Handling Sediment Transfer in Practice

Gaining from Sediments

9th International SedNet Conference
Krakow, Poland, 23.09.2015

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DB Sediments GmbH
Based on Environmental Know how

- Founded on 09.03.2009 in Duisburg, Germany
- Founders – experts each with more than 20 years of international utility background, project management, renewable energies
- Management experience, environmental leadership
- International research programs since 1994 (i.e. 5th EU FWP, …)
- Innovation Management
- Environmental Technology „Made in Germany“
- Headquarter at Tectrum – Technologie Zentrum
The German Water Partnership is a joint initiative of the German private and public sectors, combining commercial enterprises, government and non-government organizations, scientific institutions and water-related associations.

- Founded in April 2008, it has now 370 member companies
- Achieve international awareness of German excellence in water technology and water management
- Germany has more than 150 years of experience in successful water management. Efficiency in plant engineering, consulting and operation is complemented by unparalleled expertise in scientific research, education and training, and by high levels of institutional and administrative knowledge.
The environmental objectives that the Member States are required to achieve involve two obligations, namely to prevent deterioration of the status of all bodies of surface water (obligation to prevent deterioration) and to protect, enhance and restore all those bodies of water with the aim of achieving good status by the end of 2015 at the latest (obligation to enhance).
World Bank:
“The last century was used to build reservoirs. This one will be used to solve sediment problems.”
Global Water Storage Capacity
DAM CONSTRUCTION AND GLOBAL POPULATION

Source: Annandale, G. (2014) Sustainable WATER SUPPLY AND CLIMATE CHANGE
Global Water Storage Capacity

Increasing Loss

Global Risk Perception Survey
Environmental Risks are most likely and have highest impact

Environmental Risks, directly and indirectly related to sedimentation

- Water Crisis is number one!
- Extreme weather events
- Natural catastrophes
- Man-made environmental catastrophes
- Biodiversity loss and ecosystem collapse
- Climate change


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Value of Water Storage
Decreasingly falling without/stable with Sediment Management

Sustainable Investment

Current Paradigm

30 years

Time

Gregory L. Morris – personal communication

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DB Sediments:
“Sediment is not a problem. It is a challenge.”
Natural Water
The flow connects five natural elements
Sediment
Integral Part of every River

⇒ Any streaming water contains and transports sediment (upstream less, downstream more):
Use Water – Store Water
Impact to the river as an ecosystem

- Hydro Power
- Drinking Water
- Irrigation
- Retention
The Use of Water
Impact to the Ecosystem

There is more than water that “flows” in a river.
The reduction of velocity causes sedimentation and siltation.
The Two Sides of Sediment Within the Reservoir: Sediment Surplus

Sediment accumulation in reservoirs leads to:

- Reduced flood protection
- Reduced storage capacity for
  - hydro power peaking/seasonal storage
  - irrigation / drinking water supply
- Reduced biodiversity inside the reservoir
- Higher temperatures, less oxygen
- Methane emissions from impounded rivers
- WCD / ICOLD state that sedimentation in reservoirs exceeds the actual new build of reservoirs.
- Every year almost 1 % of worldwide storage volume is lost.
- 20 % of all reservoirs will be inoperable by 2050.

> sediment management is an urgent issue
The Two Sides of Sedimentation
Sediment Surplus upstream / Sediment Deficit downstream

Source: Lorke, Andreas (2013) Methanproduktion in Staustufen der Saar: https://www.youtube.com/watch?v=gW_LOHbff5Y
Problems without Sediment
Example: Sediment deficit River Rhine

Sedimentdeficit
D/NL-boarder:
about 2.500.000 t/a

Artificial adding of Sediments
about 230.000 t/a
Locks Iffezheim:
about 400.000 t/a

Adding Sediments is expensive


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Wave Dynamics
Qualitative Change with/without Sediment Transport
A river is an Eco-system
Sediments are an integral part of this system

Source: Global Water System Project
www.gwsp.org

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Sediment Deficit
Coast Erosion (e.g. Egypt,...)
Mississippi River System
Decoupling of water and sediment flows

Sediment Mismanagement
Death Threat to the Delta (eg Mississippi)

http://www.nola.com/speced/lastchance/multimedia/flashlandloss1.swf
The Two Sides of Sediment
Downstream: Sediment Deficit

**Missing sediment/changed morphology downstream of reservoirs cause:**

- Riverbed and bank erosion
- Foundation failure of civil hydro structures
- Agricultural substrate deficit
- Change of aquatic ecosystem
- Re-infiltration of saltwater into groundwater at river delta/coastline
- Coastline erosion

⇒ Replacement of missing sediment is costly (e.g. Colorado, Rhine)
Handling Sedimentation Issues
Current Ways and attempts to solve the problem

„Not doing anything“

Flushing

„Dig and Dump“

„Dredge, Spill, Dig and Dump“
Flushing of a Reservoir
Very inefficient and very expensive

ECONOMICAL LOSS: 6 Mio. $ per flushing!

source: URL: http://www.welt.de/wissenschaft/article1766616/Der_Grand_Canyon_wird_geflutet.html

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„Flushing“ and the sustainable Alternative
Langmannsperre, Austria, 2008-2009

Reservoir after "Flushing"

Very inefficient and very expensive

The sustainable alternative of DB Sediments®
ConSedTrans – Method
System Sensitive Solution - Continuous Transfer of Sediments

Specially equipped hydraulic tools in very different sizes and dimensions dredge the sediment from areas where the flow rate is too slow for natural sediment transport, pump it through a piping system and deposit it into areas where the flow rate is known and big enough for a quasi-natural transport of sediments into the downstream area of the river.
ConSedTrans – Method
Sustainable solution with production of renewable energy

The continuous transfer of sediments can be combined with the optimized regeneration of renewable energy.

