Part II. What benefits does the concept of ecosystem services offer to law, policy, and management of natural resources?

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natural capital PROJECT
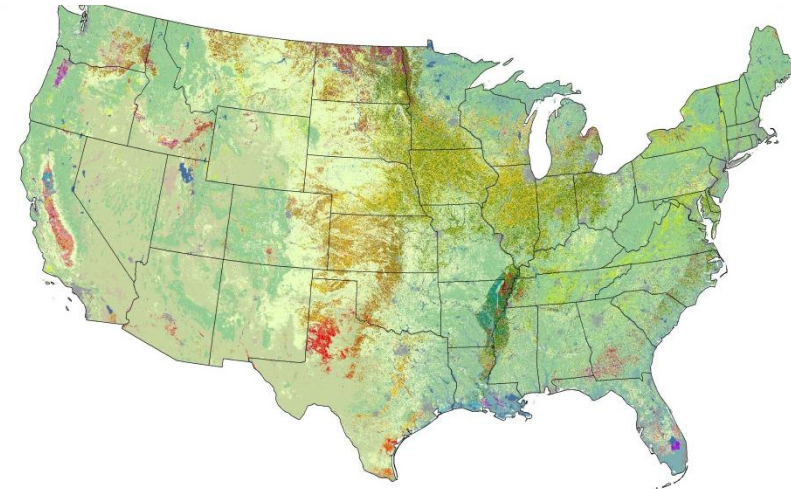
INSTITUTE ON THE ENVIRONMENT
UNIVERSITY OF MINNESOTA
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Low water in lakes, wells, aquifers surrounding Twin Cities could be big problem

By John Brewer
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Land Cover Categories (by decreasing acreage)

Agriculture
- Pasture/Grass
- Corn
- Soybeans
- All Wheat
- Other Hays
- Fallow/Idle Cropland
- Alfalfa
- Cotton
- Other Crops
- Sorghum
- Vegetables/Fruits/Nuts
- Other Small Grains
- Rice

Non-Agriculture
- Woodland
- Shrubland
- Urban/Developed
- Wetlands
- Water
- Barren
- Perennial Ice/Snow

