NORTH DAKOTA
SOLID WASTE OPERATOR
TRAINING MANUAL

Presented by

North Dakota Department of Environmental Quality
Division of Waste Management
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SECTION 1: INTRODUCTION

I. Integrated Waste Management

Solid waste disposal has changed dramatically over the years. One hundred years ago, individual households had little to discard. Some use was found for almost everything. Necessity demanded it.

Since World War II, we have seen substantial increases in the quantities of waste disposed by households and by businesses. Population pressures, less available land, increased material consumption, and increased environmental awareness are changing the face of solid waste management. Government regulations, potential environmental contamination, and land use planning limit the available locations for landfills.

Existing landfills are identified in Exhibits 1-1 through 1-4. North Dakota passed legislation (House Bills 1060 and 1061 and Senate Bill 2090) in 1991 and promulgated regulations under North Dakota Century Code (NDCC) Chapter 23.1-08 and North Dakota Administrative Code (NDAC) 33.1-20 in 1992 which placed more restrictions on landfill siting, design, and operation. The U.S. Environmental Protection Agency (EPA) also had recently promulgated 40 Code of Federal Regulations (CFR) Part 258 (Subtitle D) which affected municipal solid waste landfills.

Our society has become more aware of the need to recycle, reuse, and minimize waste. Private and public landfill operators are continuing to expand their activities to include integrated waste management, and not just waste disposal. Integrated waste management involves reuse, recycling, treatment, incineration, and/or disposal. The best method of waste management depends on many factors including the waste stream, facility location, technical capabilities, government regulations, proximity to markets, and economics.

Integrated waste management is being conducted in some fashion by most landfills in North Dakota. Some landfills accept various waste streams for recycling or reuse. Used oil, batteries, white goods (appliances), and junk cars are some of the materials which can either be recycled or reused. Some community organizations and businesses accept recyclable materials such as paper, plastic, glass, and aluminum cans in order to make waste management more convenient for households.

Landfill operators are also educating the public about how waste can be minimized. The landfill and the public benefit from waste minimization by extending landfill life and retaining one waste management method.

II. Subtitle D, Federal Regulations for Municipal Solid Waste Landfills

On September 11, 1991, the EPA promulgated municipal solid waste landfill regulations (known as Subtitle D and described in 40 CFR Part 258). Existing and new landfills were significantly affected by these rules.

Subtitle D regulations affect the following criteria for municipal solid waste landfills:

- Location restrictions
- Operations
- Design
- Groundwater monitoring and corrective action
- Closure and postclosure care
- Financial assurance

North Dakota's state program is approved by the EPA. In states that do not receive or apply for approval, the owner/operator is responsible for compliance which must be documented and made available on request to both the state and the EPA.

The regulations do include alternative requirements which allow some flexibility with the rule:

- Location Restrictions
  Extension of closure requirements for existing facilities which can demonstrate that the landfill is protecting human health and the environment.

- Operating Criteria
  Alternative cover instead of 6 inches of earthen material.

- Design Criteria
  Alternative designs instead of a composite liner.

- Groundwater Monitoring
  Alternative schedules for compliance sampling frequencies, parameters, and assessment.

- Corrective Action
  Establishing groundwater cleanup standards where maximum contaminant levels (MCLs) do not exist and determinations that cleanup of a particular constituent is not necessary.

- Closure and Postclosure
  Alternative final cover design and alternate compliance schedule.

- Financial Assurance
  Alternate mechanisms for ensuring financial assurance.

A. <u>Applicability</u>

The rule did not apply to those facilities that ceased to receive waste by the rule's publication date of September 11, 1991. Only the final cover requirements applied to facilities that ceased receipt of waste within 24 months after the publication date. The complete Subtitle D requirements applied to facilities that received waste on or after twenty-four months of publication of the rule.

Landfill exemptions are allowed in arid areas which receive less than 25 inches of precipitation and where no practical waste management alternative exists. If the owner/operator becomes aware of groundwater contamination, the facility is required to comply with the rule's requirements for design, groundwater monitoring, and corrective action.

B. <u>Location Restrictions</u>

Solid waste facilities in North Dakota are not allowed to be located in areas that may result in impacts to human health or the environment, or in areas that are unsuitable due to the topography, geology, hydrology, or soils. Facilities are required to meet location restrictions.

1. Airports

   Existing facilities within 10,000 feet of airport runways used by turbojet aircraft or within 5,000 feet of runways used by piston-type aircraft were required to demonstrate that they are designed and operated so no bird hazard is posed to aircraft. New facilities and expansions within a 5-mile radius of any airport runway must notify the affected airport and the Federal Aviation Administration (FAA). New facilities and lateral expansions of existing facilities are prohibited within 10,000 feet of any airport runway currently used by turbojet aircraft or within 5,000 feet of any runway currently used by only piston-type aircraft.

2. Flood plains

   Existing facilities located in 100-year floodplains must demonstrate that they will not restrict the flow of the 100-year flood, reduce temporary water storage capacity of the floodplain, or result in washout of solid waste so as to pose a hazard to human health and the environment. New facilities and lateral expansions of existing facilities are prohibited within the 100-year floodplain.

3. Wetlands

   New facilities and lateral expansion into wetlands are prohibited unless:

   - No practical alternative is available.

- Construction and operation of the facility will not violate any other local, state, or federal law.

- The facility will not cause or contribute to significant degradation of wetlands.

- Steps have been taken to achieve no net loss of wetlands.

- Sufficient information is available to make determination.

4. Fault Areas

   New facilities and lateral expansions of existing facilities are prohibited within 200 feet of a fault that had displacement in Holocene time (last 9,000 years).

5. Seismic Impact Zones

   New facilities and lateral expansions of existing facilities are prohibited in seismic impact zones unless demonstrated that all containment structures are designed to resist maximum horizontal acceleration in lithified earth material for the site.

6. Unstable Areas

   New facilities and lateral expansions of existing facilities in unstable areas are required to demonstrate that engineering measures have been incorporated into the design to ensure integrity of structural components and that components will not be disrupted. Examples of unstable areas include poor foundations, areas susceptible to mass movements, and karst terrains.

Existing facilities that could not make demonstrations pertaining to airports, floodplains, or unstable areas had to close within five years of the rule's promulgation date.

C. Operating Criteria

Solid waste facilities are required to submit to the department a plan of operations and other plans that address the following operating criteria:

1. Hazardous Waste

   Procedures for excluding hazardous waste (addressed in Section 6 "Waste Acceptance" of this manual).

2. Cover Material Requirements

Six inches of cover material must be placed on solid waste at the end of each day or more often as necessary to protect environmental and human health. Alternatives may be allowed with prior approval from the department, and in North Dakota, compost may be used as an alternative cover.

3. Disease Vector Control

   Prevent or control on-site disease vectors.

4. Explosive Gas Control

   A routine methane monitoring program must be established to ensure that gas:

   - Does not exceed 25 percent of the lower explosive limit (LEL) in facility structures.

   - Does not exceed LEL at property boundary.

   If the gas exceeds these levels, a remediation program must be instituted.

5. Air criteria

   Facilities are required to meet applicable requirements under the State Implementation Program (SIP) pursuant to Section 110 of the Clean Air Act (CAA). Open burning is prohibited except when a variance is provided by the department.

6. Access Requirements

   The owner/operator must control public access and prevent unauthorized traffic and illegal waste dumping.

7. Run-on/Runoff Control

   The landfill must be designed, constructed, and maintained (in the active portion of the landfill) to handle the peak discharge from a 24-hour, 25-year event.

   The facility is required to prevent discharge of pollutants into waters which would result in violation of the Clean Water Act (CWA) including the National Pollutant Discharge Elimination System (NPDES). Additionally, nonpoint sources of pollution to water should be managed to prevent a violation of an area or state water quality management plan previously approved by Section 208 or 319 of the CWA.

8. Liquids Restriction

The facility is prohibited from accepting waste with free liquids except those normally encountered in household waste. Leachate or gas condensate from the facility is also excluded if the unit has a composite liner.

9. Recordkeeping Requirements

   The owner/operator is required to maintain records of design, construction, and operation.

D. Design Criteria

North Dakota is an approved state which has two liner options for landfills. The state also requires the leachate collection system to be capable of maintaining less than a 12-inch depth of leachate over liner.

1. Liner Options

   a. A natural soil liner constructed of at least 4 feet of natural soil having a hydraulic conductivity not to exceed 1 x 10^{-7} centimeters per second (cm/sec).

   b. A composite liner consisting of two components:

   - Upper component of a minimum 30 mil flexible membrane liner (FML), <u>and</u>

   - Lower component of at least 2 feet of compacted soil with hydraulic conductivity of no more than 1 x 10^{-7} cm/sec

   If the FML component is high density polyethylene (HDPE), the thickness must be at least 60 mil.

2. Groundwater Monitoring and Corrective Action

   a. Applicability

      Existing facilities less than 1 mile from a drinking water intake (surface or subsurface) had to be in compliance within three years of the rule promulgation date.

      Existing facilities greater than 1 mile, but less than 2 miles from drinking water intakes, had to be in compliance within four years after the rule promulgation date.

      Existing facilities greater than 2 miles from a drinking water intake had to be in compliance within five years of the rule promulgation date.

   b. Groundwater Protection Standards:

Based on:

- MCLs for constituents for which MCLs have been established under the Safe Drinking Water Act (SDWA).

- Background concentration established during the monitoring program when MCL is not established.

- Background concentration for constituents where background is higher than MCL.

c. Groundwater Monitoring System

- Establish groundwater monitoring system.

- Establish detection monitoring program (includes analyses of various constituents).

- Develop an assessment monitoring program.

  This program is required when a statistically significant increase over background has been detected for one or more parameters.

  Within 90 days of triggering the assessment monitoring program, the operator/owner must annually sample and analyze groundwater for 213 organic and inorganic constituents.

  A minimum of one sample from each downgradient well must be analyzed during this sampling event. For detected constituents, a minimum of four independent samples from each well is required to be collected and analyzed to establish background.

  After initial sampling, wells must be sampled twice each year for detection monitoring parameters and those assessment parameters identified in the first sampling.

As a result of statistical analysis, the owner/operator may:

- Return to detection monitoring if it can be demonstrated what source other than the facility caused the contamination.

- Return to detection monitoring if it can be demonstrated that the increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality.

- ▶ Return to detection monitoring if the concentration of all assessment monitoring constituents are found to be at or below background values for two consecutive sampling events.

- ▶ Continue monitoring if concentrations continue to be above background but below groundwater protection standards. The owner/operator must also initiate a corrective action program if one or more constituents are detected at statistically significant levels above groundwater protection standards.

d. Corrective Action Program

The purpose of the corrective action program is to characterize the nature and extent of releases, which may include installation of additional groundwater monitoring wells. Residents and owners of adjacent properties or potentially affected parties must be informed.

The assessment monitoring program must be initiated within 90 days of finding a statistically significant increase exceeding groundwater protection standards.

The owner/operator must continue monitoring and analyzing the effectiveness of corrective action measures, and discuss results of the corrective measure assessment prior to selection of a remedy in a public meeting with interested and affected parties.

Corrective actions should then be selected and a schedule for actions should be prepared.

Appropriate corrective actions can then be implemented.

E. Closure and Postclosure

Closure and postclosure requirements are discussed in more detail in Section 8 “Closure and Postclosure.”

A final cover is required to minimize infiltration and erosion. A written closure plan must be prepared, and a notation is placed on the deed when closure is completed.

The final cover must include a layer of compacted soil material at least 18 inches thick with a hydraulic conductivity of 1×10^{-7} cm/sec or less, a second layer that is placed over the compacted layer of 12 inches or more of clay-rich soil material for the rooting zone, and at least 6 inches of suitable plant growth material (SPGM). The final cover shall be planted with adapted grasses.

Closure must begin within 30days of final receipt of waste. If adequate capacity exists and it is likely that additional waste may be disposed, the landfill may have as long as one year to commence closure.

Postclosure must be conducted for 30 years. The requirements include maintaining the effectiveness and operating:

- Final cover
- Leachate collection system
- Monitor groundwater monitoring system
- Gas monitoring system

F. Financial Assurance

Owners/operators are required to demonstrate financial assurance for closure, postclosure, and corrective action.

Financial assurance requirements are effective 30 months after this rule's promulgation.

Written estimates must be prepared for hiring a third party to perform closure, postclosure, and corrective action. Cost estimates must be based on a worst case scenario and must be adjusted annually. Mechanisms allowed are discussed in Section 8 "Closure and Postclosure."

III. Waste Reduction Goals/Solid Waste

The North Dakota Legislature established waste reduction goals in 1991. The goals were to be phased in as demonstrated below.

Target Date	Volume Reduction
1995	10%
1997	20%
2000	40%

Methods of integrated waste management include:

- Reduce the amount of solid waste generated (at source).
- Reuse materials.
- Compost leaves and grass clippings.
- Recycle materials.

- Recover energy from waste.

- Landfill remaining waste.

IV. Landfill Operator Certification

NDAC Chapter 33.1-20-16, Certification of Operators, stipulates that permittees of all municipal waste landfills, municipal waste incinerators, municipal solid waste ash landfills, and special waste landfills which accept primarily oilfield special waste or TENORM waste in North Dakota must have a certified operator on site at all times during facility operation. Permittees of all industrial waste landfills and special waste landfills which accept primarily coal combustion residuals in North Dakota must have a certified operator whose primary work location is at the facility.

Many states and professional organizations have developed and are continuing to revise professional requirements for landfill operators. The purpose of North Dakota's certification program and other programs is to enhance professional development for landfill operators. Increasing regulations, complex plans and permits and technical improvements have led to a need for increased knowledge, skills, and training for landfill operators.

Frequent review of landfill plans and permits and reference to the training manual and other sources of information will increase the efficiency of North Dakota's waste management facilities. North Dakota's program serves to provide a minimum level of competency among landfill operators and will provide them with a foundation from which they can continue to learn. With daily operations, landfill operators will apply the skills and knowledge they have gained in this certification program.

Exhibit 1-1
Municipal Solid Waste Landfills in North Dakota

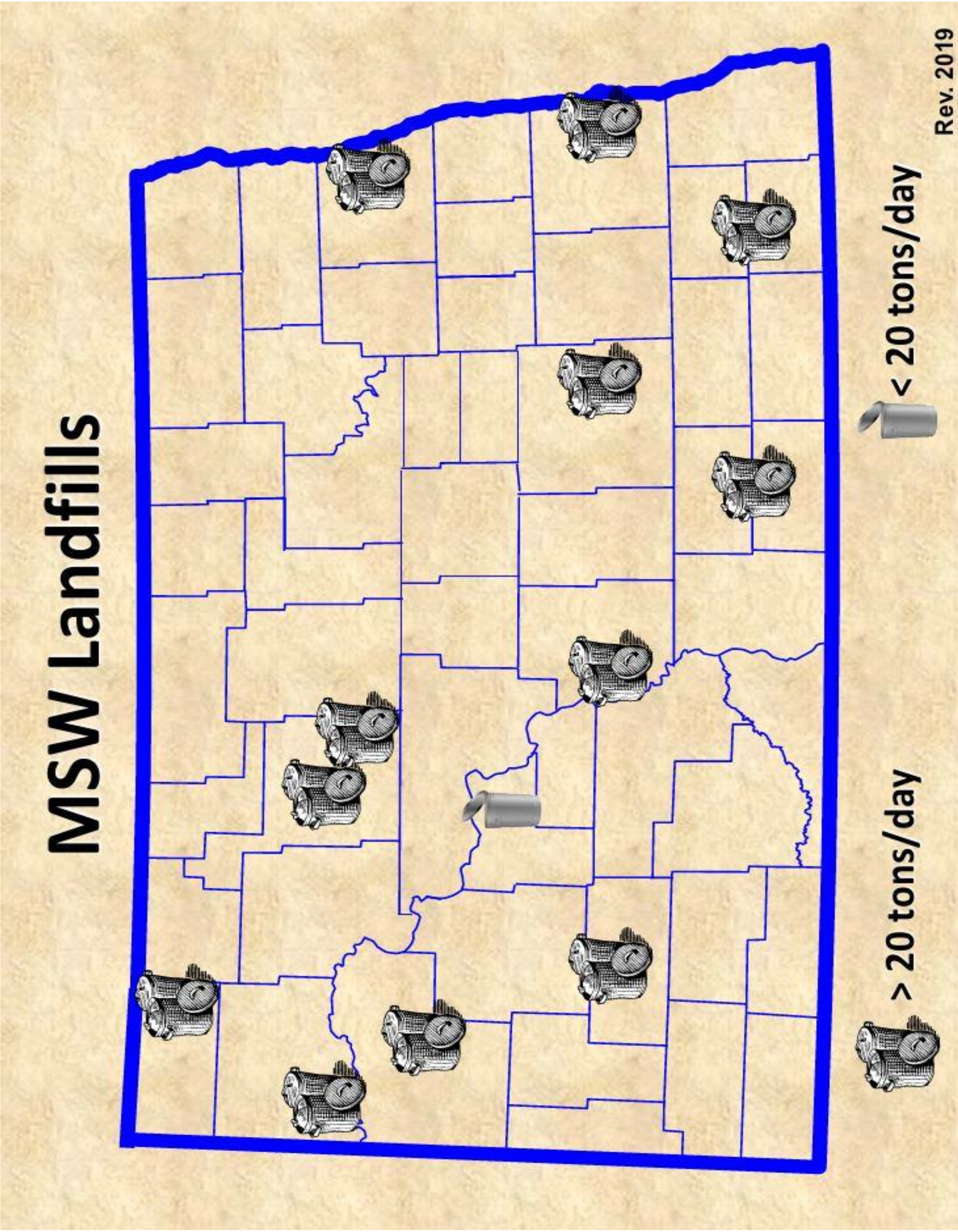


Exhibit 1-2
Municipal Solid Waste Transfer Stations in North Dakota

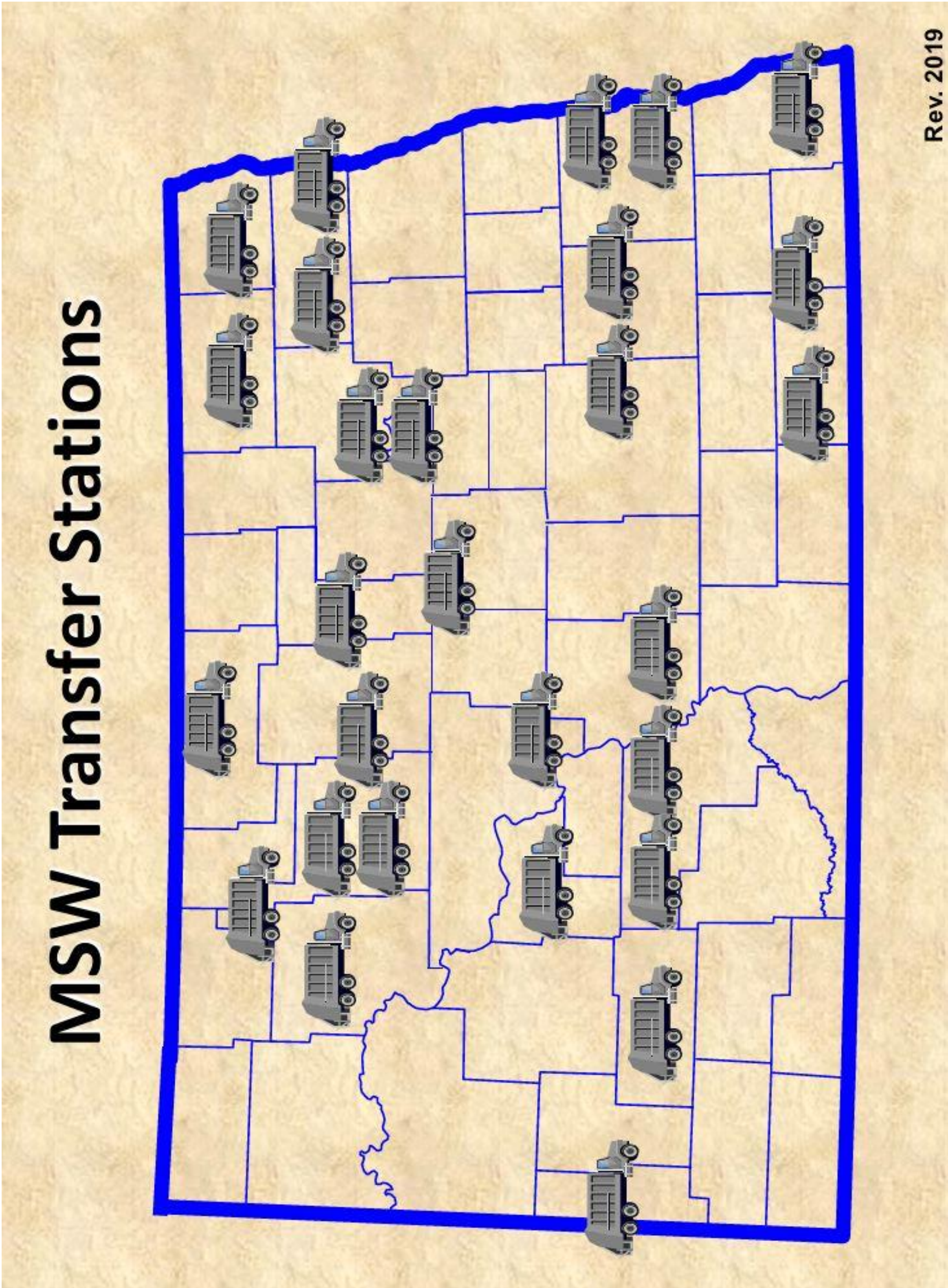


Exhibit 1-3
Special and Industrial Waste Landfills in North Dakota

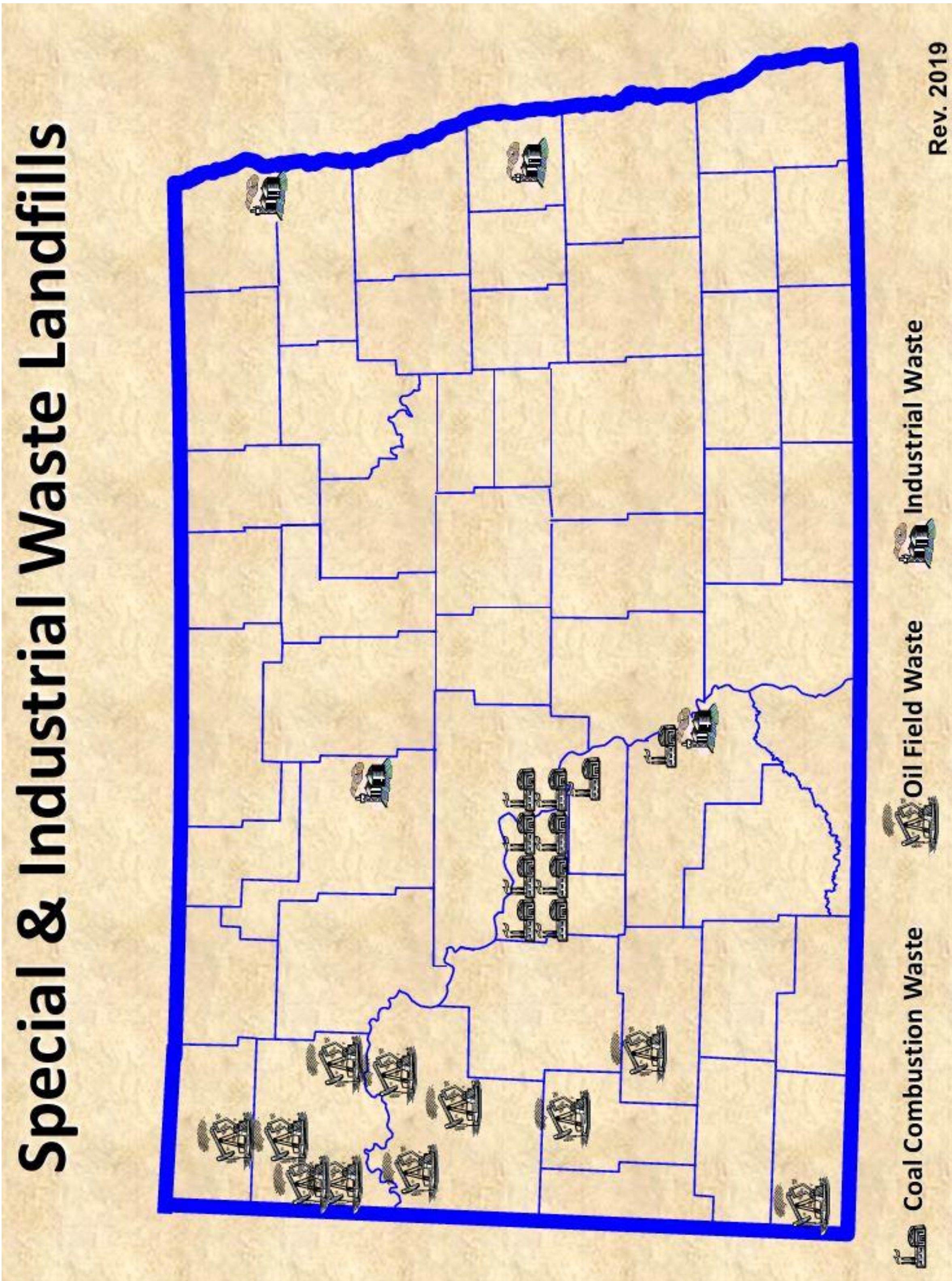
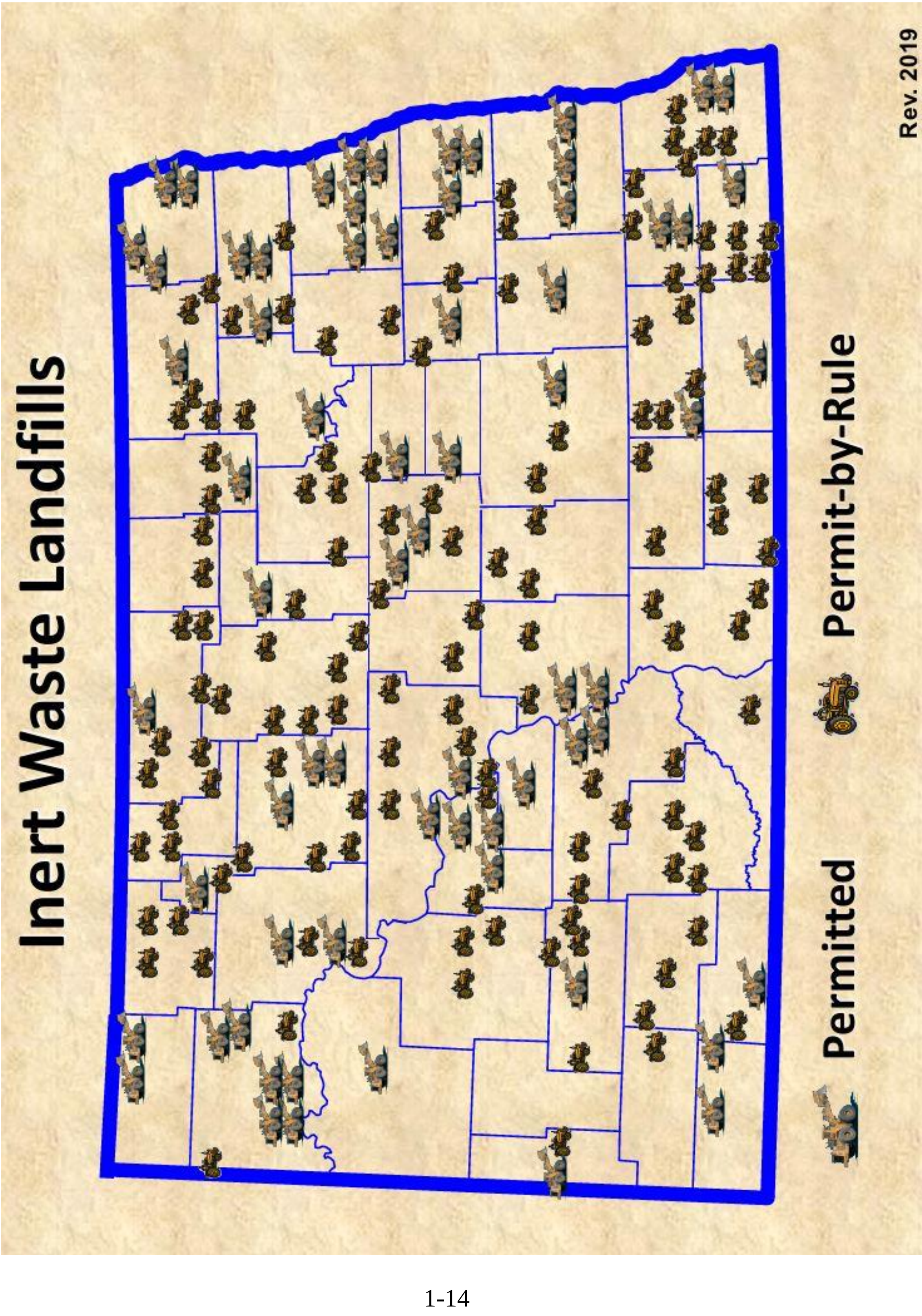


Exhibit 1-4
Inert Waste Landfills in North Dakota



Section 2
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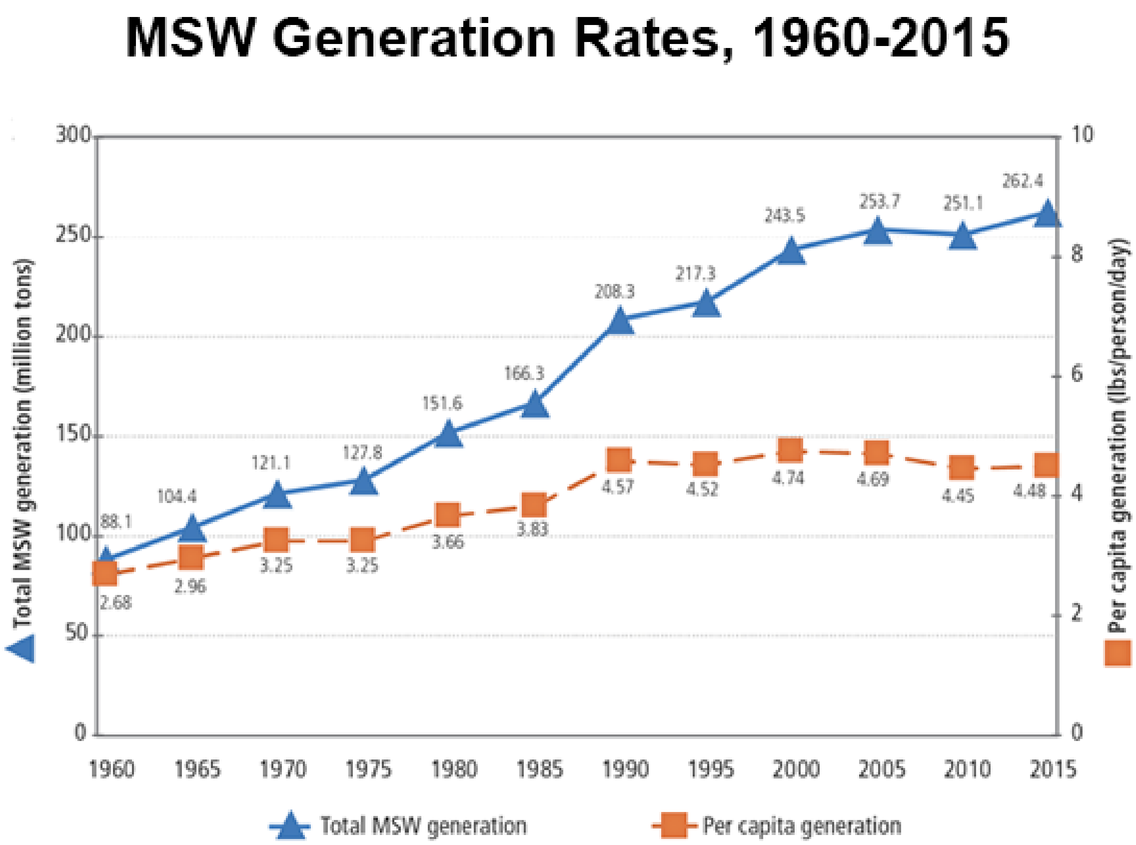
SECTION 2: SOLID WASTE COMPOSITION AND QUANTITY

I. Introduction and Background

In many areas of the United States, little data was available on waste generation and composition before 1990. Data on waste composition and quantities has improved, however, with new federal landfill regulations promulgated in 1991, increased pressures on fewer landfills, and increased quantities of waste disposal. Exhibit 2-1 illustrates municipal solid waste generation for the United States from 1960 to 2015.

Exhibit 2-1
Municipal Solid Waste Generation for the United States from 1960-2015



Each landfill is encouraged to use available information from other waste studies to estimate waste data for their local communities. Solid waste planning can be improved with field research and estimating.

Several factors which affect quantity and composition of generated solid waste include:

- Population
  Significant population increase or decrease affects the quantity of waste. Construction/demolition waste will increase with population increase.

- Time of Year
  Waste disposal increases at Christmas and during spring cleaning of houses and yards. Landfill operators may see increased waste quantities at other times of the year.

- Tourism
  Food and packaging waste increase with increased tourism.

- Agriculture
  Changes in weather patterns affect types and quantities of waste. Regulations for disposal of agricultural chemical containers influence the quantities and types of containers which can be legally disposed of in municipal solid waste landfills.

- Industrial
  Changes in types and amount of industrial activities affect waste composition and quantity.

- Neighborhood and Business Activities
  Hobbies, community interests, and local business activities will influence the waste type and quantities.

- Economic Market
  Raw material costs and consumers' preferences affect manufacturers' decisions to utilize certain materials in packaging and products. Availability of recycling centers also affect waste composition.

- Regulations
  State and federal legislation affect the composition of solid waste. Deposits on items such as aluminum beverage cans, glass bottles, and tires influence purchasing and disposal decisions. Waste stream composition and quantity can change with mandatory recycling laws and federal and state regulations for water, soil, and air quality.

- Disasters and Significant Environmental Activities
  Events such as severe storms, river channel cleaning, and major fires can all affect waste composition and quantity. The Los Angeles riots resulted in substantial demolition construction debris from fires and other damage. Landfill operators do not have the capability to anticipate how society's actions will affect solid waste

generation. Natural disasters may have more significant impacts on smaller landfills than on larger landfills. However, hurricanes Katrina (2005), Sandy (2012), and Harvey (2017), resulted in the generation of such large volumes of waste that even larger landfills have been unable to handle waste from such widespread property destruction.

- Attitudes and awareness
  Consumer buying habits and waste disposal habits are rapidly changing due to an increased awareness of packaging materials and available landfill space. Solid waste generation and disposal are also affected by increased awareness of environmental issues and natural resource management.

II. Solid Waste Composition for the United States

Accurate waste composition studies require a dedication of considerable time and money. Waste composition research involves investigation of generated waste either at the point of generation or at the disposal facility. Studies should be conducted for at least a one-year period to accurately reflect seasonal changes in the waste stream.

It is impossible for any one organization to document the composition for all solid waste produced in the United States. Exhibit 2-2 lists solid waste composition percentages which have been compiled from various studies. Exhibit 2-3 provides another depiction of municipal solid waste composition as estimated by the EPA. The state of Washington's Department of Ecology conducted a comprehensive study of solid waste composition which included investigations of waste composition of various types of generators. Exhibit 2-4 lists the waste categories and their percentage by weight for several businesses and government categories.

Exhibit 2-2
Solid Waste Composition as Estimated by Four Studies

Waste Category	EPA[1] %	Michigan[2] %	New Jersey[2] %	Washington[3] %
Paper and Cardboard	42.8	45.4	40.2	28.3
Glass	5.6	6.3	10.7	5.2
Metals				
Aluminum	1.6	1.3	- -	0.6
Tin Cans				1.5
Nonferrous Metals	0.7	1.4	1.8	2.9
Ferrous Metals	5.9	3.7	5.4	3.6
Plastics	9.3	6.9	8.5	7.4
Rubber and Leather	2.4			1.9
Textiles	2.0	6.3	4.2	3.6
Wood	3.7	2.9	- -	7.1
Food Waste	6.6	8.5	- -	8.8
Lawn and Garden Waste	16.5	12.8	4.0	17.8
Other	2.9	4.5	25.0	11.1

[1]U.S. Environmental Protection Agency, Characterization of Municipal Solid Waste in the United States: 1990 Update, 1990, EPA/530-SW-90-042.

[2]Frederick W. McCamic, Waste Composition Studies: Literature Review and Protocol, Massachusetts Department of Environmental Management, Bureau of Solid Waste Disposal, October, 1985.

[3]Washington State Department of Ecology, Best Management Practices Analysis for Solid Waste, Volume 1, 1987, Publication Number 88-33A, Table IV-2, Washington Department of Ecology, Olympia, Washington.

Exhibit 2-3
Municipal Solid Waste Composition as Estimated by the EPA

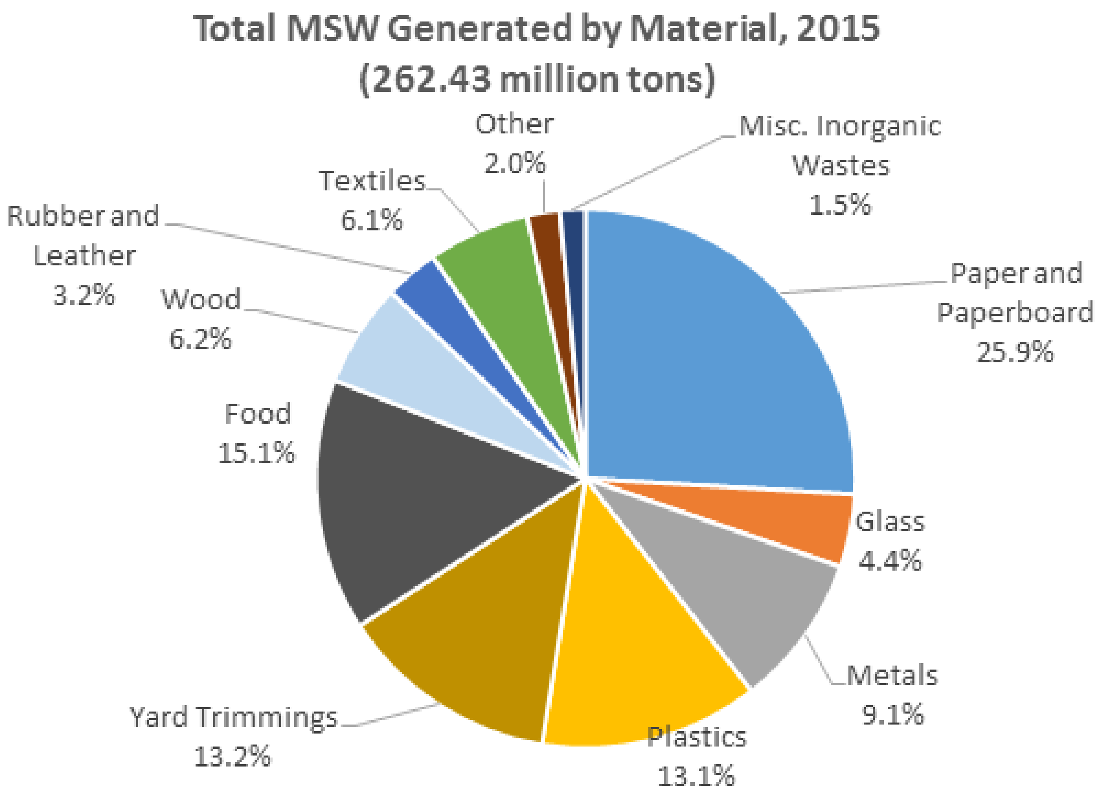


Exhibit 2-4
Washington Department of Ecology: Recycling and Waste Stream Studies
Commercial "Pure-Load" Samples

Category	Offices	Restaurants	Retail	Construction	Education	Government
	(% by Weight)					
GLASS						
Recyclable Containers	2.9	5.8	2.3	0.8	1.0	2.4
Nonrecyclable Glass	1.0	0.1	0.2	0.0	2.2	0.3
METAL						
Aluminum Cans	0.5	0.5	0.2	0.1	0.8	0.5
Aluminum Containers	0.0	0.2	0.2	0.1	0.6	0.3
Tin Cans	0.2	3.8	0.2	0.0	0.2	0.4
Bi-Metal Cans	0.0	0.0	0.0	0.0	0.0	0.0
Mixed Metals/Materials	1.3	0.2	4.9	0.1	0.7	6.4
Ferrous Metals	0.9	0.2	14.6	5.2	3.0	2.2
White Goods	0.0	0.0	0.0	0.1	0.0	0.0
Nonferrous Metals	0.0	0.0	0.4	0.2	0.5	0.0
PAPER						
Newsprint	3.6	2.5	2.9	0.9	3.3	6.7
Corrugated Containers	11.5	15.6	22.0	5.5	11.6	8.4
Computer Paper	3.8	0.0	1.0	0.1	1.9	3.1
Office Paper	6.8	0.0	0.4	0.0	4.4	4.1
Mixed Waste Paper	29.0	4.4	10.3	3.6	21.6	25.0
Nonrecyclable Paper	9.5	14.1	4.9	2.1	5.0	6.5
PLASTICS						
PET Bottles	0.1	0.0	0.1	0.0	0.1	0.1
HDPE Bottles	0.0	0.1	0.0	0.0	0.0	0.0
Plastic Packaging	3.2	8.7	7.9	4.1	4.2	2.5
Other Plastic Products	0.4	0.9	3.4	0.7	0.3	0.7
Expanded Polystyrene	0.6	4.0	0.6	0.8	0.5	0.2
RUBBER						
Rubber Products	0.0	0.0	0.9	0.6	0.6	0.2
Tires	0.0	0.0	0.0	0.0	1.3	1.2
ORGANIC						
Food	3.0	36.0	8.1	0.0	14.0	3.2
Lawn and Garden Waste	2.5	0.4	1.1	0.0	17.5	7.8
Wood Waste	5.3	0.2	9.6	32.6	3.5	12.2
OTHER						
Disposable Diapers	0.0	0.2	0.0	0.0	0.2	0.0
Textiles	6.3	0.4	1.2	1.1	0.4	0.8
Leather	0.0	0.0	0.0	0.0	0.0	0.1
Inert Material and Fines	1.0	1.2	1.6	27.2	0.1	1.5
Ash	0.1	0.0	0.0	0.0	0.0	0.3
Construction Debris	4.2	0.2	0.6	13.9	0.0	2.5
HOUSEHOLD HAZARDOUS WASTE						
Batteries	0.0	0.0	0.0	0.0	0.0	0.0
Oil	2.3	0.0	0.0	0.0	0.0	0.1
Other Chemicals	0.2	0.2	0.3	0.3	0.1	0.2

III. Solid Waste Quantity

Several methods for calculation or determination of waste quantities can be implemented. Landfill operators should utilize one or more methods to calculate waste disposed. This data should be used to estimate landfill life as the landfill development proceeds. Each method of waste calculation has advantages and disadvantages. Federal and state solid waste regulations may result in more preference being given to some methods.

A. Weight of Waste Entering Landfill

Scales located at the landfill entrance allow for an attendant to record the weight of waste entering the landfill. Some landfills do not have scales and, therefore, do not have accurate figures regarding the quantity of solid waste accepted. The installation of scales may warrant the employment of one additional individual to monitor waste. State and federal regulations may allow the landfill to justify the associated additional cost of an attendant.

One disadvantage is that this method does not provide an accurate picture of landfill space utilized. Solid waste landfill capacities are based on volume rather than weight. Most landfill operators use conversion factors between 500 and 1,000 pounds per cubic yard. Landfill experience and measurements should provide operators with more accurate conversion factors for their own landfills. Exhibit 2-5 lists the density of various waste streams.

Waste composition can be recorded to some degree. The record keeper must develop waste categories that are logical for the specific landfill and that can be used to estimate future waste composition and quantities.

Exhibit 2-5
Density of Selected Materials in Refuse Truck

Material	Pounds/ Cubic Yard	Material	Pounds/ Cubic Yard
Newsprint	900	Other inorganic waste	750
High grade paper	900	Corrugated cardboard	600
Refillable glass containers	1000	Mixed waste paper	700
Aluminum beverage containers	150	Other recyclable glass	1000
Ferrous metals	750	Steel cans	300
White goods	400	Nonferrous metals	500
HDPE bottles	300	PET bottles	300
Other plastics	300	Plastic packaging/film	300
Other rubber products	600	Tires	500
Lawn and garden waste	415	Food	1000
Construction/Demolition waste	1000	Wood waste	600
(except wood)		Other organic waste	900

B. Volume of Waste Entering Landfill

This method requires that the gatekeeper estimate and record the volume of each load entering the landfill. The monitor must develop standard estimates for various truck types.

Waste composition can be recorded to some degree. The record keeper must develop waste categories that are logical for the specific landfill and that can be used to estimate future waste composition and quantities.

C. Estimates of Weight Generated per Person Serviced by the Landfill

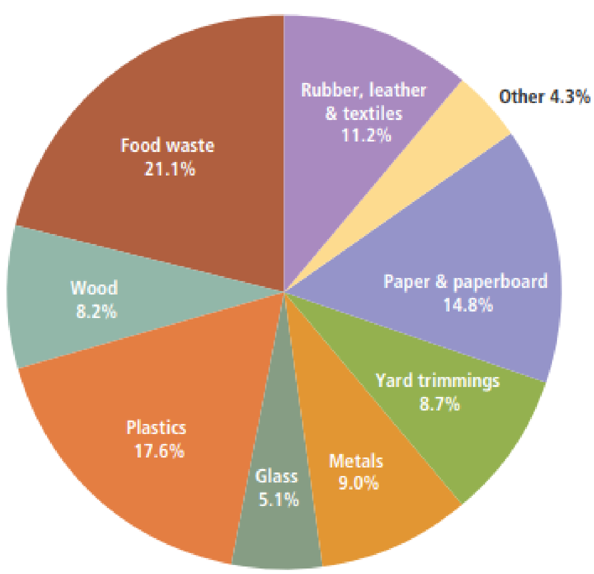
This method assumes that each individual utilizing the landfill generates the same specified amount (generally weight) per person. A second assumption is that the landfill operator knows the size of population served by the landfill.

This method has several disadvantages. Industrial and business waste may not receive adequate consideration with waste estimates. Each person does not generate the same quantity of waste. The population served by each landfill does not remain constant.

D. Land Survey of Landfill Volume Filled Over a Specified Period of Time

Since landfills are "filled" by volume rather than weight, and this may be the most accurate method of evaluating the rate of waste disposal at a landfill. Exhibit 2-6 depicts the volume of landfill discards.

Exhibit 2-6
Landfill Volume of Discards



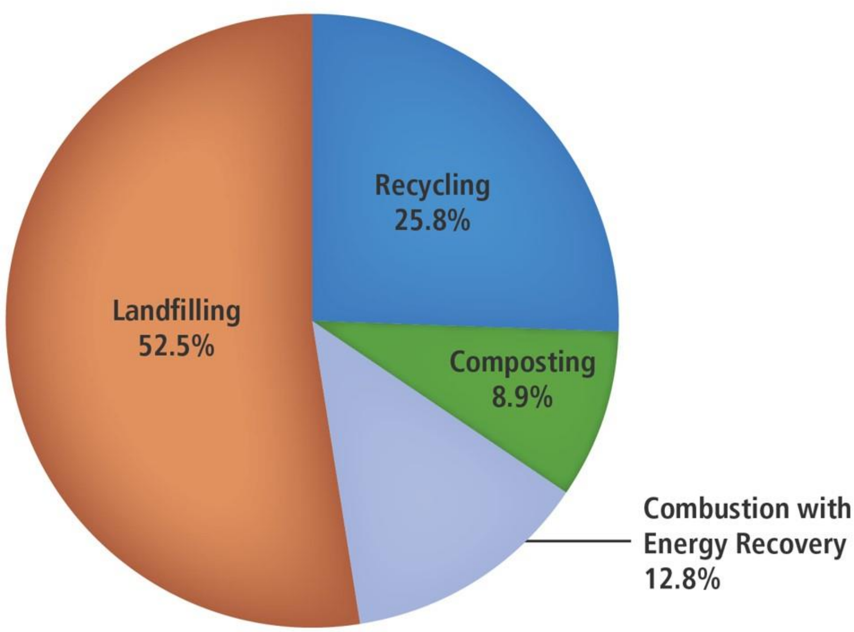
When these studies are performed periodically, the landfill operator is better able to determine the rate at which the landfill is being filled and the factors which may contribute to increased or decreased rates of disposal.

This method requires an assumption that the degree of waste compaction is fairly consistent. However, more frequent surveys allow the operator to determine if waste compaction goals are being achieved.

IV. Waste Minimization

North Dakota does not currently track the amount of solid waste that is recycled in the state. Exhibit 2-7 illustrates the destiny of generated waste and shows that 47.5 percent of waste (by weight) is recovered.

Exhibit 2-7
Management of Municipal Solid Waste in the United States



The volume of materials being recycled is continuing to increase. Recycling centers will continue to undergo many operational changes as markets become more stable. Until the recycling markets stabilize and improve, the volume of recycled material will continue to be difficult to quantify.

The number of recycling projects in North Dakota continues to increase. Glass, newspaper, white office paper, and aluminum cans are the materials generally accepted by most of these projects. White goods and salvaged autos are accepted at most landfills for collection by a scrap dealer. Landfills should encourage recycling to decrease waste disposal and thus increase the life of the landfill.

Several North Dakota landfills have identified waste management procedures which either eliminate or reduce materials from the waste stream. Landfill operators should continue to share their successful projects to increase landfill life and maximize protection of natural resources. Following are several examples of waste reduction methods presently conducted by several North Dakota landfills:

- Some landfills sell wood (primarily tree trimmings) by bid to the public.

- Yard waste and other organic wastes can be composted. Waste volume is thus reduced, and the final product is utilized for improved soil nutrient and soil organic matter.

- After it has been dried, lime sludge from water treatment plants can be used as daily cover material.

- Used oil is accepted for recycling at some landfills. This reduces the opportunities for this environmentally damaging waste to enter the landfill disposal area.

- Combustible wastes (primarily wood) are burned at some landfills. This activity is conducted only on an occasional basis. Prior to burning, landfill operators must obtain burn variances for such operations. NDAC Chapter 33.1-15-04 includes the open burning restriction. A copy of the application for an open burning variance at landfills is included in Section 7 “Operations and Management” of this manual as Exhibit 7-10.

A list of North Dakota recycling centers can be obtained from the North Dakota Solid Waste and Recycling Association.

V. Cost of Recycling

Recycling reduces the quantity of waste disposed and reuses natural resources. Market prices for recyclable materials fluctuate based on supply and demand, the intermediate brokers who are involved, and distance to markets.

Rural states face serious financial challenges to increase the quantity of recyclables which reach a market for reuse. The quantity of recyclables generated in any one rural locale is less than in an urban region of similar area. The distances between generation points and markets are great. Since waste collection and landfill costs have historically been less in rural areas than in urban areas, financial incentives for recycling are diminished.

Rural states are finding new ways to make recycling more financially balanced. Recycling centers in rural states can share information and pool buying power, recyclables, and resources. Profits can thus be increased.

Most landfills have some type of recycling activity. Their goals may be to prevent a potentially hazardous or unacceptable waste from being disposed, increasing landfill life, or increasing income. Before any landfill operator becomes involved with recycling or reusing any material, consideration must be given to all costs associated with the particular recycling project.

The department encourages recycling and is available to assist with development and operation of recycling programs.

Landfill operators should investigate recycling opportunities within their communities and regions. Cost will and should be a factor in our market economy. Various markets should be investigated to determine market prices, length of contracts, quality standards, and packaging requirements.

Exhibit 2-8 lists the past approximate market values for various recyclable materials and related shipping costs.

Exhibit 2-8
Estimated Past Market Values for Recyclables

Computer paper	\$ 60 - \$90 per ton
White ledger paper	\$100 - \$150 per ton
Colored ledger	\$ 20 - \$40 per ton
Newsprint	\$ 50 - \$80 per ton
Magazines	\$ 10 - \$50 per ton
Cardboard and corrugated boxes	\$ 20 - \$60 per ton baled
Glass	\$ 0 - \$10 per ton
Aluminum	\$500 - \$700 per ton
Steel cans	\$ 10 - \$30 per ton
Plastics	
PET, clear	\$100 - \$150 per ton
HDPE, mixed colors	\$ 50 - \$100 per ton
Shipping costs	\$0.09 - \$0.20 per ton-mile

Additional costs of recycling include labor, packaging, building, land, utilities, and overhead. Market conditions (demand and value) should be investigated prior to collecting recyclable materials. The numerous costs associated with recycling operations must be determined prior to embarking on a recyclable material operation.

Section 3
tab

SECTION 3: WASTE DECOMPOSITION

I. Introduction

If the goal is to reduce waste volume in landfills, why is waste decomposition not desired? Decomposition can result in unsafe landfill conditions for employees, the public, and the environment. Situations resulting from waste decomposition can reduce the efficiency of the landfill during design, construction, operations, closure, and postclosure.

Several situations which can develop from waste decomposition include:

- Landfill subsidence
- Development of air pockets which contribute to deposition of dangerous gases and subsequent fires
- Generation and migration of leachate
- Generation of toxic and corrosive liquids as by-products of the decomposition process

Landfills should be designed to minimize waste decomposition. Landfill operators must create conditions which are less conducive for waste decomposition. The potential for waste decomposition can be diminished by improved waste compaction and reduction of water infiltration into waste.

II. Processes of Decomposition

Decomposition occurs by both chemical and biological processes. The composition of the original waste and the decomposition process will determine the specific by-products.

A. Biological Decomposition

Microorganisms can decompose waste by utilizing organics and some inorganics as a food source. This process results in by-products of liquids, gases, and solids.

B. Chemical Decomposition

Inorganic wastes such as metals can decompose by oxidation (chemical) processes. By-products generally include solids and gases with various compounds being generated.

III. Opportunity, Degree, and Rate of Waste Decomposition

A. Particle Size

Smaller particles will decompose (chemically and biologically) more quickly than larger particles. Particles with greater surface area have more area which can react biologically and chemically.

B. Particle Shape

Bulky items tend to decompose more slowly than smaller items. However, bulky items may not receive adequate compaction which allows more air pockets around the waste items, and air pockets allow improved conditions for decomposition.

C. Density

More dense materials tend to decompose more slowly because of fewer pore (air) spaces. Increased compaction of disposed waste will increase its overall density and make it less likely to decompose.

D. Waste Composition

Of all wastes, organic wastes (including food, natural fibers, paper, and yard waste) decompose to the greatest extent. However, little decomposition has occurred in some landfills which have been excavated. Examples of inorganic waste include metals and fly ash.

E. Organisms

Microorganisms are responsible for biological decomposition of waste. Different species have various capabilities and tendencies to utilize waste as a food source or growth media. The degree and rate of waste decomposition will be influenced by populations and conditions which can support microorganisms.

The distribution of organisms within the waste cells will affect the degree and rate of waste decomposition.

F. Oxygen

Increased concentrations of oxygen result in increased decomposition by both chemical and biological processes. The introduction of oxygen into waste by creation of air pockets increases waste decomposition.

G. Moisture

Moisture is necessary for some biological and chemical decomposition. Optimum moisture levels are necessary for decomposition processes to continue. If the moisture level is too low or too high, some processes will be arrested. Anaerobic (lack of oxygen) microorganisms and aerobic (presence of oxygen) microorganisms act to various degrees at different times depending on moisture conditions. When areas are saturated, there will be little pore space or air pockets; some aerobic microorganisms will not exist.

H. Temperature

There are optimum temperatures for the existence and activities of various species of microorganisms. If the temperature is too cold or too hot, some microorganisms will be destroyed. At certain temperatures, microorganisms' activities may increase.

I. pH

Many microorganisms prefer a pH between 5.5 and 9.0. The pH will affect which species of microorganisms will thrive and their activity levels. Chemical reactions are also influenced by pH.

J. Landfill Liner and Cover

Waste in contact with permeable materials has a greater opportunity to come in contact with moisture. Increased permeability contributes to the potential for leachate and gas migration within and out of the site. Landfill liners and covers should be constructed of materials with low permeability to minimize gas and leachate migration. Exhibits 3-1 and 3-2 illustrate the effects of high and low permeability materials on gas and leachate migration and generation.

Exhibit 3-1
Lateral Migration of Landfill Gas and Leachate

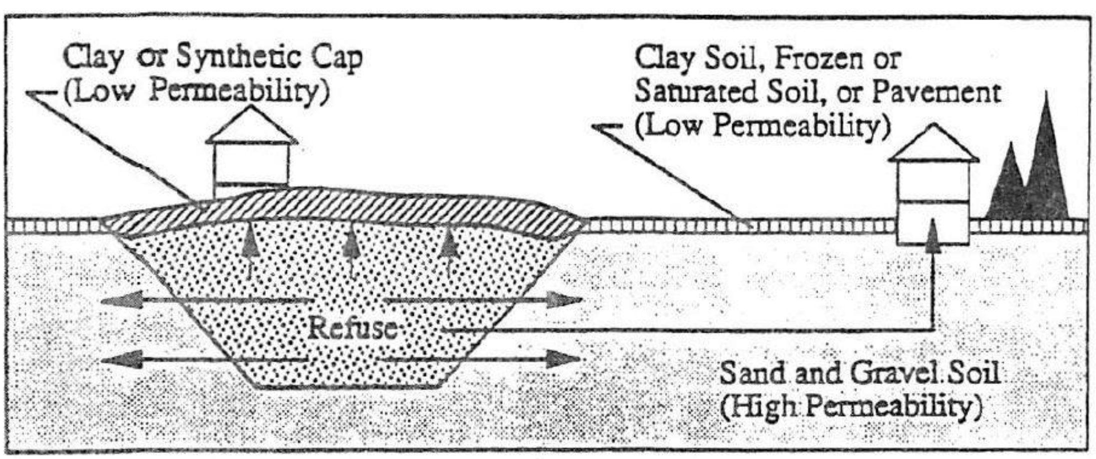
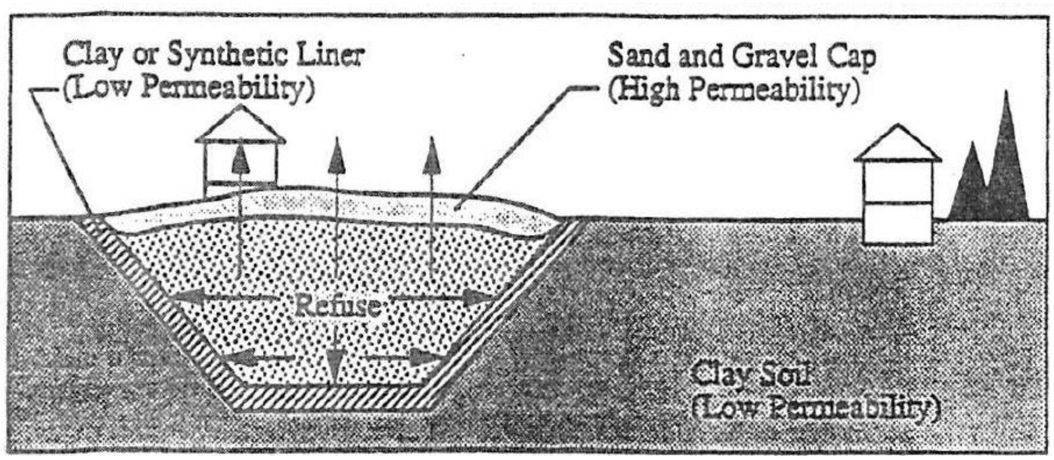


Exhibit 3-2
Vertical Migration (Exit) of Landfill Gas
Vertical Entry of Water into Landfill for Leachate Formation



A tight cover and liner can also minimize leachate generation and restrict gas movement. The restriction on gas movement (once the gas has been generated) can result in increased gas pressure. Subsequently, gas can move through even a small opening and thus enable a larger opening to develop. This means that every effort should be made to minimize the possibility of gas generation and to install gas vents, if necessary.