Source: DB Sediments (2014); WGZ Bank (2012); www.wgzbank.de; http://tinyurl.com/pbggxk4
Businessplan Example

Overcome Dig&Dump Method

ConSedTrans - Management

- Digging: twice, every 10 years
- Costs about 2.6 to 3.0 Mio. Euro

Problem, shortly after digging, the reservoir is continuing filling again

- Continuing transfer
- cost about 1.5 Mio. Euro (distributed over 20 years)

Always 100 % of the reservoir capacity/no outage
Savings of about 50 % of direct costs
**Business Case (small case)**  
*Compare: common and sustainable approach*

- **Common approach:**
  - Clearing of the reservoirs
  - Necessary every 10 years
  - Costs: about 1.2 to 1.5 Mio. Euro

- **ConSedTrans – Approach of DB Sediments®**
  - Costs of continuous transfer:
    - Installation: 0.2 – 0.3 Mio. Euro
    - Operation & Maintainance: 0.06 Mio. Euro/a
Olsberg Reservoir (Germany)
Suitable equipment
System Sensitive Solution

- automated vessel size 1

- Electric driven dredge vessel
  - depth up to up to more than 40 m

- dredge vessel size 2

  - diesel driven
  - depth up to 15 m

- Larger/other/additional and customized equipment upon request:
  - electric or diesel driven
  - dredging depth up more than 200 m
  - unlimited capacity and/or sediment transfer range
Risk Analysis
Existing and Projected Dams

- Assessment of the original storage volume
  - by processing of the original layout of the reservoir

- Determination of
  - the lost, silted or sedimented volume of the reservoir,
  - the silting rate of the dam,
  - and
  - the estimation of the probable dam life,
  - under consideration of the necessary operational range of the reservoir.

- Furthermore, an analysis will comprise
  - possible consequences, like the blockage of the bottom outlet of the dams by sliding sediments and
  - risk of flooding caused by the reduction of the retention volume of the reservoir.
Roseau Reservoir St. Lucia
Risk Analysis / Rehabilitation Dam/Reservoir
Nurek Dam, Tajikistan
Site, Sediment transport
The new process spends multiple benefit.

- **Positive operational and economical effects:**
  - The reservoir can be used completely again.
  - Avoidance of enormous dump costs and/or
  - Avoidance of generation losses.
  - Reduction of flood risk
  - Sediments in the river will reduce erosion and keep ports “on level”
  - Navigation needs proper and continuous sediment management
Continuous Sediment transfer
... is fish friendly

- Stretches of coarse sediment is important for fish requiring spawning gravel (z. B. greyling, trout).
- Reservoir flushing / sluicing will severely affect spawning gravel.
- Continuous Sediment Transfer restores a near nature sediment ratio (load/time)

**Nature shows certain variation on sediment load, too.**

Image source: Biologische Station Siegen-Wittgenstein

riverbed gravel (Interstitial)
The new process spends multiple benefit

- Positive environmental effects:
  - The process restores (and improves) natural river morphology.
  - Sediment “in Flow”.
  - It is environmentally and fish friendly.
  - Keep quality and level of groundwater.
  - Biodiversity in the river and in the coastal areas of the oceans.
Holistic Solution with SECO – Benefits
Multidimensional Benefits

- Social
- Environmental
- Commercial
- Operational
River Rehabilitation
Identify problem (i.e. Forggensee, Lech) and monitor solution

DB Sediments Customers

RWE  giz  kfw

Vorarlberger Illwerke AG  Schluchseeewerk

Mülheim an der Ruhr  WMR

Heilenbecke Wasserverband

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DB Sediments Partners

... and many others
Awards and Recognitions
Leading Global Sustainable Technology

• ** Picture left: Nomination Innovationspreis der Deutschen Wirtschaft 2015
Final Remarks

• Dramatic developing decrease of global storage capacity for water

• The River is an Ecosystem - Sediments are an important part of the system

• Proper Flood Management needs Proper Sediment Management

• There is an urgent need for a holistic sediment management in rivers and reservoirs

• The ConSedTrans- Method can contribute to handle the risk of sedimentation and siltation, flooding, soil and coast erosion, and saltation of groundwater

• Continuous sediment management brings Rivers back to balance and saves enormous costs
If you consider sediment transfer to be costly – try siltation.
“If you cut the transport of sediment in a river – you kill life in the river, as well as in the delta area of the river in the ocean”.

Juan Pablo Orrego Silva, Alternative Nobel Prize Winner, Bonn, Germany, 15.11.2011, referring to studies of Hucke-Gaete, Viddi and Bello, 2006