



Andreas Thon

IBW-Thon, Wrestedt

Wolfram Kircher



Anhalt University, Bernburg



Feuchtwiesen
und Alpenflora
Alternative
Vegetationsbilder
auf Filterzonen bei
P- oder C-Limitierung

Wet Meadows
and Alpine Flora
Alternative
Vegetation
on Filter Bodies at
P- or C- Limitation



Wo ist die
Hochschule
Anhalt ?

Where is
Anhalt
University ?

<http://www.hs-anhalt.com/>

Anhalt University of Applied Sciences Master courses of study - Windows Internet Explorer

http://www.hs-anhalt.com/nc/study/courses-of-study/master/studiengang/landscape-architecture.html

Datei Bearbeiten Ansicht Favoriten Extras ?

Favoriten

dict.cc | pilotprojekt | Wört... Anhalt University of Ap... W Screenshot - Wikipedia

Der geschützte Modus ist momentan für die Zone "Internet" ausgeschaltet. Klicken Sie hier, um die Sicherheitseinstellungen zu öffnen.

Hochschule Anhalt
Anhalt University of Applied Sciences

University Academic Study Departments Contact Research

home > Academic Study > Courses of study > Master

Courses of study

- von A-Z
- Bachelor
- Master**
- Dual courses
- Landesstudienkolleg
- Application forms
- Application Information

Master courses of study

Landscape Architecture

The international two year, full-time Master of Landscape Architecture programme is an accredited, design-based course of study. It is aimed at graduates from academic and professional backgrounds who wish to develop professional leadership potential. The programme provides students with both theoretical and practical training in an interdisciplinary framework. When finished, students have the tools to find sustainable solutions for landscape architectural challenges. The faculty come from Anhalt University's programmes in architecture, nature conservation and other related fields, as well as the urban design programme at the renowned 'Bauhaus' school. Partnerships with leading European schools for landscape architecture (e.g. University of Genoa/Italy) and top landscape professionals

Fehler auf der Seite.

Internet | Geschützter Modus: Inaktiv

DE 22:47 30.07.2013

<http://mla.loel.hs-anhalt.de/>

Inhalt:

1. *Pflanze oder Biofilm ?*
Schwimmteich – Typologie
2. *Hart oder weich ?*
P- und C- Limitierung
3. *Unter oder über Wasser ?*
Pflanzenortimente
4. *Hochmoor oder Niedermoor?*
Pilotprojekte
5. *Aufwärts oder abwärts?*
Versuche in Bernburg
6. *Alpinum oder Wasserreinigung?*
Der Steingartenfilter

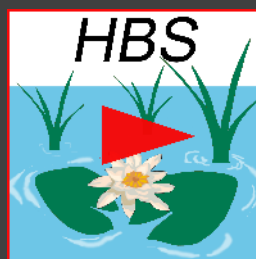
Structure:

1. *Plant or Biofilm ?*
Typology of Natural Pools
2. *Hard or soft?*
P- and C- Limitation
3. *Submersed or emersed?*
Plant ranges
4. *Acidic bog or lime fen?*
Pilot projects
5. *bottom up or top down?*
Trials in Bernburg
6. *Rockery or Water Purification?*
The rock garden filter

3 Filter – Prinzipien (FLL, 2011)

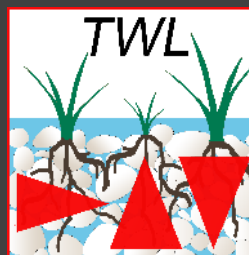
Filtration Principles

Hydrobotanisches System



Hydrobotanical System

Technisches Feuchtgebiet



Technical Wetland

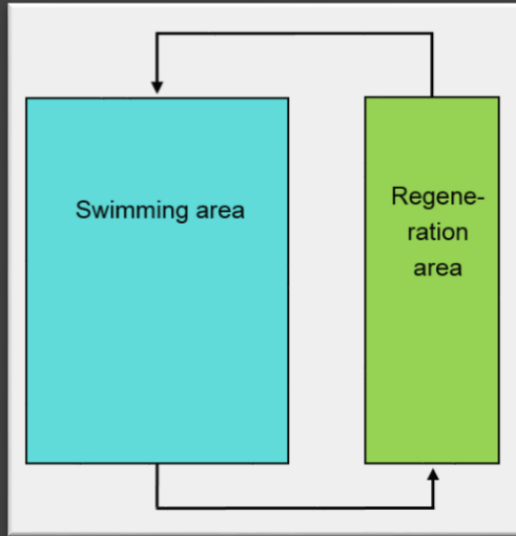
Biofilm aufbauender
Substratfilter



Biofilm accumulating
Substrat Filter

3

Aufteilungs – Prinzipien Partitioning Principles



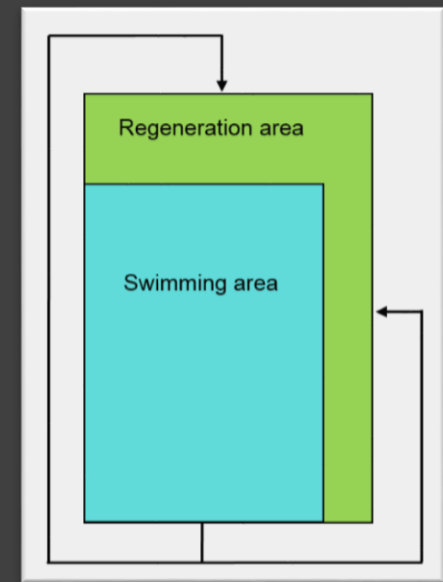
C

Schwimmbereich
komplett getrennt
(Zwei-Kammer-System)

Swimming area
completely separated
(Double chamber system)

A

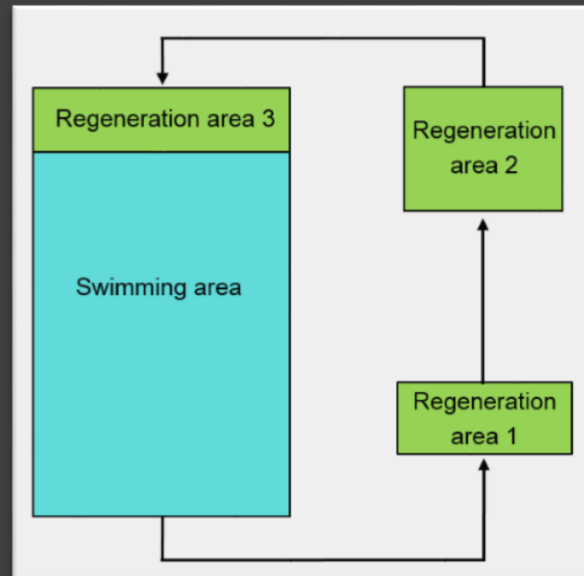
Ein-Kammer-System
Single chamber system



B

Mehr-Kammer-System
Multiple chamber system

Multiple chamber system



1

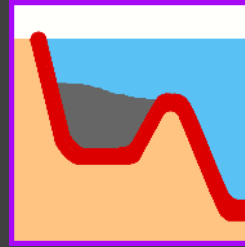
Schwimmteich-Typologie

NSP Typology

4

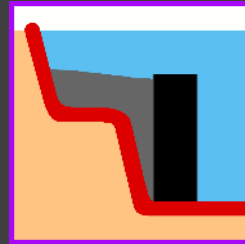
Bau – Prinzipien der Schwimmzone Construction Principles of Swimming Area

ohne Wandung



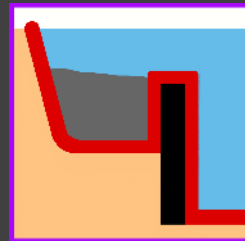
Without wall

Wand über Dichtung



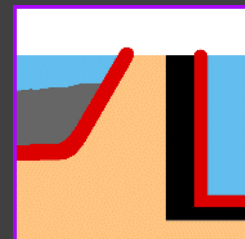
Wall above sealing

Wand unter Dichtung



Wall below sealing

Schwimmbereich
komplett ausgelagert



Swimming area
completely outsourced

4

Modelle von Schwimmteichen Models of Natural Swimming Pools

1

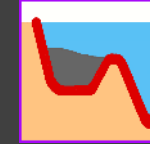
Schwimmteich-Typologie

NSP Typology

1

Stillgewässer
Standing water bodies
> 65 % planted area

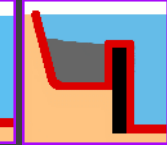
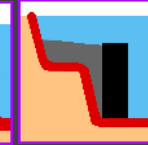
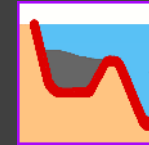
A



2

Oberflächenströmung
Surface flow
> 50 % planted area

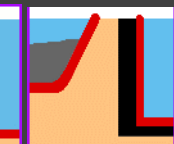
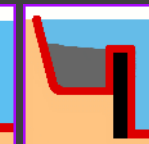
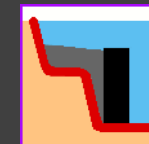
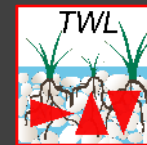
A B



3

Eher langsames
Fließgewässer mit TWL
Running water with TWL
< 30-40 % filter area

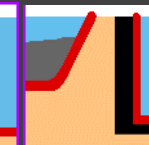
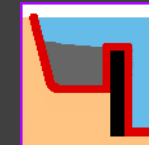
A B C



