

CLOSED LANDFILLS IN NEW HAMPSHIRE



GUIDE TO BEST MANAGEMENT PRACTICES & REQUIREMENTS

Closed landfills are a long-term liability for municipalities because they can create environmental and other problems that negatively impact residents, visitors, and others. Landfill owners, including municipalities, are responsible for the costs to cleanup environmental contamination. Therefore, **it is important that municipal officials are aware of the location and condition of all the closed landfills in their community**. Many New Hampshire towns have *more than one* closed landfill – one that long-time residents remember using (often near the location of the current transfer station) and one or more that was used before that one opened. Municipal officials need to know about and maintain all of them.

This Closed Landfill Best Management Practices (BMP) Guide is designed to help municipal officials understand the actions they should take to reduce the potential environmental contamination from closed landfills and to protect the health and safety of their community. Note that landfills that ceased operations *after July 9, 1981,* have additional requirements that are outlined on page 7 of this document.

Closed landfills can cause:

- **Contamination of water resources**
- **Generation of methane gas**
- **Physical hazards**

NHDES IS HERE TO HELP!

The New Hampshire Department of Environmental Services (NHDES) can answer questions and provide advice and limited technical guidance to municipalities. NHDES is most interested in providing cooperative assistance to address problems as soon as they arise. Contact NHDES' Solid Waste Management Bureau: (603) 271-2925 or solidwasteinfo@des.nh.gov. Additional information is available from NHDES: https://www.des.nh.gov/waste/solid-waste.

TWO INSPECTIONS EACH YEAR

A walkover inspection should be conducted at least twice a year by a knowledgeable municipal employee or a professional engineer. Inspections should be conducted in the spring following snowmelt and after/during the annual mowing event in the fall. Inspectors should look for:

- **Soil cover:** tree growth, animal burrows, erosion, and exposed waste
- **Grass cover:** bare spots and dead grass/vegetation (could indicate a methane gas problem)
- **Cover grading:** settlement or areas where water can pond; and sloughing of side slopes
- **Stormwater management:** obstructions in ditches, culverts and other features, erosion, or excessive sediment accumulation
- **Access restrictions:** evidence of ATVs, dirt bikes, or other unauthorized access

A separate Closed Landfill Inspection Checklist is available at: https://www.newmoa.org/nh_inspection_checklist/.

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CONTAMINATION OF WATER RESOURCES

An improperly monitored and maintained landfill can cause contamination of water resources. When it snows and rains, water enters the landfill where it moves through the waste and becomes what is known as leachate. Leachate can contain such contaminants as heavy metals and inorganic compounds. Contamination levels in leachate tend to decrease over time, but remain a concern for many decades.

The bottoms of old landfills were not lined the way modern landfills must be. As a result, leachate can flow downward from an unlined landfill and enter groundwater or come out at the surface at the edge of a landfill and flow into surface waters. Leachate in the groundwater can travel and pollute drinking water wells and surface water systems. Contaminated surface waters might be used by people for drinking water or recreation. Wildlife consuming contaminated water can later impact people through consumption related to hunting and fishing.

To reduce the risk of contamination of water resources, landfill owners should make sure that:

- **No waste is exposed**
- **A good depth of soil covers all waste**
- **Cover soil is kept intact and maintained**
- **Healthy grass covers waste areas**
- **No trees or woody vegetation is growing in waste areas, including the side slopes**
- **Cover soil is graded to reduce infiltration and to promote run-off**
- **Run-off is managed by diverting it off and away from the landfill without causing erosion**



Old Landfill with Tree Growth and Erosion
(note exposed waste in channels and at base)

Municipal officials should ensure closed landfills are regularly inspected and maintained. Properly maintained cover soil and vegetation systems are effective at reducing the risk of water resource contamination. Recommended practices are outlined below.

DRINKING WATER CONTAMINATED BY LANDFILL

Routine groundwater testing at a landfill in New Hampshire found contamination. The landfill owner was required to pay for testing at nearby homes, which showed that their drinking water wells contained unacceptable levels of contamination. The landfill owner was required to pay to extend a public water supply line in some homes and to install point of entry (POE) treatment systems in others to ensure that all the homes near the landfill have safe drinking water.

EROSION EXPOSES WASTE

A small municipal landfill in Vermont with a very steep slope was capped with thin soils. Annual mowing was not conducted and large trees grew. Following a rainstorm event, the slope gave way and sediment and waste materials mobilized down the slope, crossed a road, and deposited at the edge of a river.

