

Lab-Yoretown Needs a Landfill

(modified from Oregon State University)

Instructions: Read the background information on the “Siting Yoretown’s New Landfill Informational Sheet” and review the “Map of Yoretown and Buckeye County” and “Anatomy of a Landfill”. Each student at your table should choose one site to analyze (circle YOUR site in the chart below) and fill in the chart on the back of this sheet. Then discuss all four sites with your group and answer the questions below.

Additional Site Information

Site	A	B	C	D
Acres	100	80	110	90
Property Cost	\$900,000	\$700,000	\$1,200,000	\$300,000
Development Cost per acre	\$300,000	\$280,000	\$300,000	\$310,000
Soil Depth & Type	4ft, silty clay	6ft, clay	3ft, sandy loam	1ft, sand
Bedrock	shale	limestone	clay	limestone
Uppermost Aquifer	65ft	85ft	45ft	35ft

Helpful Info:

Prevailing Winds (for odor): in Winter (from NW) and in Summer (from SE)

Zoning: how the land is used (farms, business, residential, etc)

Slope: Steep Slopes (contour lines are close together) and Gentle Slopes (contour lines are far apart)

Cost: (#acres * cost/acre) + property cost

Analysis Questions

1. What factors did you determine were most important in selecting a site for the landfill?
2. Was site A selected or rejected? What factors led you to this decision?
3. Was site B selected or rejected? What factors led you to this decision?
4. Was site C selected or rejected? What factors led you to this decision?
5. Was site D selected or rejected? What factors led you to this decision?
6. Identify two additional factors that could alter your decision of landfill placement. (not given in lab)
7. Why are some materials not allowed in standard municipal landfills? (not given in lab)
8. Hazardous materials must be disposed of in a hazardous waste landfill. What characteristics of the hazardous waste landfill would differ from a standard municipal landfill? (not given in lab – think design & soil characteristics)
9. Landfills are often associated with NIMBY. What is NIMBY?
10. How is NIMBY associated with Environmental and Social Justice?
(think about where landfills are typically located ... in WHOSE backyard, if not yours)

Name _____

LANDFILL SITE COMPARISON

Goals	Location			
	A	B	C	D
Cost				
Road Access				
Zoning				
Slope				
Soil Depth				
Soil Type				
Soil Permeability				
Bedrock				
Aquifer Depth				
Danger to Groundwater				
Odors to town				
Is the site > 1000 ft from homes?				
Is the site > 2000 ft from airport?				
Is the site >200 ft from river?				
Is the site > 1000 ft from nature preserve?				
Distance of Wells or Mines from site				
Is the site near Public buildings?				

SITING YORETOWN'S NEW LANDFILL INFORMATIONAL SHEET

Yoretown has a solid waste disposal problem. The landfill used for the disposal of its solid waste is near maximum capacity. Since Yoretown is so far from other disposal sites, it would not be cost effective to have the community's waste hauled elsewhere, although this remains an option.

The city council has discussed this problem with the Buckeye Solid Waste Management District Policy Committee. The city council and the solid waste district committee have identified four possible landfill sites for a new county landfill. These are on the outskirts of town. The committee now seeks technical advice on which is the best site. Therefore, the district has established a technical advisory council to investigate these potential sites.

Unless otherwise directed by your instructor, your group, representing the technical advisory council, must evaluate the information on each site. After completing the site evaluation sheets, rank the sites. The best site will meet the most criteria and have the least environmental impact. The number one recommendation must be defended with reasons why the site was selected over the others.

CRITERIA FOR EVALUATION

Geology

1. Slope and terrain - These conditions can be important because they determine how much earth must be moved to prepare the site and which direction the surface water will flow off the site.
2. Soil depth - Shallow soils might not provide enough soil for daily cover of the landfill. (Alternative covers, such as foam or canvas blanket, can be used to cover the landfill day by day when soil is difficult to obtain, but at an additional cost)
3. Soil type and permeability - Soil type will influence the permeability at the landfill site. As a rule of thumb, clay soils will have lower permeability than sandy soils (Table 1). The more permeable the soil, the more chance that rainwater can collect in the landfill and become a carrier for leachate (chemicals from the trash). The more impermeable the soil layer at the bottom of the landfill, the less likely leachate can seep through to the groundwater.