IV. Decomposition By-Products

Gases, solids, and liquids can be generated from decomposition processes. The quantities, compounds, and form of by-products will be determined by the waste composition and the process. Some decomposition by-products can be very dangerous to landfill employees, the public, and the environment. Many of the solids generated are smaller particles of the waste. However, some solids may result from precipitation of various compounds. This section will address gases and liquids.

A. Landfill Gas

1. Generation

The quantity and composition of landfill gas depend on solid waste composition. Waste streams with substantial amounts of organic material will generate more gas than inert wastes such as asphalt and drywall. The rate of gas production depends on microbial activity which depends to a great extent on moisture and temperature.

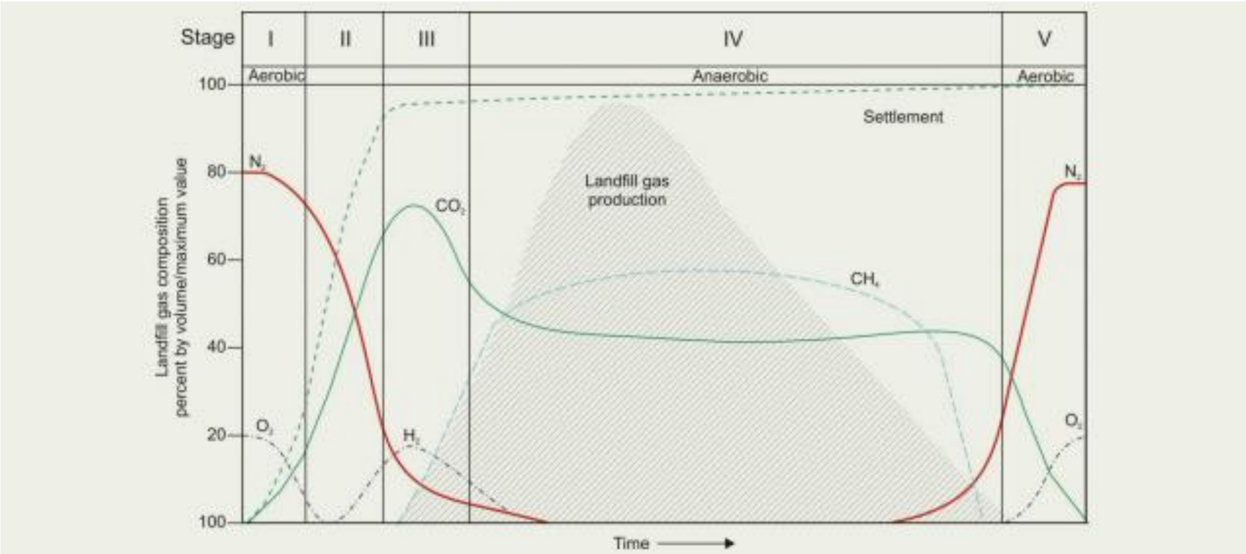
Gases can migrate into subsurface utility conduits, adjacent structures (above and underground), geologic fractures, and cracks or joints in structures. Highly permeable liners and covers serve as routes for landfill gases.

2. Constituents

The primary constituents of landfill decomposition gas are methane and carbon dioxide. Other gases such as hydrogen sulfide, nitrogen, hydrogen, and petroleum gases may be present. Exhibit 3-3 illustrates how landfill gases change in concentration as the aerobic and anaerobic conditions and thus microorganisms change.

Eventually, the concentration of methane in a landfill increases and carbon dioxide levels decrease. Aerobic decomposition (presence of oxygen) results in high levels of carbon dioxide (CO_2), and anaerobic decomposition (absence of oxygen) results in high levels of methane (CH_4).

Exhibit 3-3
Landfill Gas Generation With Time



Carbon dioxide is a by-product of both aerobic and anaerobic decomposition. Carbon dioxide in contact with groundwater can produce carbonic acid and can mineralize groundwater. Generation of carbon dioxide can increase water hardness since it can combine with water and minerals to precipitate calcium carbonate. Carbon dioxide can react with water to produce carbonic acid (H_2CO_3). This reduces the pH of water, making water more acidic. Characteristics of carbon dioxide include the following:

- Colorless
- Odorless

- Non-combustible
- Very soluble in water
- Heavier than air (vapor density greater than 1)

Methane is a by-product of anaerobic decomposition. Methane is explosive when present at concentrations between 5 and 15 percent. Methane may be present in pockets and at concentrations which are too enriched to be explosive. When the gas is vented to the atmosphere, the concentration can decrease to a point where it is between the LEL (lower explosive limit) and UEL (upper explosive limit).

LEL and UEL concentrations are expressed in percentages, with the volume of the material being compared to the volume of air. The lower explosive limit is the lowest concentration of material in air than can be detonated by spark, shock, fire, etc. The upper explosive limit is concentration of material in air that can be detonated by spark, shock, fire, etc. Between the lower and upper explosive limits (between the LEL and the UEL), the material is explosive. When the material concentration is less than the LEL or greater than the UEL, it is not explosive.

Explosive	Not Explosive
LEL $\leq$ % material $\geq$ UEL	% material $<$ LEL % material $>$ UEL

Methane can accumulate in adjacent enclosed structures. Permeable vents can be used to vent methane and other landfill gases into the atmosphere before they become safety hazards. Characteristics of methane include the following:

- Colorless
- Odorless
- Tasteless
- Highly explosive (LEL 5 percent, UEL 15 percent)
- Lighter than air (vapor density less than 1)

3. Hazards

   a. Toxicity

Landfill gases are dangerous because some of them (e.g., hydrogen sulfide-H_2S) are toxic to humans via inhalation. Toxicity can result either from inhalation of too much of a toxic gas or from insufficient oxygen being available.

Distressed vegetation is an indication that landfill gases are present. The pressure of gases can force oxygen out of the root zone. Methane is especially toxic to plant roots.

If sufficient gases are generated in certain places, oxygen can be displaced and exposure can result in asphyxiation. Landfill gases carbon dioxide and hydrogen sulfide can displace oxygen in low places since they are heavier than air. Methane is lighter than air and can collect in structures.

Oxygen levels and LEL should be monitored prior to entering any confined space and any other area which can present inhalation hazards. Oxygen should be present at greater than 19.5 percent. LEL should be 10 percent or less. Safety harnesses and life lines should be worn, and a safety watch should be designated when anyone enters an area where breathing hazards exist.

b. Flammability

Other dangers from landfill gases include explosions and fire. Methane and hydrogen are flammable gases.

Sufficient fuel, oxygen, and an ignition source are necessary for most fires to occur. Efforts must be made to prevent sufficient oxygen from being present and to prevent exposure of ignition sources to flammable gases.

Landfilled waste, however, can include chemicals which are oxidizers and thus provide oxygen. Sufficient heat can be generated from high temperature waste such as hot ashes or from chemical or biological reactions.

No smoking policies should be instituted to prevent sparks from igniting landfill gases. Gas should be vented in a direction and to a location where it will not present inhalation or flammability hazards to landfill workers and the public

B. Leachate

Landfills should be designed to minimize the generation of leachate. Liners and covers with low permeability minimize or prevent groundwater and surface water from entering landfill cells. Produced leachate can migrate off the landfill by entering soils, geologic materials, fractures in the subsurface, underground utilities, and other underground routes.

Constituents of leachate:

- Can be toxic to plant growth.

- Can degrade the quality of drinking water sources for wildlife, domestic livestock, and humans.

- Can cause deterioration of structural foundations, subsurface utilities, and natural geologic formations.

The quantity and composition of landfill leachate depend on solid waste composition. Waste streams of inert wastes may generate less toxic leachate. Leachate generated in areas where household hazardous waste may have been deposited can contain high levels of very toxic chemicals.

Leachate production increases when moisture has an opportunity to enter the landfill cells where waste is located. Factors that influence landfill gas production also influence leachate production. However, constituents of leachate vary more than landfill gas from one landfill to another because of disparate waste composition and characteristics of liners, underlying geologic materials, and landfill covers. Exhibit 3-4 compares several parameters in fresh and old leachate and wastewater.

Exhibit 3-4
Comparison of Leachate to Wastewater

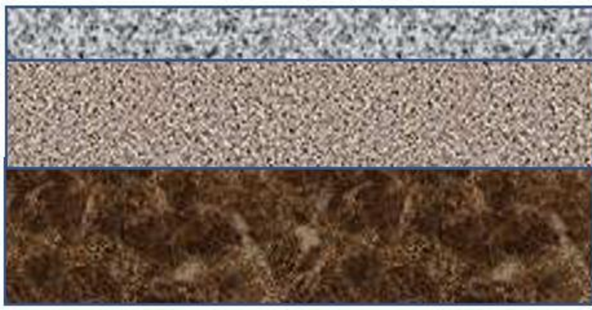
Parameter	Leachate Fresh	Leachate Old	Wastewater	Range (leachate)	
Chloride	742	197	50	2 -	11,000
Iron	500	1.5	0.1	ND -	1,500
Manganese	49	---	0.1	ND -	30.0
Zinc	45	0.16	---	ND -	700
Magnesium	277	81	30	100 -	800
Calcium	2,136	254	50	200 -	2,500
Phosphate	7.35	4.96	10	ND -	200
Copper	0.5	0.1	---	ND -	4.0
Total N	989	7.51	40	2 -	3,500
Conductivity (μmhos)	9,200	1,400	700	500 -	70,000
TDS	12,260	1,144	---	550 -	50,000
TSS	327	266	200	2 -	141,000
pH	5.2	7.3	8.0	5 -	9.0
BOD_5	14,950	---	200	ND -	195,000
COD	22,650	81	500	6.0 -	95,000

V. Controls to Minimize Waste Decomposition and Subsidence

Landfill design and operations must avoid geologic conditions which have the potential to result in subsidence and waste decomposition. Landfills which are sited in permeable or fractured geologic conditions can result in increased waste decomposition, generation and migration of landfill gas and leachate, and subsequent settling of the landfill.

Design specifications for landfill liners and covers are intended to prevent conditions which can contribute to leachate and gas generation and migration. Natural soil liners must be at least 4 feet thick with a hydraulic conductivity not to exceed 1 x 10^{-7} cm/sec. Composite liners must have an upper component of at least 30 mil flexible membrane liner and a lower component of at least two feet of compacted soil with a hydraulic conductivity of no more than 1 x 10^{-7} cm/sec. Flexible membrane liner components consisting of high density polyethylene shall be at least 60 mil thick.

Landfill covers must meet the following specifications:



6" or more of suitable plant growth material
12" or more of clay-rich soil material
Must be suitable to serve as plant root zone

18" or more of compacted soil material
Hydraulic conductivity must be 1 x 10^{-7} cm/sec or less

Most settling appears to occur within the first five years of waste deposition. Efforts to minimize waste decomposition and settling must be taken during landfill operations and closure. Efforts taken after closure may not be futile, but they will be less effective.

Differential settling of the landfill occurs because of:

- Traffic
  Traffic varies by location, volume, and weight of the traffic.

  - Build roadways with inert materials to avoid differential settling.

- Poor Compaction
  Some areas may receive more compaction than other areas. The height of the fill will affect decomposition because of the cumulative weight of the waste.

  - Greater compaction can be achieved by placing waste in lifts of about 24 inches.

- Heterogenous Waste
  Heterogeneous waste results in different rates of decomposition.

  - Settling is less likely to occur if the waste can be made to be more homogeneous. For example, bulky items such as furniture should be segregated. If segregation is not an option, more efforts should be spent compacting waste.

- Uneven Filling
  When a uniform working area is not maintained, waste cells may not be evenly filled.

  - Maintain a uniform working area.

  - Fill all landfill areas with the maximum volume of waste.

  - Grade depressions or fill them with inert materials.

Section 4
tab

SECTION 4: SITE SELECTION

I. General

Solid waste management facilities should not be located in areas which result in impacts to human health or environmental resources. Other areas may be unsuitable because of topography, geology, hydrology, or soils. Sites for land treatment units, surface impoundments closed with solid waste in place, municipal waste landfills, and industrial waste landfills should emphasize favorable geologic conditions and engineered improvements.

Substantial sequences of low permeability materials should provide a barrier to subsurface contaminant migration.

II. Site Selection

Landfill site selection is based on a wide variety of factors related to efficient landfill operation, public concerns, environmental controls, and government restrictions.

A. Accepted Wastes

Waste types, quantities, and sources dictate some of the characteristics which a landfill should have. Landfills should be located as close to the source of generation as possible to minimize transportation costs.

B. Environmental Factors

These natural, in-place factors can make a site acceptable or unacceptable.

State and other regulations may preclude some areas with unacceptable soils, geology, or hydrology from selection. Permeability, excavation limitations, and aquifer locations affect the suitability of many sites. Potential pollution of surface and groundwater should be considered when siting a landfill.

Climate, wind direction, and the ability to control litter, odor, dust, fires, and gases also influence landfill siting. In some cases, these potential problems can be controlled by planning.

Hydrogeologic investigations must be conducted prior to landfill permitting. The purpose of hydrogeologic investigations is to determine the suitability of the soils and geologic material for use as a landfill. Concerns about leachate and gas generation and their migration off the site should be addressed in an investigation. Off-site influences should also be considered since activities on other properties can also affect landfill operations and potential contamination of soil, ground and surface water, and geologic materials.

These investigations should be conducted by experienced professionals. The department has developed *Guideline 3: Hydrogeologic Investigations, Ground Water Monitoring Networks, and Ground Water Sampling for Solid Waste Management Facilities* for these projects. This guideline should be reviewed prior to development of any investigative plan to ensure that activities will be conducted in accordance with the department's recommendations.

C. Archaeological and Historical Sites

Government regulations may prevent the location of landfills close to archaeological and historical sites. Local public opinion may also be against siting landfills near these sites.

D. Area Activities and Public Opinion

Existing land uses should be supporting and not conflicting with landfill operations. Traffic congestion presents problems at landfill entrances.

Public opinion plays a major role in landfill siting. A community may be more willing to accept local landfill siting if residents have been involved in the site selection process.

E. Sequence of Development

Proposed landfill development and future extensions influence where landfills should be located.

F. Governmental Involvement with Landfill Operations

Many landfills are operated by government entities. In the future, more landfills will be operated by associations of government agencies. It is often challenging for various government agencies to work together for a common goal. Site selection must be conducted with all involved parties in mind.

G. Postclosure Use of Landfill

Future landfill use should be considered when siting landfills. End use should complement and not conflict or compete with area land uses.

H. Governmental Restrictions

North Dakota and many other county or local governments have regulations which restrict landfill siting either by specific distances or by evaluation from identified areas or conditions. These restrictions include proximity to areas such as airports and plant or animal habitats.

III. Exclusions

A. The following geographic areas or conditions are excluded from facility siting:

1. Where the waste is disposed within an aquifer.

   Information is available from the North Dakota State Water Commission.

2. Within a public water supply designated wellhead protection area.

   Information is available from the department's Division of Water Quality.

3. Within a 100-year floodplain.

   Information is available from the North Dakota State Water Commission.

4. Where geologic or manmade features may result in differential settlement or failure of the facility's structural integrity.

   Examples include underground mines and areas where groundwater dissolves surrounding geologic materials such as limestone.

   Visual observation, aerial photographs, topographic maps, and engineering maps available from a mine operator can be utilized to identify these areas.

5. On the edge of or within channels, ravines, or steep topography where the slope is unstable due to erosion or mass movement

   These areas can be identified visually with the aid of aerial photographs and topographic maps.

6. Within woody draws.

   These areas can be identified visually and with the use of aerial photographs.

7. In areas designated as critical habitats for endangered or threatened species of plant, fish, or wildlife.

The 1988 federal Endangered Species Act passed by the U.S. Congress is described in Exhibit 4-1. A list of federal threatened, endangered, and candidate species in North Dakota is included in Exhibit 4-1.

The U.S. Fish and Wildlife Service (USFWS) has fact sheets for individual threatened and endangered species of animals and plants. The USFWS can provide additional guidance with habitat evaluation. The agency can also identify other government agencies, nonprofit public interest groups, and private consultants available to provide further assistance for compliance with this law.

8. Within 10,000 feet (3,048 meters) of any airport runway currently used by turbojet aircraft.

   These areas are excluded because of the potential danger of aircraft engines to intake birds, thus preventing safe operation of the aircraft.

9. Within 5,000 feet (1,524 meters) of any runway currently used by piston-type aircraft.

   These areas are excluded because of the potential danger for aircraft engines to intake birds, thus preventing safe operation of the aircraft.

10. Within 25 feet (7.6 meters) horizontal distance from aboveground pipeline, underground pipeline, or transmission line.

    Rights-of-way and easements should be noted on deeds or other property records.

    Physical markers should be located along the route to indicate approximate location.

    The location of all such lines and easements must be indicated on all landfill permit and operating documents and on the ground where necessary.

    Activities in the vicinity of aboveground or underground lines of these types have the potential to disturb or damage the lines. Landfill staff and the public can be exposed to potential injuries and death from contact or damage to these lines.

B. The department may consider an applicant's request to operate in the following areas, but the operator should investigate all other alternatives.

The applicant should discuss their situations with the department before making a formal request to operate in these areas. The department may approve operations in these areas only if there are no reasonable alternatives. Potential dangers to the environment, landfill workers, and the public must be demonstrated to be extremely unlikely.

1. Over or immediately adjacent to principal glacial drift and aquifers.

   Information is available from the North Dakota State Water Commission.

2. Closer than 1,000 feet (305 meters) to a downgradient drinking water supply well.

   Information is available from the North Dakota State Water Commission.

   Site-specific investigations may be necessary to identify wells which may not have been reported to the State Water Commission.

   Prior to 1972, well installation reports to the State Water Commission were not required.

3. Closer than 200 feet (61.0 meters) horizontally from the ordinary high water elevation of any surface water or wetland.

   Surface waters can be identified visually or with aerial photographs and topographic maps.

   Some high-water points can be identified visually in the field.

   The North Dakota Game and Fish Department and the North Dakota State Water Commission can provide additional assistance.

   Federal regulations involving wetlands undergo continued revisions, especially in regard to field enforcement. Professionals should be consulted regarding wetlands. Soil scientists are among those who can assist with the delineation of these areas. The Natural Resources Conservation Service can also provide guidance with wetlands.

4. Within final cuts of surface mines.

   Final cuts may be identified to some degree by visual observation and, more accurately, with the use of maps available from the mine operator.

5. Within 1,000 feet (305 meters) of any state or national park.

   Topographic maps should also have state and national parks designated. The North Dakota Parks and Recreation Department should have information about state parks.

   The U.S. Department of Interior - National Park Service has information about the location of national parks.

IV. Local Restrictions

In addition to state siting requirements, counties and municipalities may have ordinances or codes which restrict landfill siting.

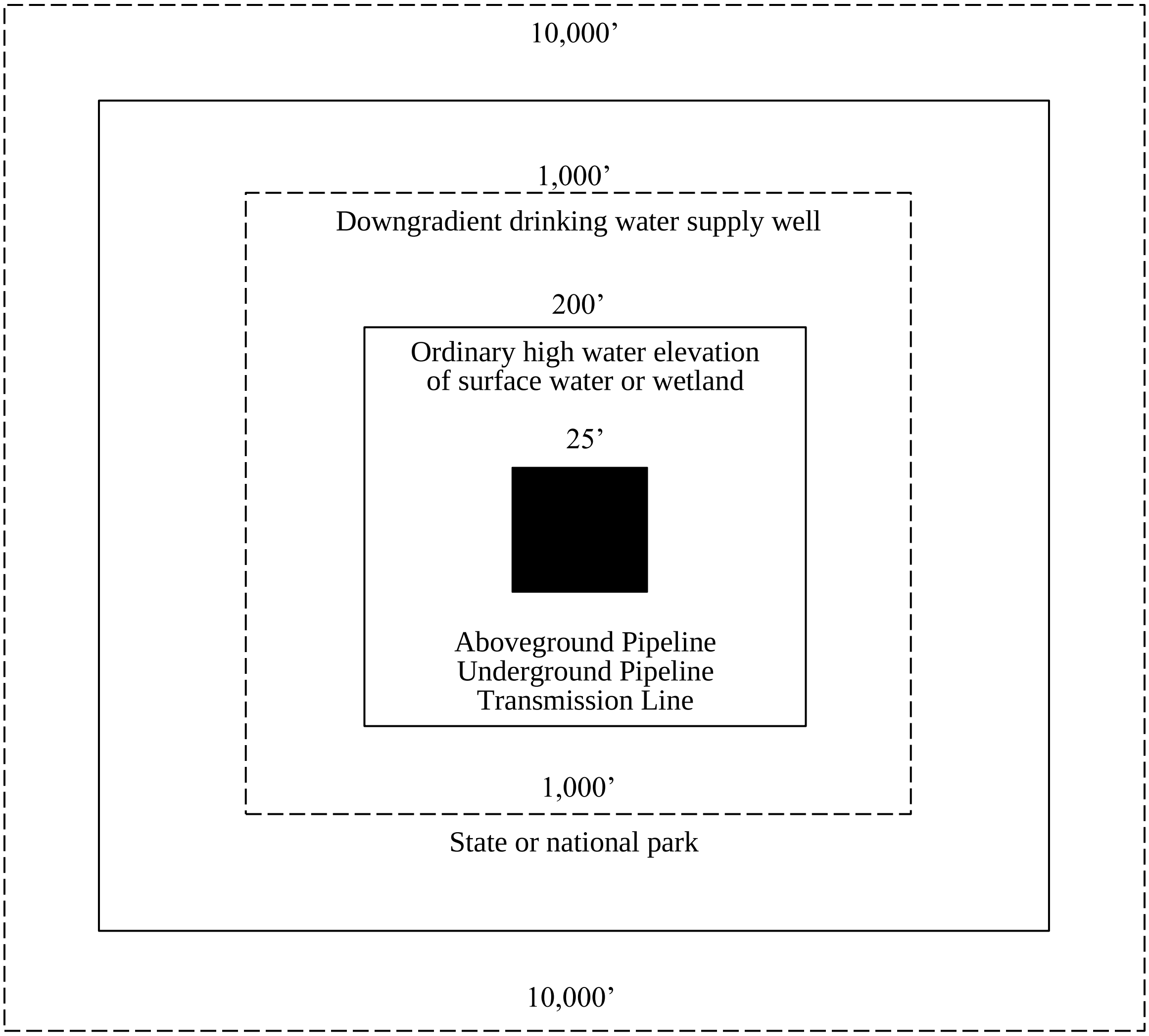
Transfer stations and solid waste collection activities may also be subject to local regulations.

Even when laws, regulations, and state or federal agencies allow a landfill to be sited, the community may not welcome its operations. Prior to siting new landfills or expanding existing facilities, public opinion should be evaluated to avoid the NIMBYs (Not in My Back Yard). Landfill operators should engage interested community members in the landfill siting and permitting process. Community members from selected groups such as media, industry, business, identified nonprofit groups, and the general public should be selected for more balanced viewpoints. When citizens believe that they are active participants, landfill siting proceeds more expeditiously. A landfill may be more readily accepted into the economic and social fabric of the community if the public has participated in the siting process.

V. Summary

The following figure provides a summary of the specific location standards. Landfill operators may wish to revise the guide to reflect local restrictions, in addition to state standards.

Turbojet airport



Turbojet airport

NO:

- AQUIFERS
- PUBLIC WATER SUPPLY DESIGNATED WELLHEAD PROTECTION AREA
- TOPOGRAPHIC. GEOLOGIC, OR MANMADE FEATURES WHICH CAN RESULT IN UNSTABLE INTEGRITY OF EXISTING FEATURES OR LANDFILL
- WETLANDS
- FLOODPLAINS
- WOODY DRAWS
- CRITICAL HABITATS FOR THREATENED OR ENDANGERED SPECIES

Exhibit 4-1
Endangered Species Act of 1973, Page 1

ENDANGERED SPECIES ACT OF 1973

AN ACT To provide for the conservation of endangered and threatened species of fish, wildlife, and plants, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the ''Endangered Species Act of 1973''.

Section 3(5)(A) The term ''critical habitat'' for a threatened or endangered species means—
(i) the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the provisions of section 4 of this Act, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and
(ii) specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 4 of this Act, upon a determination by the Secretary that such areas are essential for the conservation of the species…

FEDERAL THREATENED, ENDANGERED, AND CANDIDATE SPECIES
AND DESIGNATED CRITICAL HABITAT FOUND IN
NORTH DAKOTA
July 28, 2007

ENDANGERED SPECIES

Birds

Interior least tern (Sterna antillarum): Nests along midstream sandbars of the Missouri and Yellowstone Rivers.

Whooping crane (Grus Americana): Migrates through west and central counties during spring and fall. Prefers to roost on wetlands and stock dams with good visibility. Young adults summered in North Dakota in 1989, 1990, and 1993. Total population 140-150 birds.

Fish

Pallid sturgeon (Scaphirhynchus albus): Known only from the Missouri and Yellowstone Rivers. No reproduction has been documented in 15 years.

Mammals

Black-footed ferret (Mustela nigripes): Exclusively associated with prairie dog towns. No records of occurrence in recent years, although there is potential for reintroduction in the future.

Gray wolf (Canis lupus): Occasional visitor in North Dakota. Most frequently observed in the Turtle Mountains area.

THREATENED SPECIES

Birds

Piping plover (Charadrius melodus): Nests on midstream sandbars of the Missouri and Yellowstone rivers and along shorelines of saline wetlands. More nest in North Dakota than any other state.

Plants

W. prairie-fringed orchid (Platanthera praeclara): Locally common in moist swales on Sheyenne National Grasslands. Largest known U.S. population is on the Sheyenne.

CANDIDATE SPECIES

Invertebrates

Dakota skipper (Hesperia dacotae): Found in native prairie containing a high diversity of wildflowers and grasses. Habitat includes two prairie types: (1) low (wet) prairie dominated by bluestem grasses, wood lily, harebell, and smooth camas; (2) upland (dry) prairie on ridges and hillsides dominated by bluestem grasses, needle grass, pale purple and upright coneflowers, and blanket flower.

DESIGNATED CRITICAL HABITAT

Birds

Piping Plover – Alkali Lakes and Wetlands – Critical habitat includes: (1) shallow, seasonally to permanently flooded, mixosaline to hypersaline wetlands with sandy to gravelly, sparsely vegetated beaches, salt-encrusted mud flats, and/or gravelly salt flats; (2) springs and fens along edges of alkali lakes and wetlands; and (3) adjacent uplands 200 feet (61 meters) above the high water mark of the alkali lake or wetland.

Piping Plover – Missouri River – Critical habitat includes sparsely vegetated channel sandbars, sand and gravel beaches on islands, temporary pools on sandbars and islands, and the interface with the river.

Piping Plover – Lake Sakakawea and Oahe – Critical habitat includes sparsely vegetated shoreline beaches, peninsulas, islands composed of sand, gravel, or shale, and their interface with the water bodies.

Section 5
tab

SECTION 5: LANDFILL PERMITS, DESIGN, AND CONSTRUCTION

PERMITS

I. Introduction

All new and existing municipal solid waste landfills are required to have permits issued by the department. This section outlines permit requirements for various facilities. Much of the information which must be included in the preapplication or application is used to prepare landfill design and construction plans.

Permits are required to ensure that landfills are sited, designed and operated in regulatory compliance. Federal and state regulations will place increasing pressures on landfills and underscore the need to extend landfill life.

II. Preapplication for New Solid Waste Management Facilities

Prior to submitting a permit application, new solid waste management facilities must submit a preapplication with a preliminary facility description and site assessment to the department.

The preliminary facility description must include:

- Facility location
- Capacity (projected)
- Size (projected)
- Daily waste receipts (projected)
- Type of waste accepted (projected)
- Years of operation (projected)
- Description of operation (projected)
- Costs (projected)
- Discussion of the proposed facility's compliance with local zoning requirements
- Available information regarding site geology, hydrogeology, topography, soils, and hydrology

The department will review the preapplication in conjunction with the state geologist and state engineer to evaluate its geological and hydrogeological suitability for further evaluation and consideration.

Written approval or disapproval will be provided by the department within 60 days of receipt.

- **If disapproved**, the department will inform the applicant, in writing, of the reasons for the disapproval. The applicant may submit a new preapplication.

- **If approved**, an application may be filed.

III. Permit Applications for New and Existing Facilities

A. General Guidelines

The application must:

- Be submitted on department forms.

- Be prepared by the applicant or applicant's authorized agent and signed by the applicant.

- Include one paper copy and one digital copy, including supporting documents.

B. Public Notice

The applicant shall publish a public notice indicating that an application has been submitted to the department. The notice must include type and location of facility. The notice must be published in two separate editions of the official newspaper of the county in which the operation is located.

Proof of publication must be provided by the applicant to the department within 30 days after the second publication. This proof includes an affidavit from the publisher with a copy of the published notice showing the date of publication. The department may also require public notice for major modifications of permitted units or facilities.

C. Application Requirements

Many of the landfill design requirements and environmental monitoring data outlined in this section and operational procedures discussed in Section 7 "Operations and Management" of this manual must be included with the permit application. The following are components of the application:

- Categories of solid waste to be accepted

- Detailed geologic and hydrogeologic evaluation
- Soil survey and segregation of suitable plant growth material (SPGM)
- Site engineering plans and facility specifications
- Plan of operation
- Surface water and groundwater protection provisions
- Odors, dust, and open burning control provisions
- Accident prevention and safety provisions
- Fire protection provisions
- Inspection, recordkeeping, and reporting procedures
- Access control and facility sign descriptions
- Operator training procedures
- Construction quality assurance and quality control procedures
- Closure and postclosure period procedures
- Financial assurance provisions

D. Permit Application Review and Action

The department has 120 days to review and approve or disapprove the application and notify the applicant of the decision. If significant changes are submitted by the applicant, the department may extend the period an additional 120 days (to a total of 240 days).

The application for a permit may be:

- Approved

  The department will provide a written notice of its intent to issue the permit. A draft permit will be prepared by the department and made available for public review and comment. Interested parties may submit written comments to the department within 30 days of the public notice. If there is significant public interest in holding a hearing, a public notice for a hearing will be published. Public notification for hearings are the same as for draft permits. The hearing will be conducted by the department at least 15 days after the public notice has been published.

  If the department approves the permit application based on its review and any public comments and hearings, the department will issue a permit. The department may include additional permit conditions.

- Returned for clarification and additional information

  Within six months, an application may be resubmitted by the applicant and must include all necessary information to satisfy deficiencies. If no resubmittal is made within six months, the department shall consider the application withdrawn. Subsequent applications must be considered a new application.

- Denied

  Denial of the application may be based on:

  - False, misleading, misrepresented, or substantially incorrect or inaccurate information provided in the application.

  - Application fails to demonstrate compliance with regulations.

  - Application proposes construction, installation, or operation of a facility which will result in regulatory violations.

  - An applicant history of environmental noncompliance.

  If the permit is denied, the applicant will receive written notification and explanation of the basis for the denial. Depending on the basis for denial, a revised application may be resubmitted.

IV. Permit Amendments

Landfill owners and operators with existing permits on December 1, 1992, or later were required to apply for permit amendments necessary to bring the permit into compliance. The application was required to be submitted either before October 9, 1993, or prior to the existing permit's expiration (whichever was later).

V. Existing Nonpermitted Facilities

Owners/operators of existing facilities that did not have a permit as of December 1, 1992, and that were now required to be permitted, had to apply to the department for a permit by December 1, 1994.

VI. Permit Fees

Each facility submitting an application must also submit payment for application processing. These fees are outlined in Exhibit 5-1.

Annual permit fees are also required and are listed in Exhibit 5-2.

Exhibit 5-1
Application Processing Fees

Facility	Average Daily Waste Accepted	Processing Fee
Solid Waste Transporter		$ 200
Solid Waste Processing Facility		5,000
Resource Recovery System		
Municipal Waste Landfill	<20 tons	1,000
Municipal Waste Landfill	20 - 50 tons	3,000
Municipal Waste Landfill	50 - 500 tons	5,000
Municipal Waste Landfill	>500 tons	20,000
Surface Impoundment Facility		5,000
Industrial/Special Waste Landfill	<10 tons	1,000
Industrial/Special Waste Facility	10 - 100 tons	10,000
Industrial/Special Waste Facility	>100 tons per day	20,000
Inert Waste Landfill	>40 tons per day	2,000

When the department initiates permit modifications for unexpired permits, an application processing fee may not be required.

A processing fee may be required when a facility initiates modifications to its existing permit. The extent of the department's permit review will determine if there will be a fee and the amount .

Exhibit 5-2
Annual Permit Fees

Facility	Average Daily Waste Accepted	Processing Fee
Solid Waste Processing Facility		$ 500
Resource Recovery System		
Municipal Waste Landfill	20 - 50 tons	500
Municipal Waste Landfill	50 - 500 tons	1,000
Municipal Waste Landfill	>500 tons	5,000
Industrial/Special Waste Facility		500
Surface Impoundment Facility		500

The fee period begins July 1 of each year. The fee must be paid by July 31. All fees must be made payable to the North Dakota Department of Environmental Quality.

DESIGN

I. Design and Construction Plans

Modern landfills are engineered facilities for land disposal of municipal solid waste. Written plans and specifications are developed to construct the facility and are used as guidelines during the operation of the facility. In addition, permit application approvals are based primarily on design plans. After a site is selected, landfill design commences.

The primary steps of landfill design are to:

- Establish goals and objectives.
- Identify design basis.
- Develop alternative designs.
- Evaluate designs.
- Prepare detailed design.

A. Goals and Objectives

  - Control landfill gas and leachate, maximize landfill volume, and minimize costs.
  - Comply with rules, regulations, and permit conditions.
  - Protect environment.
  - Minimize nuisance issues (vectors, litter, dust, and noise).
  - Minimize costs.
  - Maximize operational efficiency for workers and patrons.
  - Protect safety of workers and patrons.
  - Optimize land use upon landfill closure.

B. Identify Design Basis

1. Environmental rules and regulations should be reviewed and applicable standards identified.

2. Determine volume and type of waste to be disposed.

3. Evaluate physical characteristics of the site.

   a. Review topographic maps and aerial photographs

      Identify location of transportation corridors, utilities, residential areas, industrial and business sites, wells, buildings, and drainages.

      Prepare a map with a scale of about 1 inch = 200 feet to illustrate existing features on a topographic map.

   b. Evaluate existing environmental data.

      Review available geotechnical data.

      If sufficient geotechnical data is not available, a hydrogeological investigation must be conducted. The extent of the investigation will depend on available information and hydrogeologic conditions. Heterogeneous geological conditions require more boreholes than homogeneous geology.

      Evaluate water resources, control of runoff and run-on, pollution of surface and groundwater, stream location, flow rates, floodplains, surface water runoff rates, precipitation and evaporation rates.

      Evaluate the potential for gas or leachate migration and the suitability of soil as landfill base and cover material.

      Prepare cross sections to provide a side view of soils and geology, near to and on the site.

      Determine wind velocity and direction to evaluate controls for litter, dust, and odor.

   c. Review transportation requirements in relation to design.

      - Site entry
      - Required road types
      - Traffic control

- Route of trucks to working face
- Minimize waiting times
- Public access
- Separate working areas for individuals and commercial collection services

d. Site operations

- ▶ Operator
- ▶ Waste quantities and landfill volume requirements
- ▶ Excavation requirements and available cover
- ▶ Procedures
- ▶ Equipment
- ▶ Costs and revenues

e. Postclosure use

- ▶ Options for land use
- ▶ Compatibility with surrounding land use
- ▶ Landfill limitations

C. <u>Alternative designs</u>

Alternative designs may be proposed. The engineer, operator, and other interested parties should be involved with selecting alternatives. The involvement of several entities will allow consideration of design from several perspectives.

D. <u>Evaluating Designs and Selection of Design(s)</u>

Designs should be ranked by various factors such as cost, efficiency, equipment demands, schedules, general preferences, and regulations.

E. <u>Preparation of Detailed Design</u>

1. The following items must be included in the landfill design:

- ▶ Pre-existing conditions
- ▶ Landfill elevations and slope

- Earthwork balance
- Surface water flow
- Leachate control
- Landfill gas control system
- Zones
    - perimeter
    - entrance
    - visual
    - interior
- Cell design
- Sequence and chronology of development
- Plan of operation
- Groundwater monitoring wells

2. The written document submitted to the department and used for conducting daily operations will include the requirements listed in item 1 and referenced as necessary with the following illustrations and narratives:

    - Title sheet and location map
    - Original United States Geologic Survey (USGS) quadrangle map of 1:24,000
    - Existing site conditions on a map of about 1 inch to 200 feet, with 5-foot contours
    - Phased site development plans
    - Cross section plans
    - Final contour plans
    - Operator name, address, and phone number
    - Legal land description
    - Compliance with state, federal, and local laws
    - Ownership (e.g., right-of-way, easements, mineral rights, and affected adjacent property)

- Soils, geologic, and hydrogeologic information for the site and as necessary for the surrounding area
- Limitations or restrictions for use as landfill
- Design and construction standards
- Standard operating procedures
- Environmental monitoring
- Closure/postclosure development

II. Methods of Disposal

A. Objectives

Landfills should be designed and operations should be conducted to maximize waste density. Optimizing waste density extends landfill life and makes the landfill safer for the environment, workers, and the public.

Areas within landfills are often referred to as cells. Cells may be designated by name, letter and/or number combinations, or waste category.

Completed cells or vaults at the same elevation are termed lifts. A completed fill area consists of one or more lifts. Cell dimensions are based on waste volume; waste type; acceptable working area; degree of compaction; and frequency, amount, and consistency of cover.

B. Area and Trench Landfill Design Methods

Some landfills or portions thereof are combinations of both area and trench operations.

1. **Trench** - A trench is excavated with appropriate material saved for use as daily and/or final cover. Solid waste is deposited within the trench at the shallowest portion or face. Waste is compacted and then covered. The trench is filled from the shallow end to the deep end.

   Trenches should be dug at least twice as wide as the equipment which must operate in them.

   Trench depth is based on soil, geologic, and groundwater conditions.

Trenches should be designed for operations to be conducted perpendicular to prevailing wind direction. This procedure reduces blowing litter. The trench floor should be designed for good drainage.

2. **Area** - Solid waste is deposited, compacted, and covered on the natural surface of the ground or on top of previously deposited waste. Prior to waste deposition, topsoil should be stripped for future use.

C. Sequence of Development

Areas should be excavated so that cover and topsoil material which is "first in" is "first out."

The more quickly stockpiled topsoil is used, the higher the levels of microorganisms, the better the soil structure and porosity, and the greater the levels of organic matter and other nutrients. Backhauling of topsoil (stripping topsoil and immediately placing it for use) is the most effective method of handling topsoil.

Topsoil and cover material should be stockpiled in locations which are out of the way of operations, but at distances which maximize transportation efficiency.

Haulage distances and routes should be selected to maximize equipment efficiency.

Landfill designs should incorporate sequential development so that completed portions of the landfill can be properly closed while active portions of the landfill continue to accept waste. Equipment and operational efficiency should be primary considerations with sequential development designs.

In landfills without leachate collection, it is beneficial to fill from high to low areas to facilitate drainage of leachate. Conversely, when a leachate collection system is in place, it is generally best to fill from low (where the pump is) to high.

III. Operational Calculations and Plan Reading

Landfill operators should have at a minimum the following survey equipment in order to monitor landfill construction and progression.

- Engineer's level and tripod or hand level
- 25-foot telescoping level rod
- Scale to match plans
- 100-foot plastic tape on reel
- Field book for notes

▶ Calculator

The key below is used for the following exercises:

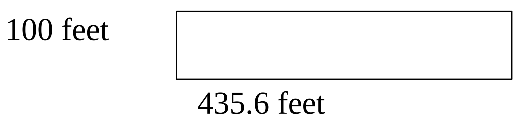
KEY

A = Area
B = Base (length)
H = Height
L = Length
V = Volume
W = Width

A. Calculation of Areas

1. Square or rectangle = length (L) x width (W)

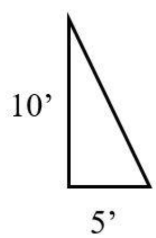
   Assume that the following landfill area will be disturbed by stripping topsoil (determine the area in square feet).



   Solution = L x W = 435.6 feet x 100 feet = 43,560 ft^2

2. Triangle = ½ x Base (B) x Height (H)

   Calculate the area of the triangle. Results are reported in square feet (sq ft).



   Solution = ½ x B x H = ½ x 5 feet x 10 feet = 25 feet

3. Number of acres in area = $\frac{\text{Square feet (sq. ft)}}{\text{43,560 sq. ft}}$ = Acres (A)

To convert the area in #1 from square feet to acres, divide the number of square feet by the number of square feet in one acre as follows:

$$43{,}560 \text{ ft}^2 \quad = \quad 1 \text{ acre}$$

$$\frac{43{,}560 \text{ ft}^2}{43{,}650 \text{ ft}^2/\text{acre}} \quad = \quad 1 \text{ acre}$$

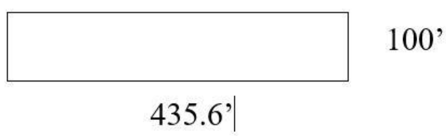
Always check the units of measure to be certain that the calculation is being done correctly.

$$\text{ft}^2 \div \frac{\text{ft}^2}{\text{acre}} = \text{acre}$$

B. Calculation of Volumes

1. Rectangular solids

Assume that the acceptable topsoil totaling 20 feet in depth will be excavated from this area. Calculate the volume of this excavation.



Volume (V) = Length (L) x Width (W) x Height (H)

Solution = L x W x H = 435.6 feet x 100 feet x 20 feet = 871,200 cubic feet or 871,200 ft^3

Convert the results, which are in cubic feet, to cubic yards.

1 cubic yard = 3 feet x 3 feet x 3 feet = 27 ft^3

To calculate the number of cubic yards of volume, divide the cubic feet by 27.

$$\frac{\text{Cubic feet}}{\text{27 cubic feet}} = \text{Cubic yards}$$

$$\frac{871{,}200 \text{ ft}^3}{27 \text{ ft}^3/\text{yd}^3} = 32{,}266.7 \text{ yd}^3$$

Assume that this excavation area will serve as an evaporation pond. How many acre-feet of water will it hold?

Convert cubic yards to acre-feet.

This conversion is often used when reference is made to soil, cover material, or water.

Solution = 1 acre-foot = 1 acre which is 1 foot deep

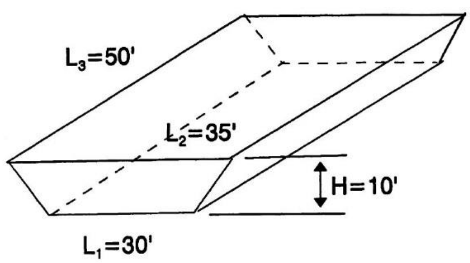
In the above example, we had 1 acre (43,560 ft^2) which was 20 feet deep. Thus, we have 20 acre-feet.

An area of 1 acre which is 20 feet deep will be equal to 20 acre-feet.
An area of 20 acres which is 1-foot-deep will also be 20 acre-feet.

2. Trapezoidal solids

The shapes of excavated areas in landfills tend not to be nice, neat, rectangular solids, but are often similar to trapezoids. The formula for the volume of a three dimensional trapezoidal solid is:

Volume of trapezoid = Area x L_3



Area = ½ (L_1 + L_2) x H
= ½ (30 + 35) x 10
= ½ (65) x 10
= 32.5 x 10
= 325 ft^2

Volume = 325 ft^2 x 50 ft = 16,250 ft^3

3. Weight and volume conversions

Solid waste is often measured in volume or in weight and must be converted to the other unit of measure. Many landfills use scales to weigh waste. Thus, weight (in tons) must be converted to volume in order to estimate landfill volume to be used or completed.

Landfill operators use a range of 500-1,000 pounds per cubic yard of waste. Various factors are used because of densities of various waste types, the use of compactor trucks or balers, and the compaction achieved within the disposal cell.

If 4 tons of solid waste are accepted at a landfill, what is the estimated volume if a conversion factor of 750 pounds per cubic yard is used?

$$\text{Solution} = 4 \text{ tons} \times \frac{2{,}000 \text{ lbs}}{\text{ton}} \times \frac{1 \text{ yd}^3}{750 \text{ lbs}} = 10 \text{ yd}^3$$

C. Elevations

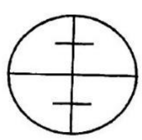
An elevation is the vertical distance between a point and a base plane. Points of equal elevation can be connected on a map by a line (referred to as a contour line). The difference in elevation between points on a map can be determined from these topographic contours.

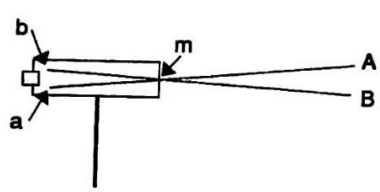
Plane elevations are drawn based on height above sea level or using the elevation of a fixed point on the site as the base elevation.

Permanent location and grade stakes/elevation markers are needed for references. There may be monuments or lag screws in a tree, utility pole, or on a building. Do not use reference points such as fence posts or roads which may be moved during construction of fill.

Overall site plan locations and elevations should be obtained daily to ensure that the operational plan is being followed. When elevations and locations are regularly checked in the field, landfill construction and development should proceed according to plan and schedule.

The most accurate method of determining elevation is with a transit or builder's level and a grade (stadia) rod. The stadia method is used in the field to determine horizontal distance and elevations. The transit has an eyepiece with cross hairs (vertical and horizontal) and two stadia hairs, one above the center line and one below the center line. The interval between stadia lines (or hairs) gives the vertical intercept of 1 foot on a stadia rod held 100 feet horizontally from the transit. The stadia method is based on the principle that in similar triangles corresponding sides are proportional.





A m B ~ a m b

The terms used in determining elevation include:

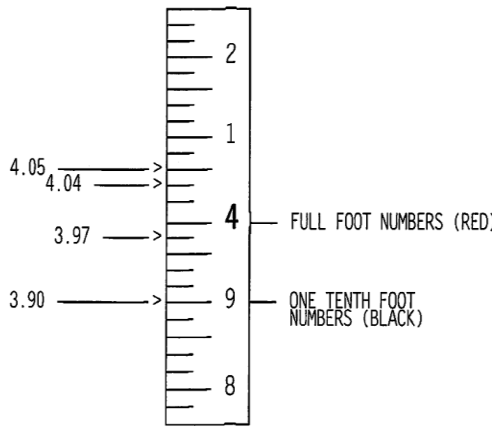
Benchmark (BM) - a permanent, immovable object that has a known elevation

Height of Instrument - the elevation of the cross hairs on a leveled instrument

Backsite (BS) - the grade rod reading (height) when placed on the benchmark

Foresite (FS) - the grade rod reading at the point where the elevation is unknown

Surveying (or grade) rods are divided into tenths of feet. The following sketch illustrates the correct interpretations of elevations on a rod if the horizontal cross hair falls on the point indicated.



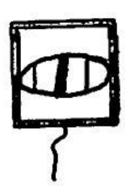
1. Determining the slope

   Although this section provides explanations of how slope can be determined by surveying, the landfill operator may prefer to use a clinometer which provides a quick slope reading. The clinometer is small (fits in pant pockets), relatively inexpensive, and easy to learn how to use. The clinometer provides a direct reading of slope in percent and angle in degrees.

   To use the clinometer, first place a stake in the ground upgrade at eye level or have someone at about the same height stand at the desired point on the slope. Then go to the base of the slope, and sight back to the stake or the person. Keep both eyes open. Look through the clinometer with one eye, and look at the object with the other eye.

   This method can be used in the reverse direction on slopes. In other words, the stake can be placed downgrade with sightings taken from the upgrade location.

   Degree Scale

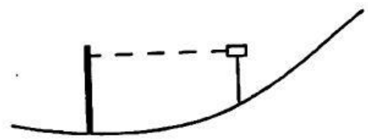
   

   Percentage of Slope Scale

   Step 1. Determine the difference in elevation between the toe and the top of the slope using methods previously outlined.

Step 2. Determine on the ground the horizontal distance between the two points. Do not measure the combined horizontal/vertical distance.

Incorrect



Correct

A tape (plastic or metal) or chain should be available to measure distance on the ground. Surveyors use metal tape because it does not stretch and, therefore, provides more accurate measurements. For estimating purposes or situations which do not require such precise measurements, a plastic tape or individual paces can be used. (Operators should measure their pace at a normal stride for later use. Paces may range from 2½ feet to 3½ feet depending upon the person's size and stride.)

At times, operators will need to know directions (north, south, east, west, etc.) and degrees. Reference to maps and plans must frequently be made, which indicate direction. A compass should be available to more accurately determine direction. Directions and degrees are depicted on faces of compasses. Maps and plans generally have "north" located on them.

Step 3. Calculate the percent of grade or slope as follows:

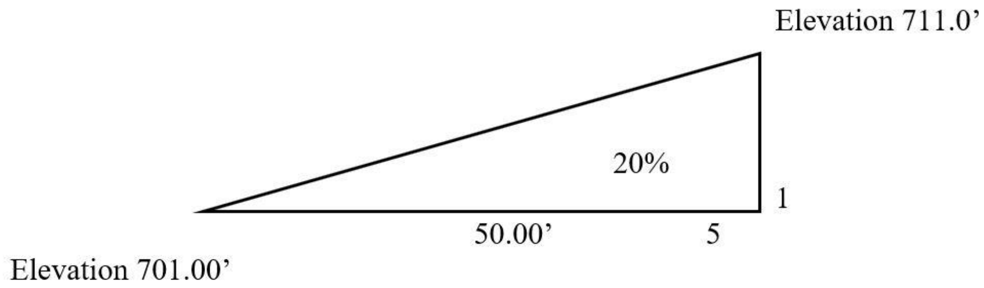
This example uses the elevations recorded from the field book page on the immediately preceding page and a measured horizontal distance of 50 feet.

$$\text{Slope (grade)} = \frac{\text{Difference in Height x 100}}{\text{Difference in Length x 100}} = \frac{\text{Rise x 100}}{\text{Run}}$$

$$\text{\% Slope} = \frac{\text{711.00 feet - 701.00 feet}}{\text{50.00 feet}} = \frac{\text{10 feet}}{\text{50.00 feet}} = 20\%$$

Slope can also be referred to as $\frac{100}{20\%} = 5{:}1$

If the designed slope was 5:1, then the as-built slope meets those specifications.



D. Contour Lines

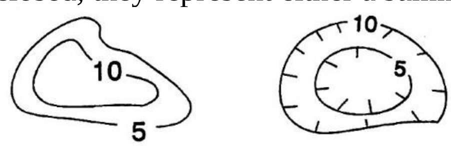
Engineering plans use contour lines to depict changes in elevation.

Contour lines:

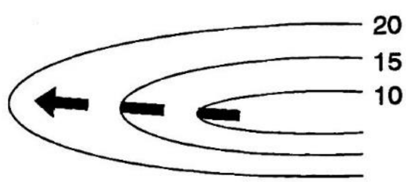
- Connect points of the same elevation.
- Never cross each other.

The closer together the lines, the steeper the slope; the further apart the lines, the gentler the slope.

When contour lines are closed, they represent either a summit or depression.



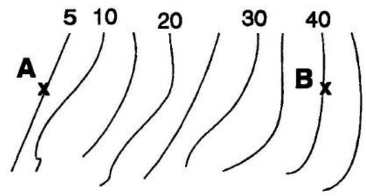
summit depression



The “Rule of V’s” is that V’s formed by map contours along a drainage will point upstream.

The difference in elevation between two points can be determined using contour lines. The distance increment or contour interval represented by each line should be noted on the map. Each line may represent 5 feet, 2 feet, etc. Count the number of lines between the two points. Multiply that number times the contour interval. The first line is not counted since that is the starting point and does not represent a change in elevation.

What is the elevation difference between the two points in the diagram?



The answer is 35 feet.

CONVERSION TABLE

To convert ==========>	multiply by	==========> to obtain:
Acres (A)	43,560	Square feet (ft^2)
Acre-feet	43,560	Cubic feet (ft^3)
Acre-feet	325,851	Gallons (gal)
Centimeters (cm)	0.3937	Inches (in, “)
Centimeters (cm)	0.01	Meters (m)
Cubic centimeters (cc)	1	Milliliters (ml)
Cubic feet (ft^3)	1728	Cubic inches (in^3)
Cubic feet (ft^3)	7.48052	Gallons (gal)
Cubic feet (ft^3)	28.32	Liters (L)
Cubic feet/second (ft^3/sec)	448.831	Gallons/minute (gal/min)
Cubic feet/second (ft^3/sec)	0.646317	Million gallons/day (mgd)
Cubic yards (cy, yd^3)	27	Cubic feet (ft^3)
Degree-angle (°)	60	Minutes (min)
Feet (ft)	30.48	Centimeters (cm)
Feet (ft)	12	Inches (in, “)
Feet (ft)	0.3048	Meters (m)
Feet (ft)	1/3	Yards (yd)
Feet of water	0.4335	Pounds/square inch (psi)
Gallons (gal)	0.1337	Cubic feet (ft^2)
Gallons (gal)	3.785	Liters
Gallons (gal)	8	Pints-liquid (pt)
Gallons (gal)	4	Quarts-liquid (qt)
Gallons water (gal)	8.3453	Pounds of water (#)
Grams (g)	1000	Milligrams (mg)
Hectare (ha)	10000	Square meters (m^2)
Kilograms (kg)	2.205	Pounds (lb, #)
Kilograms (kg)	1000	Grams (g)
Liters (L)	1.057	Quarts-liquid (qt)
Liters (L)	1000	Milliliters (ml)
Meters (m)	3.281	Feet (ft, ‘)
Meters (m)	39.37	Inches (in, “)
Miles (mi)	5280	Feet (ft, ‘)
Miles (mi)	1760	Yards (yd)
Milligrams (mg)	0.001	Grams (g)
Milligrams/liter (mg/l)	1	Parts/million (ppm)
Millimeters (mm)	0.001	Meters (m)
Million gallons/day (mgd)	1.54723	Cubic feet/second (cu ft/sec, ft^2/sec)
Million gallons/day (mgd)	694.44	Gallons/minute (gpm)

CONVERSION TABLE

To obtain <==========	divide by	<========== to convert:
Ounces (oz)	0.0625	Pounds (lb, #)
Ounces (oz)	28.349527	Grams (g)
Pounds (lb, #)	16	Ounces (oz)
Pounds (lb, #)	453.4924	Grams (g)
Pounds of water	0.01602	Cubic feet (ft^3)
Pounds of water	0.1198	Gallons (gal)
Quart-liquid (qt)	0.9461	Liters (1)
Square feet (ft^2)	1/9	Square yards (yd^2, sq yd)
Square inches (in^2)	6.452	Square centimeters (cm^2)
Square meters (m^2)	10.76	Square feet (ft^2, sq ft)
Square miles (mi^2)	640	Acres (A)
Square yards (yd^2)	9	Square feet (ft^2, sq ft)
Temperature (°C) (9/5 x C) + 32	1	Fahrenheit (temperature)
Temperature (°F) (F - 32) x 5/9	1	Centigrade (temperature)
Watts	1.341×10^{-3}	Horsepower (hp)
Yards (yd)	3	Feet (ft, ‘)
Yards (yd)	36	Inches (in, “)
Yards (yd)	0.9144	Meters (m)

EROSION CONTROL

I. Purposes

A. Purposes for Controlling Storm Water Include:

- Compliance with U.S. EPA Storm Water Regulations as described in 40 CFR Parts 122, 123, and 124
- Controlling run-on and runoff of surface waters resulting from maximum flow of a 25-year, 24-hour storm
- Prevention of surface water migration into landfill and through waste which can create leachate
- Maintenance of surface water quality

- Prevention of flooding

- Prevention of soil erosion

- Prevention of waste being carried by moving water

- Safety of landfill workers and the general public

At present, it appears that the North Dakota Solid Waste Management Rules have been written such that no additional federal regulations will apply to municipal solid waste landfills. Each landfill operator should be aware of the federal Storm Water Regulations. Landfill operators should maintain contact with the department to determine if any changes pertinent to these regulations will be required at their landfills.

B. Purposes for Controlling Wind Erosion

- Reduction of dust, waste, and odors which may blow within the landfill area and off the site

- Minimization of damage to daily cover, final cover, and topsoil piles

- Reduction of wind erosion for more successful revegetation activities

II. Methods of Control

Erosion control is intended to create energy dissipators – something that will reduce the energy of the wind or water and thus reduce its erosive force. Combinations of methods should be employed.

Knowledge of soil types and characteristics, vegetation, construction procedures, and laws of physics enable landfill operators to make more effective erosion control decisions during landfill planning and operations.

Experience is invaluable for evaluating the success of each erosion control method. Knowledge of specific areas more susceptible to erosion contributes to continued improvement to landfill erosion control plans.

Control of surface water and other environmental influences is not confined just to landfills. Transfer stations, bailing facilities, and compaction systems are susceptible to adverse effects from the weather. All solid waste management facilities should be designed, constructed, and operated to protect the tipping floor from wind, rain, or snow. Surface water and groundwater should be protected from the solid waste management units by controlling runoff and instituting equipment washdown water control measures.

The following procedures should be implemented for control of wind- and water-induced soil erosion:

A. Compaction of solid waste minimizes the potential for precipitation to enter the waste and thus become leachate.

B. Revegetation of trees, shrubs, and grasses improves wind control by slowing down wind in localized areas, reducing speed of moving water, and trapping windblown dust and waste. Vegetation also holds the soil in place to help prevent wind and water erosion.

C. Cover crops should be selected based on suitability to the local climate, compatibility with soil types, and their growth rate. At least one plant species should be planted that will provide quick cover. This holds the soil in place until other species can become established. Final reclaimed areas require permanent revegetation. Temporary vegetation may be necessary on slopes, cover stockpiles, and especially on topsoil stockpiles. Shallow-rooted species are preferred.

D. Contour tillage operations are conducted perpendicular to the slope along the contour. Whether conducting waste management operations or farming, this procedure minimizes blowing dust and waste and reduces the erosive force of surface water. This method actually creates tiny ridges which trap the water and soil before they move further down the slope. Operations are thus safer for landfill workers and patrons.