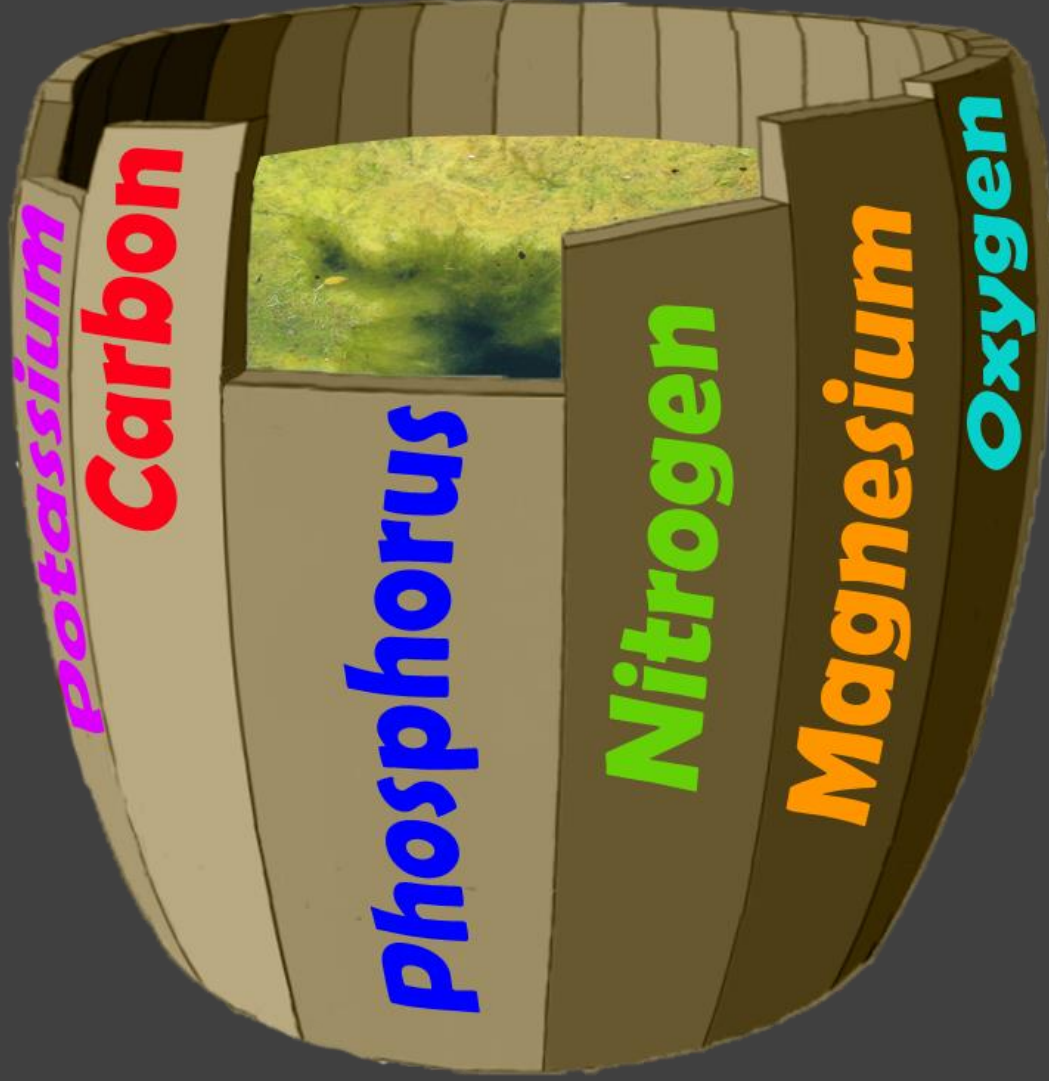
4

Schnelles Fließgewässer
mit BSF
Fast running water with
BSF < (5)-25 % filter area

A B C



Justus v. Liebig's **Minimum-Barrel**





Phosphorus – Limitation

High water
hardness



High O₂-
supply



pH ~ 8



Sediment





Phosphorus – Limitation

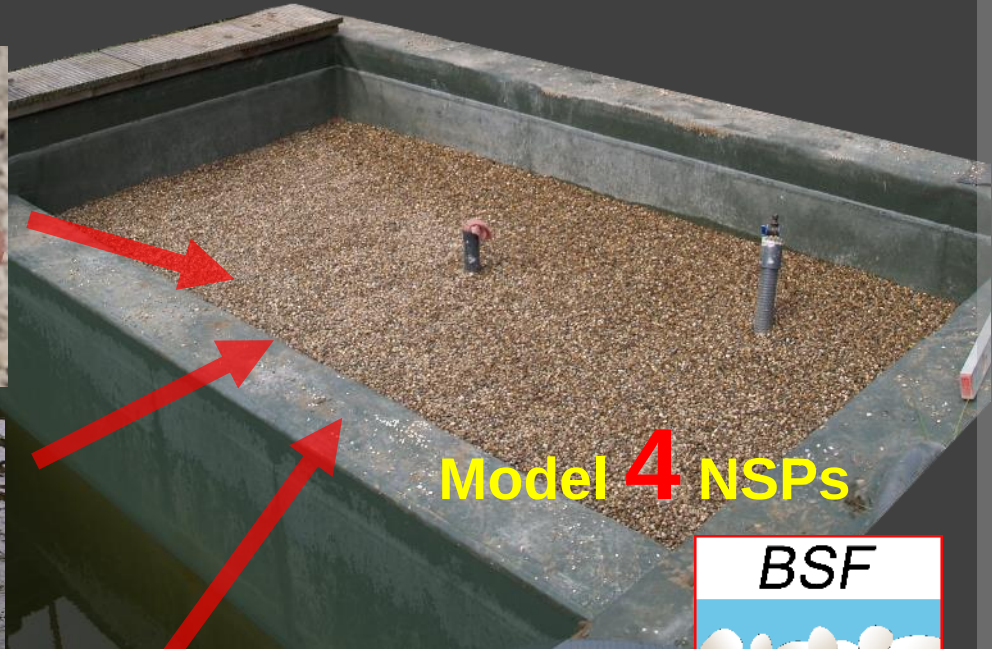
High water hardness



High O₂-supply



pH ~ 8



Model 4 NSPs

P – Einbau in Biofilm

P-incorporation into Biofilm



„Traditional“ Hints for Clear Ponds

Kein Kalk **no lime**

Niedriger pH **low pH**



↑ NSP near Graz, Austria
Model **1**

← NSP near Denton, Texas
Model **3A**



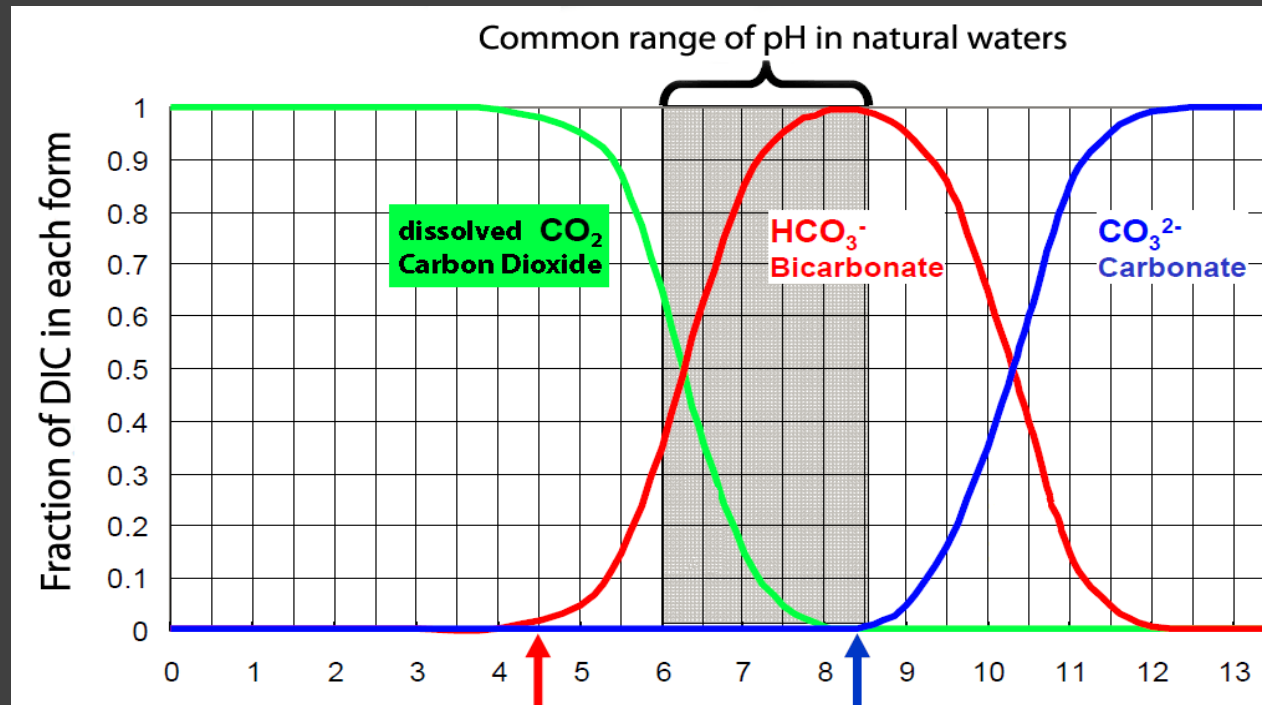
Gelöster anorg. Kohlenstoff - Limitierung

