Abundance or Scarcity? Catchments & Carbon

Friday 10 Feb 2017: University of Exeter

College of Engineering, Mathematics and Physical Sciences

Julian Jones





MUCK ON THE MIND



How do you decide what size slurry tanker to buy (or, indeed, whether it wouldn't be better to buy a pipeline system instead)? On what amounts to little more than gut-feeling, probably. But there is a rather more scientific way of going about things. John Leitch has investigated.

ILK producers often buy a slurry tanker that is either too small or too big, a short-coming spotted and acted on by Austrian slurry-handling specialists Bauer. The result is that the firm developed a computerised service which it named Economic Slurry Evalua-

Several thousand British farmers have already fed their details through the Bauer computer that now stands in the Slough office of UK distributors British & General Tube Co Ltd. At no cost, they discover the optimum size of tanker for their enterprises; the cash value of their slurry; the best application rates for grazed and conserved fields; the number of trips that will be needed to each field; and exactly how long slurry spreading will take.

Bauer are currently programming the computer further so that a similar service can also be offered to farmers who want a pump-and-pipeline system rather than a slurry tanker.

"We are putting our advice down in writing," says Julian Jones, British & General's agricultural sales manager, speaking on behalf of Bauer, "No other manufacturer is doing this. It shows that we have faith in our figures because we have then got to stand by them. This is the start of a wider service which is taking the guesswork out of slurry handling, and replacing it with accurate forecasts.

"We don't pretend to be computer experts, but we do know about slurry handling.

Too many farmers look on slurry as a problem when it should be treated as an asset: a line of reasoning that was pursued at a holding called Dean Farm where 80 cows produce slurry that is stored in a 500m3 lagoon — when the owner decided to try to make better use of

through the Bauer computer, working on a standard slurry production figure of 45 litres/day, which is used except where there is a particularly large area of open

"In calculating the required lagoon capacity, we allow for 4 months' storage, which is the period needed to be eligible for Ministry grant.

"On the computer print-out we tell the farmer (if he doesn't know!) whether he is going to be short of storage capacity with his existing lay-out. Four months allows a healthy safety margin in a wet winter to anyone with a tanker, while a man with a pipeline system could get away with less, especially if he was prepared to use it on a little-and-often basis. There are some people using pipelines on a daily basis. never mind once a week.

"We then take average values for the slurry's NPK content. In reality, only a few farmers are getting the best value from their slurry. Many miss out by not getting it on the land at the right time, or because they have the wrong type of tanker.

"Availability of nitrogen, we assert, will range from 40% to 100%, depending on when and how the slurry is spread. Once soil temperatures are up to 43°F then all the slurry nitrogen is available, which shows that it pays to store slurry until the

"Our computer divides the total slurry that has to be spread between the various available fields in the most sensible ratios. so that none of the application rates go

The maximum figures built into the computer's programme are 54m3/ha for meadow fields used for grazing-only, while with mown pastures - because grazing does stand more than cutting the limit is 32m3/ha. Clover stands as his slurry (see Table 1). We fed his details much slurry as grass. The maximum figure

for a mown field is the same whether used for hay or silage.

The most sensible split at Dean Farm was shown to be to spread 12.3m3/ha on mown pasture (assumed to be a shortterm lev) and 20.5m3/ha on the grazed fields (assumed by the computer to be permanent pastures).

What we can't build into the programme," Julian continues, "are specific aspects of a farm, such as its soil type and the slope on its fields. The farmer and his adviser will discuss any aspects of particular fields that may reduce the maximum application rate - which could be a heavy soil type, or a steep slope that pases the risk of run-off problems.

"In working out the optimum tanker size for Dean Farm -- as elsewhere -- the procedure is to tell the computer the purchase price of various model sizes. The machine knows how much slurry there is to handle, so for each size of tanker the computer works out how much usage they will get, and knowing the number of working hours/year leads it to a prediction of the tankers' working life, and hence to an annual depreciation figure.

"Light use often leads to a 7-year working life, while heavy use would drop this to around 5-years.

"Adding together the annual depreciation figure, repairs, and maintenance, we get the total tanker cost/hour. The computer joints this figure to the tractor's total operating costs/hour, and also to the hourly cost of a paid driver.

"The farmer tells us his travelling distances, and we assume a driving speed of 12 km/hour. Calculations assume a 25% dilution of slurry with water.

The original programme may have been drawn up in Austria rather than Slough, but appropriate figures from our own Ministry of Agriculture have been fed in so while the computer does work on 1982 summer fertiliser prices in Austria, it also uses current UK price of diesel, and depreciation is based on UK tanker purchase prices. Hourly labour costs are furthermore calculated from our wage rates in the UK. All figures are uprated

'To justify our statement that a 4000

Julian Jones and the Bauer computer that offers a free Economic Slurry Evaluation. So far it has only compared different sizes of slurry tankers, but the programme now is being extended to cover pump-and-pipeline systems







Agenda 21

Voluntary action plan of the United Nations for sustainable development.

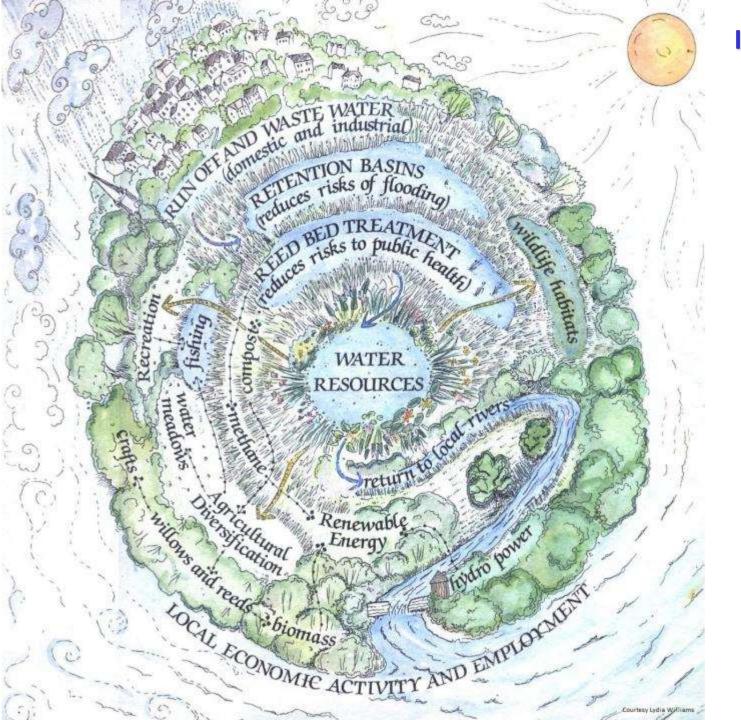
Earth Summit, Rio de Janeiro, Brazil, 1992.

"Global climate change and atmospheric pollution could also have an impact on freshwater resources and their availability ..."