E. Types of soil and cover material can be selected for the specific situation. The final cover must be less permeable than any bottom liner or natural subsoils present or have a hydraulic conductivity of at least 1×10^{-7} cm/sec, whichever is less. Soils with higher clay content are better selections for liners and final covers.

   Looser soils with a good balance of clay, silt, and sand such as silt loams are excellent for vegetative growth, but they may not have sufficiently low permeability for use in building final covers or liners.

   Soils with higher sand content are more susceptible to water erosion. When these soils are present in substantial quantities, they may serve well as daily cover.

F. Ridges can be constructed with special types of equipment. These ridges or berms slow down movement of soil due to wind and water.

G. Constructed depressions can be built in soil or other overburden with a sheepsfoot roller to make small pockets for water to be retained and not flow over exposed areas. The small depressions will to some degree also reduce wind erosion. This method should be used only for short-term erosion control.

H. Terraces can be built to reduce the length on the slope and create plateaus of which soil can be retained. Various types of earth-moving equipment can be utilized to construct terraces of various sizes.

I. Mulch of straw, hay, compost, or some type of fabric cover can be used to hold more moisture in uncovered or newly revegetated soil. The mulch also serves to hold the soil in place while plant species are becoming established. Covers include jute or nylon matting. In some cases, mulch can also be a seed source.

J. Diversion and drainage channels can be constructed to direct surface water away from the landfill and its waste. By directing surface water, it can be better managed. Channels may be ditches, berms, or culverts. Some ditches and berms may require lining or damming with straw bales secured into the ground, concrete, rock, fabric cover, or pipe to maintain the channel integrity. Concrete, rock, and fabric covers must be properly placed to ensure that they do not erode. Channels (ditches, berms, and culverts) require cleaning and maintenance to allow them to continue to properly divert surface water.

K. Surface impoundments can be constructed to hold surface water. These impoundments allow sediments to settle out of the water runoff before release into surface waters such as streams or rivers. Water in impoundments can also be sampled to determine if any constituents are present which require more extensive water treatment.

L. Inlet protection may be required to prevent sediments from accumulating to a point where the inlet no longer functions properly. Protection may include straw bales secured into the ground, fabric fence barriers, rock check dams, or metal standpipes. These protection devices provide a water-ponding effect and allow particles to settle out before entry into the water inlet system.

M. Eliminate depressions which allow ponding of substantial quantities of water and present safety hazards associated with heavy equipment and small vehicle operation.

   Trench-operated landfills present great potential for water to enter the waste. Water should be removed from trenches prior to depositing waste. Procedures and equipment should be available for conducting water removal from trench operations.

N. Optimize slope length and percentage to maximize and direct water runoff and minimize soil erosion. The grade of slopes must be between 3 and 15 percent. Steeper slopes may be allowed if justification is demonstrated. Maximum allowable slope in any instance is 25 percent. Ditches and operating areas must be sloped to allow water to flow downhill.

O. Adjacent lands must not be adversely affected by the landfill’s surface drainage system.

III. Evaluation of Erosion Control

Soils should be identified by a soil scientist and then selected for their intended use and exposure. For example, soils with higher silt contents tend to be more erodible but are good for vegetative growth. Sands may be less susceptible to wind erosion but can be too porous for good vegetative growth.

More detailed soil surveys are available for most North Dakota counties.

For those counties which do not have completed soil surveys, some field data is available. The Natural Resources Conservation Service can provide soil surveys and other soils-related information and can assist landfill operators with developing specific management practices for their landfills.

LINER DESIGN AND LEACHATE CONTROL

I. Purpose of Leachate Control

Constituents of leachate:

- Can be toxic to plants, animals, and/or humans.
- Can degrade the quality of drinking water sources for wildlife, domestic livestock, and humans.
- Can cause deterioration of structural foundations, subsurface utilities, and natural geologic formations.

Produced leachate can migrate off the landfill by entering soils, geologic materials, fractures in the subsurface, underground utilities and other underground routes.

Baseline groundwater monitoring and hydrogeologic data provide the foundation from which one designs a liner and leachate collection system for a landfill. In addition to collected data, the following field conditions may indicate uncontrolled leachate:

- Standing water in trenches
- Surface water ponding
- Mottled soils
  Soils with this marbled appearance may have a seasonal high water table of potential flows of groundwater into area
- Distressed or flourishing vegetation

- Springs, seeps, or moist soils

- Heavy rainfall or nearby irrigation events
  These events can trigger leachate problems. Subsequent to these events, the landfill operator should inspect the facility for evidence of uncontrolled leachate.

II. Leachate Migration

Landfill leachate migrates through routes of least resistance. Several potential routes for leachate migration within a landfill and off the landfill include:

- Pores and fractures in waste, soil, and geologic materials
  Water generally travels faster through sands and gravels than through silts and clays. Heavily fractured clay-rich soils may also be relatively transmissive. Liner, daily cover, and final cover should be selected with consideration of these factors.

  Air pockets within compacted waste provide avenues for water to travel. Waste compaction reduces the size and number of routes within the waste cells.

- Cracks or joints in constructed facilities
  Facilities within and adjacent to the landfill must be considered.

- Sub-surface utilities
  Leachate can migrate through disturbed areas where subsurface utilities have been placed and subsequently into service openings.

- Weak areas in basements and floors
  Leachate can exert sufficient pressure to break through weak areas and enter structures.

Weather conditions affect leachate generation and migration. Elevated temperatures increase the potential for leachate migration. Restrictive layers such as unfractured clay, clay liners, synthetic liners, and less permeable covers suppress the migration of leachate. Wet surface conditions and frozen ground may prevent leachate from escaping at the edge of a landfill.

III. Leachate Control

Leachate can be generated by vertical infiltration of precipitation or by horizontal migration of groundwater into the landfill cell. Exhibits 5-3, 5-4, and 5-5 depict potential surface and groundwater movement.

Exhibit 5-3
Lateral Migration of Landfill Leachate

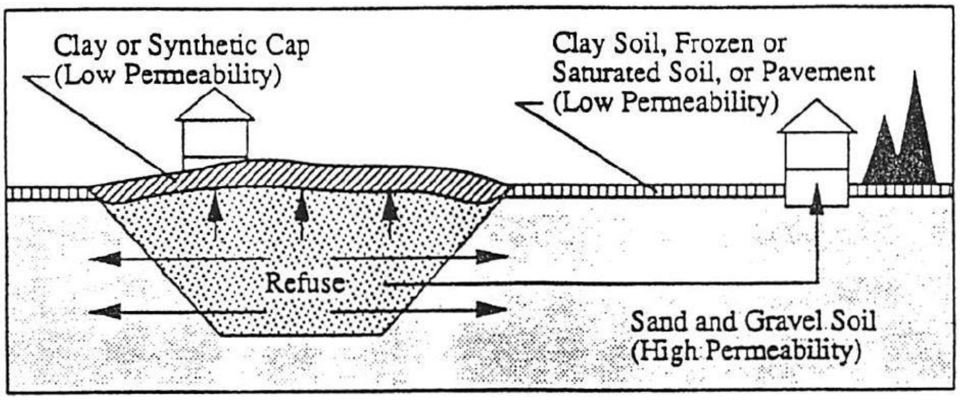


Exhibit 5-4
Vertical Entry of Water Into Landfill for Leachate Formation

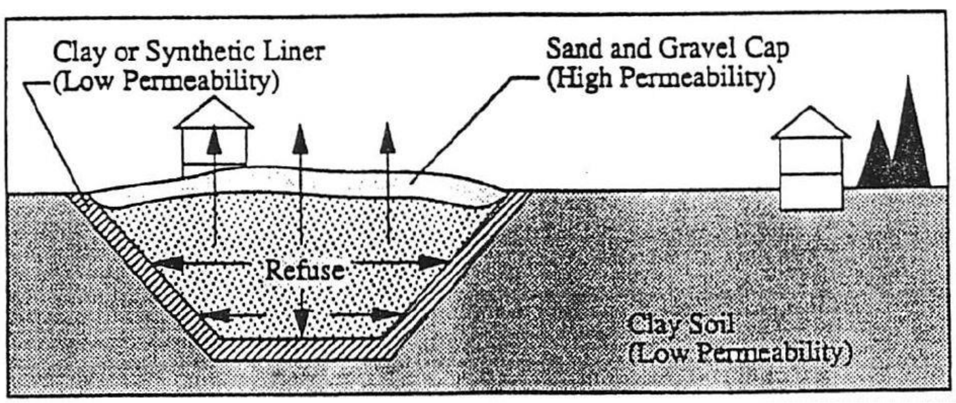
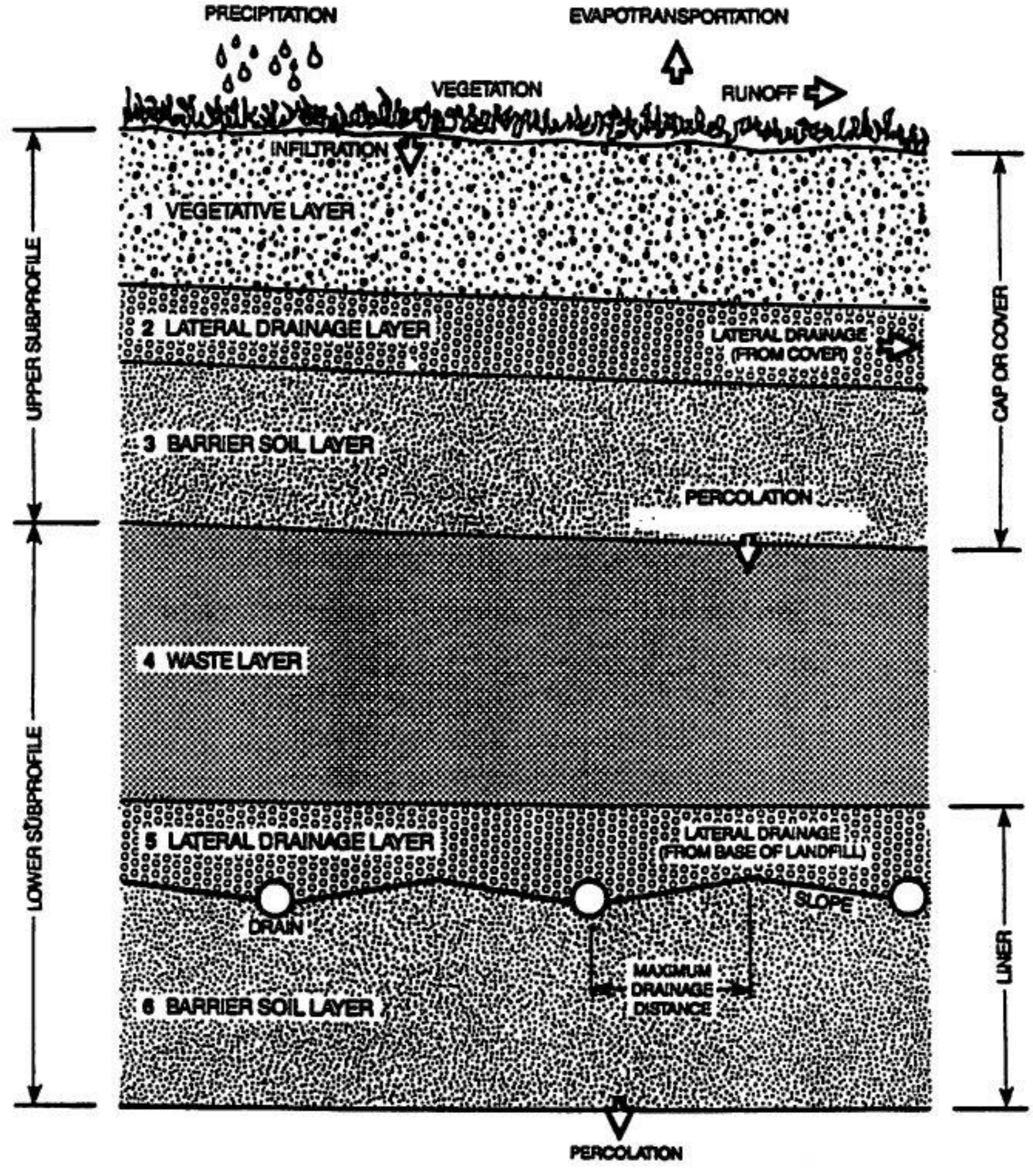


Exhibit 5-5
Profile of Liner, Waste, Cover in Relation to Water Movement

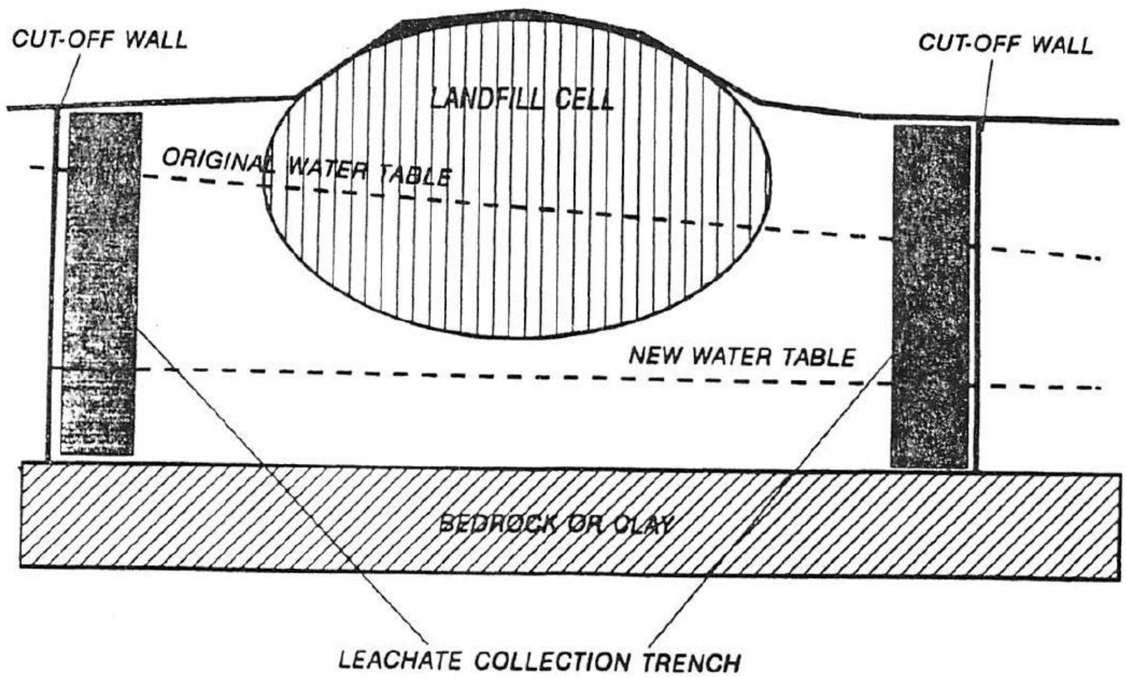


Methods of control include the following:

- Waste compaction, daily cover application, and placement of final cover with low permeability all serve to minimize infiltration of water into the solid waste cell.

- Cut-off walls constructed of clay prevent the inflow of groundwater. Exhibit 5-6 illustrates this procedure.

Exhibit 5-6
Cut-Off Wall



- The groundwater table can be controlled by the installation and operation of wells and trenches. Water tables can be lowered below the elevation of the waste by pumping water to central locations for subsequent transfer.

- Liners and leachate collection systems can be designed, installed, and operated to prevent horizontal migration of water into the cell and migration of leachate out of the lined cell.

IV. Liner Design and Leachate Collection Systems

A. Objectives

Any new or lateral expansion of a municipal waste landfill must be underlain with a hydraulic barrier (liner) and leachate removal system capable of collecting and removing leachate and contaminated surface water within the landfill. The combined final cover, liner, and leachate removal system must achieve a site efficiency of 95 percent or more for rejection or collection of the precipitation which falls on the site. Exhibit 5-5 illustrates the relative placement of liner components and leachate collection systems, and it depicts potential water movement through a landfill.

Liners prevent the flow of potential contaminants:

- By obstructing the flow by virtue of the liner's low permeability.
- By reducing pollutants by adsorption, ion exchange, complexing, or chemical reaction.

Specific liner and leachate system design depends on many site-specific factors:

- Waste quantity and composition
- Operational life of landfill
- Postclosure period
- Soils on and near site
- Hydrology and hydrogeology
- Other critical environmental factors
- Acceptable generation and migration of leachate
- Permeability of available clays
- Compatibility of system materials with waste, leachate, and groundwater
- Cost of system materials, installation, and maintenance
- System reliability

The liner and leachate system must be designed to work in conjunction with each other. Both the liner and the leachate systems must maintain their integrity for the active life and the postclosure period of the facility.

Liners must cover the bottom and the sides of the landfill. Exhibit 5-7 is a guideline for a portion of the quality assurance/quality control requirements for tests which must be performed on the natural soil subbase and liner components.

Exhibit 5-7
Incomplete QA/QC Requirements Table
(Associated with the NDDoH Quality Assurance Guidelines)

Subbase Preparation - to 12 inches	
Density and in-place moisture	≥ 90% modified or 95% standard proctor density
	≥ 1 test/100 ft grid
Grain-size distribution, soil classification, moisture content, dry density	≥ 1 test/5000 yd^3 and at major soil type change
Standard or modified proctor test	Minimum (5-point curve) for every 10,000 cubic yards with an additional test for any major change in soil type

Clay Liner Specifications	
Lift thickness	≤ 6 inches
Permeability	≤ 1 x 10^{-7} cm/s
Gravel and rock	≤ 3/4 inches
Modified proctor density	≥ 90%
Standard proctor density	≥ 95%
Placement moisture content	2 - 5% wet of optimum moisture
Unacceptable material	Visual control, appropriate testing
Density and in-place moisture	≤ 1 test/100 ft grid
Moisture-density (proctor) testing and Atterburg limits	≥ 1 test/5000 yd^3 and at any major soil type change
Grain-size distribution, size, soil classification, moisture content, dry density	≥ 1 test/1000 yd^3 or 1 test/acre and at any major soil type change
Hydraulic conductivity testing	≥ every third grain-size test
P200 content	≥ 50%
Clay-size fraction	≥ 30%

Clay Side Liner Specifications	
Everything same as clay liner, except density and as-placed moisture content	One test on each 200 lineal feet for each lift, offsetting each test on each subsequent lift
Horizontal lifts	Width of scraper

The leachate collection system design must include the following considerations:

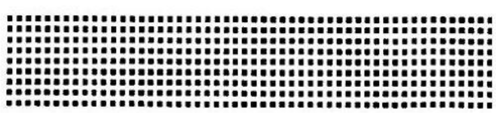
- Hydraulic conductivity of the existing landfill liner
- Thickness of the liner
- Rates of leachate percolation into the drainage layer
- Porosity of the aggregate in the drainage layer
- Hydraulic conductivity of the drainage layer
- Slope of bottom grades
- Flow distance

Decomposition by-products, natural soil in contact with system components, and groundwater should all be compatible with liner and leachate system components. Manufacturers of these components can conduct bench scale and limited field tests to determine the integrity of the liner and leachate system when exposed to waste, soil, and groundwater.

B. <u>Liner Components and Characteristics</u>

Liners must consist of one of the following:

- Natural soil liners must be at least 4 feet thick with a hydraulic conductivity not to exceed 1 x 10^{-7} cm/sec. Preferred Unified Soil Classification System (USCS) soil classifications include CH, CL, and ML (primarily the clays, loams, and silts). These soils tend to have a low permeability and high adsorption for identified contaminants.



4' natural soil with hydraulic conductivity not to exceed 1 x 10^{-7} cm/sec

- Composite liner consisting of:
  - Upper component of at least 30 mil flexible membrane liner
  - Lower component of at least a 2 -foot layer of compacted soil with a hydraulic conductivity of no more than 1 x 10^{-7} cm/sec

30 mil flexible membrane liner (60 mil if HDPE)
2' layer of compacted soil with hydraulic conductivity of no more than 1 x 10^{-7} c/sec

Flexible membrane liner components consisting of high-density polyethylene (HDPE) shall be at least 60 mil thick. The flexible membrane liner component must be installed in direct and uniform contact with the compacted soil component.

The composite liner design may be preferred due to its lower permeability and reduced thickness requirements for the natural soil component. Areas with insufficient clay for liner material may consider this alternative to be more cost-effective. If a landfill is sited and managed properly, many areas of North Dakota have adequate clay material for the liner and cover. Federal regulations give preference to composite liners.

- Alternative liner and leachate removal systems may be approved by the department based on the proposed system's demonstrated ability to control leachate migration. These alternatives may be allowed by the U.S. EPA only if the state's program is approved.

C. Clay Liner and Cap Construction Testing

Clay liners and caps require careful design, construction testing, and protection. The selection and placement of compacted clay soils is critical to meet the required permeability of 1×10^{-7} cm/sec. The condition and moisture level of the soil must be closely monitored.

If the material consists of a claystone, a rock crusher and screen may be utilized to pulverize the material to an adequate consistency. Appropriate precautions must be exercised to avoid rocks and gravel larger than 0.75 inch in the liner material. For clay liner soils which are placed within 2 feet of the top of the clay liner surface (upper 2 feet of liner), rocks and gravel larger than 0.75 inch must be screened or removed from the soil. A road reclaimer or tillage equipment may be used to break up the soil clods. If the soil is not of appropriate moisture consistency, it may be necessary to either add water or allow the soil to dry.

Clay placement should be performed as follows:

1. The clay soils should be placed to achieve a maximum thickness of 6 inches per compacted lift and compacted to a minimum of 90 percent modified moisture density (proctor) or 95 percent standard proctor density. Additional compaction efforts may be necessary, based on the moisture density relationship and permeability information.

2. The clay must be compacted 2 to 5 percent wetter than the moisture content at maximum proctor density.

3. Placement and/or compaction of frozen soils is prohibited. Frozen soils which are identified must be removed from the liner. Special precautions to prevent freezing of the clay liner are necessary. These methods include soil cover and/or insulation.

4. Attention must be given to the use of proper compaction equipment and methods. The tamp foot or sheepsfoot compactor should weigh, at a minimum, 30,000 pounds. Equipment in the range of 60,000 to 70,000 pounds is preferred since it provides better compaction. Field equipment must be operated to break clay lumps and to knead the clay materials together. A minimum of four to six passes of the compaction equipment per lift of soil are required to ensure structural improvement of the soil.

5. Visual control is necessary to identify and remove or otherwise handle unacceptable material.

Appropriate testing and documentation during clay liner and clay cap construction is required.

1. As discussed in item 1 in the previous section, one density and as-placed moisture content test are required per 100-foot grid pattern at the base of the cell on every lift and offset on each subsequent lift. Nuclear density testing may be utilized rather than sandcone tests. Some limited sandcone testing should be utilized to verify nuclear tests. Use of a 12-inch probe could allow reduced frequency of testing since the probe will effectively monitor two lifts per test. Nuclear density testing holes must be filled with clay or bentonite. Greater testing frequency should be utilized in confined areas, small facilities, or where thinner liners are allowed.

2. Moisture density (proctor) testing (minimum 5-point curve) should be completed, at a minimum, on every 5,000 cubic yards or less of material used and with any change in the major soil type with a minimum of one test per lift of soil. Modified proctor density testing is preferred to standard proctor density.

3. Laboratory determination of as-placed moisture content, dry density, and Atterburg limits at a minimum of one test for each 5,000 cubic yards of material used.

4. Soil classification tests for grain size distribution and soil classification must be completed at a frequency of, at a minimum, one test for every 5,000 cubic yards of clay placed or at a frequency of one test per acre and with any change in the major soil types.

5. Hydraulic conductivity testing of the liner should be completed at a frequency equivalent to every third grain size sample required under item 3 above, with a minimum of three tests per site or construction phase. Laboratory test methods utilizing a Shelby tube or on hand-carved samples from the liners are inferior and have been documented to underrepresent actual permeabilities by a factor of 900 to 1,300. Some in situ (in place) testing of liner and cap construction utilizing single- or double-ring devices is preferred to verify laboratory results. Landfill leachate may be used instead of water in the liner tests.

6. Porosity should be calculated in conjunction with permeability tests.

   The modified proctor compaction test is preferred to the standard proctor test. A proctor test identifies the moisture content associated with maximum compaction for a specific compactive effort. This moisture is referred to as the optimum moisture level.

   The standard proctor compaction test identifies a maximum dry density and an optimum soil moisture content for a given compactive effort. Permeability can be substantially decreased by compacting soil at controlled moisture contents. When constructing liners and cover systems, soil should be compacted at moisture contents of 2 to 5 percent of optimum to take advantage of high plasticity. Higher moisture contents may result in operational limitations.

   Permeability tests should be conducted at densities and moisture contents which can be achieved in the field. Laboratory and field tests should be as comparable as possible to prevent major discrepancies in predicted soil characteristics.

   For more information, see the department's Guideline 5: *Quality Assurance Guidelines for Construction of Landfill and Surface Impoundment Liners, Caps, and Leachate Collection Systems*.

D. Slope Stability

One major concern of natural soil liner installation is the stability of soil liners on side slopes. The type of soil liner and the undisturbed material with which it will be in contact will determine the potential for slope failure.

Factors to consider when evaluating slope failure include loads placed on the slope, soil strength, and site hydrology. Slope failure can also result from liner deterioration due to leachate generation.

In many cases, slopes less than 4:1 (25 percent) may not fail. However, some landfill designs may require steeper slopes.

The landfill's engineer should evaluate all potential factors for slope failure and must design the landfill accordingly.

Removal of the base (or "toe") of the actual or potential unstable slopes often results in greater slope instability. Additionally, a slump block may be reactivated by excavating its "toe."

E. Flexible Membranes

Flexible membrane liners (FML) can be composed of several types of polymers and/or additives to achieve the desired properties. Major types of FMLs include:

- Butyl rubber
- Chlorinated polyethylene (CPE)
- Chlorosulfonated polyethylene (CSPE)
- Elasticized polyolefin (ELPO)
- Ethylene propylene rubber (EPDM)
- Neoprene
- Low density polyethylene (LDPE)
- High density polyethylene (HDPE)
- Polyvinyl chloride (PVC)

Membrane selection should be based on:

- Weathering resistance
- Soil compatibility
- Resistance to biological attack
- Physical suitability
- Compatibility with waste
- Practicality of installation

During construction, membrane liners are subject to deterioration by ultraviolet light and potential temperature extremes.

Membrane liners are subject to soil constituents such as metal oxides, chlorides, sulfur-containing compounds, organic compounds, corrosive waste or leachate, corrosive soil pH, and petroleum products. If the soil in contact with the liner is characterized by any of these conditions, the selected membrane must be designed to be more resistant to these compounds.

Microbes, insects, rodents, larger animals, and plants may also rupture the membrane.

Physical properties of the membrane include:

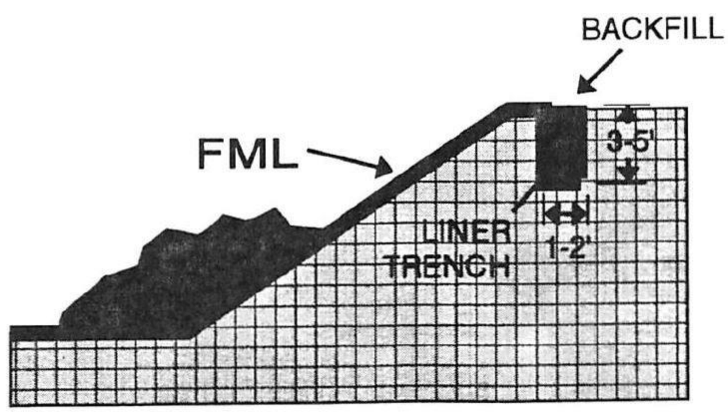
- Adequate tensile strength

- Tear, puncture, and creep resistance
- Adequate thickness
- Adequate elongation properties
- High seam strength
- Extremely low permeability (virtual impermeability)
- Ease of field seaming

Seams are the weakest link in liners. They must be installed correctly, and tests must be performed to provide proof of their reliability. Dust and temperature can affect seam performance.

Another potential problem area with liner installation is anchoring the edges of the liner. The following diagram, Exhibit 5-8, illustrates proper placement. If the liner is not properly anchored, it could be pulled out, and corners will be more susceptible to leachate generation and migration.

Exhibit 5-8
Liner Anchor



It is unlikely that a liner will be 100 percent effective. Each step of the installation process conducted correctly is one more step to maintaining an effective system. Professionals with liner installation experience must be engaged for liner installation and maintenance. When these experts are at the landfill, seize the opportunity to ask them questions about the performance of the landfill's liner and other liners with which they have experience.

F. <u>Leachate System Components</u>

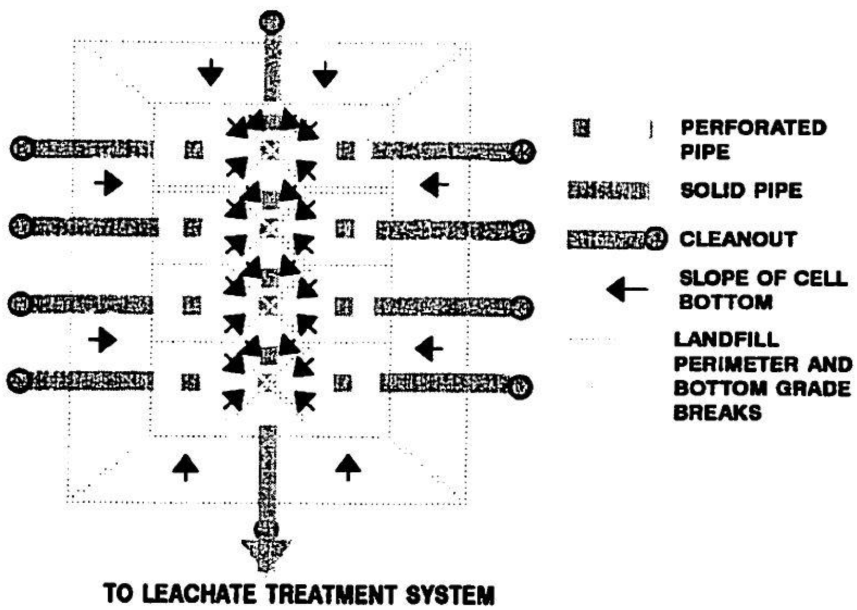
A leachate collection system includes a highly permeable layer of material over the landfill liner which directs the flow of leachate from above to a collection point outside the waste cell. The leachate removal system must have a collection efficiency of 90 percent or more and be capable of maintaining a hydraulic head of 12 inches or less above the liner.

Components of the system include:

- Highly permeable layer (drainage layer) primarily of sand or gravel
- Network of perforated pipes laid within the drainage layer (collection pipes)
- Filter layers of aggregate (sand or gravel) or geotextile fabric placed to prevent clogging of the system at intersections and within pipes

The following exhibit illustrates a general design for leachate collection systems:

Exhibit 5-9
Typical Leachate Collection System Design



1. Drainage layer

   The drainage layer provides a path for leachate to flow to collection pipes and protects the bottom liner from damage by heavy equipment and the first layer of solid waste.

   The drainage layer of the leachate removal system must have a hydraulic conductivity of 1×10^{-3} cm/sec or greater. Optimum hydraulic conductivity is generally between 10^{-2} and 10^{-1} cm/sec. The lower the conductivity, the closer together the collection pipes must be laid to prevent an accumulation of leachate without transport. Plastic drainage nets can also be used in conjunction with aggregate to achieve optimum hydraulic conductivity. However, a filter fabric must be placed between the drainage net and aggregate to prevent particles from obstructing flow through the nets.

The drainage layer must have sufficient thickness to provide a transmissivity of 3.0 x 10^{-2} cm^2/sec or more.

2. Collection pipes

Collection pipes should be placed to allow gravity to transport leachate. Installation of pumps or sumps within the operational area of the landfill is impractical due to daily operations and maintenance conflicts.

Pipe materials must be selected based on:

- Type of leachate
- Flow requirements
- Abrasive conditions
- Corrosive conditions
- Pipe material characteristics
- Installation requirements
- Maintenance requirements
- Cost

Pipe should be between 6 inches and 8 inches in diameter. In some cases, smaller pipe may be acceptable for short-term dewatering. Pipes should be laid in straight lines. In some cases, curved lines may be acceptable if undue stress is not placed on piping.

Joints do not need to be leak-proof since the pipe is perforated. However, they must be of adequate stability.

The end of each line should have a maintenance hold or cleanout to allow removal of solids and to periodically inspect the system.

3. Grading

   Bottom grading should be at least 2 percent, with a maximum of 5 percent for areas which must be excavated. Natural topography may allow greater bottom slopes with less excavation.

   The trenches in which the pipe is placed must be of a "V" shape to allow water to flow.

4. Leachate treatment

   Exhibit 5-10 illustrates an example of an above-grade leachate removal and storage system.

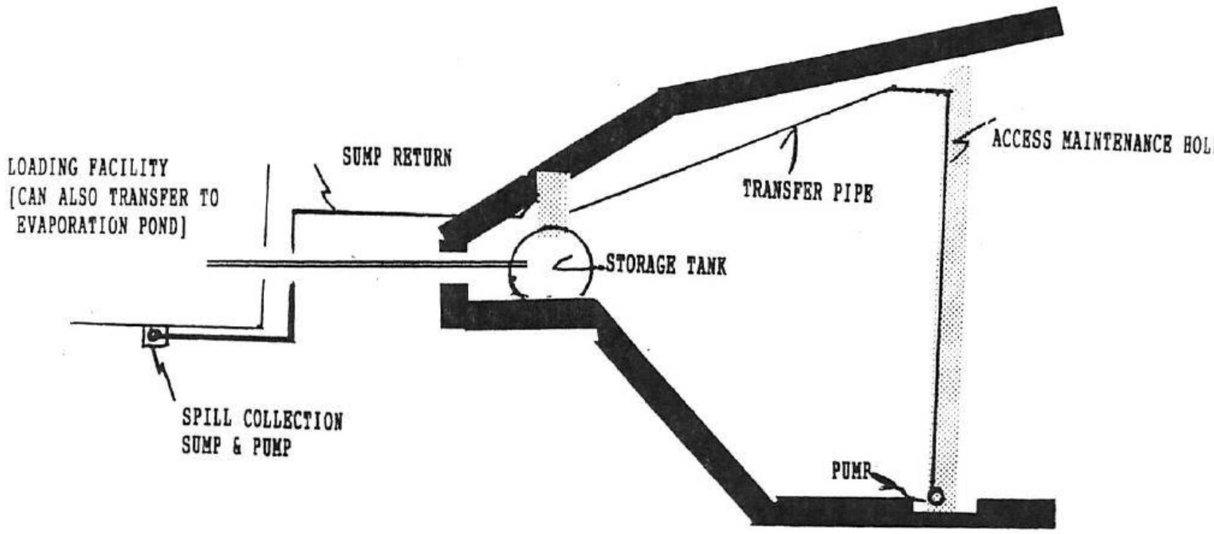
   Leachate treatment presently being utilized in North Dakota includes:

   - Collection in evaporation ponds before discharge (requires National Pollutant Discharge Elimination System (NPDES) permit)

   - Collection and transport into publicly owned treatment works (POTWs) for treatment

   Collected leachate must be analyzed to ensure that it meets permit requirements prior to discharge into surface waters or POTWs.

Exhibit 5-10
Leachate Removal System
Above Grade Example



GROUNDWATER MONITORING

I. Purpose

If insufficient groundwater information is available, groundwater monitoring may be required prior to approval of a permit application. Site characteristics and type of facility will determine to what extent a groundwater monitoring system should be designed into facility plans.

The purpose of groundwater monitoring is to:

- Document quality of water that has not been affected by solid waste activities.
- Document the quality of water passing the compliance boundary.
- Determine if off-site activities have affected the landfill's groundwater quality.
- Determine the potential for contaminated groundwater to migrate off the landfill property.
- Determine the extent and degree of groundwater contamination if generated.

Although much of the field sampling may be performed by contracted consultants, landfill operators should understand the principles of environmental sampling. Landfill operators may be required to report situations to contracted landfill consultants, may perform simple sampling tasks, or assist consultants with sample collection.

II. Written Groundwater Monitoring Plan

A written plan must be developed for approval by the department and implemented as part of the permitting process. A monitor well schematic is included as Exhibit 5-11. For each sampling event, a report must be submitted to the department with field and laboratory data included as described in this section.

A. Number and Location of Wells

- At least one groundwater monitoring well upgradient of the facility.

- At least two wells located downgradient of the facility.

- Installed at locations and depths to yield groundwater from the uppermost aquifer and all hydraulically connected aquifers below the active portion of the facility.

- Additional wells are often necessary at the landfill perimeter or within the landfill to characterize the potential for leachate migration or the extent and degree of identified groundwater contamination. Other wells may be needed to adequately characterize the site's hydrogeologic setting.

B. Procedures for Sample Collection

Most landfill operators will engage a consultant, engineering firm, or laboratory to collect samples. Although the landfill operator may not collect samples, landfill staff should understand some of the requirements of a sampling program. The selected firm should be familiar with sampling procedures.

Stagnant water must be removed prior to sample collection. At least three volumes of water should be removed. The volume removed should be noted in the written report for each sampling event.

Exhibit 5-12 includes approximate sample volumes, containers, preservatives, and holding times for selected parameters.

Deviations from proposed procedures or unusual conditions about the well should be noted in the written report.

C. Analytical Procedures

The sampling firm should ensure that the laboratory is utilizing the correct method of analysis. The sampling plan must describe the number and types of blanks, spikes, and duplicates which will be collected, prepared, and analyzed. Analytical results for blanks, spikes, and duplicates should be included with the written report. Laboratory reports should list the methods of analysis, detection limits, and quality assurance/quality control data.

D. Chain-of-Custody Control

The purpose of the chain-of-custody is to prove that the samples were properly containerized, stored, and transported prior to analysis.

E. Parameters for Analysis

A list of parameters is included as Exhibit 5-13.

Parts b and d of the parameters must be sampled and analyzed at least once each year with an approximate cost of about $250 per sample. Parts a, c, f, and g must be sampled and analyzed at least twice each year with an approximate cost of about $700 per sample. Costs may vary with the laboratory and with the number of analyses requested by the landfill.

A statistical analysis and summary of the water quality data should also be included with submitted reports.

F. Quality Assurance or Quality Control (QA/QC) Procedures

QA/QC for field sampling and for laboratory analysis must be included. The preparation, collection, and analysis of field or decontamination blanks, spiked samples, and duplicates should be addressed in the plan and described in submitted reports.

G. Monitoring Schedule

Parts b and d of the parameters listed in Exhibit 5-13 must be sampled and analyzed at least once each year. Parts a, c, f, and g of the parameters listed in Exhibit 5-13 must be sampled and analyzed at least twice each year.

The department may require more frequent sampling if:

- Baseline monitoring indicates the need.

- Off-site or on-site activities change such that groundwater could be affected.

- ▶ Groundwater sample results indicate that contamination is present or is migrating.

H. Reporting and Data Analysis Procedures

In addition to the previously described parameters, groundwater elevation must be measured in each well immediately prior to purging. Rate and direction of groundwater flow must be determined each time groundwater is sampled. The report submitted to the department must include a water table or potentiometric map of the hydrogeological unit being monitored. The map should include the locations of wells screened in the unit in relation to waste disposal cells or other constructed or natural features.

I. Decontamination of Drilling and Sampling Equipment

1. Decontamination must be performed to:

   - ▶ Prevent sampling equipment and personnel from cross contaminating samples (i.e., “dirty” equipment can add contaminants to a “clean” sample).

   - ▶ Prevent personnel from coming in direct with contaminants.

   - ▶ Prevent contamination from leaving the site on sampling equipment or personnel.

2. Methods of decontamination.

   - ▶ Chemical removal
   - ▶ Physical removal (including disposal)
   - ▶ Combination of physical and chemical removal.

3. Procedures

   Sampling equipment and materials and personnel should be decontaminated as necessary between each sampling point and prior to leaving the site.

   A decontamination zone should be established about 15 feet upwind from the sampling area.

   Equipment and material should be visually inspected to identify contamination. Gross contamination such as dirt, mud, or visible particles can be physically removed.

Wash equipment with nonphosphate detergent, then deionized water rinse, then methanol, hexane, or nitric acid (depending on parameters being tested), then water rinsed with deionized water three times.

Decontaminated equipment should be placed in clean containers for transport.

The exterior of sample containers should be cleaned prior to transport.

Disposable items (paper towels, protective gloves) should be placed in garbage bags for disposal in the appropriate landfill or other disposal facility. Contaminated wash and rinse water may not require collection.

Vehicles' interiors and exteriors should also be decontaminated if necessary.

Exhibit 5-11
Monitor Well Construction

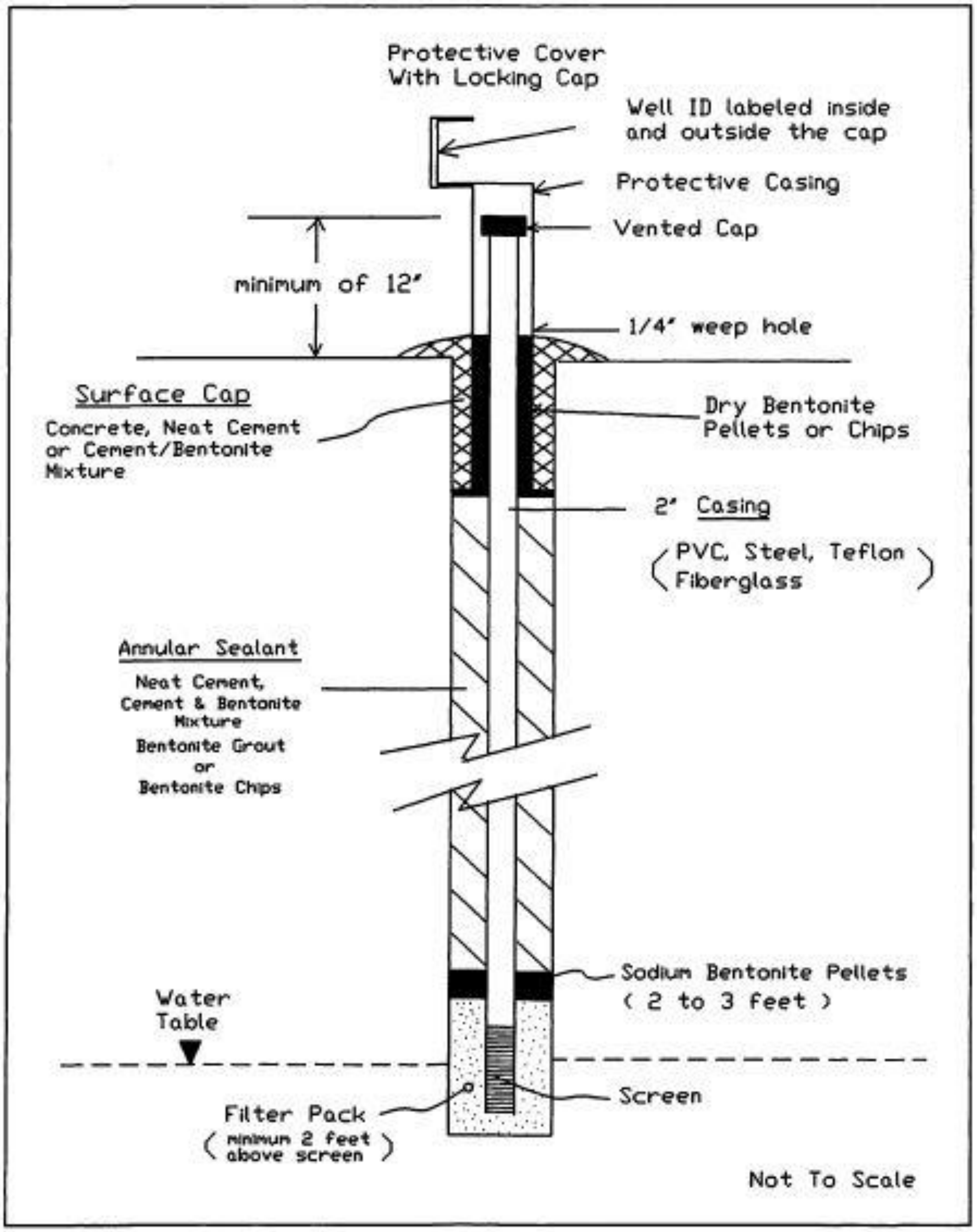


Exhibit 5-12
Sample Collection

Parameters	Sample Volume	Container	Preservative	Holding Time
Alkalinity	200	P,G.	Cool. 4°C	14 days
Chemical Oxygen Demand (COD)	100	P,G.	H_2S0_4 to pH 2 Cool, 4°C	28 days
Chloride	50	P,G.	Cool, 4°C	28 days
Color	500	P,G.	Cool, 4°C	48 hours
Fluoride	300	P	None required	28 days
Hardness	100	P,G.	$HN0_3$, to pH 2	6 months
Metals: Total Chromium VI Mercury	 100 300 500	 P,G. P,G. P,G.	 $HN0_3$, to pH 2 Cool, 4°C H_2S0_4 to pH 2 Cool, 4°C	 6 months 48 hours 28 days
Nitrogen: Ammonia Nitrate and Nitrite	 500 200	 P,G. P,G.	 H_2S0_4 to pH 2 Cool, 4°C H_2S0_4 to pH 2 Cool, 4°C	 28 days 28 days
Odor	500	G	Analyze as soon as possible Cool, 4°C	6 hours
pH	25	P,G.	Analyze immediately	- - - -
Phosphorus, total	100	P,G.	H_2S0_4 to pH 2 Cool, 4°C	28 days
Solids: Dissolved	500	P,G.	Filter onsite Cool, 4°C	7 days
Specific Conductance	100	P,G.	Analyze immediately	- - - -
Sulfate	50	P,G.	Cool, 4°C	28 days
Temperature	- - - -	P,G.	Analyze immediately	- - - -
Total Organic Carbon (TOC)	100	G. Amber, TFE-lined cap	H_2S0_4 or HC1 To pH2, Cool, 4°C	28 days
Volatile Organic Compounds	60	G. TFE-lined cap	Cool, 4°C	14 days

Exhibit 5-13
Extended List of Parameters for Assessing Groundwater Quality at North Dakota Landfills

a. Parameters measured in the field:

(1) Appearance (including color, foaming, and odor)
(2) pH[1]
(3) Specific conductance[2]
(4) Temperature
(5) Water elevation[3]

b. General geochemical parameters:

(1) Ammonia nitrogen
(2) Total hardness
(3) Iron
(4) Calcium
(5) Magnesium
(6) Manganese
(7) Potassium
(8) Total alkalinity
(9) Bicarbonate
(10) Carbonate
(11) Chloride
(12) Fluoride
(13) Nitrate + Nitrite, as N
(14) Total phosphorus
(15) Sulfate
(16) Sodium
(17) Total dissolved solids (TDS)
(18) Total suspended solids (TSS)
(19) Cation/anion balance

c. Heavy metals:

Group A:

(1) Arsenic
(2) Barium
(3) Cadmium
(4) Chromium
(5) Lead
(6) Mercury
(7) Selenium
(8) Silver

Group B:

(9) Antimony
(10) Beryllium
(11) Cobalt
(12) Copper
(13) Nickel
(14) Thallium
(15) Vanadium
(16) Zinc

d. Total organic carbon (TOC)
Chemical oxygen demand (COD)

e. Naturally occurring radionuclides:
(1) Radon
(2) Radium
(3) Uranium

---

[1]Two measurements: in field, and immediately upon sample's arrival in laboratory.
[2]As measured in field.
[3]As measured to the nearest 0.01 foot in field before pumping or bailing.

f. Volatile organic compounds, both halogenated and nonhalogenated:

Halogenated:

- Acrylonitrile
- Allyl chloride
- Bromochloromethane
- Bromodichloromethane
- Bromoform
- Bromomethane
- Carbon disulfide
- Carbon tetrachloride
- Chlorobenzene (monochlorobenzene)
- Chlorodibromomethane
- Chloroethane
- Chloroform
- Chloromethane
- Dibromomethane
- 1,2-Dibromo-3-chloropropane
- 1,2-Dibromoethane
- Dichloroacetonitrile
- 1,2-Dichlorobenzene
- 1,3-Dichlorobenzene
- 1,4-Dichlorobenzene
- Dichlorodifluoromethane
- 1,1-Dichloroethane
- 1,2-Dichloroethane
- 1,1-Dichloroethylene
- 1,2-Dichloropropane
- cis-1,3-Dichloropropene
- cis-1,2-Dichloroethylene
- trans-1,2-Dichloroethylene
- trans-1,3-Dichloropropene
- trans-1,4-Dichloro-2-butene
- Dichlorofluoromethane
- Dichloromethane (methylene chloride)
- 1,3-Dichloropropene
- 2,3-Dichloro-1-propene
- Pentachloroethane
- 1,1,1,2-Tetrachloroethane
- 1,1,2,2-Tetrachloroethane
- Tetrachloroethylene
- 1,1,1-Trichloroethane
- 1,1,2-Trichloroethane
- Trichloroethylene
- Trichlorofluoromethane
- 1,2,3-Trichloropropane
- 1,1,2-Trichlorotrifluoroethane
- Vinyl acetate
- Vinyl chloride

Nonhalogenated:

- Acetone
- Benzene
- Cumene
- Ethylbenzene
- Ethyl ether
- Methyl butyl ketone
- Methyl ethyl ketone
- Methyl iodide
- Methyl isobutyl ketone
- Pyrene
- Styrene
- Tetrahydrofuran
- Toluene
- m-Xylene
- o-Xylene
- p-Xylene

g. Pesticides:

- Aldrin
- Chlordane
- Chloroform
- 4.4 DDT
- Dibenzofuran
- Dieldrin
- Dimethoate
- Endosulfan
- Endrin
- Heptachlor
- Lindane
- Methyl bromide
- Methyl methacrylate
- Methylene bromide
- Naphthalene
- Parathion

LANDFILL GAS MONITORING AND CONTROL

I. Purpose

Solid waste decomposition can result in the generation of landfill gases. Section 3 “Waste Decomposition” of this manual addresses the generation and potential dangers of landfill gases. Landfill gases can be toxic to the environment, humans, wildlife, and domestic animals. Some landfill gases, including methane, are flammable and present extreme dangers when they collect in areas where sparks can occur. The potential dangers of toxicity and flammability of landfill gas exists not only on the landfill but also on adjacent property.

The purposes of monitoring and control are to prevent:

- Oxygen depletion
- Explosions
- Toxic effects
- Detrimental effect on cover, liners, and leachate collection systems
- Migration of gas within landfill and off landfill

Monitoring should be performed prior to landfill construction to provide baseline data during the active life of the landfill and during the closure/postclosure period. Baseline monitoring data is critical to evaluate the effectiveness of the closure/postclosure design.

II. Migration

Landfill gas migrates through the routes of least resistance. These include pores in waste, soil, and geologic formations; cracks or joints in constructed facilities; sub-surface utility service openings; and weak areas in basements and floors. Highly permeable liners and covers serve as routes for landfill gases. Gas migrates faster in sands and gravels than in silts and clays.

Layers such as frost, saturated soil, clay, or synthetic liners or covers restrict migration of gas and leachate.

Weather conditions influence migration of gas. Increased temperatures increase the potential for migration of both leachate and gas. As barometric pressure falls, gas is forced out the landfill onto surrounding formations. As pressure rises, gas is retained in the landfill until new pressure balances are established. Wet surface conditions and frozen ground may prevent gas from escaping into the atmosphere at the edge of a landfill. As soil dries or thaws, the built-up pressure at the landfill perimeter may undergo a sudden release which could result in further gas migration. In other words, the higher pressure may allow the gas to move a greater distance. After periods of drying or thawing of soil, the operator should sample more frequently and at more points to determine if there has been a pressure increase with a subsequent sudden release off the landfill.

Landfill caps are used to restrict infiltration of moisture and thus minimize leachate generation. However, the cap also serves to contain gas. If the landfill is surrounded by sands and gravels and buildings or other constructed facilities (disturbed ground), the gas will migrate under the cap and to the landfill edge and then off the landfill proper. Landfills surrounded by clays will have less tendency for gas to migrate away from the landfill.

Landfills should usually be designed and operated to minimize the generation of landfill gas. Gas monitoring and control should be aspects of each landfill's design. Most of North Dakota's landfills have not yet experienced major problems associated with landfill gas generation. However, the installation and maintenance of monitoring devices enable landfill operators to continually evaluate and characterize landfill gas.

III. Monitoring

Indications of the presence of landfill gas include:

- Measurements from landfill gas monitoring devices
- Measurements in structures, manholes, pump stations, leachate pipes
- Distressed or flourishing vegetation
- Odors
- Septic soil
- Visible venting

The type of monitoring and frequency are based on:

- Required quarterly monitoring
- More frequent monitoring if subsurface conditions warrant
- Soil conditions
- Hydrogeologic conditions
- Location of facility structures
- Risk to employees or adjacent property
- Changing landfill conditions that could result in increase of gas generation

The major landfill gases and some characteristics are:

- Carbon dioxide
  - colorless
  - odorless
  - noncombustible
- Methane
  - colorless
  - odorless
  - highly combustible (5-15 percent)
- Hydrogen sulfide (H_2S)
  - colorless
  - odor at low concentrations, but people quickly become desensitized
  - highly combustible
- Petroleum
  - colorless
  - odor
  - highly combustible

<u>***Landfills may identify additional gases which have other characteristics and which require monitoring and use of personal protective equipment (PPE) during monitoring.***</u>

When selecting an instrument, be sure that it will measure the parameter of concern. For example, many explosimeters do not measure hydrogen sulfide. The user must read the instructions and be trained in instrument use. The following should be considered by the user prior to each field application:

- Zero
- Battery check
- Clean
- Cords in good condition
- Gauges or lights working properly
- Identified contaminant(s)

- Effectiveness of measuring identified parameters
- Upper and lower limits of measurements
- Scales (e.g., 0-20, 0-200, 0-2000)
- Parameters which it will not measure
- Interference

Monitoring instruments include:

Explosimeters

- Measure explosive gases and provide explosive limit (LEL) and oxygen (O_2) measurements
- Methane (CH_4) meters
- Hydrogen sulfide (H_2S) meters
- Photoionization detector (PID)
- Organic vapor analyzer (OVA)
- Laboratory analysis of gas collected in field in specified container

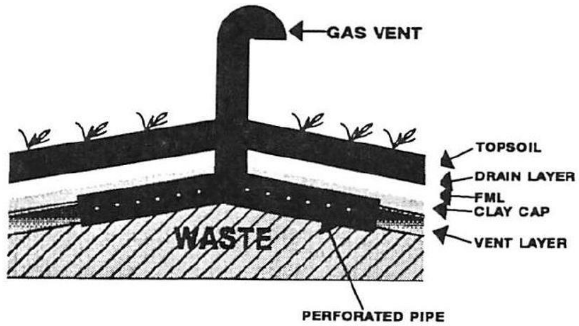
IV. Gas Monitoring Devices and Recovery Systems

Gas measurements can be made in existing structures, maintenance holes, pump stations, leachate pipes, low-lying areas, and any other location where gases are likely to collect.

Monitoring devices can be installed to obtain measurements in additional locations. Devices should be installed at the landfill perimeter to monitor gases that have the potential to migrate off the site.

Vents can be installed within the landfill based on landfill characteristics and design. Passive vents can be used for both monitoring and control. Exhibit 5-14 illustrates a passive vent and its placement

Exhibit 5-14
Passive Gas Vent



Passive gas recovery systems rely on natural pressure and convection mechanisms to vent gas to atmosphere. Shallow venting trenches or venting pipes can be installed to vent gas to the atmosphere or to a vent where flares can burn off the gas. Flares should be considered if odor is a problem.

Failure of passive vents is generally due to insufficient pressure on gas to push it to the venting device. Alternating periods of high and low barometric pressure result in atmospheric air entering the landfill.

If there is significant risk of methane accumulation in buildings, passive systems are not considered reliable. In these cases, the systems must be supplemented by active systems which engage vacuums to pull the gas to central locations for recovery.

V. Safety

Confined space entry plans should be developed by each landfill operator. Employees must receive site-specific training to properly implement these plans.

No person should enter a vault or trench without checking for methane gas and/or wearing a safety harness, with a second person serving as a safety watch.

Anyone installing wells should wear a safety rope to prevent falling into the borehole if the hole is of sufficient size.

No smoking policies should be required during installation or maintenance of boreholes, groundwater monitor wells, gas wells, and collection systems for leachate or gas. Given the unknown composition of many waste streams, landfill operators should consider no smoking policies in all areas of the landfill.

Landfill operations should be conducted and landfill gas managed to minimize air pollution and potential explosion and fire hazards.

Section 6
tab

SECTION 6: WASTE ACCEPTANCE

I. Purpose

Waste acceptance at a municipal solid waste landfill must be addressed in the landfill's waste acceptance plan by specifying the wastes which will be accepted and those wastes which will not be accepted. After review of the application, the department will determine if revisions should be made to the facility's waste acceptance plan.

II. General Acceptance Requirements

Although signs should be posted listing waste acceptance, many people do not understand the definitions for unacceptable materials. An attendant must be stationed at or near the landfill entrance to monitor, accept or reject, measure, and record wastes arriving at the facility.

Gatekeepers and equipment operators should seize opportunities to educate patrons. Landfill operators and communities can provide public education programs so that the public is aware of unacceptable wastes, disposal options, and waste minimization opportunities.

Established inspection procedures reduce the likelihood that unacceptable waste will enter the landfill. No inspection method completely ensures that unacceptable waste will be kept out of the landfill. The responsibility to develop and implement waste acceptance policies rests with the landfill operators and employees. Following are several methods of waste inspection:

- Increase employees' awareness of activities, container types, and waste characteristics that can be suspicious.

- Inspect loads periodically at the gate (e.g., every 10^{th} load) or make brief checks at the face. Loads can receive more attention during slow periods.

- Although screening for hazardous waste is required, household hazardous waste is still exempt from disposal regulations.

- Some landfill operators also provide waste collection and transportation services. The solid waste should receive inspection during collection. Such inspections help landfill operators have more knowledge about the actual and potential contents of waste transported by their staff.

- When unacceptable waste is identified, notify responsible parties and the department. Enforcement action may be appropriate. Use these opportunities to instruct landfill employees.

- According to Subtitle D regulations, regulated quantities of hazardous or PCB wastes remain the responsibility of the transporters if discovered while in their possession. The waste becomes the responsibility of the landfill owner/operator if discovered later and must be managed as a hazardous waste.

- Evaluate the effectiveness of the inspection program.

III. Unacceptable Wastes

Many solid wastes are acceptable for disposal at municipal solid waste landfills. Acceptable wastes include items such as food waste, packaging, small appliances, plastics, rubber, textiles, empty containers, glass, metals not otherwise restricted, paper and cardboard products, lawn and garden waste, and wood debris. Households, many businesses, schools, and hospitals are among the many generators of municipal solid waste which can be accepted at landfills.

Many potentially acceptable waste streams may not be permitted at municipal solid waste landfills because of their constituents or because of other materials with which they are combined.