Carbon (DIC) – Limitation

2

P- und C- Limitierung

P- and C - Limitation



Low carbonate
hardness



low HCO_3^- - concentration

$\text{pH} \ll 7$



DIC as CO_2



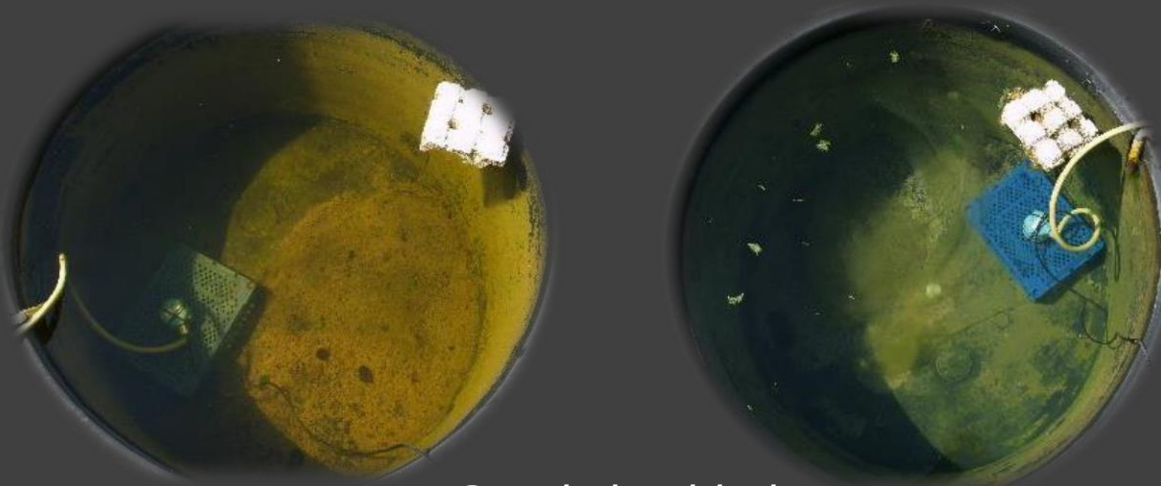
atmosphere
(0.036 % CO_2)



Probleme - **Risks of Carbon (DIC) – Limitation**

Geringe Pufferung gegen pH – Schwankungen
Low buffering against pH – fluctuations

Huminsäuren können bräunliche Färbung bewirken
Humic acids may cause a brownish hue



LWG Veitshöchheim

4 Modelle von Schwimmteichen Models of Natural Swimming Pools

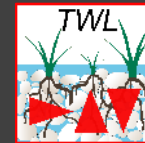
1 Stillgewässer
Standing water bodies



2 Oberflächenströmung
Surface flow



3 Langsames Fließgewässer mit TWL
Running water with TWL



4 Schnelles Fließgewässer mit BSF
Fast running water with BSF



Problem bei bepflanzten Teichen

Problem of planted pools



Bepflanzung
ist N-limitiert



Intended
vegetation is
N-limited

Konventionelle Pflanzung → hoher Nährstoffbedarf

Conventional planting → high nutrient demands



Iris pseudacorus



Lythrum salicaria



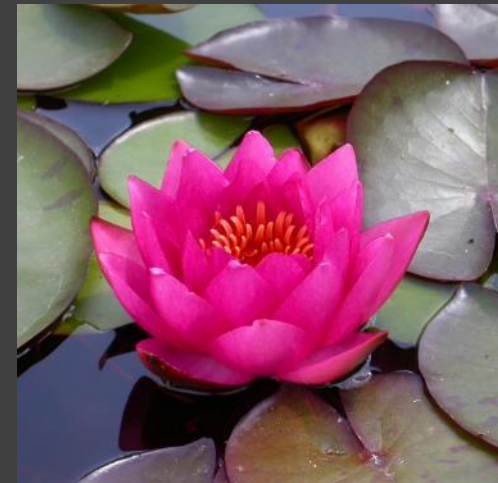
Acorus calamus 'Variegatus'



Pontederiacordata



Myosotis palustris



Nymphaea 'James Brydon'



Unterwasser-Pflanzen für Hartwasser

Submersed Plants for hard water oligo- to mesotrophic

3

Pflanzen-Sortimente

Plant Ranges



Sagittaria graminea



Myriophyllum crispatum



Potamogeton perfoliatus



Baldellia ranunculoides



Chara spp.



Utricularia australis ?
U. vulgaris ?



Unterwasser-Pflanzen für Weichwasser

Suitable submersed Plants for soft water oligo- to mesotrophic

3

Pflanzen-Sortimente

Plant Ranges



Crassula helmsii



Callitriche palustris agg.



Pilularia globulifera



Luronium natans



Hottonia palustris



Littorella uniflora

Vergleich von gärtnerisch interessanten Pflanzenarten Mitteleuropas

Comparison of Central European plants with horticultural interest

(ELLENBERGS ecological indicative values)

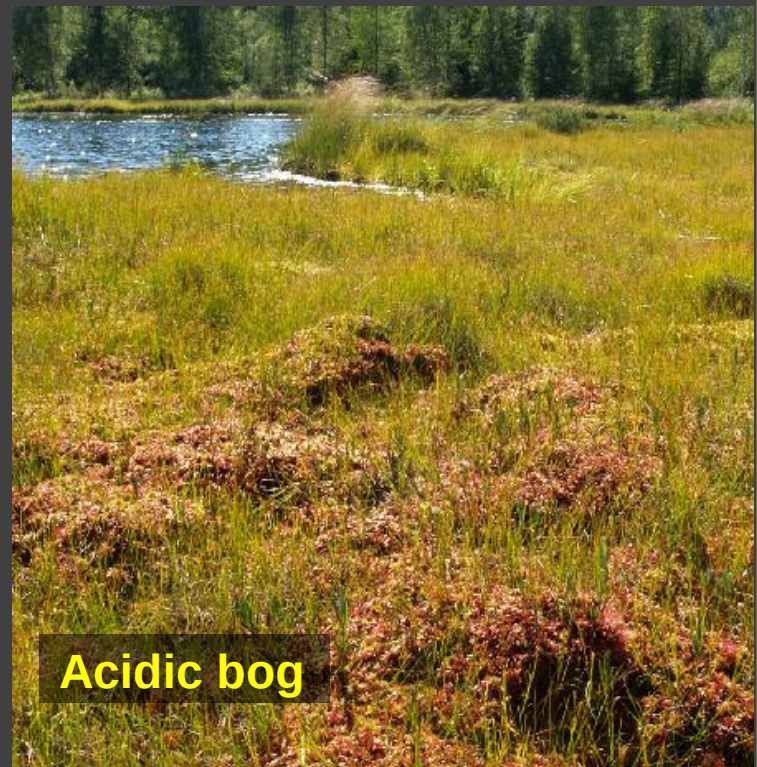
	Species on inundated sites (F = 10-12)	Species on emerged wetland sites (F = 7-9)
N = 1-3	20	118
N = 4 - 6	38	106
N = 7 - 9	54	101

