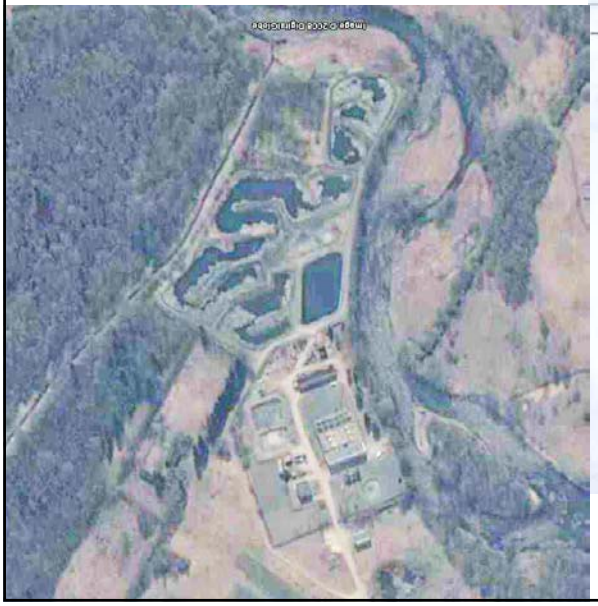
Põltsamaa, Estonia

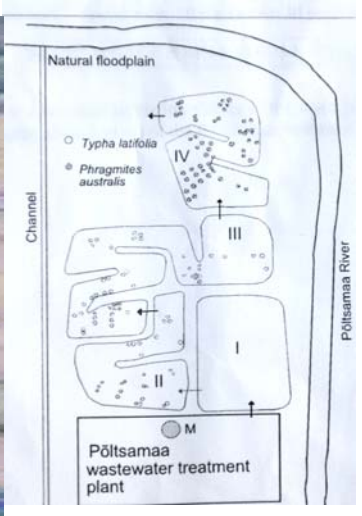
- Activated sludge plant
  - Overloaded,
  - not well functioning 5000 p.e.
- Four ponds:
  - 1.2 ha
  - 0.5 m deep
- Load: 4 cm/day
- Retention time: 10 days

First pond filled with sludge, not discharged on the small stream

Source: Mander, Tartu University, Estonia

Põltsamaa, Estonia





Removal efficiency

BOD - 70%

P - 30

NH_4 – 40

Verdict:

Not impressive?, but cheap!

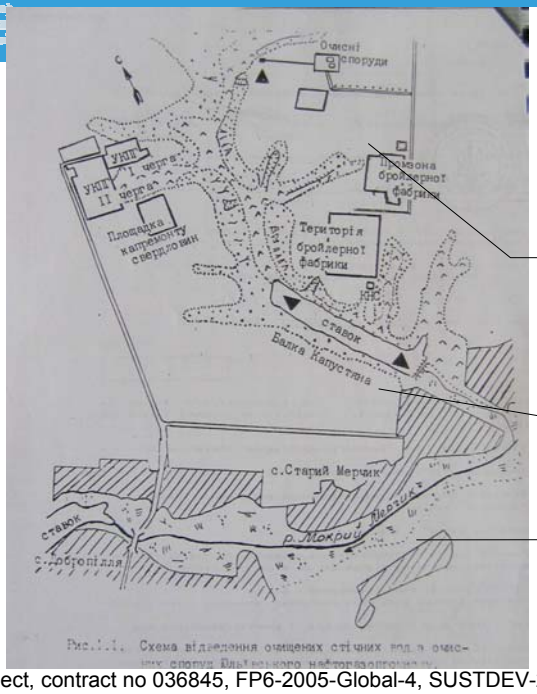
How to optimize ??

Yulievsky constructed wetland, Ukraine

- Load to the wetland 800 p.e.
- Seemed to be an economic solution to upgrade the existing plant
- Cost: 25.000 UAH instead of 400 000 estimated of new STP

- www.waterharmonica.nl/cases_waterharmonica/cases_rest_europa/oekraine/julievsky/julievsky.htm

Yulievsky



Sewage treatment plant

wetland

river

Constructed wetlands for effluent upgrading along the Besòs River (Spain)

Figure 4. Lower Besòs River.
Source: Barcelona Regional

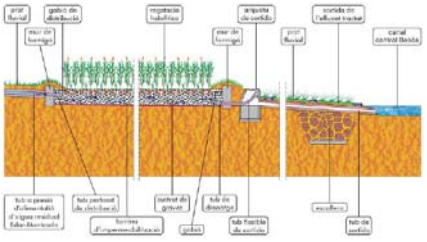


Figure 5. Diagram of the Constructed Wetland
Source: Barcelona Regional Power Point Presentation.

	mg/l	removal %
Suspended solids;	6.9	40
COD	144	62
NH4-N;	34	20
P	8	58
fecal coliforms Removal factor 10		

Removal perhaps not impressive, but it is cheap!