Landfill operators may include the following materials in their permit application only if acceptance and handling is addressed and demonstrated to the department. The department will consider special requests and permit application clauses to accept the following materials. The following wastes may not be accepted for disposal in municipal waste landfills unless approved by the department:

- Major appliances

  Appliances can be accepted and carefully stockpiled for collection by a scrap recycler. This method is encouraged to prevent patrons from surreptitiously disposing of them. The 1990 federal Clean Air Act (CAA) Amendments placed restrictions on the release of chlorofluorocarbons (CFCs) (a component in freezers and refrigerators) into the atmosphere. To prevent release of CFCs, landfills may engage a certified technician to either check the appliances or remove the CFCs. Landfills may require proof from the patron that the CFCs have been properly removed. Additional disposal fees may be necessary to cover the extra handling costs incurred by the landfill.

- Ash from municipal incinerators

- Lead acid batteries

  Batteries can be accepted for collection by battery recyclers. This method is encouraged to prevent patrons from surreptitiously disposing of them.

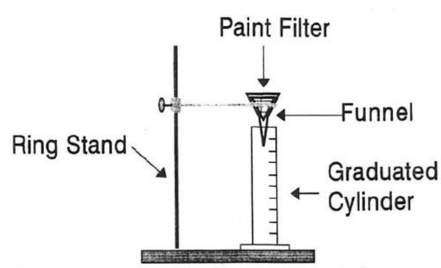
  An explanation of battery recycling is provided in Exhibit 6-1.

- Regulated infectious waste, except in amounts normally found in household waste

  Likely sources include medical and dental offices and clinics, hospitals, nursing homes, and ambulance services. Waste which has been incinerated or autoclaved may be accepted for disposal.

- Liquids, except in amounts normally found in household waste

  A paint filter test can be performed on wastes that are not frozen to determine if they in fact meet this criteria. Approximately 100 milliliters (about ½ cup) of waste should be placed on a conical, 60 mesh paint filter. Paint filters can be obtained for less than $0.25 at paint stores. If, after five minutes, liquid passes though the filter, the waste has failed the test and cannot be accepted for landfill disposal. The following figure depicts this test:



- Used oil

  Many municipal solid waste landfills have a collection tank for residential used oil.

- Pesticide containers which are not empty and have not been triple-rinsed, except those normally in municipal waste.

- Raw or digested sewage sludges, lime sludges, grit chamber cleanings, animal manure, septic tank pumping, bar screenings, and other sludges if not included in the permit.

- Hazardous waste, except in amounts normally in municipal waste.

- Industrial waste <u>if not addressed in the industrial waste management plan and the permit.</u> Industrial wastes include the following:

- Bulk chemical containers containing residue
- Asbestos
- PCB waste of concentrations less than 50 parts per million (ppm)
- Radioactive waste
- Rendering and slaughterhouse waste
- Combustible or ignitable waste
- Foundry waste
- Incinerator ash
- Paint residues
- Sludges
- Resin waste
- Spent activated carbon filters
- Oil and gas processing waste
- Contaminated soil waste

Operational or equipment limitations may prevent some additional wastes from being accepted. These limitations and corresponding waste streams may be identified in the permit application.

Occasionally, short-term situations may exist which prevent certain types of waste from being accepted. A temporary sign should be posted at the landfill entrance, or public announcements on radio or television stations can be made to inform patrons of these situations.

IV. Acceptable Wastes

Although it may seem as though few categories of waste can be accepted, there are many types of waste which can be legally and properly disposed at landfills. The department's responsibility is to prevent unacceptable wastes from entering landfills, but it can assist landfills with accepting wastes which the landfill can safely manage.

Several categories of acceptable wastes include:

- ▶ Paper and cardboard
- ▶ Glass and ceramics
- ▶ Urban wood waste
- ▶ Construction and demolition waste not containing any unacceptable waste (such as asbestos)
- ▶ Plastic
- ▶ Metals

- Fibers
- Animal carcasses (if properly managed)
- Yard and food waste

V. Identification of Potentially Hazardous Wastes

A. Definition of Hazardous Waste According to the Department

Wastes may be hazardous by virtue of meeting the definition of being either a **CHARACTERISTIC or LISTED HAZARDOUS WASTE**. The state regulation which completely defines hazardous waste is included in Chapter 33.1-24-02 NDAC. This chapter includes a portion of these definitions. Operators and those providing guidance to them should refer to the complete regulation as appropriate.

LISTED HAZARDOUS WASTES are listed by process or specific compound name. These are listed in Section 33.1-24-02-15 NDAC. Acutely hazardous wastes are identified on these pages.

CHARACTERISTIC HAZARDOUS WASTES will meet one of the following definitions:

1. Ignitability

   - Liquid with a flash point of less than 140 degrees F.
   - Not a liquid and capable, under standard temperature and pressure, of causing fire through friction, absorption of moisture, or spontaneous chemical changes and, when ignited, burns so vigorously and persistently that it creates a hazard.
   - Ignitable compressed gas or oxidizer as defined by the U.S. Department of Transportation (USDOT).

   Examples:

	Flash Point (ºF)	LEL (%)	UEL (%)
Gasoline	-45	1.4	7.6
Diesel	100	1.3	6.0
Parts washer solvent	105	0.7	6.0
Methyl ethyl ketone (MEK)	23	1.8	10.0

	Flash Point (ºF)	LEL (%)	UEL (%)
Isopropyl alcohol	53	2.3	12.7

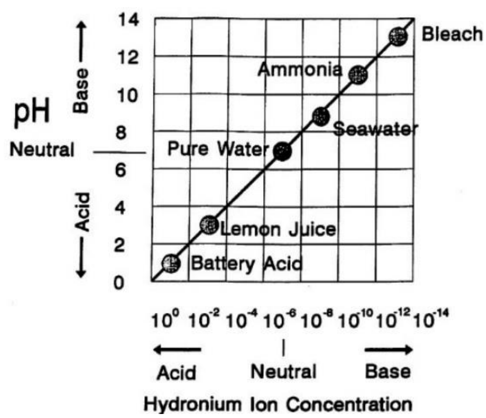
2. Corrosivity

- Aqueous and has pH less than or equal to 2 or greater than or equal to 12.5.

- Liquid and corrodes steel at a rate greater than ¼ inch per year.

The following figure places several common compounds on a pH scale. Since the pH scale is logarithmic, there is a tenfold increase in strength from one pH unit to another. For example, tomatoes (pH 4.5) are 100 times more acidic than milk with a pH of 6.5. Between tomatoes and milk, this is a difference of 2 pH units.

Exposure to compounds of either the extreme upper or lower ends of the pH scale can be detrimental to human health and the environment. Although a material may have a pH greater than 2 and less than 12.5 (thus meeting the department's definition of not being a hazardous waste), the material could still damage microorganisms in soil, surface water, and treated water. Water treatment facilities (POTWs which might receive water discharged from a landfill) must meet stringent pH guidelines to prevent substantial damage to the microorganisms which are critical to effective water treatment.



You can use a portable pH meter or pH indicator paper to determine approximate pH in the field. Be aware of field limitations.

3. Reactivity

- Reacts violently with water.

- Normally unstable and readily undergoes violent change without detonating.

- Forms potentially explosive mixtures with water.

- When mixed with water, generates toxic gases, vapors, or fumes in a quantity sufficient to present a danger to human health or the environment.

- Cyanide- or sulfide-bearing waste which, when exposed to pHs between 2 and 12.5, can generate toxic gases, vapors, or fumes in quantities sufficient to present a danger to human health or the environment.

- Capable of detonating if subjected to ignition.

- Forbidden Class A or Class B explosives as defined by the USDOT.

4. Toxicity Characteristic Leaching Procedure (TCLP)

This laboratory method of analysis is used to determine the level of contaminants in a waste sample extract or leachate. A laboratory analysis must be performed to determine if and to what extent any of these constituents are present.

Constituent	Regulatory Level (mg/l)	Constituent	Regulatory Level (mg/l)
Arsenic	5.0	Hexachlorobenzene	0.13
Barium	100.0	Hexachlorobutadiene	0.5
Benzene	0.5	Hexachloroethane	3.0
Cadmium	1.0	Lead	5.0
Carbon tetrachloride	0.5	Lindane	0.4
Chlordane	0.03	Mercury	0.2
Chlorobenzene	100.0	Methoxychlor	10.0
Chloroform	6.0	Methyl ethyl ketone	200.0
Chromium	5.0	Nitrobenzene	2.0
o-Cresol	200.0	Pentachlorophenol	100.0
m-Cresol	200.0	Pyridine	5.0
p-Cresol	200.0	Selenium	1.0
Cresol	200.0	Silver	5.0
2,4-D	10.0	Tetrachloroethylene	0.7
1,4-Dichlorobenzene	7.5	Toxaphene	0.5
1,2-Dichloroethane	0.5	Trichloroethylene	0.5
1,1-Dichloroethylene	0.7	2,4,5-Trichlorophenol	400.0
2,4-Dinitrotoluene	0.13	2,4,6-Trichlorophenol	2.0

Endrin	0.02	2,4,5-TP (silvex)	1.0
Heptachlor	0.008	Vinyl chloride	0.2

B. Identification of Potential Generators of Hazardous Wastes

1. Locations and Uses

The location and use from which identified waste is generated can provide indications about the type of waste. For example, road construction projects are likely to have fuels, oils, greases, and solvents, many of which are flammable and/or toxic. Cleaning products used for custodial maintenance are found in many retail stores. On the other hand, it would be unlikely to find radioactive materials in waste generated from a clothing store.

The following list provides examples of waste streams generated by business activities:

Business	Type of Hazardous Waste Generated
Building Cleaning and Maintenance	Acids/Bases Solvents
Chemical Manufacturing	Acids/Bases Cyanide Wastes Heavy Metals/Inorganics Reactives Solvents
Cleaning Agents and Cosmetics	Acids/Bases Heavy Metals/Inorganics Ignitable Wastes Pesticides Solvents
Construction	Acids/Bases Ignitable Wastes Solvents
Educational and Vocational Shops	Acids/Bases Ignitable Wastes Pesticides Reactives Solvents

Business	Type of Hazardous Waste Generated
Equipment Repair	Acids/Bases Ignitable Wastes Solvents
Formulators	Acids/Bases Cyanide Wastes Heavy Metals/Inorganics Ignitable Wastes Pesticides Reactives Solvents
Funeral Services	Solvents Formaldehyde
Furniture/Wood Manufacturing and Refinishing	Ignitable Wastes Solvents
Laboratories	Acids/Bases Heavy Metals/Inorganics Ignitable Wastes Reactives Solvents
Laundries and Dry Cleaners	Dry Cleaning Filtration Residues Solvents
Metal Manufacturing	Acids/Bases Cyanide Wastes Heavy Metals/Inorganics Ignitable Wastes Reactives Solvents Spent Plating Wastes
Motor Freight Terminals and Railroad Transportation	Acids/Bases Heavy Metals/Inorganics Ignitable Wastes Lead-Acid Batteries Solvents
Other Manufacturing: Textiles Plastics Leather	Heavy Metals/Inorganics Solvents

Business	Type of Hazardous Waste Generated
Pesticide End Users and Application Services	Heavy Metals/Inorganics Pesticides Solvents
Printing and Allied Industries	Acids/Bases Heavy Metals/Inorganics Ink Sludges Spent Plating Wastes Solvents
Vehicle Maintenance	Acids/Bases Heavy Metals/Inorganics Ignitable Wastes Lead-Acid Batteries Solvents
Wood Preserving	Preserving Agents

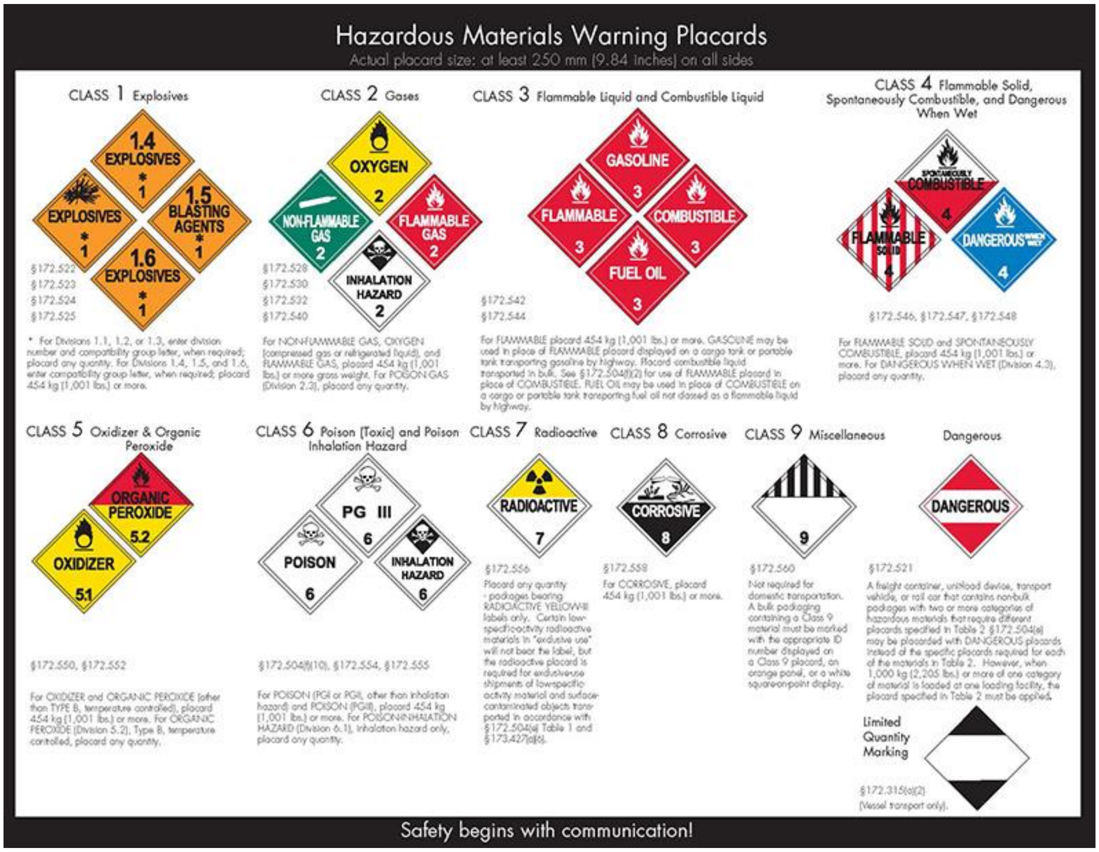
A list of hazardous waste generators, transporters, treatment/storage/disposal facilities can be obtained from the department's Hazardous Waste Program. Those on the list have applied for and received a State/EPA Identification number. Generally, those with State/EPA identification numbers have adequate awareness to properly dispose of their hazardous waste and not include it with their regular soil waste.

2. Safety data sheets (SDS)

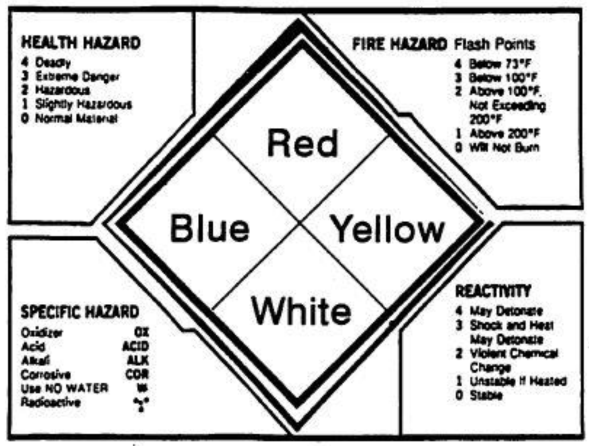
Most chemicals produced today have safety data sheets which provide chemical and physical characteristics of the product. Manufacturers are required to prepare these forms, which should be supplied to businesses that purchase the products. If waste or waste containers are collected for which a trade name or chemical name is listed, ask the generator for a copy of the SDS to familiarize yourself with the hazards of the residual container contents.

3. Labels

a. The USDOT requires certain types of labels on many containers, trucks, and rail cars. This labeling system utilizes several features to provide an indication of the type of chemical hazard. The system is designed such that if any portion of the label is damaged, some information may still be provided. The four features of this system are: (1) distinctive color, (2) symbol, (3) one digit number, and (4) descriptive word. Following is a depiction of this system.



b. The National Fire Protection Association (NFPA) has also developed the National Fire Rating which is a labeling system depicted in four diamonds. This information is often provided on safety data sheets. Many organizations which use chemicals have implemented this system of identification.



Numbers ranging from 0 to 4 are listed in three colored diamonds. The higher the number, the more dangerous the product.

Blue (health) - indicates that the material may, directly or indirectly, cause permanent or temporary injury due to acute exposure by physical contact, inhalation or ingestion.

Red (flammability) - assesses the relative susceptibility of materials to fire-burst based on the form or condition of the material and its surrounding environment.

Yellow (reactivity) - advises that the material may be susceptible to explosion whether through self-reaction or polymerization, or by exposure to certain conditions or substances.

White (special hazard) - covers special properties and other hazards associated with a particular material.

c. Manufacturers' labels specifying contents, date of manufacture, chemical characteristics, and handling procedures can also provide information regarding the contents and appropriate disposal methods.

4. Containers

Container types provide indications of the type of hazard present or previously present in the container. The following are descriptions of some examples of container types. Continued learning and experience by the landfill operator allow for quicker identification of <u>potential</u> contents. Questionable containers should not be accepted for disposal until contents can be identified.

Environmental consultants, the local emergency management agency or fire department, a local chemistry teacher, and chemical suppliers can contribute to this knowledge base.

Compressed gas cylinders have distinctive labels, colors, shapes, regulator types, and imprinted numbers on the cylinders which can provide clues as to the contents.

Many corrosive materials are stored in plastic, rubber, or plastic-lined containers since they can corrode metals.

Hydrofluoric acid is often stored in one gallon plastic containers with four protrusions similar to fist size on the bottom of the jug.

Amber or other dark-colored containers often indicate that the contents are photosensitive (degrade in sunlight).

5. Reactions

Landfill operators should never attempt to mix waste streams in order to get a chemical reaction. This can be extremely dangerous and, in some cases, deadly.

Reactions can provide identifications of the waste type or of the material mixed with it. If waste is discarded and a reaction ensues, the type of reaction and materials involved should be noted and reported. This information can contribute to determining what the waste types were and if the worker was exposed to toxic materials.

6. Field analyses

Field instruments, pH indicator paper, and other types of QA/QC kits are available to provide quick tests for certain compounds. Workers utilizing these materials should receive training prior to use of equipment and kits.

The correct instrument or materials must be used for identified compounds. There is no one instrument that checks for all compounds.

7. Laboratory analyses

Prior to waste disposal, some businesses or industries may be required by the department or the landfill operator to obtain laboratory analyses of the waste. In most cases, waste which is potentially hazardous (according to the department's definition) must be analyzed by a laboratory. The department can provide guidance for questionable situations. The basic rule of thumb is that if in doubt, one should continue to question and possibly require laboratory analyses. Records of laboratory reports should be maintained by the landfill owner/operator. In some cases, accompanying forms, applications, and reports should be maintained as a disposal record.

C. Determining Quantity of Hazardous Waste Generated

Generator	Time Limit	Quantity Limit
Large Quantity Generator (>2,200 pounds per month)	90 days	None
Small Quantity Generator (>220 pounds and <2,200 pounds)	180 days (within 200 miles) 270 days (>200 miles)	13,200 lbs
Conditionally Exempt Small Quantity Generator (<220 pounds per month)	None	2,200 lbs

Wastes not counted include:

- Spent lead-acid batteries
- Used oil that has not been mixed with hazardous waste
- Reclaimed precious metal wastes
- Discharges to POTWs.
- Waste reclaimed continuously on site without storing prior to reclamation
- Empty containers
  - Containers which hold more than 110 gallons must have 0.3 percent or less by weight remaining in the container.
  - Containers which hold less than 110 gallons must have 3 percent or less by weight remaining in the container.
  - Compressed gas containers must have inert pressure that approaches atmospheric pressure.
  - Inner liners are empty if they meet the requirements of 1. or 2.
  - Containers which held inner liners are considered empty if material did not leak out of the inner liner or if the outer container meets the requirements of 1. or 2.
  - Acute hazardous waste containers and inner liners must be triple rinsed and may require additional special handling.

D. Waste Minimization

- When generating wastes, do not mix:
  - Solvents, oil, or coolant
  - Listed hazardous waste with any other waste
  - Characteristic hazardous waste with any other waste
  - Incompatible wastes

- Reuse materials and recycle whenever possible.
  A list of recycling centers can be obtained from the North Dakota Solid Waste and Recycling Association.
  An explanation of battery recycling is provided in Exhibit 6-1.
  Many municipal solid waste landfills have a collection tank for residential used oil.

- Read and follow label directions. When products are used properly and for intended purpose, little to no waste should be generated.

- Use products in well-ventilated areas.

- Never mix chemicals or different brands of same product.

- Reduce use of aerosols. Aerosol droplets offer greater worker exposure to chemicals. Airborne product presents a greater hazard than the liquid or solid form of a product. When possible, use the liquid or solid form.

- Never overuse or buy more than needed.

- Don't leave containers open. Products can evaporate or give off dangerous vapors. Open containers increase chances for spills.

- Keep product in original containers to avoid accidental poisoning and to retain important information for product age and ingredient. Periodically check for leaks.

- Use and store away from pets and children. Put child-protective latches on cupboards; lock cabinets; store and use away from food; and store and use away from fire and areas of extreme heat.

- Wear protective clothing (protective gloves, goggles, respirators).

- Keep safety equipment near work areas (fire extinguisher, towels to wipe spills, and first aid kits). Have another person in immediate vicinity to assist if injuries occur.

- Don’t eat, drink, smoke, touch mouth or eyes, or wear contact lenses when using toxic products.

- Phone numbers for doctor and poison control center should be posted near telephone. Check with these people before giving antidotes recommended on a product’s label, especially if product is old.

- Call immediately if you believe poisoning has occurred.

- Avoid using products when you are tired, tense, or ill.

- Pregnant women should avoid exposure to hazardous products.

- Be alert for reactions to product use. Headache, rash, numbness, burning sensation, coughing, watery eyes, etc. may develop during or sometime after use.

- Do not use product that has been banned.

VI. Conversion and Comparison Factors

<u>Comparing a part per million to the real world</u>

1 ppm is one part per million or one part of something and 999,999 parts of something else.

1 ppm is the same as:

1 ounce of sand in 31 tons
1 inch in 15.7 miles
1 minute in 1.9 years
1 ounce of water in 7,503 gallons
1 square inch in 1/6 acre
1 pound in 500 tons
1 cent in 10,000 dollars
1/6 inch thickness in a pile 1 mile high

1 ppb is one part per billion.
Since one billion is 1,000 times one million, 1 ppb is 1/1,000 of 1 ppm.

Exhibit 6-1
Recycle Old Batteries

Lead-acid batteries are those used in cars, trucks, motorcycles, motorboats, and snowmobiles. Although lead-acid batteries can be recharged many times, they eventually become “spent” or “used” when they no longer hold a charge.

A standard automobile battery contains almost 18 pounds of lead and one gallon of lead-contaminated sulfuric acid. When disposed of improperly, lead-acid batteries present a threat to the environment. High lead levels in drinking water can cause anemia, fatigue, joint pain, and nervous disorders in adults. Lead can also harm unborn children if ingested by the mother, and it can affect the nervous system of children, resulting in slowed learning ability and possible brain damage.

According to NDCC Chapter 23.1-08 of the North Dakota Century Code, it is illegal to dispose of lead-acid batteries improperly. Lead-acid batteries must be accepted as trade-ins for new lead-acid batteries by any person who sells lead-acid batteries at retail.

In addition to battery dealers, many recyclers and scrap metal dealers currently take batteries for recycling. Contact the department or local solid waste officials to find a battery recycler in your area.

Exhibit 6-2
Recycle Used Oil

When disposed of improperly, used oil presents a threat to the environment. Used oil contains benzene (a known cancer-causing agent), lead, and other toxic metals. One quart of oil can make 250,000 gallons of water undrinkable. This is more water than 30 people will drink in a lifetime.

Today, almost 60 percent of the nation's automobile oil is changed by customers themselves. Used oil from cars, trucks, boats, motorcycles, recreational vehicles, and lawn mowers can be recycled. The department encourages the recycling of used oil. "Recycling" means used oil that is burned for energy recovery, used to produce a fuel, reprocessed or re-refined into new motor oil.

It is illegal to place or dispose used oil in municipal waste or in a landfill. After changing your oil, put your used oil in a clean plastic container with a tight lid. <u>Don't mix it with anything else</u> (paint, gasoline, solvents, antifreeze, etc.). Take it to a service station, municipal collection center, a used oil recycler, or another location that collects used oil for recycling. Contact your local city or solid waste officials for information on collection centers near you.

The department encourages every city and county to establish used oil recycling centers in your area. Many municipal solid waste landfills have a collection tank for residential used oil.

Section 7
tab

SECTION 7: OPERATIONS AND MANAGEMENT

PREFACE

The requirements for operation of a municipal solid waste landfill are based on rules, laws, permits, and enforcement decisions. Each landfill will have a specific set of requirements. For any facility, however, design plans, phase development plans, and common sense dictate operations. The design plans are the basis for a facility permit and are discussed in Section 5 "Landfill Permits, Design, and Construction" of this manual.

Landfill operators and designated staff must routinely refer to plans. Projected elevations of excavation areas and fill, waste volume, cell locations, drainage patterns, and slope are aspects of landfill design which are referenced on engineered drawings. In reviewing design plans, a determination should be made regarding compliance with design specifications. Facility operators should periodically consult with site engineers and surveyors for facility construction, waste fill elevations, grade staking and other landfill construction aspects.

Phased development plans determine the daily operations necessary to construct the landfill according to design. Since conditions affecting the operations may change, these plans may be revised. The landfill operator should have the knowledge, expertise, equipment, and materials to adapt to necessary modifications to phased development plans and the consequent alterations to daily operations.

BUDGETS

I. Purpose

Financial records must be maintained by any private or public enterprise which utilizes money, equipment, materials, and personnel. Records offer accountability, indications of operational efficiency, and planning data. Construction firms with similar management concerns have maintained financial record databases for decades. These databases provide more accurate figures for daily and future planning.

Public landfills must be accountable to their constituents. Private landfills must show a profit, or they will go out of business and leave their patrons with fewer waste disposal options.

Landfills can use financial data to better evaluate design and operational efficiency and to plan future landfill requirements and operations. Accounting systems should be developed to track equipment maintenance costs and personnel, equipment, and material costs by task. Capital costs should also be recorded.

Landfill operators should work with their accountants to develop cost accounting systems which are easy to use. Some equipment manufacturers have developed written and computerized cost accounting systems specifically for the types of operations conducted by landfills.

II. Landfill Costs Based on Size

Generally, the larger the landfill, the lower the cost per ton (or per cubic yard). Every landfill has some capital costs, planning costs, operating costs, and closure/postclosure costs. No matter what the size of the landfill, some minimum amount of money must be spent in each of these four categories of cost. The economy of scale is at play with landfill operations just as it is with any type of business. The following four exhibits depict how cost per ton diminishes as the size of the landfill increases.

Exhibit 7-1
Landfill Cost per Ton vs. Size
Total Cost/Ton

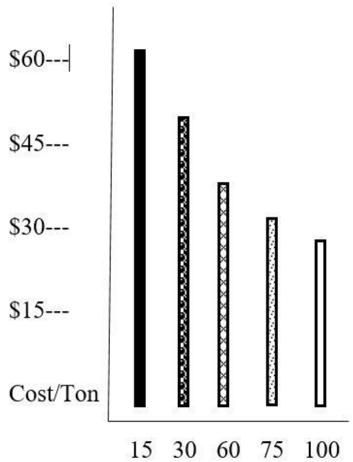


Exhibit 7-2
Landfill Cost per Ton vs. Size
Capital Cost/Ton

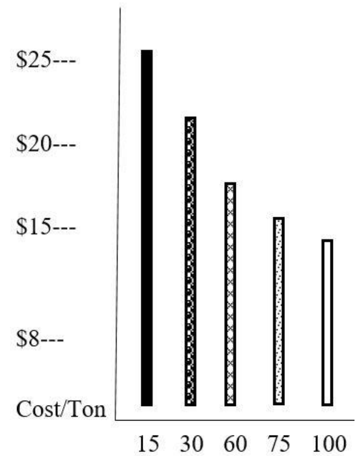


Exhibit 7-4
Landfill Cost per Ton vs. Size
Financial Assurance Cost/Ton

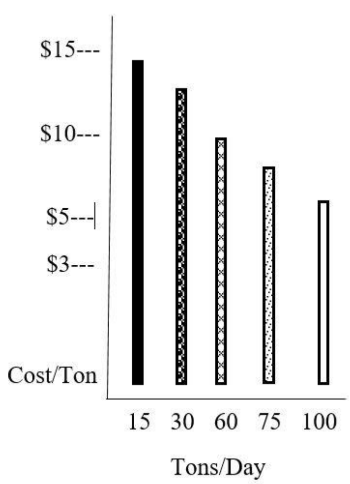
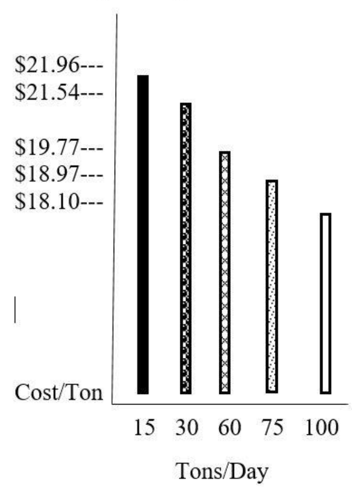


Exhibit 7-3
Landfill Cost per Ton vs. Size
Operating Cost/Ton



III. Job Costs

Recordkeeping categories for landfill operations can include:

- Equipment codes

  For example, pickups can have the prefix 02, and the first pickup purchased can have a number 02-01. Scrapers can have a prefix of 12, with the first scraper purchased having a number 12-01.

- Tasks

  The landfill operator should determine the tasks to be monitored. Tasks at each landfill may vary based on their specific operations. Following are several examples of tasks and codes which can be assigned.

Mowing (grass and weeds)	010
Excavation of cover	020
Topsoil stripping	030
Topsoil pile maintenance	040
Cover pile maintenance	050
Cover application	060
Daily cover	061
Final cover application	062
Waste control and compaction	070
Road construction	080
Road maintenance	090

- Hours

  Hours should be recorded by task, for equipment, and for personnel. For example, if a scraper spent four hours stripping topsoil and four hours applying daily cover, it could be coded as four hours to 12-01-030 and four hours to 12-01-061. Personnel costs can be coded similarly.

When a landfill operator knows equipment and personnel cost, the cost of each landfill task can be calculated. Weekly, monthly, annual, and landfill lifetime costs can thus be determined and used for budgeting purposes.

IV. Landfill costs

Landfill operations involve many costs at various times. Operators must evaluate the following associated costs and revenues prior to applying for landfill permits:

- Site selection
- Planning
- Capital expenditures
- Operational costs
- Closure/postclosure financing

Revenues come primarily from tipping fees or, in the case of government-owned landfills, tax levies. Additional income can be provided by material or energy recovery and sale of landfill gas.

Many of the cost and revenue items related to landfill operations are listed in Exhibit 7-5. Each landfill is unique. Listed items may not be applicable to all landfills. Additional cost items not listed may be identified for some facilities.

Some costs are based on units such as per well or per acre. Ask the department for assistance with any costs for which you do not have data.

Prior to conducting site selection and investigations for landfills, operators should complete this form or one similar to it. Every business should prepare a business plan which involves some type of cost estimating to determine its potential profitability. Landfill operations are no different than any other business in this regard.

The time to begin monitoring costs and revenues is now. Once a database has been developed, the information can be used for future planning purposes.

Exhibit 7-5
Current Operation Costs Analysis

LANDFILL FACILITIES

Site Selection Costs

Feasibility study (including preliminary engineering,
public affairs, hydrogeologic study, and testing .... ________

Total Site Selection Costs .... ________

Planning Costs

Legal and accounting costs .... ________
Detailed hydrogeologic site study........ ________
Detailed engineering design plan .... ________
Extensive review of past usage and potential
liability of site .... ________
Engineering fees........ ________
Permit application fee and review fee........ ________

Total Planning Costs........ ________

Capital Costs

Land (acres) .... ________
Building(s) .... ________
Construction labor costs........ ________
Site improvements (including roads, drainage
landscaping, fencing, gates, and signs)........ ________
Incinerator and related equipment .... ________
Instrument and controls .... ________
Permit fees (for solid waste, water, and air) .... ________
Stationary equipment (including pumps and scale) .... ________
Vehicle (compactor, scraper, loader, and dozer) .... ________
Leachate collection system and treatment .... ________
Synthetic liner .... ________
Explosive gas control system .... ________
Groundwater monitoring wells .... ________
Clay liner........ ________
Topsoil excavation........ ________
Surface water diversion structures........ ________
Sedimentation basins .... ________
Initial excavation .... ________

Contingencies...________
Other costs (including air pollution control
equipment, resource recovery system, etc.)..________

Total Capital Costs...________

Annual Operating Costs

Operation/maintenance (O&M)

Labor costs (including manager, operator,
laborer, and bookkeeper) ....________
Vehicle and stationary O&M (includes
maintenance, fuel, oil, repair parts,
consumables, and replacement costs) ....________
Leachate control and treatment O&M ....________
Groundwater system monitoring O&M..________
Explosive gas control ....________
System monitoring O&M ....________
Surface water diversion structures (including
sedimentation basins O&M) ....________
State and local disposal fees ....________
Utilities (electricity, natural gas, water, wastewater,
residue disposal, non-processable disposal) ....________
Other costs (including administration, taxes,
telephone, insurance, etc.)..________
Quality control/quality assurance ....________
Program costs...________

Total Annual Operating Costs ....________

Closure Costs

Closure construction labor costs ....________
Cover material:
Clay cover ....________
Vegetative soil cover ....________
Seed, fertilizer ....________
Mulch or straw ....________
Drainage material:
Drainage layer material ....________
Drainage letdowns ....________
Drainage pipe ....________
Explosive gas control:
Vents (passive) ....________
Blower system (active) ....________

Monitoring probes	________
Flares	________
Administrative	________
Engineering	________
Quality control/quality assurance	________
Program costs	________
Total Closure Costs	________
<u>Postclosure Costs</u>	
Monitoring and system (O&M)	________
Explosive gas monitoring wells	________
Groundwater monitoring wells	________
Leachate collection and storage system	________
Surface water management system	________
Vegetative cover	________
Soil cover	________
Leachate treatment	________
Onsite plant operation	________
Off-site transport/treatment/disposal	________
Contingencies	________
Unexpected costs (as a percentage of total cost estimate)	________
Administrative	________
Inspections	________
Reports	________
Total Postclosure Costs	________
<u>Revenues</u>	
Sale of methane gas	________
Electricity revenue	________
Steam revenue	________
Materials recovery revenue	________
Total Revenue	________

Following are some costs from an imaginary landfill. Not all costs have been listed. The landfill capacity is 180,000 cubic yard volume available every third year with 60 tons received per day.

1993 Summary		
Capital expenditures	=	$ 1,009,019.00
Capital repayment and fund payments	=	233,829.00
Operating costs	=	341,632.00
Financial assurance costs	=	142,701.00
Capital Costs		
Engineering design, hydrogeologic evaluation permitting	=	295,698.00
Land acquisition, 171 acres	=	110,900.00
Building construction	=	40,000.00
Road construction	=	15,000.00
Monitor well installation $5,400 per well, nine wells	=	48,600.00
Leachate/storage pond/aeration system	=	60,000.00
Initial liner installation	=	819,019.00
Equipment purchase	=	40,000.00
Old landfill area final cover clay cover system	=	31,000.00 per acre
Operating Costs		
Contracted services	=	13.00 per ton
Well testing, nine wells tested	=	1,500.00 per well
Aeration maintenance Leachate 225 gal per acre, 5 acres Runoff 80,000 gal per acre, 5 acres	=	8,000.00
Annual final cover	=	46,676.00
Annual fees	=	1,350.00
Miscellaneous and contingency	=	16,000.00
Total operating costs $18.16 cost per ton	=	341,632.00

Capital and operating costs
$30.59 per ton
Capital, operating, and financial assurance
$38.17 per ton

RECORDKEEPING AND REPORTING

I. Purpose

State and federal regulations have resulted in major changes to solid waste management programs. Some landfills are closing, and more waste is being taken to existing landfills.

Routine recordkeeping will allow existing landfills to better evaluate their compliance with landfill plans and state, federal, and local regulations. Revisions to future plans and operations can be more efficient with the use of landfill records.

Landfills should develop and maintain a recordkeeping system to allow efficient operational monitoring. Recordkeeping provides the opportunity to evaluate the success of landfill planning. Community solid waste management programs, including recycling programs, also benefit from landfill recordkeeping.

II. Annual Report

The owner or operator of a solid waste management facility must prepare and submit a copy of an annual report to the department by March 1 of each year.

The annual report must cover facility activities during the previous calendar year and must include the following general information:

- Name and address of the facility
- Calendar period covered by the report
- Annual quantity for each category of solid waste in tons or volume
- Occurrences and conditions that prevented compliance
- Other items identified in the facility plans and permit

III. Detailed Frequent Reports

In addition to the annual reporting requirements, the department may require more frequent reports. Regular reports (annual and otherwise) should include more comprehensive and detailed information. Summaries of daily or weekly reports may be acceptable.

A. Waste Disposed or Handled at the Facility

Date	Generator	Hauler	Waste Type	# Loads	Volume/Weight

B. Control of Spillage, Windblown Debris, Dust, Odor, and Vectors

- Generation of dust, odor, and vectors or spillage of waste
- Standard control measures and action taken during unplanned incidents

C. Condition of Berms, Dams, and Noncontact Surface Water Containment Structures

Construction, repair, maintenance, and replacement of structures used for surface water containment.

Reports should be prepared as activities are conducted. This will make it easier to summarize the operations in the annual report and in other periodic reports required by the department.

D. Surface Water Runoff and Run-on Control

- Precipitation measurements for snow and rain
- Surface water from spring thaws or snow melt
- Significant surface water run-on and runoff events, location, and impact of each event
- Maps or diagrams for better illustration
- Controlled and uncontrolled water releases
- Laboratory analyses for surface water as required by the department

E. Removal and Stockpiling of Suitable Plant Growth or Topsoil Material

Suitable topsoil material (including the A horizon and the B horizon) must be removed from all areas intended to be disturbed by landfill operations.

- Locations, quantities, soil types, and procedures for topsoil removal
- Stockpile locations
- Revegetation practices (e.g., seed mix, equipment used, and methods)
- Soil types, quantities, depths, and locations of topsoil removed and replaced
- Analytical data for soils, seed mixes, and amendments such as fertilizers and mulch
- Maps and diagrams

F. Geologic, Soil, and Liner Conditions

- Quantities and types of geologic materials and soils identified in the soil survey available at the facility

- Variations to normal operating procedures
  For example: interception of lignite, sand, gravel, or fractured materials; interception of groundwater; and breach or damage to the liner

- Liner construction and repairs
  All construction and repair must follow department QA/QC.

G. Condition, Operation, and Maintenance of Leachate Collection System

- Routine inspections and regular maintenance of leachate management systems
- Condition of various components
- Damage and subsequent repairs
- Leachate removal from the landfill proper, containment structures, and the site
    - Quantities
    - Dates
    - Quality
    - Routine management procedures
- Analytical data for leachate

H. Landfill Trench Filling and Covering Operation

- Condition of disposal area
- Filling of landfill area to grade
- Daily cover and interim cover placement
- Settling of landfill areas after filling

I. Landfarming Activities

The following log should be maintained:

Date	Generator	Hauler	Waste Type	# Loads	Volume/Weight

The following items should be recorded:

- Inspection schedule
- Rate of waste application
- Waste characterization
- Application of amendments (water, fertilizer, etc.)
- Tillage
- Degradation rates
- Soil sampling frequency and results

J. Composting

Acceptance of these materials should be addressed in Item A. Waste Disposed or Handled at the Facility.

- Results of the monitoring program (e.g., odor, moisture, temperature, general condition)
- Pile size
- Frequency of turning
- Routine maintenance procedures

K. Surface Impoundment Condition

- Volume of water in pond(s)
- Remaining capacity
- Amount of freeboard
- Condition of features such as liners, piping systems, spillways, etc.
- Quality of liquids or other waste materials contained in pond(s)
- Releases (leaks, spills, overtopping, etc.)
- Inappropriate contact of water with waste
- Response to unplanned events
- Regular maintenance activities

L. Reclamation

- Final slope conditions
- Construction of low permeability cap over landfilled wastes
- Placement of additional fill or drainage media
- Replacement of buffer soil and suitable topsoil
- Final revegetation of filled areas
- Quality assurance and quality control procedures for site capping and reclamation
- Filling of settled areas
- Significant surface water erosion, settling, and cover repair
- Success of revegetation

Final cover placement should be conducted in accordance with the permit conditions.

M. Groundwater and Surface Water Monitoring and Leachate Seepage

- Water level
- Laboratory analyses
- Condition of wells, springs, and other surface water structures not elsewhere addressed

- Leachate seepage in or near the site
- Maps and diagrams for illustration of site conditions

N. Methane Generation

- Condition of methane collection and venting systems
- Quantity generated
- Uncontrolled methane generation
- Distressed vegetation
- Field and laboratory data
- Maps and diagrams as appropriate

O. General Site Operations

- Summary of general disposal standards
- Summary of completed inspection reports
  Conditions should be inspected daily and a report completed weekly.

P. Permit, Site Development, and Operating Plans

All site plans and department rules should be regularly reviewed to ensure that the landfill is operating within permit guidelines and department rules. Changes to existing plans may require permit or plan modifications. In some cases, the department must be notified about modifications.

All site documents should be easily accessible for review by landfill personnel and department staff.

Landfill personnel should receive appropriate training. A description of required and completed training should be described in the report.

Facility compliance with department rules and permit conditions should be addressed.

IV. Summary

A. Required Reports
Annual report due by March 1.
Periodic reports may be specified by the department.

B. Recommended Reports

1. Daily

The following reports are the most likely to be required by the majority of landfills on a daily basis.

a. Waste acceptance

b. Recycling (acceptance, collection, or other management)

c. Trench filling or area building

d. Cover

e. Operations

2. Daily, weekly, or as conducted or experienced

The following reports or information should be prepared or recorded on the periodic basis which best suits the operation.

a. Precipitation
As it occurs.

b. Litter control
Period depends on when areas are patrolled.

c. Construction
Reports should be prepared as operations are conducted.

(1) Liner

(2) Leachate system

(3) Overburden management

d. Groundwater, surface water, and leachate management

e. Topsoil removal, reclamation, and revegetation

f. Landfarming activities

g. Composting activities

h. Surface impoundment management

i. Methane control and monitoring

EQUIPMENT SELECTION

I. Background

No single "do it all" piece of equipment has been designed to do everything at a landfill – even with attachments.

There are mathematical models which can be used to evaluate the equipment offering the greatest cost efficiency for specific landfills. Caterpillar is one of several equipment manufacturers that has a computer model into which pertinent factors can be entered to determine equipment selection. Some of these decision-making models involve recording information on paper rather than into computer.

No matter how complex equipment selection may become, two factors will undoubtedly carry the most weight when making judgments – cost and experience.

II. Landfill Activities

Equipment selection is based on a number of factors including the operations which must be performed. Selected equipment must achieve the desired goal and perform efficiently and safely.

Landfill operations include:

- Clearing of vegetative and geologic material
- Topsoil stripping, stockpiling, and replacing
- Road construction and maintenance
- Trench excavation
- Spreading and compacting waste
- Transportation and compaction of fill and cover material
- Vegetation control (revegetation, mowing, and weed control)
- Surface water runoff control
- Litter control
- Maintenance of equipment and structures

Other factors to consider with equipment selection include:

- Cost
  - Purchase versus rental
  - Subcontracted services
  - Maintenance cost
- Period of use

- Versatility
- Operator skill

A. <u>Clearing of Vegetative and Geologic Material</u>

Site clearing may be required in some localized areas. For the most part, North Dakota does not have heavy vegetation which reduces the need for clearing equipment.

1. Track type dozers can be used to remove trees, brush, or other heavy vegetation.
2. Track loaders with two-way buckets can also remove and transport vegetation.
3. Wheel loaders can be effective in areas of light vegetation.

B. <u>Topsoil Stripping, Stockpiling, and Replacing</u>

1. Activities

   a. Stripping

   Topsoil should be evaluated by a soil scientist to determine the depth of the A and B horizons which should be saved for reclamation.

   Topsoil is a precious commodity; it can take more than 50 years for 1 inch of topsoil to develop.

   Topsoil removal should be monitored to ensure that all available and acceptable topsoil is removed for future use.

   b. Stockpiling

   Stockpiles can be seeded to reduce soil erosion. Smaller stockpiles are encouraged since the larger the stockpile, the fewer soil microorganisms are viable when topsoil replacement occurs. Diversion ditches installed around topsoil piles can reduce soil loss. Direct placement of topsoil is encouraged whenever possible. Plants, seeds, and microorganisms are more viable in directly placed topsoil, allowing quicker and better revegetation.

2. Equipment

   In many cases, scrapers are the equipment of choice for topsoil handling. However, other pieces of equipment can be used. Factors for equipment selection include transport distance, depth of topsoil, working slope, material type, and weather conditions.

a. Scrapers

Scrapers are recommended for hauling distances up to 5,000 feet.

A push dozer may not be necessary if the scraper is working in relatively loose material.

Single-engine scrapers can self-load, but they generally cannot get a full load unless they are working in relatively loose material. Steep or wet conditions are limiting factors for scraper operations.

Types of scrapers include the following:

- Elevating (paddle wheel)
  Elevating scrapers work best with material smaller than 6 feet in diameter.

- Open can
  Tandem powered (twin engines)
  Pushloading (single engine)

  This type generally requires a track dozer to push the scraper through the material while loading.

- Auger
  This type works better with looser and finer materials.
  Few landfills utilize this type of scraper.

b. Track dozers and loaders

Transport distance should be less than 300 feet.
Track dozers' rippers can be used in frozen topsoil.

c. Wheel loaders

Transport distance should be less than 600 feet.
Slope may be a limiting factor.
Uneven surfaces can be created when using wheel loaders to scatter material, thus slowing the operation.
If topsoil depth is substantial, the working face can be developed for a truck/loader operation.

C. Road Construction and Maintenance

Roads may be permanent or temporary depending on the road location and site activities. Site access roads, traffic control roads, and landfill maintenance roads are required.

1. Road purpose

   a. Site access roads

      Site access roads will tend to have the longest life and should receive the most attention when it comes to construction and maintenance. Site access roads are most likely to be composed of asphalt or well-constructed gravel. Roads constructed of asphalt will probably be built by a contractor because of the specialized equipment necessary.

   b. Traffic control roads

      Traffic control roads are those roads within the landfill where patrons drive to deposit waste or where recyclers drive to collect materials.

      These roads receive substantial traffic and change drastically over the course of a landfill's life.

      These roads may be constructed of gravel or dirt. Other types of inert material such as broken concrete or ash may be used for repair or to provide a more substantial base. Traffic control roads are in most cases constructed by landfill staff.

   c. Landfill maintenance roads

      Landfill maintenance roads are those roads upon which landfill employees or vendors must travel to gain access to the landfill perimeter, cover stockpiles, surface impoundments, or equipment requiring repairs. These roads receive little traffic, and travelers on these roads are generally quite familiar with obstacles.

      Maintenance roads are likely to be constructed of gravel or dirt. Traffic control and landfill maintenance roads are, in most cases, constructed by landfill staff.

2. Activities

   - Road base construction
   - Building and maintaining a crown (to maximize surface water runoff)
   - Maintaining a smooth surface

- Constructing and maintaining diversion ditches
- Dust suppression

  Dust suppression can be achieved by spraying water on a road surface. If too much water is sprayed on the road, the surface can become too slippery for the public and landfill equipment. Caution should be used in the winter and during periods of substantially cooler temperatures after sunset. A thin layer of water can become a thin layer of ice very quickly.

  A second method of dust suppression involves the application of chemical solutions designed to suppress dust on gravel or dirt roads. Road bases require substantial time investment to prepare the road for application. Applications are conducted in the summer (during periods of low rainfall). After application, roads should receive the very minimum in grading since that action reduces the chemical's effectiveness. Periods of heavy precipitation also remove the chemical solution from the road and reduce its efficiency. Although these applications suppress dust for only a limited time, the method is cost-effective for many road maintenance operations.

3. Equipment

   a. Track dozers, rippers, and blades

      Rippers can be used to scarify surface and remove sharp or large rocks.

      Dozers can be used to transport material for road base preparation.

      Dozers can be used to compact road material.

      Blades can be used to cut and maintain diversion ditches.

   b. Wheel and track loaders and buckets

      Loaders can be used for road base preparation.

      Buckets can be used to clean diversion ditches.

   c. Motor graders (blades or maintainers) and rippers

      Graders can be used for road base preparation.

      Rippers can be used to scarify roads to provide material with which to redevelop smooth surface.

      Blades can be used to construct and maintain diversion ditches, and to maintain smooth surface and develop crown.

   d. Backhoes - front-end loader/backhoes and track hoes

      Backhoes can be used to construct and clean ditches and generally selected to work on ditches smaller than those constructed by dozers.

e. Water trucks or water scrapers

Water trucks or scrapers can be used for dust suppression.

Water trucks or scrapers can be used to provide water when needed for road maintenance.

D. Trench Construction and Cover Handling

1. Activities

Trenches must be excavated for landfills which utilize the trench method. Material excavated from trenches is often used as daily or final cover.

Daily and final cover comprise 20 to 40 percent of the final landfill volume. Cover must be excavated, transported, and stockpiled until ready for use. Cover must then be loaded into the appropriate piece of equipment, transported, placed, and compacted. Equipment is selected based on size and number of trenches, material to be excavated, and transport distance.

2. Equipment

In many cases, a combination of equipment is used. For example, dozers can rip and doze material into piles which can then be picked up by scrapers.

Consideration should be given to subcontracting operations which are infrequently undertaken. Trench excavation and reclamation are examples of activities which many landfill operators subcontract. Work should be scheduled at a time of year when the weather will not create operational problems. If the activities will adversely impact landfill operations, consideration should be given to relocating landfill operations or rescheduling excavation.

a. Track dozers and loaders

Transport distance should be less than 300 feet.

Track dozers' rippers can be used in hard material.

After a load of cover has been dumped, the track dozers can spread material faster than track loaders.

b. Wheel loaders

Transport distance should be less than 600 feet.

Slope may be a limiting factor.

Uneven surfaces can be created when using wheel loaders to scatter material, thus slowing the operation.

c. Scrapers

Transport distance should be 300-5,000 feet.

Scrapers should be used when large volumes of cover must be transported.

d. Steel-wheel compactors

Transport distance should be less than 300 feet.

Compactors can be used for transport and compaction of material if a load has been dumped by another machine.

Compactors cannot be used to carry a load of cover, and they cannot be used for excavation.

E. Handling Waste Material

1. Tasks

Waste must be scattered into manageable layers no greater than 2 feet in thickness.

Bulky items or other items needing special attention must be handled with equipment.

Waste must be compacted.

2. Equipment

a. Track dozers

Dozers can be used to spread and compact materials.

Good compaction can be achieved with track dozers.

Dozers cannot be used to easily pick materials out of loads for special handling.

Track dozers work well on slopes up to 3:1, since track equipment is designed to work well on slopes.

Grousers tear waste while the dozer compacts it.

The optimum slope for dozer operation is 20 percent.

b. Track loaders

Loaders can achieve compaction densities similar to track dozers.

Loader bucket allows special handling and can be used to load cover to increase weight during compaction.

Track loaders work well on slopes up to 3:1, since track equipment is designed to work well on slopes.

Grousers tear waste while the loader compacts it.

The optimum slope for loader operation is 20 percent.

Caution must be used when operating the bucket. The center of gravity must be maintained as low as practical by controlling the tilt and height of the bucket.

c. Wheel loaders

Loaders can be used to scatter and compact waste.

Loader bucket allows special handling and can be filled with cover to increase weight during compaction.

Robber tires are of concern due to the potential for punctures.

Slope is a limiting factor due to greater difficulty with controlling a wheel machine and with maintaining a low center of gravity.

d. Steel wheel compactors

Compactors are designed specifically for scattering and compacting waste.

They are designed to work best on relatively flat slopes; generally, a slope of 4 percent is the optimum.

Blades on the steel wheels are designed to tear waste and allow a greater degree of compaction.

F. Final Reclamation

In North Dakota, many of the revegetation operations are subcontracted due to the availability and cost of farm equipment and experience pool. In many cases, revegetation operations are often not conducted frequently enough to warrant owning revegetation equipment.

Many revegetation operations, whether along the roadside, on surface coal mines, or on landfills, involve minimum tillage operations. These reduce the potential for soil erosion due to surface water runoff and wind.

1. Activities

   Final cover must be transported, spread, and compacted.

   Topsoil must be transported and spread.

   A proper seedbed in the topsoil must be prepared.

   Agricultural chemicals such as fertilizer, herbicides, and pesticides may be applied. Soil types, vegetation, and objectives will determine preferred chemicals and the levels and times of application.

   Planting of crops, grasses, forbs, shrubs, and trees must be conducted. Each plant species dictates the time of year and the soil conditions under which planting should commence.

2. Equipment

   Transport and spreading of final cover and topsoil can be performed with various types of equipment. The specific task will determine the best equipment to use. Equipment can include dozers, loaders (track and wheel), compactors, scrapers, and blades.

   Prior to seedbed preparation, motor graders and farm tractors with drags can be used to level the final landfill surface. A variety of farm implements are available to further prepare the seedbed prior to planting. Landfill conditions and plant species will determine the best combination of implements.

   Many types of farm equipment can be used for revegetation operations. Among these are tractors, seed drills, planters, various types of tillage equipment (chisel plow and moldboard plow), and fertilizer spreaders.

   The most widely used combination of planting equipment for landfill operations in North Dakota is a farm tractor with a seed drill attached.

G. Equipment and Landfill Maintenance

Equipment maintenance and facility maintenance tasks must be performed. The specific tasks will depend on the landfill operation and available equipment. Performance of specialized or seasonal tasks may be best performed with rented equipment. Listed below are several pieces of equipment and tasks which can be performed with them:

1. Water pumps and pipe for water removal and transfer from ditches, ponds, and leachate systems

2. Generators and compressors to provide remote power supplies, power to pumps, and when regular power sources are unavailable

3. Service trucks to fuel, lube, and repair equipment

4. Backhoes for installation of underground piping, soil sample collection from test pits, small excavation jobs, and specialized tasks

5. Pickups for transport of employees

6. Four-wheelers

   Can be used for carrying small amounts of material great distances. One landfill has modified a four-wheeler for an operator to conduct litter control. The four-wheeler has a cage on the rear to collect litter. Attachments can also be used for farming operations (seeding, herbicide application, and fertilizer application).

III. Equipment Maintenance

All equipment requires preventive maintenance in order to maintain its good working condition and to ensure a longer life. Preventive maintenance allows more efficient and safer operation of the equipment and decreases cost of operation.

A. Factors Affecting Equipment Maintenance

The specific tasks of preventive maintenance vary with the equipment type. The equipment manufacturer will provide recommendations for the specific tasks and the frequency with which each task should be performed. The operator’s manual and equipment specifications will provide additional information regarding preventive maintenance.

Site conditions affect equipment maintenance and repairs. For example, dustier conditions require more frequent servicing of air cleaners. Increased fueling and lubrication will be necessary for equipment used constantly.

Repairs will occasionally be necessary. Those individuals responsible for maintenance and repairs should receive substantial training in their craft. The equipment operator’s experience can contribute to expedited repairs and improved maintenance.

The equipment operator is the first line of defense with equipment maintenance. The operator should conduct a walk-around inspection at the start and end of each shift and prior to getting on the equipment at any time during the shift. Walk-around inspections allow the operator to identify problems before they become more serious. For example, noting a slight engine oil leak could prevent engine damage.

Backup equipment must be available in the case that regularly scheduled equipment is unavailable due to maintenance or repairs. Some types of equipment have multiple applications, and thus secondary equipment may not be necessary. For example, if a scraper requires repairs and cover material must be transported less than 300 feet, an available loader can be utilized.

B. Equipment Features and Procedures to Minimize Maintenance and Repairs and Extend Equipment Life

1. Waste control

Equipment damage and personal injury may occur in the course of landfill operations. Items can become trapped or tangled under the equipment, around wheels, around hydraulic hoses, around dozer arms, and around or in other parts.

Striker bars can prevent material from climbing equipment wheels. Striker bars can be an integral part of the dozer arm on the front or part of the drawbar assembly on the rear of equipment.

Trash screens can be installed on top of blades to prevent trash from coming over the top of the blade and into hoses.

Radiator guards reduce the potential for waste to enter the radiator grill. Mud, dirt, ice, and waste can collect in tracks and prevent ease of track movement.

Compressed gas cylinders and aerosol cans may explode when crushed. Metal shards and chemicals from such an explosion can cause personal injury and equipment damage. Sealed and unknown containers should not be crushed.

Operators should pay special attention to sharp edges of solid waste which can damage tires, hoses, and other equipment parts. Special handling may be necessary to avoid equipment damage.

Cables and tires can become entangled in equipment. Extreme caution should be used when handling such items. Walk-around inspections should be performed after handling cables, tires, or any other potentially physically dangerous waste item.

2. Mud, ice, and snow control

   A shovel or spade should be kept with each piece of track equipment to allow the operator to regularly clean the tracks. Mud and other material which may collect in dozer tracks and around moving parts of equipment should be removed prior to it becoming a safety hazard, and it should always be removed at the end of each shift. Wet material can freeze and prevent the equipment from operating properly.

   The radiator, tracks, and pivot points should be inspected and cleaned at least once each shift.

3. Engine warm-up

   The engines of heavy equipment require several minutes to warm up before commencing operations. The engine and the hydraulic oil need to warm up for efficient operations. Hot starts or electric plug-ins should be used when equipment is parked for several hours during cold weather.

4. Fluid levels

   Fluid levels should be checked during walk-around inspections. Proper levels must be maintained and fluids drained on a regular schedule.

5. Safety devices

   a. Clean windows

      When windows are clean, the operator has better visibility to perform assigned tasks. Each operator is responsible for cleaning windows during and after each shift.

   b. Rollover protection

      Most items of heavy equipment are now manufactured with rollover protection (ROPS). Holes should never be drilled in ROPS.

   c. Seat belts

      Seat belts are essential to protecting an operator.

   d. Horns

      Horns can be used to warn people on the ground or other equipment operators. Horn signals also can be used to provide brief instructions.

e. Back-up warning devices

Back-up alarms should ALWAYS be in good working condition.

f. Lights

Lights provide better visibility. Sometimes lights can create shadows making an operation more dangerous. If work must be conducted in the dark, consider the use of a portable light plant.

g. Fire extinguishers

Each piece of equipment including pickup trucks should be equipped with at least one fire extinguisher. Operators should know the location of other fire extinguishers which may be located on permanent structures throughout the landfill.

