Question 3

(a) Assume that the city council chooses the first option. Describe TWO problems that result from removing the contaminated soil from the brownfield.

(*2 points possible*)

One point is earned for describing each problem associated with removal of the contaminated soil.

ACCEPTABLE PROBLEMS

- High cost of removing/cleaning/replacing large amounts of soil
- Need to find a place to dispose of contaminated soil—may only move the problem from one site to another
- Erosion at the site
- Ecological disturbance of the area
- Risks from transporting contaminated soil
- Exposure of workers or residents to contaminants (airborne)
- Groundwater contamination remains a problem

(b) Assume that the city council chooses the second option. Explain how vegetation could be used to decontaminate the soil. Discuss one advantage and one disadvantage of using this reclamation method.

(3 points possible)

One point is earned for explaining how vegetation can be used for soil decontamination, 1 point is earned for one advantage of using plants to decontaminate the soil, and 1 point is earned for one disadvantage of using plants to decontaminate the soil.

CORRECT VEGETATION USAGE

When vegetation is planted on a brownfield, the plants take up the contaminants (along with water and nutrients) from the soil.

Advantages of Using Plants	Disadvantages of Using Plants
• Low cost. • Reduces soil erosion. • Reduces the amount of material that has to be taken to a landfill. • Less habitat disruption (not removing the soil). • Aesthetically pleasing.	• Process may be slow. • Vegetation may become hazardous to insects or animals that feed on it. • When the vegetation is removed, it is still hazardous. • May not remove all of the contaminants /effective only to the depth that the roots reach. • May introduce exotic species. • Appropriate plant species may be difficult to grow on the site. • Volatilized compounds may be emitted through plant pores.

Question 3 (continued)

(c) Describe and explain one environmental benefit and one societal benefit of brownfield reclamation.

(2 points possible)

One point is earned for one environmental benefit, and 1 point is earned for one societal benefit.

ACCEPTABLE ENVIRONMENTAL BENEFITS

- Creates green spaces—habitat for plants, insects, animals
- Reduces hazardous runoff into streams, lakes, rivers
- Reduces groundwater contamination
- Reduces urban sprawl by reclaiming urban land

ACCEPTABLE SOCIETAL BENEFITS

- Cleaned up area improves property values
- Can provide green space for parks, athletic fields, or aesthetic value
- Can provide area for housing, businesses, or crops
- Land made available for development can add to tax base and provide jobs
- Decreases health risks related to living near a brownfield
- Use as a positive model for successful reclamation which could increase environmental awareness/community service
- Reduces urban sprawl (if not credited above)

(d) Identify and describe

(i) one method currently used to reduce the production of hazardous waste and
(ii) one method of legally disposing of hazardous waste.

(4 points possible)

Two points can be earned for each section. In part (i), 1 point can be earned for correctly identifying one current method, and 1 point can be earned for describing that method. In part(ii), 1 point can be earned for correctly identifying one current method, and 1 point can be earned for describing that method.

Question 3 (continued)

(i) One method currently used to reduce the production of hazardous waste

Acceptable Method of Reduction	Acceptable Description of Reduction
Recycling, reuse of materials	• Reusing the waste for another application • Establishing trading centers where leftover paint, solvents, pesticides, or cleaning solutions are reused • Reusing batteries (rechargeable) • Gas stations accepting oil for recycling
Substitution of nonhazardous materials for hazardous materials	Using a less toxic material • Acetamide—Substitute: Stearic acid • Chromic acid cleaning solutions—Substitute: Detergents Formaldehyde—Substitute: Ethanol • Mercury thermometers—Substitute: Alcohol thermometers
Government regulation of the contaminant	• Prohibition of PCBs, CFCs, DDT • Specific limitations or acts/laws/regulations (EPA: RCRA) • Pollution prevention act • Monitoring for compliance • Pollution credits, tax credits, or trading credits • Requiring the use of catalytic converters
Substitution of alternate energy sources that do not produce hazardous wastes	Wind, solar, hydroelectric, or geothermal
Becoming more efficient in the manufacturing process	Specific examples of increased efficiency

Question 3 (continued)

(ii) One method of legally disposing of hazardous waste

Acceptable Legal Method of Disposal	Acceptable Description of Legal Disposal of Hazardous Wastes
Incineration	Burning waste plus one of the following: • reduces volume • detoxify the waste • may produce air pollution
Bioremediation	Using organisms to decompose the contaminants.
Chemical methods	Detoxification or stabilization before disposal, vitrification of nuclear wastes (glass rods)
Landfills	Description of the site to include at least one of the following: • lined • contained • sealed drums
Deep well injection	Injection of hazardous wastes into underground sites that are geologically stable
Exportation of wastes	Ship to a less regulated country
Utilize a local hazardous waste collection site (only 1 point)	Must include specific details about the collection or the site. Must specify that there is a local site.
Name of a specific disposal site (e.g., Yucca Mountain)	Description of the site must include at least one of the following: • monitored for leakage • geologically stable • isolated from population centers
Surface impoundments	Lined liquid disposal pits

3A1

3. The city of Fremont has a large brownfield located along the Fremont River. The brownfield is a former industrial site where contamination by hazardous chemicals impedes redevelopment. The city council is considering two options for reclaiming the brownfield. The first option is to excavate and remove the contaminated soil, and the second option is to decontaminate the soil on the site using vegetation.