"... demand integrated water resources planning and management. Such integration must cover all types of interrelated freshwater bodies .. and duly consider water quantity and quality aspects. The multisectoral nature of water resources development in the context of socioeconomic development must be recognized, as well as the multi-interest utilization of water resources for water supply and sanitation, .. hydropower generation, .. fisheries, .. and other activities. .. Priority, however, must be accorded to flood prevention and control measures, as well as sedimentation control, where required."

THE UNITED MATERIAL

Agenda 21, Chapter 18



Integrated water resources planning and management

Functioning landscapes that benefit water resources, livelihoods & meet WFD

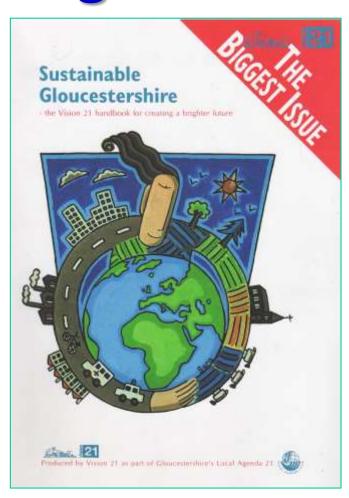
Food, energy, water, biodiversity, leisure, etc.

Stroud Urban Wetlands

Lydia Williams, Leeds M U, 1993

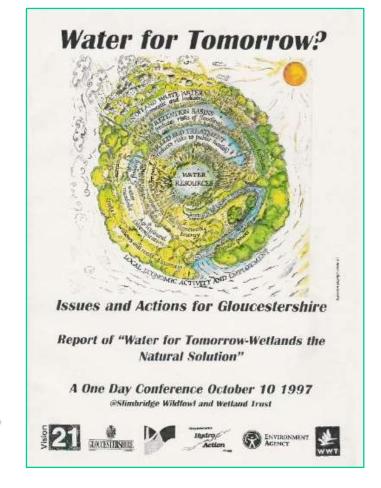
Stroud District Council

Agenda 21 in Gloucestershire



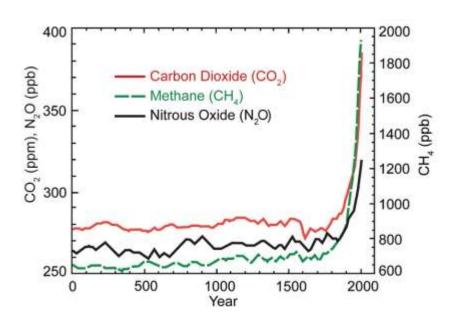
1996 – The world's first municipal Agenda 21 strategy, *The Biggest Issue*, Vision21

1997 – First UK CaBA community planning conference, Water for Tomorrow, called for Water21



IPCC: "Human activity 'dominant cause' of warming ..."

Why can't we fix it?
Causes or effects?
What are the 'tools'?



- Catchment Water Balance (Attenuation)
- Nutrient (Carbon) Cycling Planning (Soil Carbon)
- Public Health
- Biodiversity Gain

Water21 Ltd

Strictly non-profit, self financed & community led

Agenda 21 protocol – voluntary & collaborative goodwill basis

Experienced professional mentors – funding postgraduate interns & dissertation studies

Owns Water21 Power Ltd – supporting UK Ossberger sales

Heritage hydropower impoundment - up to 25,000 m³ of flood water storage lost here

Adam Broadhead, University College London & Ilaria Pretto, Trento University, 2008



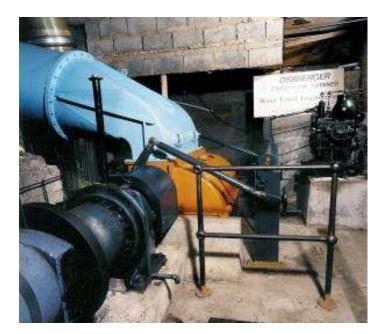




Osman Goring, Coaley Mill, Gloucs.
Water Power Engineering Ltd
Founder member of NAWPU
Water21 postgraduate student mentor



25kW Ossberger Crossflow, installed 1977



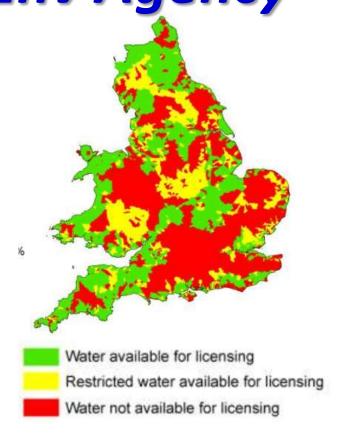
"hydropower sterilises rivers for our other uses" - Env Agency



From left to right: Richard Hodkin, Julian Jones, Helen Phillips, Colin Candish, Graham Haw, Alan Butterworth, Sean Kent and Ian Barker

Meeting the EA – 2 December 2000 International Power & Dam Construction

In an attempt to promote greater understanding and support for the successful development of hydro power on the river Thames, environmental regulators and industry members met recently in the UK. Lengthy but valuable discussion took place



A hydro turbine license for non-consumptive abstraction limits further upstream abstractions, eg for fracking

Is there a UK water shortage?

"It cannot be repeated often enough that there is no shortage of water in Britain. We divert only a small fraction of the throughput of our water cycle for human purposes. We use less than 1% of total UK rainfall and less than 10% in the South East."

GMB Union, Huffington Post, 30 April 2012

... rapid changes in perception presently

(Non) Regulation of Watercourses

Public Health standards (weirs etc)

Planning for Catchment Water Balance (attenuations/soils/sedimentation)

Eco-toxicity or Biodiversity Gain standards(Agrochemicals/Sewage Treatment)

Nutrient/Carbon cycling planning

Thermal standards (Power Stations, Farmland)

Water Framework Directive ?
Public economic interests not protected

River hydropower and fisheries



"Unscreened hydros and water pumps are a massive killer of eels"

Sustainable Eel Group, Gloucestershire

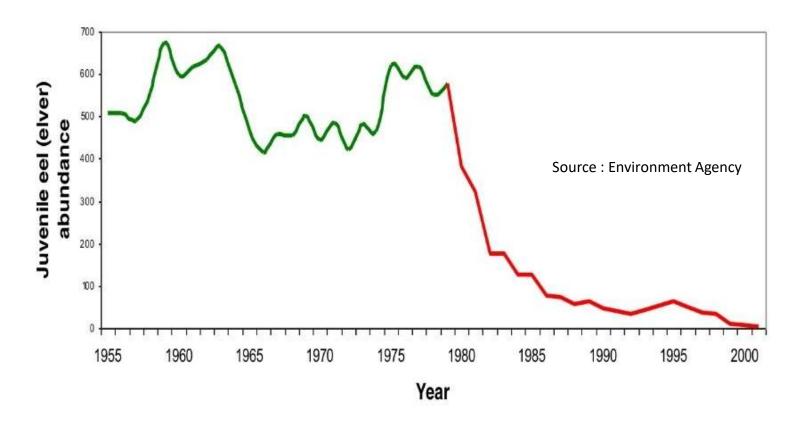


Hydropower: An Angling Trust Guide to Objecting



All river turbines are screened – both these images are very misleading. The eels most likely died from a pollution event

The collapse in European eel recruitment

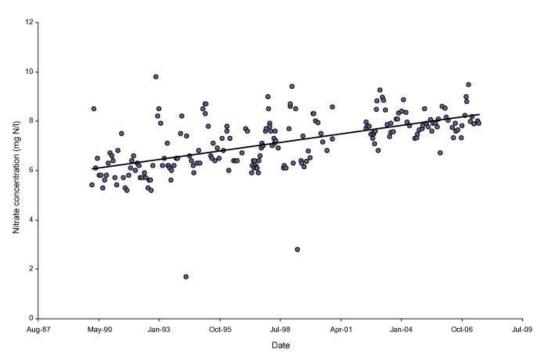


The collapse of freshwater fisheries shows no relationship to use of river hydropower ...