Due to the wide variety of materials in landfills, an ABC fire extinguisher is probably the best choice. Dirt and water are also available in case of fire. See Part V "Fires" of this section for a further discussion of fire prevention.

h. First aid kits

Operators should know the location of all first aid kits. When first aid items are used, the items should be replaced immediately. Periodic inspections should be conducted for missing items or missing kits.

i. Grab bars and foot holds

Grab bars and footholds are to be used — not jumped over. Grease, oil, and loose objects on or about grab bars and footholds should be removed prior to getting on and off equipment.

j. Personal protective equipment (PPE)

Steel toe and steel shank boots, hard hats, safety vests, gloves, respirators, protective clothing appropriate to the chemical or physical hazards, sunglasses, warm clothes, and long-sleeved shirts and pants are just a few of the many items which can be used by landfill employees to provide protection from landfill hazards. PPE provides safety only if it is used.

6. Safe operation procedures

Never get on or off a moving machine.

Blades and buckets should be operated at a low level to allow the operator better visibility and a lower center of gravity.

Place the transmission in neutral when dismounting equipment, and engage the transmission lock. Equipment should be parked on level ground with all attachments lowered each time the operator disembarks from the equipment. When parking wheeled equipment, set the park brake. Park all equipment perpendicular to slope when possible.

Unattended equipment should not be kept running.

While pushing piles, observe and control objects to prevent their falling into other equipment, people, and structures.

Do not work on a side slope unless it is safe to do so. Work should be performed up and down slopes as much as possible. DO NOT TEST THE LIMITS OF THE MACHINE.

Do not speed and never take equipment out of gear during its operation. Heavy equipment was not designed to travel at high speeds.

Material piles should not be moved unless the area has been checked to be sure no one is behind the pile and no one can be injured by its movement.

Move slowly over bulky objects to prevent tipping the equipment. Approach bulky items at an angle whenever possible.

7. Out-of-service equipment

   DO NOT START OR OPERATE DEFECTIVE EQUIPMENT.

   Observe policies regarding down tags.

   Out-of-service equipment should be parked away from high-traffic areas.

IV. Equipment Records

A critical factor in the equipment purchase/utilization equation is equipment experience. Equipment records (inspection, maintenance, cost, downtime, etc.) can substantially contribute to better equipment selection. The time to start keeping equipment records is now – not when the equipment purchase is imminent.

Periodic review of records can help a landfill operator to identify trends, monitor costs, and evaluate the effectiveness of landfill operating procedures.

A. Safety and Task Training of Each Worker

Examples of training include task training and regular safety meetings (weekly or daily). Procedures for safe operation of equipment and safe work practices should be discussed during safety meetings. At a minimum, instruction should include walk-around inspections, proper operation in a variety of situations, emergency procedures, and basic preventive maintenance. Operators should know their own limitations, as well as the limitations of each piece of equipment.

B. Vehicle and Equipment Inspection Reports

These provide a record of equipment status. A historical record of minor equipment damage or missing parts contributes to employee accountability and better equipment maintenance, both of which contribute to safety.

C. Equipment Repair Reports

These offer a history of work performed on equipment and parts changed. This information contributes to knowledge of equipment status and continued safe operation of equipment.

D. Preventive Maintenance

Regular and periodic maintenance such as oil changes, tire rotations, and cutting edges should be scheduled and monitored. Excessive or unusual wear can be better identified when records are maintained. Records allow equipment to be maintained more efficiently and in a safer condition.

E. Accident Reports: Equipment and Personal

Accident reports for personnel offer a historical perspective of the time of day, work time elapsed, location, employee's position, equipment operated, and type of incident. Near-misses should also be recorded since they indicate the increased possibility of an accident.

When good records are maintained, a review can reveal the potential sources of the accident causes. One might discover that accidents are occurring on the second day of the work week or that new hires are more prone to accidents. If one can identify the causes, one can take precautions to minimize and prevent future accidents.

WASTE MANAGEMENT

I. Confinement, Compaction, and Cover

Confinement, compaction, and cover are referred to as the three C's of landfill management. Efficient landfill operations strive to achieve optimum levels of the three

C's in order to maximize landfill space, cost, effort, equipment, and time. Additionally, the three C's also contribute to a safer working area for employees and patrons. Environmental objectives are also more easily attained with the adherence to confinement, compaction, and cover.

A. Waste Confinement

The working face of an operation should be as small as possible. The area should be large enough to safely and efficiently accommodate equipment and vehicles.

Smaller working faces provide the following advantages:

- Decrease litter due to smaller exposed surface area
- Discourage scavenging by people, birds, and animals
- Increase compaction efficiency
- Require less cover material

B. Compaction

Compaction efficiency is based on:

- Equipment configuration
- Equipment and waste weight
- Equipment capability
- Operational technique
- Waste composition

Benefits of increased compaction include:

- Extended landfill life
- Lower permeability of fill
- Surface water runoff promotion
- Reduced potential for groundwater pollution
- Reduced landfill settling and thus long-term maintenance of landfill

▶ Less cover since less soil sifts vertically through waste

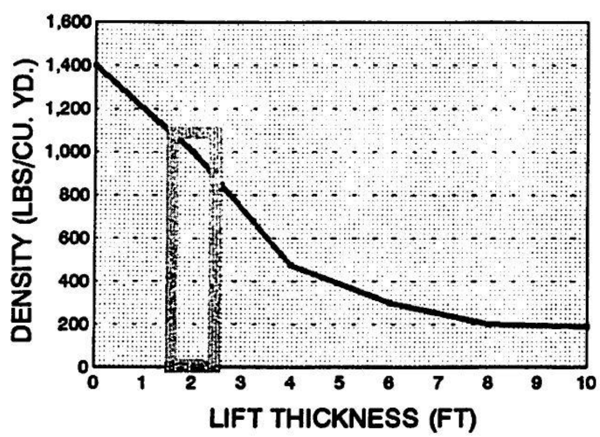
▶ Reduced potential for fires by reducing air (and thus oxygen)

▶ More cost-effective operations

Since the municipal solid waste stream is comprised of a wide variety of materials, the density and shapes of the materials are not homogeneous. Items such as cardboard, plastic, cans, and brush can be crushed with little pressure. These waste types can be cushioned and bridged by other waste which can prevent them from being easily crushed. Control of layer thickness can minimize the impact that homogeneous waste has on compaction.

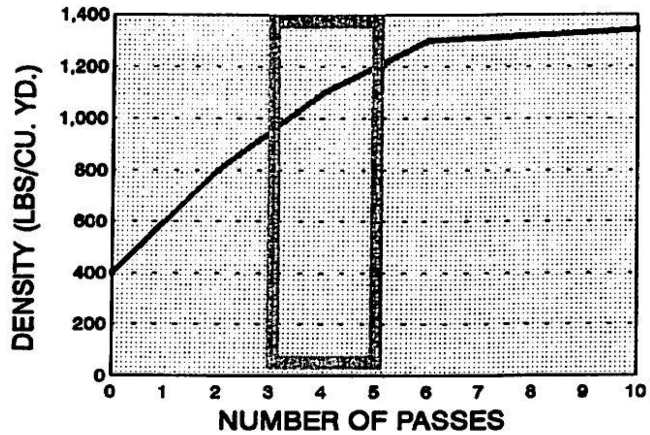
Waste should be compacted in layers less than 2 feet thick. Exhibit 7-6 illustrates how density can be increased and equipment efficiency can be maintained by having a lift thickness of 2 feet or less.

Exhibit 7-6
Lift Thickness vs. Waste Density



Density of waste can be increased by running equipment over it three to five times. Exhibit 7-7 illustrates the appropriate number of passes to achieve optimum density.

Exhibit 7-7
Number of Passes vs. Waste Density

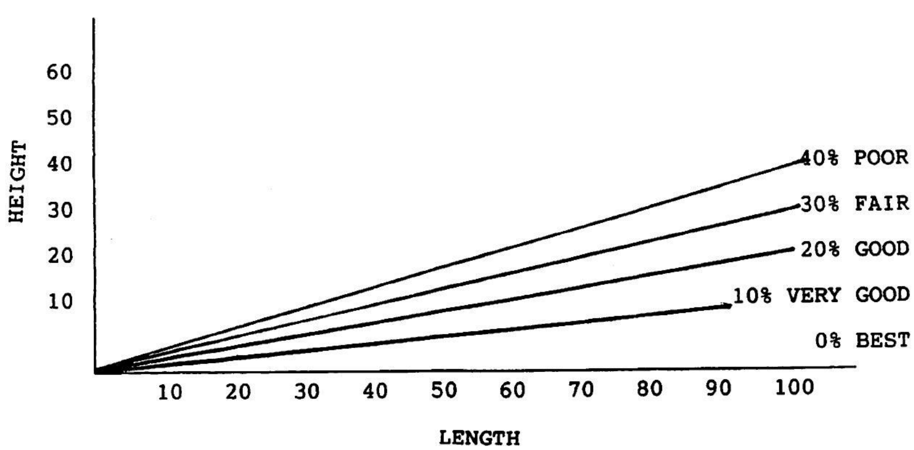


The slope on which equipment is operated should be based on the manufacturer's recommendations for operational efficiency. For example, track dozers work best on slopes of about 20 percent. Most landfills now utilize compactors to achieve waste compaction. Compactors are designed to operate on relatively level ground. Better compaction due to weight distribution and improved chopping/kneading action by grousers, cleats, or lugs improves the operator's vision, comfort, and safety.

Waste should be deposited at the bottom of the slope and compacted up the slope. Spreading waste up rather than down a slope results in better waste control. In some cases, working up a slope may not be the safest method of operation due to bulky items or unstable working surfaces. Good judgment should be exercised when determining the slope direction for waste compaction.

Exhibit 7-8 depicts how the slope affects compaction.

Exhibit 7-8
Slope vs. Compaction



C. Cover

Cover must be placed on all solid waste by the end of each working day.

Daily cover must be a uniform, compacted layer of at least 6 inches of suitable earthen material. Some landfills may have little topsoil and suitable daily cover. Compost can be used as a suitable daily cover instead of soil as the top layer of final cover for vegetative growth. Landfills may consider developing a compost facility in order to generate compost for cover purposes.

Cover must be free of trash, garbage, or other similar waste.

Where final cover or additional solid waste will not be placed within one month, an additional 6 inches or more of compacted, clay-rich earthen material shall be placed. This intermediate cover may be removed when disposal operations resume.

II. Traffic Control

Landfill access must be controlled to protect equipment and facilities from vandalism and to protect the public from personal injury and personal property damage.

Access to the facility must be controlled by locking gates and a combination of fencing, and natural or artificial barriers. The gates must be locked when an attendant is not on duty.

Traffic routes will be changed to accommodate operations. Roads, walkways, and traffic direction must provide safe and efficient traffic control. Since many people may be somewhat unfamiliar with landfill operations, traffic control must be designed to enable people to find their way easily. Signs and barriers can contribute to safer traffic flow. Roads must be constructed of material to serve the intended purpose.

III. Weather

A. Wet conditions

During wet conditions, equipment is more difficult to control. Slipping and falling hazards increase. Soils which are high in clay content often become more slippery during wet weather.

Rain can reduce visibility which creates hazards for landfill employees and patrons.

Depressions can develop in areas which are not regularly or properly graded. Water, snow, and ice can collect in depressions.

Wet-weather hazards can be reduced by implementing the following procedures:

- Provide all-weather roads where practical.

- Construction of dirt and gravel roads should allow good drainage by crowning surfaces and installing diversion ditches and culverts.

- Remove water from trenches, diversion structures, and depressional areas as quickly as possible. Use pumps or drains to expedite water removal from these areas.

- Utilize disposal areas which are drier or closer to landfill entry points during periods of wet conditions.

B. Winter

Extremely cold temperatures, temperature variations, frost, snow, and ice present hazards to landfill operations, employees, the public, and equipment.

Topsoil and cover piles can freeze and become unworkable. Stockpiles can be insulated with leaves, straw, hay, or sawdust to reduce freezing. Calcium chloride ($CaCl_2$) can be placed on top of stockpiles to prevent freezing. Coarse, dry cover material should be saved for winter use. Use rippers on heavy equipment to loosen frozen ground. Eliminate or reduce traffic on stockpiles to maintain a looser consistency.

Blowing snow presents visibility and physical hazards to landfill staff, the public, and general operations. Snow drifts prevent access, and snow can fill trenches and diversion ditches thus preventing flow of water and reducing the structures' abilities to catch snow. Trenches and ditches should be cleaned as soon as practical. The installation of snow fences reduces blowing snow. Operations can be conducted at a direction to minimize the impact from blowing snow. In extreme situations, landfill operations should be closed.

During periods of cold temperatures, equipment, especially diesel powered, may be difficult or impossible to start. Oils and greases in equipment are circulated with greater difficulty. Equipment can be plugged into hot starts or stored in heated buildings to prevent problems with starting and operating heavy equipment. Additives can be used with diesel fuel during periods of low temperatures.

Landfill staff should utilize warmer clothing during cold periods. Breaks should be scheduled to allow workers to increase body temperature.

C. Sun and Heat

Glaring sun presents visibility hazards for landfill employees and for patrons. Sun visors, tinted windows, and sunglasses should be used when necessary. Landfill staff should be aware that patrons may experience difficulty when driving into the sun or into areas where glare is a problem.

Heat presents problems for equipment operation and landfill staff. Proper levels of fluids should be maintained to reduce the possibility of equipment overheating. Direction of operation can to some degree minimize overheating. Radiators should be cleaned to remove dirt and waste which can prevent adequate cooling. Air-conditioned equipment allows staff to continue working without undue stress. Staff should drink adequate amounts of fluid to minimize the potential for heat stress. Breaks should be scheduled to allow workers to reduce body temperature.

IV. Nuisance Control

A. Vector Control

Frequent and adequate placement of cover removes vectors' food, shelter, and breeding areas. Sandy cover material inhibits burrowing. Ponded water, which serves as breeding grounds for insects and water sources for all vectors, should be eliminated. Landfill employees should be able to identify the Norway rat, which is a primary disease carrier. Professional exterminators must be engaged to eliminate rat populations, since rats can move from landfills to other habitats.

B. Dust/Odor Control

Blowing dust presents safety and health problems for landfill staff, patrons, and surrounding occupied areas. Earthmoving operations by nature result in dust. Waste deposition and compaction activities can also result in dust. It can damage equipment by plugging air and fuel filters. Blowing dust can reduce visibility and thus lead to accidents. Schedule earthmoving activities to coincide with periods of less dust.

Operations can be relocated to reduce the impact of dust on adjacent areas during dry or windy periods. Filled areas of the landfill should be reclaimed promptly to minimize exposed areas.

Traffic on dirt and gravel roads contributes to dust. All-weather roads should be built where practical. Magnesium chloride or calcium chloride can be placed on dirt and gravel roads in the summer to prevent dust from being generated. Magnesium chloride and calcium chloride are hygroscopic and thus attract water. Roads with these chemical applications do not generate as much dust. The effectiveness of the application is reduced after periods of high rainfall, repeated bladings, and time.

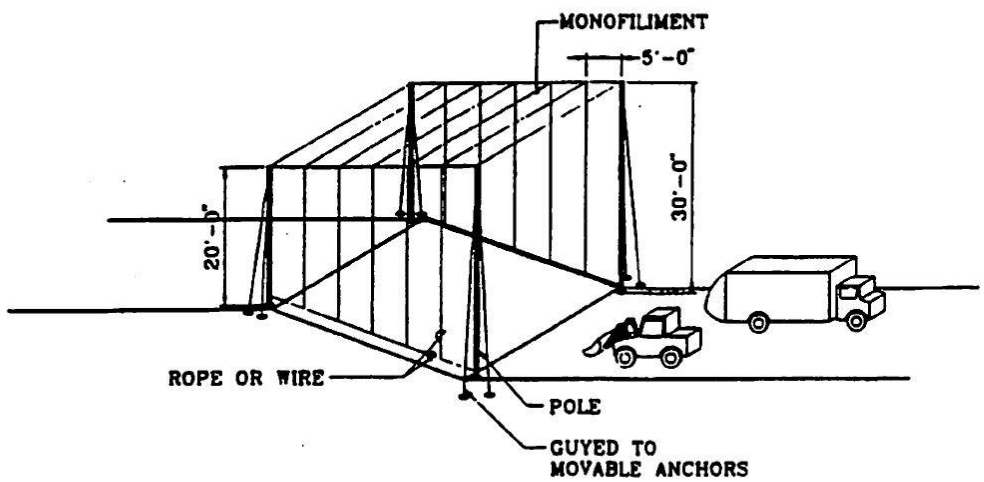
Water applications to roads and other operational areas minimize dust. Too much water can result in slick roads.

Use vegetative covers (grasses and windbreaks) to reduce the potential of blowing dust.

Odors in landfills can be generated from waste decomposition gas, landfill leachate, putrescible waste, sludges, and dead animals. Buffer areas should be installed to reduce the number of people off site who are affected by odors. Cover applications reduce odors. Particularly odoriferous waste can be located in segregated cells. Landfill gases should be vented or collected. Leachate odors can be controlled by reducing the potential for leachate to be generated or by collecting and managing leachate.

C. Bird Control

Birds can be not only a nuisance but also pose safety hazards around landfills. Birds should be controlled by any method which is legal and cost-effective. Unfortunately, there are few methods that meet both requirements. One type of bird control device, which has had some success, is illustrated in the following diagram:



D. Noise Control

Landfill equipment and patron traffic result in noise levels which may be unacceptable or undesirable for the surrounding area. Landfills should be designed with buffer areas, in other words, areas between active portions of the landfill and adjacent property where no noisy activities occur.

Operations with higher noise levels should be scheduled at times when they will not unduly disturb surrounding neighbors. The loudest operations should not be conducted during the early morning, late evening, and weekends.

New equipment is designed to reduce noise to both the operator and the surrounding area. Equipment maintenance should allow noise reduction features to work properly.

Landfill staff should work upwind from noise whenever possible. Ear plugs and ear muffs must be available and utilized by employees. All ear protection has an assigned noise reduction rating (NRR), which is the number of decibels to which the user will be protected. Ear plugs and ear muffs can be used in combination to provide additional hearing protection. For example, if one is exposed to 75 decibels, ear plugs with an NRR of 20 will result in the user receiving 55 decibels.

Noise level in dB - NRR in dB = noise received
[75 dB - 20 dB = 55 dB]

E. Litter control

Trenches and area fills should be designed with consideration of the wind direction to minimize blowing litter and reduce the distance which it may travel.

Operations should be conducted to expedite unloading of waste. This means that the waste has the potential to blow during a shorter period of time.

The working area should be in as small of an area as possible with waste deposited at the bottom of the slope and pushed up the slope.

Covered loads can be required. Signs stating this should be posted.

Windbreaks composed of shrubs or trees can be planted to collect blowing litter and prevent its migration off site. Permanent fences and portable litter catch screens can be installed to catch blowing litter. Special procedures should be developed for operating during periods of high wind and other severe weather. Some landfills close when the wind speed reaches a predetermined speed. Notices can be posted on major roads accessing the landfill or broadcast over local radio stations. When people are aware of the potential for severe weather, they will anticipate landfill closure.

In some landfills, work areas can be relocated to areas where blowing litter has less impact.

V. Waste Management

A. Burning

Burning at municipal solid waste landfills is allowed only with a special department permit. The regulations for open burning are described in NDAC Chapter 33.1-15-04, Open Burning Restrictions. The most likely material to be considered for burning by municipal solid waste landfills is wood waste from construction/demolition or from tree clearing or trimming. An application for an open burning variance follows as Exhibit 7-9:

INSERT

SFN 3473
APPLICATION FOR OPEN BURNING VARIANCE OF CLEAN WOOD AT LANDFILLS

IDENTIFY AS 'EXHIBIT 7-9'

INCORPORATE CORRECT PAGINATION

B. Infectious Waste

Infectious waste cannot be disposed at landfills until it has been rendered noninfectious. Sharps must be rendered nonsharp. Bodily fluids must be incinerated prior to disposal. The largest infectious waste generators will be veterinarians, dentists, medical clinics, hospitals, and convalescent care facilities. These organizations, for the most part, are aware of their responsibilities for preparing infectious waste prior to disposal. Solid waste collection and landfill operations should know which of their patrons fall into these categories and thus can better discuss concerns with them.

To a lesser degree, businesses and industries may generate some infectious waste as a result of first aid and medical care which may be provided at work. Some households will also generate some infectious waste from home health care such as provided to diabetics or home-bound patients. These potential generators present greater concerns to solid waste collection and landfill workers. Although businesses and industries are becoming increasingly aware of their disposal responsibilities, workers can still be unknowingly exposed to sharps and infectious body fluids from households.

C. Dead Animals

Many landfills designate cells specifically for disposal of animal carcasses.

Household pet animal carcasses may be buried along with municipal household waste.

Larger animal carcasses should be disposed of immediately and should be placed at least 4 feet below grade with at least 12 inches of cover material directly covering the carcasses.

Landfill operators should inquire as to the cause of death for animals to ensure that landfill staff are protected from communicable diseases. Landfill employees should handle animal carcasses only with equipment and not by hand to prevent contact with pathogens.

D. Asbestos

Asbestos-containing material is accepted by some municipal solid waste landfills. Below are some management procedures for asbestos-containing material:

- Asbestos waste must be placed in leak-tight containers.
- Container labels must indicate asbestos hazard warning, name of generator, and location of generation.
- Disposal during high winds should be avoided.
- Disposal should not occur in standing water or during excessive precipitation.

- Disturbance of containers must be minimized to prevent container damage.

- Material must be covered with non-asbestos-containing material within 24 hours.

- Material must be routinely inspected by landfill operator.

E. White Goods and Junk Cars

Private firms collect white goods (appliances) and junk cars from several landfills. Interviews with several landfills revealed that some presently have white goods and/or junk cars collected or are in the process of enlisting collection firms. Others have used their services in the past, but either the landfill or the private firm chose not to continue the service.

Due in part to the market (i.e., volume of white goods or junk cars available, transportation costs, and end market value), the status of collection changes frequently. The most economical approach is for a collection firm to have several landfills on a route to reduce transportation costs. Some firms presently employ this type of scheduling.

F. Soil, Asphalt, and Concrete

Asphalt and concrete from demolition operations contribute a relatively small amount to North Dakota's landfills. Occasionally, the material can be reused as cover or on landfill roads. Other entities may be able to utilize the material in road construction projects.

Separate cells or areas can be created to segregate these materials when brought in large quantities. Operations which can utilize these types of materials (asphalt recycling or fill material) can benefit from this type of segregation. Quality control and effective management of the waste are prime concerns and require additional personnel, equipment, money, and time.

G. Petroleum-contaminated Soil

Some municipal solid waste landfills are permitted to accept petroleum-contaminated soils. Exhibit 7-10 lists land treatment for petroleum-contaminated soil from underground storage tank sites, contains recommendations for sampling soils during the treatment process, and includes a brief reporting form for monitoring results of this type of soil.

Land treatment of petroleum-contaminated soils includes:

- Nearly level to gently sloping area where soil can remain undisturbed and not in the flow of traffic

- Surface water controls for run-on and runoff

- Tilled to a depth of 6 inches and nutrients added as necessary

- A minimum of a 45-day residence time with soil tilled at least every two weeks until cleanup objective of 10 ppm total petroleum hydrocarbons (or other department standard) is met

- Treated soil used as daily cover

H. Tires

Although North Dakotans probably generate waste tires at a rate similar to that of other states, there is a relatively small volume of waste tires generated. The distances (between communities and from points of generation to markets) and low volumes result in few opportunities for tire utilization.

Road construction operations throughout the United States are performing pilot projects which incorporate tires into asphalt mix. These mixes can also be used for running and walking paths and are often more resilient than asphalt or concrete. Crack seal with crumb rubber from reprocessed used tires is another use for tires.

Some landfills are shredding tires prior to landfilling in order to reduce required space. Whole tires, especially when placed with other waste streams, eventually rise back to the landfill surface. Tires also present problems with becoming entangled in heavy equipment. The problems associated with landfilling tires has resulted in several landfills shredding tires prior to landfilling. Some states have instituted a deposit or tax on purchased tires in order to subsidize tire utilization operations.

Facilities which have tire piles in place prior to landfilling or off-site transport must adhere to the following:

- Tire piles can be comprised of no more than 1300 tires.

- Access to pile must be controlled by fencing.

- The size of the pile must be limited to a maximum basal area of 10,000 ft^2 and a height of 20 feet.

- A fire lane of 50 feet must be in place around the tire pile.

- Fire control equipment must be available for access to the pile.

- Run-on and runoff control systems for control of surface water from a 25-year, 24-hour precipitation event must be in place.

- If the total accumulation of tires in the pile exceeds a basal area of 10,000 ft^2, the installation of liners, groundwater monitoring systems, leachate collection systems, financial assurance, and other environmental controls may be required by the department.

I. Glass

Some landfills accept glass for recycling. Recycled glass can be used to make new glass containers. Recycled crushed glass is also used in highway strips (yellow and white line markers) to provide better reflection. Some asphalt plants can utilize crushed glass as a component of asphalt to make it more durable.

J. Plastic

Plastics are very difficult to recycle even in urban areas of the East and West Coasts and the Midwest. Plastics have a large volume to weight ratio. Plastic containers must be mechanically compacted in order for a truckload to have sufficient weight to pay for the transportation. Market value is a problem with this recyclable material.

Several firms in the United States are manufacturing plastic car stops, posts, park benches, and outdoor tables from waste plastics. These products generally last longer than their wooden counterparts, and spray paint vandalism can easily be removed. Plastic car stops are a less expensive alternative than concrete since their weight makes them easier to install.

K. Compost

Materials such as grass clippings and leaves can be composted in properly managed systems. Other organic materials may be added to some compost piles, but the operator must be familiar with the limitations of the compost system.

Compost piles require some special management.

- Direct surface water or storm water away from composting and waste storage.
- Control surface water drainage to prevent leachate runoff.
- Store solid waste separated from compostable material in a manner that controls vectors and allows for aesthetic degradation. Remove this solid waste from the site to an appropriate facility at least weekly.
- Turn the yard waste periodically to aerate the waste, maintain temperatures, and control odors.

- Prevent the occurrence of sharp objects greater than 1 inch in finished compost offered for use.

North Dakota residents probably generate less yard waste than residents of other states with more precipitation and longer growing seasons. However, yard waste also offers an excellent opportunity to reduce waste volume and create compost piles.

Illinois was the first state to pass legislation preventing yard waste from entering landfills. This law went into effect in 1990 and required the permitting of composting facilities. Illinois' initial experience was that substantially less yard waste was entering landfills.

Increased cost for disposal appeared to serve as the impetus for a decrease in yard waste generation in Illinois. In many cases, grass clippings are not removed from the yard but left in place. This keeps the nutrients in the yard, and the yard requires less fertilizer. Many people started compost piles in their own yards. In addition to composting facilities being permitted, individual farmers are allowed to accept yard waste for use on their fields.

Composting operations for yard waste and animal manure can be successful, but experienced staff must control disposal and manage the system properly. Potential use of composted material should be investigated prior to creating a compost pile. Markets and distribution systems must be studied and established.

L. Used Oil

Used oil can be accepted for intermediate storage at municipal solid waste landfills. The collection tank should be located for easy access by both the public and the oil transporter.

Signs should be posted explaining which type(s) of oil are acceptable.

A funnel will enable the public to more easily transfer oil into the tank and prevent spills which require cleanup. A rain cap on the funnel should be used to prevent rain, snow, and dirt from entering the tank. Water and dirt can increase the amount of material in the tank and increase the option of contaminants in the oil.

The landfill operator should consider retaining collection records from the used oil collection service to provide written documentation of the destination and use of the used oil.

Exhibit 7-10
(Nine pages)

GUIDELINE 7 VARIANCE FOR LAND TREATMENT OF REFINED PETROLEUM CONTAMINATED SOIL: SINGLE APPLICATION SITES

North Dakota Department of Environmental Quality - Division of Waste Management
918 E. Divide Ave., 3rd Fl., Bismarck, ND 58501-1947
Telephone: 701-328-5166 • Fax: 701-328-5200 • Website: https://deq.nd.gov/wm
Revised: 12-2019

I. Introduction

The North Dakota Department of Environmental Quality (department) requires that excavated refined (gasoline and diesel) petroleum contaminated soil from underground tank cleanups and spill remediation be treated or disposed properly at facilities permitted or approved by the department. A list of permitted treatment and disposal facilities is on the department's website (see Links).

The department will consider one-time variances for treatment at other sites if the **waste generator** can document that management at a permitted facility is not practicable as prescribed in the North Dakota Administrative Code:

> **33.1-20-01.1-14. Variances.** Whereupon written application the department finds that by reason of exceptional circumstances strict conformity with any provisions of this article would cause undue hardship or would be unreasonable, impractical, or not feasible under the circumstances, the department may permit a variance from this article upon such conditions and within such time limitations as it may prescribe.

Variances will not be approved for crude oil impacted soils, oil-based drilling cuttings or other wastes that do not readily break down due to the wider variety of hydrocarbon molecules (asphaltenes, paraffins, etc.) and/or waste containing contaminants such as salt, metals, or other contaminants.

Residual amounts of refined hydrocarbons (gasoline and diesel) may be broken down by aerobic bacteria common to good surface soils (and compost operations). Land treatment of wastes can be effective when approached scientifically, using naturally occurring soil microorganisms to biodegrade petroleum. Some volatilization of petroleum hydrocarbons will also occur during the process.

This document provides information on suitable site and soil characteristics, land application procedures, soil sampling procedures, and the department's approval requirements for applicants proposing a single application of petroleum contaminated soil. Applicants must also obtain approval by local zoning officials. On a case-by-case basis, the department may allow single applications on two or three discrete areas of a single application site; however, appropriate documentation must be provided as outlined herein. Repeated or routine applications of petroleum contaminated soil must meet the permit requirements of Article 33.1-20 of the North Dakota Administrative Code.

Form SFN-51601 entitled "Land Treatment Variance Application" must be completed and submitted by the **Waste Generator** to the department for approval prior to any land application.

II. Background Information

The minimum information which should be provided to the department with the application includes:

A. Land treatment site location description and site location map.

B. Landowner's name, address, telephone number, and approval.

C. Documentation of approval or notification (providing a reasonable time for response) of the appropriate local officials (county, city, or township).

D. Topographic and soil survey maps with the proposed land treatment site outlined and a map scale presented.

E. Estimated volume of soil to be land treated.

F. Projected date of soil application.

G. Site and soil characteristics (see below).

H. Proposed land application procedures (see below).

I. Proposed sampling, tillage, and reporting schedule (see below).

J. Any previous history of waste disposal activities at the proposed site.

III. Site and Soil Characteristics

Published soil survey information (available through local Natural Resources Conservation Service offices or online) provides an excellent reference for site slope, depth to ground water, and soil type for most locations in North Dakota. If specific soil information is not available or if more detailed soil information is required, a Professional Soil Classifier can be utilized to determine site-specific soil conditions. Soil borings or trenching, and/or a hydrogeologic evaluation, may be required to evaluate the proposed land application site. The recommended site and soil characteristics for a land treatment site are as follows:

A. Site slope: 6 percent maximum.

B. Minimum distance to surface water, drainage ways, etc.: 200 feet.

C. Minimum distance to residences or buildings: site-specific, but in general, 200 feet.

D. Minimum depth of three feet to seasonal high water table for most soils.

E. Soil characteristics:

   1. Permeability: slow to moderate, less than two inches per hour. Areas underlain by highly permeable (sandy) soils, very slowly permeable soils, or sodium affected soils should be avoided.

   2. pH: minimum pH of 6.5, neutral or slightly alkaline preferred.

   3. Nutrients: soils with moderate to high levels of fertility and organic matter are preferred.

Generally cropland areas are preferred for land treatment. The department may make exceptions to the recommended criteria on a site-specific basis. Environmentally sensitive areas such as flood plains, wetlands, ravines, gravel pits, or high water tables must be avoided. Areas with highly permeable soils or areas that are excessively steep should not be considered for land treatment sites.

Adequate soil nitrogen and phosphorus levels are critical for bacterial growth and effective land treatment of contaminated soil. Soil nitrogen and phosphorus tests are recommended to determine if minimum fertility levels exist at the land treatment site, and if fertilizer application is necessary. See Part IV.B for details on soil fertility sampling and testing. The amount of soil nitrogen necessary for effective land treatment is based on a ratio of parts per million (ppm) total petroleum hydrocarbons (C) to ppm nitrogen (N). The department considers a C:N ratio of 100:2 acceptable. Adequate extractable soil phosphorus levels are also required for effective land treatment.

Recommended land treatment site fertility levels are listed in the following table. The table illustrates what fertility levels are required to maintain a C:N ratio of 100:2 at specific total hydrocarbon concentrations. Using results from soil fertility testing, one can determine if fertilizer should be added to the treatment site. For example, assume soil contaminated with 2000 ppm total hydrocarbons is land treated. If soil fertility tests indicate the six-inch surface layer contains 40 pounds per acre nitrogen, an additional 40 pounds per acre nitrogen should be added to the treatment site. Extractable soil phosphorus levels should be maintained in the 20 to 30-pound per acre range.

Soil Contaminant Concentration	**Fertility Requirements (Pounds Per Acre)**	
	Nitrate-Nitrogen	**Extractable**
	Phosphorus	
1000 ppm Total Hydrocarbons	40	20-30
1500 ppm Total Hydrocarbons	60	20-30
2000 ppm Total Hydrocarbons	80	20-30
2500 ppm Total Hydrocarbons	100	20-30
3000 ppm Total Hydrocarbons (or greater)	120	20-30

NOTE: Fertility levels assume four-inch soil application thickness. Maintain proportionally lower fertility levels for thinner soil application. Fertility levels should not exceed 120 pounds per acre nitrate-nitrogen or 30 pounds per acre extractable phosphorus.

IV. Land Application Procedures

Recommended procedures for land application are described below. The department will consider exceptions on a site-specific basis.

A. Contaminated soil should be applied only when the land is tillable, but no earlier than April 1 and no later than November 1. If contaminated soil is to be stockpiled, it should be in an area where surface water run-on and runoff are controlled.

B. Surface water run-on and runoff should be diverted or contained around storage and treatment areas. Ditches and berms up slope of the site should divert surface water run-on around and away from the treatment area. Surface water runoff must not cause degradation of any streams, rivers, wetlands, lakes, etc. Berms, ditches, or impoundments down slope of the site may be needed to contain and store any contaminated runoff during precipitation events.

C. Contaminated soil should not be applied more than four inches thick. Thinner applications may be required on a site-specific basis. Soil application rates for specific application thicknesses are as follows:

1. 530 cubic yards/acre at 4-inch spreading thickness
2. 400 cubic yards/acre at 3-inch spreading thickness
3. 270 cubic yards/acre at 2-inch spreading thickness
4. 135 cubic yards/acre at 1-inch spreading thickness

(1 cubic yard = 27 cubic feet, 1 acre = 43,560 sq. ft.)

The petroleum loading rate should not exceed 2 percent or 20,000 parts per million (ppm) total petroleum hydrocarbons as fuel oil or gasoline in the soil to be land applied. This corresponds to approximately 67 barrels (2800 gallons) per acre for soil applied four inches thick and contaminated with relatively heavy oil.

D. Contaminated soil application method (spreader, dozer, grader, etc.) should be specified.

E. Land applied soil should be incorporated (mixed) with the upper four to six inches of native soil within 48 hours after application. Fertilizers should be broadcast either just before or just after contaminated soil application, but prior to contaminated soil incorporation. Fertilizer should be added as necessary to maintain an optimum C:N ratio of 100:2 and extractable phosphorus levels of 20-30 pounds per acre. Addition of compost, manure, straw etc. is helpful.

F. To enhance hydrocarbon breakdown, the soil should be tilled at least four times during the land application season. Less frequent tillage may not provide adequate aeration and mixing and, therefore, may slow hydrocarbon breakdown. More frequent tillage could be done if soil moisture is adequate, soil compaction is not a problem, and wind erosion can be controlled.

For fields where petroleum contaminated soil is land applied prior to July 1, tillage may not be needed in subsequent years. However, soil monitoring should continue until contamination is below levels, as outlined in Part IV.C. For land applications after July 1, a minimum of four tillage operations are necessary (excluding the period from November 1 to April 1), unless soil monitoring results are below the acceptable levels (Part IV.C).

G. Depending on site conditions, climatic conditions, and other factors, measures to control soil moisture and wind erosion as well as to improve the soil bacterial culture may be necessary. If the soils are excessively dry, addition of moisture to the site may be necessary (ponded surface runoff water could be used). Optimum soil moisture content is 50-70 percent of the soil water holding capacity. More frequent tillage or site drainage may be necessary if the site is wet. The incorporation of grass or legume hay is advised to help control wind erosion and improve soil aeration. If the soil is deficient in organic matter and/or oil-degrading soil bacteria, the addition of inoculants, rotted manure, mature compost, or topsoil is advised.

V. Soil Sampling Requirements

A. Contaminated stockpiled soil: Soil samples are necessary to evaluate and document contamination levels in the soil to be treated. Obtain a composite soil sample by digging a minimum of one foot into the pile at least three places within the pile before collecting subsamples. To avoid cross-contamination, subsamples should be taken using clean disposable gloves (and other clean sampling utensils) at each sample location (refer to NDDH “Procedures for the Collection of Soil Samples at Underground Storage Tank (UST) Sites”). Mix equal portions of each subsample to obtain a composite sample. Completely fill each sample vial so that no headspace exists, wipe soil from the vial threads, and seal the vial using a cap with a Teflon septum. Label the vial, wrap it in aluminum foil, and place it in a covered cooler with ice for transport to a laboratory for analysis.

B. The number of soil samples should be based on the following table:

Volume of Soil (cubic yards)	**Number of Samples**
<10	0
10-50	1
50-500	2
500-1000	3
1000-2000	4
2000-4000	5
Each additional 2000	One additional sample

Soil samples should be analyzed for total petroleum hydrocarbons as fuel oil or gasoline, lead (for leaded gasoline or any lead-bearing petroleum hydrocarbon, required once per sample prior to application) and pH. Other analysis such as benzene, ethylbenzene, toluene, and xylenes may be necessary depending on site conditions or depending upon the product involved.

C. Land application site soil fertility level determination: A composite of several representative soil samples from the top six inches of native soil should be collected to evaluate fertility status of the proposed land application site. The composite sample should be handled and prepared for analysis in accordance with the procedures recommended by the soil testing laboratory to be used.

Soil fertility samples should be analyzed for nitrate-nitrogen, extractable phosphorus, and pH according to methods accepted by the North Dakota State University Soil Testing Laboratory (telephone 701.231.8942). Nitrate-nitrogen levels are generally reported in pounds per acre, whereas extractable phosphorus levels are generally reported in ppm. To convert pounds per acre to ppm, divide by two. Conversely, to convert ppm to pounds per acre, multiply by two. For example, 80 pounds per acre nitrate-nitrogen equals 40 ppm, and 10 ppm extractable phosphorus equals 20 pounds per acre.

C. Follow-up monitoring: Follow-up monitoring is recommended to assess and document hydrocarbon breakdown. Soil samples should be taken from a depth of four to six inches in the land treatment area (using the sampling methods discussed in Part IV.A above). The number of samples to be taken at each sampling interval should follow the table in Part IV.A and should adequately represent the entire land treatment area. Samples need only be analyzed for total petroleum hydrocarbons; however, the department may require sampling for additional constituents under some circumstances.

During the year of land application, samples should be taken at the times specified below until soil analytical results indicate 10 ppm total petroleum hydrocarbons or less.

Land Application Date	Soil Sampling in First Year
Before July 1	Once in August & once in October
July 1 to September 15	Once in October
After September 15	None

Sampling in subsequent treatment years should include three samples taken approximately in June, August, and October, unless results indicate 10 ppm total petroleum hydrocarbons or less.

Refer to Form SFN-50336 "Soil Monitoring Results for Land Treated Petroleum Contaminated Soil" for reporting results.

VI. Land Use and Zoning

This guideline is written to help facilitate approval by the landowner and local zoning and health officials. The variance notification form requires information from the landowner and local officials. Careful planning and compliance with state rules helps to assure local authorities and citizens that the waste will be properly managed. Coordination with local emergency managers, county agents, and/or local health districts may suffice for local zoning approval under emergency conditions, contingent upon concurrence by local (county) planning personnel.

VII. Submittal and Approval Process

Applications must be initiated and completed by the waste generator (tank owner). Contractors proposing a variance simply to save money or to win a bid are not considered an "Exceptional Circumstance" (see NDAC 33.1-20-01.1-14). The form SFN-51601 "Land Treatment Variance Application" should be completed and submitted with the maps and information to the department. Arrangements should be made with the department for a site inspection. The site inspection will be done by either department staff, by an individual authorized by the department (e.g., local government officials), or by a qualified environmental consultant whose evaluation is subject to department review and approval. If approved, the inspector will sign and date the application form. On a site-specific basis, a site inspection may not be required.

Following these procedures does not guarantee approval of a variance. The department reserves the right to make any modifications or require remedial measures in the event of issues that are not protective of human health or the environment. Issuance of a variance does not convey property rights of any sort or any exclusive privilege, nor does it authorize any injury to persons or property, any invasion of other private rights, or any infringement of state or local law or regulations. An approval or variance does not supersede local zoning authority or any other requirements of any political subdivision of the state.

Compliance with terms of a variance or approval does not constitute a defense to any order issued or any action brought under NDCC 23.1-08, NDAC 33.1-20, NDCC 23.1-04, NDAC 33.1-24, Sections 3013, 7003, or 3008(a) of RCRA, Sections 106(a), 104 or 107 of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (42 U.S.C. et. seq.) or any other law providing for protection of public health or the environment.

VIII. Links

ND Division of Waste Management publications (scroll to "Land Treatment-Petroleum under "Solid Waste Program") https://deq.nd.gov/wm/publications.aspx
Solid Waste Facilities for Treatment/Disposal Of Petroleum Contaminated Soils
Land Treatment Variance Application
Land Treatment Annual Report
Soil Monitoring Results For Land Treated Petroleum Contaminated Soil

INSERT

SFN 51601
LAND TREATMENT VARIANCE APPLICATION

AND

SFN 50336
SOIL MONITORING RESULTS FOR
LAND-TREATED, PETROLEUM-CONTAMINATED SOIL

AND INCORPORATE CORRECT PAGINATION

SIGNS

I. Purpose

After operational procedures have been developed, signs describing activities must be designed, constructed, and placed. Signs provide information to workers and landfill patrons. Public access can be better controlled by designing, constructing, and installing signs which specify speed, routes, and locations of various cells.

During landfill planning and design, consideration must be given to the specific signs which must be installed. The locations of permanent and temporary signs must also be determined.

Placing a sign does not necessarily mean that people will obey the instructions. However, landfills can become uncontrollable with no signs.

II. Construction and Placement

Signs should be placed where people can anticipate activities.

Sturdy materials should be used to construct signs. Signs and supporting posts should be placed to prevent the wind from blowing them over.

The sign’s purpose and landfill operations will determine if the sign should be permanent or portable. For example, activities which frequently move and require signs warrant portable signs. Alternatively, signs located at the landfill entrance should be permanent.

Signs should be made of weatherproof materials. Colors, letters, and phrases should be carefully selected for readability and understandability.

Alternative materials such as fences (portable and permanent), physical barriers such as hills or trees, and traffic cones can also be used to control traffic.

III. Required Signs

The department requires that permanent sign(s) must be posted at the entrance of the facility which indicates:

- Facility name
- Permit number
- Owner and operator name and telephone number
- Operating hours and days
- Unacceptable wastes
- Restrictions for trespassing, burning, hauling, or nonconforming dumping

The department's *Guideline 9 - Signs Required at Solid Waste Management Facilities* (available upon request or online at https://deq.nd.gov/wm/publications.aspx) lists the necessary information to be posted on signs at the entrance to a landfill facility.

IV. Informational Signs

Additional signs may be considered for other information purposes:

A. Monitor Wells

A label or sign will allow landfill workers and field technicians to know which monitor well is indicated.

B. Topsoil Stockpiles

Signs may include the word "TOPSOIL," the A or B horizon, and number designation. Confusion can be avoided when questions arise regarding topsoil piles or when stockpile work is assigned.

C. Cover Material

Signs may include the word "COVER" and a number designation. Confusion can be avoided when questions arise regarding stockpiles or when stockpile work is assigned. Additional designations such as daily cover or final cover can be included.

D. Disposal Cells or Areas

Many landfills have designated areas for waste streams such as white goods, tires, dead animals, trees, yard waste, scrap metal, bulky items, or other segregated wastes. Patrons and landfill workers thus know to which area waste should be transported.

E. Traffic Control Signs

Signs indicating speed limit and traffic direction provide some degree of traffic control. Additional information may include a statement that children and pets should not be allowed out of vehicles.

V. Fires

A. Causes

One of the most serious problems associated with landfill fires is that waste can burn under the ground for years, and extinguishing can be difficult if not impossible.

1. Equipment

   Equipment can catch on fire from oil and fuel leaks. Electrical malfunctions on equipment and lighting can result in fires. Proper maintenance and regular walk-around inspections can minimize the possibilities that equipment does not catch on fire from fluid leaks or electrical systems.

2. Lightning

   Lightning can strike buildings, vegetation (trees, grass, etc.), combustible waste, and equipment. Lightning rods, grounding, and good housekeeping can reduce the risk of major fires from lightning.

3. Waste

   Spontaneous combustion can occur with solid waste. Frequent and adequate cover can minimize the potential for this type of fire.

   Hot ashes, especially those from residential fireplaces and wood or coal stoves, present hazards with which landfill operators have less control. There are limits to the degree which operators can prevent disposal of hot ashes. Immediately upon discovery of hot or smoldering ashes, ashes and fires must be contained and extinguished.

   Some chemical reactions can generate heat or result in fires. Patrons can discard waste which has the potential to react with waste from other generators. Fires resulting from chemical reactions require firefighting and chemical response.

4. Geologic Material

   Subsurface material such as coal seams can spontaneously combust or catch fire from contact with other materials. Landfills which are located in areas with exposed coal seams must take special precautions to prevent these fires. Barriers of soil or rock can be placed adjacent to coal seams to prevent contact with equipment and waste.

B. Prevention and Control

Two features serve to minimize the spread of fires. Landfills tend to be located some distance from residential, business, and industry areas which could be seriously affected by major fires.

Geologic material (soil and rock) present in landfill areas can be used as cover for fires. Ditches and berms can be built to prevent fires from spreading.

Fire lanes must be designed into the landfill plans.

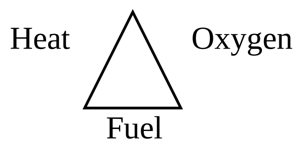
A list of emergency contacts must be posted in conspicuous places, and landfill staff must be informed of the locations of the lists.

Communication systems must be available to all landfill employees in case of fire or other emergency.

When small fires occur, investigate the option of isolating the burning material and pushing it to the side. Then assess the cause of the fire and the appropriate response.

Fires can also be depicted as pyramids with the fourth side being the chemical reaction. Removal of any side of the triangle or pyramid means that it is no longer a triangle or pyramid and thus not a fire.

Most firefighters endeavor to remove at least two sides of the triangle or pyramid to further decrease the likelihood that the fire will start again.



Always use the correct type of fire extinguisher for the fire:

Class A fires involve wood, clothing, paper, and rags. These fires can usually be extinguished with water.

Class B fires involve flammable liquids such as gasoline, fuels, oils, grease, some solvents, and paints. Extinguishants blanket the fire surface and create a smothering effect.

Class C fires involve electrical equipment and electrical facilities. The extinguishing agent must be a conductor of electricity and provide a smothering effect.

Class D fires involve certain metals. No one fire extinguishant is acceptable for all metals. Do not fight these fires with a fire extinguisher. Experienced qualified personnel should be contacted immediately. The first priority is to maintain a safe distance and prevent others from injury.

Prior to using a fire extinguisher, be sure that it is the appropriate choice for the type of fire.

A sufficient number of fire extinguishers should be located at each structure and on each piece of equipment. The best fire extinguishers to place in public areas are ABC rated.

Fire extinguishers should be checked as part of the daily walk-around inspection. Missing or damaged fire extinguishers should be replaced immediately.

Extinguishers should be protected from the elements as much as possible. Weather covers or protective boxes can be utilized at little expense. The cost of a fire is great in comparison to the cost of an extinguisher's weather cover. Mud, dirt, ice, and snow can become lodged in the working areas of the fire extinguisher and thus prevent it from working properly.

VI. Emergency Management

Fires are not the only emergency which can occur at landfills. Medical emergencies, chemical releases, weather catastrophes, and traffic or equipment accidents are some of the many emergencies which can involve landfill workers and patrons. Landfill operators are charged with responsibility for landfill staff's safety and the general public's safety. Since the public is often present at the landfill, operators should prepare for emergencies.

A. Contingency Plans

Contingency plans for various emergencies should be developed. For example, chemical releases have a relatively high likelihood of occurrence. On the other hand, some landfills may have less of a need to prepare for tornadoes if they are located in an area which rarely experiences them.

A written contingency plan should be developed for the emergencies which present the greatest risk. Local emergency management agencies, fire department, ambulance services, and police or sheriff departments can provide assistance with preparation of contingency plans. The time to prepare for an emergency is before one occurs.

Staff should know what specific procedures are to be implemented with various types of emergency situations.

B. Drills and Safety Training

Drills should be conducted to develop landfill staff's planning and action skills. A few minutes of a drill can save valuable seconds during an emergency. Drills also provide the opportunity for operators to see what their staffs do well, what could be improved upon, and what should be completely changed before the real emergency strikes.

Safety meetings can also be used to further discuss emergency management.

C. Emergency Contacts

Emergency contacts should be posted where all landfill employees know the list will be located. A telephone or other communication device should be near the contact list. Communities with the 911 service have the advantage of calling one number and relaying the emergency and their immediate needs. A list of key individuals in the landfill management system and appropriate government agencies (police, fire, ambulance, hospital) should be posted.

D. Exit Routes

Exit routes must be developed and posted. Staff should know how to exit the landfill and where to meet.

Alternate routes should be available.

Exit routes should always remain clear and open for foot and equipment traffic.

E. Trained Medical Personnel

A list of landfill staff trained in first aid or emergency care will enable other landfill employees to contact those on-site individuals immediately. Staff should receive medical care training at the landfill's expense if funds are available.

F. Summary

Landfill safety has been addressed in each portion of this manual. Safety is not a separate topic, but rather it is a subject of concern with each and every landfill activity from the planning phase to the postclosure phase. Landfill operators are charged with the immediate safety and the long-term health of landfill workers and the public during operations and postclosure. Potential contamination of the air, water, and soil must be considered when developing safety plans and procedures. Safety is a process, not a goal that is ever 100 percent achieved. Landfill operators should consider each working day another opportunity to improve operations safety and to better prepare for emergency incidents.

Section 8
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SECTION 8: CLOSURE AND POSTCLOSURE

I. Purpose

The purpose of landfill closure and postclosure activities is to minimize the need for further landfill maintenance. The specific objectives are to control, minimize, and eliminate escape of solid waste constituents, leachate, fugitive emissions, contaminated runoff, and waste decomposition products. In other words, the goal is to keep the waste in its place.

II. Definitions

A. "Closed Unit" - landfill or surface impoundment or a portion thereof that has received solid waste for which closure is complete.

B. "Closure" - taking of actions to close and reclaim a solid waste management unit or facility.

Closure tasks include:

- Sloping filled areas to provide adequate drainage
- Applying final cover
- Providing erosion control measures
- Grading and seeding
- Installing groundwater and landfill gas monitoring devices
- Constructing surface water control structures (e.g., ponds and ditches)
- Installing gas control systems
- Site security measures (e.g., gates, fences, video cameras)

C. "Postclosure Period" - the period of time following closure of a solid waste management unit during which the owner or operator must perform postclosure activities.

D. "Sequential Partial Closure" - bringing discrete, usually adjacent, portions of a disposal facility to elevation and grade (in an orderly, continually progressing process as part of the operations of the facility) for facilitating closure.

Sequential closure affords more efficient landfill operations on a daily and long-term basis. Landfills should be designed such that construction, daily disposal operations, and closure activities can be conducted during the same time periods.

With sequential closure, solid waste can be better controlled for more efficient disposal, safer work areas, and better environmental management. Equipment and personnel can be utilized more effectively by distributing efforts more evenly over closure periods.

III. Closure and Postclosure Plan

A written closure plan must be filed with the landfill permit application. The written plan must include:

- Projected time intervals at which closure activities will be implemented
- Resources and equipment to be utilized for closure operations
- Final topographic plan
- Site drainage plan
- Source and characteristics of cover material
- Vegetative cover and landscape plans
- Closure sequence for phased landfill operations
- Engineering requirements and procedures for on-site structures
- Land use
- Cost estimates and projected fund withdrawals from the financial assurance instrument

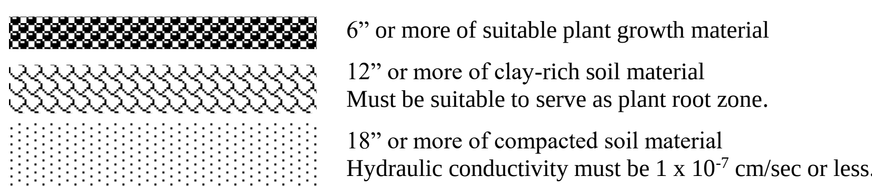
IV. Closure Design and Operation Standards

A. Purpose

- Prevent water infiltration into closed landfill.
- Promote surface water erosion from site.
- Prevent wind and water erosion of final cover.
- Control landfill gas and allow its safe escape or prevent its escape.
- Prevent or minimize landfill subsidence.
- Minimize area of landfill working face during sequential partial closure.

B. Closure Materials

1. Cover layer sequence



2. Cover characteristics

- The compacted layer must be free from cracks and extrusions of solid waste.

- The chemistry of all final cover materials should be evaluated to ensure that compounds in the final cover are not toxic to the cover vegetation.

  In North Dakota, the most likely chemical parameter of concern will be SAR (sodium adsorption ratio) which is a mathematical ratio of sodium (Na) to calcium (Ca) and magnesium (Mg). SAR is an indication of the sodium level in soils. If the SAR is too high for plant species selected for revegetation, cover material with lower SARs must be selected, or plants adapted to higher SAR levels must be planted. Public Service Commission regulations are that SAR must be less than 4.

  Electrical conductivity (EC) is an indication of the salt levels which can be a limiting factor in plant growth. Some plants are more tolerant to higher EC levels than others. Public Service Commission regulations are that EC must be less than 2.

- Limit the amount of percolation that may enter the waste to meet the efficiency requirements for that type of solid waste management unit. The purpose is to minimize water infiltration and allow it to run off the landfill without contacting solid waste. Hydraulic conductivity of the layer in contact with waste must be 1 x 10^{-7} cm/sec or less.

- Plant species selected for revegetation should be shallow rooted and should be tolerant of the chemistry of cover materials.

<u>C. Slope Standard</u>

- Slopes must be between 3 and 15 percent.

- Although exceptions may be allowed, no slope can exceed 25 percent.

- Precipitation run-on from adjacent areas must be minimized.

- Topographic relief must provide a surface drainage system which does not adversely affect drainage from adjacent lands and which minimizes erosion and optimizes drainage of precipitation falling on the landfill.

- The closed landfill should conform to original topography and surrounding topography. Some disturbed areas cannot be returned to their original appearance (e.g., sheer rock cliffs). The engineered design and final reclamation should reshape the land into an area that approximates natural topography.

V. Postclosure Design and Operations

A. Written Plan

A written postclosure plan must be included with the permit application and must be approved by the department prior to implementation. The postclosure plan must address facility maintenance and monitoring activities for a postclosure period of 30 years.

The written plan must address:

- Projected time intervals for activities
- Postclosure cost estimates
- Projected fund withdrawals from the financial assurance instrument

B. Construction and Operations

After closure, the applicant must maintain the right of access to the site throughout the postclosure period. Closed solid waste management units may not be used for cultivated crops, heavy grazing, buildings, or other uses which might disturb the protective vegetative and soil cover. The landfill operator must ensure that postclosure use agreements logistically and contractually allow for access to conduct any of the following postclosure activities:

- Facility maintenance
  - structures
  - integrity and effectiveness of the final cover
  - correction for settlement or subsidence
- Prevention of surface water run-on and runoff from eroding or otherwise damaging the final cover
- Surface water monitoring
- Groundwater monitoring
- Operation and maintenance of leachate collection and removal system

  See Section 5 “Landfill Permits, Design, and Construction” of this manual for leachate collection system specifications and requirements.
- Gas monitoring
- Liner maintenance

  See Section 5 “Landfill Permits, Design, and Construction” of this manual for liner specifications and requirements.

VI. Timetable for Closure and Postclosure Activities

A. Closure and Postclosure Plans for Submittal with Permit Application

As previously stated, the following list of information should be included with the closure and postclosure plans submitted with the permit application. Additional information may be necessary to accurately and completely describe the proposed plans, and the department may request additional information.

- Final topographic plan
- Site drainage plan
- Source and characteristics of cover material
- Vegetative cover and landscape plans
- Closure sequence for phased landfill operations
- Engineering requirements and procedures for on-site structures
- Land use

During the permit renewal process, changes to the plans (due to operational or design changes) must be addressed to prevent major construction problems during closure.

B. Three Months Before Closure

- Review closure plan for completeness and necessary revisions.
- Schedule closing date.
- Prepare timetable for closure procedures.
- Notify appropriate regulatory agencies.
- Notify site users by letter (municipalities or contract haulers) or published announcement (individual waste generators).

C. During Closure

Within 30 days after receiving final solid waste, closure activities including the following must be implemented:

- Erect structures to limit access.
- Post signs indicating site closure.
- Identify alternative disposal sites on posted signs.
- Collect litter or debris and place in final cell for covering. Place cover over exposed surfaces.

D. Three Months or More After Closure

1. The department requires that the following be completed within 180 days of the beginning of closure activities. However, for efficiency and construction integrity the tasks should be completed within three months of initial closure activities.

    - ▶ Complete drainage control features or structures.
    - ▶ Complete gas collection or venting system, leachate containment facilities, and gas or groundwater monitoring devices.
    - ▶ Install devices for detecting subsidence.
    - ▶ Place required thickness of cover over landfill.
    - ▶ Establish vegetative cover.

2. Within 60 days after completion of final closure and prior to sale or lease of the property, file a record or plat on the property deed indicating that the land was used as a solid waste landfill. See Exhibit 8-1 which is a copy of such a record.

3. Within 60 days of recording information on a deed, submit a certified copy of affidavit or plat to the department.

4. Postclosure activities must be conducted for a period of 30 years.

VII. Land Use

A. Purpose

- ▶ Active and closed solid waste management units should be managed to prevent disturbance of the protective vegetative cover and soil cover.
- ▶ Land use should be selected based on a demonstration that the landfill will be safe for the public, livestock, wildlife, and the environment.
- ▶ Development plans for closed sites should minimize wind and water erosion, ponding of water, cracking of the final cover, and water infiltration.