ANNUAL MOWING

Tree growth must be prevented on landfills because the shallow cover soils will not support trees as they mature, making them susceptible to being blown over. Blown over trees will damage the cover soils and can expose waste. Tree roots also provide a pathway for water into the waste, increasing leachate generation. BMPs include:

- **Mow** closed landfills *at least once annually* or as needed to control woody growth
- **Plan** to mow in late September to avoid killing butterflies and nesting birds and animals
- **Vary** the mowing pattern to avoid creating ruts and erosion problems
- **Mow** beyond the base of the landfill *so an inspector can walk all the way around at the bottom of the landfill* – also include any run-off swales
- **Cut back**, manually if needed, encroaching trees and brush at the landfill base or near gas vents, groundwater monitoring wells, and drainage features; and remove trees that have fallen onto the landfill



Deep Ruts and Runoff-channels Created by Mowing Tractor

GRASS COVER

Good grass cover prevents soil erosion by water or wind. Unchecked erosion will remove the cover vegetation and soil, increase leachate generation, and expose waste. BMPs include:

- **Repair** all eroded areas as soon as practical
- **Reseed** areas of sparse grass growth or amend them with manure, fertilizer, or another nutrient rich source to promote vigorous growth
- **Repair** "rill" type erosion – small, concentrated channels on the landfill surface that are no more than a few inches deep – by raking out the rills and reseeding
- **Use** structural measures to repair deeper erosion gullies by adding soil, changing cover soil grades, and reestablishing vegetation
- **Contact** a professional engineer or NHDES if waste is exposed, as remedial measures are required

ANIMAL BURROWS

Animal burrows provide a direct pathway for water infiltration into the waste. If a burrow is found, trap or otherwise remove the occupant and fill in the burrow with loam. Consider adding peppermint oil, hot sauce, jalapeño peppers, red pepper flakes, or the urine of a predator animal to the loam fill. A mixture of castor oil, liquid dish soap, and water may also deter some burrowing animals. Do not use sandy or gravelly soil because they will not limit water infiltration and may prevent the needed cover grass from growing.

SETTLEMENT

Waste can settle over time, causing depressions in the landfill surface that allow for ponding water. BMPs include:

- **Fill** depressions with soil to restore positive drainage, then reseed and mulch to reestablish grass cover
- **Contact** a professional engineer or NHDES if any of the following conditions are observed as they could indicate a stability problem and might require remedial measures:
  - Differential (uneven) settlement
  - Cracking of the cover soil
  - Sloughing of side slopes



Ponding On a Landfill Due to Settlement



Slope Failure and Erosion

DRAINAGE

Some landfills have engineered stormwater control features, such as swales, ditches, culverts, check dams, and detention ponds. Inspectors should note the condition of stormwater control features during each inspection and after major rainfall events. BMPs include:

- **Remove** accumulated sediment and overgrown vegetation
- **Make sure** culverts and storm drains are intact and free of obstruction
- **Ensure** that drainage swales/ditches are unobstructed and free flowing
- **Conduct** any needed cleanout and repairs in a timely manner
- **Remove** encroaching tree and shrub growth from drainage features

If sediment is observed in a drainage swale or culvert, it means that erosion is occurring and the source of the problem must be found so it can be corrected.

Landfills without engineered features have runoff channels that develop over time. If possible, runoff should be diverted into engineered features. If that is not possible, the naturally formed runoff channels should be protected to prevent scouring by ensuring good grass cover growth and/or adding gravel or riprap.



Woody Growth and Blocked Drainage Swale

LEACHATE BREAKOUTS

Leachate breakouts or "seeps" are usually orange or rust-colored liquid that comes out of a landfill side slope or at the base (or toe) of the landfill. A leachate seep creates a potential hazard and **must be addressed immediately**. Actions include:

- **Cover** the seep location with a "tight" soil, such as silt or clay, and observe the area at least once a day for several weeks to see if that stops the seep
- **Remove** the stained soil *under the guidance of a professional engineer* and dispose of it at an authorized solid waste facility; stained soil should be stockpiled on plastic tarps and covered with additional tarps (or placed directly in soil roll off containers that are covered when waste is not being added or removed) until analytical testing is complete, and the soil is accepted for disposal at a permitted landfill
- **Determine** and correct the source if the seep reoccurs over time; the services of a professional engineer will likely be required; contact NHDES for advice and assistance to identify next steps



Leachate Seep on Landfill Side Slope

GENERATION OF METHANE GAS

As organic wastes in a landfill age, they decompose and generate methane and other gases. **Gas production can continue for decades after a landfill closes.** Methane gas is particularly dangerous because, at certain concentrations, it can explode or otherwise fuel a fire.

- **Methane** gas will migrate along the path of least resistance and can be present in the ground at a significant distance from the landfill; (the gas can migrate about 1,000 ft. through the ground, and possibly further if it enters an underground utility line)
- **One** visual sign of methane gas is stressed or dead vegetation
- **Landfill** gas can emit a musty smell; methane gas is odorless

Structures should not be built on top of landfilled waste or near an old landfill. Gas levels should be measured in the soil at the property boundary and in any on-property buildings at least once a year.