Groundwater irrigation boom

The past five years have seen an increase in permits to water crops with water from underground.
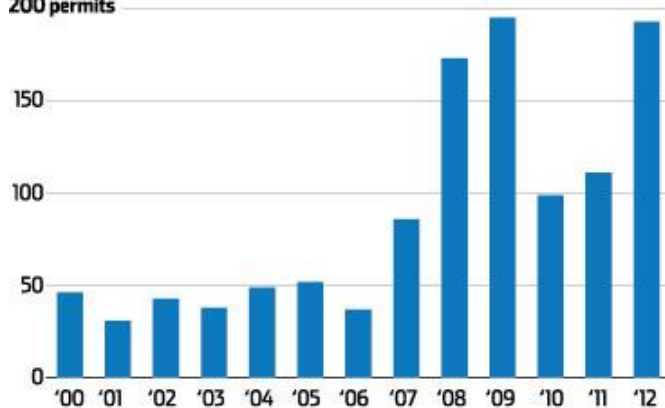
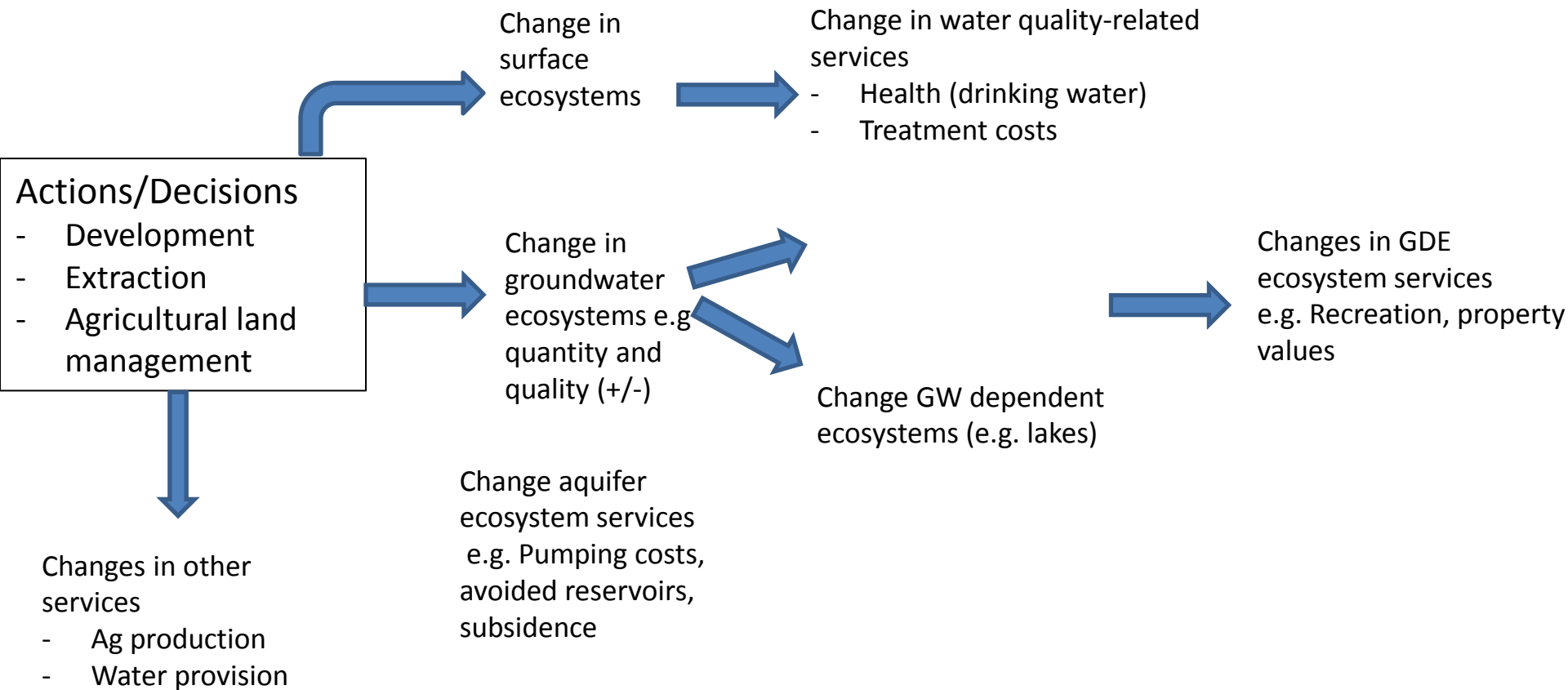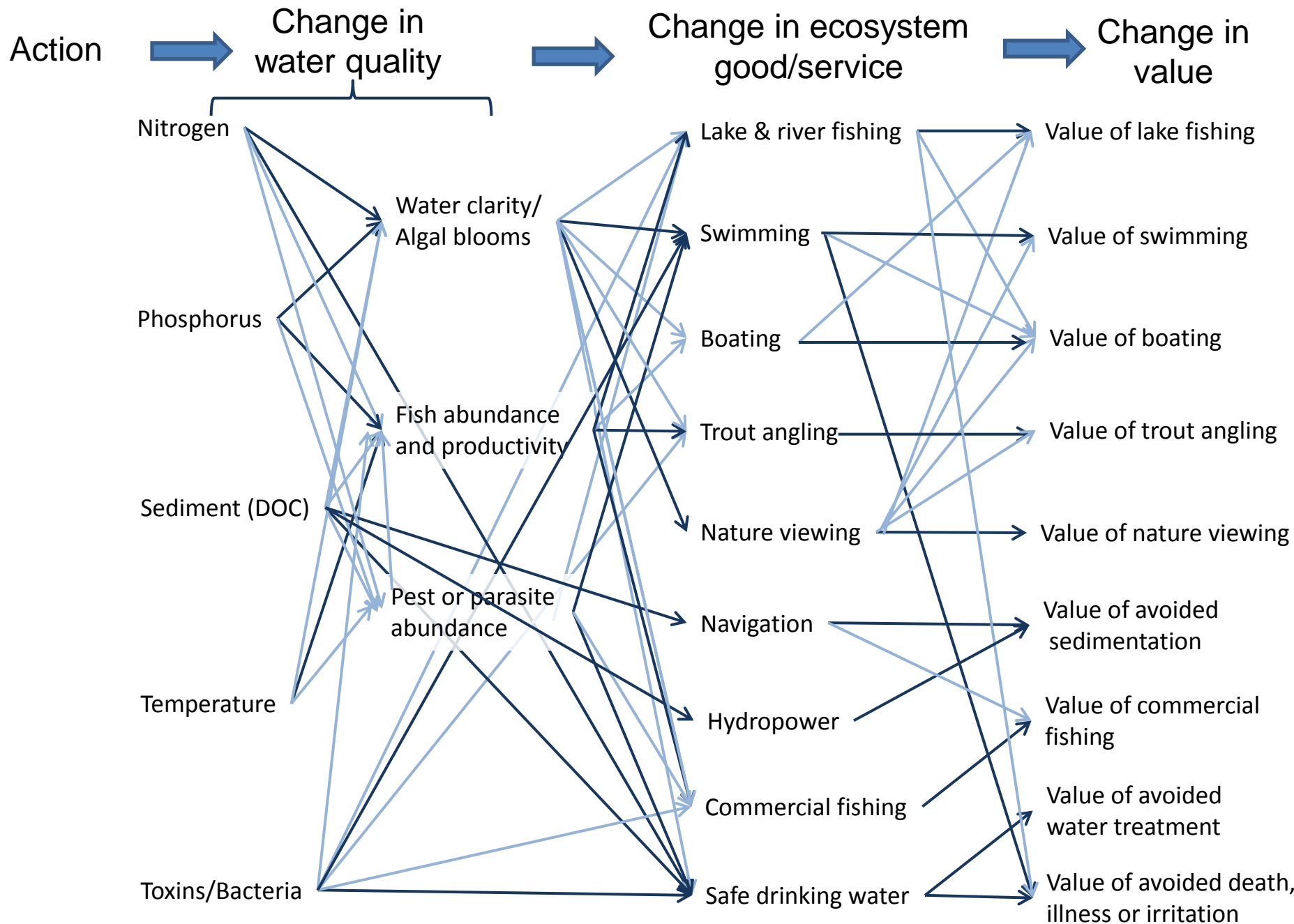Source: Minnesota Department of Natural Resources   PIONEER PRESS

