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Cost and Benefits of Reducing Nutrients in Lake Winnipeg: Using an ecological goods and services approach

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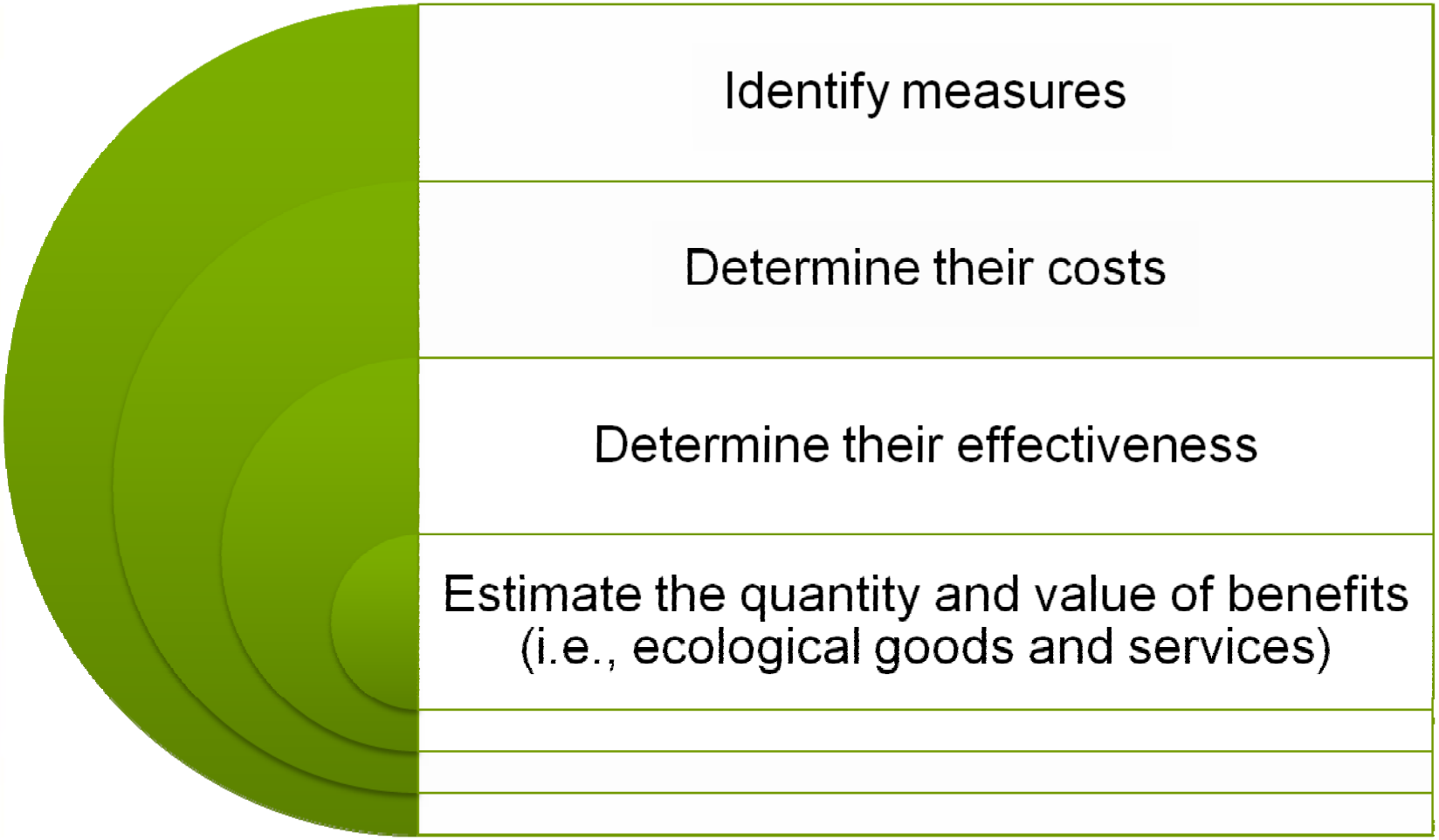
Introduction