Table 1.

Soil Particle Type	Particle size Diameter (mm)	Permeability
Clay	Below 0.002	Very slow
Silt	0.05 - 0.002	Slow
Very Fine Sand	0.10 - 0.05	Moderately Slow
Fine Sand	0.25 - 0.10	Moderate
Medium Sand	0.5 - 0.25	Moderately Rapid
Coarse Sand	1.0 - 0.5	Rapid
Very Coarse Sand	2.0 - 1.0	Very Rapid

4. **Bedrock** - Exposed bedrock can have pores or fractures that allow the water to flow through. Bedrock of a less porous nature and, without fractures, lessens the chance for liquids to drain out of the landfill.

Groundwater

Depth of uppermost aquifer system - Many farms and cities rely on ground water for drinking water. Sites close to an existing water well or well field should be carefully evaluated. There should be at least 15 feet between the bottom of the landfill (landfill liner) and the uppermost aquifer.

Gas Migration

Potential explosive gas migration - Over a period of time as waste decomposes, explosive gases such as methane can develop. Potential pathways for this gas to migrate beyond the landfill include underground utility structures such as sewers, water lines or electric cables, pipelines, oil wells, and gas wells. These should not be within 1000 feet of the landfill.

Wells, Mines, and Quarries

Wells, mines, and quarries can be sources of potential subsidence, especially if within 2,000 feet of the buried solid waste. Subsidence can cause rupturing of the liner systems which are designed to contain hazardous liquids that collect at the bottom of landfills.

Other Issues

1. **Access** - Can trucks get to it? Can traffic be managed?
2. **Zoning and land use** - What is the land currently used for? Is the land more valuable for those uses? How will a landfill affect growth and development in general, and in particular, at this specific site?
3. **Location** - Would the presence of a landfill cause any detriment to an already established cultural feature?
4. **Residence** - No solid waste placement can be within 1,000 feet of a home whose owner has not consented to construction of the landfill.
5. **Natural features** - Generally it is unacceptable to locate solid waste landfill within 200 feet of a stream, lake or natural wetland unless proof of satisfactory diversion of stream or protection of the lake is offered.
6. **Airports** - If solid waste is placed within 10,000 feet of an airport serving turbine-powered aircraft or within 5,000 feet of an airport serving piston-type aircraft, the permit application must demonstrate that the facility will not pose a bird hazard to aircraft.
7. **Nature preserves** - A landfill cannot be located within 1000 ft of nature preserves.

Typical Anatomy of a Landfill

Protective Cover

- 1 **Cover Vegetation**
As portions of the landfill are completed, native grasses and shrubs are planted and the areas are maintained as open space. The vegetation is visually pleasing and prevents erosion of the underlying soils.
- 2 **Top Soil**
Helps to support and maintain the growth of vegetation by retaining moisture and providing nutrients.
- 3 **Protective Cover Soil**
Protects the landfill cap system and provides additional moisture retention to help support the cover vegetation.

