



Ecological Impacts of Water Withdrawals in the Great Lakes-St. Lawrence Basin

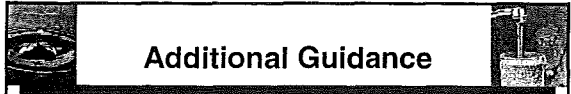
Experts Workshop
Ann Arbor, Michigan
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Workshop Charge

- Review and refine a listing of “essential questions” to assess ecological impacts.
- Identify other tools (e.g., models, literature, related studies) that should be incorporated into a “decision support” system.

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Additional Guidance

- Questions will be focused on scientific issues, and not on regulatory or socio-economic issues.
 - Although final Decision Support System will do so
- Questions may be posed to either regulated or regulator parties.
- Localized as well as regional and cumulative impacts should be considered.
- Human health impacts should be considered.

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Represented Disciplines

- Fisheries
- Wetlands ecology
- Terrestrial ecology
- Aquatic ecology
- Bird ecology
- Threatened & endangered species
- Hydrogeology
- Surface water hydrology
- Water resource engineering
- Environmental engineering
- Coastal engineering

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Categories of Water Use

- Public water supply
- Self-supply – domestic
- Self-supply – irrigation
- Self-supply – livestock, aquaculture
- Self-supply – industrial
- Self-supply – thermoelectric power (fossil fuel plants)
- Self-supply – thermoelectric power (nuclear plants)
- Self-supply – hydroelectric power
- Other –fish/wildlife, environmental, recreation, navigation, waste assimilation

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Definitions

- Withdrawal:
 - Water removed or taken from surface or groundwater
- Intrabasin Diversion:
 - Water transferred from the watershed of one of the Great Lakes into that of another
- Interbasin diversion:
 - Water transferred from the Great Lakes basin into another watershed
- Consumptive use:
 - Water withdrawn or withheld from the Great Lakes basin and assumed to be lost or otherwise not directly returned to the source due to evapotranspiration, incorporation into products, or other processes.

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Examples of Ecological Impacts

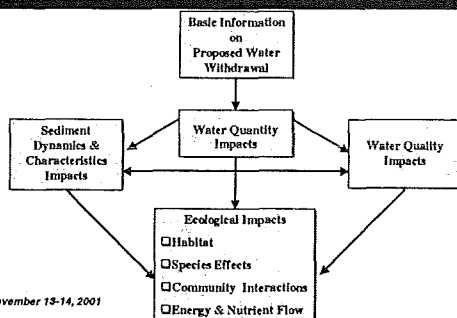
- Reduced fish productivity due to reduced dissolved oxygen due to reduced river flow
- Aquatic toxicity or reduction in ability to support aquatic life from water quality degradation during non-consumptive use
- Reduced plant diversity in wetland or reduced accessibility to fauna (fish, birds) due to narrowing the range of water levels as a result of consumptive withdrawal of wetland source water

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Framework for Assessment



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protection, perspective

alternatives
need

Basic Information on Water Withdrawal

1. Where is the proposed water withdrawal?
 - If water withdrawal is from a Great Lake, St. Lawrence River, or Connecting Channel:
 - ♦ What is the specific location and depth of withdrawal?
 - ♦ What are the relevant hydrology, geometry, hydrodynamics, and water quality in the vicinity of the withdrawal?
 - If water withdrawal is from a river:
 - ♦ Where is it located on the river?
 - ♦ What are the statistics on flow regime (average flow, 7Q10, 100 year flow)?
 - ♦ What are the key characteristics of the river and watershed?

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Basic Information on Water Withdrawal



1. Where is the proposed water withdrawal?

- If water withdrawal is from an inland lake:
 - ♦ What are the inflows and outflows?
 - ♦ What is the lake geometry?
 - ♦ What is range of water levels?
 - ♦ What is hydraulic retention time?
- If water withdrawal is from a groundwater source:
 - ♦ What is the elevation of the water table?
 - ♦ What is the size of the aquifer?
 - ♦ How does this aquifer relate to the surface waters of the Great Lakes basin?
 - ♦ Does the area of influence contain a significant amount of seasonal/semipermanent wetlands, bogs or fens that are directly linked to the water table?

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Basic Information on Water Withdrawal



2. What is the existing quality of the source water and sediments?

- Temperature
- Dissolved oxygen
- Total dissolved solids
- Pathogens
- Dissolved organic carbon
- Nutrients
- Water conductivity
- Persistent Toxic Substances

3. Are there endangered or threatened species or fragile habitats associated with the source water?

4. What are the existing uses of the source water body?

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Basic Information on Water Withdrawal



5. What is the proposed use of the withdrawn water?

- What are the water-use processes?
- Will its water quality be altered by this use?
- Will the use be consumptive?
 - ♦ If yes, what fraction of withdrawn water is consumed?

