

The Economic Value of Establishing Freedom Space for Rivers:

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5th International Conference on Natural Channel Systems
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a) What is Freedom Space?
b) How is it Economical?

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Climate Change Driver for Sustainable Management

COMPLETED PROJECT

FREEDOM SPACE: AN INTEGRATED RIVER MANAGEMENT APPROACH FOR DEALING WITH CLIMATE CHANGE

OURANOS

VULNERABILITIES, IMPACTS AND ADAPTATION PROGRAM / WATER RESOURCES

PROJECT START AND END DATES
FEBRUARY 2011 - JULY 2013

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CONTEXT
Climate change will bring more frequent floods and more severe low water levels, which will pose a threat to public safety and alter the condition of river ecosystems. The freedom space concept relies on using the hydrogeomorphology of rivers to manage the entire river corridor. The goal is to identify areas where the river is prone to flooding or to shift paths, and let these processes occur instead of forcing the river into a path shaped by human interventions. This approach seems promising for sustainable development under the current climate and also in a changing climate, because it maintains the natural physical functions of the rivers (transporting water and sediment) while at the same time it improves the functions of ecosystems and provides ecological services. Ultimately, this helps increase the resilience of the entire river ecosystem.

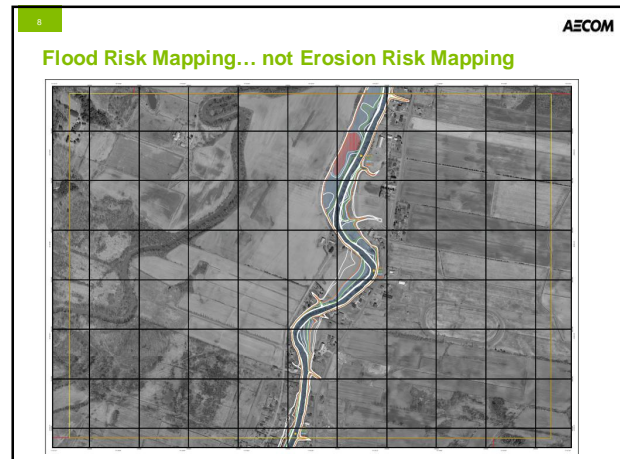
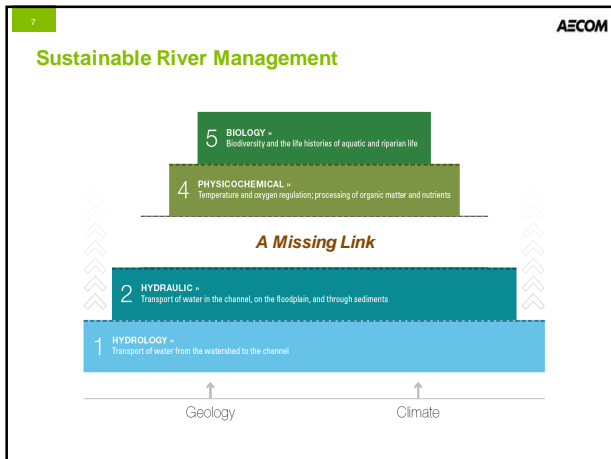
Logos: Concordia, UQAR, UQAM




Historic approach was not/ is not sustainable

Figure 2: Aerial photographs of the residential reach in a) 1952, b) 1964 and c) 2006. River is from left to right.

Rousseau & Biron (2009)



9 **River Management Around the World** AECOM

ROOM FOR THE RIVER
Netherlands

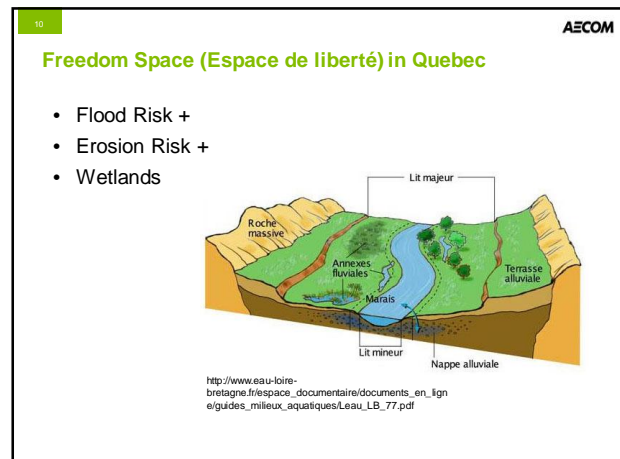
Making space for water
Taking forward a new Government strategy for flood and coastal erosion risk management in England
UK

And more recently erosion...

