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Comment Submitted:

Comments on:
Inventory of Available Controls for Aquatic Nuisance Species (ANS) of Concern – Chicago Area Waterway System (CAWS)

Thomas J. Murphy, Ph. D.

17 February 2012

These are comments related to the paper, **Inventory of Available Controls for Aquatic Nuisance Species of Concern Chicago Area Waterway System**; December 2011, related to GLMRIS Phase I project, CAWS.

This report is a reasonable but significantly limited beginning to look at the possible ways of controlling the passage of aquatic nuisance species (ANS) of concern between the Great Lakes and Mississippi River watersheds via hydraulic connections in the Chicago Area.

Unfortunately, the applicability of the results of this process will restricted by the scope of the GLMRIS authority – limited to transfer of ANS via aquatic pathways. What is needed to be done and what GLMRIS should be doing, is to evaluate the probability of success of proposed projects to ecologically isolate the two watersheds as well as risks of their failure. The difficulty is that it will not be possible to do this if transport via pathways other than hydrologic separation are not also considered and evaluated. To their credit, the US Army Corp of Engineers (COE) defines the project as to '*prevent or reduce the risk* of ANS transfer' between the basins as it is unreasonable to expect permanent isolation. Fortunately, what the COE seems to understand, is that the *best* that can be done is to reduce the risk. Quantification of the risk is very important. If the probability of long-term success is too low, it will be best to do nothing, to do no harm.

The COE seems to have done its homework in looking at possible ANS control methods, as attested to by the Fact Sheets for 27 different techniques. Unfortunately, most of the techniques can be easily dismissed as not being practical for a system involving 100 m^3/sec of flow. Many of the others are not sufficiently specific or effective and would cause significant collateral damage. Others would use quite large amounts of chemicals; would leave toxic residues in the water ways; or would be prohibitively expensive.

For example the Lethal Water Temperature technique would involve heating the water 10°C or more. This would require 4,000,000 KW of power–half of Chicago's power demand, to heat the 100,000 kg/sec of water 10° unless there were also an elaborate heat exchange system to recycle the thermal energy. Regardless of how this enormous thermal input would be handled, it would have severe environmental consequences in the immediate vicinity as well as far downstream.

The technique that shows the most promise at this time is Hydrologic Separation (HS) the technique which has gotten considerable attention so far in this project, as well as in the Jan. 31, 2012 report of the Great Lakes Commission- Great Lakes and St. Lawrence Cities Initiative. Unfortunately, the description of the advantages and the limitations of this most promising technique in the fact Sheet in the CAWS is too brief and rudimentary.

The big limitation on the effectiveness of HS, however, will be transfer of ANS between the watersheds via other mechanisms. All parties seem to agree that ecological separation is necessary and it is timely. *However, most participants incorrectly equate hydrologic separation with ecological separation*. If the **only** route of transfer of organisms between watersheds is via physical movement of organisms in the water or via the movement of water craft through hydrologic connections, then hydrologic separation might accomplish the desired ecological separation or isolation. Since other transfer routes exist, they must also be evaluated if the project is to accomplish its goals.

Other Transfer Routes

In addition to transfer via hydrologic routes, ANS can be transferred between watersheds:

- Accidently or inadvertently by people.
- Deliberately by people.
- Inadvertently on fishing boats, and on other vehicles and equipment.
- By bait - as used or discarded.
- By animals and birds.
- By the failure, bypassing or overtopping of hydrologic barriers.

The evidence that ANS can transfer between watersheds by non-hydrologic routes is overwhelming. For instance:

- Zebra mussels:
  - Entered the Great Lakes and then the Mississippi River system via hydrologic connections, and have since been found in Lake Mead and the California aqueduct system, having made it over the Rocky Mountain continental divide.
  - Now colonize numerous lakes and watersheds in Wisconsin and Minnesota hydrologically isolated from the Mississippi River system despite intensive information campaigns instructing boaters and other water-sports participants how to avoid transferring them to new watersheds.
- Asian snakehead fish:
  - A giant snakehead (Channa micropeltes) was found dead in April 2010 in the Saint-Charles River, in Québec City. It was likely an aquarium release.
  - The Northern snakehead fish (Channa argus), first identified in the Potomac River is now in a dozen eastern streams in 5 states and has become established in the Arkansas River (Mississippi River system).
  - On April 25, 2011, a northern snakehead was found above Virginia's Great Falls near Whites Ferry on the Potomac River. Great Falls was supposedly a natural barrier that the fish was unable to cross.
  - **Many ANS are part of the legal or illegal aquarium trade.** In May 2011, a Brooklyn fish importer was arrested for importing 350 live snakeheads into New York.
  - A fisherman caught a single snakehead on October, 2004 at Burnham Harbor in Chicago likely a single, local release.
- The first ANS salmonids in the Great Lakes were pink salmon deliberately released from the Port Arthur Hatchery at Thunder Bay on Lake Superior.
- The western Mediterranean Sea is inundated with an aggressive alga from the Pacific Ocean inadvertently released from the Oceanographic Institute in Monaco.
- Hundreds of isolated drainages and lakes in the Rocky Mountains and Sierra have non-native salmonids and Mysis relicta deliberately introduced by well-meaning people. In many of those systems the native Cutthroat, Golden or Dolly Varden trout (Arctic char) have been extirpated.
- Mature catadromous Lake Michigan Lake trout were transferred by unknown means from Lewis Lake in Wyoming across the continental divide to Yellowstone Lake in 1988. There they are pushing the native anadromous Cutthroat trout to extinction and changing the ecology of the Yellowstone Lake watershed.

- H. *anomala*, a recent ANS in Lake Ontario is now present in Oneida Lake 53 river km upstream from Lake Ontario, having surmounted the significant hydrologic barriers of, ". . . several large rapids, locks, and dams."
- There are numerous examples of ANS in Florida wetland ecosystems that could not have come by hydrologic transfer. Many are thought to be former pets released by their owners.
- Regulations, rules, education, etc. can only go so far in preventing the transfer of species between ecosystems. Individuals sometimes do releases of exotic species through ignorance, for ill-conceived benefits, for spite, or for their own—sometimes irrational, reasons. While not ANS, the recent release of more than 50 non-native animals by an owner in Ohio illustrates the difficulty of trying to control or regulate the movement of species once they are established on a continent.
- Follow-up investigations indicate that the Asian carp found in Lake Calumet in 2010 that it had lived there for six years or so, indicating that Asian carp can survive in the Great Lakes ecosystem. Its entry route is unknown, but a non-hydrologic transfer route is a good possibility.
- Rare or extreme hydrologic events can also lead to temporary hydrologic connections that permit the transfer of ANS. The escape of imported Bighead carp from inland fishponds in Arkansas to the Mississippi River system when flooding in 1994 overtopped the ponds is an example.
- Before the Chicago area was developed in the mid-1800s, aquatic species could often and readily transfer between the Des Plaines River (Mississippi River system) and the Great Lakes when the natural, hydrologic divide between these two systems–the Mud lake region of western Chicago, when it was inundated with heavy spring runoff or heavy rains.
- In many cases the mechanism of the introduction of an ANS to a new watershed is not known.

To ignore this evidence and these transfer routes and mechanisms could lead to the doom of any proposed hydrologic separation project. Deliberate transfer by people is usually of adult individuals, while inadvertent transfer and transfer by birds and animals is often of egg, larval or young individuals. Aquatic avian individuals in particular readily transport plant propagules between watersheds. This risk must be quantified and the results incorporated into this GLMRIS study if it is to be a useful planning document.

The probability that an ANS that is established in the US and able to colonize the Great Lakes, will ***not*** make it to the Great Lakes by some route, is one of the first determinations to be made. If the chance of ***not*** getting into the Great Lakes is small–and there is good support for such a thesis (see above), then for all practical purposes the game may already be over–the Titanic has hit the iceberg and it is only a matter of time. Such a finding would indicate that the project goes no further.

Hydrologic separation as the sole focus of this ecological separation requirement is equivalent to constructing a Maginot Line between the watersheds. As the Maginot line constructed in France between WWI and WWII was easily thwarted by the German invasion in 1939 by making an end-run around it through Belgium, two guys–sober or drunk, ignorant or vindictive, anti-environment or anti-establishment, displaced barge crewman, etc., in a small boat with a plastic tub could negate a billion dollar HS project in one night.