6. What is the proposed rate of withdrawal?

- Will there be seasonal or diurnal variations in withdrawal rate?
- What is the anticipated duration of this withdrawal? Will the diversion be essentially irreversible?

all water uses

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Basic Information on Water Withdrawal



- Where is the unconsumed water proposed to be returned?
 - Will the water be impounded before being returned?
 - Will it be treated before it is returned?
 - If in same water body, where is return located with respect to withdrawal?
 - If different water body, what is the location of the water return?
 - What is the quality of the receiving water for the return?
 - Are there endangered or threatened species or fragile habitats associated with the receiving water?
- What will be the structure and operation of the proposed water withdrawal and return?

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Water Quantity



- For the source water, receiving water for returns, and any other impacted waterbodies, does the withdrawal affect:
 - Baseflow?
 - Range and timing of water levels or water table elevation fluctuations?
 - Flows and flow variability?
- If there are impoundments, will there be a reduction in peak flows?

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Water Quantity



- For groundwater withdrawals:
 - How important is groundwater seepage in the overall water budget and water characteristics of hydrologically-connected surface waterbodies (e.g., baseflows, water temperature)?
 - Will there be a reduction in the amount of groundwater seepage in the river? Or timing of?

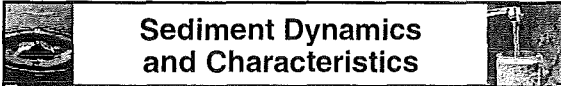
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Sediment Dynamics and Characteristics

- Will there be a change in sediment suspension and distribution (i.e., erosion, accretion/deposition, turbidity)?
 - What is the anticipated magnitude and extent of this impact?
 - Will this alter the shoreline geomorphic features or the location and area of shallow water zones?
 - Will this change result in increased dredging?
 - If there are impoundments, will there be a reduction in total sediment delivery?

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Sediment Dynamics and Characteristics

- Will there be a change in sediment characteristics?
 - Will there be an increased sediment contamination by persistent toxic substances?
 - Will there be a change in the properties of suspended or bedded sediments?
 - Will there be an alteration of the organic carbon content of sediments?
 - Will there be an increased sediment oxygen demand?

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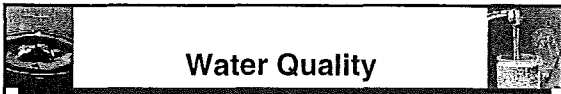
Will it result in
marine mammals from
water that is disposed
site.



Water Quality

- How will the withdrawal alter the water quality of the source water?
 - Temperature
 - Dissolved oxygen
 - Total dissolved solids
 - Pathogens
 - Dissolved organic carbon
 - Nutrients
 - Water conductivity
 - Persistent Toxic Substances

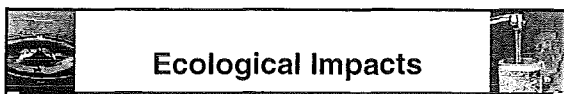
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Water Quality

- How will the return water alter the water quality of the receiving water (same parameters)?
- Are there invasive species in the source water?
- Will the water use (e.g., irrigation) lead to degradation of unrelated water supplies (e.g., groundwater)?
- Will there be alteration of the thermal profile in the source or receiving water?
 - If there are impoundments, will there be an increase in water temperature?

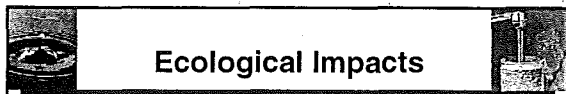
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Ecological Impacts

- Will the changes in water quantity, sediment dynamics, and/or water quality :
 - affect aquatic or terrestrial habitats associated with the source or return flow systems?
 - If yes, which species habitats are impacted? (fish, benthos, birds, amphibians, reptiles, mammals, invertebrates)
 - If yes, what are the habitat attributes that are impacted?
 - affect production or diversity of flora (including phytoplankton, periphyton, and macrophytes)?
 - cause acute or chronic toxicity to any species?
 - affect population levels or growth rates of any species in impacted system?

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Ecological Impacts

- How will the changes in water quantity, sediment dynamics, and/or water quality:
 - affect predator-prey relationships or food web structure and/or function in the impacted system?
 - If yes, which species are impacted?
 - If yes, how will the whole community structure and function be impacted?
 - cause a change in the energy flow or nutrient cycling through the ecosystem?
 - cause an increased bioaccumulation of contaminants in the food web?

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Janice A. McLaughlin
 10/10/01



Cumulative Impacts



1. From a lake-wide, river, connecting channel, and/or system-wide basis, how will this withdrawal affect:
 - water levels and flows?
 - water quality and ecological health of the source water?
 - water quality and ecological health of the receiving water for the return?
2. Will this withdrawal, when combined with ongoing and anticipated future withdrawals, cause a deviation from the hydrology/hydraulics of the system that is required to maintain the health and integrity of the ecosystem?
3. Will changes in the hydrology/hydraulics of the Great Lakes-St. Lawrence system that may result from global climate changes affect the total maximum withdrawal allowable for a given source water?

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