**Nährstoffarme
Feuchtwiesen**
Nutrient-poor wetlands
Often P-limited!

**Transition bog
moderately acidic**



Lime fen – oligotrophic, alkaline



Acidic bog



1988: Erlangen 2B



1998: Staßfurt 2A



2001: Aschersleben 2B



2007: Gardelegen 3B

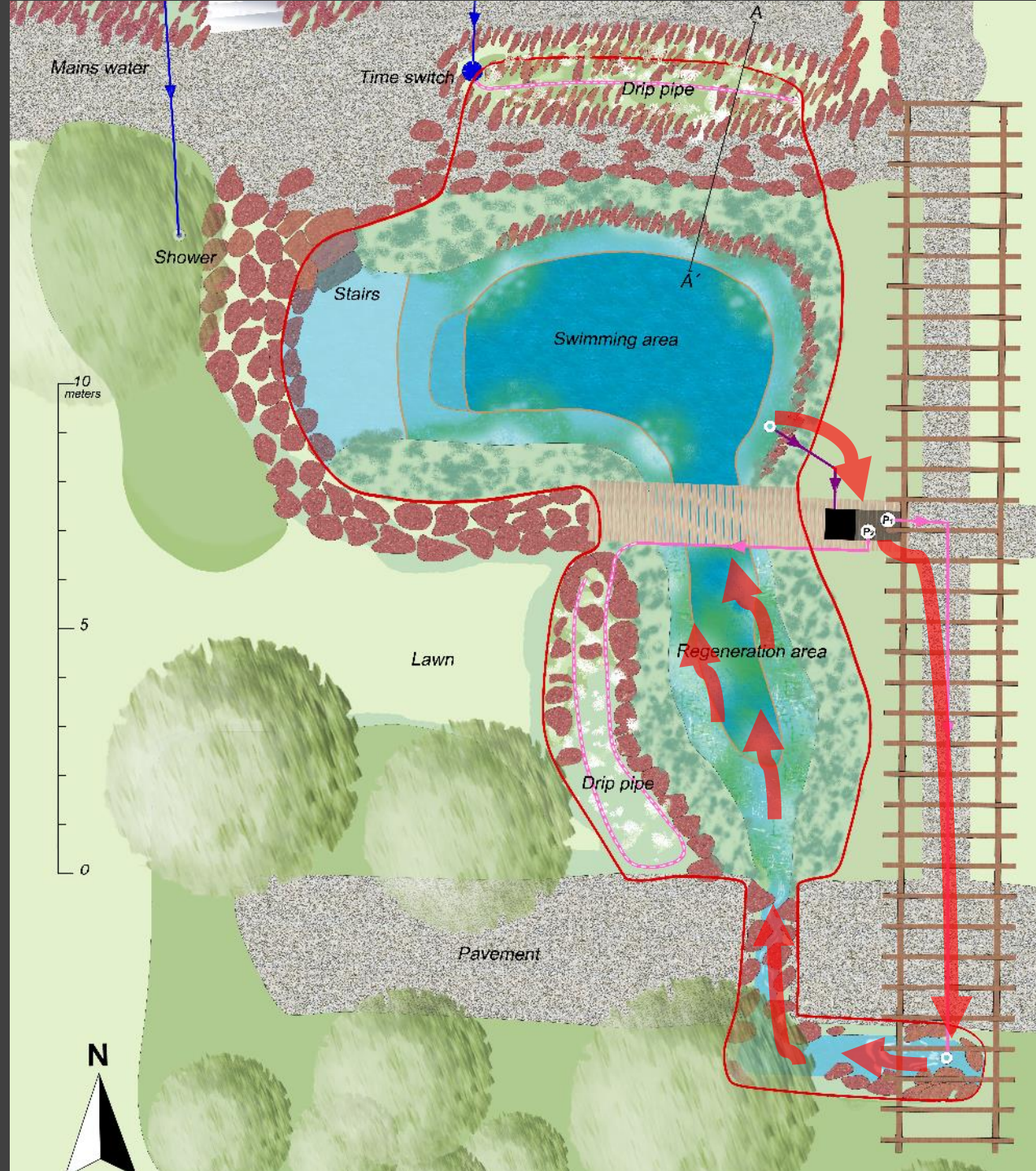


2008: Bernburg 4A



2010: Quenstedt 4B

1998: Staßfurt 2A



20 cm acid peat → 2013 → 20 cm gravel 2-8 mm

15 cm gravel 8-16 mm
protection membrane







Staßfurt



April

4

Pilotprojekte



Cardamine pratensis



Leucojum aestivum



Caltha palustris



Fritillaria meleagris

Pilot projects

Staßfurt



May



Dactylorhiza Hybrids



Eriophorum latifolium



Iris sibirica

4

Pilotprojekte

Pilot projects

Staßfurt



June

4

Pilotprojekte



Dianthus superbis



Bletilla striata

Pilot projects



Staßfurt

July



4

Pilotprojekte



Parnassia palustris



*Gentiana
pneumonanthe*



Swertia perennis



*Allium
angulosum*

Pilot projects

Staßfurt



August

4

Pilotprojekte



Liatris spicata



Lysimachia quadriflora



Epipactis palustris



Pilot projects



Allium suaveolens



*Spiranthes
cernua*



Lobelia sessilifolia



*Parnassia
glauca*

Staßfurt

1999 - 2005



4

Pilotprojekte



Pilot projects

Staßfurt

2007

12° dH (2,14 mmol/l)



4

Pilotprojekte

Pilot projects

*Eriophorum
latifolium*

Gladiolus palustris

Tofieldia calyculata





*Vaccinium
macrocarpon*

Staßfurt 2007 - 2015

12° dH (2,14 mmol/l)



4

Pilotprojekte

Eriophorum latifolium



*Pogonia
ophioglossoides*



Sphagnum palustre



Research Project in Bernburg 2007 – 2010 (→ 2015)

Projekträger für das

Bundesministerium
für Bildung
und Forschung



5

Versuche in Bernburg



3 Natural Swimming Pools, Bernburg

Jörg Petrowsky



TeichMeister

BALENA GMBH

TEICH- UND POOLTECHNIK



Trials in Bernburg

Vegetation mats, Eschede

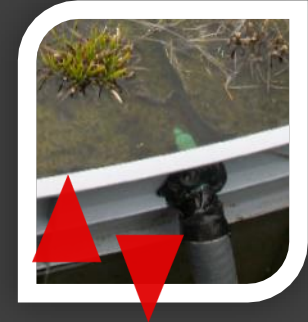
Trial-models, Bernburg

Research Objectives

Plant combinations
for percolated filters



Percolation
bottom-up
or top-down?