B. Exclusions for Active and Closed Facilities

- ▶ Cultivated crops
- ▶ Heavy grazing
- ▶ Other food chain crops
- ▶ Buildings
    - Disturbance of final cover to construct buildings (such as installation of footings) can provide a route of entry for water to infiltrate the disposed waste.

- Buildings can be constructed only if the bearing capacity of the site is found to be adequate.

- Foundations may require additional reinforcement.

- Consideration must be given to integrity of the structure during its life and to the potential for the site to settle.

- Some structures can be built to adapt to differential movement.

- The potential for groundwater and gas movement should be evaluated when developing closed sites for future use. As a result of structural weight, gases can accumulate and create explosion hazards.

- Decomposing waste can damage foundations. Decomposing waste tends to be very corrosive; foundations may require corrosion resistant coatings.

▶ Roads and walkways

Roads and walkways should be constructed of material that can be easily repaired. Gravel, asphalt, and dirt should be used.

C. <u>Options for Closed Facilities</u>

▶ Recreational purposes
Parks, ski slopes, sled runs, golf courses, ball fields, playgrounds, and outdoor theaters are examples of site development.

▶ Small, lightweight, one story buildings
Examples include concession stands, equipment storage, and sanitary facilities.

▶ Production of food chain crops only with specific approval in writing from the department.

VIII. Records

A. <u>Written closure and postclosure plan</u> must be submitted as part of the landfill permit.

B. <u>Record or plat</u> must be filed with deed (within 60 days after closure) providing information about its service as a landfill. See Exhibit 8-1 for an example record.

C. <u>As-built drawings</u> showing the topography, pertinent design features, extent of waste, and other appropriate information must be entered into the operating record and submitted to the department upon completion of closure or partial closure.

D. Certification of completed closure must be entered into the landfill operating record and submitted to the department by the owner or operator upon completion of closure or partial closure. A professional engineer must certify this in accordance with the approved closure plan and North Dakota Solid Waste Management Rules, NDAC Article 33.1-20.

IX. Financial Assurance

A. Applicability

Financial assurance requirements apply to all:

- New solid waste disposal facilities
- Expanded solid waste disposal facilities
- Existing solid waste disposal facilities not closed by April 9, 1994

These requirements do not apply to inert waste landfills.

B. Estimates

Section 7 "Operations and Management" of this manual describes costs associated with closure and postclosure activities. All estimates include the anticipated costs to complete those tasks at the time they are planned. In other words, inflation must be factored into estimates. Anticipated cost increases associated with new regulations must also be considered with cost estimates for future closure and postclosure operations.

Each owner or operator must prepare separate written closure and postclosure cost estimates to complete facility closure and postclosure plans. Estimates must be revised as necessary and resubmitted to the department annually.

When any of the following occurs, the owner or operator must prepare a new closure or postclosure cost estimate:

- Operating plans or facility design have been revised such that closure or postclosure plans are affected.
- Anticipated year of closure changes.
- The department directs the owner or operator to revise the closure or postclosure plan.

C. Accounts

Methods for funding the accounts must be established. Schedules and plans for withdrawing money from the accounts must also be established. The application for permit must include this information to ensure that sufficient money will be available to complete closure and postclosure activities in case the landfill closes unexpectedly.

1. Publicly owned or operated facilities

   One account may be established for both closure and postclosure care of each facility.

   For nonpayment of funds, a procedure must be established with the financial assurance instruments' trustees for such notification to be sent to the department.

   An annual report of the financial assurance accounts must be filed with the department.

2. Privately owned or operated facilities

   Separate accounts for closure and postclosure must be established.

   Annual audits for both closure and postclosure accounts must be conducted by a certified public accountant licensed in the state. The audit must be filed with the department no later than August 31 of each year for the previous calendar year, including each of the postclosure care years.

3. Mechanism

   Financial assurance mechanism(s) must be approved by the department. One or more of the following financial assurance instruments must be established in an amount equal to the closure cost estimate and postclosure cost estimate.

   - Trust fund
   - Surety bond
   - Irrevocable letter of credit
   - Insurance policy
   - Corporate guarantee

Exhibit 8-1
Affidavit and Notice of Disposal Facility

STATE OF NORTH DAKOTA)
) SS
COUNTY OF _____________)

The undersigned states that (s)he is an officer of the City of ______________, and makes this Affidavit in that capacity and to satisfy the requirements of § 23.1-08-21 of the North Dakota Century Code:

1.

City of ____________ operated a landfill for inert waste on the following described property in ____________ County, North Dakota:

[Legal Description]
. . . . described in the attached plat.

2.

The facility received and buried inert waste until it was closed (month) (day), (year).

3.

All wastes are covered by a final cap of clay, followed by topsoil to a thickness of at least 24” and revegetated with grasses.

4.

The public is hereby notified that this facility, because of its prior use, is not suitable for building, earthmoving, or tillage, except such actions as are necessary to ensure the long-term integrity of the final cover over the closed facility.

Dated this (day) day of (month), (year).

CITY OF _________________________________:

By: _______________________________________
An authorized officer

STATE OF NORTH DAKOTA)
) SS
COUNTY OF _____________)

The foregoing instrument was acknowledged before me this (day) day of (month), (year), by ______________________ an authorized officer of the City of _________________________.

NOTARY SEAL

____
Notary Public
My commission expires: __________________

Section 9
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SECTION 9: DEPARTMENT INSPECTIONS

I. Purpose

The department will inspect each landfill many times during its life and during each phase of operations. When the landfill operator receives a permit, the operator agrees to abide by the permit terms and applicable regulations. The department is charged with environmental protection for all citizens of North Dakota and thus has a responsibility to ensure that the landfill operator is meeting the requirements of the landfill permit. Landfill operators should be prepared for inspections.

Most landfills will have inspections three or four times a year. If a landfill has had difficulty meeting permit requirements, inspections may be made more often or as necessary. Inspections may be announced or unannounced. The landfill should be operated in such a manner that it is ready for an inspection at any time.

II. Problems

In some cases, the department must be notified about noncompliance. The landfill operator's efforts to inform the department demonstrate initiative to bring the landfill back into compliance.

Each landfill will probably have some problems that are unique to its specific operation. Landfill operators should make extra efforts to minimize those problems which can be more easily anticipated. Remedial actions must be taken immediately and, in some cases, only after the department has approved the course of action.

A. <u>Common problems encountered at many landfills may include</u>:

- Blowing litter off the property
- Soil erosion due to water
- Uncovered waste or inadequate covered waste
- Insufficient cover due to freezing temperatures
- Insufficient topsoil due to inadequate handling of topsoil during initial stripping
- Waste materials which cannot be handled due to equipment or operational problems
- Unacceptable waste which has been accepted either unintentionally or intentionally by the landfill
- Poor access due to poor roads

B. <u>More serious problems may include</u>:

- Generation of leachate which cannot be handled by the leachate system

- Odors
- Impassable roads
- Severe soil erosion
- Improperly handled waste
- Waste materials which cannot be handled due to equipment or operational problems or which was accepted unintentionally or intentionally by the landfill

III. Penalties for Noncompliance

Permits can be revoked if the landfill is not in compliance with the rules or its permit terms. Future landfill permits may be denied because of past performance. Fines of up to $12,500 per violation per day can be levied.

IV. Preparing for and Conducting an Inspection

When an inspection is scheduled, the operator should be prepared. A well-prepared and knowledgeable operator will help the inspection proceed more smoothly.

A. Review the landfill permit application and permit terms.

B. Assemble all related documentation.

This will include correspondence with the department, plans, permit application, engineering data compiled since the last inspection, in-house inspections, waste acceptance records, reports of daily operations, department inspections, and a summary of all landfill activities which have occurred since the last inspection.

C. Assemble photographs of pertinent activities.

D. Inspect and maintain access roads.

Roads should be in good condition so that the inspector can get to each portion of the landfill with no difficulty.

E. Operations should be investigated to ensure that they are in compliance with permit requirements.

F. Check all equipment.

Equipment should always be in good working order, but checking before an inspection is good practice.

G. Inform all landfill employees of the inspection.

Employees should be prepared to answer the inspector's questions and to assist during the inspection.

H. Schedule adequate time to be with the inspector.

Be prepared to spend some time with the inspector in an office area to review plans and specifications for construction and development. All written landfill records should be well organized and available. This will allow the operator to more quickly answer the inspector's questions and will demonstrate knowledge of the landfill development.

I. Take photographs or video during the inspection.

If a condition requires action, photographs or video should be taken before and after the action. An inspector may or may not return after the action to visually inspect the condition. When the inspector requests some type of corrective action, he or she may request that photographs or video be taken after the action and then be provided to the department.

J. When the inspector makes comments during the inspection, ask what the inspector's expectations are for this landfill and for other landfills.

K. During or after the inspection, ask the inspector what the landfill is doing well, what improvements can be made, and what should be completely changed.

The operator should take the initiative to ask about the results of the inspection. The inspector will then know that the landfill operator's primary objectives are regulatory compliance, sound environmental practices, and safe, efficient operations.

L. If the operator does not know the answer to an inspector's questions, the operator should say that he or she does not know.

Offer to provide the information as quickly as it can be obtained, and then give the information to the inspector.

M. Ask the inspector if any notices of violation will be written for this inspection.

N. Ask the inspector when a written report of the inspection will be available.

The operator should make written notes throughout the entire inspection to avoid any confusion about conditions.

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United States Department of Agriculture, Natural Resources Conservation Service, *Technical Guide Notice ND-11*, U.S. Department of Agriculture, Natural Resources Conservation Service, North Dakota, 1992. (The guide includes charts, tables, and graphs for use when calculating soil erosion due to wind and water.)

United States Environmental Protection Agency, *Characterization of Municipal Solid Waste in the United States: 1990 Update*, EPA/530-SW-90-042, 1990. (Data from this EPA study is widely used for estimating purposes in many communities.)

United States Environmental Protection Agency, *Decision-Makers Guide to Solid Waste Management*, EPA/530-SW-89-072, Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C., 1989.

United States Environmental Protection Agency, *Office Paper Recycling, An Implementation Manual*, EPA/530-SW-90-001, Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C., 1990.

United States Environmental Protection Agency, *Yard Waste Composting, A Study of Eight Programs*, EPA/530-SW-89-038, Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C., 1989.

Washington State Department of Ecology, *Best Management Practices Analysis for Solid Waste, Volume 1*, Publication Numbers 88-33A, B, C, and D, Washington Department of Ecology, Olympia, Washington, 1987. (This detailed study commissioned by the Washington Dept. of Ecology includes comprehensive waste composition and cost data. Some data can be used for estimating solid waste generation in communities elsewhere in the United States.)

Magazines

The following are some of the most popular magazines related to waste management. Check your local public library, college library, or the department library for available periodicals. Subscriptions are also available.

Periodicals and Unclassified Sources

Source	Publisher/Location	Focus
BioCycle	Emmaus, PA 18049	Sewage sludge and yard waste composting
Mill Trade Journal	540 W. Frontage Rd, Ste 3124 Northfield, IL 60093-1230	Secondary fiber trade
Recycling Today	5811 Canal Rd. Valley View, OH 44125	Magazine of scrap materials emphasizing nonferrous metals
Recycling Times	Level 4, Building 1 Kimka Creative Valley 2021 Mingzhu Rd. S. Zhuhai, China	Recycling market
Resource Recycling	P.O. Box 42270 Portland, OR 97242-0270	Post-consumer waste recycling efforts
Scrap Tire News	Recycling Research Institute Scrap Tire News P.O. Box 4430 Leesburg, VA 20177	Recovery, recycling, and disposal of scrap tires

GOVERNMENT CONTACTS
tab

Government Contacts

For some agencies, central numbers are listed. Tell the receptionist your question so that you can be connected with the correct individual.

Government agencies have much information and technical assistance available for free or at a nominal charge. If you require further assistance, these agencies can provide you with names of private firms.

Federal Government

U.S. Environmental Protection Agency, Region VIII
1595 Wynkoop Street
Denver, CO 80202-1129
(303) 312-6312
Website: https://www.epa.gov/aboutepa/epa-region-8-mountains-and-plains

U.S. Fish & Wildlife Service
North Dakota Field Office
3425 Miriam Avenue
Bismarck, ND 58501-7926
(701) 250-4481
Website: www.fws.gov

U.S. Department of Interior
Bureau of Land Management
99 23rd Avenue West
Dickinson, ND 58601
(701) 227-7700
Website: www.blm.gov

U.S. Geological Survey
821 East Interstate Avenue
Bismarck, ND 58503
(701) 250-7400
Website: https://www.usgs.gov/centers/dakota-water

OSHA (Occupational Safety and Health Administration)
5212 East Main Avenue, Suite 200
Bismarck, ND 58501
(701) 250-4521
Website: www.osha.gov

U.S. Forest Service
2000 Miriam Circle
Bismarck, ND 58501
(701) 989-7300
Website: www.fs.usda.gov

North Dakota State Government

North Dakota Forest Service
916 East Interstate Avenue, Suite 4
Bismarck, ND 58503
(701) 328-9944
Website: https://www.ag.ndsu.edu/ndfs

North Dakota Game and Fish Department
100 East Bismarck Expressway
Bismarck, ND 58501
(701) 328-6300
Website: https://gf.nd.gov/

North Dakota Geological Survey
1016 East Calgary Avenue
Bismarck, ND 58503
(701) 328-8000
Website: https://www.dmr.nd.gov/ndgs/

North Dakota Department of Environmental Quality
918 East Divide Avenue
Bismarck, ND 58501
Website: https://deq.nd.gov

Air Quality
(701) 328-5188
Municipal Facilities
(701) 328-5211
Waste Management
(701) 328-5166
Water Quality
(701) 328-5210

North Dakota Public Service Commission
600 East Boulevard Avenue #408
Bismarck, ND 58505
(701) 328-2400
Website: https://www.psc.nd.gov/

North Dakota State Water Commission
900 East Boulevard Avenue #770
Bismarck, ND 58505
(701) 328-2750
Website: http://www.swc.state.nd.us/

North Dakota Technology Transfer Office
NDSU Dept. 4000
P.O. Box 6050
Fargo, ND 58108
(701) 231-6681
Website:
https://www.ndsu.edu/research/tech_transfer/

Federal Government Contacts for Maps

FLOODPLAIN MAPS

Delaware River Basin Commission
25 Cosey Road
P.O. Box 7360
West Trenton, NJ 08628-0360
(609) 883-9500
Website: https://www.state.nj.us/drbc/

Federal Emergency Management Agency
Map Service Center
500 C Street Southwest
Washington, D.C. 20472
(877) 336-2627
Website: https://msc.fema.gov/portal/home

U.S. Army Corps of Engineers
441 G Street Northwest
Washington, D.C. 20314-1000
(202) 761-0011
Website: https://www.usace.army.mil/

(Aerial Photographs and Other Remotely Sensed Images)
U.S. Geological Survey
EROS
47914 252nd Street
Garretson, SD 57030
(605) 594-6511
Website: https://www.usgs.gov/centers/eros

(Earth Science Information, Maps, and Aerial Photographs)
U.S. Geological Survey
Eastern Geographic Science Center
12201 Sunrise Valley Drive, Suite MS-521
Reston, VA 20191
(888) 275-8747
Website: https://egsc.usgs.gov/

SEISMIC MAPS

National Institute of Building Sciences
Building Seismic Safety Council
1090 Vermont Avenue Northwest, Suite 700
Washington, D.C. 20005
(202) 289-7800
Website: https://www.nibs.org/page/bssc

KARST

U.S. Geological Survey
Eastern Geographic Science Center
12201 Sunrise Valley Drive, Suite MS-521
Reston, VA 20191
(888) 275-8747
Website: https://egsc.usgs.gov/

NATIONAL WETLANDS INVENTORY MAPS

(Fish Hatcheries and Wildlife Refuges Maps)
U.S. Fish and Wildlife Service
5275 Leesburg Pike
Falls Church, VA 22041

(Aerial Photographs and Other Remotely Sensed Images)
U.S. Geological Survey
EROS
47914 252nd Street
Garretson, SD 57030
(605) 594-6511
Website: https://www.usgs.gov/centers/eros

COMPUTER PROGRAMS

PC STABL 5M

Purdue University
Civil Engineering
West Lafayette, IN 47907

HELP Version 3.07

U.S. Environmental Protection Agency
US EPA Research
Mail Drop: D343-04
109 Alexander Drive
Durham, NC 27711

HEC-Models

U.S. Department of The Army
Corps of Engineers
Institute for Water Resources
Hydrologic Engineering Center
609 Second Street
Davis, CA 95616-4687
(530) 756-1104

GLOSSARY
tab

GLOSSARY

Absorption - Penetration of a substance into the body of another or transformation into other forms suffered by radiant energy passing a material substance.

Acid - A hydrogen-containing compound that is corrosive. The pH is less than 7, with 7 being neutral.

Aeration - Process of exposing bulk material to air. Process used with compost operations.

Aerobic - A biochemical process or condition occurring in the presence of oxygen.

Aerosols - Liquid droplets or solid particles dispersed in the air that are of sufficiently small particle size (0.01 to 100 microns) to remain dispersed for a period of time.

Agricultural waste - Solid waste derived from the production and processing of crops and livestock such as manure, spoiled grain, grain screenings, undigested rumen material, livestock carcasses, fertilizer, and fertilizer containers. This does not include pesticide waste or pesticide containers.

Alkali - Any substance that in water solution is bitter or caustic to the skin. Strong alkalies in solution are corrosive to the skin and mucous membranes. The pH is greater than 7, with 7 being neutral.

Anaerobic - A biochemical process or condition occurring in the absence of oxygen.

Anhydrous - Free from water.

Aquifer - A geological formation, group of formations, or portion of formation capable of yielding significant quantities of groundwater to wells or springs.

Asbestos - Any material containing more than 1 percent asbestos in any form.

Asbestosis - Disease of the lungs caused by inhalation of the fine airborne fibers of asbestos.

Asphyxiant - A vapor or gas which can cause unconsciousness or death by suffocation (lack of oxygen). Most simple asphyxiants are harmful to the body only when they become so concentrated that they reduce oxygen in the air to dangerous levels. This is the primary potential hazard of working in confined spaces.

ASTM - American Society for Testing and Materials.

Baler - A machine used to compress solid waste or recyclables into bundles to reduce volume.

Base or basic - Any substance that in water solution is bitter or caustic to the skin. Strong alkalies in solution are corrosive to the skin and mucous membranes. The pH is greater than 7, with 7 being neutral.

Biodegradable material - Material capable of being decomposed by microorganisms into simple, stable compounds such as carbon dioxide and water. Although some manufacturers claim that their products are biodegradable, the material may not be completely biodegradable or may not be located in an area which would allow biodegradation to take place.

BOD - Biochemical oxygen demand. A common laboratory analysis to determine organic content of a waste. The five-day BOD for landfill leachate can range from 2,000 to 3,000 milligrams per liter (mg/L).

Boiling point - The temperature at which a liquid changes to a vapor state at a given pressure usually expressed in degrees Fahrenheit at sea level. Flammable materials with low boiling points generally present special fire hazards.

Broker - An agent which serves as an intermediary between buyers and sellers of recyclable materials.

BTU - British Thermal Unit, which is a unit of measure for the amount of energy a given material contains. One BTU is the quantity of heat required to raise the temperature of 1 pound of water 1 degree Fahrenheit.

Buffer zone or area - An area which serves to protect one area from another. For example, an area of a specific size may be required to protect citizens from odors associated with compost piles, and tree breaks may be planted to prevent waste from blowing out of a landfill and to minimize odors drifting to surrounding residential areas.

ºC - Degrees Centigrade or Celsius.

CAA - Clean Air Act. This act was passed by the U.S. Congress in 1975 to provide that the air would be “safe enough to protect the public’s health.” This law required that National Ambient Air Quality Standards (NAAQS) be established for major primary air pollutants.

Carcinogen - A substance capable of causing cancer.

Caustic - Any substance that in water solution is bitter, or caustic to the skin. Strong alkalies in solution are corrosive to the skin and mucous membranes. The pH is greater than 7, with 7 being neutral.

cc - Cubic centimeter, a volume of measurement in the metric system equal in capacity to 1 milliliter (ml).

Cell - A portion of the landfill in which waste is placed. Areas or cells may be designated for specific waste streams. Cells may also have number or letter designations to afford better tracking of landfill utilization.

Centigrade (Celsius) - The internationally used scale for measuring temperature; at sea level 100^o is the boiling point of water and 0^o is the freezing point for water.

CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act. Also referred to as Superfund. This act requires reporting and cleanup of hazardous materials releases.

CFC - Chlorofluorocarbons. A class of compounds containing both chlorine and fluorine used as refrigerants or cleaning solvents and commonly referred to as Freons ^{tm}.

CFR - Code of Federal Regulations.

Chain-of-Custody - A system which documents the origin of samples and containers from collection to completion of laboratory analyses. Chain-of-custody also refers to the actual form (paper) which is prepared at sample collection and signed and dated by all individuals who have possession of the sample containers. This system offers proof that the samples have been correctly handled.

CHEMTREC - Chemical Transportation Emergency Center operated by the Chemical Manufacturers Association.

Closed unit - A landfill or surface impoundment or a portion thereof that has received solid waste for which closure is complete.

Closure - The taking of those actions to close and reclaim a solid waste management unit or facility. Closure actions may include, but are not limited to, sloping filled areas to provide adequate drainage, applying final cover, providing erosion control measures, grading and seeding, installing monitoring devices, constructing surface water control structures, installing gas control systems, and implementing measures necessary to secure the site.

COD - The measure of the quantity of oxygen consumed during chemical oxidation of organic and some inorganic compounds.

Commercial waste - Solid waste generated by stores, offices, restaurants, warehouses, and other nonmanufacturing activities exclusive of household waste, inert waste, infectious waste, industrial waste, and hazardous waste.

Compaction - A method by which solid waste, cover material, or liner material is made to have a greater weight per volume (density). Compaction can be achieved by running a steel-wheeled trash compactor or other heavy equipment over waste or other material.

Compactor - A power-driven device used to compact materials into a smaller volume. This device can either be an attachment which is pulled by mobile heavy equipment or it can be a self-contained unit.

Compliance boundary - Vertical planar surface that circumscribes the waste management units at which the groundwater protection standards apply. Compliance boundary may be either the facility boundary or an alternative boundary within the facility.

Compost - Relatively stable decomposed organic material resulting from the composting process. Many composting facilities utilize grass clippings, leaves, and plant trimmings for composting. The process involves biological decomposition or organic solid waste and must be controlled under controlled aerobic conditions.

Composting - Controlled biological decomposition of organic solid waste under aerobic conditions.

Compressed gas - Material packaged in a cylinder, tank, or aerosol under pressure exceeding 40 pounds per square inch (psi) at 70^{o} F or other pressure parameters identified by the U.S. Department of Transportation.

Concentration - The relative amount of a substance when combined or mixed with other substances.

Construction and demolition waste - Waste which results from construction, remodeling, repair or demolition of buildings, bridges, roads, and other structures.

Corrugated cardboard or paper - Cardboard with a wavy piece of cardboard sandwiched in between two flat pieces of cardboard.

Cullet - Clean, often color-sorted, crushed glass used to make new glass products.

CWA - Clean Water Act. The U.S. Congress passed this act to protect the nation’s water resources. It has established a system of national effluent standards for major water pollutants and use of secondary sewage treatment for all municipalities.

Densified refuse-derived fuel (dRDF) - A refuse-derived fuel that has been processed to produce briquettes, pellets, or cubes.

Destructive testing - Testing of prepared samples of materials that involves destruction or damage of the materials; often performed to evaluate the strength or effectiveness of materials which will be installed in field situations.

Detinning - Recovering tin from “tin” (steel) cans by a chemical process which makes the remaining steel more easily recycled.

DOT – U.S. Department of Transportation.

Downgradient - Downward grade or slope. Monitoring devices may be installed down slope or downgrade from potential sources of contamination. Consideration should be given to the impacts potential sources of contamination may have to downgradient residents.

Drop box facility - A facility used for the placement of a detachable container including the area adjacent for necessary entrance and exit roads, unloading, and turnaround areas. Drop box facilities normally receive loose loads from the general public and solid waste from off site.

Energy recovery - Conversion of waste energy, generally through the combustion of processed or raw refuse to produce steam.

Evaporation rate - The rate at which a material will vaporize when compared with the rate of vaporization of a known material. Useful for evaluation of a material's health and fire hazards. Known material for comparison is generally normal butyl acetate (NBUAC or n-BuAc) with an evaporation rate of 1.0. Three general classifications are as follows:

1. FAST, if greater than 3.0; e.g., methyl ethyl ketone = 3.8, acetone = 5.6, hexane = 8.3.

2. MEDIUM, if 0.8 to 3.0; e.g., 190-proof ethyl alcohol = 1.4, methyl isobutyl ketone = 1.6.

3. SLOW, if less than 0.8; e.g., xylene = 0.6, isobutyl alcohol = 0.6, water = -0.3, mineral spirits = 0.1.

Existing unit - A landfill or surface impoundment or a portion thereof that is receiving or has received solid waste for which closure has not been completed.

Explosion proof equipment - Apparatus enclosed in a case capable of withstanding an explosion of a specified gas or vapor that may occur and of preventing the ignition of a specified gas or vapor surrounding the enclosure by sparks, flashes, or explosion of the gas or vapor within, and that operates at an external temperature such that a surrounding flammable atmosphere will not be ignited.

Explosive limits - Some materials have a minimum and maximum concentration in air which can be detonated by spark, shock, fire, etc. The lowest concentration is known as the lower explosive limit (LEL). The highest concentration is known as the upper explosive limit (UEL).

Extrusion welding - Operation of using pressure (sometimes in conjunction with heat) to attach two or more separate pieces. Reference is generally to the attachment of two or more pieces of high-density polyethylene (HDPE) liners or covers.

ºF - Degrees Fahrenheit.

Facility - All contiguous land and structures, other appurtenances, and improvements on land which include one or more solid waste management units, such as a transfer station, solid waste storage building, a solid waste processing system, a resources recovery system, an incinerator, a surface impoundment, a surface waste pile, a land treatment area, or a landfill. A facility may or may not be used solely for solid waste management.

Ferrous metals - Metals derived from iron. They can be identified and removed from waste streams by using magnets.

Final cover - Any combination of compacted or uncompacted earthen material, synthetic material, and suitable plant growth material which, after closure, will be permanently exposed to the weather and which is spread on the top and side slopes of a landfill or facility.

Flammable - Flash point is less than 100^{o}F (U.S. DOT usage).

Flammable limits - Flammable liquids produce (by evaporation) a minimum and maximum concentration of flammable gases in air that will support combustion. Lowest concentration is known as the lower flammable limit (LFL). Highest concentration is known as the upper flammable limit (UFL).

Flash point - The lowest temperature at which a liquid gives off enough vapor to form an ignitable mixture with air and produce a flame when a source of ignition is present.

Fly ash - Small solid particles of ash and soot generated when coal, oil, or waste materials are burned. Fly ash is suspended in flue gas after combustion and then removed by pollution control equipment.

Free liquid - The liquid which separates from the solid portion of a solid waste under ambient pressure and normal, above-freezing temperature. The EPA Paint Filter Liquids Test method or visual evidence shall be used to determine if a waste contains free liquid.

Friable - As related to asbestos, capable of being pulverized with hand pressure.

Fumes - Gas-like emanation containing minute solid particles arising from heating of solid body materials (e.g., lead). Physical change is often accompanied by chemical reaction, such as oxidation. Fumes flocculate and coalesce. Odorous gas and vapors should not be called fumes.

Fusion welding - Operation of using heat to melt or melt together two or more separate pieces. Reference is generally to the attachment of two or more pieces of HDPE liners or covers.

g/kg - Grams per kilogram.

Garbage - Putrescible solid waste such as animal and vegetable waste resulting from the handling, preparation, cooking, and consumption of food, including wastes from markets, storage facilities, and processing plants.

Groundwater - Water below the land surface in a geologic unit where soil pores are filled with water and the pressure of that water is equal to or greater than atmospheric pressure.

Hazardous waste - Defined by NDCC 23.1-04-02, NDAC 33.1-24-02, and EPA in 40 CFR Parts 261-265. Waste can be considered hazardous by specific compound or process or by meeting a characteristic. The characteristics include:

- Ignitability - flash point equal to or less than 140^o F.
- Corrosivity - pH less than or equal to 2 or pH greater than or equal to 12.5.
- Reactivity - reacts with other materials or changes in pressure or temperature to form explosive or reactive materials. Cyanide- and sulfide-bearing waste are also included in this category.
- Toxicity characteristic leaching procedure - Regulatory levels for 40 chemicals have been established. In order to determine levels of these chemicals in waste, laboratory analyses must be conducted.

HDPE - High density polyethylene. A type of plastic used as part of landfill liner or cover systems. HDPE can be manufactured in various thicknesses and must be designed specifically for the landfill where it will be used. Experienced professionals must install and test the HDPE prior to its use.

Household waste - Solid waste, such as trash and garbage, normally derived from households, single and multiple residences, hotels and motels, bunkhouses, ranger stations, crew quarters, campgrounds, picnic grounds, and day use recreation areas.

Hydraulic conductivity - Measure of a material's ability to allow water to flow or be conducted through it. Landfill liners and covers should have a hydraulic conductivity of 1 x 10^{-7} centimeters per second or slower. Drainage layers of the leachate removal systems must have a hydraulic conductivity of 1 x 10^{-3} centimeters per second or faster.

Hydraulic gradient - The slope or grade over which water will flow.

Hydrogeology - The study of surface or subsurface water.

ID number - Four-digit number preceded by United Nations (UN) or North America (NA) and assigned to hazardous materials and dangerous goods.

Ignitable - A liquid with a flash point of less than 140^o F.

Incinerator - Facility in which the combustion of solid waste occurs as defined in NDAC 33.1-15-01-04.

Industrial waste - The following list includes potential industrial waste categories. North Dakota's definition for industrial waste is provided in NDCC 23.1-08-02. Acceptance of any of the following require special permitting.

- Waste from the combustion or gasification of municipal waste.
- Waste from industrial and manufacturing processes.
- Waste from crude oil and natural gas exploration and production.

Inert waste - Non-putrescible solid waste which will not generally contaminate water or form a contaminated leachate. Inert waste does not serve as food for vectors. Inert waste may include construction and demolition material such as metal, wood, bricks, masonry, concrete, and asphalt; tires; tree branches; bottom ash from coal-fired boilers; and coal fines from air pollution control equipment.

Ingestion - The process of taking substances into the body as by food, drink, medicine, or other method of introduction.

Inhalation - The breathing in of a substance in the form of gas, vapor, fume, mist, or dust.

Inorganic waste - Waste composed of material other than plant or animal. Inorganic waste contains no carbon.

kg - Kilogram.

Land treatment - The controlled application of solid waste, excluding application of animal manure, into the surface soil to alter the physical, chemical, and biological properties of the waste.

Landfill - Defined in NDCC 23.1-08-03; does not include land treatment units, surface impoundments, injection wells, or waste piles.

Leachate - A liquid that has passed through or emerged from solid waste and contains soluble, suspended, or miscible materials removed from such waste.

Leachate collection system - Any combination of landfill base slopes, liners, permeable zones, pipes, detection systems, sumps, pumps, holding areas or retention structures, treatment systems, or other features that are designed, constructed, and maintained to contain, collect, detect, remove, and treat leachate.

LEL - Lower explosive limit. Lowest concentration of the material in air that will support combustion from a spark or flame.

Lift - Layer of waste in landfills. Lift thicknesses should be less than 2 feet. Each layer is referred to as a lift.

LUST - Leaking underground storage tank.

Methane - CH_4, an odorless, colorless, flammable, and explosive gas produced by anaerobic decomposition of solid waste.

mg - Milligram. Metric unit of weight; 1,000 milligrams are in one gram.

Microorganisms - Small living organisms which are of microscopic size. Some of these organisms reside in soil and solid waste and through metabolic activity decompose and convert materials into useful nutrients for plant and animal growth.

mL - Milliliter. Metric unit of capacity equal to 1 cc.; 1,000 milliliters in one liter.

Mulch - Yard wastes which may be ground or mixed and placed around plants to prevent evaporation, minimize root freezing, and provide nutrients to the soil.

Municipal waste incinerator ash - The residue produced by the incineration or gasification of municipal waste.

NDAC - North Dakota Administrative Code.

NDCC - North Dakota Century Code.

NESHAP - National Emission Standards for Hazardous Air Pollutants.

NFPA – National Fire Protection Association.

NIMBY - "Not in My Back Yard." This expression of opposition by area residents has resulted in many facilities, including solid waste operations, being relocated.

NIOSH - National Institute for Occupational Safety and Health.

NMOC - Nonmethane organic compounds.

Nondestructive testing - Generally field or in-place testing performed on completed products, materials, or systems. Usually does not involve destruction or damage to components of the tested materials.

Nonflammable gas - Material or mixture in a cylinder or tank, other than poisonous or flammable gas, having an absolute pressure exceeding 40 psi at 70^{o}, or having an absolute pressure exceeding 104 psi at 130^{o}(49 CFR).

Nonpoint source - Ill-defined water runoff that enters waterways.

NOS or n.o.s. - Not otherwise specified. U.S. DOT usage.

NPDES - National Pollutant Discharge Elimination System.

NRC - National Response Center (1-800-424-8802).

Optimum moisture - Moisture content of soil, cover, or liner materials which is the best moisture concentration for the material's intended use. The optimum moisture content for soil to be used for plant growth will differ from the optimum moisture content for clay to be prepared for compaction as a liner or cover.

OSHA - Occupational Safety and Health Administration of the United States Department of Labor.

Oxidizer - Chemical other than blasting agent or explosive as defined in 29 CFR 1910.109 (a) which is capable of initiating or promoting combustion in other materials and thereby causing fire either itself or by release of oxygen or other gases.

Pathogen - Microorganism capable of causing disease.

PCB - Polychlorinated biphenyl (40 CFR 761.3).

PCB-contaminated electrical equipment - Electrical equipment, including transformers, which contains at least 50 parts per million (ppm) but less than 500 ppm PCB.

PCB item - Item which contains PCBs at a concentration of 500 ppm or greater.

PCP - Pentachlorophenol, wood preservative for poles, etc. or (1-phenylcyclohexyl) piperidine (angel dust) that may produce serious psychologic disturbances.

Percolate - To ooze or trickle through a permeable substance. Surface and groundwater may percolate through solid waste and into the bottom of a landfill and can either be collected or can migrate through an aquifer system.

Permeable - Refers to material which has pores or openings that permit liquids or gases to pass through.

Piezometer - Device for measuring pressure exerted by liquids or gases. Similar to groundwater monitoring wells but used to measure hydrostatic pressure and in-place tests of soil properties rather than water quality. Piezometers are generally 2 inches or less in diameter.

Plan of operation - The written plan developed by an owner or operator of a facility detailing how a facility is to be operated during its active life.

Post-closure period - The period of time following closure of a solid waste management unit during which the owner or operator must perform post-closure activities.

POTW - Publicly owned treatment works.

PPE - Personal protective equipment.

ppb - Parts per billion.

ppm - Parts per million.

psi - Pounds per square inch.

Quality assurance/quality control plan (QA/QC) - A plan which is designed to assure precision, accuracy, completeness, representation, and quality of project data and designs.

Radioactive waste - Solid waste containing radioactive material and subject to the requirements of NDAC 33.1-10.

RCRA - Resource Conservation and Recovery Act. (Cradle-to-grave waste tracking.)

Recover or recycle - Any method, technique, or process utilized to separate, process, modify, convert, treat, shred, compress, or otherwise prepare solid waste so that component materials or substances may be beneficially used or reused.

Recyclables - Materials with useful properties after serving their initial purpose and which can be reused or remanufactured into useful products.

Recycling - The process by which materials otherwise destined for disposal are collected, reprocessed, or remanufactured, and reused.

Reportable quantity (RQ) - Specified in 49 CFR 172.101 (Hazardous Materials Table) or in 40 CFR 173 (Reportable Quantities of Hazardous Substances). U.S. DOT and EPA.

Residential waste - Waste generated from single and multiple family dwellings.

Resource recovery - The extraction and utilization of materials and energy from the waste stream. Resource recovery is often used synonymously with energy recovery.

Retention basin - An area designed to retain surface water runoff and to prevent erosion and pollution.

Roll-off container or box - A large waste container which fits onto a tractor trailer and can be hydraulically dropped off and replaced onto the trailer. This type of container is used when waste will be generated over time at one location, thus allowing the tractor to be otherwise utilized.

Runoff - Water which is removed from surface or through drains beneath the surface.

Run-on - Surface water which originates from off-site sources and flows onto the site of concern.

Sanitary landfill - A land-based waste disposal site located to minimize water pollution from surface water runoff and leaching.

Scavenger - One who illegally removes materials at any point in the solid waste management system.

Scavenging - Uncontrolled removal of solid waste materials from any solid waste management facility.

SCBA - Self-contained breathing apparatus.

SDS - Safety Data Sheet.

SDWA - Safe Drinking Water Act.

Sequential partial closure - Bringing discrete, usually adjacent, portions of a disposal facility to elevation and grade (in an orderly, continually progressing process as part of the operations of the facility) for facilitating closure.

Sludge - Solid waste in a semisolid form consisting of a mixture of solids and water, oils, or other liquids.

Solid waste processing - An operation for the purpose of modifying the characteristics or properties of solid waste to facilitate transportation, resource recovery, or disposal of solid waste, including any process designed to recover or recycle waste.

Standard proctor density - A soil density measurement conducted in the field by using a hammer dropped from a height.

Subtitle C - The hazardous waste section of the Resource Conservation and Recovery Act (RCRA).

Subtitle D - The solid, nonhazardous waste section of the Resource Conservation and Recovery Act (RCRA).

Suitable plant growth material - Soil material (normally the A and the upper portion of B horizons which are dark colored due to organic staining) which, based upon a soil survey, is acceptable as a medium for plant growth when replaced on the surface of regraded areas.

Superfund - Common name for Comprehensive Environmental Response Compensation and Liability Act (CERCLA) to remediate abandoned or inactive hazardous waste sites.

Surface impoundment - A human-made excavation, diked area, or natural topographic depression designed to hold an accumulation of solid waste which is liquid, liquid bearing, or sludge for containment, treatment, or disposal.

Tipping fee - A case fee levied for unloading waste at a waste management facility. The fee is generally based on weight of waste rather than volume.

Trade waste - A solid, liquid, or gaseous waste material resulting from construction or the conduct of any business, trade, or industry, or any demolition operation. Trade waste includes but is not limited to wood, wood-containing preservatives, plastics, cartons, grease, oil, chemicals, and cinders.

Transfer station - A site or building used to transfer solid waste from a vehicle or a container, such as a roll-off box, into another vehicle or container for transport to another facility.

Trash - Material considered worthless, unnecessary, or offensive that is discarded. Often used as a synonym for garbage, rubbish, refuse, or waste.

TSCA - Toxic Substances Control Act.

TSDF - Treatment, storage, and disposal facility.

TSS - Total suspended solids.

UEL - Upper explosive limit. Highest concentration in air that can be detonated.

UFL - Upper flammable limit. Highest concentration in air that will support combustion.

UN number - United Nations Identification Number. When UN precedes a four-digit number, it indicates that this number is used internationally to identify a hazardous material.

Upgradient - Upward grade or slope. Monitoring devices may be installed up slope or grade from potential sources of contamination. Upgradient monitoring provides information about how site activities have affected groundwater, surface water, soil, and air quality.

Used oil - Any oil that has been refined from crude oil, or any synthetic oil, that has been used and as a result of such use is contaminated by physical or chemical impurities.

Vapor - Air dispersion of molecules of a substance that is liquid or solid in its normal physical state at standard temperature and pressure. Vapors of organic liquids are often referred to as fumes, but this is incorrect terminology.

Vapor density - Ration of vapor weight of material compared to that of air. Vapors diffuse and mix with air. If the ratio is greater than 1, vapors are heavier than air and may settle to ground; if lower than 1, vapors will rise.

VOC - Volatile organic compound(s).

Waste pile or pile - Any noncontainerized accumulation of nonflowing solid waste.

White goods - Large household appliances such as refrigerators, stoves, air conditioners, washing machines, and dryers.

Windrow - A large, elongated pile of material. Large composting facilities work compost material into windrows for more efficient handling.

Yard waste - Leaves, grass clippings, tree and shrub trimmings, and other organic matter discarded from yards and gardens. Stumps and limbs are included in this category, but they are not generally handled as compost.

DAY 1

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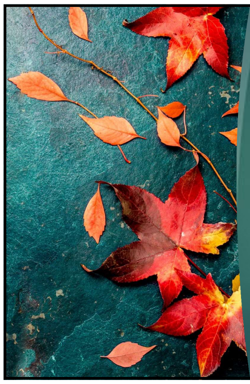


Solid Waste Program Update

DIANA TRUSSELL

JANUARY/FEBRUARY 2021

NORTH Dakota | Environmental Quality

1

Overview

- Program Updates
- Background
- Rule Changes
- Questions

2

Solid Waste Program Updates

- 9 Full Time and 1 Half Time Staff
- Bismarck Office
  - Diana Trussell, Program Manager
  - Lexi Craig
  - A.J. Delzer
  - Kabeya Ilunga
  - Kirk Johnson
  - Dedrick Lund
  - Ted Poppke
  - Brad Torgerson
- Field Offices - Onsite Inspectors
  - Dan Gertis – SDS Landfill (Sawyer Field Office)
  - Jane Kangas – Fargo Landfill (Fargo Field Office)
  - Tracy Lundquist – WM-Big Dipper Landfill (Gwinner Field Office)

3

Solid Waste Program Updates cont.

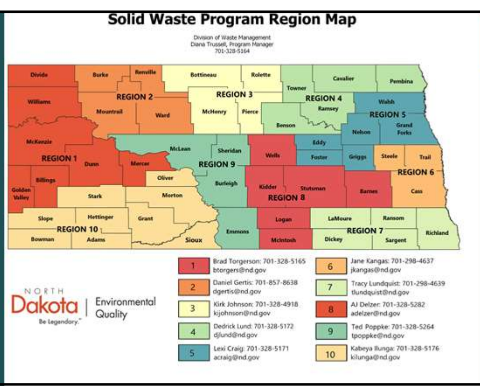
- Large facilities have 2 people assigned to them
  - Ag. facilities
  - Industrial landfills
  - MSW landfills
  - Power Plants
  - Oilfield Special Waste Landfills
- Inspection frequency – quarterly, may be more frequent
  - Monthly for oilfield special waste landfills

4

Solid Waste Program Updates cont.

- 10 Regions in the state
  - Smaller Facilities
  - Complaints
  - Questions from the public and regulated community
- Smaller facilities have 1 person assigned to them by region
  - Inert landfills
  - PBR landfills
  - Transfer Stations
- Inspection frequency – annually, may be more frequent

5



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Solid Waste Program Updates cont.

- Facilities were notified in December 2020:
  - Solid Waste staff responsible for the facility
  - Procedures for submitting documents
  - Facility Contact Form – return to the Department by January 31, 2021

7

Background

- Rule Timeline
  - 2015
    - Federal coal combustion residual (CCR) rules established
  - 2017
    - ND started working on adopting the CCR rule
    - NDDoH (now NDDEQ) established a beneficial use and recycling stakeholder group
  - 2018
    - Beneficial Use and Recycling Stakeholder group met several times

8

Background

- Rule Timeline
  - 2019
    - Public Comment in December
  - 2020
    - Public Hearing in February
    - AG approval in April
    - Administrative Rules Committee approval in June
  - July 1, 2020 – Rules became effective
  - September 21, 2020 – CCR rule package submitted to EPA for review and approval

9

33.1-20-01.1 General Provisions

- Major change in this Chapter was the addition of numerous definitions
  - Many from the CCR rule
- Variance language updated
  - EPA approval needed for CCR facilities

10

33.1-20-02.1 Permit Provisions and Procedures

- Major change in this Chapter was addition of a General Permit Program
- Recycling exemption from permitting requirements removed for both facilities and transporters
- Clarified what is considered a major permit modification

11

33.1-20-03.1 Permit Application Provisions

- Added language for public notices for general permits
- Clarified language for notifying the county regarding a county vote

12

33.1-20-04.1 General Performance Standards

- Annual groundwater reports for non-CCR facilities due April 1st and must include:
  - Name and address of facility
  - Calendar period covered
  - Map, aerial image or diagram showing the solid waste unit and all wells (up and downgradient) labeled
  - Description of any installation or decommissioned wells

13

33.1-20-04.1 General Performance Standards cont.

- Annual groundwater reports for non-CCR facilities due April 1st and must include:
  - All monitoring data and summary of number of samples
  - Statistical interpretations
  - Narrative discussion of any transition between monitoring programs
  - Identification of occurrences and conditions that prevented compliance
  - Other items identified in facility plans and permit

14

33.1-20-04.1 General Performance Standards cont.

- Added the requirement that a composite liner may not be exposed to freezing more than one winter
- Requirement was moved from 33.1-20-10 Large Volume Industrial Waste and Municipal Solid Waste Ash Landfills

15

33.1-20-05.1 Inert Waste Landfills

- Clarified the final cover depth
  - 2 feet with a compacted clay layer
  - 4 feet with no compacted clay layer

16

33.1-20-06.1 Municipal Waste Landfills

- Fixed a typo that previously stated:
  "The gates must be locked when an attendant is on duty"

17

33.1-20-07.1 Small Volume Industrial Waste Landfills and Special Waste Landfills

- Updated to reflect that this chapter does not apply to CCR landfills that are subject to chapter 33.1-20-08

18

33.1-20-08 Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments

- New chapter for facilities that dispose of CCRs from electric utilities and independent power producers
- Contains the following sections:
  - Definitions
  - Applicability
  - Location Standards
  - Design Criteria
  - Operating Criteria
  - Ground Water Monitoring and Corrective Action
  - Closure and Postclosure Care
  - Recordkeeping, Notification, and Posting of Information to the Internet

19

33.1-20-08.1 Surface Impoundment Provisions

- Updated to reflect that this chapter does not apply to CCR surface impoundments that are subject to chapter 33.1-20-08

20

33.1-20-09 Land Treatment Provisions

- No updates or changes

21

33.1-20-10 Large Volume Industrial Waste and Municipal Solid Waste Ash Landfills

- Removed the requirement that a composite liner may not be exposed to freezing more than one winter
- Requirement was moved to 33.1-20-04.1 General Performance Standards

22

33.1-20-11 Landfill Disposal of TENORM

- Updated two citations for NDAC code references

23

33.1-20-12 Regulated Infectious Waste

- Updated language to ensure consistency with CDC, DOT and OSHA
- Updated section on management standards
- Added section for recordkeeping requirements

24

33.1-20-13 Water Protection Provisions

- Added exemption for CCR facilities for some requirements
- Fixed several typos

25

33.1-20-14 Financial Assurance Requirements

- Clarified the use of multiple mechanisms
- Removed the use of reserve accounts
- Added section on releasing financial assurance for completion of closure and postclosure

26

33.1-20-15 Solid Waste Management Fees

- Solid Waste Transporters:
  - Application fee of $200
  - No annual fee
  - 5-year permit which expires June 30th of the 5th year
  - Decals required for each transport vehicle and cost $25 per pair of decals (1st pair free)
  - Online application – pay by credit card or ACH
- Application fees and annual fees are based on each permitted unit, not the permitted facility

27

33.1-20-16 Certification of Operators

- Added requirement for a certified operator to be onsite at all times during the operation of the facility for:
  - Oilfield Special Waste Landfills
  - TENORM Landfills
- Added requirement for at least one certified operator whose primary work location is at the facility for:
  - Industrial Waste Landfills
  - CCR Special Waste Landfills

28

33.1-20-17 Solid Waste Management Planning

- Removed references to solid waste management districts
- Updated language to reflect requirements can apply to any person or political subdivision within North Dakota in accordance with North Dakota Century Code chapter 23.1-08

29

33.1-20-18 Solid Waste Management Fund

- No updates or changes

30


NORTH
Dakota | Environmental Quality
Be Legendary.
Questions?
DIANA TRUSSELL
(701) 328-5164
DTRUSSELL@ND.GOV

PRETEST

JANUARY 2021

PLEASE ANSWER THE FOLLOWING QUESTIONS TO THE BEST OF YOUR ABILITY. THIS TEST WILL NOT BE GRADED OR COLLECTED - **PLEASE USE FOR A STUDY GUIDE**.

Please **match** Column A (answers) to Column B, to answer or complete the statement. Place the letter from Column A into the blank on Column B.

<u>Column A</u>

a) Compaction

b) 3-15

c) Scale house

d) Liquids

e) Would not

f) Gentle (slight) slope

g) Asbestosis

h) Daily

i) March 1st

j) Grass clippings and scrap iron

k) Between the LEL and UEL

l) Methane

<u>Column B</u>

________ What type of gas is monitored at a landfill?

________ An applicant ____________ be allowed to place a landfill in a wellhead protection area.

________ Done well, this results in less wasted air space.

________ How often should six inches of clean cover be applied to an active area of an MSW landfill?

________ Where are wastes first accepted or rejected?

________ Annual reports are due when?

________ A paint filter tests for ________ in waste.

________ Two items frequently collected and recycled at an INERT landfill.

________ Indicated on a contour map by lines spaced far apart.

________ Methane is explosive ________________.

________ Most of the time, final cover slopes are ___%.

________ Scarring of the lungs by asbestos particles is called what?

For the next few questions, please fill in the blanks.

1. What do the 3 C's of landfill management represent (three words)?

    ______________________, ______________________________ and

    _____________________________________.

2. According to Subtitle D, there are 2 types of acceptable liners (bottom) for MSW landfills. The first is a 4-foot compacted clay liner; the second is a composite liner that consists of compacted clay and HDPE. What is HDPE and what is it primarily made from?

   ____

3. If there is a closed area at your landfill and you notice springs, seeps, or moist soils – this may indicate that ___________________________ is being generated.

4. Please list 2 types of regulated infectious waste:

   ___________________________________&_____________________________________.

This section is True or False; please circle or underline the correct one.

5. Mathematically speaking when one is figuring the "area" of a space, it is length multiplied by width. True or False

6. Asbestos Concrete pipe can be disposed in an MSW without any special precautions or regulations? True or False

7. You should always remember to label your mathematical answers such as Sq. Ft., percent {%}, tons, or cubic yards per month {C.Y./Month}.

   True or False

8. Access to the inert waste landfill facility must be controlled by lockable gates and a combination of fencing, natural barriers, or artificial barriers.

   True or False

9. Landfill cells are typically measured in square inches OR centimeters.

   True or False

10. Extra precautions are necessary when dealing / handling leachate instead of stormwater.

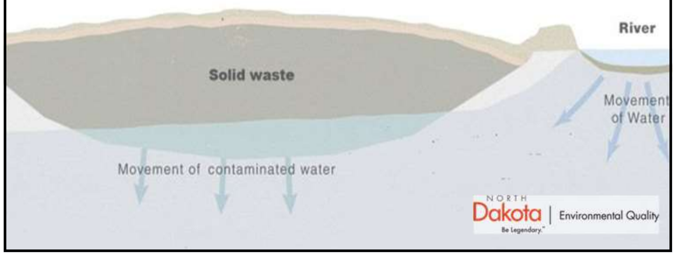
    True or False

This section is a couple of multiple choice - Please select the answer that best fits.

11. Run-off from a landfill, that has contacted the waste, is considered contact leachate water so:
    A. Run-off must be treated as leachate.
    B. Run-off, if pumped out of the active cell, can be treated as stormwater.
    C. Run-off is hard to catch up with.
    D. Both B and C are correct.

12. Run-on at a landfill is considered contact leachate water if it touches the open working face, so:
    A. If the run-on water does not touch the open working face, it can be used for controlling dust.
    B. If the run-on water does not touch the open working face, it can be stored in a sediment basin.
    C. ALL water should be considered leachate no matter what and treated as if it was leachate.
    D. Both A and B are correct.

LANDFILL SITE SELECTION
&
SOILS FOR COVER & LINERS



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LANDFILL SITE SELECTION

2

WHERE DO YOU START?!

- Area Considerations
- Site Considerations
- Location Standards
- Location Restrictions

3

AREA CONSIDERATIONS

- Regional/State politics
- Does a county waste management plan exist?
- Waste source area:
  - Transportation distances
  - Transportation routes
- Township, local zoning, & land costs
- Cooperative land owners
- Local attitudes

4

A LANDFILL SITING CHALLENGE:

- Local attitudes: NIMBY!, NOPE!, etc.

5

SITE CONSIDERATIONS

- Size of operation
- Landscape features (slope, soils, etc.)
- Adjacent Watersheds
- Adjacent Aquifers
- Past & present land uses (cultural, urban, agricultural, etc.)
- Other considerations

6

LOCATION STANDARDS
NO SOLID WASTE MANAGEMENT FACILITY MAY BE IN…

- Areas which result in impacts to:
  - Human Health
  - Local Environment
- Areas Unsuitable because of:
  - Topography
  - Geology
  - Hydrology
  - Soils

7

LOCATION RESTRICTIONS
EXCLUDED AREAS

- Unstable areas (channels, ravines, steep topography, underground mines, fault areas, seismic zones)
- Within aquifers
- Wellhead protection areas
- 100-year floodplain

Photo credit: joevare

8

LOCATION RESTRICTIONS
EXCLUDED AREAS (CONTINUED)

- Woody draws
- Endangered or threatened species critical habitats
- < 10,000’ to Jet Airport Runway
- < 5,000’ to Non-Jet Airport Runway
- < 25’ to Utilities
- Areas the Department considers unsuitable

9

LOCATION RESTRICTIONS

DOUBTFUL AREAS

- Final cuts of surface mines
- < 1,000' to downgradient well
- < 1,000' to national or state parks
- < 200' horizontally from ordinary high water elevation of any surface water or wetland
- Siting new landfills near city residential zones

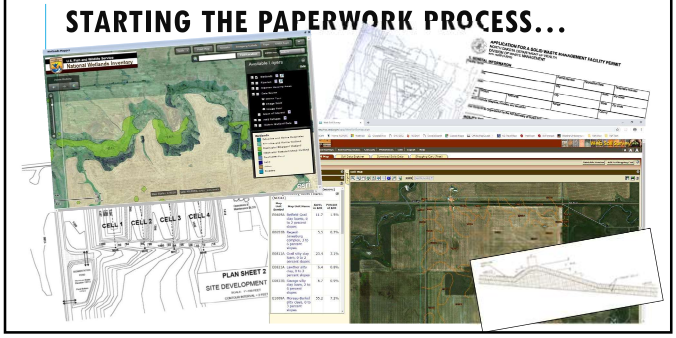
10

WHAT MAKES A GOOD SITE?

- High and dry
- Clay soils are best (avoid sandy/gravelly soils)
- Not too steep
- Deep water table
- ND location restrictions

11

STARTING THE PAPERWORK PROCESS…



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SOURCES OF INFORMATION FOR SITING LANDFILLS

- US Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS)
https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm
- ND NRCS→ local offices!
https://www.nrcs.usda.gov/wps/portal/nrcs/site/nd/home/
- USDA Farm Service Agency
https://www.fsa.usda.gov/

13

SOURCES OF INFORMATION FOR SITING LANDFILLS

- Federal Emergency Management Agency (FEMA)
https://msc.fema.gov/portal/home
- US Fish & Wildlife Service (USFWS)
https://www.fws.gov/wetlands/Data/Mapper.html
- ND State Water Commission
http://mapservice.swc.nd.gov/

14

SOURCES OF INFORMATION FOR SITING LANDFILLS

- US & ND Geological Surveys
https://ngmdb.usgs.gov/topoview/
https://www.dmr.nd.gov/ndgs/
- ND Department of Environmental Quality(NDDEQ) 701-328-5166
https://deq.nd.gov/WQ/1_Groundwater/1_SW.aspx
- Other local information

15

PRE-APPLICATION
HELP SCREEN OUT UNSUITABLE SITES!

- Use existing information:
  - Regional zoning: agricultural, etc.
    - State will NOT supersede Local Zoning Authority
  - Soils – NRCS soil survey
  - Regional geological studies
  - Regional groundwater studies
  - Other existing site information
  - Preliminary facility description

16

APPLICATION
AFTER SITE PRE-APPLICATION APPROVAL NECESSARY STEPS:

- Hydrogeological investigation (geology and ground water)
- Soil survey (NRCS webpage)
- Site engineering plan
- Develop a Plan of Operation
- New facilities may be subject to public vote

17

SOILS FOR COVER & LINERS

18

WHAT IS SOIL?

- Top several feet of earth's surface
- Influenced by five soil forming factors
  - Parent material, Climate, Vegetation, Topography, and Time
- Natural three dimensional bodies with distinct horizons
- Medium for plant growth
  - Suitable Plant Growth Material (SPGM) = "topsoil"
  - Clay-rich soil material = "subsoil"

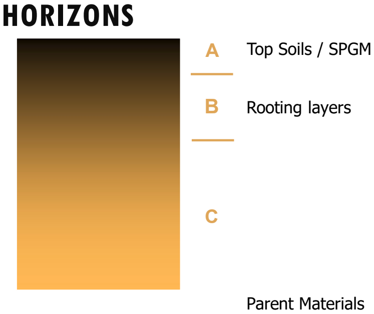
19

SUITABLE PLANT GROWTH MATERIAL (SPGM)

- Commonly referred to as "topsoil"
- "A" horizon and the upper "B" horizon
- Darker colored from the organic matter content
- Survey before removal
- Stockpile, label, and seed for site closure

20

SOIL HORIZONS



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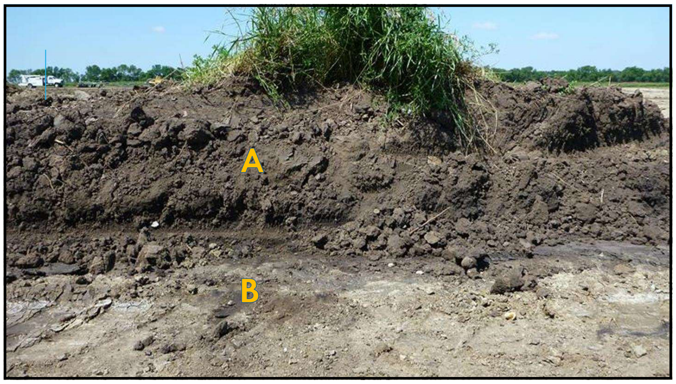


22

WHY ARE SOILS IMPORTANT TO THE LANDFILL OPERATOR?