Huertas, Desalination 188 (2006) 141–147
jhoney.googlepages.com/Honey_Roses_Besos.pdf

STP Everstekoog, The Netherlands

sewage treatment plant

presettling basin

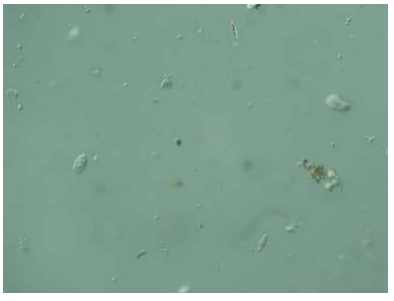
9 parallel ditches with reed/cattail and aquatic plants

discharge ditch

Research project 1995 - 1999

After constructed wetland more useful water

- Natural oxygen regime
- No odour
- Less sludge particles lead to desinfection
- More, but different suspended solids
- Living water:
  - algae, daphnia
  - all kind of “waterlife”
  - fish
  - birds



EU Water Framework Directive

- The environmental value of water

Environmental value

Agricultural and recreational value

Photos by courtesy of Consorci de la Costa Brava

- Questions:
  - Where has water the highest environmental value?
  - What kind of water is best to be used for irrigation?

Slide kindly provided by Lluis Sala, Consorci de la Costa Brava, IWA, 2007, Antwerp

Change of approach

- "Treat and dispose" is obsolete: "old-fashioned"
- Develop new resources with the least environmental impact
  - Limitation in water transfers (as a general rule)
  - Limitation of desalination plants (energy)
- Water recycling: give water a second chance
- All water used for urban supply is concentrated in one facility (useful volumes)
- Already after adequate biological secondary treatment useful
  - But "upgarding" is needed

Get the water out the waste"

Water reuse: wetlands !!

Is water reuse a fantasy?

- No! Increase in water reuse projects implemented worldwide specially in dry areas

Is water reuse a fashion?

- No! Projects on operation get improved, not abandoned. In Mediterranean countries it is a reason to build STP's

Is water reuse a necessity?

- Water reuse has an essential role in our water resource management.
- Used water, when treated, is not a waste product but an essential water resource"
- "If wastewater treatment plants would turn into reclamation plants we would have reclaimed water, pure and clear

How?: by advanced technical means like membrane filtration: yes, but expensive

How?: with combined, multi-purpose wetland systems, yes, cheap, attractive

Why reuse in Bulgaria?

- Greater overall water demands per capita -agricultural irrigation
- increase in population: tourism
- Irregular rainfall patterns and exposure to frequent droughts
- Future need to comply with the WFD, a challenging task in eastern Europe

Source: Knight, C.G. and Staneva, M.P., 1996, Water Resources Bulgaria

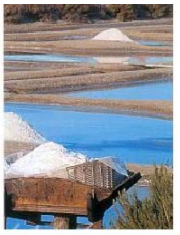
Slide kindly provided by Lluis Sala, Consorci de la Costa Brava, IWA, 2007, Antwerp

Successful water reuse projects in southern Europe: France

Lagoons for upgrading treated waste water for agricultural irrigation

- Noirmoutier:
  - Tertiary treatment by lagooning for 6,100 m3/day.
  - Irrigation of 500 ha of high value crops (potatoes) and protection of shellfish areas. Demand of farmers for the reuse of 100% of wastewater.

- Clermont-Ferrand:
  - Tertiary treatment by lagooning for 10,000 m3/day.
  - Irrigation of 700 ha of corn.
  - First EU epidemiological study: no adverse health effects



Photos by courtesy of Dr. Valentina Lazarova

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Successful water reuse projects in southern Europe: Empuriabrava, Spain

Wetlands for upgrading treated waste water for agricultural irrigation

- Environmental reuse (funded with EU Cohesion Funds)
  - Empuriabrava, Costa Brava, Spain: Since 1998, approx. 650,000 m3/year
  - Effluent is further polished in a 7 ha constructed wetland.
- Reclaimed water is used at the Aiguamolls de l'Empordà Natural Park
  - to recreate wetlands and restore vanishing wet meadows,
  - Improving an ecosystem of high value and that has suffered a steady decline in quality

Photos by courtesy of Consorci de la Costa Brava

Slide kindly provided by Lluis Sala, Consorci de la Costa Brava, IWA, 2007, Antwerp