Groundwater-related ecosystem services

Change in surface ecosystems

Change in water quality-related services
- Health (drinking water)
- Treatment costs

Actions/Decisions
- Development
- Extraction
- Agricultural land management

Change in groundwater ecosystems e.g quantity and quality (+/-)

Changes in GDE ecosystem services e.g. Recreation, property values

Change GW dependent ecosystems (e.g. lakes)

Change aquifer ecosystem services e.g. Pumping costs, avoided reservoirs, subsidence

Changes in other services
- Ag production
- Water provision

Action → Change in water quality → Change in ecosystem good/service → Change in value

Keeler et al. PNAS 2012

Biophysical Modeling **Economic Modeling**

Ecosystem Service	Change in Constituent	Endpoint	Change in Valued Attribute	Beneficiaries	Valuation Approach

Biophysical Modeling   **Economic Modeling**

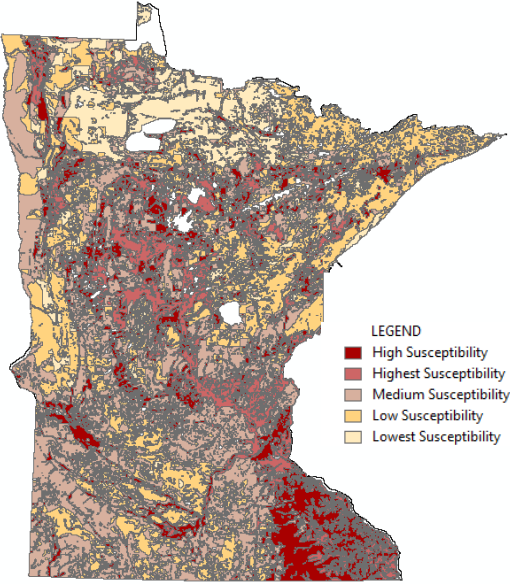| Ecosystem Service	Change in Constituent	Endpoint	Change in Valued Attribute	Beneficiaries	Valuation Approach
Lake recreation	P	Lakes	Water clarity	Lake recreationists Lakeshore property owners	Recreational demand model Willingness to pay for recreation Hedonic pricing

