

2013 AP[®] ENVIRONMENTAL SCIENCE FREE-RESPONSE QUESTIONS

ENVIRONMENTAL SCIENCE

SECTION II

Time—90 minutes

4 Questions

Directions: Answer all four questions, which are weighted equally; the suggested time is about 22 minutes for answering each question. Write all your answers on the pages following the questions in this book. Where calculations are required, clearly show how you arrived at your answer. Where explanation or discussion is required, support your answers with relevant information and/or specific examples.

Fremont Examiner

May 1, 2013

GULF OF MEXICO: TROUBLED WATERS

The Mississippi River watershed has been repeatedly altered to improve both navigation and flood control. In addition, human actions in the watershed have harmed coastal wetland ecosystems and the water quality in the Gulf, affecting the regional economy along the Louisiana coast. A group of visiting scientists from Fremont University has released a preliminary report that suggests strategies to address and reverse this

damage. In a recent interview, Dr. Claire James stated, “We urgently need to reconsider our activities in the watershed and have very little time to clean up our mess. Our two biggest priorities have to be restoring the flow of sediment to the Gulf and reducing fertilizer runoff into the River. This will allow us to restore and conserve habitat so that our children and grandchildren will be able to enjoy this precious natural resource.”

1. (a) **Identify** TWO human activities that alter the natural flow of sediments into Gulf Coast ecosystems. Explain how each of the activities alters the flow of sediments.
- (b) Dr. James says that it is important to restore sediments. **Describe** TWO ways that the loss of natural sediment harms Gulf Coast wetland ecosystems.
- (c) Dr. James also indicates that it is necessary to limit fertilizer runoff into the Mississippi River.
 - i. **Describe** TWO environmental impacts on the marine ecosystem that are caused by fertilizer when it flows into the Gulf of Mexico.
 - ii. What are TWO economic consequences that result from the flow of fertilizer into the Gulf of Mexico?
 - iii. **Describe** ONE strategy, other than reducing the use of fertilizer, that can be employed to reduce the flow of nutrients into the Mississippi River.

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Question 1

(a) Identify TWO human activities that alter the natural flow of sediments into Gulf Coast ecosystems. Explain how each of the activities alters the flow of sediments.

(4 points: 1 point for each activity; 1 point for each explanation [change in sediment load must be linked to its appropriate activity]; only the first two answers are accepted)

Activity	Explanation
Building dams*	<ul style="list-style-type: none"> Blocks flow of sediment from upstream, decreases deposition downstream (coast starved of sediments) Prevents flooding that deposits sediment in floodplain Increases flow velocity, increases downstream erosion
Channelization/straightening/re-routing of river	<ul style="list-style-type: none"> Prevents deposition in wetlands Increases velocity, decreases deposition in floodplain/coast starved if sediments carried offshore
Building levees*	<ul style="list-style-type: none"> Prevents deposition in wetlands Increases velocity, sediments carried offshore
Loss of riparian/buffer zones and degraded stream banks*	<ul style="list-style-type: none"> Increases erosion, increases sediment load to river Decreases sediment trapping due to root loss, increases sediment load to river
Agriculture/irrigation practices	<ul style="list-style-type: none"> Increases erosion, increases sediment load to river
Construction/urbanization	<ul style="list-style-type: none"> Increases erosion, increases sediment load to river Decreases infiltration leading to greater runoff, increases sediment load to river
Deforestation/logging*	<ul style="list-style-type: none"> Increases erosion, increases sediment load to river Decreases sediment trapping because of root loss, increases sediment load to river
Water use/extraction	<ul style="list-style-type: none"> Over pumping/use of water reduces river flows, decreases sediment load to Gulf
Dredging/ditching*	<ul style="list-style-type: none"> Removes sediment from the ecosystem Increases erosion, increases sediment load to river
Draining of wetlands*	<ul style="list-style-type: none"> Increases erosion due to increased overland flow, increases sediment load to river Decreases sediment trapping because of vegetation loss, increases sediment load to river
Overgrazed rangelands*	<ul style="list-style-type: none"> Increases erosion, increases sediment load to river
Mining (strip mining)*	<ul style="list-style-type: none"> Increases erosion, increases sediment load to river

*opposite activities and explanations accepted as appropriate

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Question 1 (continued)

- (b) Dr. James says that it is important to restore sediments. Describe TWO ways that the loss of natural sediment harms Gulf Coast wetland ecosystems.**

(2 points: 1 point for each description [must be ecological, not economic]; only the first two descriptions provided can earn points)

- Conversion of wetlands to open water (flooding) due to lack of sediment renewal
- Loss of nutrients that are needed to maintain wetland plants (lower productivity)
- Loss of plant productivity leads to loss of biomass at higher trophic levels
- Loss of replenishment for floodplain soils, coastal beaches, barrier islands, marshes, estuaries
- Loss of specific coastal habitats (e.g., bird breeding areas, fish nurseries)
- Flooding of coastal wetlands due to loss of barrier islands and beaches

- (c) Dr. James also indicates that it is necessary to limit fertilizer runoff into the Gulf of Mexico.**

- (i) Describe TWO environmental impacts on the marine ecosystem that are caused by fertilizer as it flows into the Gulf of Mexico.**

(2 points: 1 for each impact description [must be ecological, not economic]; only the first two descriptions provided can earn points)

- Over-enrichment by excess nutrients (nitrates and phosphates)
- Increased growth of algae
- Decreased levels of light/decreased levels of photosynthesis
- Formation of dead zone (increased fish/shellfish death)
- Lower dissolved oxygen (hypoxic/anoxic conditions)
- Increased populations of bacteria
- Increased biochemical oxygen demand (BOD)/increased respiration of decomposers
- Outbreaks of red tides/harmful algal blooms (HABs)

- (ii) What are TWO economic consequences that are caused by fertilizer when it flows into the Gulf of Mexico?**

(2 points: 1 for each consequence [must be economic, not ecological]; only the first two consequences provided can earn points)

- Decreased income/revenue due to lower fish catches (e.g., shrimp, oysters, fin fish)
- Loss of jobs in the fishing industry
- Lower rates of tourism due to impacts (e.g., HAB, lower fish diversity, less aesthetically pleasing)
- Cost of cleanup of fish kills
- Increased seafood prices due to lower seafood supply
- Lower sales of seafood due to HABs
- Loss of property taxes if people move away
- Decreased property values

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Question 1 (continued)

(iii) Describe ONE strategy, other than reducing the use of fertilizer, that can be employed to reduce the flow of nutrients into the Mississippi River.

(1 point for a description of a reduction strategy; only the first description provided can earn points)

- Protection, re-establishment of riparian/buffer zones (replanting) to trap fertilizer
- Limit farming near floodplains
- Limit development (e.g., lawns, golf courses) near floodplains
- Improve agricultural or residential practices (use techniques such as intercropping, cover crops, no till, timing of fertilizer application)
- Treatment of storm water to reduce nutrients before releasing into river
- Requirement of tertiary treatment for wastewater treatment plants and other point sources
- Education of public on techniques to reduce nutrient flow
- Limit septic systems near riparian zones
- Treatment of waste from livestock farms (CAFOs) to reduce nutrients
- Catchment basins/retention ponds to trap nutrients
- Green roofs to decrease runoff
- Permeable pavement to reduce flow of water into waterways