Fortunately, it seems that the principal route of new invasions to the Great Lakes–ANS hitchhikers in ballast water of ships using the St. Lawrence Seaway, is effectively closed. In 2010 the Coast Guard inspected all 7754 ballast tanks on the 415 vessels that transited the

Seaway. They ascertained that all the vessels exchanged their ballast water, flushed their ballast tanks or they were required to either retain the ballast water and residuals on board and treat the ballast water in an environmentally sound and approved manner. Follow-up inspections were performed when required. The Ballast Water Working Group anticipates continued high vessel compliance rates with the regulations to continue in subsequent years.

Implications of Hydrologic Separation on Flooding in Chicago and Water Quality in Lake Michigan

If HS becomes a major part of the ecological separation goal of the watersheds, and some or all of CAWS is reconnected to Lake Michigan, there will be major changes in the hydrology of the river and to the ecology of lake Michigan. These include:

1. Most of the hydrologic divide proposals show the treated effluent from at least one of the three major Metropolitan Water Reclamation District of Great Chicago (MWRD) water reclamation plants (WRP) being discharged to Lake Michigan. Treated and disinfected effluent from one or more of the major WRPs will be discharged causing a doubling or more of the inputs to the southern basin of the Lake of biological oxygen demand (BOD), suspended solids (SS), nutrients, pharmaceuticals and their metabolites that survive passage through the treatment process, refractory halogenated and non-halogenated organic compounds, trace metals, etc.
2. Until the Tunnel & Reservoir Project (TARP) of the MWRD is completed (now projected for 2029), flooding due to heavy precipitation-related combined sewer overflows (CSOs) will be a major factor in Chicago. Until then, the choice will remain to discharge the CSOs to the Lake, or to store them temporarily in highway underpasses and basements.
3. The water level in the river is normally kept at about two feet below the level in the lake. If the river is again hydraulically connected to the lake, its level will rise somewhat above lake level, an increase of more than two feet. A significant increase in the level of the water in the lake would then lead to an additional increase in water level in the connected river system, increasing the extent and severity of all flooding events. Should lake levels begin to approach those that occurred during 1986–five feet above current levels, this would lead to considerable additional flooding in the city even during dry weather. Also, because the level of the river will not be able to be lowered in anticipation of storms, this storage capacity of about 2 billion gallons of stormwater will no longer be available to mitigate flooding in the city when storms occur.
4. Richard Lanyon, the recent Executive Director of the MWRD estimates that it will cost $77 million to construct treatment facilities for CSOs at the North Side Pumping Station and $11 million for each of the 253 CSO discharges with treatment space available ($2.8 billion). Unfortunately, 63 CSO outfalls are located in urban areas–including downtown Chicago, where adjacent land is not available for on-site treatment before discharge to the river.
5. Should the North Side WRP discharge their treated effluent (average discharge of 225 million gallons (MG)/day) to Lake Michigan, about 1,900 lbs/d (340 tons/yr) of phosphorus will go into the lake while still meeting the Water Quality standard of the 1978 Great Lakes Water Quality Agreement (GLWQA) of 1 mg or less of total phosphorus in discharges to the Great Lakes basin. It is probably that similar additional amounts will be contributed by the multiple CSO events that will occur during the year, totaling more than 10% of the GLWQA goal of 5,600 tons of annual phosphorus inputs to Lake Michigan.

In the early 70's, silica-rich diatoms were the dominant algae in the oligotrophic lake. However, increasing inputs of P to the lake stimulated diatom growth until silica depletion limited further increase in their numbers. The excess P then stimulated the growth of large numbers of smaller green algae, leading to a major biogeochemical change in the lake. Implementation of the GLWQA controls on phosphorus discharges to the lake reversed this eutrophication. Five to six hundred tons/yr of additional P inputs to the southern end of Lake Michigan could again increase the trophic state of the lake and bring back green algae blooms.

Public Support for hydrologic Separation

Finally, the health of Lake Michigan is the principal or a major focus of most of the environmental organizations in Chicago that include a water-focus in their programs–*Alliance for the Great Lakes, Sierra Club, Environment Illinois, Natural Resources Defense Council, Environmental Law & Policy Center*, etc. 'Saving the Lake' is a most important issue for them to attract & retain members and foundation support. They aggressively and collectively attack even minor threats to the Lake. Recent 'threats'–the increased discharges from the Whiting, Ind. BP refinery and the ash from the coal-burning Badger ferry, for instance, pale in comparison to 500-600 tons/yr of phosphorus, 1,700 tons/yr of SS (normal flow + CSOs), pharmaceuticals, bioaccumulative organics, trace metals, etc. that will come down the North Branch Chicago River from the North Side WRP.