Keeler et al. PNAS 2012

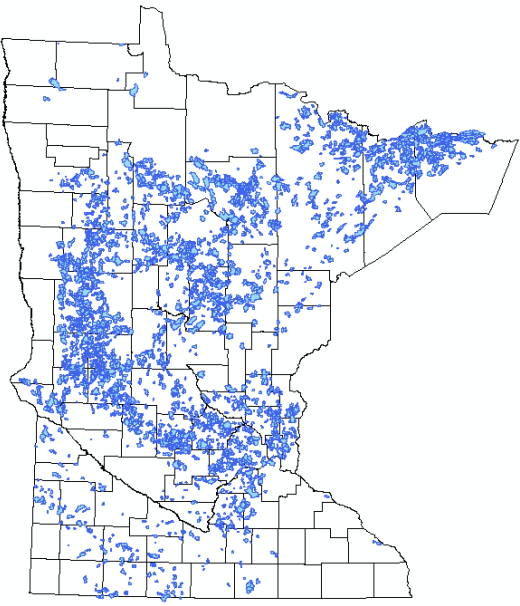|	**Biophysical Modeling**			**Economic Modeling**	
Ecosystem Service	**Change in Constituent**	**Endpoint**	**Change in Valued Attribute**	**Beneficiaries**	**Valuation Approach**
Lake recreation	P	Lakes	Water clarity	Lake recreationists Lakeshore property owners	Recreational demand model Willingness to pay for recreation Hedonic pricing **+**
Clean drinking water	N	Sourcewater treatment facilities	[Nitrate] above 10ppm	Treatment facility & taxpayers	Avoided treatment costs for nitrate **+**
Clean drinking water	N	Groundwater	[Nitrate] above 10ppm	Well owners	Avoidance costs (bottled water) Remediation costs (treatment) Replacement costs (new well) **+**
Clean drinking water	N	Drinking water (surface or groundwater)	[Nitrate]	Consumers, particularly at-risk subpopulations	Increased risk of disease * value of statistical life/health Avoidance costs **+**
Commercial fisheries	N	Bays, estuaries, coasts	Fish and shellfish productivity	Fish and shellfish industry and consumers	Fishery rents Value per unit fish/shellfish **+**
Coastal recreation	N	Ocean beaches and coasts	Extent, frequency, or intensity of algal blooms	Coastal recreationists	Willingness to pay for recreation Recreational demand model

Total Value = _____

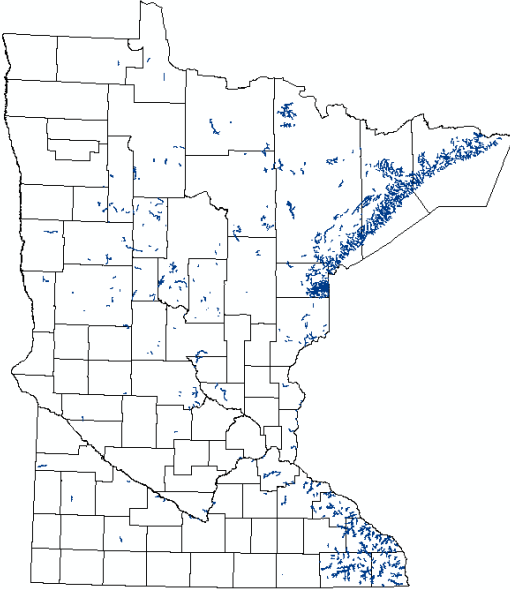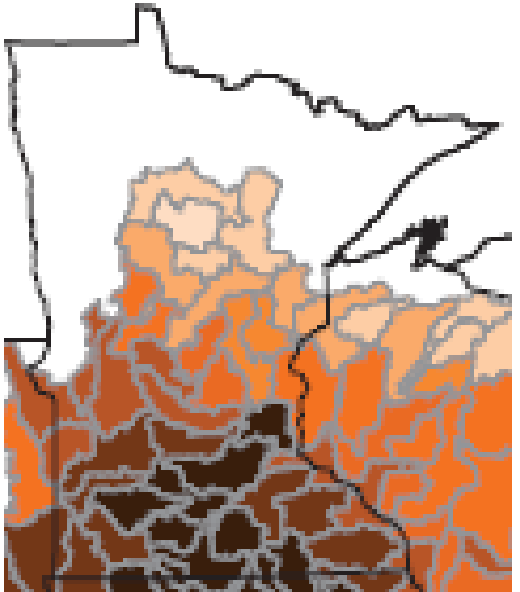# There is little spatial overlap in targeting areas for different water-related services

Groundwater contamination

LEGEND
- High Susceptibility
- Highest Susceptibility
- Medium Susceptibility
- Low Susceptibility
- Lowest Susceptibility

Recreational catchments

N delivery to the Gulf

Lessons Learned

- Information on water-related ES is in high demand

- Water is multiple services, many different beneficiaries

- Successful tools require integrating biophysical and economic models/data

- Alternative metrics to monetary valuation that address tradeoffs and can assess benefits now and into future