

A Survey of Current Approaches to Contaminated Sediment Remediation in Various Countries

SedNet Meeting
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Imagine the result

Observation: Awareness of Contaminated sediments is Growing.

- More countries publish standards every year
- Waterfront redevelopment is occurring rapidly in many areas
- Other environmental media more controlled

History

- The relationship between sediment contamination and human disease was recognized as early as 1956 when mercury poisoning from the ingestion of contaminated fish and shellfish was identified as the source of Minamata Disease.
- Observations that in spite of dramatic improvements in water quality, there were still significant problems in benthic and epibenthic ecology which began to surface in the late 1970s.
- The research of Varanasi, Malins, and others and others clearly established the link between sediment contamination and lesions and other abnormalities in fish.

Method

- Internet search for “country + contaminated sediment
- Looked at 192 UN Member States plus Kosovo, Palestine, Taiwan, and The Vatican

Results

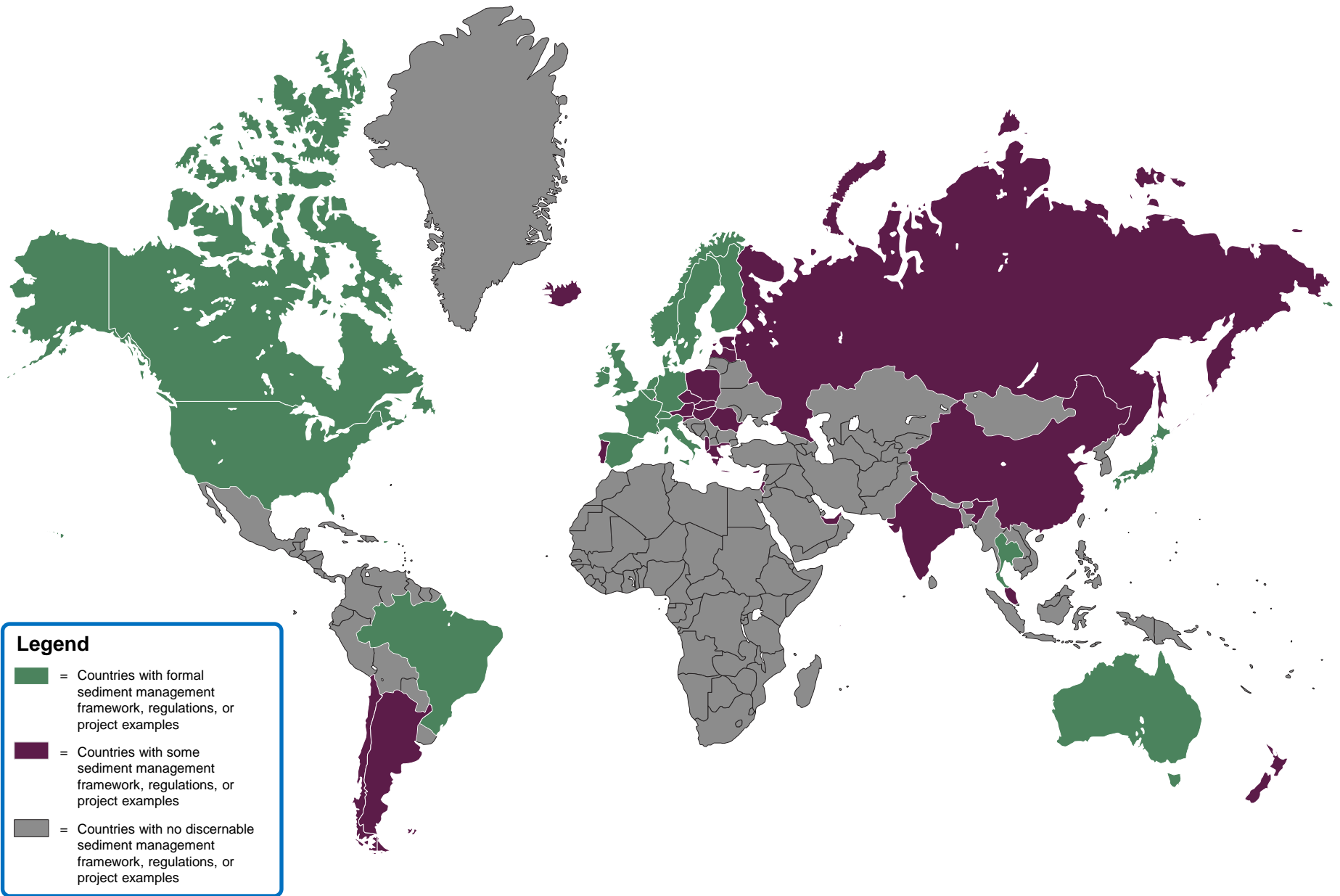
- Range from 239,000 (USA) to 1,490 (Andorra)
- 6,000 appears to be “noise”

