Nutrient Cycles and Pollution, Lake Michigan Style

Cheryl A. Heinz, Benedictine University
CQ#2: How many people drink Lake Michigan water?

A. 2 million
B. 4 million
C. 6 million
D. 8 million
E. 10 million
F. 12 million
More from WBEZ

Eight Forty-Eight 7/18/2007, Speaking to Michael Hawthorne of the *Chicago Tribune*  
“License to Dump?”

http://www.wbez.org/episode-segments/license-dump
CQ#3: Which nutrient level in the lake is expected to be most affected by this refinery expansion?

A. Carbon
B. Water
C. Nitrogen
D. Sulfur
Indiana Agency responds

City Room, produced by Michael Puente, Saturday, July 21, 2007
“Indiana Agency Defends BP Approval”

CQ#4: Can increased pollution be allowed in a major source of drinking water?

A. Unqualified yes
B. Qualified yes
C. Qualified no
D. Unqualified no
General schematic: Nutrient cycling
Generalized nutrient cycle schematic
Nutrient cycles

• For a nutrient to cycle globally, there must be a volatile phase:

• Phosphorus cycles locally
  – Stays within an ecosystem
  – Not very mobile
    • No mechanism for long-distance travel

• Nitrogen cycles globally
  – $\text{N}_2$ gas moves easily from place to place
CQ#5: Does water cycle locally or globally?

A. Locally
B. Globally
C. I’d have to guess
CQ#6: To what extent is the refinery expansion expected to affect the water cycle?

A. Greatly
B. Some
C. A little
D. Not at all
Generalized case of nutrient cycling through a forest
Global nitrogen cycle

Atmospheric Nitrogen ($N_2$)

Plants

Assimilation

Denitrifying Bacteria

Nitrogen-fixing bacteria living in legume root nodules

Decomposers (aerobic and anaerobic bacteria and fungi)

Ammonification

Ammonium ($NH_4^+$)

Nitrification

Nitrites ($NO_2^-$)

Nitrates ($NO_3^-$)

Nitrifying bacteria

Nitrogen-fixing soil bacteria
CQ#7: Where will the refinery impact the nitrogen cycle the most?

A. More nitrogen in the air (N₂)
B. More nitrogen in the water
C. More nitrogen in the soil
D. All of the above
Some numbers

• BP says it would increase CO$_2$ emissions by 20% (though their own studies range up to 50%)
  – The equivalent of another 200,000 to 400,000 more cars in terms of air pollution
• Nitrous oxides could exceed limits by 11 times
• Carbon monoxide by 5 times

Source: http://www.progressillinois.com/2008/06/30/bp-emissions-higher-than-claimed
CQ#8: Where will the refinery impact the carbon cycle the most?

A. More carbon dioxide in the air (CO$_2$)
B. More carbon in the water
C. More carbon in the soil
D. Same impact in air, water, and soil
Some numbers

• Into the lake:
  – 54% more ammonia (NH₃)
  – 35% more sludge (suspended solids)

• Into the air:
  – 20-50% more CO₂
  – Nitrous oxides 11 times the limit
  – Carbon monoxide 5 times the limit
EPA steps in

City Room, produced by Michael Puente, 1 Aug 2007
“EPA Has No Plans to Stop BP Chemical Dump”

Mayor Daley’s reaction

City Room, produced by Mike Rhee, 1 Aug 2007
“Mayor Daley Says BP Dumping Unacceptable”

CQ#10: Over time, does Indiana stand to gain from the expansion?

A. Proximately yes, ultimately yes
B. Proximately yes, ultimately no
C. Proximately no, ultimately yes
D. Proximately no, ultimately no
Why Indiana said yes

“Jobs Versus Environment in Northwest Indiana”

What other states border the lake?

- Illinois, Michigan, and Wisconsin.
- It is the only Great Lake that is entirely within the U.S.
CQ#11: Should Indiana be allowed to make exceptions for companies polluting the lake?

A. Yes, unconditionally
B. Yes, under certain conditions
C. No, unconditionally
D. No, under certain conditions
What’s to lose?

City room, Produced by Michael Puente, 29 Aug 2007
“BP In Trouble Again”

Updating the score

• BP will not release nitrogen or sludge into the lake
• But it will continue to release the same levels of air pollution
  – With the State of Indiana’s permission
  – Excusing it from Federal laws requiring a reduction
CQ#12: How would you resolve this issue?

A. Allow the expansion with no limits on increased air or water pollutants
B. Allow the expansion with limits on water pollutants only
C. Allow the expansion with limits on air pollutants only
D. Allow the expansion with limits on both air and water pollutants
E. Deny the expansion