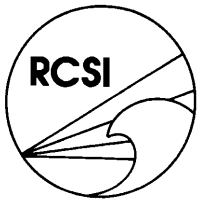


*Rochester Committee*
*for Scientific Information*
*Rochester, NY*

*RCSI Bulletin 177*
*Demonstration of a Method for Locating Potential Sites for Sanitary Landfills: Penfield, Monroe County, New York*

*By: R. Laurence Davis*
*February 1975*

*THE ROCHESTER COMMITTEE FOR SCIENTIFIC INFORMATION*
*P. O. Box 5236, River Campus Station*
*Rochester, New York 14627*

Bulletin #177

February 1975

# Demonstration of a Method for Locating Potential Sites for Sanitary Landfills: Penfield, Monroe County, New York

by
R. Laurence Davis*

## Summary

A new sanitary landfill is being planned at the southeast corner of Gloria Drive and Kennedy Road in Penfield. It is the first in Monroe County to be chosen through a screening procedure based on the geological characteristics of the ground.

Standards for satisfactory physical, environmental and cultural conditions are set before any area is excluded from consideration. Then areas are eliminated as they fail to meet the standards. Elimination was a three-step process. In the first, areas which did not meet standards for depth to bedrock and ground water, type of bedrock, and surface land use were eliminated. The remaining areas were examined more closely in the second phase. All or parts of areas were eliminated if they did not meet the standards for size, soil permeability, soil suitability for cover material, visual screening, topography, accessibility, haul distance and surface ecosystem compatibility (among other criteria). The remaining areas were subjected to field testing in a third phase, to confirm the findings of the first two phases and to look for any physical or cultural conditions which were not noted earlier. The data and a list of recommended sites were provided to the County administration for a final decision. In the case of Penfield, several possible sites were recommended and the site at Gloria Drive was selected by the County from the group.

It was found that it was difficult to apply this method in Monroe County, N.Y. because of the lack of sufficient, up-to-date information on geological conditions. New York does not have a law requiring water well drillers to keep accurate logs of the wells that they drill. Most other states(including Massachusetts, Indiana, Illinois, Missouri, and others) have such a law and these logs, which are on file for public use at the State Geological Survey, provide much valuable information on ground water, surface materials and bedrock. Such a law, which would make site selection processes such as the one described here a good deal simpler and less costly, should be seriously considered in New York State.

## Background

The sanitary landfill is by far the most common method for disposing of solid municipal waste. In a sanitary landfill, waste is deposited in units of specified size, called "cells". Each cell is covered, as soon as it is completed, with soil or other suitable material to prevent three undesirable conditions from occurring: 1) blowing or washing of waste from the site; 2) entry of insects and rodents and 3) (ideally) entry of water. These problems are all characteristic of the old-style "dump". Consequently, the proper covering of the waste is an important difference between a dump and a sanitary landfill.

* Department of Geological Sciences, University of Rochester

There are three basic methods of operating a sanitary landfill:

(1) In the "fill" method, cells are placed in a natural depression or valley.

(2) The "area" method spreads the cells over a relatively flat area, thereby raising the ground elevation.

(3) In the "trench" method a trench is dug and filled with cells.

Often the trench and area methods are combined and additional cells are spread on top of the filled trenches.

In order to choose an acceptable site for a sanitary landfill, the impacts of a landfill on the environment around it must be known. The first, and one of the most important of these impacts, is the production of leachate, a solution of water and waste. Leachate frequently contains toxic and harmful chemicals, organic matter and microorganisms. If allowed to leave the landfill without sufficient natural or artificial treatment, it will pollute ground and surface waters. Other possible impacts are alterations in surface runoff patterns and changes in ground water elevations. There are, of course, important biological and cultural impacts such as noise, odor and other nuisance caused to neighbors, incompatibility with the natural ecosystem or human land use, etc. These also must be considered in selecting a site.

A desirable site will minimize as many of these impacts as possible simply through its geologic and geographic attributes. Careful site selection also minimizes the extent of engineering procedures necessary to correct any objectionable characteristics. The desirable attributes of a site can be considered in two categories, geologic-pedalogic and cultural-ecologic. In the first category, the following characteristics should be met. The site should be hydrologically isolated so as to minimize the production and movement of leachate. There should be sufficient depth to bedrock so that there will be no interference with excavation. There should be no steep slopes or other topographic features that might make operations difficult or pose landslide problems, either during or after the operation of the landfill. Finally, there should be enough cover material of acceptable quality either on the site or very near to it.