Production of
vegetation mats
ready to install



Rock gardens
as filter bodies



Improving the
water quality with
Sphagnum mosses



Suitability of
acid bog species



Prüfglieder

Trial variants



5

Versuche in Bernburg

Trials in Bernburg

Faktor A: Vegetation

unplanted



conventional



oligotrophic lime fen



acidic *Sphagnum* bog



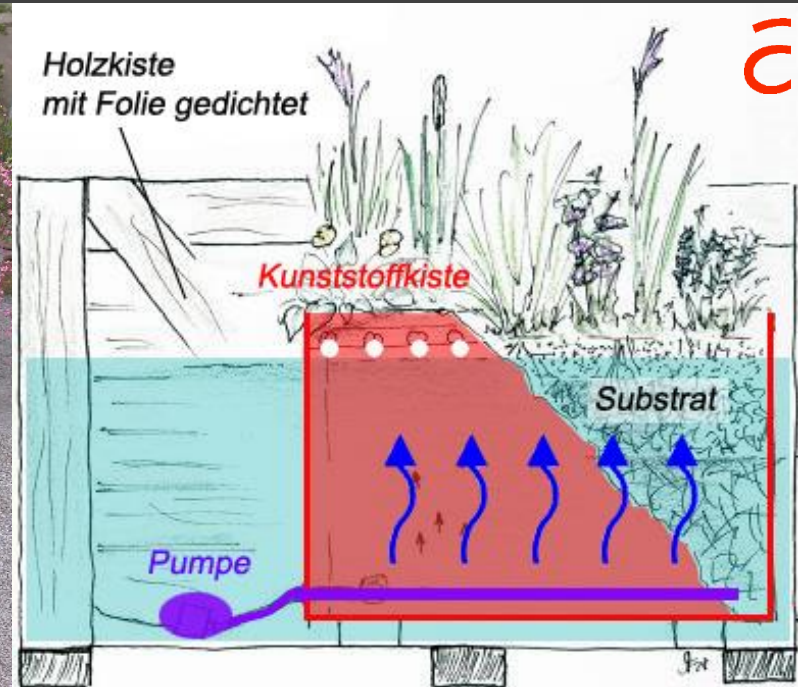
Prüfglieder

Trial variants

5

Versuche in Bernburg

Trials in Bernburg



Faktor B: Percolation

No pump, only diffusion ~

Bottom up



Top down



Nachfüllwasser

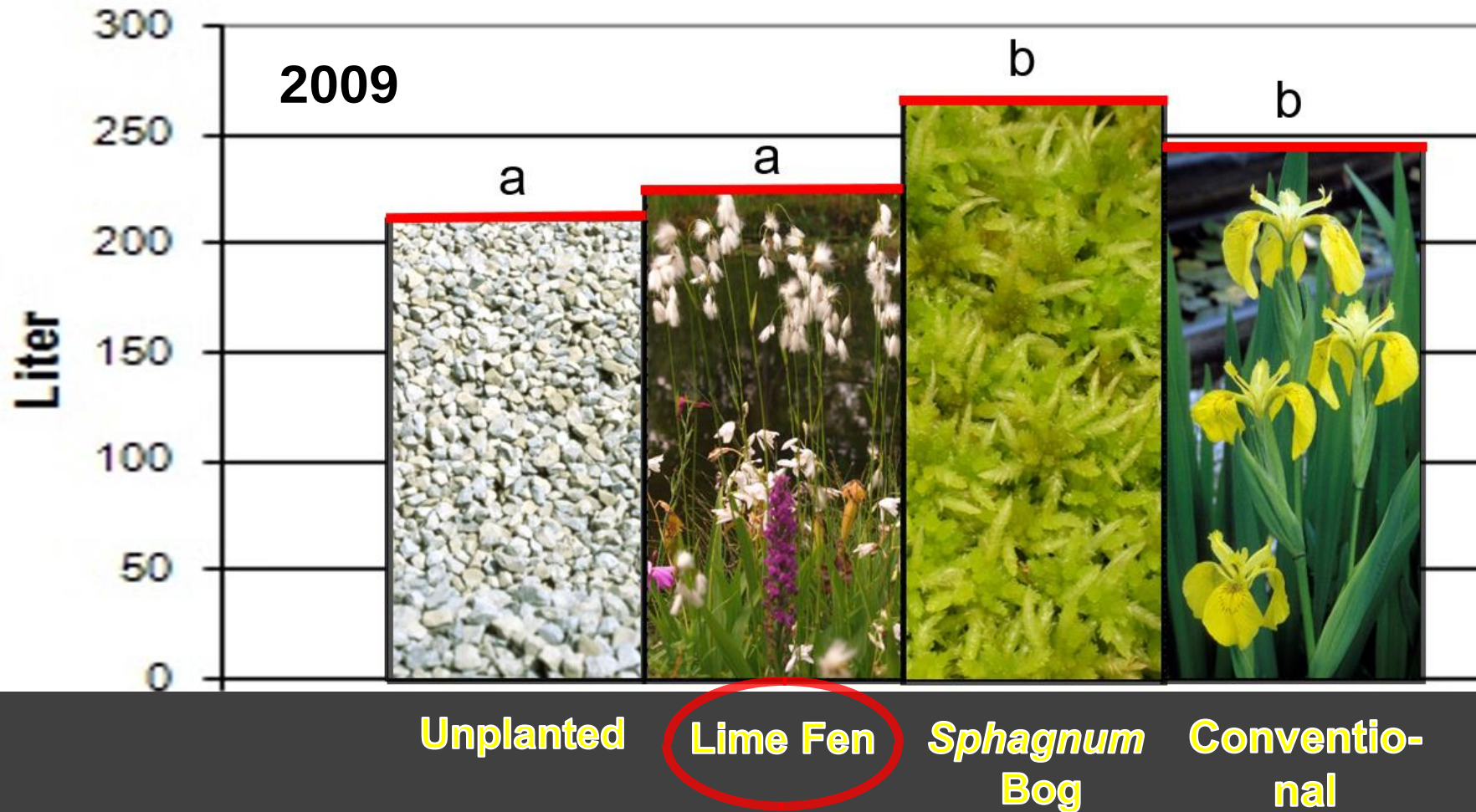
Refilling water



5

Versuche in Bernburg

Trials in Bernburg

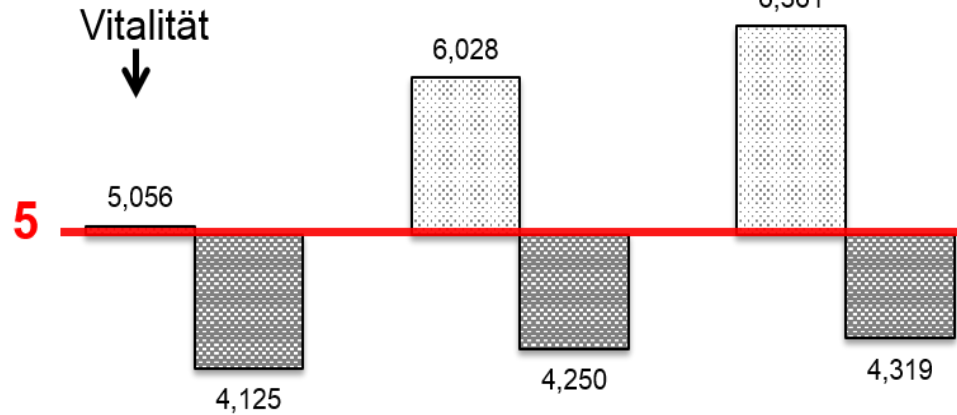


Vitalität

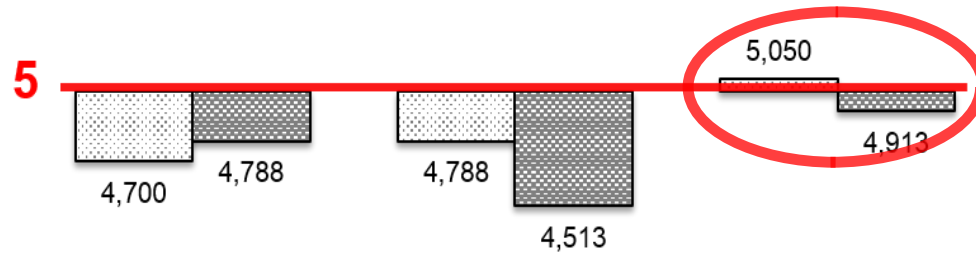
Plant Vitality



2008 2009 2008 2009 2008 2009



Conventional

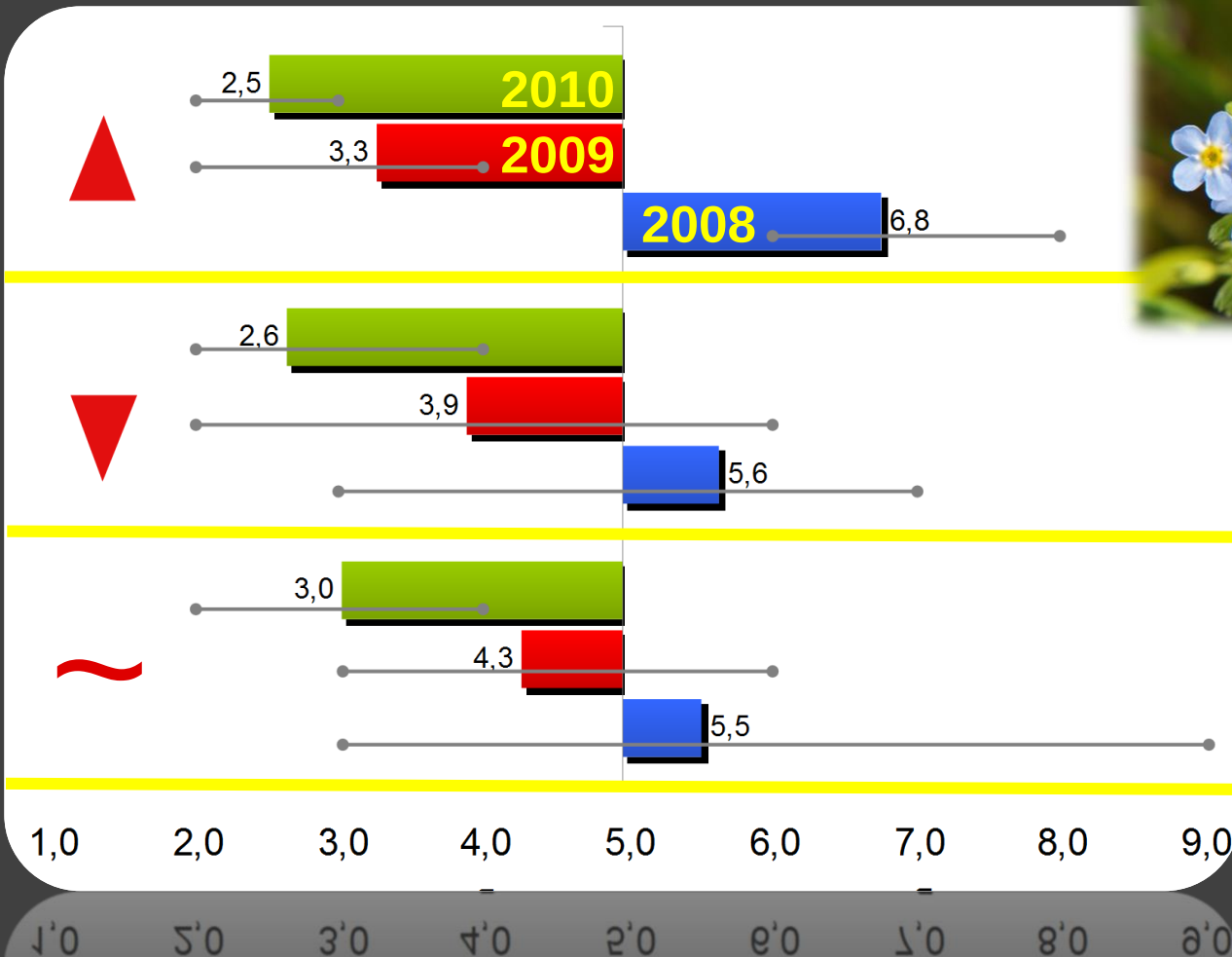


Oligotrophic lime fen





Myosotis palustris (conventional)



Vitalität

Plant Vitality



5

Versuche in Bernburg

Carex davalliana (lime fen)