... but closely follows the use of agrochemicals and other unregulated discharges to rivers.

How well do NVZ, HLS, CSF work?



Ogbourne St. George NVZ over time since designation

This study considers the concentrations of water nitrate in areas designated as Nitrate Vulnerable Zones (NVZs) for between 12 and 15 years.

- 69% of NVZs showed no significant improvement in water concentrations even after 15 years.
- In comparison to a control catchment 29% of NVZs showed a significant improvement but 31% showed a significant worsening.
- Differences between NVZs could not be significantly related to the size of the NVZ, uptake of the scheme, extent of uptake, land use change or geology of the local aquifer.
- The lack of objective success for NVZ designation suggests that <u>nitrate pollution</u> <u>control strategies based on input</u> <u>management need to be rethought</u>.

Veterinary Medicines & Environmental Risk







Wherever possible avoid grazing stock treated with ivermectin on unimproved grassland. Ivermectin is excreted largely unaltered in dung, so it remains powerfully insecticidal. This reduces the number and variety of insects in dung, thereby slowing down its decomposition which can lead to a reduction in food resources for insectivorous birds such as curlew and chough. Bolus formulations result in ivermectin being excreted in dung over a longer period of time.

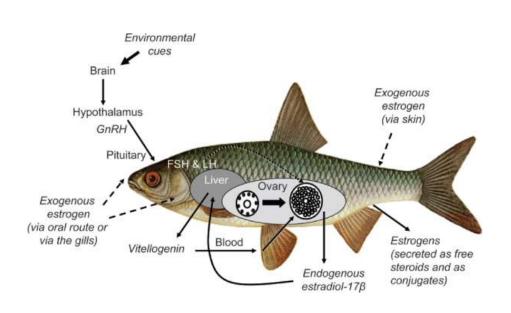
Scottish Natural Heritage





Gender bending fish

"... wild roach, caught from a wastewater treatment works (WWTW) effluent settlement lagoon and at a site downstream of this discharge in the River Thames (London), were neither male nor female, but rather intersex."



We set up an extensive survey to investigate this hypothesis. Rainbow trout and carp (Cyprinus carpio) were placed in cages in or close to the effluent discharges at 28 WWTW throughout England and Wales, and we measured blood VTG concentrations after a two-to three-week exposure period (Purdom et al. 1994). The results were astonishing. Almost all of the effluents studied were estrogenic and induced up to a millionfold increase in the amount of circulating vitellogenin in males.

Roach, Sex, and Gender-Bending Chemicals: The Feminization of Wild Fish in English Rivers, Charles R. Tyler and Susan Jobling **BioScience, Volume 58, Issue 11, 2008**

Multi drug resistant bacteria develop in sewage treatment plants



As bacteria wind their way through sewage treatment processes, the selective pressures against them increase. In consequence, there is a greater effort by bacteria to pass on survival enhancing genetic information.

The further along that the wastewater had progressed through the treatment process the greater the tendency was development of multi-resistant strains. Additionally, the study demonstrated that these multi-resistant bacteria also simultaneously carried, and then passed around their multiple transferable drug-resistance plasmids. Thus drug resistance and the transfer of multi-drug resistant occurs in wastewater treatment plants.

[Nippon Koshu Eisei Zasshi 1990 Feb;37(2):83-90.]

Costing the Earth ...

Campaigners claim England's river life is under threat from 'insidious' pollution, yet the Environment Agency says rivers are at their healthiest in 20 years.

BBC Radio 4, Costing the Earth, 3 Nov 2015

Decline in river' quality hidden

Jonathan Leake Environment Editor

THE Environment Agency has masked a long-term decline in the quality of rivers by publicising selective and misleading statistics, according to an analysis by leading conservation groups.

The Royal Society for the Protection of Birds, WWF (the World Wide Fund for Nature) and angling groups attacked the agency over its claim, published two weeks ago, that 2000-2010 was the best decade for English and Welsh rivers since the industrial revolution.

They accused the agency of cherrypicking scientific data to find figures that supported its claim — while ignoring many others that undermined it, such as the continuing decline of salmon and other fish.

Mark Avery, the RSPB's director of conservation, said: "This is little short of propaganda from a government body and is a clear attempt to mislead the public into believing that our rivers are healthy and clean.

"In fact 75% of rivers in England and Wales are failing European standards, wildlife is suffering and little is being done to deal with serious issues."

Janina Gray, head of science at the Salmon and Trout Association, said the agency ignored evidence of falling salmon populations but highlighted data suggesting improvement in pollutant levels.

The Environment Agency said its claims had not been misleading but accepted there were still problems. It said: "Rivers in England and Wales are the cleanest they have been since the industrial revolution but we agree with RSPB and the other organisations that there is more to do . . . Meeting the new European Union standards for water will be difficult. It will require sustained effort . . . to tackle sources of pollution and over-abstraction."



"This is little short of propaganda from a government body and is a clear attempt to mislead the public into believing that our rivers are healthy and clean".

Mark Avery, RSPB Director of Conservation

THE SUNDAY TIMES 16 Jan 2011

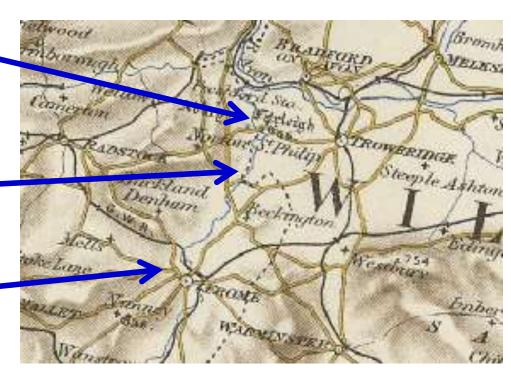
Shannon Weiner Biodiversity Index, measured from 0 (biologically inert) to 5 (undisturbed tropical rain forest)

Benefits of Hydropower

Archimedes Screw upstream 1.69 'downstream 1.97 (Gain, 0.28).