Among the desirable cultural-ecologic attributes are the following. There should be no conflicting land use near the site and the existing land use on the site should be such that no great loss of valuable resources will be caused by the conversion to a landfill. In other words, the site should not be a vacant lot in the middle of a subdivision (for example) in the first case or a valuable vineyard, sand and gravel pit, etc. in the second. The site should be easily accessible, both in respect to the roads that must be traveled or built and in distance from the waste source. The landfill must be compatible with the existing ecosystem on the site, and, finally, the site should be screened from the view of both passers-by and nearby residents.

## Method for Locating Potential Landfill Sites

In order to meet the above requirements for a good landfill site, a method of site selection was derived from suggestions by McHarg (1) and Miles (2). A similar method was used by the author to find a landfill site for Tippecanoe County, Indiana (3).

The general procedure is outlined in Table 1. The method is based on the premise that all parts of the region under consideration are initially acceptable and then those parts of the region not meeting standards of a good site are eliminated, leaving only potentially good sites.

Before beginning, it is first necessary to assemble all of the available information about the region under consideration. Some of the types of information needed are shown in Table 1. In some cases maps will be available in a usable form and in others they will have to be constructed from whatever data can be obtained. One frequent problem is map scale. All maps used for this procedure should be uniform in scale, but available maps generally vary greatly in scale.

In the first phase, the entire region is under consideration. Minimum acceptable standards are set for depth to bedrock and groundwater, bedrock type and compatible land uses (both "on site" and adjacent). For each of these items, a transparent map overlay is made. All areas which do not meet the standards are colored red. When the four overlays are combined, the areas remaining uncolored can be called "potential landfill areas" and considered in Phase II.

Table 1. Outline of Method

PRELIMINARY

Step 1: Assemble available data
2: Gather and/or construct base maps
- Groundwater, Bedrock, Topography, Drift/Overburden, Thickness, Surficial Geology, Engineering Soils, Agricultural Soils, Land Use, Air Photos, etc.

PHASE I

Step 1: Set standards for:
a) Depth to Bedrock
b) Depth to Groundwater
c) Bedrock Type
d) Conflicting Land Use
2: Make overlays for a-d above
3: Combine overlays and outline "POTENTIAL LANDFILL AREAS"

PHASE IIA

Step 1: Set minimum acceptable size
2: Eliminate undersize areas
3: Point scores for:
a) Soil Permeability
b) Cover Material Quantity
c) Cover Material Quality
4: Set minimum acceptable score and eliminate those below

PHASE IIB - FIELD CHECK

Step 1: Point scores for:
a) Topography
b) Ecosystem Compatibility
c) Present Land Use
d) Screening
e) Nuisance to Neighbors
2: Set minimum acceptable score and eliminate those below - remaining areas are "POTENTIAL LANDFILL SITES"

PHASE IIC - ACCESS

Step 1: Rate each potential site for:
a) Accessibility
b) Haul Distance
2: HIGH SCORES - "Primary Potential Sites"
LOW SCORES - "Secondary Potential Sites"

PHASE III - FIELD TESTING

Phase II consists of three parts. The first consists of further map studies, the second a field check and the third an access study. The first step is to select the desired minimum size for the site and then eliminate all smaller areas. The other steps consider only the remaining areas. These areas are then rated on a 1 (poor) to 5 (excellent) scale for each of the following characteristics: soil permeability (moderate impermeability is desirable) and cover material quality and quantity. The points are totaled and those areas that fall below a minimum acceptable score are eliminated. The remaining areas are then considered in the second part of Phase II, the field check.

The work up to this point has been done from available records, with no visits to the sites. Site visits are now required for areas still under consideration. Each area is assigned a rating (1 - 5) for the following characteristics: topography (no steep slopes); ecosystem compatibility (are there rare species present?, etc.); present land use (valuable agricultural land, new subdivision not shown on the land use maps, etc.); screening; and nuisance to neighbors (will the trucks pass through congested areas?, will the noise of operations be easily heard?, etc.). Again a minimum acceptable point score is set and those meeting it are deemed "potential landfill sites". These are considered in the third part of Phase II.

Each of the potential sites is now rated for accessibility (How close is it to a major road? What routes must be used? What is the condition of the roads? etc.), and haul distance. Those sites with high ratings can be considered "primary potential sites" and those with lower ratings can be considered "secondary potential sites".