(a) Assume that the city council chooses the first option. Describe TWO problems that result from removing the contaminated soil from the brownfield.

(b) Assume that the city council chooses the second option. Explain how vegetation could be used to decontaminate the soil. Discuss one advantage and one disadvantage of using this reclamation method.

(c) Describe and explain one environmental benefit and one societal benefit of brownfield reclamation.

(d) Identify and describe

(i) one method currently used to reduce the production of hazardous waste and

(ii) one method of legally disposing of hazardous waste.

(a) One problem of removing the contaminated soil is that during the removal process some of the contaminated soil could accidently be washed into nearby lakes and stream by rainfall and erosion. This would pollute the water, causing potential health risks. Also, after removing the contaminated soil the council would have to properly dispose of the soil which would be costly and could result in simply moving the soil to another brownfield.

(b) Vegetation could be used to decontaminate the soil. During phyto remediation, plants would undergo photosynthesis to break down contaminants. Legumes could be planted to take in ~~[illegible]~~ wastes, such as nitrogen, and restore nutrients. One benefit would be the profit made by selling legumes and having nutrient-rich soil to plant crops. One disadvantage is the great amount of time that this reclamation method would take. It would be much slower than physically removing the contaminants.

GO ON TO THE NEXT PAGE.

ADDITIONAL PAGE FOR ANSWERING QUESTION 3

(c) An environmental benefit of brownfield reclamation is that habitats could be restored. Animals such as birds, could form breeding and feeding grounds on the land ~~[illegible]~~. One societal benefit of reclamation is that reclaimed land could be used for parks, field, recreational areas and other developmental puposes without posing as a health risk.

(d) (i) One method of reducing production of hazardous waste is using alternate materials instead of potentially hazardous wastes. For example instead of ~~[illegible]~~ producing hazardous radioactive wastes from nuclear plants, fossil fuels are burned instead, so no ~~[illegible]~~ radioactive wastes are produced.

(ii) One method of legally disposing of hazardous wastes are secured landfills. Secured landfills are made especially for hazardous wastes such as corrosives, radiactive wastes, etc. They have test wells, security, and specific regulations to contain the wastes.

GO ON TO THE NEXT PAGE.

3B1

3. The city of Fremont has a large brownfield located along the Fremont River. The brownfield is a former industrial site where contamination by hazardous chemicals impedes redevelopment. The city council is considering two options for reclaiming the brownfield. The first option is to excavate and remove the contaminated soil, and the second option is to decontaminate the soil on the site using vegetation.

(a) Assume that the city council chooses the first option. Describe TWO problems that result from removing the contaminated soil from the brownfield.

(b) Assume that the city council chooses the second option. Explain how vegetation could be used to decontaminate the soil. Discuss one advantage and one disadvantage of using this reclamation method.

(c) Describe and explain one environmental benefit and one societal benefit of brownfield reclamation.

(d) Identify and describe

(i) one method currently used to reduce the production of hazardous waste and

(ii) one method of legally disposing of hazardous waste.

(a) Two problems from removing the contaminated soil are, one once they have the soil, what will they do with it. Putting it in another area will just ruin the soil there, which would just move the problem not get rid of it. Another problem would be, what the effects of the soil removal will have on the life around it. Nutrient runoff may increase into streams, also plants around may need nutrients from that soil.

(b) Vegetation can be used by plants taking in the toxins in the contaminated soil and releasing them, to they are eventually depleted. This method would rid the soil of its contamination but, the toxins may then be released into the air causing the atmosphere to be hazardous, and harmful to breathe in.

GO ON TO THE NEXT PAGE.

ADDITIONAL PAGE FOR ANSWERING QUESTION 3

(c) An environmental benefit from brownfields reclamation is, hazardous chemicals will be removed from soil causing less destruction to the environment. A societal benefit is, new homes will be able to be built on this land once it becomes safe to live on. When the land is cleaned development can take place.

(d.) (i) To reduce the production of hazardous waste, energy is being conserved. The more energy conserved and items being reused, the less of a need for new items therefore reducing the amount of hazardous waste.

(ii) Some hazardous waste is locally disposed of by dispersing the waste into lakes and rivers.