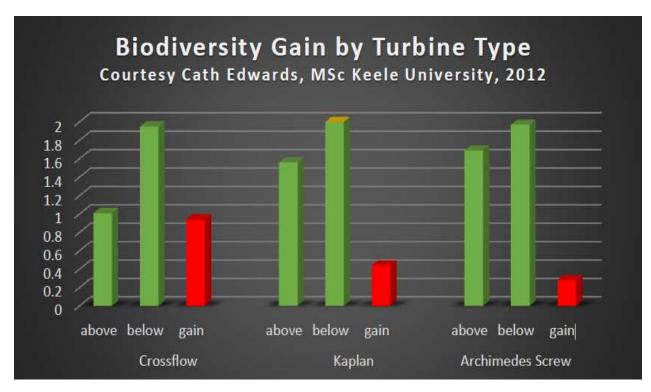
Ossberger Kaplan upstream 1.56 downstream 2.00 (Gain, 0.44).

Ossberger Crossflow upstream 1.01 downstream 1.95 (Gain, 0.94).



Traditional turbines are more effective at remediating the agricultural toxins that harm fisheries

Cath Edwards MSc Keele University 2012, Water21





Air intake valve on Ossberger Crossflow

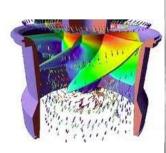


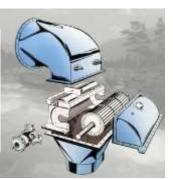


Economic benefits of Hydropower

Ebley Mill Comparison	Head	Kaplan	Crossflow	Archimedes Screw
Return On Investment	Lowest	£1,236,775		£220,160
Range over Lifetime	Highest	£4,925,990	£4,938,585	£1,289,440

Arun Cappi
MSc Loughborough University
2012, Water21







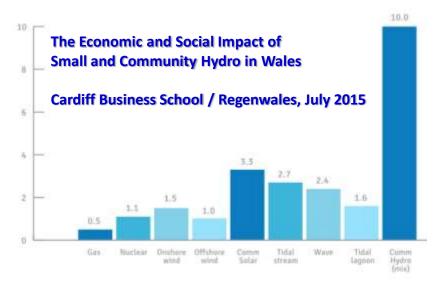
.... 500 other neglected millsites in Gloucestershire





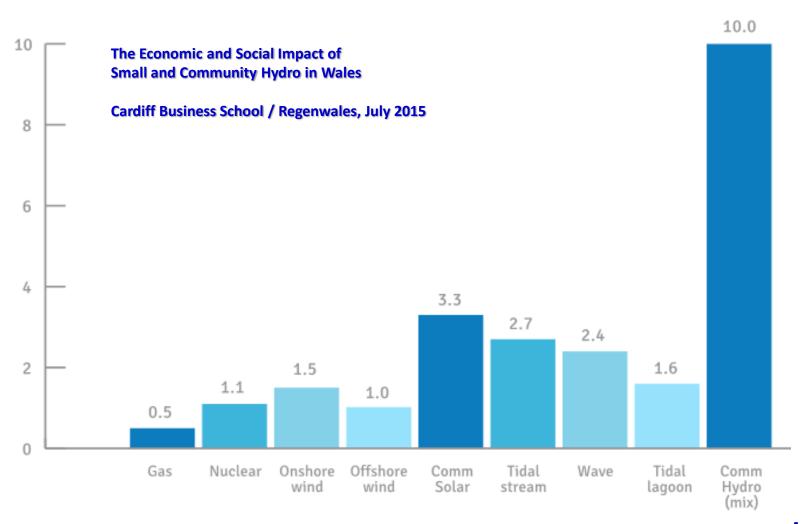


4 decades continuous operation of 25kW crossflow turbine here has created rich diverse ecology and 45 full time manufacturing jobs.





Economic benefits of Hydropower



.... 500 other neglected millsites in Gloucestershire

£300K EA 'Greenwash' fish pass



Stroud Valleys Soil Erosion Map

Key Findings

 Erosion risk map indicates high erosion rates in Stroud Valleys, with hotspots in Painswick and Russembe catchments. This strengthens the rationale to tackle the sediment problem.

High proportion of silt in most samples indicates erosion occurring in catchment.

Soil analysis to determine viability of sit re-use as a soil improver.

- High organic carbon content (improves soil structure and moisture retention).
- +High silt content in most siles (clay would reduce infiltration, sand wouldn't retain nutrient).
- Phosphate and Nitrogen content variable: 3-45% that of artificial fertilisers.
- Some nutrient hotspots in Ruscombe and Painswick valued at ~2100/t.
- Analysis indicated one site that cannot be used for silt reuse due to high levels of Zinc.

The evidence supports the anecdotal claims that silt is beneficial as a soil improver for agriculture.

River	Ruscombe Brook		Palnswick Stream		Slad Brook		River Toadsmoor	
Site	P ₂ O ₅	N	P ₂ O ₅	N	P ₂ Q ₅	N	P ₂ 0 ₅	N
1	\$45.41		629.74	£43,91	135 14		£21.33	648.04
2	235.91	£20.80	E31 12	E54.35	121.95		£28.53	E19.14
3	£49.50	£33.92	745.79		£24.34	822.64	T48.04	E70.65
4	040.27	017.27	10432	025.70	£32.83	£21.97	£41.76	042.03
5			£39.11	630.10	£31.57	£40.49	\$23.45	524.30

Le



Legend

Frome River System

USLE

Value

High: 69.0163



Low:0

Recommendations

 Conducting comparative field trials of river silt, farmyard manure and fertiliser application to agricultural land to show impacts on soil health and crop/grass production.

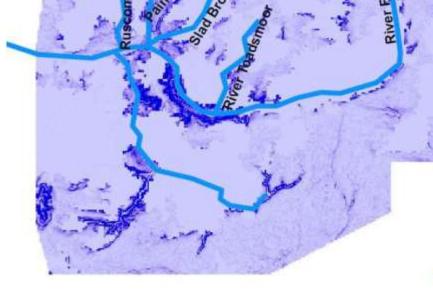
 integrate soil transport models with Erosion Risk Map to estimate availability of sitt resource.

Determine economic costs of capture and reuse at local scale
 Investigate environmental costs of sitt extraction.



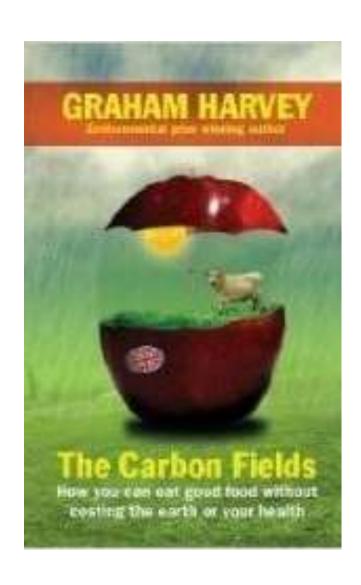
Kat Gorham Water 21

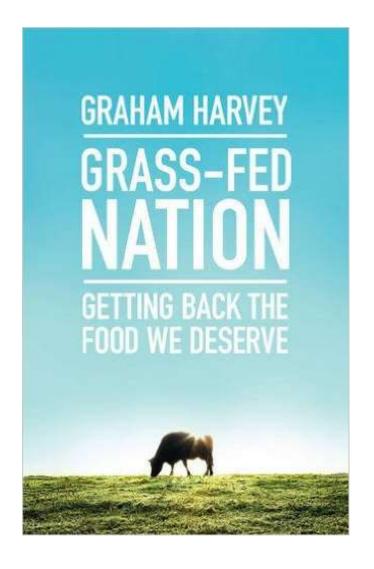






The Carbon Fields ...?





