

I. Introduction

Some city and private inert waste landfill disposal sites and open dumps in North Dakota are planning to close their facilities. Sites undergoing closing include environmentally unsuitable facilities located in gravel pits, ravines, sloughs, wetlands, etc. And facilities filled to capacity or that are closing due to increased operating costs, increased inconvenience in operating the facility and more stringent regulatory requirements. Owners of landfills that continue to be operated must plan for proper closure of filled portions of the site. All landfills must eventually receive closure when filled to capacity.

To properly close a landfill, two basic goals must be kept in mind. These are: (1) minimizing the need for continual maintenance of the landfill site; and (2) placing the landfill in a condition that will minimize future environmental impacts.

Criteria for closure of landfills are provided by Article 33.1-20 of the North Dakota Administrative Code. Recommendations for completion of the criteria follow.

II. Problems in Closing Landfills

In closing landfills that have been open to the public, the owner or operator must keep in mind some difficulties of closing such facilities. Old habits are often hard to break. It is impossible to properly close a landfill that continues to be used as a dump site. To address these difficulties, the following steps are suggested:

1. Provide a viable alternate facility or a collection system for waste disposal.
2. Inform and educate the public on the need to close the landfill site and the options available for waste disposal. Newspaper articles, public meetings, and signs in the community and at the landfill are a few measures that help inform citizens of the new arrangements.
3. Close access to the site. The fence and gate to the site must be maintained or upgraded and the site locked to prohibit public access. The signs placed at the site should notify the public that the facility is closed, should provide information on alternative disposal, and should specify appropriate provisions or penalties against trespassing or dumping.
4. Enforce closure of the site as appropriate. For a short time after site closure, it is common for problems to arise such as disposers or vandals tearing out gates, driving through fences, or dumping wastes on access roads or in ditches near the disposal facility. Local officials should consider enacting appropriate ordinances prohibiting unauthorized disposal and local law enforcement officials should be enlisted as needed. All vandalism should be resolved and the site cleaned up and resecured immediately.
5. If necessary, exterminate rats with experienced or qualified personnel to prevent

migration of rats to populated areas. The area should be posted with adequate poison warnings. Area residents should be informed of possible danger to pets running at large.

III. Basic Principles of Landfill Closure

After closing the site to public access, the facility and surrounding area should be cleaned up so that any waste piles or piles of metallic materials, burnable materials, debris, and windblown paper are consolidated and placed in a final disposal cell for final covering. Particular attention should be given to any environmentally sensitive areas where waste may have been piled too steeply, may have been placed in or next to wetlands, or where wastes have been placed in drainage ways or in areas that impede surface water drainage. Site closure should help moderate the environmental impact of such improper disposal. As appropriate, waste materials may need to be moved or relocated to higher portions of the site, or the waste may be placed in appropriate areas to help sloping of the closed site.

It is important to promote surface water drainage from landfill areas in order to keep surface water from filtering into and through the garbage, thus creating a hazard of ground water and surface water degradation. A primary concern of site closure is the slope of filled portions of the site to promote surface water runoff without causing ponding or severe erosion of the final cover. The slope or grade of the land and the length strongly affects soil erosion of the slope. Final slopes of filled portions of the landfill site should be at least 2 percent in grade and should not exceed 8 percent in grade. Slopes of up to 12 percent may be used where the slope length is short and run off is not concentrated or increased by adjacent slopes. Terraces, waterways, diversions or other measures should be used as appropriate to minimize soil erosion. The USDA Universal Soil Loss Equation may be used to predict soil loss and the life of the cover.

IV. Final Cover

After the landfilled areas have been sloped and all waste buried, compacted, and covered, an inert waste landfill site should be covered with at least 24 inches of clay-rich soil and 36 inches for municipal solid waste landfills. This final cover of clay-rich soil should be placed in layers. The first or deepest being about 12 inches for inert waste landfills or 18 inches for municipal solid waste landfills, which should be carefully compacted in six-inch lifts to minimize surface water infiltration. Compaction testing of this "barrier layer" may be required to ensure the soil material be properly placed. An additional 12-18 inches of soil material should be placed over the compacted clay layer to help protect it from damage due to erosion, plant roots, vehicular traffic, freezing and thawing, etc. This "buffer layer" also provides a rooting depth for the final vegetative cover. Based on site conditions, additional layers may be desirable.

At least six inches of topsoil or suitable plant growth material should be spread over the site. Soil nutrient testing of the topsoil is suggested. Soil pH, nitrogen, potassium, phosphorous, conductivity, bulk density, and organic matter are suggested parameters. Based on this analysis, appropriate fertilizers and organic matter may be added to the topsoil to increase fertility. The site is then ready for revegetation.

