United States
Environmental Protection
Agency

Municipal Environmental Research
Laboratory
Cincinnati OH 45268

Research and Development

EPA-600/S2-83-055 Aug. 1983

EPA

Project Summary

Standardized Procedures for Planting Vegetation on Completed Sanitary Landfills

Edward F. Gilman, Franklin B. Flower, and Ida A. Leone

A manual was developed for those charged with establishing a vegetative cover on completed landfills. Special problems associated with grownig plants on these sites are discussed, and step-by-step procedures are given for converting a closed landfill to a variety of end uses requiring a vegetative cover. Instructions are given for vegetating landfills with either limited or adequate funds. A hypothetical case of landfill conversion is also included.

This Project Summary was developed by EPA's Municipal Environmental Research Laboratory, Cincinnati, OH, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

Completed landfills throughout the United States are being developed into parks, golf courses, nature areas, and other multiple-use facilities. An effective vegetative stand must be established and maintained on the final cover soil to achieve one of these successful end uses, however. This manual was written for those charged with establishing such a vegetative cover.

Step-by-step procedures are given for vegetating a completed landfill with either limited or adequate funds. Each step is to be performed in sequence. A hypothetical case of landfill conversion to a multiple-use recreational facility is also described to illustrate the procedures outlined in the manual. This hypothetical site includes a nine-hole golf course, botanical garden, toboggan run, picnic area, nature area, tree and shrub nursery, bicycle paths, and campgrounds.

Data were collected from more than 60 site visits in 21 states, other field experiences, textbooks, and standard references on the growth of plants under adverse conditions.

Vegetating Landfills with Limited Funds

Step A-1. Selecting an End Use

An end use should be selected as soon as possible. In cases where funds are limited, the plan might include a park, a hunting ground, or a natural open space for trees, shrubs, and grasses. Intensive recreational uses such as golf courses require greater expenditures.

Step A-2. Determining Depth of Cover

Cover soil must be at least 60 cm deep for grass establishment and 90 cm for trees. Soil depth can be determined with a backhoe or a soil auger and shovel. A minimum of one hole per acre should be dug for large sites (50 acres) and two holes per acre for smaller areas. When funds are limited, trees may be planted wherever 90 cm of cover soil exists, or soil may be moved from one section of the site to the area desired for tree planting.

Step A-3. Establishing an Erosion Control Program

The soil on recently covered landfills must be stabilized soon after spreaing to prevent erosion. Because the soil is frequently of poor quality and growing conditions are often adverse, a one-growing-season study should be

conducted to select landfill-tolerant grasses. Seeds should be handspread and raked into the soil. Mulch and tack should be used to hold the seed in place in sloping areas and to conserve moisture. Microterracing is recommended before seeding and mulching for steep, sloping ground. Grass and ground cover growth should be evaluated once a month by a qualified specialist during the first 4 to 6 months.

Step A-4. Determining the Soil Nutrient Status

Before or during the grass and ground cover experiments, soil tests should be made for pH, major nutrients (nitrogen, potassium, and phosphorus), conductivity, bulk density, and organic matter. Samples should be collected over the entire landfill in a number of areas within the proposed planting sites. The local county agricultural agent or soil conservation service office can help evaluate site specific problems and recommend the addition of fertilizer or lime.

Step A-5. Determining Soil Bulk Density

Cover soil is frequently compacted by landfill equipment during spreading operations to bulk densities that will severely restrict plant root growth. Bulk density can be determined by weighing two or three undisturbed soil cores of a known value for each acre. Compacted soil should at least be scarified and organic matter should be added to enhance the physical properties.

Step A-6. Amending Cover Soil

The soil over the entire planting area should be amended with lime, fertilizer, and/or organic matter according to the recommendations from the soils laboratory one to several weeks before planting. These materials should be incorporated into the top 15 cm of soil.

Step A-7. Selecting Landfill-Tolerant Species

Grasses and other ground covers can be selected for planting in the soil cover by evaluating the results of the experimental plots established earlier to determine landfill-tolerant species.

Step A-8. Planting Grass and Ground Covers

No studies have been done to define the best planting techniques for establishing grasses on landfills, but it is generally desirable to embed the seed in the soil. Mulches have been used as an alternative to embedding the seed, but this approach is less likely to be effective on adverse growing sites such as landfills. Mulches must be used on steep slopes where embedding or drilling is impossible. Special techniques such as hydroseeding may be used on steep slopes inaccessible to conventional equipment. Gently sloping or flat sites may be planted by any of a number of methods (hand spreading, cyclone spreading, drilling, furrowing, etc.). Barren areas where plants will not grow because of high landfill gas concentrations may have to be landscaped with wood chips or large stones to prevent erosion and provide a pleasing appearance.