"No Measuring, Monitoring or Management ..."

No empirical determination or management of landscapes according to soil carbon (humus) content ... or rainwater storage (attenuation & infiltration).



Dave Stanley Film, 'Floody Farming' 2014

4 PER 1000



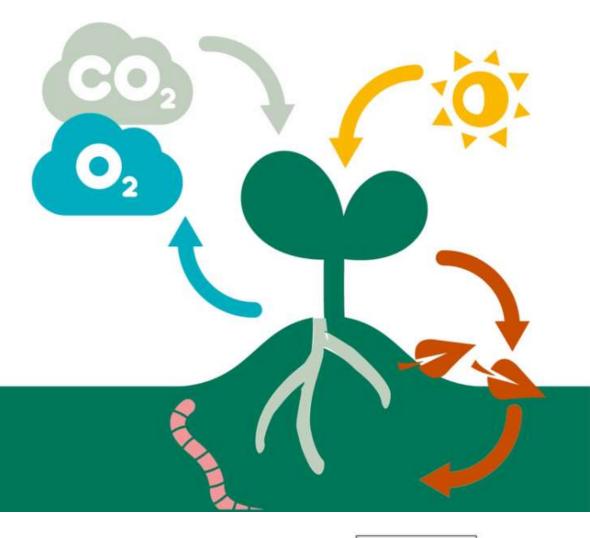




MINISTÉRE DE L'AGRICULTURE DE L'AGROALIMENTAIRE ET DE LA FORÊT



PHOTOSYNTHESIS
CO2 ABSORPTION
OXYGEN PRODUCTION
ORGANIC WASTE
CO2 CAPTURE IN SOIL





MINISTÉRE DE L'AGRICULTURE DE L'AGROALIMENTAIRE ET DE LA FORÊT



HOW MORE CARBON CAN BE STORED IN SOIL?



FERTILISERS
LIMIT THE WORKING
OF THE SOIL

HEDGES AGROFORESTRY LAND Restoration



MINISTÈRE DE L'AGRICULTURE DE L'AGROALIMENTAIRE ET DE LA FORÈT







MINISTÈRE DE L'AGRICULTURE DE L'AGROALIMENTAIRE ET DE LA FORÈT



Paris COP 21 Briefing



Restorative Land Use: Paris 2015 and beyond...

Paris COP December 2015: Policy Discussion Document 25 October 2015

Land-based climate solutions are

We are in a state of climate energency with increasing carbon dioxide from industrial development and methane releases from damaged natural systems. Existing viable alternatives in land use road political will and policy innovation to be protected, joined up and scaled up.

The living Earth system is being changed by human activity across the whole range - including food production, accesystems and soils. This living economy is currently in a serious decline but the good news is that we already know the basics of how to restore it for the benefit of people and

Current climate regotiations are concentrating on emissionsfrom the industrial economy. This is important - but not sufficient. The purpose of this paper is to highlight solutions based in the living economy. The evidence shows that without this assential aspective cannot hope for the stabilised climate assential to the future of its on Earth.

Taking on challenge of justice in land use essential for climate

Global civil socially can mobilise support for protection and restoration of sols, ecologies and sustainable livelihoods, investing in food security and biodiversity. This will mean lobbying for policies supporting greater equality and human rights for food, land and livelihood. We need to re-design the industrial economy to support living processes and to share the bursefits of development within and between countries.

iere will by no jobe on a dised planet." Risk: Disease of the International Labour Digestions (III



Stabilization Wedges' for the Uning Sconorry Industrial ferming estimated to be responsible for 64-57% of all GHG emissions (16) Here's how to make immediate reductions (detail see gill).

WE CALL FOR LIVING SOLUTIONS:

Recognition in climate agreements for governments who both defend small scale forms of sustainable food. production and enable/empower localised food

Allocation of equal global research funds for positive climate mitigation measures of land use. Research to include social science, enthropology and local knowledge in co-creation of strategies.

Rapid policy development for dietary change as part of climate strategy. Assisting farmers in changing the food system in policy/oractice.

Enabling of localised economies/food systems. These systems need research and policy support at local, national, global regional and global levels to be resilient in the face of global change.

Promotion of austainable soil cultures as exemplary: A global awareness compaign is needed to support small producers and large scale ecological restoration linked to livelihoods.

Civil society movement collaboration across the industrial and living economies for sustainability and nocial justice.



Stabilisation 'Wedges' for the Living Economy

'Industrial farming' is estimated to be responsible for 44-57% of all GHG emissions





A (micro)biological understanding of soil function



Tillage and agrochemicals kill carbon sequestrating soil microbiology, limiting rain infiltration.

Historic and ongoing releases of soil carbon to the atmosphere exceed that from burning fossil fuels.

Biological monoculture farming enables carbon sequestration, water resource (flood & drought) benefits.

- A long term transition for farmers.

Light-independent photosynthesis by soil bacteria:

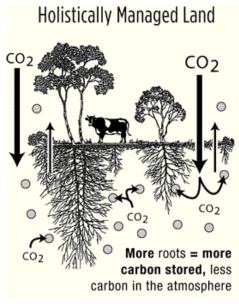
3 CO2 + 9 ATP + 6 NADPH + 6 H+ →
C3H6O3-phosphate + 9 ADP + 8 Pi + 6 NADP+ + 3 H2O

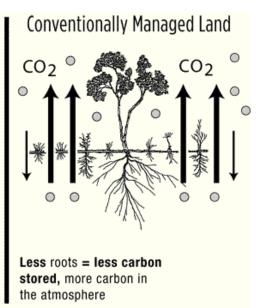
(The Calvin Cycle – an endothermic, <u>cooling reaction</u> that stores carbon (humus) & creates water).



Grazing livestock for improved soil carbon function (Mob Grazing)







Rob Richmond, Chedworth, Gloucestershire (Nuffield Scholar).

Achieving 0.8% Soil Carbon Sequestration per annum – by reverting to traditional grasses & herb varieties, careful 'mob grazing', no artificial fertiliser (composted manure only) – and few modern chemicals ... enabling symbiotic microbial associations on plant roots.