V. Site Revegetation and Long-Term Management

The site should be revegetated when practicable to a mixture of adapted grasses. The local office of the Soil Conservation Service may be consulted to determine an appropriate native grass mixture. The Department has guidelines on grass seed mixtures, application rates,

and cover crops. To protect the clay barrier layer, deep-rooted plants such as alfalfa or clover should not be planted on the landfill site as the roots may increase water infiltration. Stubble mulch tillage or mulching is recommended to help control erosion. Tree plantings may be placed around the landfill site, however, unless special precautions are taken, trees should not be planted on top of the landfill and should not be planted in positions which will cause excessive snow drifting on the landfill. Tree plantings help improve the aesthetics of the landfill site and may improve the site for long term use as wildlife habitat, scenic areas, golf courses, etc. Closed landfills are not suited to buildings or permanent structures without extensive site engineering. Vehicular traffic over closed landfills should be prohibited to protect the soil and vegetative covers. Closed landfills must not be used for cultivated crops or for grazing.

For at least two years after site closure, the landfill facility should be checked monthly to ensure vegetation reestablishment and to monitor any erosion or settling of the final cover. The closed landfill should continue to be monitored on a less frequent basis for up to thirty years after site closure. As appropriate, the landfill site may need additional covering applied, additional erosion control structures installed, and/or reseeded of the vegetative cover.

VI. Notification on Deed

Section 23.1-08-21 of the North Dakota Century Code states:

"A person operating a solid waste management facility for disposal under a permit issued under this chapter shall, upon completion of the operation at each site, file a plat of the area with the recorder of each county in which the facility is located, together with a description of the wastes placed therein."

The permit for the landfill facility may have more specific requirements for a notification on the deed to the property. The notice should indicate the boundaries of the landfill, the types and quantities of waste placed in the site, any appropriate details on the sites' construction or closure, and a precaution against any building, earth moving, tillage, or any other activity that might disrupt the site or the protective soil and vegetative covers. The owner or operator should forward both an affidavit by the Register of Deeds certifying that a record of notice was filed and a copy of the notice to the Department within sixty (60) days of the recorded date.

VII. Closure Plan Requirements

Closure plans are best developed before a landfill is put into service. The final use of the site should be kept in mind during the daily operation of the facility to minimize the final cost of site closure. Sites that have been adequately planned generally cost less for reclamation at closure of the site than facilities that have not been carefully thought through and planned.

Preliminary planning for site closure, whether before the site is placed into use, during the site operation, or before site closure, should begin with a discussion with the Department. The site engineer should identify the final site topographic plan, prepare a site drainage plan and prepare appropriate cross-sections of the closed site. The closure plan should also specify a source of cover material, especially for any required clay cover that may be necessary. Laboratory testing of the cover material should be completed to determine the soil's permeability when properly compacted. The closure plan should specify procedures for compaction testing of the "barrier layer" during its installation.

Topsoil and subsoil should be stockpiled on the site and revegetated to minimize erosion of the material. This topsoil and subsoil are necessary in final site closure. Sites that have wasted topsoil or have not conserved the topsoil will need to import suitable plant growth material for the final site covering. The closure plan should also identify the vegetative cover and landscaping plan and should identify the closing sequence for phased operations. A copy of the closure plan should be provided to the Department for review and approval. The closure plan may need to be updated during the site's operation and again before closure.

VIII. Other Considerations

The Department reserves the right to require any additional construction modifications or installations at closed landfill facilities. Some landfills may have or may be required to install ground water monitoring wells to detect and monitor any leachate migration from the closed landfill. The wells must be maintained and protected during and after site closure. The landfill owner or operator may be required to monitor the ground water wells on a regular basis.

In many areas of the country explosive gasses, including methane are generated by closed landfills. In North Dakota, methane generation has not been a widespread problem due to the semiarid nature of the climate, however, in areas with high water tables or where surface water infiltrates into the waste, methane generation can be a problem. Closed landfills may have problems with methane generation, thus, building sites should be prohibited on or around the landfill site. If methane generation may be a problem, the owner or operator should consult the Department.

Similarly, if any seepage, springs, or wet spots are noted on or around the landfill, the owner or operator should contact the Department.

Finally, some communities may want to keep a small part of the landfill site open for inert waste (trees, concrete, etc.) disposal. Such continued use will need Departmental approval and may require an inert waste disposal site permit. Any continued disposal should be in an area well away from the closed landfill and all activities should be monitored to protect the environment and the closed landfill. The Department may specify that continued use of the site as an inert waste landfill facility may be allowed for a limited time period to accommodate the needs of the local communities.

Landfill site closure can be a difficult and detailed matter and requires some patience. There is no guarantee that site closure will prevent short or long-term environmental hazards. The owner or operator might consider more extensive engineering of the site to help minimize any environmental degradation.

Additional Departmental guidelines are available on inert waste landfill developments on our website. If you have any questions regarding landfill site closure, contact the North Dakota Department of Environmental Quality, Division of Waste Management at 701-328-5166, or 918 E. Divide Ave., 3rd Fl., Bismarck, ND 58501-1947.