- Eutrophication of Lake Winnipeg is a major concern
- Excess nutrients contribute to the development of blue-green algae
- Results in economic and health impacts

- Various sources of nutrients (point and non-point sources) = Many possible measures to reduce nutrients
- Need an approach to assess the measures based on their costs and benefits

Approach to assessing measures



Identify measures

Measure	Scenario
Nutrient Management	Applied in all crop land in study area watersheds
Crop Selection	Applied in 5% of crop land in study area
Conservation Tillage	Not assessed further since assume P increases
Vegetated Filter Strips	Apply in 1.5% of crop land in study area.
Surface Water Control Structures (i.e. Dams)	Applies to 3% of study area. Assume 1 structure per section (640 acres) = 128 structures total

Determine costs

- The costs of adopting the measures are primarily private costs

Costs	Value	Units
Opportunity cost of crop production	$9.23	$/ha/yr
Manure treatment and transport	$36,340,000	$/year
Reduced fertilizer requirement	$526 - $1,500	$/tonne
Capital costs (dams)	$12,587	$/structure
Seeding costs	$41.16	$/ha/yr

Determine effectiveness of measures

- What is the effectiveness of BMPs in reducing phosphorus?

Relative Export Coefficients for Phosphorus from Agricultural Land to Surface Waters in Manitoba (BMP/no-BMP)

BMP	Low	Main	High
Nutrient Management	0.84	**0.94**	0.95
Crop Selection	0.90	**0.95**	1.00
Conservation Tillage	0.50	**1.12**	3.00
Vegetated Filter Strips (In-field)	0.90	**0.95**	1.00
Vegetated Filter Strips (Riparian)	0.80	**0.90**	1.10
Surface Water Control Structures (In-field)	0.85	**0.95**	1.00
Surface Water Control Structures (Headwater)	0.88	**0.90**	1.00

Ecological Goods and Services

- Healthy ecosystems are the foundation of healthy economies. To develop policies and programs that ensure the viability of ecosystems while supporting sustainable development and the needs of human societies we must document:
  - The functional benefits of EG&S to society, and
  - The economic value of EG&S to society

- **Key Principles**
  - Identify EG&S
  - Measure EG&S in biophysical terms
  - Value EG&S (both market and non-market values)

Estimate EG&S

Ecological Goods and Services Related to Nutrient Management Strategies in the Lake Winnipeg Basin

Economic Benefits from Potential EG&S	Nutrient Management	Crop Selection	Vegetated Filter Strips	Surface Water Control Structures	Constructed Wetlands
Maintain water quality	X	X	X	X	X
Regulate water cycle (flood control)		X	X	X	X
Maintain good quality soil	X	X	X	X	
Provision of terrestrial & aquatic habitat		X	X		X
Maintain biodiversity	X	X	X		X
Carbon sequestration and/or reduction of GHGs	X	X	X		X
Provision of aesthetic landscapes		X	X		X