- Liner construction
- Daily cover
- Landfill cap
- Site reclamation
- Support vegetation

23

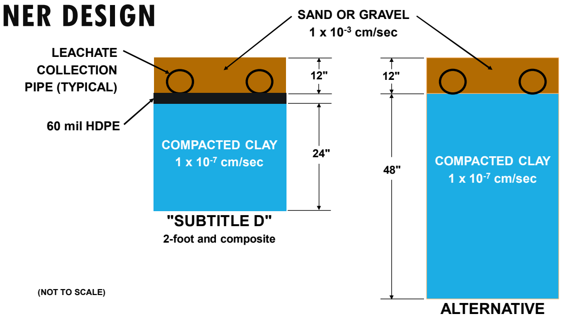
SOIL SURVEY SOIL CLASSIFICATION

WHEN EXCAVATING FOR A NEW CELL:

- Professional Soil Classifier
- Determine soil properties
- Outline soil types on map
- Determine depth to remove
- Quantify and Stockpile

24

LINER DESIGN



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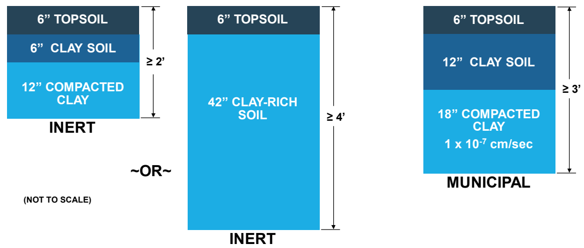
LINER CONSTRUCTION

26

LINER CONSTRUCTION

27

COVER SYSTEMS



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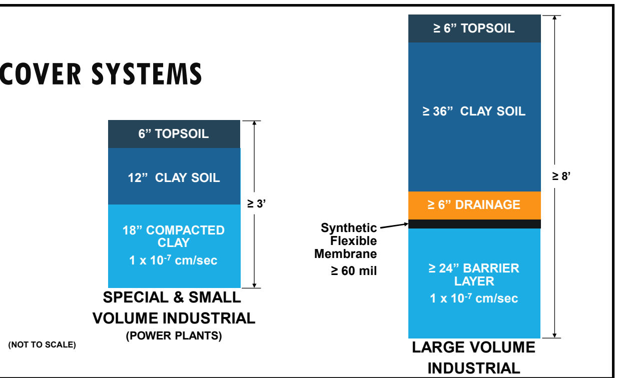
COVER SYSTEMS



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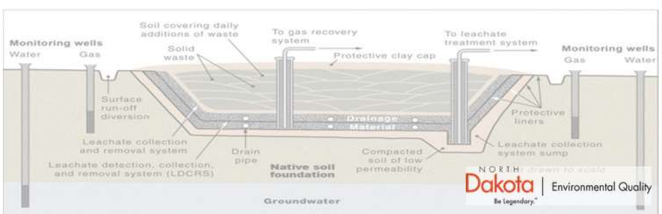
COVER SYSTEMS

30

COVER SYSTEMS

31

ANY QUESTIONS?



32

Access Control, Signs and Scale House Operations

1

"Access to the facility must be controlled by lockable gates and a combination of fencing, natural barriers, or artificial barriers"

NDAC 33.1-20-05.1-02(1) & 33.1-20-06.1-02(1)

2

Gates must be locked when an attendant is not on duty

3

Access Control:

- Comply with the law
- Prevent illegal dumping
- Keep out kids
- Keep out scavengers
- Relatively inexpensive
- Limits liability

4

5

6

7

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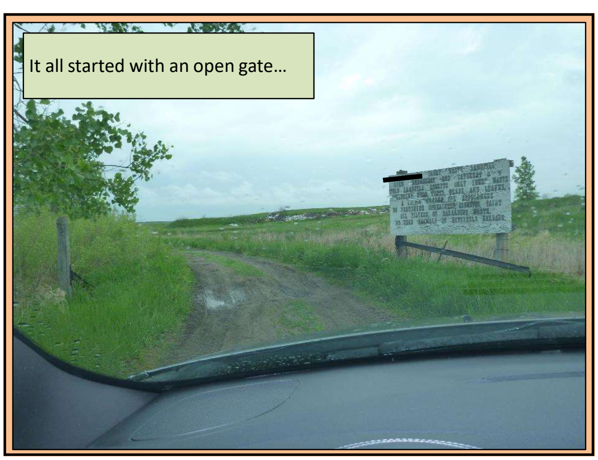

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10

11

How This Could Have Been Avoided:

- **Locked gate** – Access control isn't enough if it isn't secured
- **Attendant on duty** – Discourage disposal of unacceptable waste
- **Better signs** – Direct what waste belongs where
- **Public Education Campaign** – Talk at City Council meeting or other local venue, ask City to include simple info in electronic newsletter or communications.

12

Fence Design:

- Keep Vehicles Out
- Keep Waste In
- Reuse Materials
    - Railroad Ties, Rails
    - Barbed Wire
- Use Imagination!
- Natural Barriers May Be Acceptable

13

14

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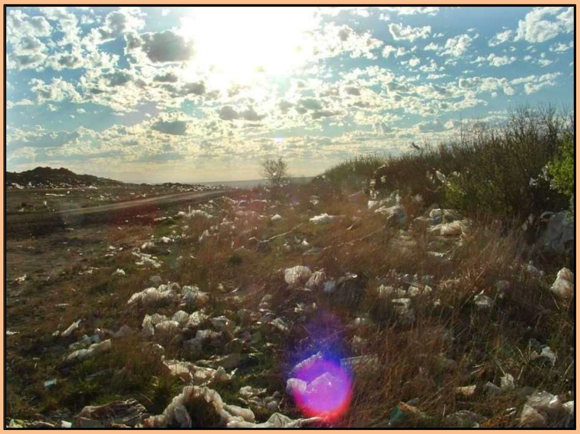


16

Is there potential for windblown waste?

What practices could be used to prevent windblown waste in this situation?

17

TDA2

18

19

20

SIGNAGE

A permanent sign must be posted at the entrance of a facility, or at the entrance of a solid waste management unit used by a facility for wastes generated onsite, which indicates the following:

- The name of the facility;
- The permit number;
- The name and telephone number of the owner and the operator (if different than the owner)
- The days and hours the facility is open for access;
- The wastes not accepted for disposal; and
- Any restrictions for trespassing, burning, hauling, or nonconforming dumping.

21

CITY OF "YOURTOWN" INERT WASTE LANDFILL

PERMIT NUMBER (IF APPLICABLE)

OPEN FRIDAY AND SATURDAY 12-3 P.M.

THIS LANDFILL ACCEPTS ONLY INERT WASTE INCLUDING WOOD, TREES, CONCRETE, GRASS AND LEAVES, AND METAL

MUNICIPAL, INDUSTRIAL, COMMERCIAL AND INFECTIOUS WASTE IS NOT ACCEPTED

NO PESTICIDE CONTAINERS, ASBESTOS, PAINT, OIL FILTERS, OR HAZARDOUS WASTE

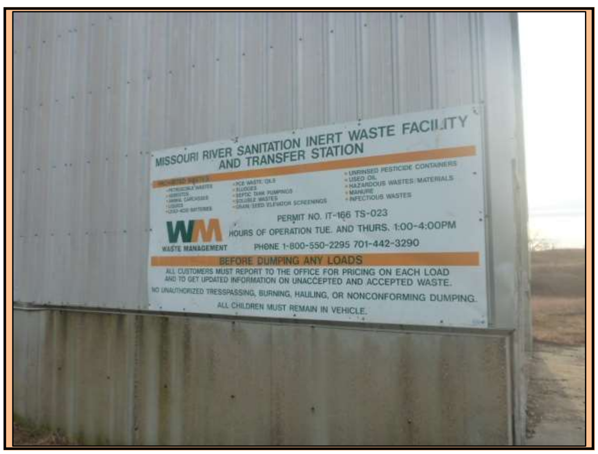
LOCAL ORDINANCE INFORMATION

IN CASE OF EMERGENCY OR FOR INFORMATION

CALL "YOUR NAME" 555-555-5555

22

23



24


Grand Forks Municipal
Solid Waste (MSW) Landfill
Permit #0347
City of Grand Forks Public Works #701-738-8740
After Hours Contact #701-746-2595
Facility Hours of Operation
Monday - Friday 7:30am - 5:00pm
Saturday 7:30am - 12:00pm
Access to this facility limited to
City of Grand Forks
authorized personnel and equipment.
No unauthorized disposal, trespassing,
scavenging, vandalism, littering, burning.
Prohibited Wastes:
Liquids
Unrinsed Pesticide Containers
Lead-Acid Batteries
Used Oil
PCB Waste/Oil
Sludges
Manure
Septic Tank Pumpings
Regulated Infectious Waste
Hazardous Wastes, i.e.:
Ignitables (Solvents, Paints, Fuels)
Corrosives (Acids, Alkalies)
Reactives
Listed Wastes
The Operation of this Landfill Facility
is regulated under Article 33-20 of the
North Dakota Administrative Code.

25


City of Devils Lake Inert Landfill
Permit# IT-154
OPEN BY APPOINTMENT CALL 662-7624 OR 662-7600
DISPOSAL OF THE FOLLOWING WASTE IS PROHIBITED
AGRICULTURAL WASTE
MUNICIPAL WASTE
RADIOACTIVE WASTE
ASBESTOS WASTE
COMMERCIAL WASTE
LIQUIDS
HAZARDOUS WASTE
INDUSTRIAL WASTE
REGULATED INFECTIOUS WASTE & MUNICIPAL WASTE INCINERATOR ASH
NO TRESPASSING OR DUMPING IN
UNAUTHORIZED AREAS

26


LITTLE MISSOURI SPECIAL
PETROCOMP, A DIVISION OF D&M WATER SERVICE, INC.
OWNER: DALE LEIVESTAD
HOURS OF OPERATION
MONDAY-FRIDAY
8:30AM TO 4PM
NDDH SOLID WASTE PERMIT #0357
NDDH Phone # 701-328-5166
OFFICE (701)279-7060
AFTER HOURS (406) 978-2969
EMERGENCIES: DIAL 911
THIS FACILITY ONLY ACCEPTS
EXEMPT NATURAL GAS AND CRUDE OIL EXPLORATION AND PRODUCTION WASTE
1. "ALL LOADS OF WASTE BROUGHT TO THIS SOLID WASTE FACILITY SHALL BE PROPERLY LOADED, CONTAINED, AND, IF NECESSARY, COVERED TO PREVENT ANY SCATTERING, SPILLAGE, OR LEAKAGE OF WASTE DURING TRANSPORT. WHERE SPILLAGE DOES OCCUR, THE MATERIAL SHALL BE PICKED UP IMMEDIATELY BY THE COLLECTOR OR TRANSPORTER AND RETURNED TO THE VEHICLE OR CONTAINER AND THE AREA CLEANED."
2. "THE OPERATION OF THIS FACILITY IS REGULATED UNDER ARTICLE 33-20 OF THE NORTH DAKOTA ADMINISTRATIVE CODE."
SOLID WASTE NOT ACCEPTED AT THIS FACILITY:
• REGULATED INFECTIOUS WASTE
• HAZARDOUS WASTE
• RADIOACTIVE WASTE
• HOUSEHOLD GARBAGE
• PUTRESCIBLE WASTE
• CARCASSES
• WASTE GRAIN SEED AND ELEVATOR SCREENINGS
• OTHER SLUDGES OR LIQUIDS
• UN RINSED PESTICIDE CONTAINERS
• BATTERIES
• WASTE OIL PCB WASTES/OILS
• PCB CONTAMINATED
• MATERIALS
• MUNICIPAL WASTE

27

28

29

Additional signs within the landfill may help
reduce confusion of what should be disposed of where

30


SITE 1
SITE 2 Compost
SITE 3 Concrete
SITE 4 Building Materials
SITE 5 Appliances
CHILDREN MUST STAY IN VEHICLES

31


Transporters Note:
North Dakota Solid Waste Transporters Permit Required!
All loads brought to this facility must be carefully loaded and transported such that waste will not fall, leak, spill or release airborne waste materials during transit.
Waste containing free liquids will not be accepted for disposal.
All waste must be cleaned from outer vehicle surfaces and tires before exiting this facility.

32


ATTENTION
-DURING HIGH WIND EVENTS-
(WINDS 20 MPH AND HIGHER)
ALL LOOSE MATERIALS SUCH AS BUT NOT LIMITED TOO...
PLASTIC, CARDBOARD, STYROFOAM, INSULATION AND PAPER ITEMS WILL NOT BE DUMPED DUE TO HAZARDS CAUSED BY FLYING DEBRIS ON LANDFILL PROPERTY AND PRIVATE PROPERTY.
ALL LOOSE LOADS WILL BE TURNED AWAY UNTIL THE WIND EVENT IS CONSIDERED OVER BY THE LANDFILL PERSONNEL.
IF THE LOAD MUST BE DUMPED YOU WILL BE CHARGED THE CURRENT SOLID WASTE RATE OR YOU WILL BE TURNED AWAY.

33

34

Scale House Operations

- Communicate with hauler
- Record types and amounts of waste
- Conduct waste screening
- Accept or reject wastes
- Record final waste disposal location
- Direct waste disposal activities

35

Scale House Records

- Vehicle ID
- Date and time
- Vehicle weights
- Waste types
- Disposal location
- Collected fees
- Computerize

36

37

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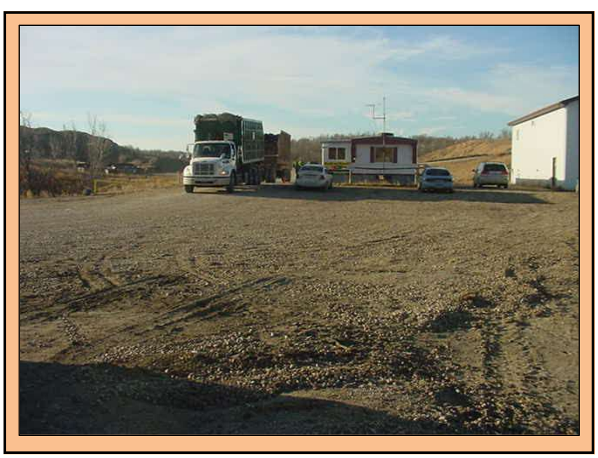
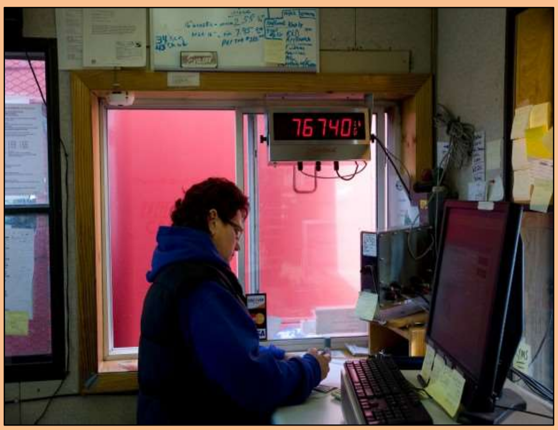


39

Scale House Operator

- Questions and screens haulers at gate
- Provides list of prohibited waste to haulers
- Rejects loads of prohibited waste
- Determines if waste was transported correctly
- Accepts fees

40



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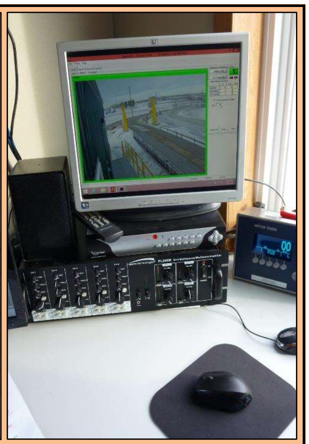


47

Waste Rejection Reports

Should be used to reject:

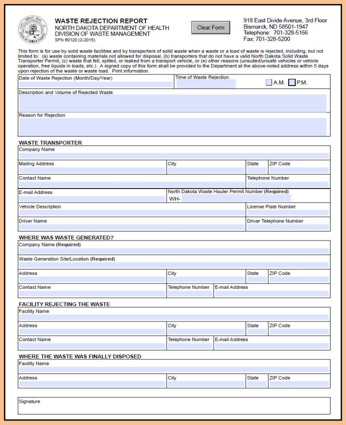
- Poorly separated waste
- Waste suspected of being misleading or mislabeled (ex. hidden filter socks, etc.)
- Waste prohibited in rules and/or permit for disposal at facility
- Etc.

Use your best judgment!

If waste was rejected, the transporter or landfill staff must file a report with the Department within five days of the rejection.

- Determine a load will be rejected and why
- Record as much information on the rejection form as possible (important for follow-up)
- Remind transporter to supply a copy of the rejection form to the generator
- Submit form to the Department

48



WASTE REJECTION REPORT
NORTH DAKOTA DEPARTMENT OF HEALTH
DIVISION OF WASTE MANAGEMENT
SFN 60120 (2-2015)

Clear Form

918 East Divide Avenue, 3rd Floor
Bismarck, ND 58501-1947
Telephone: 701-328-5166
Fax: 701-328-5200

This form is for use by solid waste facilities and by transporters of solid waste when a waste or a load of waste is rejected, including, but not limited to: (a) waste containing materials not allowed for disposal, (b) transporters that do not have a valid North Dakota Solid Waste Transporter Permit, (c) waste that fell, spilled, or leaked from a transport vehicle, or (e) other reasons (unsuited/unsafe vehicles or vehicle operation, free liquids in loads, etc.). A signed copy of this form shall be provided to the Department at the above-noted address within 5 days upon rejection of the waste or waste load. Print information.

Date of Waste Rejection (Month/Day/Year) | Time of Waste Rejection ☐ A.M. ☐ P.M.

Description and Volume of Rejected Waste

Reason for Rejection

WASTE TRANSPORTER

Company Name

Mailing Address | City | State | ZIP Code

Contact Name | Telephone Number

E-mail Address | North Dakota Waste Hauler Permit Number **(Required)** WH-

Vehicle Description | License Plate Number

Driver Name | Driver Telephone Number

WHERE WAS WASTE GENERATED?

Company Name **(Required)**

Waste Generation Site/Location **(Required)**

Address | City | State | ZIP Code

Contact Name | Telephone Number | E-mail Address

FACILITY REJECTING THE WASTE

Facility Name

Address | City | State | ZIP Code

Contact Name | Telephone Number | E-mail Address

WHERE THE WASTE WAS FINALLY DISPOSED

Facility Name

Address | City | State | ZIP Code

Signature

The waste rejection form (SFN 60120) can be found online at the Department's website:

https://deq.nd.gov/Forms/WM/WasteRejectionReport.pdf

Contact Kirk Johnson at the Department for questions regarding waste rejection reports

49

The Paint Filter Test

- Used to determine if a waste contains "free liquid"
- NDAC 33.1-20-01-03 (32) "'Free liquid' means the liquid which separates from the solid portion of a solid waste under ambient pressure and normal, above freezing temperature. The environmental protection agency paint filter liquids test method or visual evidence must be used to determine if a waste contains free liquid"
- NDAC 33.1-20-06.1-02 (8)(d) Municipal Waste Landfills- Liquids may not be accepted (except in amounts normally in household waste)
- Special Waste Landfills- Free liquids referred to in individual permits
- Method 9095b Procedure is online at http://www.epa.gov/osw/hazard/testmethods/sw846/pdfs/9095b.pdf

50

Scale House Review

- Scale house is critical
- Sets tone for operation
- Helps prevent prohibited waste disposal
- May be the only contact
- Opportunity to educate patrons
- Establishes relationship with customers

51

52

Questions?

Dedrick Lund
djlund@nd.gov
701-328-5172

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Be Legendary.

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LANDFILL SAFETY

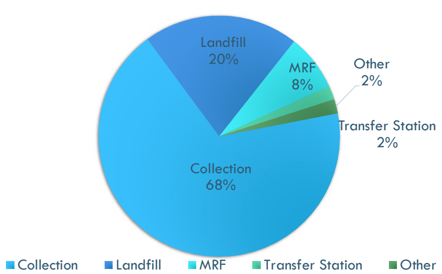
1

STATISTICS

- According to the Bureau of Labor Statistics(BLS), employee injury and illness rates rose from 3.9 per 100 solid waste employees to 4.9 incidents per 100 employees from 2018 to 2019.
- The incident rate for solid waste collection workers is 5.5 per 100 workers in 2019. The BLS found collection workers had the sixth deadliest occupation in 2019.

2

2019 WORKER FATALITIES BY LOCATION



3

TYPICAL INJURIES OF SOLID WASTE WORKERS

Include:

- Cuts and bruises
- Sprains and strains including back injuries
- Broken bones
- Head trauma
- Severed appendages
- Chemical burns
- Puncture wounds
- Crushing trauma

4

WHY SAFETY FIRST?

- Reduce human pain and suffering
- Reduce Liability
- Save money
- Comply with laws and regulations (OSHA)

5

A SAFE WORKPLACE

- Leading cause of an unsafe workplace in the US is the lack of safety training by employers!
- All employees deserve a safe workplace!
- Safety plans are effective when combined with initial and ongoing training and consistent enforcement of safety policies by supervisors

6

SAFETY PLANS

- Comprehensive Safety Program
- Identify common hazards
- Make safety a priority

7

SAFETY PLANS

- Emergency Response Training
- Fire control
- Gas management
- Confined space entry
- Waste screening for hazardous, liquid and infectious wastes
- First aid training
- Exit Routes

8

SAFETY MEETINGS/TRAINING

- Applicable (may vary from site to site)
- Held at least once a month
- Identify potential risks
- Review your facility's history
- Discuss appropriate response
- Document all training events
- Keep it simple
- Be consistent
- Include everyone (rookies, old-timers, outside contractors)

9

SAFETY BASICS

Personal Protective Equipment (PPE)

- Hardhat and Boots
- Safety vest
- Coveralls and gloves
- Radios
- Ear Plugs
- Dust mask
- Safety goggles
- Other………

10

LANDFILL SAFETY

Hold monthly safety meetings and require all employees to attend

Operate machinery slowly and carefully

Let the public know that random load inspections occur

Regularly update safety plans

Celebrate success to encourage accident prevention

11

LANDFILL SAFETY

- Clearly mark the area where the public arrives
- Discourage scavenging
- Provide materials to educate the public about how to dispose of materials in the landfill
- Keep fire extinguishers on hand and post the fire department number by the phone

12

SAFETY ISSUES FOR LANDFILLS

- Heavy Equipment
- Trash
- Public
- Trucks
- Fires
- Backing up
- Falls
- Accidents and Emergencies
- Random load checks and material handling
- Working alone
- Inexperience
- Scavenging
- Contaminated Medical Waste

13

EQUIPMENT OPERATIONS

- Too frequently the cause of accidents and traumatic injuries
- Maintain safe work clearances around heavy equipment
- Never work around or under a raised bucket or blade

14

EQUIPMENT OPERATIONS

- Never walk behind a moving piece of equipment
- Know how to stop machines such as conveyers, balers, and sorters
- Keep guards and safety devices in place except when servicing

15

EXCAVATION HAZARDS

Employees can be:

- Struck or crushed by heavy equipment
- Caught in a trench collapse
- Encounter hazardous atmospheres
- Equipment can tip or roll over
- Contact overhead power lines
- Hit underground installations

16

FALL HAZARDS

- Typical fall hazard of 6 feet or more occurs when workers stand on heavy equipment or trucks and containers
- 849 fatalities due to slips, trips, and falls in 2016 in the US

17

FALL HAZARDS

To avoid fall hazards:

- Move work to ground level
- Adding platforms, guard rails and toe boards
- Ensure that floor openings, pits, etc. are securely covered or guarded
- Personal fall protection devices

18

OVEREXERTION

- Workers risk overexertion injuries due to manual lifting, handling tools, materials and trash
- To avoid, use better mechanization, such as forklifts and conveyers
- Make sure employees are trained in proper lifting techniques and ask for help when lifting heavy or awkward items

19

WELDING

- Can cause burns, hazardous air contaminants and fires
- Workers should only weld in designated areas away from fire hazards and combustibles
- Use shields for protection

20

WELDING

- Ban personal lighters from work area
- Ensure adequate local ventilation where landfill gasses may accumulate
- Never weld or cut on used drums, barrels, tanks, or other containers unless they have been thoroughly cleaned

21

SWANA – 5 TO STAY ALIVE

Safety campaign of five simple tips to help solid waste workers stay safe on the job

Specialized for workers based on job function and location

Basic information to help reduce accidents and injuries

22

5 TO STAY ALIVE: SAFETY TIPS FOR COLLECTION EMPLOYEES

1. Always wear PPE, especially high visibility vests and/or outwear
2. Never use your cell phone while driving the truck or at a disposal facility
3. Don't ride on the step if the truck is BACKING or going more than 10mph
4. Always comply with safety belt rules
5. Don't exceed the speed limit and don't rush

23

5 TO STAY ALIVE: SAFETY TIPS FOR LANDFILL EMPLOYEES

- Proper PPE is a MUST!
- Are you the right person for the task?
- Maintain situational awareness
- Heavy equipment has the right of way
- No scavening

24

5 TO STAY ALIVE: SAFETY TIPS FOR TRANSFER STATIONS

- Wear PPE at all times
- Know your danger zones
- Establish/enforce vehicle separation rules
- Good housekeeping is essential
- Lock out/tag out always!

25

IS THIS SAFE??

26

IS THIS SAFE??

27


QUESTIONS?

Maps, Math and Plans

For Landfill Operators

North Dakota | Environmental Quality

Be Legendary.

1

Objectives

- Identify four types of plan sheets
- Read and use information on the plan sheets
- Feel comfortable about basic math following a short review
- Interpret key features on topographic maps
- Calculate area, volume and slopes

2

4 Types of Plan Sheets

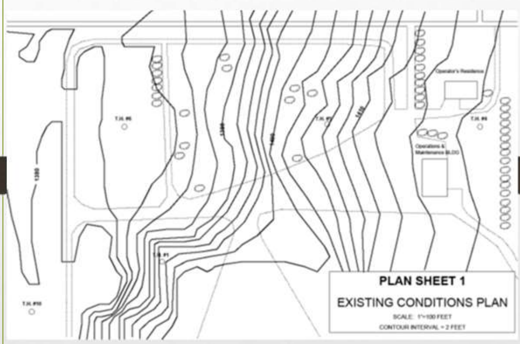
- Existing conditions plan
- Phase development plans
- Final contour plan
- Cross section plans

3

Existing Conditions Plan

- Shows pre-development site features:
  - Existing buildings
  - Roads
  - Drainage
- Uses contours lines to indicate elevations

4



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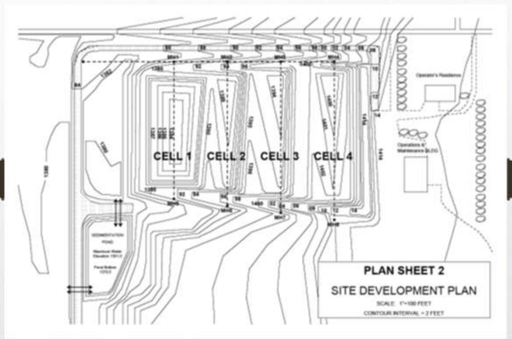
Phase Development Plans

- Series of sheets showing:
  - Site development in phases over time
  - Location/sequence of filling
- Includes:
  - Construction/development over time
  - Drainage
  - Monitoring points

6

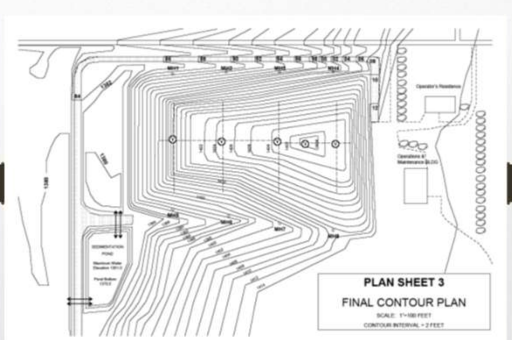


7

Final Contour Plan

- Shows:
  - Site appearance when complete with final cover
  - Drainage

8

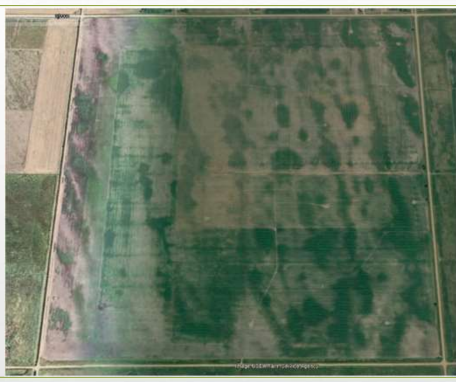


9

Plan Characteristics

- Existing conditions, phase development and final contour plans:
  - Plan (bird's-eye) view
  - Scale: 1 inch = 100 feet
  - Contour interval = 2 feet

10



11

12

Cross Section Plan

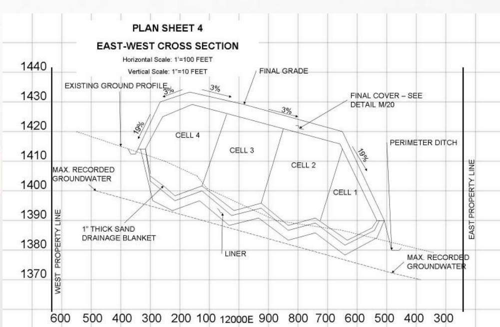
- Shows:
  - Vertical limits of excavation
  - Filling sequence
  - Depth to water table
  - Liner thickness
  - Cover thickness

13

Cross Section Plan Characteristics

- “Slice of pie” view
- Shows elevation on grid
- Horizontal scale: 1 inch = 100 feet
- Exaggerated vertical scale: 1 = 10 feet

14



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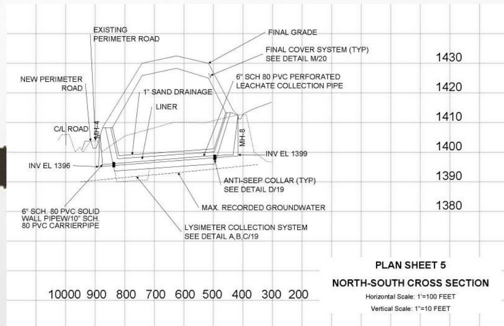
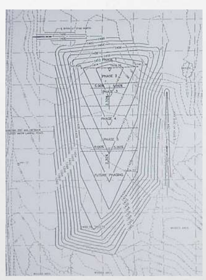


16

Plan Reading Skills

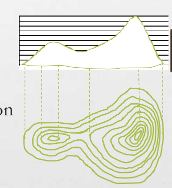
- Read the scale
- Interpret contour lines
- Identify and interpret key features on topographic maps



17

Contour Lines

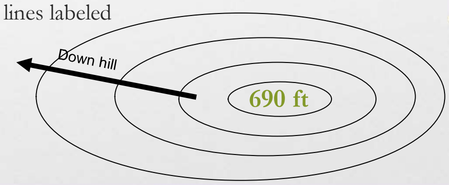
- Used on a plan view to:
  - Show change in elevation
  - Add dimension to flat paper
  - Connect points of equal elevation
  - Represent slope steepness
- Contour lines do not cross



18

Hill or Hole?

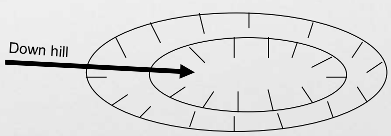
- A hill should be represented by the standard contour line convention, with every 5 – 10 lines labeled



19

Hill or Hole?

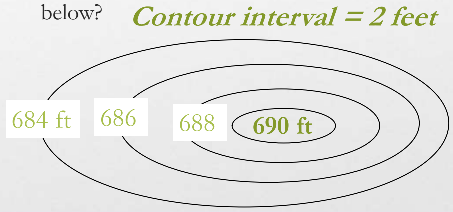
- A hole or depression should have hatch marks on the down hill side of the contour line, otherwise, every contour should be labeled



20

Contour Example #1

- What is the elevation at the top of the slope below? ***Contour interval = 2 feet***

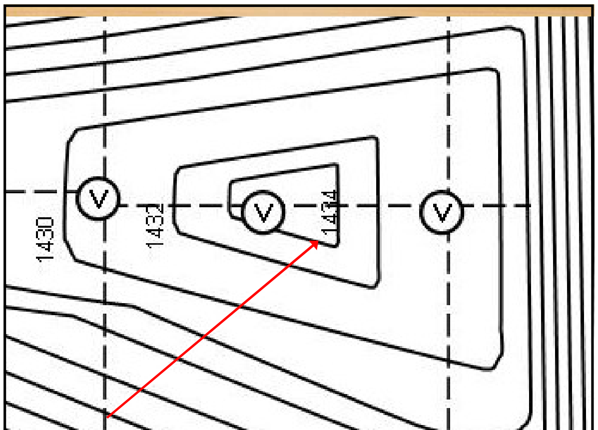


21

Contour Example #2

- On Plan Sheet #3, what is the maximum final height of the fill area?

22



23

Calculating

- Calculations will be set up using the Factor-Label method
  - Factors are the numbers
  - Labels are the units (ft., yd., in.)
  - Use conversion factors to get the units you want to know
  - Multiply factors on top
  - Divide by factors on the bottom

24

Example

- How many feet are in 60 inches?

$$\_\_\_\_\_ \; ft. = 60in. \times \boxed{\frac{1\,ft.}{12in.}}$$

Conversion Factor

25

Conversion Factor

- A Fraction that equals 1
- Used to convert from known unit (in.) to unknown units (ft.)
- Arrange the factors so that the known units will cancel each other

26

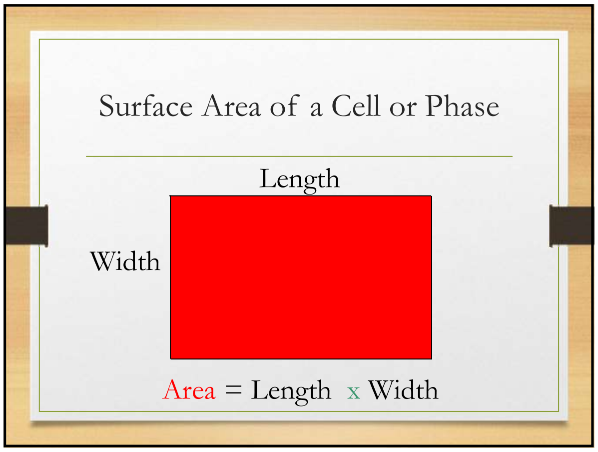
Example

- How many feet are in 60 inches?

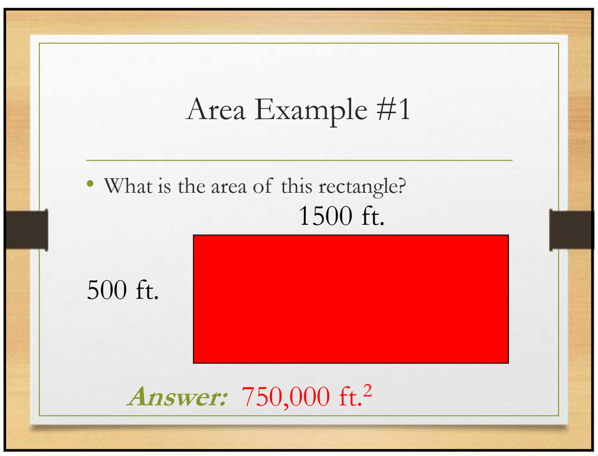
$$\boxed{\_\boxed{5}\_ \; ft.} = \frac{60\cancel{in.}}{1} \times \frac{1\,ft.}{12\cancel{in.}}$$

60 X 1 = 60 ÷ 12 = 5

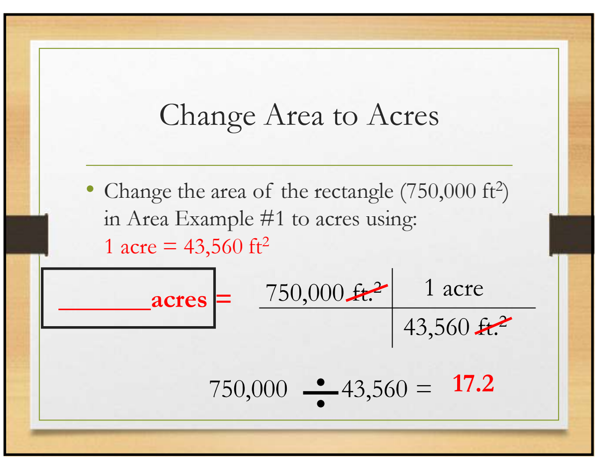
27


Surface Area of a Cell or Phase
Length
Width
Area = Length x Width

28

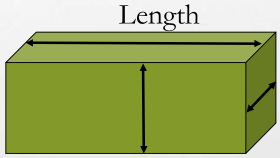

Area Example #1
What is the area of this rectangle?
1500 ft.
500 ft.
Answer: 750,000 ft.²

29


Change Area to Acres
Change the area of the rectangle (750,000 ft²) in Area Example #1 to acres using:
1 acre = 43,560 ft²
________acres =
750,000 ft.²
1 acre
43,560 ft.²
750,000 ÷ 43,560 = 17.2

30

Volume of a Rectangular Solid



Volume = $\underbrace{\text{Length} \times \text{Width}}$ $\times$ Height

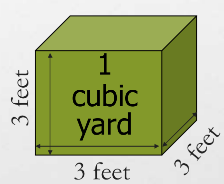
Volume = Area $\times$ Height

31

32

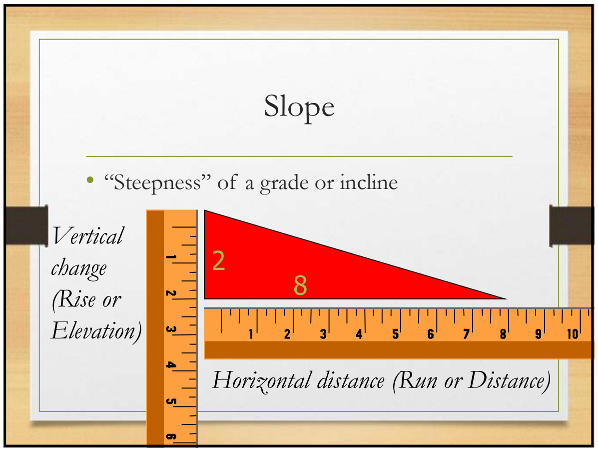
Volume Example #1

- Calculate the volume of a cubic yard

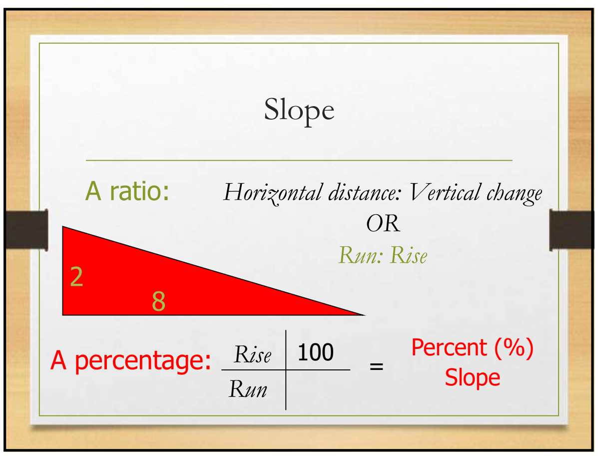


1 yd.^{3} = 3ft x 3ft x 3ft = $\boxed{27 \text{ ft.}^3}$

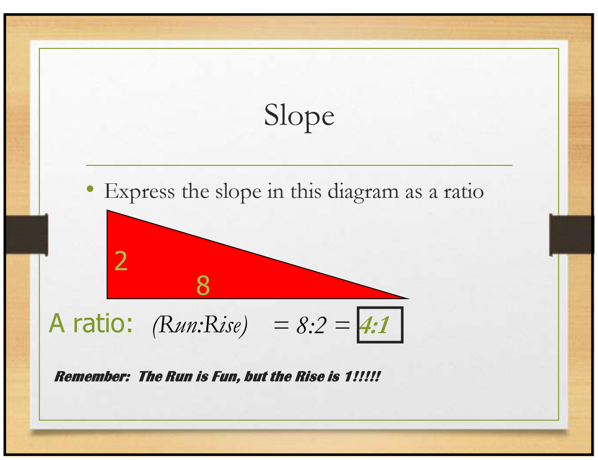
33


Slope
"Steepness" of a grade or incline
Vertical change (Rise or Elevation)
2
8
1 2 3 4 5 6 7 8 9 10
1 2 3 4 5 6
Horizontal distance (Run or Distance)

34


Slope
A ratio:
Horizontal distance: Vertical change
OR
Run: Rise
2
8
A percentage:
Rise
100
Run
=
Percent (%) Slope

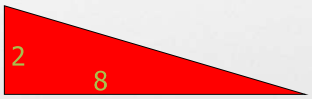
35


Slope
Express the slope in this diagram as a ratio
2
8
A ratio: (Run:Rise) = 8:2 = 4:1
Remember: The Run is Fun, but the Rise is 1!!!!!

36

Slope

- Express the slope in this diagram as a percentage



A percentage: $\frac{Rise}{Run} \Big| 100 = \frac{2}{8} \Big| 100 = 25\%$

37

Slope Review

Slope = $\frac{\text{Rise } \textit{(vertical change)}}{\text{Run } \textit{(horizontal distance)}}$

Expressed as a ratio – Run:Rise

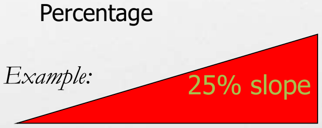
Expressed as a percentage – $\frac{Rise}{Run} \Big| 100$

38

Converting: Slope Percentage to Ratio

$\frac{100}{\text{Percentage}}$ = **Run:1**

Example:



$\frac{100}{25}$ = **Run:1** = **4:1**

39

Slope Conversions

- Convert the following percentages to a ratio:

8%	$\frac{100}{8}$	=	**12.5:1**
2%	$\frac{100}{2}$	=	**50:1**
30%	$\frac{100}{30}$	=	**3.3:1**

40

Converting: Slope Ratio to Slope Percentage

To change Slope Ratio to Slope Percentage

$$\frac{100}{\text{Run}} = \text{Percentage}$$

41

Slope Conversions

- Convert the following slope ratios to a percent:

4:1	$\frac{100}{4}$	=	**25%**
10:1	$\frac{100}{10}$	=	**10%**
100:1	$\frac{100}{100}$	=	**1%**

42

Calculating with 2 variables (Example #1)

- How much electricity, in kW, does your computer use per month if you leave your computer on for 9 hours each day? You know your computer uses .50 kW every hour that it is turned on. Your computer is turned on an average of 23 days each month.

43

Calculating with 2 Variables (Example #1 Solution)

- How much electricity, in kW, does your computer use per month?

$$\boxed{\frac{103.5\ \textbf{kW}}{\textbf{month}}} = \frac{0.5\ \text{kW}}{\cancel{\text{hour}}} \times \frac{9\ \cancel{\text{hours}}}{\cancel{\text{day}}} \times \frac{23\ \cancel{\text{days}}}{\text{month}}$$

44

Calculating with 2 variables (Problem #1)

- What is the fuel efficiency of your car in miles per gallon if you buy 2 tanks of gas every week? The fuel capacity of the tank is 13.5 gallons and you average 1000 miles per week.

45

Calculating with 2 Variables (Problem #1 Solution)

- What is the fuel efficiency of your car in miles per gallon if you buy 2 tanks of gas every week?

$$\boxed{\frac{37.0 \text{ miles}}{\text{gallon}}} = \frac{1000 \text{ miles}}{1\ \cancel{\text{week}}} \times \frac{1\ \cancel{\text{week}}}{2\ \cancel{\text{tanks}}} \times \frac{1\ \cancel{\text{tank}}}{13.5 \text{ gallons}}$$

46

More Calculations

- For additional practice calculations, please attend a help session.
- Special thanks to the Minnesota Pollution Control Agency for materials

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Be Legendary.

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DAY 2

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Waste Acceptance

January 2021

NORTH Dakota | Environmental Quality
Be Legendary.

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Proper Waste Acceptance starts at the Scale House

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Scale House Operator

- Questions and screens haulers at gate
- Provides list of prohibited waste to haulers
- Rejects loads of prohibited waste
- Determines if waste was transported correctly
- Accepts fees and records load weights

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Waste Categorized by Source and/or Characteristic

- **Source**
  - Municipal
  - Industrial
  - Commercial
  - Special (Energy)
  - Medical
  - Construction
  - Demolition
  - Renovation
- **Characteristic**
  - Solid
  - Liquid
  - Inert
  - Hazardous
  - Infectious
  - Radioactive
  - Asbestos

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Acceptance/Screening Program Includes:

- Employee Training
- Random Inspection of Incoming Loads and frequency
- Recordkeeping
- Agency Notification

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Waste Screening Fundamentals (Outside the gate)

- **Know waste sources**
  - **Businesses, Industries, Commercial etc.**
  - **Industrial Waste Procedures**
  - **Special Waste Procedures**
- **Educate sources (generators)**
- **Educate Transfer Station Operators**
- **Educate Haulers**

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Waste Screening Fundamentals (Inside the gate)

- Train personnel
- Develop procedures
- Develop checklists, Keep records
- Monitor Repeat or Problem Haulers or Generators
- Return problem loads – Do Not Accept
- **Contact the Department if there are issues or problems**
- **Document acceptance issues and inspections in Operating Record**

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Waste Screening Fundamentals (Inside the gate, cont.)

- **Contact the Department on issues/problems**
  - **NDDEQ can help with guidance and follow-up**
- **Document acceptance issues and inspections in Operating Record – provide to Department**
  - **Who** brought material in? Name, license, truck ID. Contact information
  - **What was it?** Type of waste, what was the issue?
  - **When** did this occur? Date, time
  - **Where** did this occur (ie landfill name?)
  - **Where** is the waste from – what company, location
  - **Follow–up** where did this waste go (if known)?

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Acceptance Requirements

- Section 33.1-20-04.1-03.1.a NDAC requires a plan of action that includes:
  - A description of waste acceptance procedures:
    - Includes categories of solid waste to be accepted
    - Waste rejection procedures

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Prohibited or Restricted Wastes for Permitted Landfills

- <u>Industrial waste</u> if not addressed in plan/permit
- <u>Special waste if not addressed in plan/permit</u>
- Hazardous waste
- Lead acid batteries
- Liquids (in excess of household amounts)
- Major appliances
- Scrap metal for disposal (Allowed for recycling purposes)
- Pesticide containers
- PCB waste
- Used Oil
- Regulated infectious waste
- Sludges (sewage, lime, grit chamber cleanings, manure, septic tank pumpings)
- <u>Radioactive Waste</u>
- Municipal waste incinerator ash

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Worker Dress Code

- Eye protection
- Boots
- Gloves
- Safety Vest
- Hard hat
- Coveralls
- Respiratory Protection

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Keep Records

- Comply with State/Federal Regulations
- Evidence during legal challenges
- Assists in fine-tuning waste screening program
- Maintain Operating Records, Logbook
  - Available for Departmental Review

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Load Inspection Record

- Who, What, When, Where, Why, To what extent, Action
  - Name of facility and Inspector
  - Date, time, weather
  - Type of vehicle, capacity (yards or tons)
  - License Plate Info & Driver name,
  - ND Waste Hauler Permit No.
  - Contact info, phone number

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Load Inspection Record (cont.)

- Results of inspection: Note any compliance problems
- What action was taken
- If unsure, contact the Dept.
- Create load inspection checklist
- Have camera, take pictures as needed

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Random Load Checking

- Initially check 1% of incoming loads
- Random check eliminates human bias
- Level of effort can increase or decrease depending on what you find

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Waste Acceptance Challenges

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Random Load Checking (cont.)

- Have a separate area to inspect/sample loads
- If possible, create an impervious pad/cover
- Barrier protection for employees as needed
- Sampling tools: cup size to shovels/rakes
- Review facility procedures for rejected wastes
- Industrial/Special waste screening (use radioactive meters if needed
- **KEEP RECORDS**
- Dispose only acceptable wastes

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What to Look For in Load

- Large containers, Drums, many containers
- Gas cylinders
- Strong Chemical smells (Chemical cans, gas, pesticide, etc.)
- Lead Acid Batteries
- Scrap Metal and Appliances
- Powders/granular materials
- Transformers/large capacitors
- Liquids, especially oils, solvents, etc.

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What to Look For (cont.)

- Transfer Stations or Incinerators that separate hazardous materials, e-waste, etc.
- Loads from new customers, new haulers, etc.
- Business or Industrial changes, expansions
- Industrial Waste Loads.
- Metal manufacturers, equipment operators, etc.
- Change-out of lighting, equipment, etc.
- Oilfield Exploration, Production, Service?

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What to Look For (cont.)

- Natural Disaster Response, fires, demo or renovation waste that may have:
  - Electronics, Lighting (ballasts, fluorescent bulbs, HID)
  - Asbestos, chemicals, paint etc.
  - NDDEQ Guidance available to help segregate
- Service/Retail Businesses
  - TV's, CRTs, Painting, Contractors, etc
- Loads brought in outside of working hours, weekends, at night, etc.

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Free Liquids

- **"Free liquid"** means the liquid which separates from the solid portion of a solid waste under ambient pressure and normal, above freezing temperature.
- The environmental protection agency **paint filter liquids test** method or
- **visual evidence** must be used to determine if a waste contains free liquid.

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Free Liquids Determination Procedures

- **Paint Filter Test**
  - Place a sample of waste in a paint filter and see if water comes out.
- **Liquids**
  - Look for free liquids in loads
  - Have them evaluate the waste **before and after hauling**
- Watch sludges, waste that has been in ponds, spills, etc.
- Look for evidence of waste spilling from loads

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The Paint Filter Test

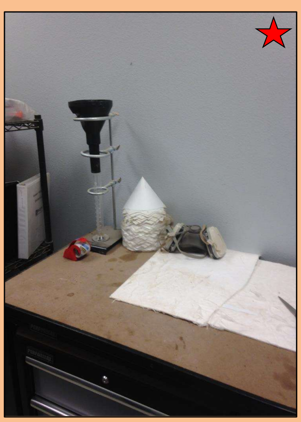
•Used to determine if a waste contains "free liquid"

• NDAC 33.1-20-01-03 (32) "'Free liquid' means the liquid which separates from the solid portion of a solid waste under ambient pressure and normal, above freezing temperature. The environmental protection agency paint filter liquids test method or visual evidence must be used to determine if a waste contains free liquid"

•NDAC 33.1-20-06.1-02 (8d) Municipal Waste Landfills- Liquids may not be accepted (except in amounts normally in household waste)

•Special Waste Landfills- Free liquids referred to in individual permits

• Method 9095b Procedure is online at https://www.epa.gov/hw-sw846/sw-846-test-method-9095b-paint-filter-liquids-test



33

Paint Filter Test

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- Look for evidence of waste spilling from Loads

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Acceptance/Screening Program Includes:

- Employee Training
- **Random** Inspection of Incoming Loads and frequency
- Recordkeeping
- Agency Notification
- Potential Radioactive Waste Screening

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Types of Hazardous Waste

- Listed Hazardous Wastes
- Characteristic Hazardous Wastes
  - Ignitable
  - Corrosive
  - Reactive
  - Toxicity
- Regulated under the hazardous waste rules if a business generates >220 lbs/mo

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COMMON GENERATORS
OF HAZARDOUS WASTE IN NORTH DAKOTA

- Vehicle Maintenance Facilities
- Painting Operations
  - Body Shops
  - Manufacturing
  - Steel Structures
- Dry Cleaning Businesses
- Homes, Hospitals, Schools, Repair Shops, etc.

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PCBs

- Dielectric in Transformers and Capacitors
- Banned in 1979
- May be in older electrical equipment, transformers, capacitors, ballasts, etc
- Greater than 500 ppm must be incinerated
- 50 to 500 ppm must be incinerated or disposed of in chemical waste landfill
- less than 50 ppm ?
  - Address in Industrial Waste Procedures
  - Need Departmental Approval

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Examples of Prohibited Wastes: if you're not sure what was (or still is) in it, reject.

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Waste Acceptance/Management Guide (for generators, haulers, etc.)

- **LEAD BATTERIES ARE PROHIBITED FROM DISPOSAL** in North Dakota landfills and must be segregated for recycling. Lead batteries should not be mixed with other materials and cannot be disposed. Please manage lead batteries carefully to ensure they are not broken.
- **USED OIL IS PROHIBITED FROM DISPOSAL:** Lubricating oil from vehicles and equipment must be recycled. Used oil must be separated in properly labeled containers. Any spillage must be promptly cleaned up.

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Lead Acid Batteries

- Auto, marine, yard
- Seal lead batteries
- Lead is toxic; recyclable
- Retailers required to take them back
- Many Solid Waste facilities accept for recycling

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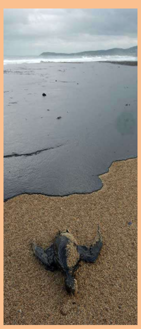
Used Oil



- Defined as any oil that has been refined from crude oil or any synthetic oil which has been used.
- **It is illegal to dispose of used oil in solid waste landfills, on the ground and surface waters.**
- Recycled or burned for energy recovery.

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Used oil is prohibited from disposal

Used motor oil - largest single source of oil pollution in our ocean, creeks and lagoons.

An estimated average of 180 million gallons of used oil spilled each year into our waters, **16 times the amount spilled by Exxon Valdez**.

Used Oil is Very Recyclable

Oil Disposal/Recycling: EPA has some good information: https://www.epa.gov/recycle/managing-reusing-and-recycling-used-oil

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Waste Acceptance/Management Guide
(for generators, haulers, etc.)

- **<u>OIL FILTERS</u> can often be recycled as scrap metal** if they are hot drained and either crushed or punctured. Once crushed or punctured and well drained, they may be placed in containers and be checked to make sure free oil is removed. Some landfills may not accept oil filters from commercial or industrial sources. Work with your local scrap dealer.
-

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Asbestos

- MSW Landfills need an approved plan for management; if received: GPS it at designated site
- Inert Waste Landfills are prohibited from taking Asbestos: NDDEQ will consider variances for Non-Regulated Asbestos – Guideline 14 + Operation review
- Asbestos Containing Material, whether regulated (friable) or not may be delivered to solid waste facilities without the operators knowledge, consent and/or approval.

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Three Categories of Asbestos Containing Materials (ACM)

- **<u>Regulated</u>** - Friable materials. If the amount is over 3 square feet or 3 linear feet, it must be removed by certified individuals before demolition or renovation.
- **<u>Category I</u>** - Not regulated, generally flooring and roofing materials. Does not have to be removed before demolition. If removed during a renovation, it does not have to be removed by certified individuals <u>IF using hand tools</u>.
- **<u>Category II</u>** - Not regulated, includes mastic, transite panels or transite siding, and cement pipe. MUST be removed before a demolition or renovation but not by certified individuals <u>IF using hand tools</u>.

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Friable & Category 1 & 2 Asbestos

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Waste Acceptance/Management Guide (for generators, haulers, etc.)

- **<u>ASBESTOS CONTAINING MATERIAL</u>** may include asbestos pipe wrap, boiler coatings, loose insulation, transite (older cement type siding and electrical backing), vermiculite (light, platy insulating material), etc. Please label all bags or containers "Asbestos Waste." **<u>REGULATED (friable)</u>** <u>Asbestos must be disposed at approved solid waste facilities (**with GPS**)and cannot be disposed with inert waste</u>. See NDDEQ guidance.
- **<u>GARBAGE AND PUTRESCIBLE WASTE</u>** (liable to spoil, decay or become putrid) including discarded food, bagged garbage, lunch waste, sanitary products, small animal carcasses, and similar waste <u>cannot be mixed with inert waste or the entire load must be managed as municipal waste.</u> These wastes should be placed in plastic bags and hauled to an MSW Landfill or Transfer Station.

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Waste Acceptance/Management Guide (for generators, haulers, etc.)

- **RECYCLABLE METALS ARE PROHIBITED FROM DISPOSAL** in North Dakota landfills. Separate metals in labeled containers or piles and do not mix with waste. Power equipment, metal parts, ducting, pipes, structural steel, stoves, water heaters, etc., and other metal items can be managed to recover metal. **Oil, fuel and fluids may need to be removed** from some equipment for proper management. **Work with your local scrap metal recycler.**
- **APPLIANCES ARE PROHIBITED FROM DISPOSAL. Freon containing appliances such as refrigerators, freezers, dehumidifiers, air conditioners,** must have the refrigerant removed by licensed technicians at a processing site. Capacitors and other electronic equipment may need to be removed. Remove food from appliances.

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Waste Acceptance/Management Guide (for generators, haulers, etc.)

RECYCLABLE METALS ARE PROHIBITED FROM DISPOSAL

- Scrap metal in a landfill can damage equipment, create safety hazards and cause the facility to be out of compliance.
- Some piping may contain radioactive materials which are not recyclable. North Dakota promotes recycling of valuable scrap metals that is properly handled.
- **Waste containers, trucks or waste rolloffs with comingled recyclable metal should not be picked up.**

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Proper Handling of Potential TENORM at MSWs

- The following natural gas and crude oil production and transportation wastes (and wastes that may have been contaminated by such materials) shall not be accepted unless it is analyzed for Naturally Occurring Radioactive Material (NORM), specifically, Ra-226 and Ra-228 concentrations and Lead-210 by a state-approved analytical procedure or screening process, prior to acceptance at this facility: …(See Next Slide).
- **Waste material** suspected to contain TENORM or likely to have accumulated NORM or TENORM in concentrations **equal to or greater than five picoCuries/gram (pCi/gm).**

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Potential TENORM, cont.

a. **Accumulated materials,** including: solids, scale, sediment, production sand, emulsion, sludges, and other tank bottoms from storage facilities, separators, heater treaters, vessels, tanks, and production impoundments that hold product or exempt waste;
b. **Pipe scale, hydrocarbon solids, hydrates, and other deposits removed from tubular goods, piping, casing, filters, clean-out traps and other equipment;**
c. **Pigging wastes from gathering lines;**
d. **Filter Socks and Proppant** from oilfield exploration, production and deep well injection activities; and
e. **Any other waste material** suspected to contain TENORM or likely to have **accumulated NORM or TENORM in concentrations** equal to or greater than 5 picoCuries/gram (pCi/gm).

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Waste Acceptance/Management Guide (for generators, haulers, etc. for potential TENORM

- If the total laboratory-measured Ra-226 plus Ra-228 or Lead-210 activities are equal or greater than five (5) picocuries/gram (pCi/gm), the waste will not be allowed for acceptance, treatment or disposal at this facility but shall be rejected.
- **The owner/operator shall note the source, amount, generator and other identifying information of the rejected waste and shall notify the Department within five (5) days of the rejection of such material.**

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Oilfield Used Filter Socks: MSWs

- Potential TENORM Waste or other isolated wastes:
- Best to reject the load and follow the appropriate procedures for notification and documentation
- Generator may decide to take waste to another permitted landfill or do analyticals at their site
- > five picocuries/gram prohibited for disposal at ND landfills

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Electronic Waste Concerns

- **Lead**
  - In glass in TV and PC Cathode Ray Tubes (CRTs);
    - CRTs typically contain on average 4 to 7 lbs of lead (newer CRTs contain closer to 2 lbs of lead)
  - Solder (37-40% lead)
  - Small sealed lead batteries (laptop power supplies, UPS devices & emergency lighting.)
- **Mercury**
  - Small amount in bulbs to light flat panel computer monitors and notebooks (4 to 5 milligrams).
  - Fluorescent lighting
  - Mercury containing devices – switches, thermostats, etc.

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Waste Acceptance/Management Guide (for generators, haulers, etc.)

- **<u>ELECTRONIC WASTE (E-WASTE)</u> from businesses, industries, public facilities** includes monitors, T.V.s, computers, stereos, light ballasts, mercury devices (thermostats, mercury switches, fluorescent fixtures and bulbs, mercury bulbs, thermometers, etc.); light ballasts, transformers; circuitry, and similar materials. Please package fluorescent devices and bulbs and other fragile materials to avoid breaking. Electronic waste generally is hazardous and should be recycled.