Unaccounted costs of agriculture

- Increased flood & drought cost largely results from aridification of topsoil, compromised aquifer recharge, increased run-off & evaporation (intensified rainfall).
- Flood damage & shrinkage of house foundations are the biggest UK insurance cost.
 (UK home insurance premiums may be surcharged 10% for raised flood risk).
- Agricultural chemical contamination of aquifers (nitrate & pesticide) is a major limitation on the UK's public water supply. (increased water treatment costs and leads to greater costs for water storage and transfer).
- Huge siltation effects of watercourses, loss of nutrient, eco-toxicological effects and contamination of coastal waters.
- Even livestock farming implicated. eg over-the-counter anthelmintics increased mobilisation of manure into watercourses compromised nutrient cycling.
- Nutrition & public health standards.

... other costs arising from 'modern' agriculture, eg compromised river hydropower.

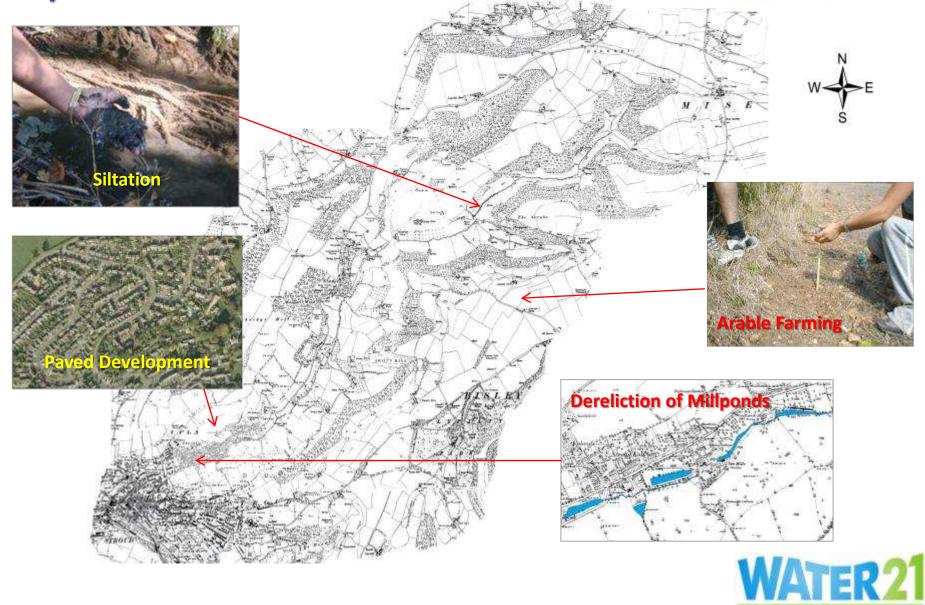
Lack of regulation & selective science

"... there are dozens of time-tested strategies that our best farmers and ranchers have begun to use. The problem is that several agribusiness advocacy organizations have done their best to block any federal effort to promote them, including leaving them out of the current farm bill, or of climate change legislation at all. " "One strategy would be to promote the use of locally produced compost to increase the moisture-holding capacity of fields ..." " ... we need to reduce the bureaucratic hurdles to using small- and mediumscale rainwater harvesting ... food production can be greatly enhanced through proven techniques of harvesting rain and biologically filtering grey water ... ".

New York Times, 21 July 2013

Slad, Historic Land-Use Changes – Key Catchment Flood Identifiers



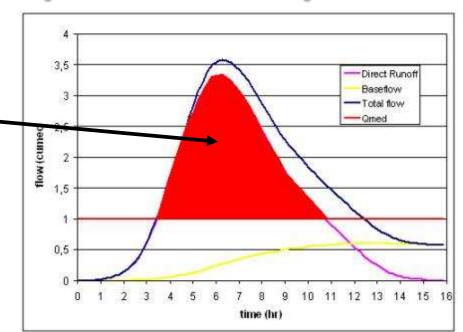


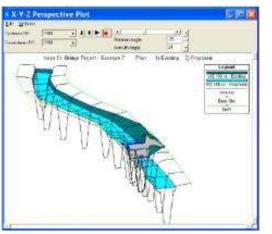
Defining a flood risk resolution methodology for upstream dispersal

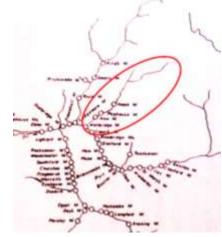
180,000+ cubic metres of water to store in catchment for control of a 1 in 75 year flood event – in a 14.5 Km² catchment.

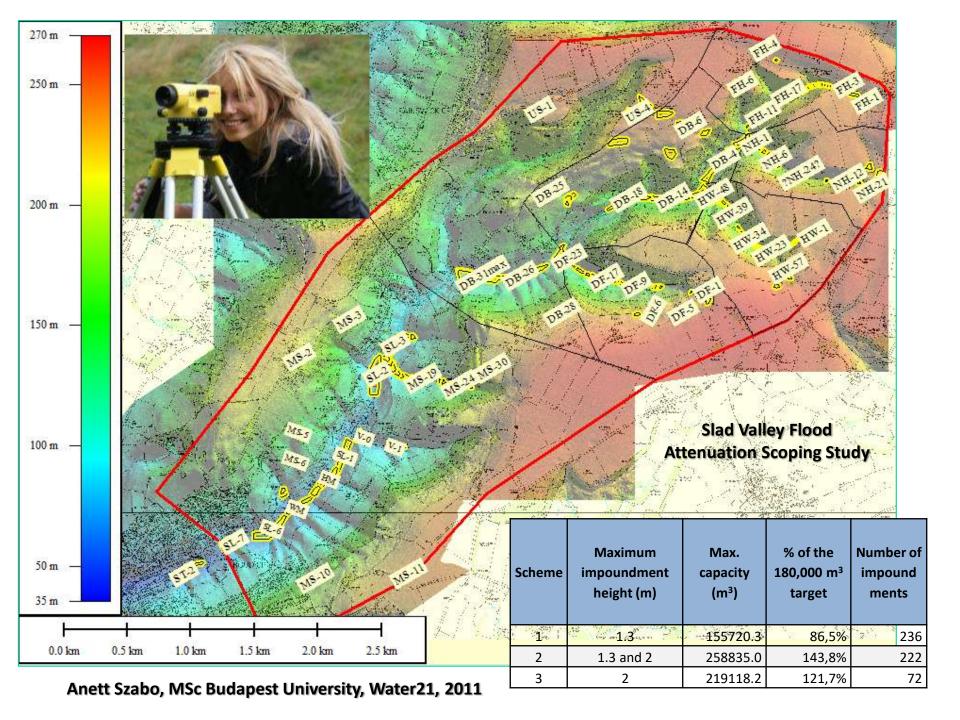


Ilaria Pretto, MSc Trento University, Water21, 2008











Arun Cappi, MSc Loughborough University, Water21, 2011 - Gabriella Kovacs, MSc Budapest University, Water21, 2011