Trials in Bernburg



Fadenalgen im Freiwasser

String algae in the pool water

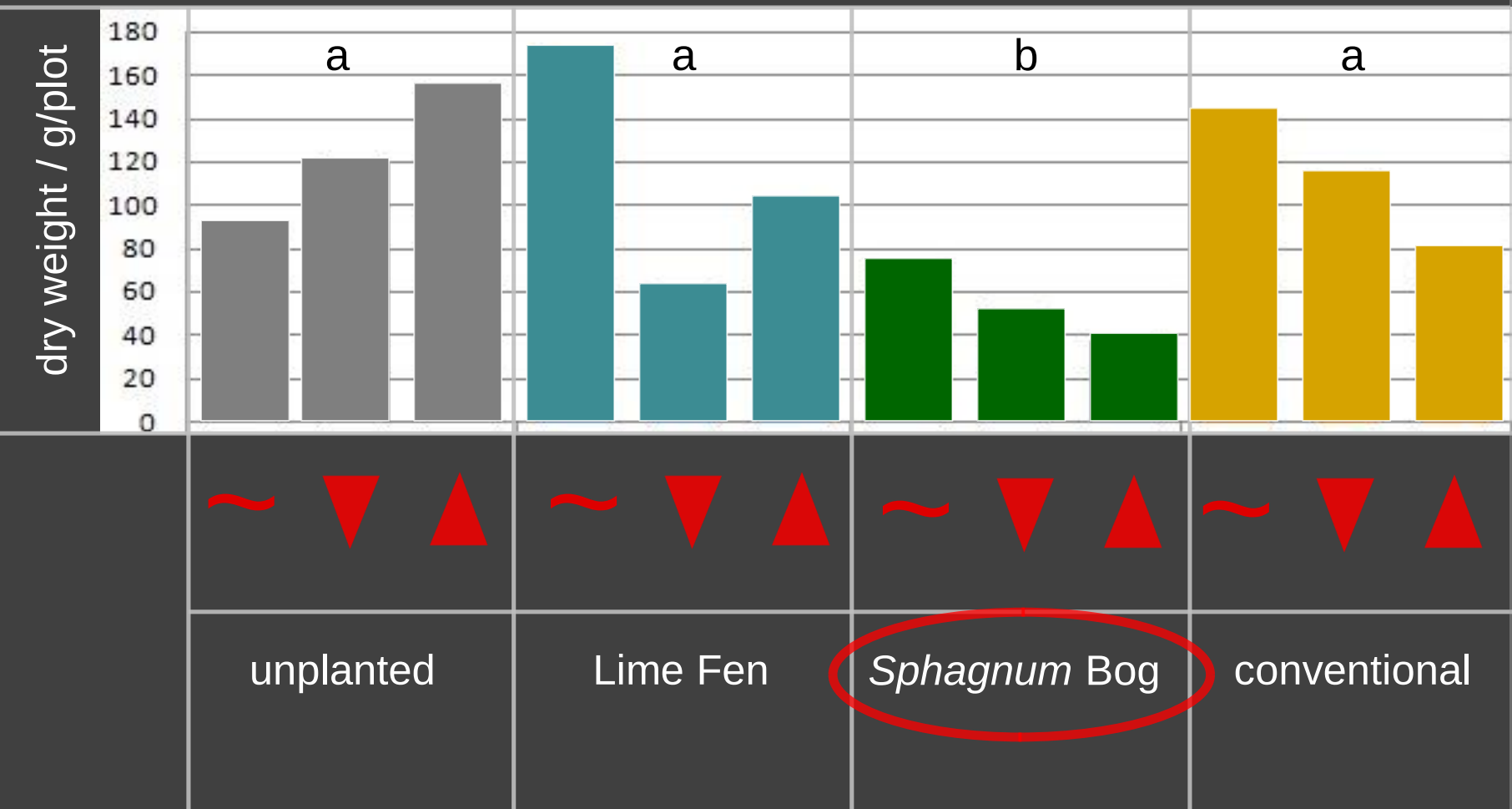


5

Versuche in Bernburg

Trials in Bernburg

2009



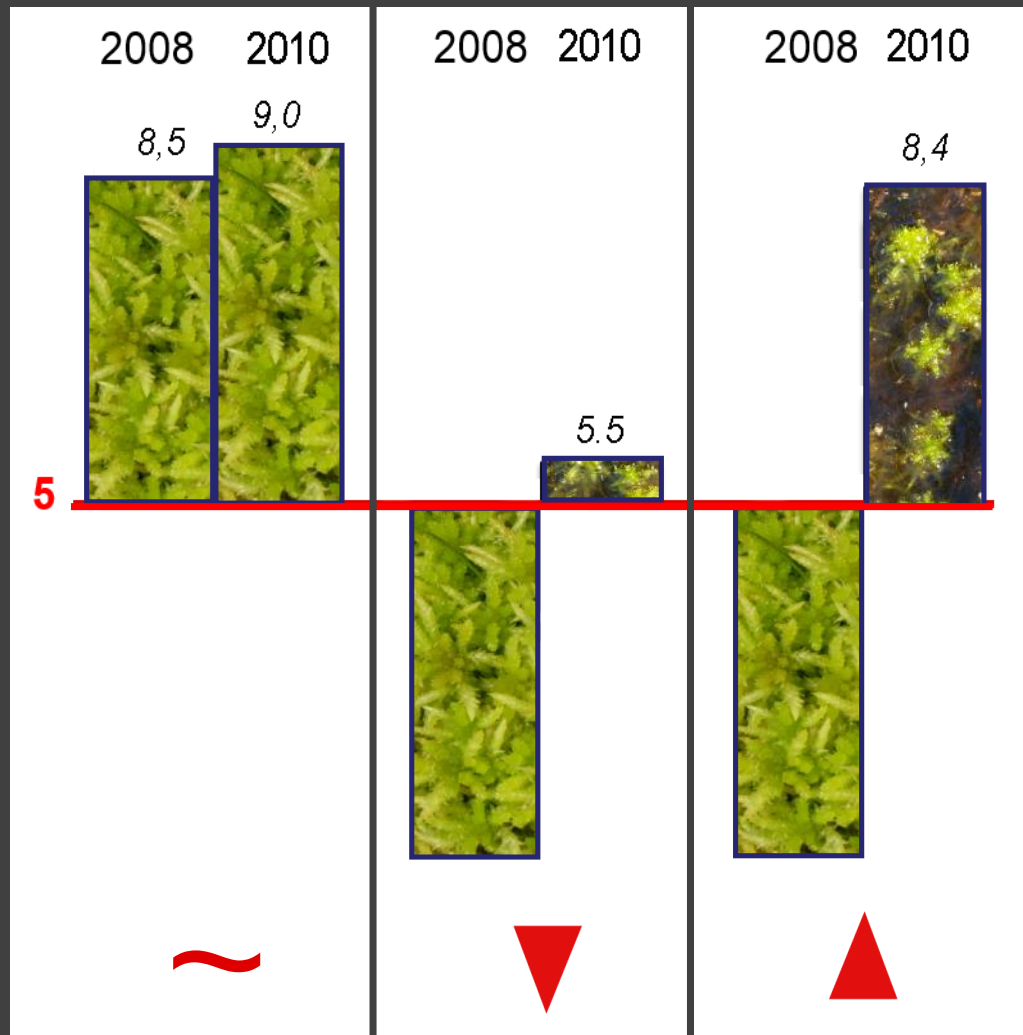
Entwicklung *Sphagnum*-Moor

Sphagnum Bog development



5

Versuche in Bernburg



Sphagnum palustre



Sphagnum squarrosum



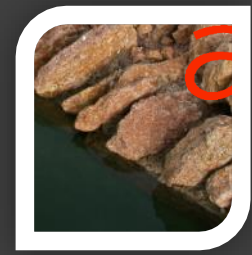
Trials in Bernburg

Messwerte im Freiwasser 31. KW 2009 (Spannen der Einzelmessungen)

Variante	P _{tot} / µg/L	NO ₃ / mg/L	KH / mmol/L
Ohne Bepflanzung	4,7 – 215,2	< 1	0,4 – 0,8 2 – 4 °dH
Konventionelle Bepflanzung	4,7 – 359,5	< 1	1,3 – 1,4 7,2 °dH
Kalkmoor	2,4 – 42,6	< 1	1,0 – 1,6 (3,6) 5 – 9 (20) °dH
Hochmoor	23,6 – 288,5	<1 - 4	0,3 – 1,0 1,5 – 5 °dH

Pilot-Schwimmteiche in Bernburg

Pilot Natural Swimming Pools



6

Der Steingartenfilter

The Rock Garden Filter



Rock Garden Filter

Water level:

0 – 20 cm below filter surface

Lime Fen Filter

Water level:

5 cm below filter surface

Conventional Filter

(Teichmeister System)

Water level 20 cm above filter

4A

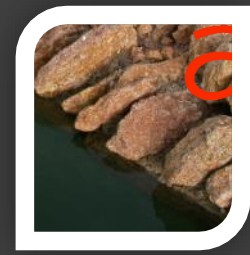
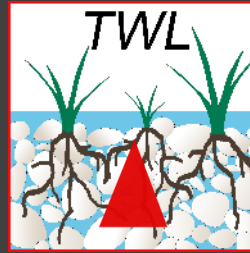
20% filter surface

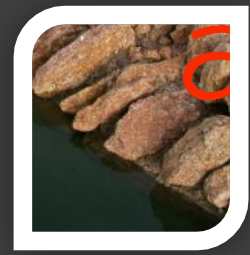
400-500 Liter per m²/hour



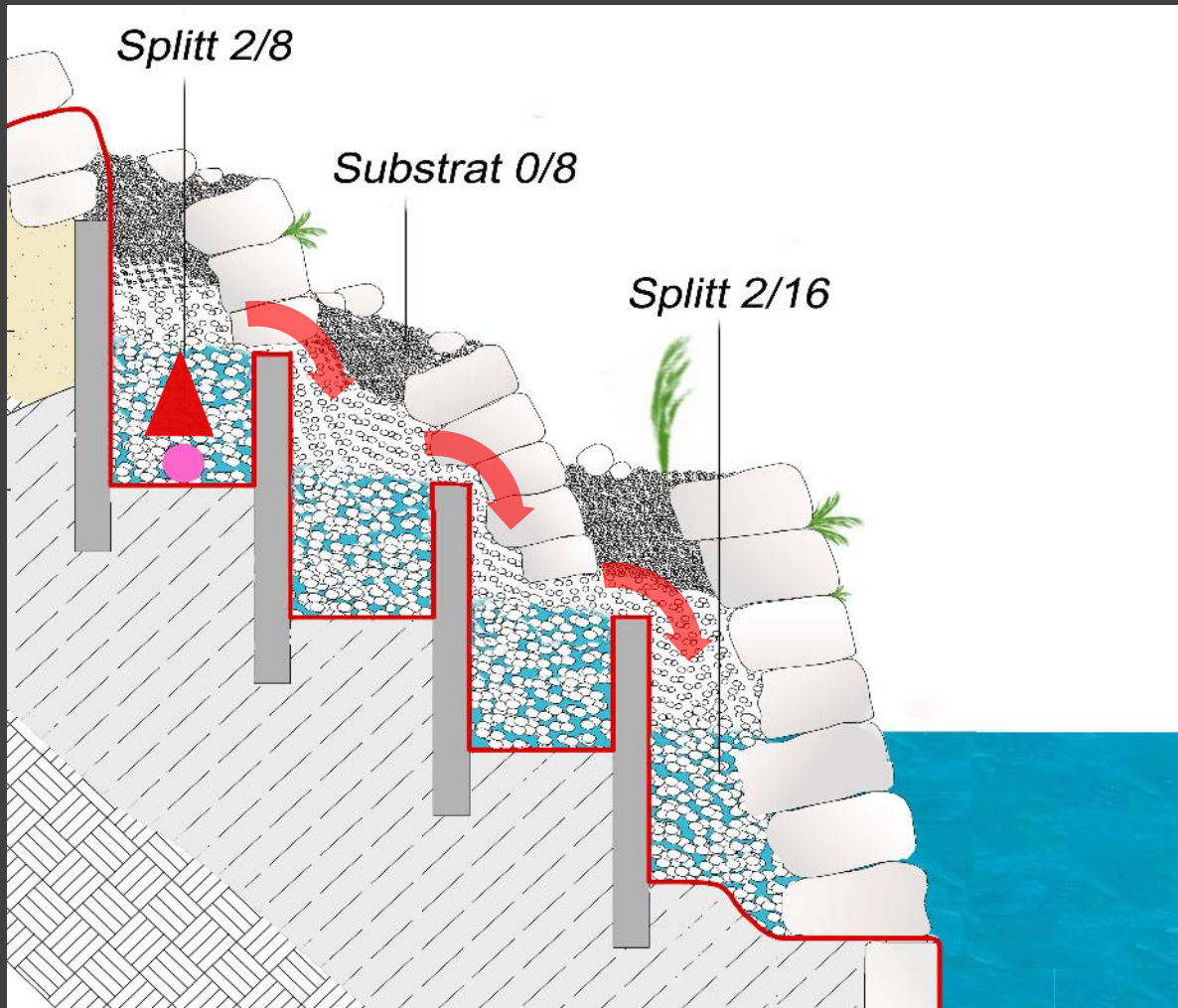
Steingarten als Technisches Feuchtgebiet

Rock Garden as Technical Wetland

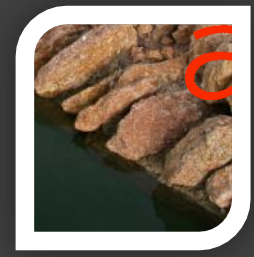




Prinipcle section sketch



Model 3A



6

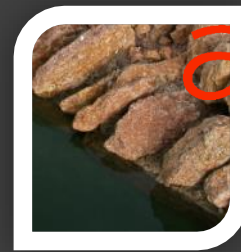
Der Steingartenfilter

The Rock Garden Filter

Felsspaltengarten

Crevise Garden Design by Zdeněk Zvolánek





6

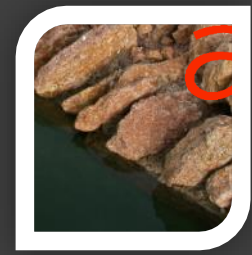
August 2010



Der Steingartenfilter

The Rock Garden Filter

Alpine Arte sind sehr erfolgreich...
Alpine species are most succesful...