Table 1

The state of contaminated sediment issues around the world in 2010

Country	Regulatory Framework	Scientific Framework	Technologies Employed ¹	Search Result	References
United States of America	Yes	Yes	d, c, nr, ss, sp, it, et, b	239000	Linkov 2006
Canada	Yes	Yes	d, c, nr, ss, sp, it, et	133000	Canadian Council of Ministers of the Environment 1999, 2001, Sydney Tar Ponds Agency 2010
United Kingdom	Yes		d, c	106000	Brewer 1997
Germany	Yes	Yes	d, c, ss, l, sp, it, et, b	85400	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety 1998, Löser 2001
China (PRC)	Unknown	Yes	d	76900	Liu 1999, Chen 2007
Japan	Yes	Yes	d, c, ss, sp, it, et	74800	Ministry of the Environment - Japan 1994, Hosokawa 1993
Australia	Yes	Yes	d	70700	National Working Party on Acid Sulfate Soils 2000, Guerin 2001, Rae 2006
Netherlands	Yes	Yes	d, c, nr, ss, l, sp, it, et, b	67900	Ministry of Housing, Spatial Planning and the Environment 1998, 2009
France	Yes	Yes	d, c	65000	Poirier 2007
India	Unknown	Yes	Unknown	44500	Jumbe 2009
Italy	Yes	Yes	d, c, l	44300	Carere 2008
Spain	Yes	Yes	d	42800	Garg 2009
Sweden	Yes	Yes	d, c, it, et, b	42400	Hultsfreds 2010, Turingen 2003
New Zealand	Yes	Unknown	Unknown	35700	Ministry of the Environment - New Zealand 2009, 2010
Russia	Unknown	Yes	d, c	34100	Koukina 2003
Switzerland	Yes	Yes	d	33800	Wildi 2004
Brazil	Yes	Yes	d	31700	Amorim 2007
Belgium	Yes	Yes	d, c, nr, ss, l, sp, it, et, b	27200	Vervaeke 2003
Norway	Yes	Yes	d, c, ss	26800	Norwegian Council on Contaminated Sediments 2006, Barton 2008
Denmark	Yes	Yes	d, c, ss	26600	Sear 1996
Poland	Yes	Yes	Unknown	25200	Aleksander-Kwaterczak 2008, Kuperberg 2001
Ireland	Yes	Yes	Unknown	21500	Environmental Protection Agency - Ireland 2008, Brogan 2002, Jarvis 2006
Greece	Yes	Unknown	Unknown	19200	
Chile	Unknown	Yes	Unknown	19000	Godoy-Fáunderz 2008
Finland	Yes	Yes	d, c, ss, sp	18400	Ministry of the Environment - Finland 2008, Londesborough 2005, Dauvalter 2006
Austria	Yes	Yes	Unknown	18100	Liska 2008
Portugal	Yes	Unknown	d	18100	
Argentina	Unknown	Yes	d	17400	Andrade 2002, Ronco 2008
Thailand	Yes	Yes	d	17000	Panichayapichet 2006
Israel	Unknown	Unknown	d	16600	
Malaysia	Unknown	Yes	Unknown	14000	Praveena 2007
Czech Republic	Yes	Unknown	Unknown	11900	
Hungary	Yes	Unknown	Unknown	11800	
Romania	Yes	Unknown	Unknown	11000	
Iceland	Yes	Unknown	Unknown	8510	
Slovakia	Yes	Yes	Unknown	7970	Aptiz 2006
Slovenia	Yes	Unknown	Unknown	6810	
Estonia	Yes	Unknown	Unknown	6250	
Luxembourg	Yes	Unknown	Unknown	5790	
Cyprus	Yes	Unknown	Unknown	5650	
Malta	Yes	Unknown	Unknown	5050	
United Arab Emirates	Unknown	Yes	Unknown	5050	El-Sammak 2001
Latvia	Yes	Unknown	Unknown	4670	
Albania	Unknown	Yes	Unknown	4370	Çelo 2004
Seychelles	Yes	Unknown	Unknown	3190	National Assembly 1994