During Phase III, actual field tests are performed on some or all of the potential sites. The sites to be tested can be chosen by the public officials who must eventually approve the site, or there may be another screening on technical grounds such as availability of the land for purchase, number of parcels in the potential site, etc. Tests include drilling, digging, measurements of quality and quantity for both ground and surface waters. Tests are done to confirm the conclusions of Phases I and II and also to try and uncover unknown drawbacks. Tests also provide information for preliminary engineering designs.

## The Penfield Example

This method has been demonstrated in the Town of Penfield, Monroe County, New York. The first site selected for development by the method is in Penfield.

The study was conducted by Monroe County Environmental Management Council (preliminary and Phase II) and by the author (Phase I). Phase III was performed by the Monroe County Public Works Department with the aid of an outside consultant.

The information available for this study included: topographic maps(scales, 1 inch= 2000 feet, 1 inch = 1200 feet and 1 inch = 800 feet); existing land use map (scale 1 inch = 800 feet); soil survey (scale 1 inch = 1320 feet); and a ground water report prepared in 1935 (4) which lists all of the wells then known in the County. Well data included depth of well, depth to bedrock, water, water-bearing rock formation, and some water quality information. From this information, additional maps were constructed at a scale of 1 inch = 1200 feet, showing depth to groundwater, depth to bedrock, ground water elevation and potential recharge areas.

The standards used in Phase I are shown in Table 2. After overlays were prepared (Figures 1 a - e), 35 potential landfill areas were located. All areas smaller than 50 acres were eliminated, and the remainder were rated for soil permeability, and cover material quality and quantity (Table 3). Those with less than 10 of 15 possible points were eliminated. The remaining areas were rated in the field using the sheet illustrated in Figure 2. The results of this rating are shown in Table 3. All areas with less than 15 of 25 points were eliminated, leaving 11 potential landfill sites. Finally, those areas adjacent to a state highway were rated as having "good" access, county highway rated "average", a town road "poor" access. Then the potential sites were transmitted to the County Public Works Department for consideration. Drilling was ordered at 5 sites, and the site on Gloria Drive (#30 in Figure 1e) was selected. It is now under development.

Table 2. Standards for Potential Landfill Sites in Penfield. It was assumed that the method of landfill construction would be the trench method, initially excavated to a depth of ten feet. The standards set are based on this assumption.

DEPTH TO BEDROCK

| | |
|---|---|
| Low Permeability Bedrock | 15 feet |
| Permeable Bedrock | 25 feet |
| in a potential recharge zone | 30 feet |

DEPTH TO GROUNDWATER

| | |
|---|---|
| Normal | 15 feet |
| In Potential Recharge Zone | 25 feet |

COMPATIBLE EXISTING LAND USES

(Monroe County Planning Council Classifications)

1) Commercial Recreation Outdoor
2) Junk Yards
3) Dumps
4) "Other Open Space"
5) Agricultural Land
6) Vacant Land