6

Der Steingartenfilter

The Rock Garden Filter

June 2012



Leontopodium alpinum

April 2013



Saxifraga aizoides

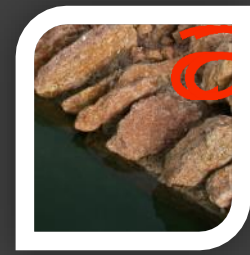
May 2015



Aquilegia flabellata cv.

...sowie Arten feuchter Prärien, Kalkmoore
und Übergangsmoore

...as well as species from damp prairies,
Lime fens & transition bogs



6

Der Steingartenfilter

The Rock Garden Filter



Dodecatheon meadia



*Anticlea (Zigadenus)
elegans*



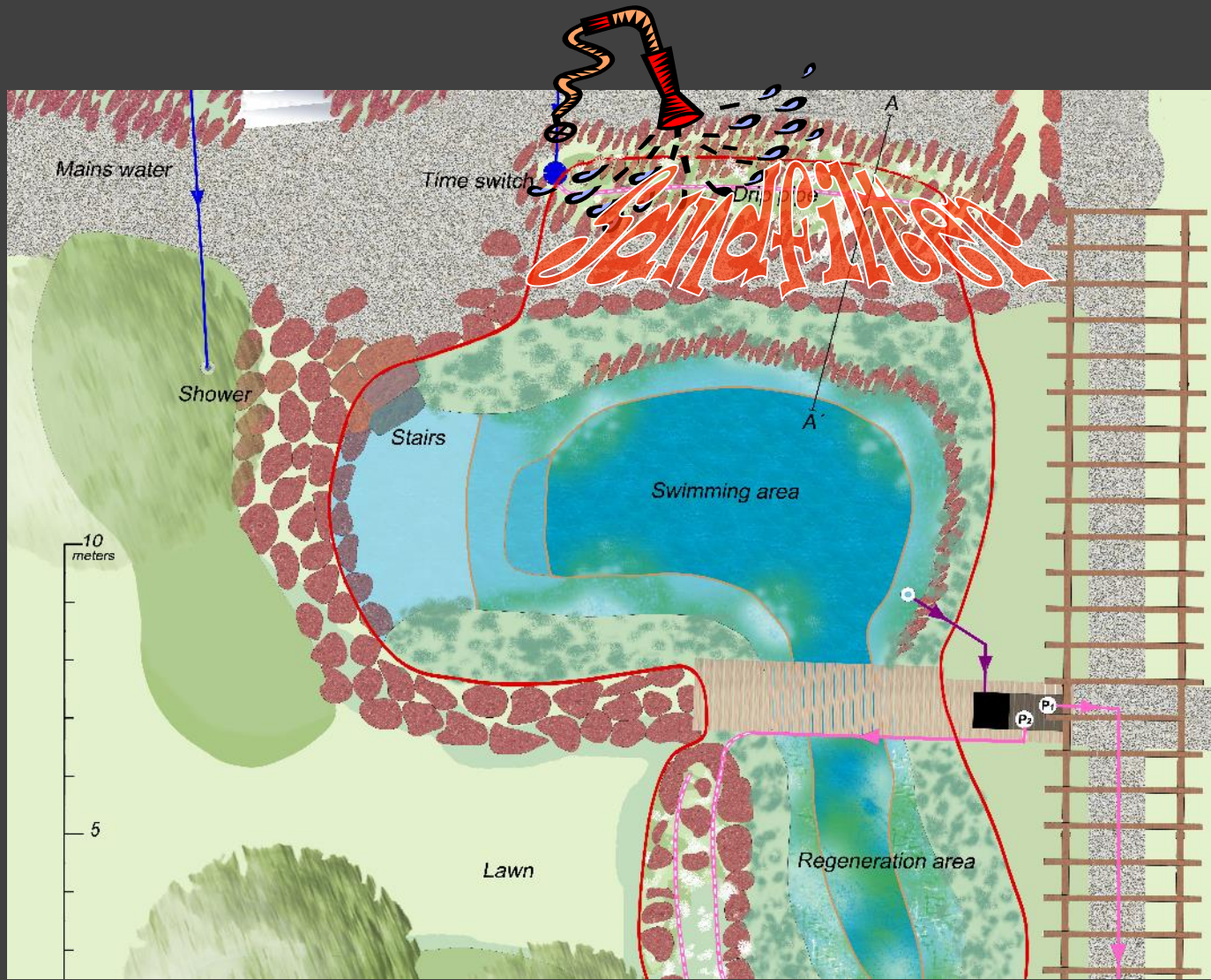
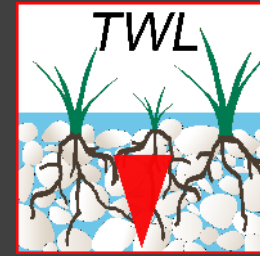
Trichophorum alpinum



Schoenus ferrugineus

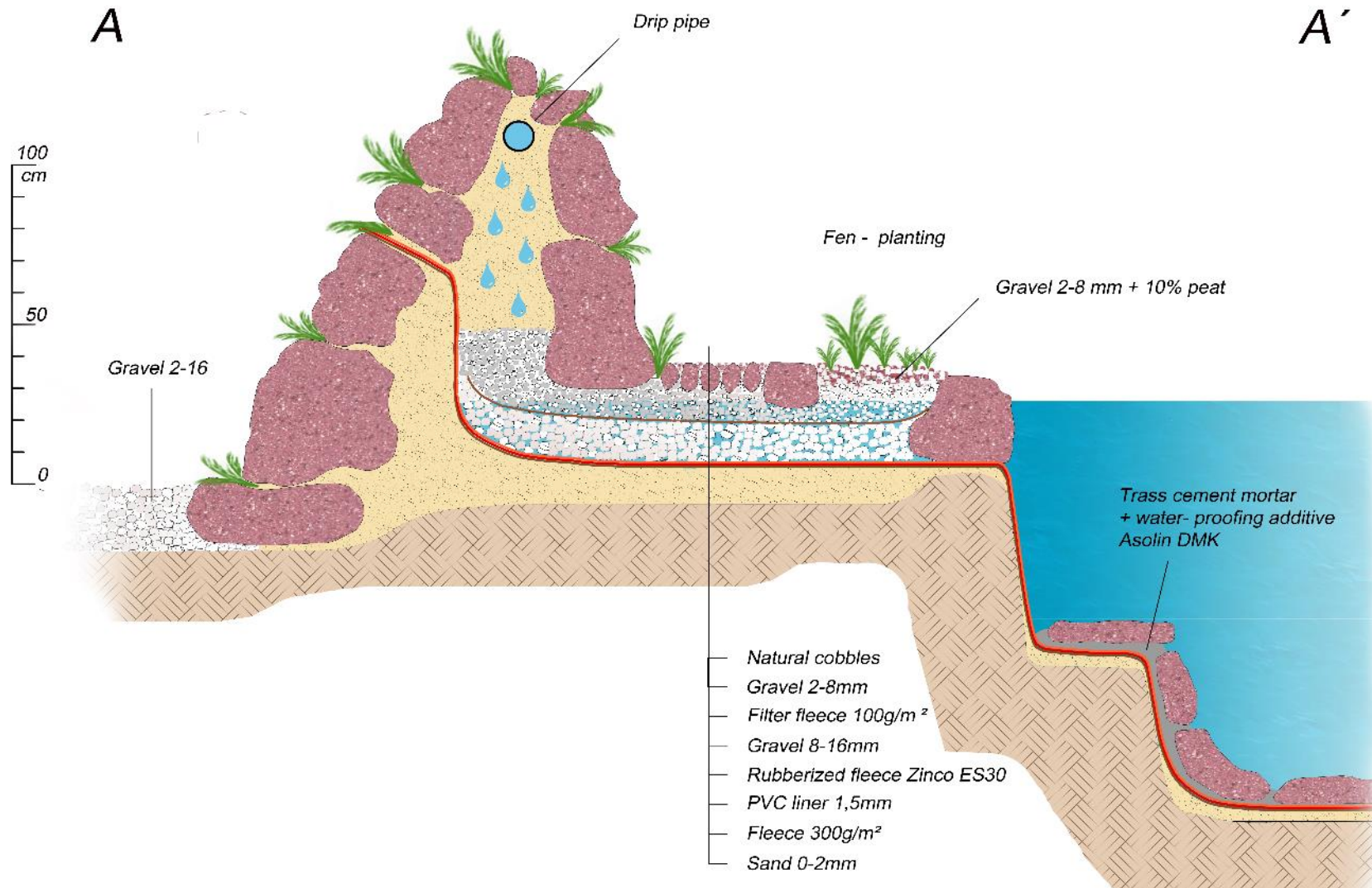
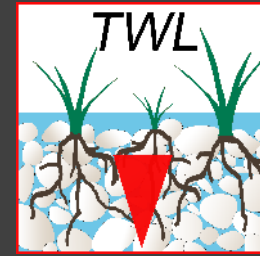
Steingarten als emerger Filter