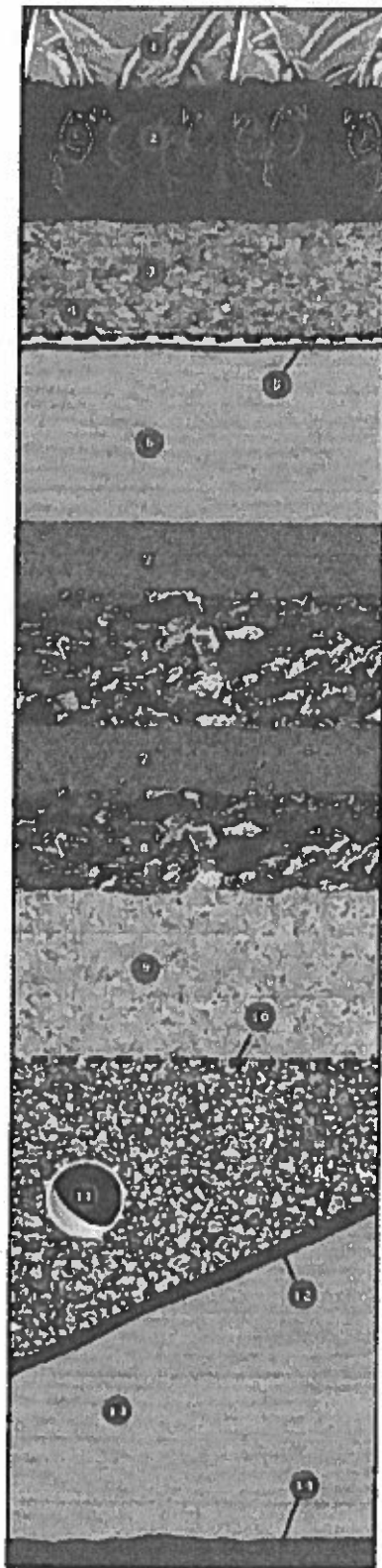
Composite Cap System

- 4 **Drainage Layer**
A layer of sand or gravel or a thick plastic mesh called a geonet drains excess precipitation from the protective cover soil to enhance stability and help prevent infiltration of water through the landfill cap system. A geotextile fabric, similar in appearance to felt, may be located on top of the drainage layer to provide separation of solid particles from liquid. This prevents clogging of the drainage layer.
- 5 **Geomembrane**
A thick plastic layer forms a cap that prevents excess precipitation from entering the landfill and forming leachate. This layer also helps to prevent the escape of landfill gas, thereby reducing odors.
- 6 **Compacted Clay**
Is placed over the waste to form a cap when the landfill reaches the permitted height. This layer prevents excess precipitation from entering the landfill and forming leachate and helps to prevent the escape of landfill gas, thereby reducing odors.

Working Landfill

- 7 **Daily Cover**
At the end of each working period, waste is covered with six to twelve inches of soil or other approved material. Daily cover reduces odors, keeps litter from scattering and helps deter scavengers.
- 8 **Waste**
As waste arrives, it is compacted in layers within a small area to reduce the volume consumed within the landfill. This practice also helps to reduce odors, keep litter from scattering and deter scavengers.

Please Note: This illustration depicts a cross section of the standard environmental protection technologies of modern landfills. While the technologies used in most landfills are similar, the exact sequence and type of materials may differ from site to site depending on design, location, climate and underlying geology.



(Not to scale)

Leachate Collection System

Leachate is a liquid that has filtered through the landfill. It consists primarily of precipitation with a small amount coming from the natural decomposition of the waste. The leachate collection system collects the leachate so that it can be removed from the landfill and properly treated or disposed of. The leachate collection system has the following components:

- 9 **Leachate Collection Layer**
A layer of sand or gravel on a thick plastic mesh called a geonet collects leachate and allows it to drain by gravity to the leachate collection pipe system.
- 10 **Filter Geotextile**
A geotextile fabric, similar in appearance to felt, may be located on top of the leachate collection pipe system to provide separation of solid particles from liquid. This prevents clogging of the pipe system.
- 11 **Leachate Collection Pipe System**
Perforated pipes, surrounded by a bed of gravel, transport collected leachate to specially designed low points called ramps. Pumps, located within the ramps, automatically remove the leachate from the landfill and transport it to the leachate management facilities for treatment or another proper method of disposal.