BEDROCK TYPE

Sand and Gravel (Valley Fill) - Unacceptable

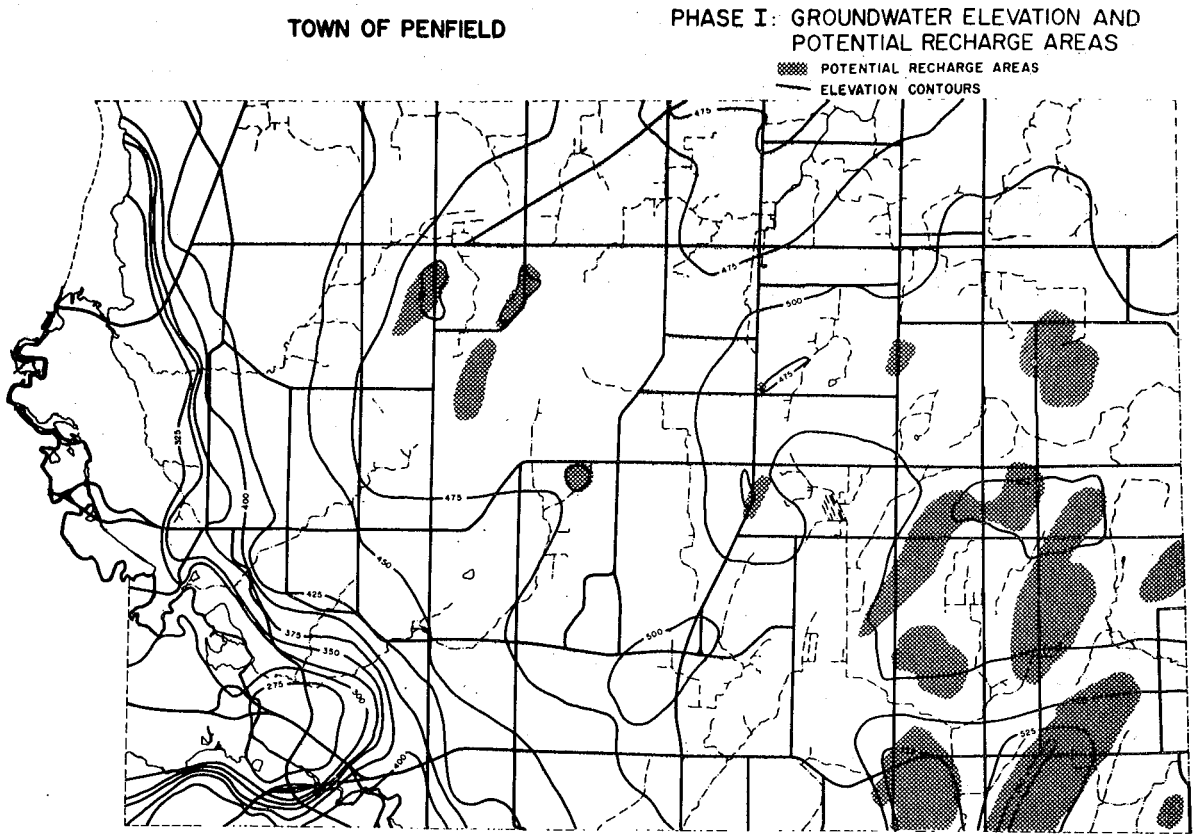


Figure 1a: Ground Water Elevation and Areas of Potential Ground Water Recharge

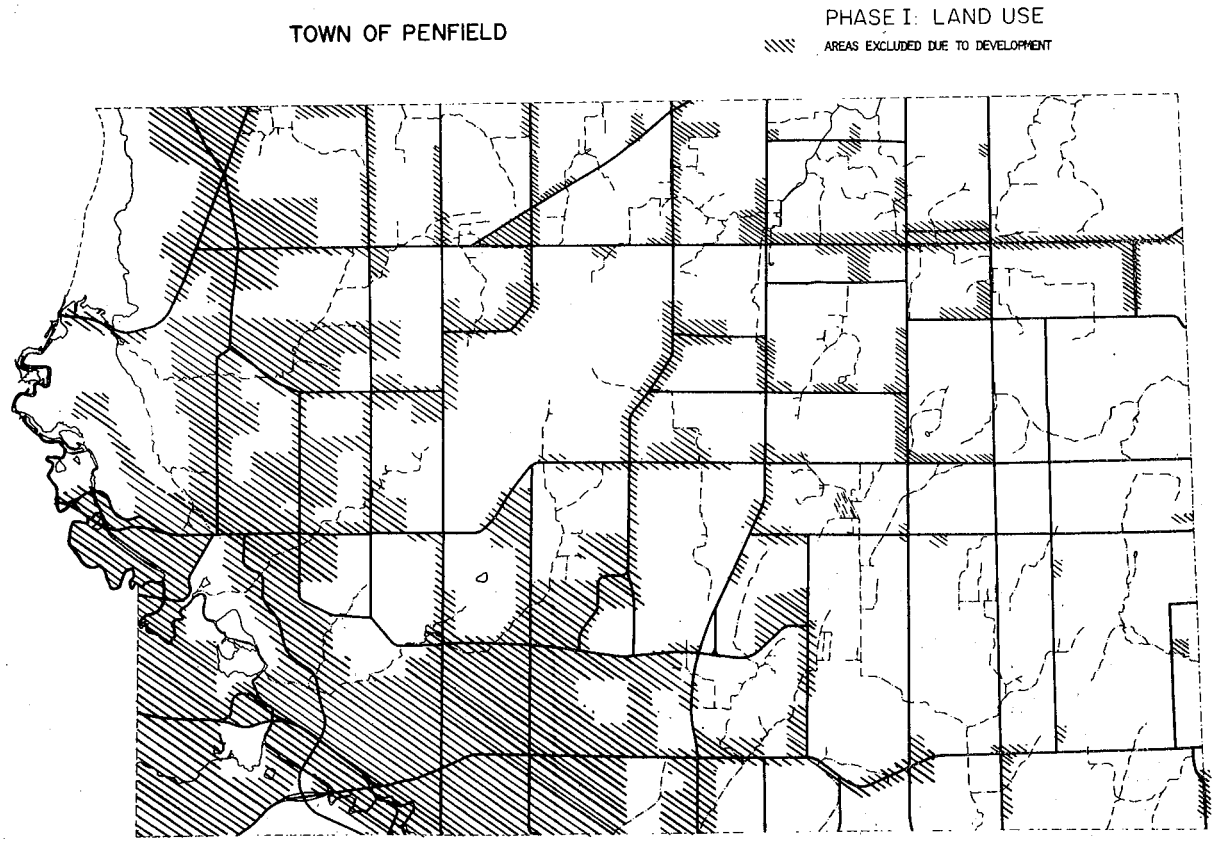


Figure 1b: Areas Excluded by Existing Land Use

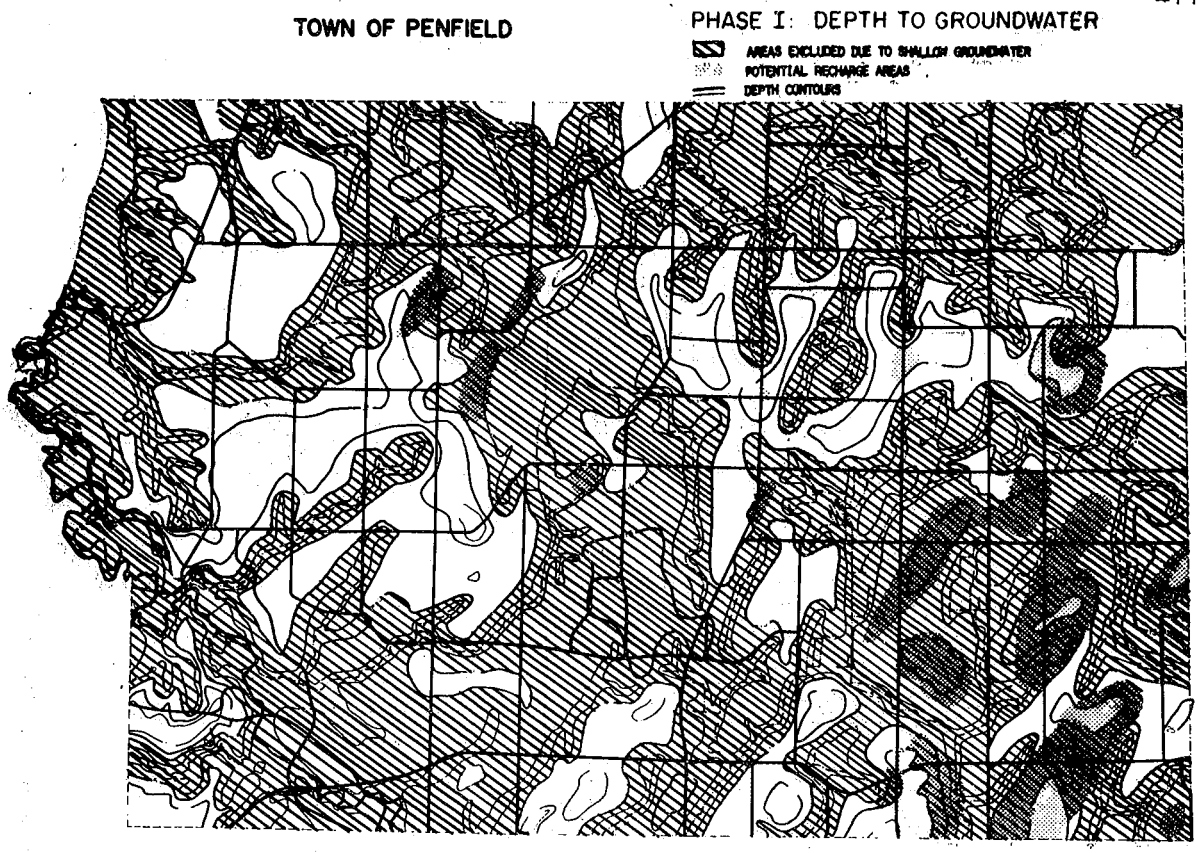


Figure 1c: Areas Excluded by Depth to Ground Water

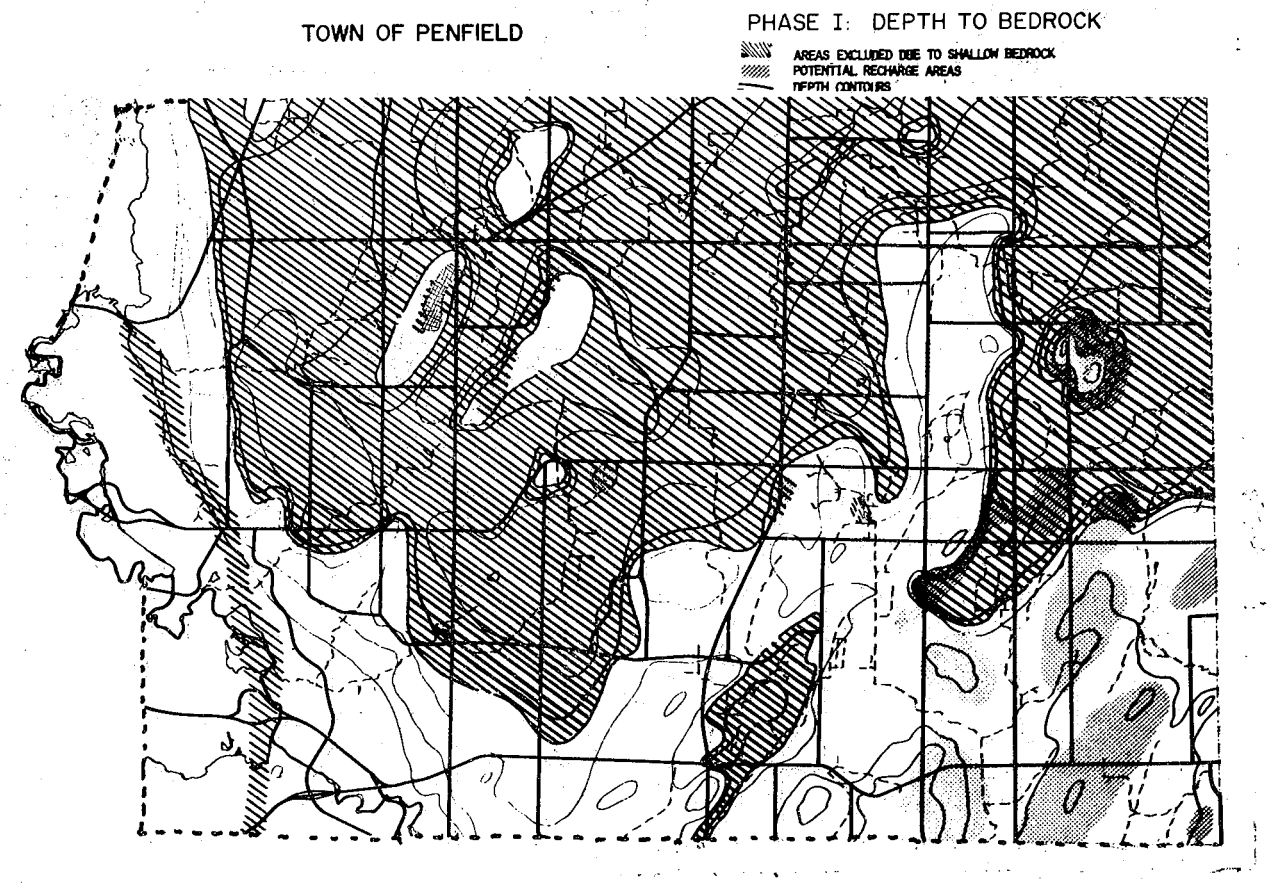


Figure 1d: Areas Excluded by Depth to Bedrock

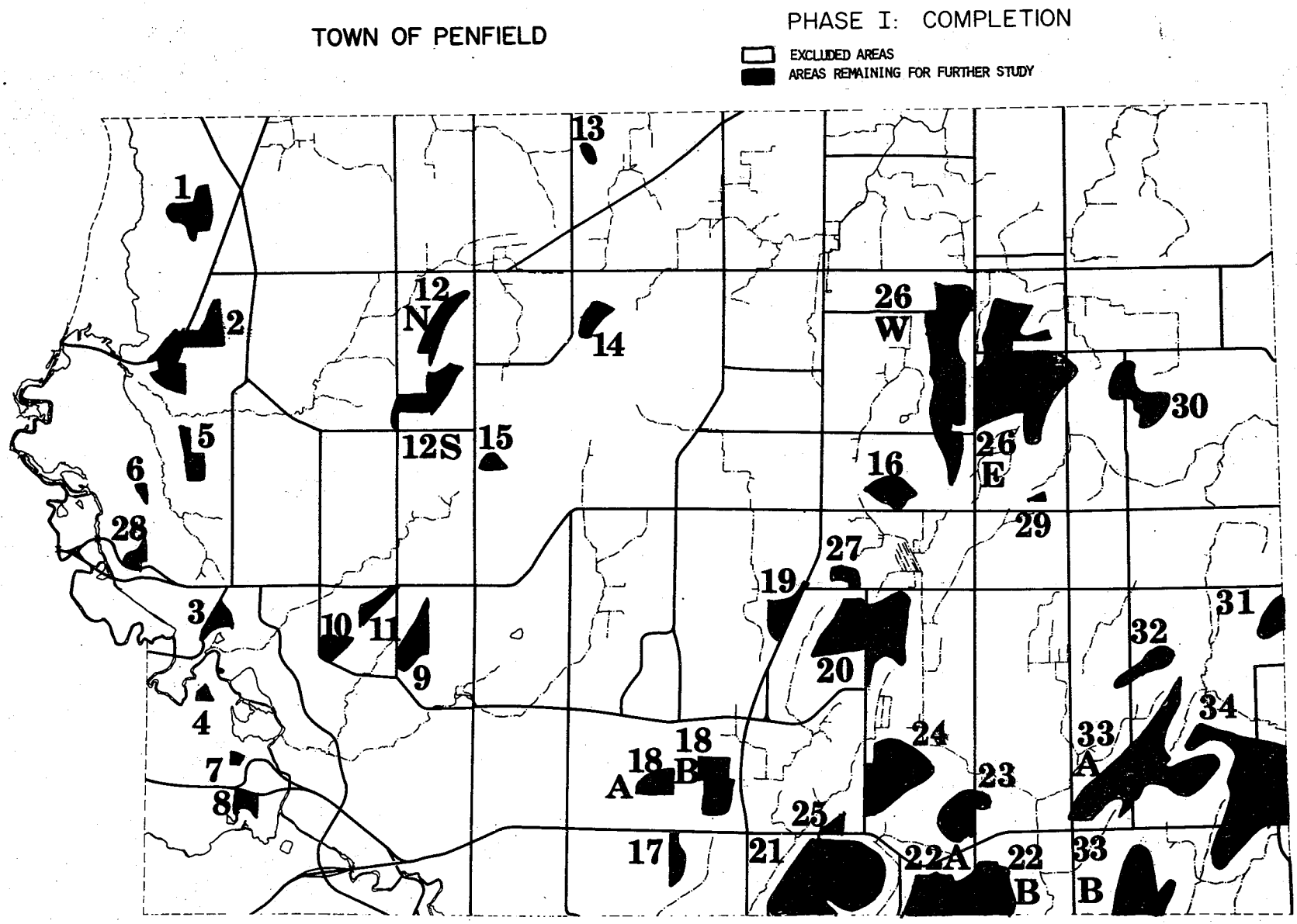