Empuriabrava constructed wetlands as a recreation of a natural wetland

Aqualân Grou, The Netherlands

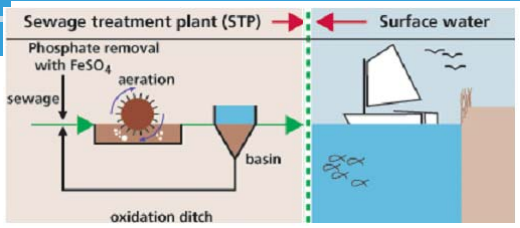
Aqualân Grou

urbanwatercycle

http://www.interregnorthsea.org/project-details.asp?id=1-16-31-7-37-04

Aqualân Grou and STP

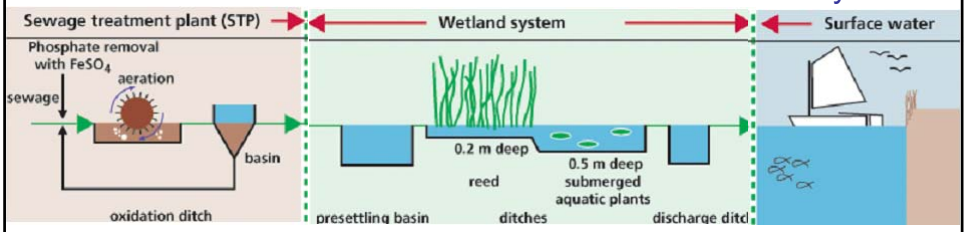
Aqualân Grou



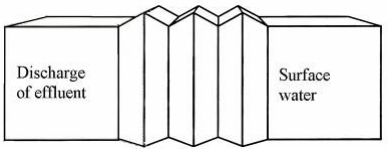
Planning of a waste water treatment

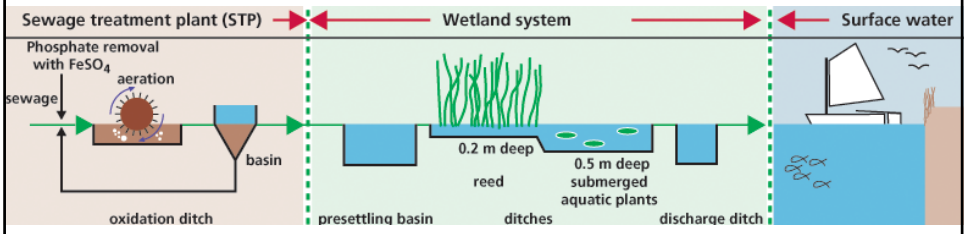
Water chain

Water system



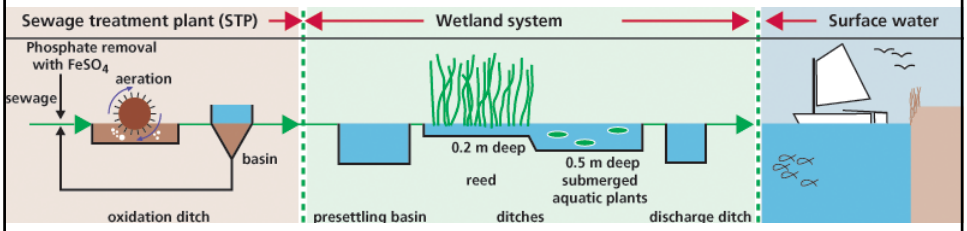
The Waterharmonica: water
the link between treated waste and surface water





www.waterharmonica.nl

From STP via wetland to surface water



STP Oxidation Ditch

Constructed wetland

Surface water

A constructed wetland to make a "living water" from treated waste water

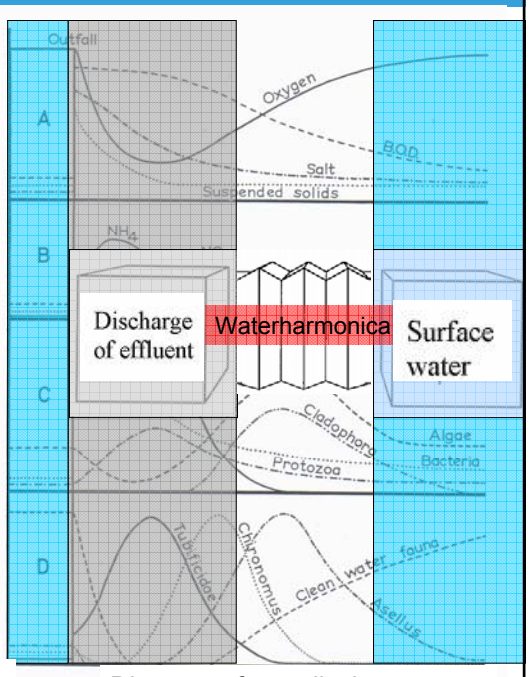
Influence of a discharge on a river

A: fysical - biochemical

B: chemical

C: micro-organisms

D: "larger" organisms



Based on Hynes, 1960 The biology of polluted waters

Conclusions

- Constructed wetlands are an attractive option fop Bulgaria
  - To treat waste water form small communities, farms, etc.
- As a short term solution to upgrade overloaded STP's
- To upgrade the effluent from existing plants to:
  - Meet the new EU-standards
  - To produce a treated waste water to be used in agriculture, nature enhancement, etc

Waste water is a source !!

That is a reason to treat waste water

- Links
- www.waterharmonica.nl/posters/trophics_webs_russian.htm
- www.waterharmonica.nl/cases_waterharmonica/cases_rest_europa/oekraine/julievsky/yulievsky.htm
- Presentations provided by Lluis Sala:
- http://www.ccbgi.org/docs/antwerp_2007/eu-med_initiative_sala_et_al.pdf
- http://www.ccbgi.org/docs/antwerp_2007/constructed_wetlands_014.pdf

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