Un espace de liberté pour l'Allier
France

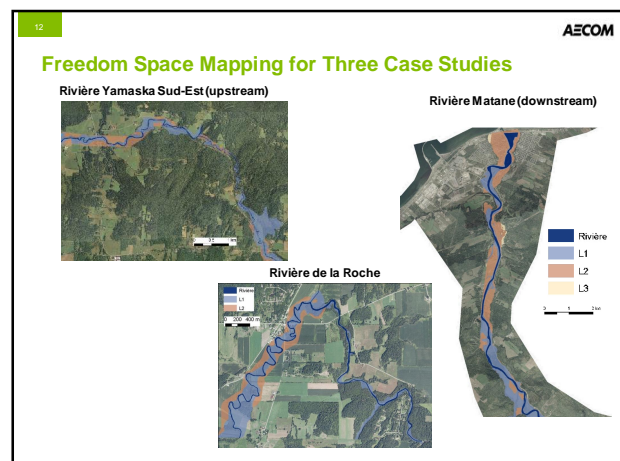
Fluvial territory
Spain

Alternatives for River Corridor Management
Forward 2010 River Management Program
Vermont



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- L1 (Minimal Level):**
 - Frequent flooding AND/OR
 - At risk of erosion based on observed and extrapolated bank erosion AND/OR
 - Riparian wetlands
- L2 (Functional Level):**
 - Frequent flooding AND/OR
 - At risk of long-term erosion, based on the meander belt width
- L3 (Rare Level):**
 - Rare floods with minor erosion risk






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Cost-Benefit Analysis

- 50 Years
- Discount Rate of 4% *Sensitivity analysis with rates of 2% et 6%*
- Based on Freedom Space Level L1 (Minimal Level)

Costs	Vs Benefits
<ul style="list-style-type: none"> • Loss of right of construction • Loss of right of cultivation 	<ul style="list-style-type: none"> • Reduced bank protection costs • Reduced damages caused by flooding • Wetland protection • Enhanced riparian zone



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Costs: Loss of Right of Construction


- Future construction only
- Urban areas:
 - Ø Yamaska Sud-Est: Cowanville, Lac Brome, Brome et Sutton
 - Ø de la Roche: Saint-Armand;
 - Ø Matane: St-René-de-Matane et Matane
- Median value of land:
 - Ø 122 400\$/ha (Yamaska Sud-Est et de la Roche);
 - Ø 17 500\$/ha (Matane)

Sensitivity analysis of 50% and 75% lower cost

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Costs: Loss of Right of Cultivation

- Calculated based on the concept of « easements » used in Vermont
- Forbidden to protect banks, fill or dredge the river.




Ø Yamaska Sud-Est and de la Roche: 3200\$/ha
Ø Matane: 755\$/ha

Ø Sensitivity Analysis (6400\$ et 1510\$/ha)

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Benefits: Reduced Bank Protection Costs

- Bank protection broadly estimated at 500\$/m
 - Based on data from local municipality (MRC Brome-Missisquoi) and consultant experience.
- Maintenance of **existing** protection not required.
- Additional **future** protection avoided in zones of active erosion.




Rivière Matane: Protection typical in the region of Gaspésie

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Benefits: Reduced Damages Caused by Flooding

- Reduction of damages caused to **agricultural crops** taken out of the freedom space (no further need to insure harvests in these zones).
- Value based on statistics from Financière Agricole du Québec (2012).
- Potential reduction of damages in **urban** areas not taken into account (no expropriation).

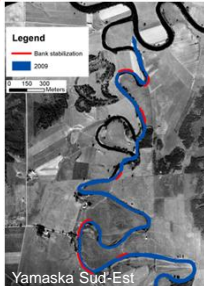


Rivière Yamachiche: Corn without riparian buffer zone

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Benefits: Wetland Ecosystem Services

- Creation of new wetlands (meander cut-offs, ox-bows) over 50 years (2% of value per year) in the freedom space.
- Sensitivity analysis for over 25 years (4% par year)
- Services:
 - Ø Buffer to regulated water levels (flood and drought)
 - Ø Filtration of sediments
 - Ø Biodiversity
- Value from He et al. (2013) on the Yamaska basin: 5,590\$/ha/yr adjusted for Matane to 4,950\$/ha/yr