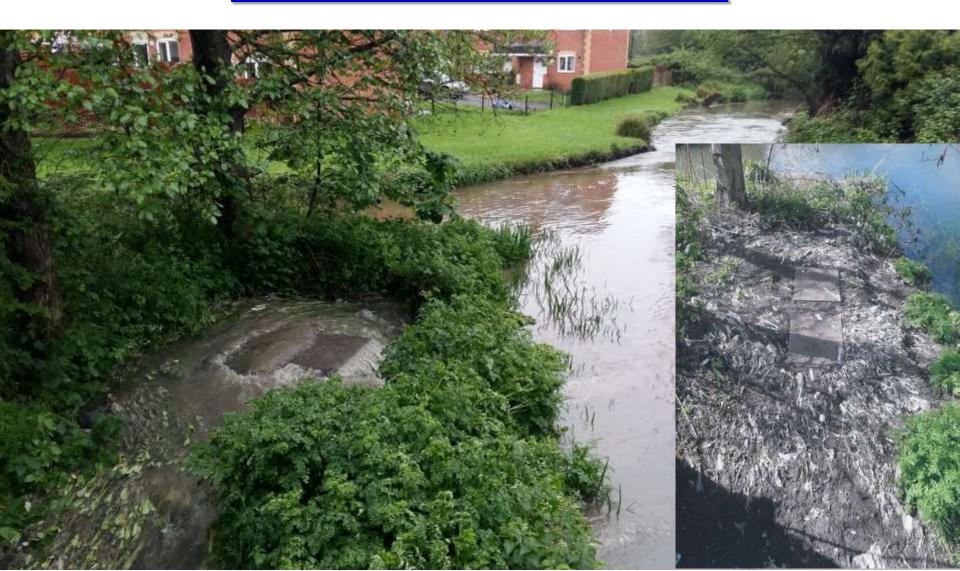


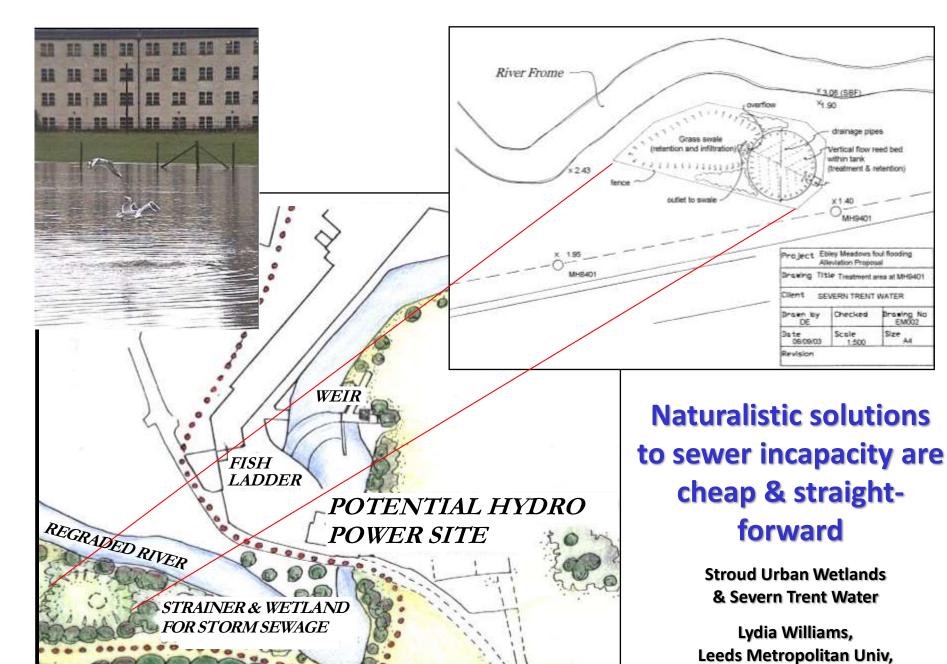
Surveying for flood attenuations



Planning 'Leaky Weirs' in steep flood gullies

Hydraulically balanced river & sewer catchments





1993 & 2003 (Water21)

A Local Authority ... Taking Responsibility



... major flood events look unmanageable – but can be dealt with by a piecemeal approach.

Annual rainfall is around 700mm per annum (Churchdown, Gloucestershire).

Annual water volumes available for periodic pond recharge will approximate to :

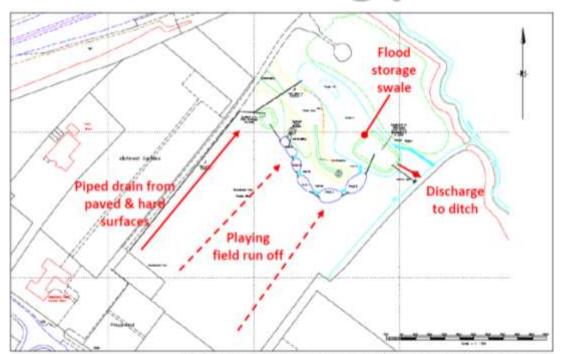
Annual run-off for paved area of Churchdown Park – 2550 m2 x 700mm = 1820 m3

Annual run-off for total area of Churchdown Park - 30,000 m2 x 700mm = 21,000 m3



Storm Water Swale, Reedbeds & Ponds at Churchdown Park for Churchdown Council
Tamás Böröndi, MSc Budapest University, 2011, Water21

Estimating peak storm events



Churchdown Park					
Return Period 100 years	Paved area		Playing Field area		
	2550	m2	30,000	m2	
Storm Duration (hrs)	Peak Flow (I/s)	Volume (m3)	Peak Flow (I/s)	Volume (m3)	
0.5	51.57	92.82	606.67	1092	
1	29,96	107.87	352,50	1269	
3	12.68	136.94	149.17	1611	
6	7.37	159.12	86.67	1872	
12	4.29	185.13	50.42	2178	

the state of the same of the s	A comment of the comm	Carlotte and Carlotte and Artist and Carlotte and Carlott	and the first and the control of the
Orderance Survey (c)	Crown Conveight	2010. All rights reserv	ed. Licence number 100020449

Return Period	Storm Duration				
(years)	30 min	1 hr	3 hr	6 hr	12 hr
2	8.2	10.5	15.3	19.4	24.7
5	12.9	15.9	22.3	27.7	34.2
10	16.8	20.4	27.9	34.0	41.4
25	23.0	27.5	36.5	43.6	52.1
50	29.0	34.2	44.3	52.2	61.6
100	36.4	42.3	53.7	62.4	72.6





CHURCHDOWN PONDS 2012

Water good Fashion model unveils plans to keep our rivers flowing A SOMALIAN fashion model unveiled plans this week to set up a company to treat Strong's sewage.

Revion girl Waris Dirie, whose English home is in plans to transform 250 acres of verlands so that they can be used to treat the whole district's sewage, instead of taking water

Standing in the dried-up had of the River Prome, just five miles from Samed, Warn sad: "These room are like these in my home to Africa.