Rock garden as emerged filter
built in 2013



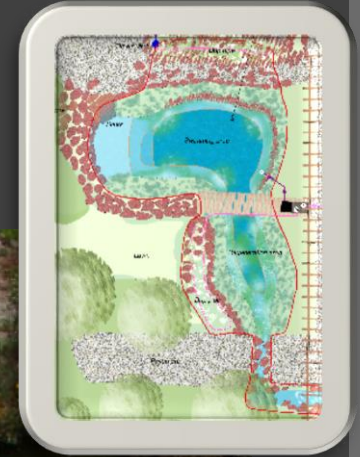
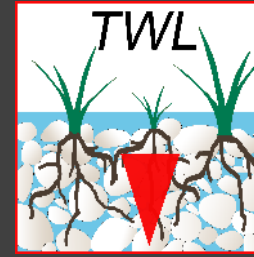
Steingarten als emerger Filter

Rock garden as emerged filter built in 2013



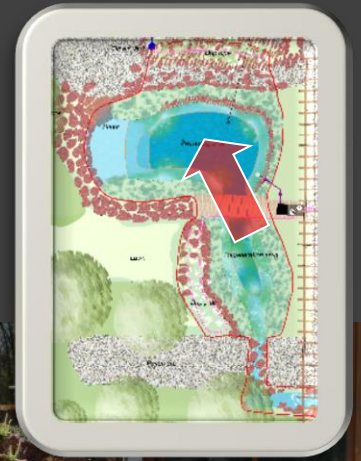
Steingarten als emerger Filter

Rock garden as emerged filter built in 2013



Filter für Nachfüllwasser

Fill-up water 4 hours per day 80 L/h



Sommer nass – Winter mäßig feucht

Summer wet – winter slightly moist



Antennaria dioica cv.

Arabis bryoides

Gentiana acaulis Grp.

Sommer nass – Winter mäßig feucht

Summer wet – winter slightly moist



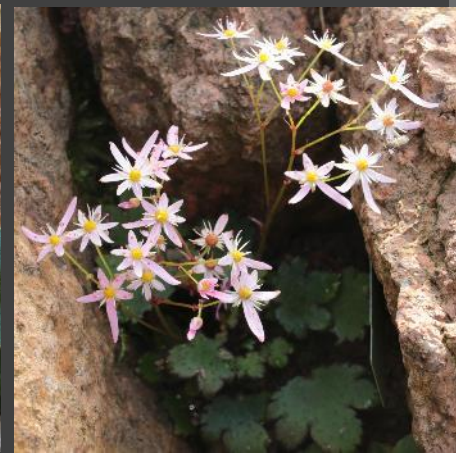
Saxifraga oppositif.



Carex baldensis



Primula speciosa



Saxifraga cortusif. cv.



Calluna vulg. 'Humty D.'



Pleione limprichtii



Bulbinella angustifolia



Rhodohypoxis baurii

Empfehlungen

Recommendations



✿ Durchströmte Steinanlagen können Filterfunktion übernehmen und erweitern die Gestaltungsmöglichkeiten
Percolated rock gardens can work as filters and extend design approaches

✿ Bei P-Limitierung sind Pflanzen oligotropher Kalkmoore empfehlenswert
Plants from oligotrophic lime-fens are recommendable at P-limited pools

Kalkmoor-Wiese statt nackte Kiesfläche ?

Lime fen meadow instead of pure gravel ?



Empfehlungen

Recommendations



Sphagnum-Moose sind ein geeignetes, pflegeleichtes Medium für attraktive Hochmoor-Pflanzen

Sphagnum-Mosses are a suitable medium with low maintenance demands for attractive species from acid bogs



Bestimmte *Sphagnum*-Moose gedeihen selbst bei mittelhartem Wasser
Particular *Sphagnum*-Mosses thrive even in moderately hard water



Sphagnum squarrosum gedeiht auch bei Wasserbewegung sehr gut
Sphagnum squarrosum grows very well even in moving water

Staßfurt 2007 - 2015

12° dH (2,14 mmol/l)

4

Pilotprojekte



Eriophorum latifolium



*Pogonia
ophioglossoides*



Sphagnum palustre



Forschungsbedarf

Research demands

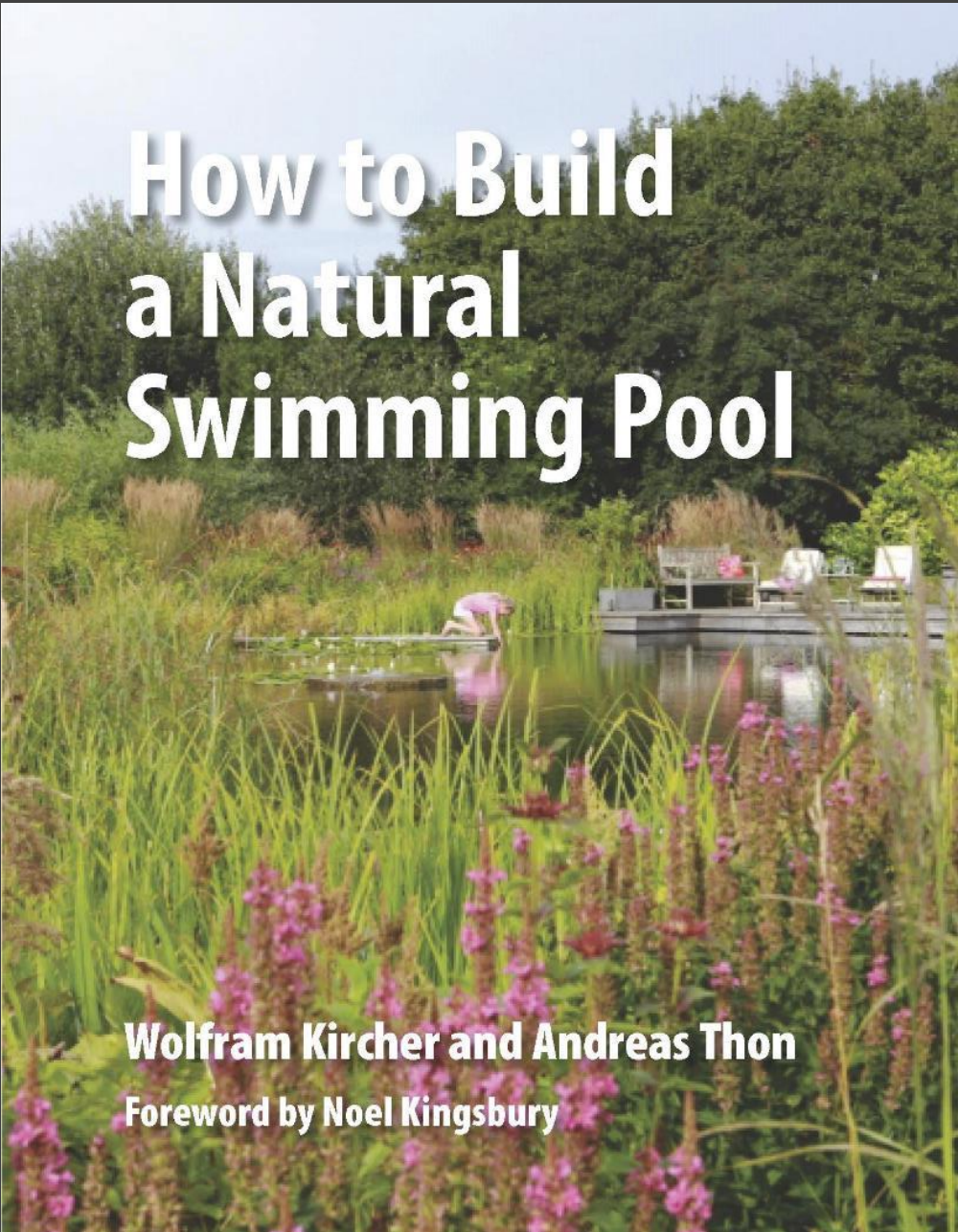


🌼 Wie und wo lässt sich C-Limitierung nachhaltig verwirklichen ?
How and where can C-limitation be realized sustainably?

🌼 Welche Auswirkungen auf die Wasserqualität haben Sphagnum-Bestände an Schwimmteichen langfristig ?
How do Sphagnum stocks influence the long term water quality?

🌼 Wie lassen sich Steingarten-Filter weiter optimieren ?
How to further optimize rock garden filters?

🌼 Wie lassen sich Lebende Wände oder Dachgärten als Filter einsetzen?
How to use Living Walls or Roof Gardens as filters for NSPs?

The book cover features a photograph of a natural swimming pool. In the foreground, there are tall green reeds and purple flowers. A person is swimming in the pool, which is surrounded by dense green trees and foliage. The title 'How to Build a Natural Swimming Pool' is written in large white letters across the top half of the image.

How to Build a Natural Swimming Pool

Wolfram Kircher and Andreas Thon

Foreword by Noel Kingsbury

Filtration principles and
NSP models

Construction, planting,
maintenance

*Published March 2016 by
Filbert Press, London*

available from [amazon.de](https://www.amazon.de)
and all good bookshops