Composite Liner System

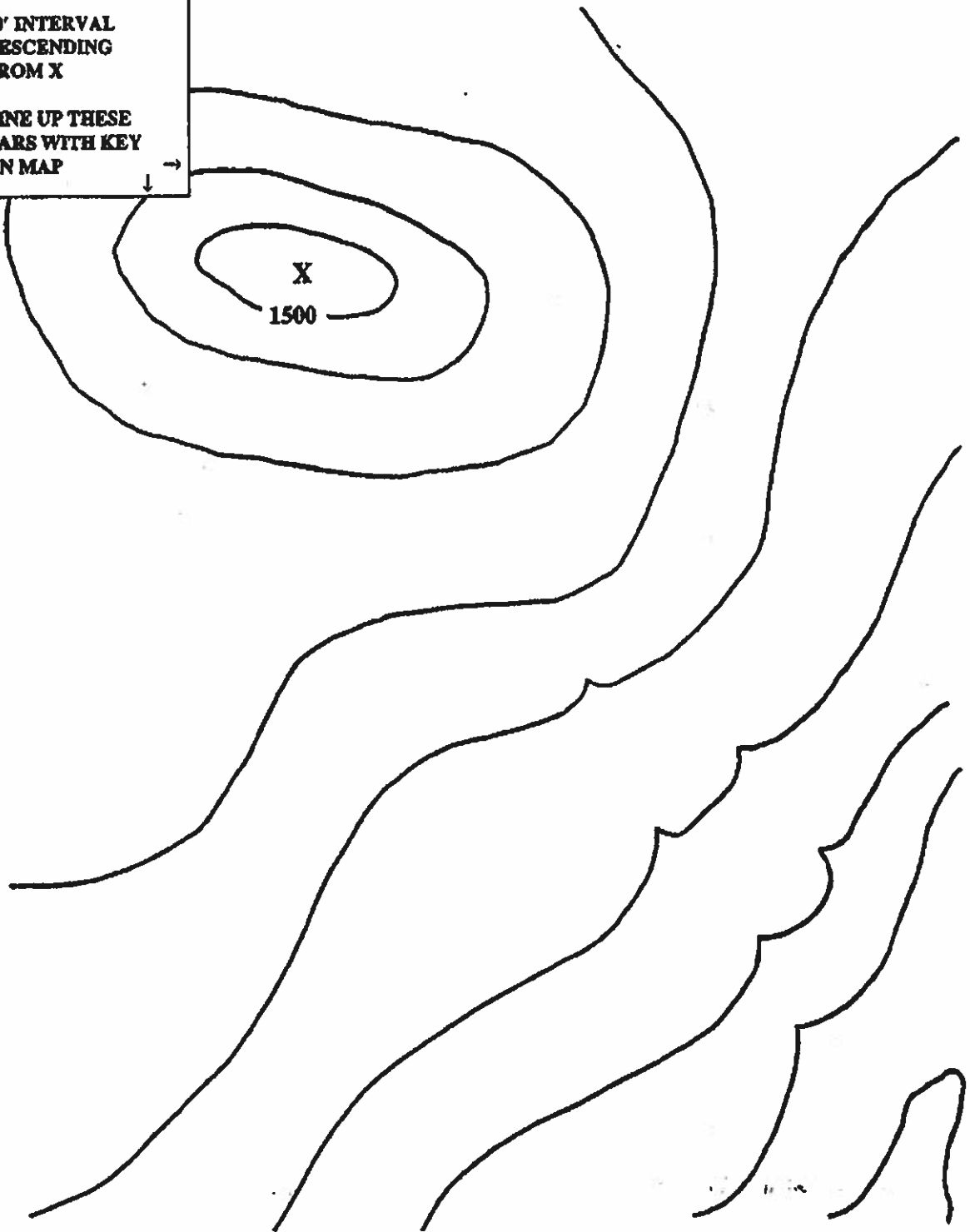
- 12 **Geomembrane**
A thick plastic layer forms a liner that prevents leachate from leaving the landfill and entering the environment. This geomembrane is typically constructed of a special type of plastic called high-density polyethylene or HDPE. HDPE is tough, impermeable and extremely resistant to attack by the compounds that might be in the leachate. This layer also helps to prevent the escape of landfill gas.
- 13 **Compacted Clay**
Is located directly below the geomembrane and forms an additional barrier to prevent leachate from leaving the landfill and entering the environment. This layer also helps to prevent the escape of landfill gas.

- 14 **Prepared Subgrade**
The native soils beneath the landfill are prepared as needed prior to beginning landfill construction.