Estimate EG&S

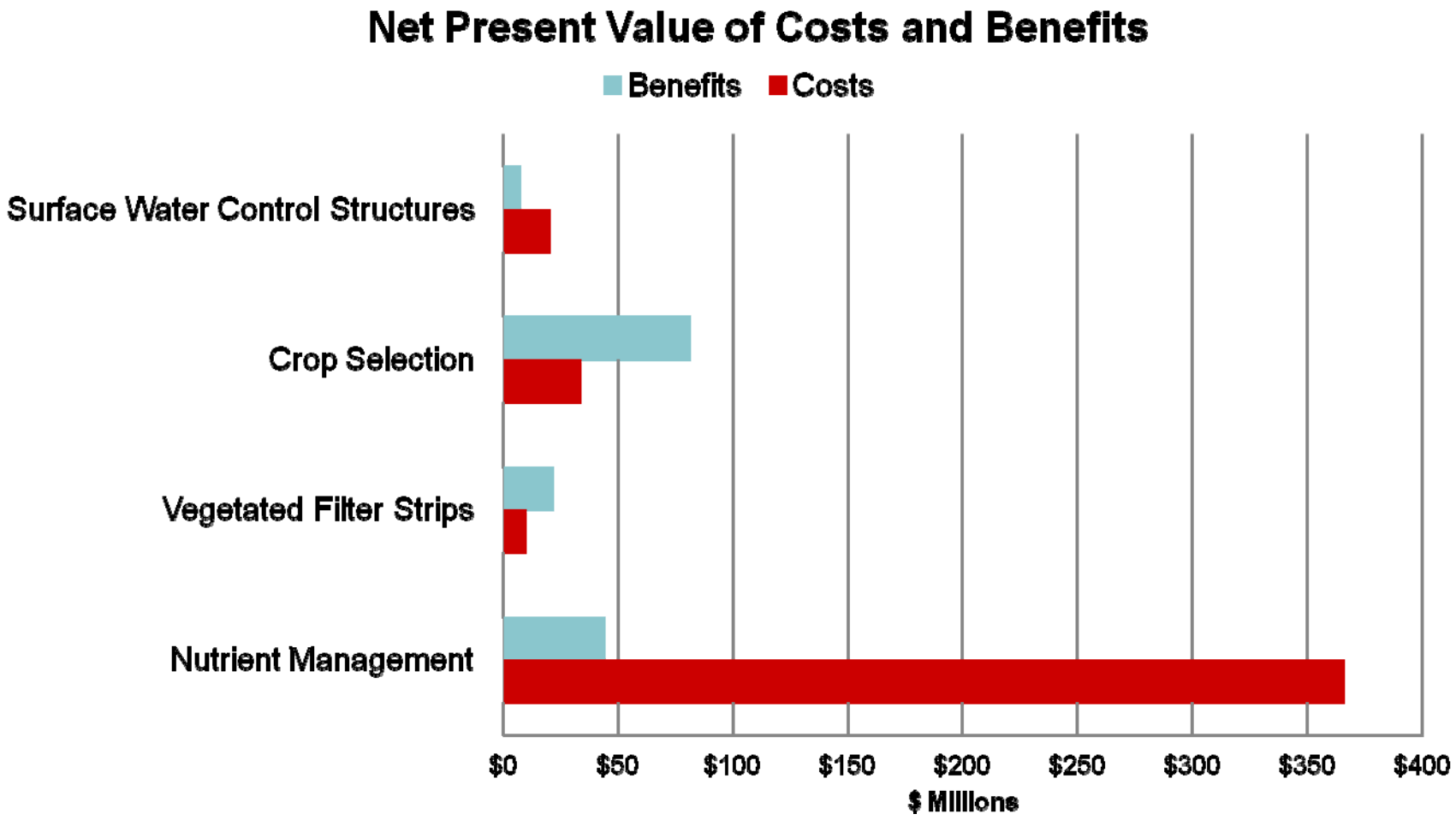
Ecological Good or Service	Value	Units
Phosphorus reduction	Not monetized	tonnes
Carbon sequestration	$25	$/tonne CO2e
GHG emission reduction	$25	$/tonne CO2e
Nitrogen reduction	$526 - $1,500	$/tonne
Soil erosion control	$0.25 - $2.21	$/ha/yr
Pollination	$127.06	$/ha/yr
Wildlife habitat	$2.83 - $6.65	$/ha/yr