This is an universal distance and at the section waster for years, and te Norted on the water compaties pumping too much from their

This is the real region that the

Waris, but appeared a report which chans, seed bees could process at the district's screage at half the cost and

pag water linek iray the rivers. The report is the work of her bes-bird, expent fallow hores. He word. The water companies are

staying the mer. These are you people billion, but the fact that we can out water hills in half comes as a bit of a

which in Severa Torid's system." both the NRA and Square Treat, " may don't take a up, we will," card ment a clean of the food re-installe Warts can star his on a water-compa

AND UTILIZATION

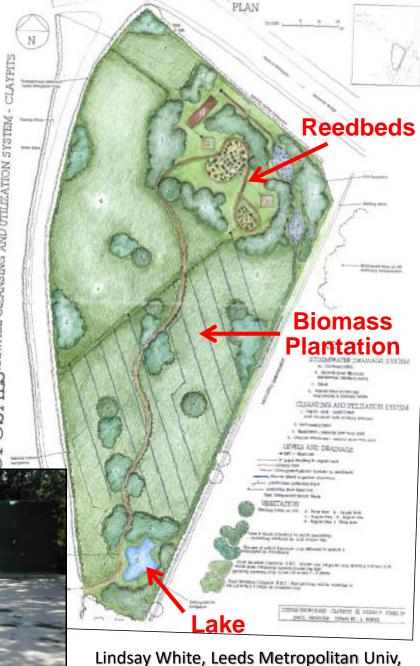
A I G:SEWAGE CLEANSING



ERIES – GLOUCESTERSHIRE'S MOST READ-NEWSPAPER (Source: JICREG 1994)

Above: Claypits village near Stroud. 60 acres of additional plantation can provide 100% of the village's potential domestic energy needs for a total cost of £25,000.

Right: pumping station and conventional sewer connection, by comparison, costs an estimated £500,000, which wastes energy and fails to realise the full value of sewage as a sustainable resource - all adding up to negative environmental & climatic impacts.



1995 (Water21)

Storm & Waste Water Treatment





(filling)
Lake

Biomass
Plantation

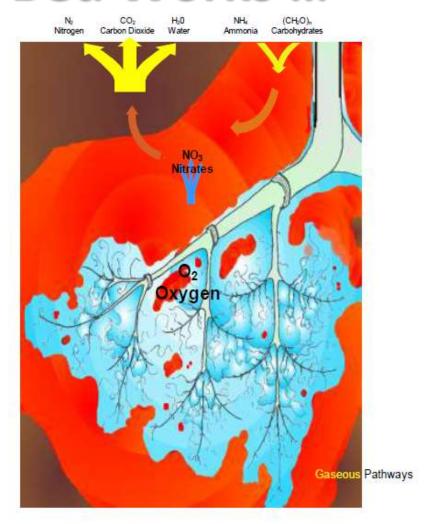
Reedbeds

Above, courtesy Biologic Design

Left, courtesy Oceans-ESU

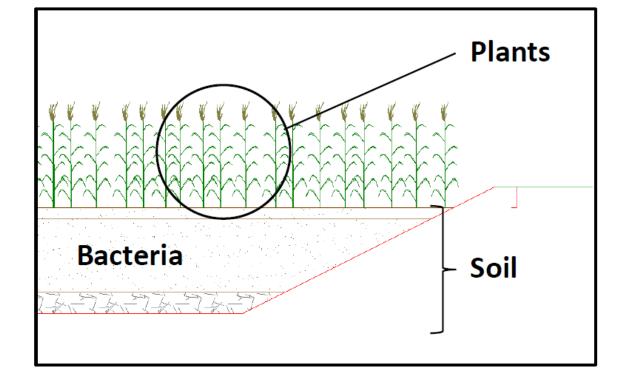
How a Reed Bed Works ...





Microbial activity in root zone provides cleansing of pollutants





Comparative Effect of Roots on Permeability

Species	Soil Type	Depth, cm	Development time (from 50cm pot)
	а	5 - 25	2 years
Juncus inflexus	b	5 - 25	2 years
#LECTURE CONTRACTOR	a	0 - 30	4 years
Iris pseudacorus	b	5 - 25	5 years
T-1-1-15-11-	a	10 - 45	3 years
Typha latifolia	b	10 - 45	3 years
01	a	10 - 60	3 years
Phragmites australis	b	10 - 60	3 years
		•	

a) loamy sand

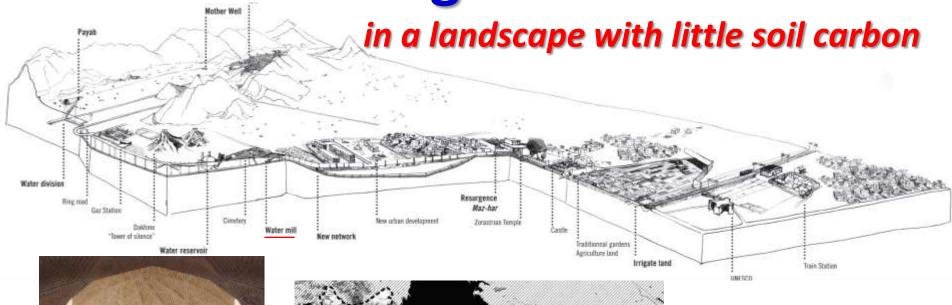
b) silty clay

Plant Selection Considerations

- Suitable root depth and root structure
- Wetland species supplies oxygen to roots
- Over 90 ecotypes of *P. australis* varying efficacy
- Suited to climate
- Indigenous to area
- Quick to establish

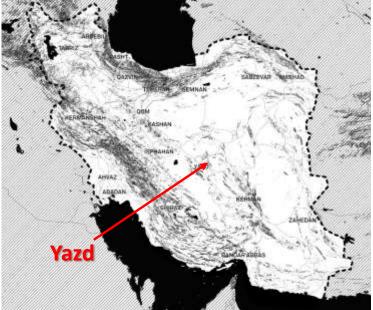


Valuing water ...







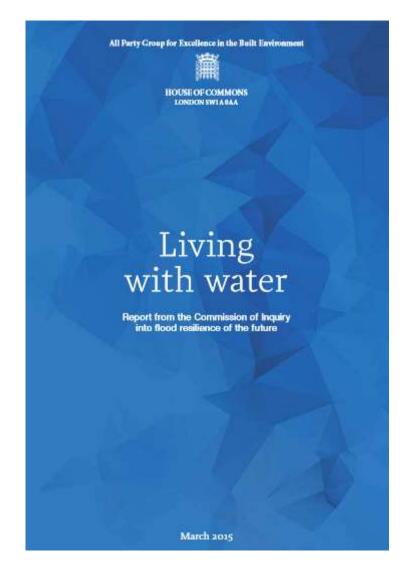








What is missing is the overarching catchment planning and facilitation by a favourable regulatory requirement. I suggest that a means to allocate responsibility for managing rainwater according to land ownership and tenure is devised, and appropriate practice facilitated through the structures and the professions, be set in place by the Flood and Water Management Act, to be overseen by the local authorities including public health as an aspect of their normal planning obligations.



'The Need for Catchment Wide Management' Water 21, APPG, 2015



julian.jones@water21.org.uk

www.water21.org.uk

www.water21.org.uk/category/video/