The Lake Michigan campaign of Environment Illinois is based on preventing beach closings (500/year) by stopping 'sewage discharges' to the Lake. This is in spite of the fact that Chicago discharges sewage to the Lake only about once per year, and the three closest sewage discharges upstream of Chicago–Kenosha, Racine and Milwaukee all disinfect their effluent. How many beach-closing per year will there be when the flow will be treated effluent from one or more MWRD WRPs, and CSO discharges enter the lake every three weeks or so?

These groups are very successful in mobilizing the press, politicians, foundations and the public behind their positions. It would be very difficult for the COE to undertake a HS project in Chicago without their strong support. Their current view of such a project is that a hydrologic separation would be **permanent** and would **totally halt** all ANS movement between the two watersheds; it would be equivalent to an ecological separation. Will they be willing to revise their long-standing policies of total protection of Lake Michigan to support a project that 1) would bring WRP effluents and CSOs to the lake and 2) could be undermined by the occurrence of a 500-year storm event in northwestern Indiana in the next decade or two; by a new home-owner dumping the non-descript fish in the backyard pond (Asian carp) into the local stream which happens to be a tributary to Lake Michigan; or by two misguided or disgruntled guys in a small boat with a plastic tub?

Interactions with Other Possible Hydrologic Connections Sites

A final complication of the limited focus of the GLMRIS CAWS study is looking at CAWS in isolation. GLMRIS studies to date indicate that CAWS is only one of 31 possible hydrologic connections between the basins. The Hydrologic Separation Fact Sheet uses the 100-year storm–1% per year reoccurrence probability, as the design criteria. That sounds good–100 years before we have to worry, but of course that is not true. A 1% chance per year is also a 22% chance within 25 years, a 50% chance in 69 years and a 63% chance that it will occur within 100 years. Is this probability sufficient for a multi-billion dollar project, a 50:50 chance that it will last only 63 years?

The actual case is much worse. GLMRIS studies identified four other locations along the watershed boundary where interbasin transfer is Ideal, Favorable or Possible. Now if each of them is built to the same 1% per year occurrence probability, then the chance that a hydrologic event could occur that would permit ANS transfer at one of the five locations is 4.9% per year

[1-.99^5], and there is a 50% chance that it could occur within 14 years–perhaps before the HS is complete! The chance that such a situation could arise with a 69 year time period is 97% and there is a 99% chance of occurrence in 100 years. 'Black Swan' events occur regularly. One solution to these disheartening probabilities is to build the HS to higher criteria, say the 500-year storm (0.2% per year occurrence). Now there is only (!) a 22% chance of a hydrologic connection within 25 years and a 40% chance within 50 years.

An additional concern here is climate change. It is believed that storm intensities will increase, and there is already some evidence for that prediction. The 100-year storm becomes the 50 or 30-year storm, greatly increasing the chance of overtopping a HS structure. For five locations and the 1000-year storm (0.1% per year occurrence probability), there is a 12% chance of overtopping within 25 years, and 40% within 100 years (or 50 years if the frequency of intense storms doubles). Maybe the HS structures need to be designed for the 5,000-year storm giving only a 9.5% chance of failure in 100 years, with current storm frequencies.

The other 26 possible areas of connection between the two watersheds are not now thought to present a significant threat to ANS transfer. However, in the hundred or more years that the HS should be designed for, one could foresee that seemingly innocuous changes could occur in the landscape of one or more of these areas–revised drainage systems, road or building construction, etc., Such changes could increase the possibly of ANS hydrologic transfer between the two watersheds.

Summary

- A mechanism needs to be found to include in the planning and evaluation process for an ecological separation project the possibility and the mechanisms of non-hydraulic transfer of ANS between the two watersheds.
- A realistic evaluation of the inevitability of Asian carp successfully invading the Great Lakes needs to be part of the process.
- A realistic evaluation needs to be included of all of the risks and downsides of an ecological separation project in addition to looking at the benefits.
- Some of the non-monetary costs of such a project will be a significant increase in flooding in the Chicago area as well as an increase in the trophic state and toxic contamination of the south basin of the lake.