Yamaska Sud-Est

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Benefits: Riparian Zone Ecosystem Services

- Current width of 3 m increased to 15 m on each bank.
- Services:
 - Ø Water quality (filtration of sediments, temperature)
 - Ø Pollinisation
 - Ø Regulation of floods
 - Ø Reduced soil erosion
 - Ø Biodiversity
- Value Transfer from Batker & Schmidt (2012) in Oregon.
- Used lower value – carbon storage, aesthetic and recreative benefits not included.
 - 958\$/ha - Yamaska Sud-Est et de la Roche,
 - 908\$/ha - Matane



YamaskaDaily

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Findings of the Cost-Benefit Analysis

Type	Catégorie	Valeur (\$ CAD)	
Rivière Yamaska Sud-Est	Partie de droit de construction	-2 913 120	
	Partie de droit de culture	-1 453 832	
	Réductions des coûts de protection – mesures additionnelles	3 269 000	
	Réductions des coûts de protection – mesures existantes	589 260	
	Avantages	142 703	
Rivière De La Roche	Augmentation de la superficie des milieux humides	1 499 615	
	Création d'une bande riveraine de 15 m	27 755 263	
	Total	27 755 263	
	Rivière Matane	Partie de droit de construction	-183 600
		Partie de droit de culture	-115 959
Réductions des coûts de protection – mesures additionnelles		706 487	
Réductions des coûts de protection – mesures existantes		42 676	
Avantages		11 296	
Rivière Matane	Augmentation de la superficie des milieux humides	57 848	
	Création d'une bande riveraine de 15 m	224 567	
	Total	3 953 963	

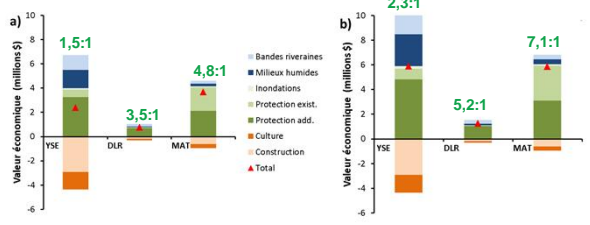
+2,4 million \$

+0,7 million \$

+3,7 million \$

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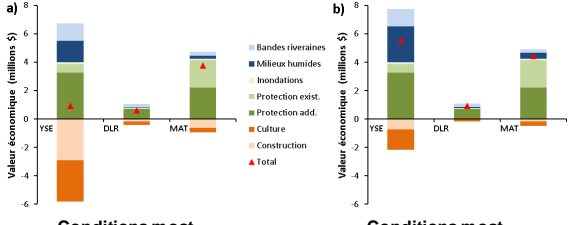
Findings of the Cost-Benefit Analysis



Discount rate 2% (preferable to take into account ecosystem services that occur on a long-term basis)

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Sensitivity Analyses

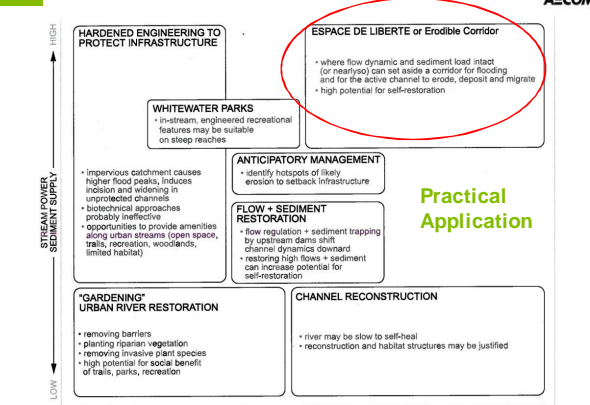


Conditions most unfavourable to Freedom Space approach

Conditions most favourable to Freedom Space approach

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Practical Application



Source: Kundolf (2011)

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Key Messages

- Sustainable river management in Quebec must take into account **natural geomorphological processes**.
- **Zones at risk of erosion** should be incorporated into fluvial risk maps.
- The freedom space approach defines the **minimal and functional space** required to maintain river integrity.
- Cost-benefit analysis has demonstrated that establishment of at least the minimal freedom space is **economically of benefit** to society in the long-term.

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Freedom Space for Rivers: A win-win approach!

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