Method

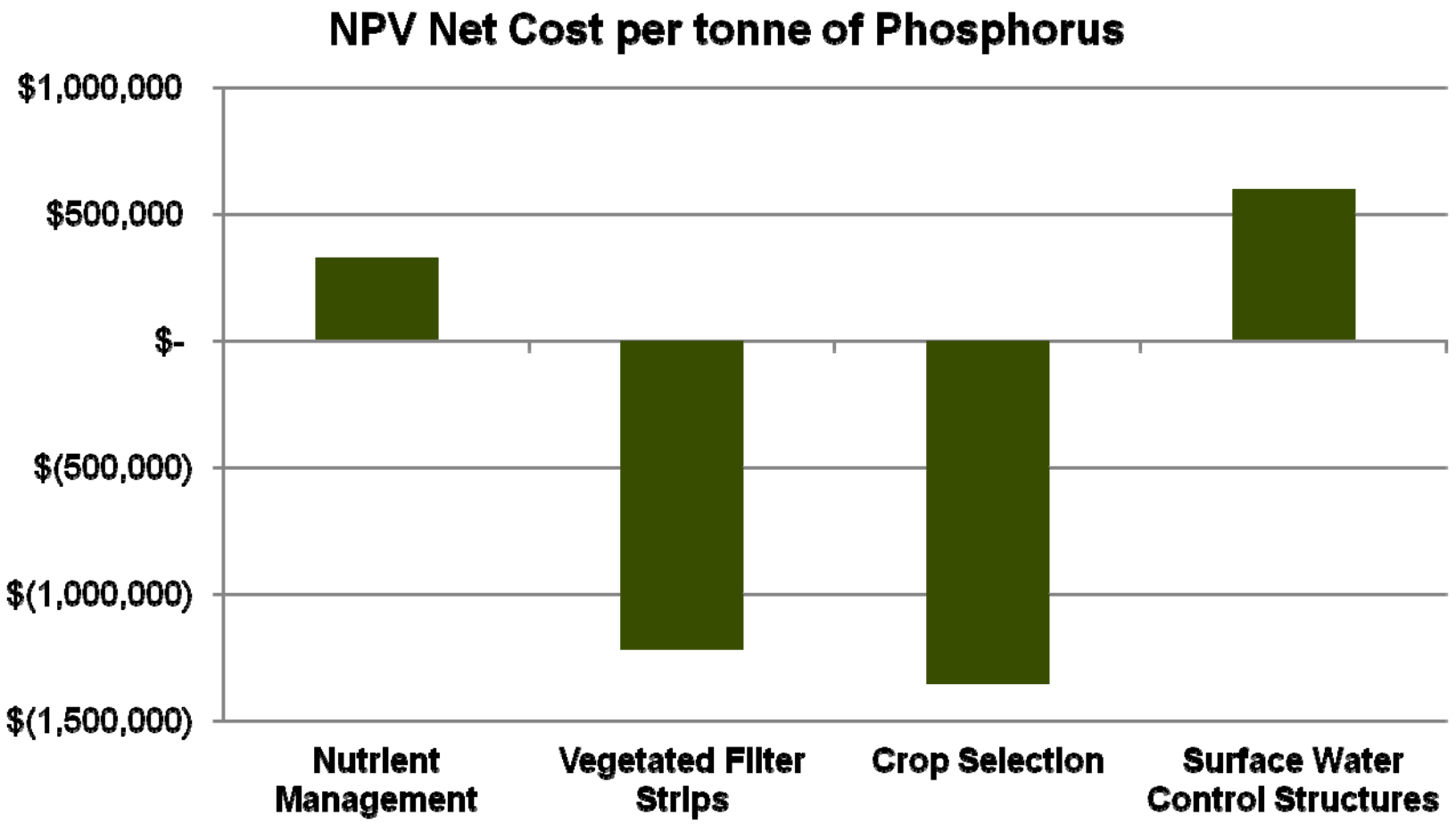
- What is the net cost per tonne of phosphorus reduction over time?
- Adjusted cost-effectiveness of phosphorus reduction
  - Adjusted to reflect EG&S co-benefits
  - Discounted (i = 3%)

$$\text{NPV of P-reduction} = \frac{\sum_{t=0}^{n}\left[(costs_t - benefits_t)/(1+i)^t\right]}{\sum_{t=0}^{n}\left[(tonnes\ of\ P\text{-}reduction_t)/(1+i)^t\right]}$$

Preliminary Results



Preliminary Results



Next steps / Improvements

- Validate assumptions
  - BMP scenarios
  - Costs of BMPs
  - Values of EG&S
- Synthesis Report – Spring 2012
- BMPs are not adopted in isolation; need to examine a **portfolio** approach
  - Implement a suite of BMPs
  - Balance overall costs and benefits to society for optimal policy
  - Cost curves

Conclusions

- Proof-of-concept that we can build upon
- Designed an approach for assessing environmental policy options that consider EG&S
- Significant gaps exist
  - Science: nutrient transport, effectiveness of BMPs, provision of EG&S
  - Economics: values of EG&S (especially phosphorus reduction)

Thank you

Comments, questions?

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