3C,

3. The city of Fremont has a large brownfield located along the Fremont River. The brownfield is a former industrial site where contamination by hazardous chemicals impedes redevelopment. The city council is considering two options for reclaiming the brownfield. The first option is to excavate and remove the contaminated soil, and the second option is to decontaminate the soil on the site using vegetation.

(a) Assume that the city council chooses the first option. Describe TWO problems that result from removing the contaminated soil from the brownfield.

(b) Assume that the city council chooses the second option. Explain how vegetation could be used to decontaminate the soil. Discuss one advantage and one disadvantage of using this reclamation method.

(c) Describe and explain one environmental benefit and one societal benefit of brownfield reclamation.

(d) Identify and describe

(i) one method currently used to reduce the production of hazardous waste and

(ii) one method of legally disposing of hazardous waste.

Industrial sites cause a lot of contamination to many places because of the hazardous chemicals that are used.

A) Two problems that would result from removing the contaminated soil would be. One) that the wildlife in the soil will be displaced from their habitats causing a reduction in biodiversity and two) removing the contaminated soil would just cause it to leachate to somewhere else.

B) vegetation could be used to decontaminate the soil because every plant and crop takes up different nutrients out of the soil. An advantage to this is that it would get rid of the chemicals then would be no leachate anywhere else. A disadvantage to this would be that it would take a lot of time and effort.

C) One environmental ~~benefit~~ benefit of the brownfield Reclamation is that the contam-

GO ON TO THE NEXT PAGE.

3C2

ADDITIONAL PAGE FOR ANSWERING QUESTION 3

mixed soil is getting rid of one way or the other, one societal benefits of the Reclamation is that the society will benefits from the land in some way, shape, or form after the contaminated soil has been decontaminated,

b) i) one method of reducing the production of hazardous waste is to find another chemical that does the same thing but is not a hazard,

ii) one method of disposing hazardous waste is like the ocean dumping ban that says you can't dump it into the ocean

GO ON TO THE NEXT PAGE.

AP® ENVIRONMENTAL SCIENCE
2006 SCORING COMMENTARY

Question 3

Overview

This question assessed knowledge of contemporary environmental issues related to brownfield reclamation. Given two possible options for reclamation, students were required to describe problems that might occur with each. Differentiating between advantages and disadvantages of using plants to reclaim the brownfield was expected. The difference between an environmental and a societal benefit of reclamation had to be addressed. Part (d) also required knowledge of legal methods related to hazardous waste disposal and current methods to reduce production of these wastes.

Sample: 3A
Score: 10

Part (a): Two points were earned: 1 point for identifying the problem associated with erosion, and 1 point for saying that the removal of soil is "costly."

Part (b): This section earned 2 points: 1 point for indicating that the plant takes in the wastes from the soil, and 1 point for saying that a disadvantage of using plants is that it takes a "great amount of time." The advantage point was not earned: crops would not be safe for consumption if grown on the brownfield.

Part (c): This section earned 2 points. The environmental advantage point was earned for stating that the reclaimed land would be toxin-free and able to support a habitat. The societal point was earned for indicating that the area could be turned into a park.

Part (d): Four points were earned: 2 points in (di) for suggesting the use of alternate materials that do not produce hazardous wastes and providing an example of an alternative, and 2 points in (dii) for identifying and describing landfills.

Sample: 3B
Score: 6

Part (a): Two points were earned: 1 point for identifying the problem associated with where to put the contaminated soil, and 1 point for stating that removal disrupts the "life around" the area.

Part (b): Two points were earned: 1 point for stating that the plants will take in toxins from the soil, and the volatilization point for citing the disadvantage of using plants: "toxins may then be released into the air." The advantage point was not earned.

Part (c): The societal point was earned for indicating that the development of "new homes" will be possible. The environmental advantage point was not earned because the question is just restated.

Part (d): One point was earned in (di) for the method of reusing hazardous wastes. Part (dii) did not earn any points: hazardous wastes are not legally dumped in lakes and rivers.

Question 3 (continued)

Sample: 3C
Score: 3

Part (a): One point was earned for identifying the problem associated with disruption of the existing habitat. The second point was not earned.

Part (b): One point was earned for stating that the disadvantage of using plants is that it "would take a lot of time." No point was earned for stating that the plants will absorb the nutrients from the soil, since contaminates in the soil are not addressed. The advantage point was not earned because the mention of cleaning up the area is a restatement of brownfield reclamation.

Part (c): Neither the environmental advantage point nor the societal point was earned because the question is just restated.

Part (d): One point was earned in (di) for suggesting an alternative chemical that does not produce hazardous wastes. Part (dii) did not receive a point: hazardous wastes are not legally dumped in oceans.