1Abbreviation Definitions	
b	Bioremediation
et	Ex-Situ Remediation
it	In-Situ Remediation
d	Dredging
c	Capping
nr	Natural Resources
ss	Stabilization/Solidification
l	Lagooning
sp	Sediment Processing



Contaminated Sediment Screening Levels

Almost 30 countries, regions, or states have some type of published guidelines

- Australia
- Belgium
- Brazil
- Canada
 - British Columbia
 - Quebec
 - Ontario
- Finland
- France
- Germany
- Hong Kong
- Italy
- Japan
- Netherlands
- Norway
- Spain
- Sweden
- United Kingdom
- United States
 - Florida
 - Massachusetts
 - New Jersey
 - New York
 - Oregon
 - Texas
 - Washington
 - Wisconsin

Select a Framework Select an Approach Select a Technology

- Sediment as waste
- Sediment as soil
- Sediment as water
- Sediment as resource
- Sediment as habitat
- Sediment as sediment

- Intervention value
- Risk assessment
- Equilibrium partitioning
- Pore water chemistry
- Triad
- Weight of evidence
- Inventory reduction
- Something new?

- Source Control
- Institutional controls
- Monitored natural recovery
- Enhanced natural recovery
- Capping in place
- Dredging and confined disposal
- Dredging and treatment
- In-situ treatment
- Beneficial reuse

Unfortunate Realities

- Legislation – are we required to address the issue?
 - The WFD and Superfund are essentially vague as to sediments
- Risk Assessment – can science afford us an acceptable path?
 - Yes, if the circumstances and time allow
- Unfortunately, legislation and risk assessment do not always show a clear path forward. So....
 - Political expedient
 - Social tradeoff
 - Economic motivation

Toolbox Management Approach ?

- Technologies can be applied in combination so that the approach for a given sediment management unit is commensurate with the risk
- When remediation is necessary, consider the full range of risk-based options



Advice for Countries Considering Regulations for Managing Contaminated Sediments

- Identify the risks to human health and the environment
- Propose actions based on risk, which will be more effective and more cost-effective
- Take landscape and other factors into account
- Use an array of management approaches commensurate with individual risks
- Avoid a poorly conceived, one-size-fits-all solution
- Identify and control sources
- Take people and their communities into account

Advice to Those Who Will be Regulated: Be Engaged and Aware

- The array of legislation implies future scrutiny for dredging projects in general and especially contaminated sediments
- Emphasis on managing contaminated sediments will only increase
- Scrutiny of contaminated sediment problems is on the increase worldwide
- In some parts of the world, under-regulation is a concern and stewardship depends on corporate, not regulatory, risk management
- In other places, over-regulation is customary and stewardship demands presenting regulators, NGOs, and other stakeholders with the systems view of the risks (as opposed to simple chemical thresholds)
- Assess and mitigate the impact of contaminated sediments on both the environment and your business enterprise
- Uncertainty is not an effective strategy
- Taking action will reduce uncertainty

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Imagine the result