TOPOGRAPHY OF TERRAIN

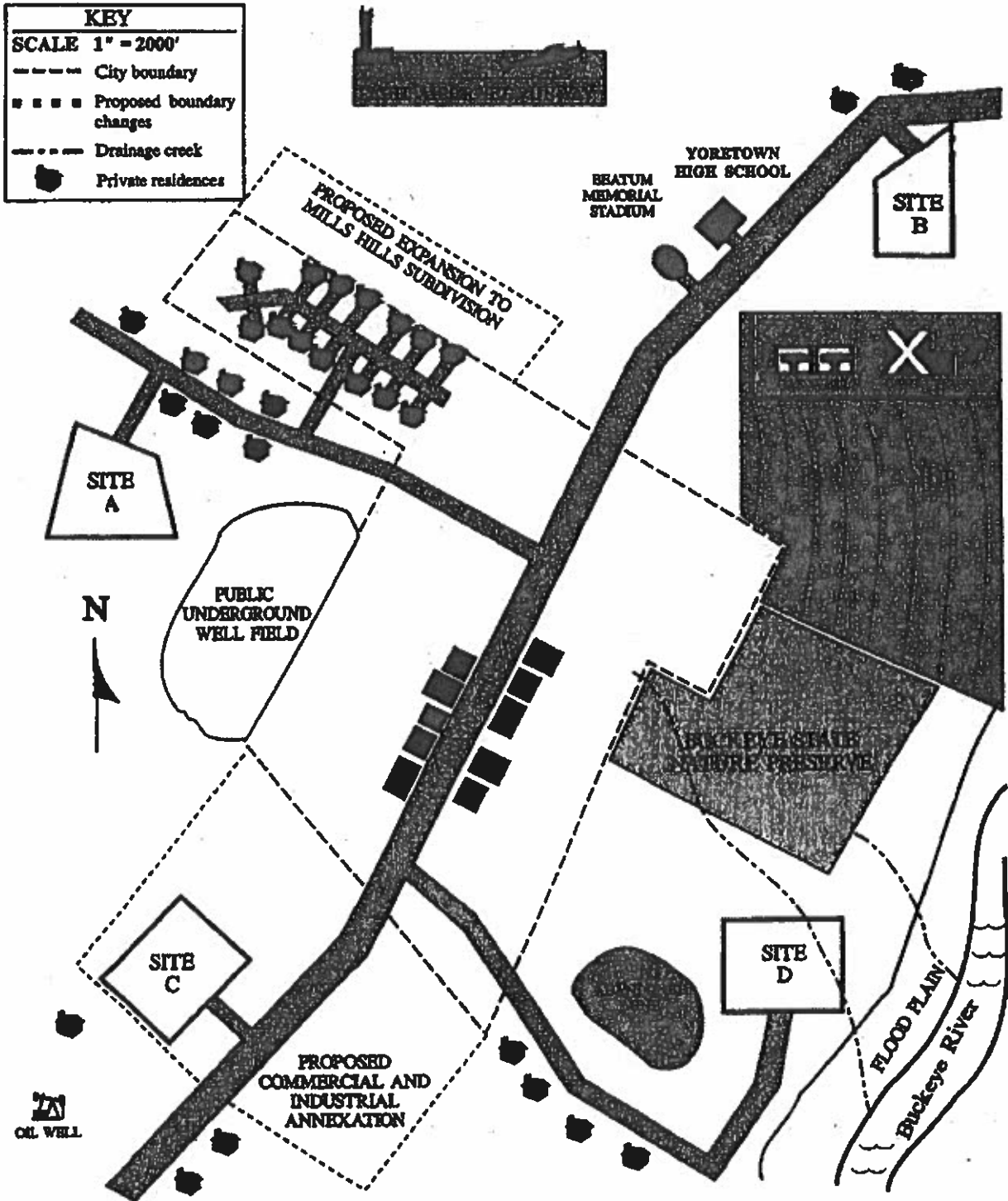
20' INTERVAL
DESCENDING
FROM X

LINE UP THESE
BARS WITH KEY
ON MAP



Investigating Solid Waste Issues: Ohio Department of Natural Resource

MAP OF YORETOWN AND BUCKEYE COUNTY



Investigating Solid Waste Issues, Ohio Department of Natural Resources