Distressed Vegetation Due to Landfill Gas

LANDFILL GAS EXPLOSION

A town maintenance garage was located adjacent to a closed municipal landfill in Vermont. A particularly cold and snowless winter froze the ground deeper than normal, likely causing the landfill gas to migrate into the floor drainage system of the garage. A welder's spark fell into the drain and set off an explosion, which fortunately did not injure anyone and did not cause significant damage.

LANDFILL GAS IMPACTS UTILITY WORK

Utility workers in New Hampshire measured gas levels before entering their roadside excavation. Explosive levels were found, and the contractor had to wait an hour for the gas to dissipate. The source was determined to be a nearby old landfill that had been closed for more than 20 years. The property owner was required to pay to install a landfill gas interceptor system and *must keep paying every year* to conduct gas monitoring.

Measurement BMPs include:

- **Take** measurements in the late fall or winter when buildings are closed-up and when the ground is frozen and provides a barrier to gas release
- **When** inside buildings, take measurements at floor drains, cracks, and other penetrations of the floor
- **Contact** the local fire department or an environmental consultant who should have meters to measure methane gas levels and might be able to assist

The measured level of landfill gas, typically indicated by methane levels, should lower over time. If the measured level increases, measurements need to occur more frequently to make sure a dangerous situation does not develop and to inform potential corrective actions.

- **Measured** levels should always be less than 50 percent of the lower explosive limit (LEL) for methane in soil at the property line and less than 25 percent of the LEL for methane inside any building
- **If gas** concentrations exceed these amounts, the local fire department should be notified so proper protective measures can be taken
- **If measured** concentration in soil at the property boundary exceeds 50 percent of the LEL, then residences or other occupied buildings within 1,000 feet should be tested
- **If levels** exceed 100 percent of the LEL, the area should be immediately evacuated, the fire department called, and NHDES notified

PHYSICAL HAZARDS

Old, closed landfills can make tempting locations for all-terrain vehicle (ATV) and other unauthorized uses, including illegal waste disposal or dumping. These uses create injury hazards and liabilities for the landfill owner. ATV trails and other trespassing can disturb the landfill cover and increase erosion, promoting leachate generation and potentially exposing waste. Inspectors should look for signs of trespass, and make sure access controls, such as gates, are in place and functional. BMPs include:

- **Restrict** access with:
  - Gates across entrances and exits – and making sure such gates are closed when no one is at the landfill
  - Large boulders, tree logs, or other creative barriers at entry points around the property and/or at the foot of a landfill
- **Post** weather resistant signs with large letters identifying the old landfill
- **Ensure** that no structures are built on the landfill
- **Check** the condition and effectiveness of access control measures during inspections and improve them, if necessary
- **Remove** illegal waste dumped on the property or at the entrance and take preventative measures, such as using a game camera to identify people dumping waste



Example of Access Restriction and Signage



Solar Panels on a Closed Landfill

SOLAR PANELS

Closed landfills are typically large open areas that can be evaluated for potential solar energy generation. Solar panel arrays can be installed under a lease agreement or other arrangement in collaboration with a solar energy developer. The installation generates electricity that is fed into the regional electrical grid and potentially generate money and/or electricity for a municipality.

For a landfill solar panel installation project to be successful, there typically needs to be a three-phase power line available near the site. If not, the costs for installing the required infrastructure tend to exceed the benefits, and solar array companies may not be interested in the property. If three-phase power is located nearby, the municipality should contact a solar developer or NHDES to help them identify next steps.

Lessons Learned: When initiating discussions with a solar developer or developing a lease agreement, make it clear who will be responsible for:

- Routine maintenance of the landfill cover (such as annual mowing and removal of problematic vegetation)
- Inspections of the landfill following installation of the solar array
- Repairs to any damage to the landfill cover or stormwater management features
- Removal and recycling or disposal of the panels at the end of their useful life, which is typically 20 to 30 years

Before solar panels can be installed on a closed landfill, the project must be reviewed and approved by NHDES. The landfill must first meet the closure requirements in State regulations.

ADDITIONAL REQUIREMENTS FOR LANDFILLS THAT CLOSED AFTER JULY 9, 1981[1]

Landfills that stopped receiving waste after July 9, 1981 need to have a permit and a Closure Plan. A Closure Plan sets out the engineering requirements to properly close a landfill and must also include a Post-Closure Inspection, Monitoring, and Maintenance Plan that basically makes the BMPs outlined in this Guide into requirements.