Figure 1e: Potential Landfill Areas

| CRITERIA | AREA NUMBER | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SIZE - 50 acres plus | 13 | 20 | 21 | 22A | 22B | 23 | 26E | 26W | 30 | 32 | 33A | 33B |
| SOILS (1) Permeability | 3 | 4 | 4 | 4 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 4 |
| Rated (2) Cover Quantity | 3 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 5 | 5 | 5 | 5 |
| on a (3) Cover Quality | 3 | 4 | 4 | 4 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 1(poor) | 9 | 13 | 13 | 13 | 11 | 12 | 13 | 12 | 13 | 13 | 13 | 13 |
| to 5(excellent) | | | | | | | | | | | | |
| scale for each | | | | | | | | | | | | |
| category | | | | | | | | | | | | |
| -15 total | | | | | | | | | | | | |
| Area numbers scoring 10 points or more | | 20 | 21 | 22A | 22B | 23 | 26E | 26W | 30 | 32 | 33A | 33B |
| FIELD CHECK | | | | | | | | | | | | |
| (1) Topography | | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 4 | 3 | 3 | 4 |
| (2) Ecosystems | | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 4 | 4 | 4 | 4 |
| (3) Present Land Use | | 2 | 2 | 4 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 |
| (4) Screening | | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 3 | 1 | 2 | 1 |
| (5) Nuisance to Neighbors | | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 2 |
| TOTAL (1-5 scale) -25 possible | | 12 | 12 | 15 | 12 | 13 | 11 | 13 | 17 | 12 | 14 | 14 |
| Area numbers scoring 14 points or more | | | | 22A | | | | | 30 | | 33A | 33B |
| ACCESS | | | | Avg. | | | | | Good | | Good | Good |