Step A-9. Developing Tree and Shrub Growth

Trees and shrubs should not be planted for 1 or 2 years after grass has been planted. If the grass cannot grow because of gases from the landfill, other deeper-rooted species are not likely to thrive either.

To develop a good cover of woody plants, 90 cm of soil must be in place. If funds are available, a barrier should be placed beneath each tree-planting area to protect the root system from harmful landfill gases.

Vegetating Landfills with Adequate Funds

Step B-1. Constructing the Landfill

A successful vegetation program is more likely to be implemented if the end use plan has been established before construction or closure of the landfill. If such a plan has been developed, steps can then be taken to minimize gas production and surface settlement accordingly. Final contouring can also be planned to hinder erosion and promote vegetation.

Step B-2. Extracting Gas

The most successful landfill-to-park conversions will incorporate a gas extraction system in the landfill to reduce the volume of gases escaping into the final soil cover and inhibiting root growth. These systems will be compatible with gas recovery operations and may eventually pay for some park construction and maintenance.

Step B-3. Selecting Gas Barriers

Landfill gases may migrate into the final cover soil even with a commercial gas extraction system in operation. The best procedure is to cover the entire landfill with an impervious soil layer or synthetic membrane to keep gases from entering the final cover soil. But if funds are not available for such extensive barriers, they should at least be installed in areas where trees and shrubs are to be planted.

A variety of barriers are currently available to control gas migration, including a 30- to 60-cm-thick layer of impermeable clay followed by 60+ cm of fertile soil, polyvinyl chloride, hypalon, and other types of membrane sheeting.

Step B-4. Selecting Cover Soil

Though final cover soils may be costly and difficult to obtain, they are essential to the success of any revegetation program. A soil should be chosen with a texture resembling loam for areas where trees and shrubs will be planted, since they require looser, deeper soil for root development than do grasses and ground covers. The soil should be tested for pH, Mg, Ca, P, K, NO_3, NH_4, conductivity, Cu, Fe, Zn, Mn, particle size distribution, bulk density, and organic matter. The soil should be tested before it is delivered to the site, since it can be easily amended before or during spreading.

Step B-5. Spreading Cover Soil

The clay soil layers should be spread over the final refuse layers to prevent infiltration of precipitation. Final cover soil should then be placed using special methods to avoid compacting. The avoidance or elimination of these compacted layers can be the key to a successful reclamation project.

Step B-6. Providing Proper Soil Depth

Areas in which trees and shrubs are to be planted should be spread with 90 cm of cover soil, with the top 20 cm consisting of topsoil to accommodate most of the fine feeder roots. At least 60 cm of cover soil should be spread in areas where grasses and other stabilizing vegetation will be grown.

Step B-7. Locating Areas Unsuited for Tree and Shrub Growth

Areas unsuited for tree and shrub growth may be identified by several

indicators: dead vegetation, no vegetation, anaerobic soil, high soil temperatures, and thin cover soil.

Step B-8. Selecting Tree and Shrub Material

Factors to be considered in choosing tree species to be planted include end use of the landfill, geographic location, type of refuse in the landfill, and characteristics of the species (growth rate, final size, rooting depth, flood tolerance, mycorrhizal fungi, and pathology).

Step B-9. Planting and Maintaining Vegetation

Special planting instructions must be followed for specific areas, species, and types of planting materials. The principles of maintaining plant material on completed landfills are the same as those for nonlandfill areas, except that additional irrigation is required.

The full report was submitted in fulfillment of Grant No. CR-807673 by Rutgers University under the sponsorship of the U.S. Environmental Protection Agency.

Edward F. Gilman, Franklin B. Flower, and Ida A. Leone are with Cook College, Rutgers University, New Brunswick, NJ 08903.
***Robert E. Landreth** is the EPA Project Officer (see below).*
The complete report, entitled "Standardized Procedures for Planting Vegetation on Completed Sanitary Landfills," (Order No. PB 83-241 018; Cost: $8.50, subject to change) will be available only from:
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Telephone: 703-487-4650
The EPA Project Officer can be contacted at:
Municipal Environmental Research Laboratory
U.S. Environmental Protection Agency
Cincinnati, OH 45268

☆U S GOVERNMENT PRINTING OFFICE 1983—659-017/7167

United States
Environmental Protection
Agency

Center for Environmental Research
Information
Cincinnati OH 45268

Postage and
Fees Paid
Environmental
Protection
Agency
EPA 335

Official Business
Penalty for Private Use $300

RETURN POSTAGE GUARANTEED

Third-Class
Bulk Rate

MERL0063240
LOU W TILLEY
REGION V EPA
LIBRARIAN
230 S DEARBORN ST
CHICAGO IL 60604