Closed landfill permittees are also required **to complete and submit to NHDES an "Annual Post-Closure Report" every year[2].** The Report has eight sections:

1- Facility Identification: location address and Solid Waste Facility Permit Number

2- Permittee Information (site owner): name, address, email, phone number

3- Contact Person: name, affiliation, job title, email, phone number

4- Inspections: date, inspector name, date report submitted to DES

   a. Inspection reports are due 30 days after the inspection

5- Action Items Summary: each item requiring action with date completed or date scheduled for action

6- Summary and Assessment: must include

   a. A summary of groundwater and other environmental sampling analytical results

   b. A statement from a professional engineer as to whether the landfill is achieving post-closure performance standards and whether adjustments should be made to the approved Post-Closure Plan.

7- Additional Information: particularly details on action items

8- Signature: of the permittee or authorized representative (for example, the Selectboard Chair or Town Manager if the permitee is a municipality)

INSPECTION REPORTS

An inspection report should have at least five sections:

1- General Site Condition: access restrictions, signage, road, site use, groundwater monitoring well condition

2- Stormwater System Condition: maintenance/ condition of detention ponds, culverts, drainage swales, berms/benches, runoff channels, and storm drains; and evidence of erosion

3- Decomposition Gas Control System Condition: are all soil gas probes in good condition and functioning? Any odors? Evidence of stressed vegetation?

   a. Methane gas monitoring results from vents, soil probes, indoor air monitors, and resulting actions; or an explanation of why monitoring is not needed

   b. If an active system: is it working properly? Date it was inspected

   c. If a passive system: are all components in good condition and functioning?

   d. If a building is on site, are all air quality monitors in good condition and functioning?

4- Cap (Cover) Condition: evaluation of settlement, runoff, vegetative layer, damage due to human and/or animal activity

   a. Date(s) the landfill was mowed

   b. If required, include instrument survey date(s) and data summary table

5- Leachate Systems Condition: Are there any breakouts or seeps on or off the property?

   a. If the landfill has a collection system: is the system in good condition and functioning? If leachate is stored on-site prior to disposal – how much is currently on-site? Where is leachate disposed and what is the frequency of shipment?

[1] New Hampshire Code of Administrative Rules, CHAPTER Env-Sw 800 LANDFILL REQUIREMENTS, PART Env-Sw 807 CLOSURE REQUIREMENTS, pages 32-36 at: **https://www.des.nh.gov/sites/g/files/ehbemt341/files/documents/2020-01/Env-Sw%20800.pdf**.

[2] The report form is available at: **https://onlineforms.nh.gov/app/#/formversion/b1f20409-b048-430c-b28a-2cc1d493e3f1?FormTag=NHDES-S-05-057**

ENCROACHMENT OF DEVELOPMENT

A potentially significant liability is residential and other development near an old landfill, especially if the new building(s) will rely on a groundwater well for their water supply. Groundwater might already be contaminated from the landfill, and/or the new pumping might cause contamination to spread and move into the well. The other danger to nearby development is methane gas concentrating in structures, as discussed on page 5.

LANDFILL GAS IN HOMES

Housing encroached on a closed landfill in New Hampshire. Gas monitoring at the landfill indicated landfill gas was potentially migrating off-site. A subsequent investigation revealed that landfill gas was in the newly built homes. The landfill owner had to pay to construct a landfill gas interceptor trench and *must keep paying each year* to regularly monitor and maintain it.

Suggested improvements are to:

- **Include** a notice on the deed for the landfill property that is recorded at the Registry of Deeds
- **Increase** awareness of the location of old landfills, particularly among local officials that oversee real estate development
- **Consider** adjusting zoning and planning ordinances and codes to limit development near old landfills

ADDITIONAL RESOURCES:

Two helpful checklists accompany this Guide:

- **Municipal Checklist** – designed to help towns ensure that all monitoring, tracking, and inspection activities are completed on an annual basis. The Municipal Checklist should be completed by one or more senior municipal officials, such as the Selectboard Chair, the Town Manager, the Director of Public Works, and/or the Town Clerk. The Municipal Checklist is available at: https://www.newmoa.org/nh_municipal_checklist/.
- **Inspection Checklist** – a walkover inspection of the landfill site should be conducted at least twice a year by a knowledgeable municipal employee and/or professional engineer. The Inspection Checklist is designed to help ensure that the inspector reviews and documents the condition of all the important features. The Inspection Checklist is available at: https://www.newmoa.org/nh_inspection_checklist/.

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NORTHEAST WASTE MANAGEMENT OFFICIALS' ASSOCIATION

NEWMOA is a non-profit, non-partisan, interstate association whose membership is composed of the state environment agency programs that address pollution prevention, toxics use reduction, sustainability, materials management, hazardous waste, solid waste, emergency response, waste site cleanup, underground storage tanks, and related environmental challenges in Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont (www.newmoa.org).

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- New Hampshire Department of Environmental Services (NHDES)
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- Vermont Department of Environmental Conservation (VT DEC)

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