RECOMMENDATIONS 15 points or more and good access = primary
15 points or more and average access or 14 points and good access = secondary

PRIMARY AREAS - 30
SECONDARY AREAS - 22A, 33A, 33B

TABLE 3

Phase II Ratings for Areas in Penfield

Figure 2. Field Sheet Used in Phase II in Penfield

Site Selection - Phase II - Field Check Data Sheet

Town of _____
Area No. _____

Comments

I. Compatibility Factors

A. Topography
1) Steep slopes
2) Low wet areas
3) Availability of natural barriers (land relief)
4) Surface drainage

Rating (1 to 5) _____

B. Ecosystems
1) Prime farmland
2) Large and valuable woodlot
3) Wetland or marsh
4) Unique geology
5) Large stream
6) Hazard area (floodplain)

Rating (1 to 5) _____

C. Present Land Use
1) Woodland (%)
2) Agricultural (%)
3) Non-Agricultural open (%)
4) Wetland (%)
5) Other
6) Within Agricultural District
7) Adjacent land use

Rating (1 to 5) _____

D. Screening
1) Availability of natural barriers (trees)
2) Use of artificial barriers (berms)

Rating (1 to 5) _____

E. Nuisance to Neighbors
1) Distance to nearest neighbor
2) View from road
3) View from neighbors

Rating (1 to 5) _____

Section I - Total Rating _____

II. Transportation

A. Access
1) Onto site
2) Type of existing roads and condition
3) Routing through population centers

B. Haul distance
1) From City
2) From other population centers

## Conclusions

The method set forth here for finding potential landfill sites has been successfully demonstrated in Tippecanoe County, Indiana (3) and in Penfield, New York. It is currently being used to identify potential landfill sites in the other 18 towns in Monroe County, New York. The experience in Monroe County has shown the method to have several important advantages.

It provides a methodical scientific approach to replace rather haphazard and often politically guided procedures for resolving an issue which is frequently highly charged with emotion. The method and its results are simple and easily understood by citizens and public officials. The method is inexpensive. The cost for the entire procedure through Phase II for all 19 towns in Monroe County was only about $10,000 including the cost of staff work in County agencies. Not included in the cost, however: a) salaries for Environmental Management Council staff time; b) many hundreds of hours put in by the volunteer citizens and specialists serving on the Landfill Monitoring Committee and the Environmental Management Council in guiding the landfill study. The sites identified by this method should require a minimal amount of special engineering alteration, because the method selects those sites which have inherently good characteristics. Finally, the method is extremely flexible. At any point standards may be lowered and additional sites identified, although these may require remedial alteration at added cost.

The primary disadvantage of this method is the necessity for sufficient information about the region. In Monroe County, the bare minimum of necessary information was available, including a large portion of out-of-date information. The deficiency is in part explained because the New York Geological Survey and the U.S. Geological Survey have done almost no work in Western New York, and local universities appear to be completely uninterested in survey studies of surface and shallow depth.

This method can be used also in many other problems of site selection simply by identifying the requirements and setting standards at appropriate levels. The author has successfully used it to locate potential sites for a large cattle feed lot in Tippecanoe County, Indiana and McHarg (1) has used a similar method to locate highway corridors, in New York.

## References

(1) McHarg, Ian, *Design with Nature*. New York: Doubleday, 1969

(2) Miles, Robert D., Class notes for "Engineering Site Selection", Purdue University, Spring, 1972

(3) Davis, R. Laurence; West, Terry R.; Rundel, Ralph T., *Applying Environmental Geology Concepts to Urban Development Planning; An Example: Tippecanoe County, Indiana.* Paper delivered at the meeting of The Society of Mining Engineers in Birmingham, Alabama, October, 1972

(4) Legette, R. M. et al., *Ground Water Resources of Monroe County, N.Y.*, Monroe County Planning Council, Rochester N.Y., 1935