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Electronic Waste Concerns (cont.)

- **Brominated flame retardants**
  - Computers, TVs and household textiles
  - Being phased out of newer products but remain in older products.
- **Cadmium**
  - Ni-Cd rechargeable batteries, contacts and switches in older laptops and other portables.
  - Newer batteries (nickel-metal hydride and lithium ion) do not contain cadmium.

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Electronic Waste, Lamps, Mercury Devices

- Old and obsolete equipment change-out, changes in lighting, etc.
- Lead, mercury, cadmium and brominated flame retardants substances of concern
- May fail criteria for hazardous waste
- Household quantities are exempt
- Challenges for haulers, transfer station, and landfill operators – potential for exposure

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Examples of Lamps and Bulbs

- Includes:
  - Fluorescent tubes
  - Neon
  - Compacts (Biax)
  - Mercury vapor
  - High pressure sodium
  - Metal halide
  - Green tipped bulbs

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Fluorescent Bulbs Etc.

EPA Recommendations for Businesses:

1. Assess your Facility (and operation)
2. Become knowledgeable about State and Federal Requirements
3. Select a Recycler
4. Establish a process for managing Used Fluorescent Lamps, etc.
5. Safely Handle and Store Used Fluorescent Bulbs
6. Properly Manage Broken Lamps
   a. Create Procedures
   b. Remove lamps carefully
   c. Store in manner to prevent breakage

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Fluorescent Bulbs

Material Safety Information

- "Breakage of the lamp may result in some exposure to the phosphor powder dust and to a very little amount of elemental mercury vapor. No adverse affects are expected from occasional exposure to broken lamps, but as a matter of good practice, prolonged or frequent exposure should be avoided through the use of adequate ventilation during disposal of large quantities of lamps."
- Here is a Safety data sheet (SDS) link on these bulbs:

https://www.lightbulbdepot.com/common/images/msds/SDS_1201.pdf

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Improper Fluorescent Disposal vs. Recycling

Segregate whenever possible for recycling

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Examples of Mercury-containing Devices

- **Tilt sensors**
  - **Doors**
  - **Lids**
- **Sprinkler system contacts**
- **Thermometers**
- **Thermostat probes**
- **Barometers**
- **Relay switches**

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Household Quantity Wastes Not Prohibited But Can Cause Problems at MSWs

- Electronic Waste (E-Waste, computers, TVS, printers, etc.)
- Mercury and old PCB Containing Devices
- Lamps and Ballasts

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Fluorescent Bulbs, Mercury Devices Recycling Recommendations - Businesses:

- **Dedicated Pick-up** - Larger Quantities - once a month or upon request.
- **Mail-In or Box Program** - smaller amounts
  - Recycler provides container which, when filled can be sent to the recycler via a prepaid ground mail shipment program.
  - Work with your lamp recycler to ensure that proper packaging, labeling and shipping requirements are met.

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Fluorescent Bulbs, Mercury Devices Recycling Recommendations - Businesses:

- **Milk-Run** - Most common type of pick-up. Recycler schedules a number of pick-ups from you. Usually on set schedule.
- **Self-Transport** - Lamp recyclers provide boxes that are designed to reduce breakage during transport to a recycling facility. Self-transport of waste lamps must still comply with Department of Transportation requirements under the Universal Waste Rule.
- http://www.epa.gov/cfl/recycling-and-disposal-cfls-and-other-bulbs-contain-mercury
- There is a very small generator exemption: federal rule: CFR Title 40, Part 273.

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Industrial Waste or Special Waste Management Procedures:

(1) **Notify generators and haulers** of the facility operating requirements and restrictions;
(2) Evaluate waste characteristics,
(3) Inspect and identify special management requirements, and the rationale for accepting or rejecting a waste based on its volume and characteristics;
(4) Procedures for managing specific industrial and special wastes;

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Industrial waste or special waste management procedures (cont'd):

(5) Describe solid waste that will not be accepted at the facility; and

Amend the plan whenever operating procedures, contingency actions, waste management procedures, or wastes have changed.

The owner or operator shall submit the amended plan to the department for approval or disapproval.

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Infectious Waste

- “Infectious waste” means solid waste that may contain pathogens with sufficient virulence and in sufficient quantity that exposure of a susceptible human or animal to the solid waste could cause the human or animal to contract an infectious disease.

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Waste Acceptance/Management Guide (for generators, haulers, etc.)

- **MEDICATIONS AND INFECTIOUS WASTE** including pills, medicines, dressings, needles, sharps, human blood or tissue, isolation waste, pathological waste, infectious human or animal waste, etc. may not be mixed with inert waste but may be properly containerized and disposed with other non-regulated infectious waste. Small amounts in labeled containers may be disposed with Municipal Waste (garbage). DO NOT FLUSH OR DISPOSE MEDICATIONS IN A SEWER OR A SEPTIC SYSTEM.

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What is “Regulated Infectious Waste”?

- Cultures and stocks
- Pathological waste
- Human blood and blood products
- Sharps
- Animal waste
- Isolation waste
- Unused sharps

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Prohibited Infectious Wastes: From a hospital

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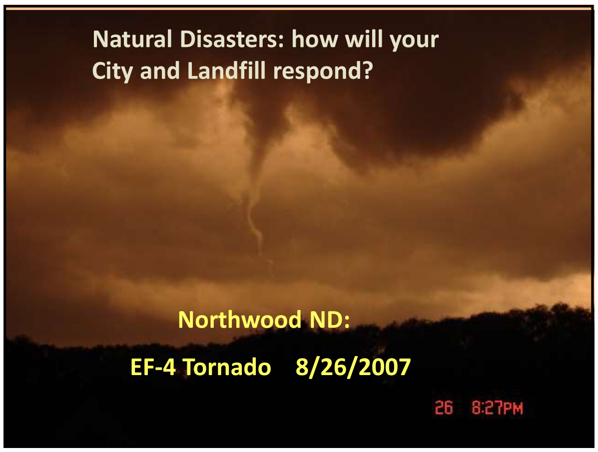

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Disaster Response: 2011 MINOT FLOOD CLEANUP

- TREMENDOUS IMPACT ON COMMUNITY
- 4100 HOMES AND BUSINESSES FLOODED
- UNIFIED RESPONSE BY CITY STAFF
- DEBRIS SEPARATION, PROCESSING AND RECYCLING PLAYED IMPORTANT ROLE

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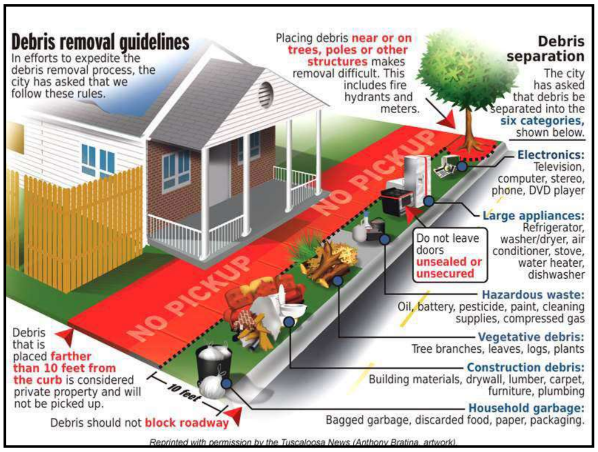
Debris removal guidelines
In efforts to expedite the debris removal process, the city has asked that we follow these rules.
Placing debris near or on trees, poles or other structures makes removal difficult. This includes fire hydrants and meters.
Debris separation
The city has asked that debris be separated into the six categories, shown below.
NO PICKUP
NO PICKUP
NO PICKUP
Electronics: Television, computer, stereo, phone, DVD player
Large appliances: Refrigerator, washer/dryer, air conditioner, stove, water heater, dishwasher
Do not leave doors unsealed or unsecured
Hazardous waste: Oil, battery, pesticide, paint, cleaning supplies, compressed gas
Vegetative debris: Tree branches, leaves, logs, plants
Construction debris: Building materials, drywall, lumber, carpet, furniture, plumbing
Household garbage: Bagged garbage, discarded food, paper, packaging.
Debris that is placed farther than 10 feet from the curb is considered private property and will not be picked up.
10 feet
Debris should not block roadway
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Waste Rejection Reports

Should be used to reject:	If waste was rejected, the transporter or landfill staff must file a report with the Department within <u>five days</u> of the rejection.
• Poorly separated waste, or waste suspected of being misleading or mislabeled (ex. hidden filter socks, etc.) •Waste prohibited in rules and/or permit for disposal at facility •Etc.	-Record as much information on the rejection form as possible (important for follow-up) - Remind transporter to supply a copy of the rejection form to the generator, Determine if a load will be rejected and why -Submit form to the Dept.

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WASTE REJECTION REPORT
NORTH DAKOTA DEPARTMENT OF HEALTH
DIVISION OF WASTE MANAGEMENT
SFN 60120 (2-2015)

Clear Form

918 East Divide Avenue, 3rd Floor
Bismarck, ND 58501-1947
Telephone: 701-328-5166
Fax: 701-328-5200

This form is for use by solid waste facilities and by transporters of solid waste when a waste or a load of waste is rejected, including, but not limited to: (a) waste containing materials not allowed for disposal, (b) transporters that do not have a valid North Dakota Solid Waste Transporter Permit, (c) waste that fell, spilled, or leaked from a transport vehicle, or (e) other reasons (unsuited/unsafe vehicles or vehicle operation, free liquids in loads, etc.). A signed copy of this form shall be provided to the Department at the above-noted address within 5 days upon rejection of the waste or waste load. Print information.

Date of Waste Rejection (Month/Day/Year)	Time of Waste Rejection	☐ A.M. ☐ P.M.

Description and Volume of Rejected Waste

Reason for Rejection

WASTE TRANSPORTER

Company Name			
Mailing Address	City	State	ZIP Code
Contact Name		Telephone Number	
E-mail Address	North Dakota Waste Hauler Permit Number **(Required)** WH-		
Vehicle Description		License Plate Number	
Driver Name		Driver Telephone Number	

WHERE WAS WASTE GENERATED?

Company Name **(Required)**			
Waste Generation Site/Location **(Required)**			
Address	City	State	ZIP Code
Contact Name	Telephone Number	E-mail Address	

FACILITY REJECTING THE WASTE

Facility Name			
Address	City	State	ZIP Code
Contact Name	Telephone Number	E-mail Address	

WHERE THE WASTE WAS FINALLY DISPOSED

Facility Name			
Address	City	State	ZIP Code

Signature

The waste rejection form (SFN 60120) can be found online at the Department's website:

http://www.ndhealth.gov/wm/Publications/Forms/WasteRejectionReport.pdf

Contact Kirk Johnson at the Department for questions regarding waste rejection reports

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Questions?
Contact the NDDEQ

North Dakota Department of Environmental Quality

- Division of Waste Management

918 E. Divide Av., 3rd Floor
Bismarck ND 58501-1947

(701) 328-5166 (701) 328-5200 fax

Website: www.deq.nd.gov

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Landfill Operations:
The 3 C's of Landfill Management,
Landfill Nuisances,
and Landfill Fires

Craig/Gertis/Lundquist

North Dakota | Environmental Quality
Be Legendary.

1

Landfill Operations

Operations which routinely include the three C's (confinement, compaction and cover) are key to a well-maintained facility

The three C's:
- Confinement
- Compaction
- Cover

2

3

Operations and Nuisances

The amount, frequency and severity of nuisances will typically reflect how effective a facility's operations are

General landfill nuisances:
- Vectors
- Nosie
- Dust
- Litter

4

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Waste Confinement

Waste confinement is the first of the three C's as it can greatly influence the effectiveness of the other two (compaction and cover)
- More effort is needed to compact waste spread over a larger area
- More cover material is needed to cover waste spread over a larger area

Bottom line – confining waste is the starting point for successful landfill operations

6

Waste Confinement

Effective waste confinement:
- Unloading waste at the bottom of the working face
- Working face as small as practicable

Benefits:
- Less windblown waste (smaller surface area exposed)
- Less cover material needed
- Less scavenging

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8

9

Waste Compaction

Waste compaction is the second of the three C's (it's "compacted" between them)

Compaction is dependent upon:
- Equipment type
- Waste type
- Operational technique

Bottom line – the better the compaction, the less "air space" that will exist throughout the waste

10

Compact waste up the slope

11

12

Waste Compaction

Effective waste compaction:
- 2 foot max lift thickness
- 3-5 passes with heavy equipment is ideal for optimum density

Benefits:
- More space = more life for the landfill
- Reduces the potential for permeability through waste
  - Reduces potential for groundwater contamination
- Better run-off control
- Reduces landfill settling
  - Reduces long-term maintenance
- Reduces windblown waste

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Waste Compaction

More benefits:
- Provides better roadways and working areas
- Completed fill area may be more-suitable for other purposes
- Reduces potential for fires
- Less cover needed (less soil loss sifting vertically through waste)

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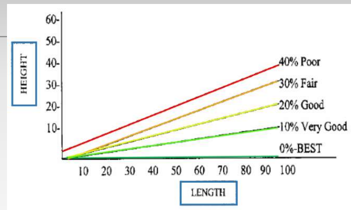
Slope vs. Compaction



16

Waste Cover

Waste cover is the last of the three C's

Check the total permitted open area for your facility (should be in your permit or plan of operation)

Bottom line – cover provides a simple but protective barrier between waste and potential issues caused by its exposure

17

Waste Cover

Benefits:

- reduces windblown waste
- Reduces odors
- Reduces fire potential
- Reduces contact and infiltration between water and waste
- Reduces scavenger access
- Reduces vermin potential
- Increases aesthetics

18

Waste Cover - Daily

At least 6 inches of suitable earthen material or other Department-approved material must be placed on all municipal waste by the end of each working day

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Test Question!

HOW OFTEN MUST 6 INCHES OF COVER BE APPLIED TO THE ACTIVE AREA OF AN MSW LANDFILL?

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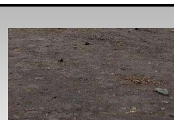
Waste Cover - Daily

Tarp



6” Earthen Material

Saving Air Space with Alternative Cover

21

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Waste Cover - Intermediate

In areas that will not receive final cover or additional solid waste will not be placed within one month – an additional six inches or more of compacted, clay-rich earthen material or other departmentally approved material must be placed. The intermediate cover may be removed when disposal operations resume in that area

23

Landfill Operations REMINDER

Operations which routinely include the three C's (confinement, compaction and cover) are key to a well-maintained facility

The three C's:

- Confinement
- Compaction
- Cover

24

Sequential Partial Closure

Sequential Partial Closure (SPC) is the basic practice of operating a "close-as-you-go" Landfill, leaving as little open area as practicable while covering and closing areas that are not actively receiving waste

The 3 C's and SPC together can minimize the potential for multiple issues:

- Compliance
- Complaints
- Fires
- Leachate generation
- And ??? ______You fill in the blank

25

Sequential Partial Closure

10,000 square feet of active area and 40,000 square feet of uncovered (no final cover) area total for small facilities. Larger facilities will have specific numbers included in their permit or plan of operation

26

Sequential Partial Closure

2004

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Sequential Partial Closure

- Use steel wheel compactors whenever possible
- All wastes must be covered with a minimum of six inches (daily for MSW waste, at least twice a year for inert waste or more if specified in permit)

28

Landfill Nuisances

29

Landfill Nuisances - Vectors

Vectors – insects or animals that carry disease-producing organisms:

- Flies
- Mosquitoes
- Rats
- Mice
- Birds
- Dogs
- Cats
- Skunks
- And More

30

Landfill Nuisances - Vectors

- Landfills may offer food, shelter and/or breeding areas that attract nearby vectors or support vectors brought in with waste
- In addition to harboring disease, some vectors may cause property damage
- Vectors can pose a safety hazard (birds vs. aircraft)
- Evidence of vector presence may include burrows, droppings, visual operations etc.

31

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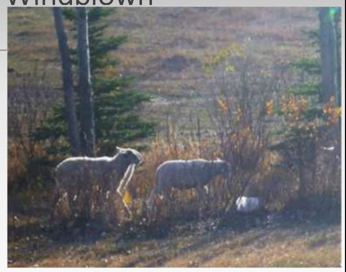
Landfill Nuisances - Vectors

Prevention and control:

- Limit standing water at the facility
- Use daily cover
- Eliminate access to food/shelter
- Bait
- Professional exterminator
- Baling waste
- Bird kill permit

33

Landfill Nuisances – Windblown Waste/Litter



Windblown waste and litter is typically the most common complaint regarding inert and MSW landfills
- Could move onto neighboring property
  - safety issue for livestock and animals
  - Strain surrounding property relationships
- Compliance issues

34

Landfill Nuisances – Windblown Waste/Litter

Collect as soon as practicable – waste accumulation can build up and quickly "creep" over a fence or deteriorate into smaller pieces

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Landfill Nuisances – Windblown Waste/Litter

Prevention:

- Regular compaction and cover
- Litter fences and other barriers to intercept waste
- Tarped loads
- Designated area for disposal during windy days
- Delay waste acceptance based on wind speed or advisories
- Education
- Fees for primarily – plastic waste loads

42

Test Question!

NAME TWO WAYS TO HELP REDUCE WINDBLOWN WASTE/LITTER AT A FACILITY:

43

Landfill Nuisances - Dust

Dust can be generated by traffic on roadways, construction activities, daily operations and/or wind

44

Landfill Nuisances - Dust

Prevention:

- Pave access roads
- Water application to dirt/gravel roadways and construction areas when appropriate
- Limit the size of disturbed areas
- Revegetate bare soil and stockpiles
- Plant temporary vegetation on intermediate cover

45

Landfill Nuisances - Odors

Generated by:

- Decay of organic materials (food waste, compost, etc.)
- Chemical reactions in landfills
- Escape of landfill gas
- Uncorrected leachate seeps

46

Landfill Nuisances - Odors

Prevention:

- Regular cover (clay, "tight" soils are helpful)
- Keep the wind in mind during operations
- Use masking chemicals
- Properly control landfill gas
- Promptly correct any leachate seeps
- Regularly turn/aerate compost areas

47

Landfill Nuisances - Noise

Can occur from:

- Routine operations
- Acceleration of engines
- Dumping noisy loads

48

Landfill Nuisances – Noise

Prevention:

- Buffer zones
- Maintain equipment (mufflers, proper greasing)
- Limit hours of operation
- Shelter belts or other noise barriers
- Site selection – remote landfill location

49

Crews fight fire at [redacted] landfill

Landfill fire near [redacted] takes 5 hours to control

Landfill Fires

Fire Breaks Out at Private Landfill

Tire pile fire doused at private rural landfill

Cause of landfill fire unidentified

50

Landfill Fires - Causes

- Hot loads (smoldering wastes)
- Spontaneous combustion
- Cigarette smoking
- Burning near landfill
- Equipment-related fires (flammable debris on hot equipment parts, etc.)
- Salvage or repair activities
- Glass exposed to sunlight
- Unpermitted waste acceptance
- Crushed Lithium Ion Batteries

51

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Landfill Fires – Prevention

- Have fire extinguishers located on all equipment
- Buffer between burn and fill areas
- Segregate any smoldering wastes and monitor
- Salvage areas located in a separate, approved area
- Cover glass wastes quickly

53

Landfill Fires – Prevention

- Keep working area as small as practicable (Sequential Partial Closure)
- Keep cover material close by
- Extinguish fires promptly
- Screen for prohibited wastes and keep disposal area secure

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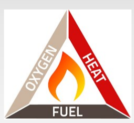
Landfill Fires – Prevention

To sustain itself- a landfill fire must have oxygen, fuel and heat



Fire spreads where there are air voids and fuel

Elitefire.co.uk

56

Landfill Fires – Prevention

The three C's can help minimize fire risk, for example:

- Confinement- reduces the area a fire could spread through waste
- Confinement – reduces the area that soil, foam or other fire suppressant needs to be applied
- Compaction – reduces air voids to fuel fire
- Cover – reduces the area available for ignition from the surface
- Cover – reduces amount of oxygen available to fuel a fire

57

Landfill Fires – December 2002 Fire

- Noted for thick uncompacted lifts
- Presence of prohibited waste
- Lack of cover
- Excessively steep slopes

One year later, the facility experienced a landfill fire

58

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Landfill Fires - Preparation

Fire and explosion contingency plan: Should include:

- Topographic map showing the exact location and address of the landfill
- Site map
- Emergency contacts
- Location of fire-fighting water sources
- All roads and major site features

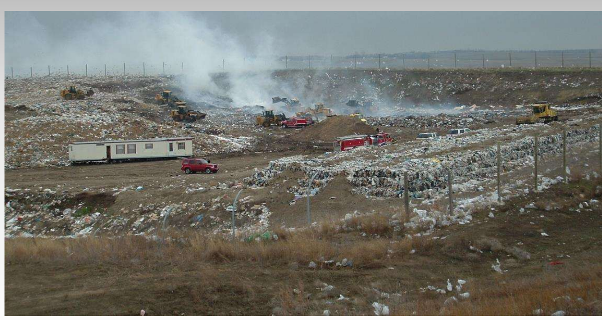
60

Landfill Fires - Preparation

Fire and explosion contingency plan:

- Should include (continued):
  - Identify all on-site equipment
  - Measures to reduce the risk of fire
  - Procedures to follow when responding to a fire
  - Any other important information regarding hazards on-site
- Plan should be routinely updated and <u>staff routinely trained</u>
- Copy should be provided to the local fire department

61



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Landfill Fires – How to Respond

As always – safety first!

Call the fire department immediately

If the fire is underground the area surrounding the fire should be saturated first before applying water to the fire itself

Smoldering wastes should then be carefully excavated and completely cooled before they are returned to the disposal area

64

Landfill Fires – How to Respond

If the fire can not be controlled or spreads underground:

- Call the Department
  - Burning waste may be a hazardous materials incident – toxic gases (burning plastic, rubber, etc.), HazMat Incident Response crew may be needed
- Excavation of waste may be needed
- Separate area for extinguishing waste may be needed

65

Landfill Fires – How to Respond

- Foam and/or dirt may be helpful to control or knock the flames down
- Water management may be needed (excess leachate or contact water generation)
- May inject inert gas (nitrogen) into fill if appropriate
- Safety is key!!!

66

Landfill Fires – The Aftermath

Pollution of the environment (air, water, soils)

Media attention

Expense (import more soil for stockpile, equipment replacement)

Change in landfill layout (replace soil stockpile, change designated disposal areas)

67

Questions?

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68

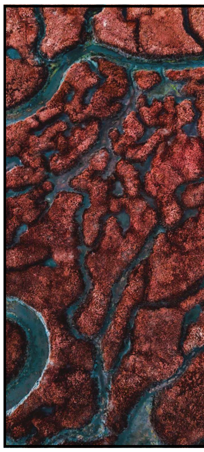
REGULATED INFECTIOUS WASTE NDAC 33.1-20-12

NORTH DAKOTA DEPARTMENT OF ENVIRONMENTAL QUALITY

JANUARY 27, 2021

North Dakota Be Legendary.™
Environmental Quality

1



INFECTIOUS WASTE

- solid waste that may contain pathogens with sufficient virulence and in sufficient quantity that exposure of a susceptible human or animal to the solid waste could cause the human or animal to contract an infectious disease.

2

WHO DOES IT APPLY TO?

- Hospitals
- Nursing Homes
- Clinics
- Physician Offices
- Dental Offices
- Laboratories
- Funeral Homes
- Veterinarians
- Blood Banks
- Health Units
- Tattoo Parlors
- Chiropractors

3

ARE THERE ANY EXEMPTIONS??

4

WHAT IS "REGULATED INFECTIOUS WASTE"?

- Cultures and stocks
- Pathological waste
- Human blood and blood products
- Sharps
- Animal waste
- Isolation waste
- Unused sharps

5

Year	Incinerated	Autoclaved	Treated waste disposed of in State	Shipped out of State
2019	0	879	790	1170
2018	1198	659	885	1054
2017	2109	547	1061	987
2016	3531	663	1411	983
2015	4297	635	1847	753
2014	3010	568	1358	357

INFECTIOUS WASTE MANAGED BY PERMITTED IWF (IN TONS)

6

CULTURES AND STOCKS

- Cultures and stocks of infectious agents and associated biologicals, including cultures from medical and pathological laboratories;
- Cultures and stocks of infectious agents from research and industrial laboratories;
- Wastes from the production of biologicals;
- Discarded live and attenuated vaccines; and
- Culture dishes and devices used to transfer, inoculate, and mix cultures.

7

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Got Germs? → Got No Germs

University of Pittsburgh

9

PATHOLOGICAL WASTE

- Human pathological waste, including tissues, organs, and body parts and body fluids that are removed during surgery or autopsy, or other medical procedures, and specimens of body fluids and their containers.

10

INFECTIOUS FLUIDS

- Any body fluid with visible blood
- Amniotic fluid
- Cerebrospinal fluid
- Pericardial fluid
- Pleural fluid
- Semen and vaginal secretions
- Synovial fluid

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IS MOTHER'S MILK AN INFECTIOUS FLUID?

13

HUMAN BLOOD AND BLOOD PRODUCTS

- Liquid or semi-liquid waste human blood;
- Products of blood (ex. serum, plasma, and other blood components);
- Items saturated or dripping with human blood; or
- Items that were saturated or dripping with human blood that are now caked with dried human blood (including serum, plasma, and other blood components, and their containers).

14

OSHA BLOODBORNE PATHOGEN STANDARD – REGULATED WASTE

- Means liquid or semi-liquid blood or other potentially infectious materials;
- Contaminated items that would release blood or other potentially infectious materials in a liquid or semi-liquid state if compressed;
- Items that are caked with dried blood or other potentially infectious materials and are capable of releasing these materials during handling;
- Contaminated sharps; and
- Pathological and microbiological wastes containing blood or other potentially infectious materials.

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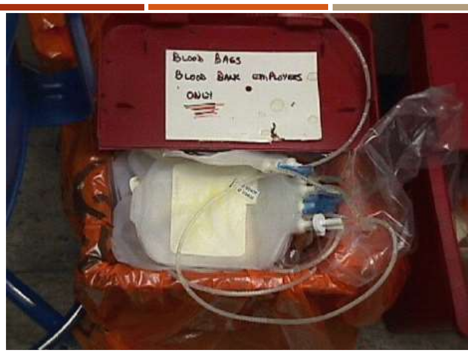

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- Sharps that have been used in animal or human patient care or treatment or in medical, research, or industrial laboratories, including hypodermic needles, syringes (with or without the attached needle), pasteur pipettes, scalpel blades, blood vials, needles with attached tubing, and culture dishes (regardless of presence of infectious agents).
- Also included are other types of broken or unbroken glassware that were in contact with infectious agents, such as used slides and cover slips.

SHARPS

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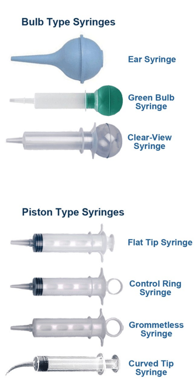

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ANIMAL WASTE

- Contaminated animal carcasses, body parts, and bedding of animals that were known to have been exposed to infectious agents during research (including research in veterinary hospitals), production of biological, or testing of pharmaceuticals.
  - euthanized animals (pets) from veterinary clinics are exempt

21

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- Biological waste and discarded materials contaminated with blood, excretion, exudates, or secretions from humans who are isolated to protect others from highly communicable diseases, or isolated animals known to be infected with highly communicable diseases.
  - Ebola

ISOLATION WASTE

23

UNUSED SHARPS

- Unused, discarded sharps, hypodermic needles, suture needles, and scalpel blades.

24

MANAGEMENT STANDARDS

- Separate infectious waste at point of origin.
- Place in distinctive containers (i.e. red bags)
  - Leak proof, tear resistant, puncture resistant
  - Tied, closed or sealed securely
- Minimize exposure to employees, transporter and public.
- Recycled containers disinfected after each use.
- Incinerated or disinfected.

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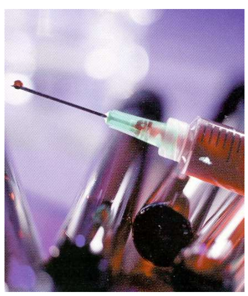
SHARPS

- Separated from other regulated infectious waste
- Placed in rigid and puncture-resistant containers.
- Incinerated or disinfected
  - If not incinerated must be rendered non-sharp before disposal.



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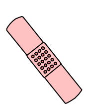
WHAT ARE SOME EXAMPLES OF NON-INFECTIOUS WASTE?

- Band-Aids
- Diapers
- Feminine hygiene products
- Blood-splattered linen and clothing
- Pharmaceuticals



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TYPICAL NON-INFECTIOUS WASTE CONT.

- bubble wrap
- paper towels, either from drying hands after washing them or from wiping down the bench with a disinfectant
- scalpel blade wrappers
- needle wrappers
- Benchkote or any other bench protector
- packaging materials such as cardboard, Styrofoam "peanuts", etc.
- Paper, newspapers, and food containers
- pipettes
- food wrappers
- Sterile tubing
- Gloves with no visible contamination

28

Generally but not always followed.

29

WASTE FROM HOUSEHOLDS

- May see some of the same wastes coming from households.
- Exempt from solid waste regulations.
- Needles and syringes don't have to be rendered non-infectious or non-sharp.

30

SHARPS MANAGEMENT FOR HOUSEHOLDS.

1. Place in a hard-plastic or metal container with a screw-on or tightly secured lid.
2. Add bleach to disinfect.
3. Reinforce the lid with heavy-duty tape and place in trash container.

31

Yes

NO!

32

KNOWLEDGE CHECK

33

1. Which of the following is considered regulated infectious waste?
   a. Heavily soaked bloody dressing
   b. A bloody urine cup
   c. Needles
   d. Saliva contaminated gloves
   e. Blood contaminated flexible tubing

34

2. Which of the following are examples of regulated infectious waste?
   a. Drop of blood on a cotton ball
   b. Heavily blood and body fluid soaked 4x4 dressing
   c. Bloody vinyl gloves
   d. Sterile tubing

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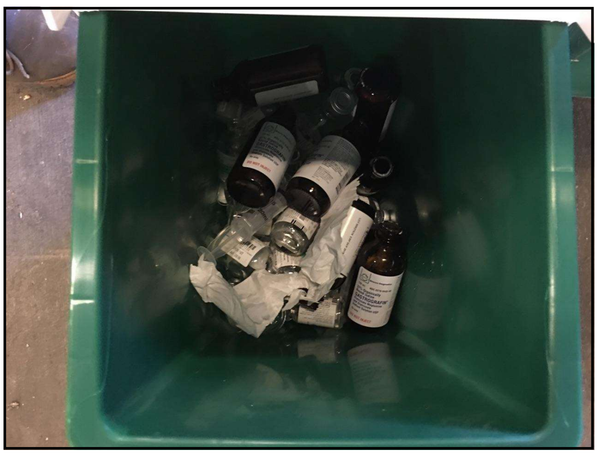

47

48

WHAT ABOUT COVID-19?

- Follow CDC Guidance, unless Healthcare facility (considered infectious waste)
  - Wear proper PPE
  - Double bag
  - Put in trash

49

- Division of Waste Management
  - Jane Kangas, Fargo
    - (701) 298-4637
    - jkangas@nd.gov
  - Lexi Craig, Bismarck
    - (701) 328-5171
    - acraig@nd.gov
- www.deq.nd.gov/WM

STATE CONTACTS

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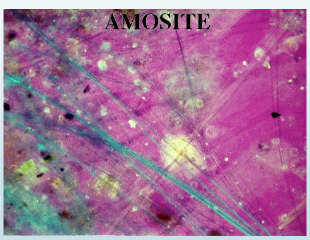
Asbestos: Identification, Hazards & Regulations

1

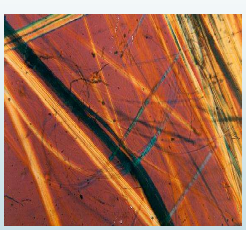
Asbestos – Is a naturally occurring mineral that is characterized by crystals that form long, thin fibers



2

Characteristics of Asbestos that made it Useful

- Fire Resistant
- Strong
- Non-corrosive
- Thermal Insulation
- Acoustical Insulator



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Uses For Asbestos

- Thermal insulation (pipes, boilers, ducting)
- Fireproofing (sprayed-on beams and pillars)
- Acoustical and decorative plaster (sprayed or trawled)
- Cement-type products (Transite siding, shingles, wallboard & pipe)
- Asphalt roofing materials
- Vinyl floor coverings (tile & linoleum)

4

Detecting Asbestos

- The only way to determine if a material has asbestos in it is to have it analyzed at a laboratory
- Samples may only be taken by a certified asbestos inspector

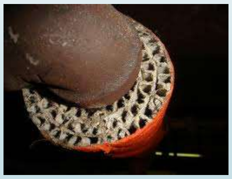
5

Three Categories of Asbestos-Containing Materials (ACM)

- **Regulated** - Friable materials. If the amount is over 3 square feet or 3 linear feet, it must be removed by certified individuals before demolition or renovation
- **Category I** - Not regulated, generally flooring, gaskets and roofing materials. Does not have to be removed before demolition. If removed during a renovation, it does not have to be removed by certified individuals IF using hand tools
- **Category II** - Not regulated, includes mastic, Transite panels or Transite siding, elevator brake shoes and cement pipe. MUST be removed before a demolition or renovation but not by certified individuals IF using hand tools

6

Uses of Asbestos
(Thermal System Insulation)



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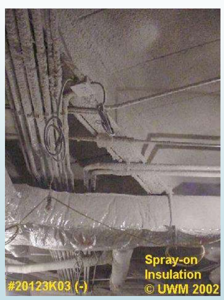
Uses of Asbestos
(Surfacing materials)

"popcorn" ceiling



8

Uses of Asbestos
(Ceiling tiles)

9

Uses of Asbestos
(Flooring materials)

10

Uses of Asbestos
(Roofing)

11

Uses of Asbestos
(Transite siding & shingles)

12

Uses of Asbestos
(Gaskets)

13

Uses of Asbestos
(Countertop, fume hood)

ASBESTOS CEMENT COUNTER TOP
(STAUFFER II)

14

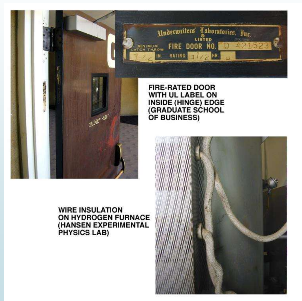
Uses of Asbestos
(Caulk & glazing)

BROWN CAULK
AT PIPE PENETRATION

GLAZING (WHITE)
ON SKYLIGHT
WINDOWS

15

Uses of Asbestos
(Door, wiring insulation)



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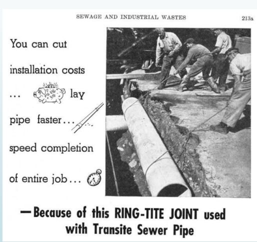
Asbestos Cement Pipe



17

Asbestos Cement Pipe

- First used in the United States in 1929
- A mixture of Portland cement and asbestos fibers; 4-42 inches in diameter
- ACP more durable and resistant to corrosion
- 600,000 miles of asbestos cement pipe in North America!
- ACP has transite or ACP stump on the product

18

Asbestos Cement Pipe

19

Asbestos Cement Pipe

- Category II nonfriable asbestos-containing material if *in good condition*
- Does not need to be removed by certified individuals IF using hand tools & keeping the material wet
- When using mechanical tools you must be certified to cut and remove the material
- EPA & ND do <u>NOT</u> allow pipe bursting

20

Asbestos Cement Pipe

- Must be inspected by a certified inspector before removal or disturbance, to determine the condition of the material
- The Department has determined the majority of ACP pipe to be old and brittle, due to age
- Notification of the removal of ACP pipe is required if the material will be made friable

21

Friable Asbestos Cement Pipe

- wrapped
- labeled
- needs a waste manifest
- must go to an approved landfill

22

Vermiculite

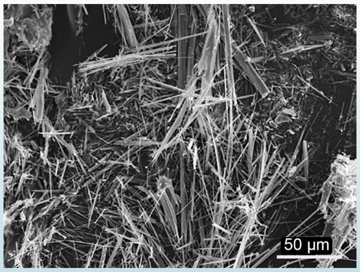
23

Vermiculite

Libby, Montana vermiculite mine

24

Asbestos in Vermiculite



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Vermiculite Policy

- The ND Department of Environmental Quality agrees with the current EPA stance that:
- There are currently no validated and approved analytical methodologies to accurately analyze and quantitate asbestos concentrations in vermiculite
- The Department will not accept current testing methods that may classify vermiculite as non-ACM

26

Vermiculite Policy

- According to EPA, it is a friable ACM.
- Therefore, vermiculite that will be disturbed during demolition or renovation activities, must be treated as a Regulated asbestos-containing material (RACM)

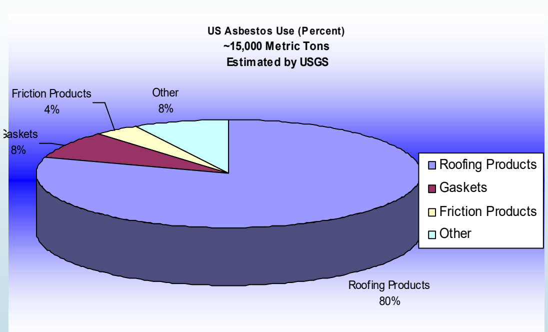
27

Uses of Asbestos
(Misc.)

The Evil Dust - the history of asbestos

https://www.youtube.com/watch?v=5yz4H_7JFQo

Asbestos Use Today



Asbestos Uses
Chinese crayons sold in USA

31

Asbestos Uses
Smoke eating umbrellas

Asbestos Umbrellas for Firemen

THE utilization of asbestos umbrellas has helped the "smoke-eaters" of a German provincial city to combat the fire peril. The novel device, illustrated below, is an imitation of the asbestos protective method used during the World war by Allied troops against the terrible effects of liquid fire.

Every brigade member is equipped with one of these umbrellas, which permits closer approach to base of flames.

This large type of asbestos umbrella permits several hose nozzles to be thrust through it, protecting firemen from heat.

32

Asbestos Uses
Safer smoking

33

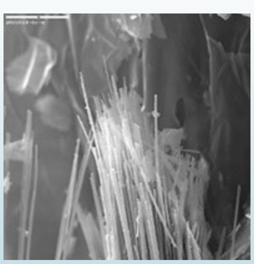
Asbestos Uses
Asbestos toothpaste recommended by top dentists

34

Asbestos Uses
Realistic, fake snow

35

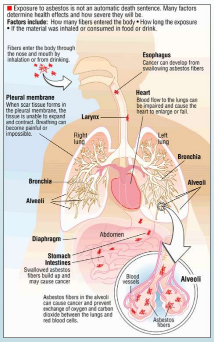
Health Effects of Asbestos



- microscopic in size
- airborne fibers
- very aerodynamic
- can be breathed deep into the lung where they can cause serious lung damage

36

Health Effects of Asbestos



- Inhalation is the most common and damaging pathway
- Most asbestos diseases show a dose-response relationship
- https://www.youtube.com/watch?v=jifoNSXvTuQ

37

Health Effects of Asbestos

- **Asbestosis** - scarring of the lungs (15-30 years to develop)
- **Lung cancer** (30 years)
- **Mesothelioma** - cancer of the lining of the lung, almost always fatal (15-45 years)
  - The average life expectancy is 6-12 months. New medical treatment has extended the life expectancy to 18-24 months

EPA has determined there is no safe exposure limit!

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Federal Asbestos Regulations

- OSHA (1971) - Health and safety of workers, respiratory protection, decontamination, emission control
- EPA (1973) - Health and safety of everyone else and protection of the environment

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Federal EPA Regulations

- National Emission Standard for Hazardous Air Pollutants (NESHAP)
  - Authority given under the Clean Air Act (1973)
  - Adopted in full by the State – ND Air Pollution Control Rules 33.1-15-13
  - Standards for handling and disposal of Asbestos Containing Material (ACM) during renovation and demolition activities

40

NESHAP Facility Definition:

- **Facility** - means any institutional, commercial, public, industrial, or residential structure, installation, or building (excludes residential buildings having four or fewer dwelling units)
- Residences are excluded except during Urban Renewal

41

Urban Renewal Housing

- Urban renewal is defined as the:
  - acquisition of land
  - relocation of displaced site occupants
  - site clearance
  - installation of site improvements
  - rehabilitation of properties
  - acquired land for redevelopment

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Urban Renewal

- **Urban Renewal Project:**
- The demolition of one or more houses by a government entity, such as a city
- The building is subject to the asbestos regulations
- Must be inspected for asbestos prior to demolition, renovation, or moving.

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General Requirements

- Prior to being renovated or demolished, an asbestos inspection must be completed
- This inspection will determine if the building has any ACM
- The inspector must be certified through this Department
- Emergency repair jobs can be made by mechanical means if under 3 linear feet or 3 square feet *per project*

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General Requirements Cont.

- Asbestos Notification of Demolition and Renovation (SFN 17987)
- Must be submitted 10 working days prior to beginning the following activities:
  - A facility being demolished. This is required whether or not the facility being demolished has ACM in it
  - A facility being renovated, where more than 160 square feet, or more than 260 linear feet of regulated asbestos-containing material (RACM) will be disturbed
- RACM must be properly removed before beginning the project

45

General Requirements Cont.

- Companies removing RACM must have a ND Asbestos Contractors License and all individuals removing the material must be certified
- All asbestos-containing waste material (ACWM) must be properly disposed of in an approved landfill
- The disposal rules for asbestos-containing waste material are located in 33.1-15-13-02 of the ND Air Pollution Control Rules

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General Requirements Cont.

- Proper disposal of *regulated* ACWM includes:
  - maintaining the material wet in leak-tight containers
  - contains a danger symbol
  - a waste generator label
  - vehicles used to transport ACWM must be marked as such during loading and unloading

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General Requirements Cont.

- A waste shipment record (WSR) must:
  - be started prior to transportation of asbestos-containing waste material
  - be delivered to the landfill operator at the time the material is deposited for disposal
  - be submitted to this Department by the generator upon depositing the waste material within 10 days
  - be retained by the landfill operator for two years

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Enforcement

- The Department can levy monetary fines and other penalties for non-compliance; currently $10,000 per day per violation.
- **Who can be held liable?**
- owner
- architects
- contractors
- waste transporter
- asbestos companies
- city, county and state government agencies in ND
- A landfill can also be held liable for asbestos violations

49

Quick Quiz!
True or False?

1. Asbestos is a lung hazard.
2. Notification of demolition to the state is required, regardless if asbestos is present.
3. Vermiculite testing for asbestos content is accurate and reliable.
4. Asbestos inspections are required in a facility if the building is to be remodeled and was built 2020.
5. A landfill can be held liable for breaking open asbestos waste bags that are uncovered.
6. An asbestos sign is not required during unloading at the landfill.
7. Asbestos waste is a hazardous waste.

50

For more information, please contact the ND Department of Environmental Quality at:

https://deq.nd.gov/WM/asbestos/

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Asbestos Villains

Asbestos Man, 1963


Asbestos Lady, 1947

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Asbestos Program:

Jane Kangas
701-298-4637

Justin Otto
701-328-5246

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Landfill Inspections and Recordkeeping & Reporting

1

2

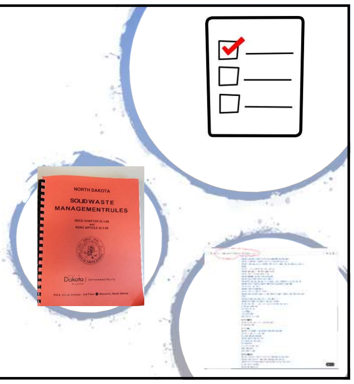
Why doing landfill inspections?

- Monitor Compliance
- Follow-up on past or continuing concerns
- Educate & Inform
- *Assist in solving issues*

3

Inspection Tools

- Checklists
- Recordbook/logbook
- Solid Waste management Rules
- Solid Waste Guidelines
- Solid Waste Permit
- Department approved Plan of Operation
- Camera
- Department staff



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Factors influencing inspections

- Time of the day
- Time or season of the year

5

TIME OF DAY

- Morning Operations Inspections
  - Preoperational - early a.m.

+ Assess status of landfill cover, etc.
+ Assess for vectors, any uncovered wastes, other landfill concerns
+ Assess status of landfill equipment

6

TIME OF DAY

- **Working Hours Inspections**

+ Site is operating
+ Evaluate operator/personnel
+ Monitor wastes (incoming)
+ Working face, safety

7

Time or season of the Year

- **Summer vs. Winter**
  - **Covering may be different**
  - **Waste flow may be different**
- **Rain**
  - **Evaluate operation, runoff, leachate**
- **Wind**
  - **Evaluate paper/plastic control**

8

Type of inspections

- Facility self inspection
- Department inspection

9

1. Facility Self Inspections

Goal: Compliance	Owner/Operator Must Consult:
• Prepared for Department inspection • Correct past non-compliance	• Waste Acceptance Plan • Plan of Operation • Compliance with Permit • Compliance with Rules

10

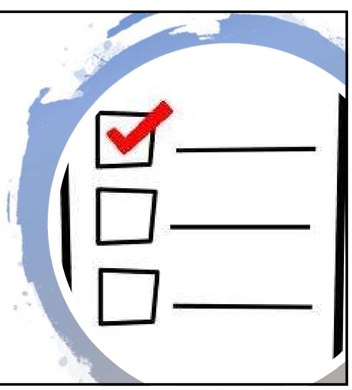
1.Facility Self Inspections

- Routine inspections
  - During or end of day
  - Vehicle maintenance
  - Fire and safety
- Greater frequency, easier to correct problems

11

Facility Self-Inspection Checklists

- Can use Department checklist
- Facilities can develop own checklist (with Department approval)
- Checklist examples, depending on status of landfill:
  - Routine landfill operation
  - Records
  - Landfill Permit compliance
  - Landfill Closure/Postclosure



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2.Department Inspections

- Department's Responsibility to Evaluate Compliance w Rules, Permit, Plans, etc.
- Goals:
  - Communication with landfill staff
  - Landfill compliance evaluation
  - Record landfill inspection & review
  - Respond to citizen complaints

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Department Inspection Process

- PLAN (pre-inspection)
  - Review file, determine type, schedule
- PREPARE
  - Equipment, forms, notify facility(if needed)
- PERFORM
  - Conduct inspection; any interviews
- POST-INSPECTION
  - Prepare formal report, any follow-up

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PLAN AND PREPARE

- ANNOUNCED

1. Ensure facility access
2. Ensure we can meet personnel in charge
3. Minimize disruption

- UNANNOUNCED

1. "Drop-in" inspections
2. Reinspections
3. Resolving concerns

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PERFORM (Site inspection)

- ARRIVAL
  - Access controls (scale house) and housekeeping
  - Intro and discussion of issues
- FACILITY Review/Inspection
  - Cover, dust control, active working face
  - Waste acceptance and load inspection

16

PERFORM (Site inspection)

- Landfill Perimeter
  - Monitor wells, closure, fence
  - Windblown debris, run-on/runoff

Departure

- final landfill review (gates, interior road, signs, etc)

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Post-inspection

- Inspection report
- Are Formal Record of Observations
  - Need to be factual & accurate
  - Must be relevant at the time
  - Should be comprehensive (dealing with all perceived issues)
  - Coordinated

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Post -Inspection

- Facility responsibilities:
  - Correct issues soon as possible
  - Provide follow-up information
  - Respond to Department's letter's questions, etc.
    - WARNING LETTERS
      - Call Department if you have questions
      - Meet response dates
      - Meet compliance requirements
  - Re-inspect to ensure action taken

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Department Enforcement Actions

- Non-Compliance/Violations--Pressure may be increased to achieve compliance:
- Administrative
  - Informal actions (follow-up visits, phone calls, letters, etc.)
  - Formal warning letters
- Judicial
  - Notice of Violations (NOV)
  - Civil Court Actions
- Criminal Court Actions

20

Penalties

- Common Civil Enforcement
  - Fines - up to $12,500 per day per violation
  - May involve attorneys ($$$)
  - Increased self-inspection/reporting
- Permits reevaluated: modified, non-renewed, or revoked

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Recommendations

- Operators: Be Informed/Aware
  - State Rules
  - Facility Permit
  - Facility Operation and Closure Plans
  - Facility Checklists
  - Guidance (ask questions!)

22

Recommendations

- Review available documents:
  - NDAC Rules
  - Department Guidelines
  - Facility Permit & Plan of Operation
- Ask Questions
  - Supervisors
  - Department
  - Consultants, etc.

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Recommendations

- Be Knowledgeable
  - Operator training
    - Symposiums/workshops (Continuing Education)
    - North Dakota Solid Waste and Recycling Association
    - Magazines and newsletters
- Follow Up On Issues Promptly
- Call Department to discuss, inform, or if there are questions or concerns

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25

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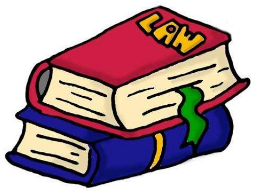
"How do you know where you're going if you don't know where you're at?"

- Recordkeeping provides answers!

27

Why Keep Records:

- **Legal Basis**
- It's the Law
  - Federal: RCRA
    - CFR 40 Subtitle D
  - State Law: NDCC 23.1-08
  - State Rules: NDAC 33.1-20



Why Keep Records: Economics

- Determine Tipping Rates
- Pay for Operating Expenses and Necessary Maintenance

Why Keep Records: Compliance

- Identify waste types:
  - Industrial, Special, MSW, or Inert
  - Wood, Metal, Plastics, any Chemicals or TENORM/NORM?
- Keep track of waste sources:
  - Record Responsible Parties
  - Know what kinds of waste they generate
  - Help identify the landfill's servicing region
- Non-Department financial or safety audits

Why Keep Records: Planning

- Keep track of Waste Generation Rate totals
  - Daily, Weekly, Monthly, Quarterly, or Annual basis
- This, helps make landfill Capacity and Operational Predictions that help estimate life of the facility utilizing volumes and trends

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Keeping Records helps Staff to:

- Understand Type of Community Generation: residential vs. commercial, urban vs. rural, etc.
- Track Quantities
  - Types of incoming wastes (wood, yard wastes, metal, etc.) per month, year, etc.
  - Amounts of Industrial Waste

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Keeping Records helps Staff determine:

- If Industrial Waste can go in:
  - MSW: up to 10% of industrial waste per month of the weight of municipal waste
    - Max 20,000 tons/yr. or 3,000 tons in any given month
  - Small Volume Industrial & Special
    - Max 25,000 tons/yr. or 3,000 tons in any given month
  - Large Volume Industrial
    - When amount exceeds 25,000 tons/yr.

33

Keeping Records helps Staff to:

- Determine Landfill Volume and Compliance with State Rules
  - Waste Volume Increases – Is there a need to modify permit? (e.g. McKenzie Co landfill)
  - Waste Type Change – Modify Permit?
  - Determine correct Permit Fees, based on disposal volumes

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Operating Record

- "The comprehensive written record of the facility site investigation, design, operation, monitoring, and closure."

35

Operating Record needs to be:

- Kept at or near ND licensed Facility
- Accessible to all staff
- Available to provide a copy of ANY document upon request by the Department

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Operating Record must include:

- Permit Applications: both pre-application and final application materials
- All Plans (including Plan of Operation, Waste Acceptance Plan) other Reports, Legal Notices
- Landfill Drawings (diagrams) & Ground Water monitoring
- Staff facility inspections (some facilities now use electronic reporting)
- Et al.

37

Why Reports are Required

- To Monitor Facility Status for:
  - Site Conditions
  - Operations + Maintenance
  - Construction Activity
- To Determine Waste Quantity & Type Accepted: (e.g. metal, wood, plastics, etc.)
- State regulators keep yearly totals of waste types received over the landfill's life span

38

What Reports to File

- Monthly
- Quarterly
- Annual

39

Monthly/Quarterly Reports

- Applies to some Facilities (primarily MSWs and Industrial/Special Landfills)
- Provides More Operational Details
- Department has Guidelines
- Makes Annual Reports easier to compile

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Annual Reports

- Annual groundwater report due by April 1st of each year
- All solid waste management facilities, except those permitted by rule, must submit Annual Reports by March 1st each year
- Include in Annual Report
  - Waste Quantity by Type/Tonnage
  - Items of NonCompliance & Rejections
  - Items Specified in Permit
  - Any deviations from Plan of Operation or Waste Acceptance Plan

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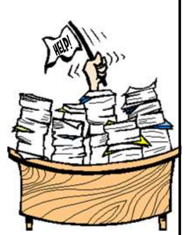
Any Questions?



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Inert Waste Management Facilities, Transfer Stations, and Scrap Tires

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1

Inert Waste Management Facilities

Inert Waste – What is it?

Site Selection

Acceptable Waste/Screening

Inert Landfill Construction and Development

Landfill Fires

Closure/Post-Closure Care

2

North Dakota Inert Waste Definition

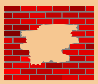
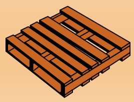
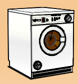
"Inert waste" means nonputrescible solid waste which will not generally contaminate water or form a contaminated leachate

- Inert waste does not serve as food for vectors
- Inert waste includes but is not limited to: construction and demolition material such as metal, wood, bricks, masonry and cement concrete; asphalt concrete; metal; tree branches; bottom ash from coal fired boilers; and waste coal fines from air pollution control equipment

3

Inert Waste

- Construction and Demolition Waste
- Concrete, Metal, Wood, Tires
- Lower Cost Landfills
- Local Management of Wastes
- Some City/County Partnerships

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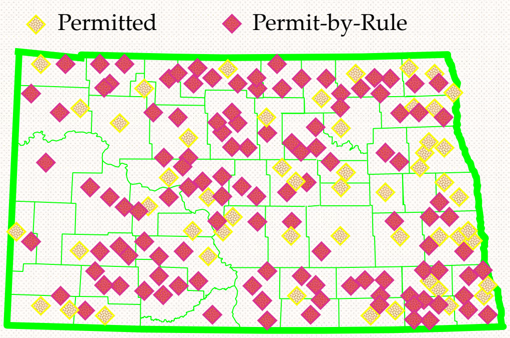
Inert Waste Landfills in ND



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Inert Waste Management Options

- Waste Reduction – Reuse buildings, move, renovate, etc.
- Reuse/ Deconstruction – wood, doors, windows, etc.
- Recycling – concrete, bricks, metal, etc.
- Composting – yard waste
- Energy Recovery – wood for fuel

6

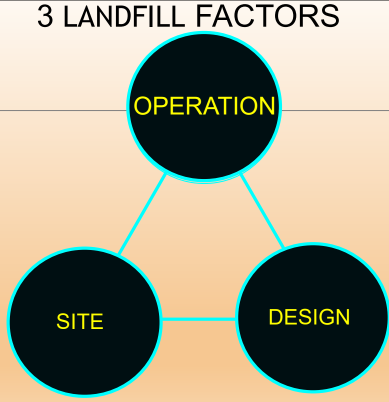
Inert Waste Management Options

- Stockpile wood for public use as fuel
- Stockpile wood chips for use
- Stockpile concrete for crushing
- Stockpile asphalt for grinding
- Yard waste material can be composted
- Metal and appliances for recycling

LANDFILL ONLY WHAT YOU HAVE TO!

7

3 LANDFILL FACTORS



"UNBREAKABLE LINKS"

8

Inert Landfill Site Selection

9

Inert Landfill Site Selection

- High and dry
- Clay and silt, not sand
- Deep water table
- Avoid steep areas

10

Inert Landfill Site Selection

Possible Restrictions:

- 100 Year Floodplain
- Wellhead Protection Areas
- Within Aquifers
- Steep areas
- Endangered Species Habitats
- Unstable areas

11

Inert Landfill Site Selection

Possible Resources for Site Information:

- Geological Survey
- State Water Commission
- ASCS (Large-scale Air Photos)
- SCS (District Conservationist)
- Department of Environmental Quality

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Operations

13

Inert Landfill Operations

- Access control, signs, roads
- Site layout
- Waste acceptance
- Routine cover
- Phased development
- Water management, stormwater BMP's
- Inert landfill fires

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Access Control

- Gate, Fence and Sign
- Prevent Illegal Dumping
- Keep Out Kids/scavengers
- *Limits Liability*
- Reduces Problems

15

Facility Signs

- Name of facility
- Permit number
- Telephone number
- Days and hours of operation
- Wastes not accepted
- Other restriction, fines, etc.

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CITY OF YOURTOWN INERT WASTE LANDFILL

PERMIT NUMBER (IF APPLICABLE)

OPEN FRIDAY AND SATURDAY 12-3 P.M.

THIS LANDFILL ACCEPTS ONLY INERT WASTE INCLUDING WOOD, TREES, CONCRETE, GRASS AND LEAVES, AND METAL

MUNICIPAL, INDUSTRIAL, COMMERCIAL AND INFECTIOUS WASTE IS NOT ACCEPTED

NO PESTICIDE CONTAINERS, ASBESTOS, PAINT, OIL FILTERS, OR HAZARDOUS WASTE

LOCAL ORDINANCE INFORMATION

IN CASE OF EMERGENCY OR FOR INFORMATION
CALL YOUR NAME 555-5555

17

18

Fence Example

- Reuse materials
- Railroad ties, rails
- Barbed wire
- Use imagination
- Natural barriers OK

19

Facility Access Roads

- All weather surface
- Drainage
- Routine maintenance
- Gravel, wood chips, coal bottom ash
- Restrict access if conditions are poor

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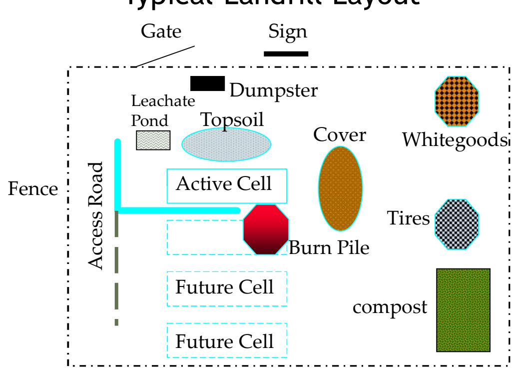
Typical Landfill Layout



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Waste Acceptance

Acceptable Wastes:

- Wood
  - -Allow re-use, firewood/fuel or mulch
- Bricks and concrete (can be recycled)
- Tires (recycle or bury promptly)
- Lime sludge (if approved)
- Yard waste for compost (not disposed)
- Metal (for recycling)

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Prohibited Wastes in Inert Waste Landfills *33.1-20-05.1-02 NDAC*

- Agricultural waste
- Asbestos
- Municipal waste
- Commercial waste
- Industrial waste
- Special waste
- Infectious waste
- Liquid waste
- Hazardous waste
- Radioactive waste

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Wastes Prohibited From Disposal

- Lead acid batteries
- Used oil
- Appliances (refrigerators, freezers, dehumidifiers, air conditioners, washers, driers, dish washers, copiers, etc.)
  - -May be stockpiled for recycling
  - -Refrigerants/CFCs/HCFCs must be removed by licensed recycler

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Wastes Prohibited From Disposal

- Manure and animal carcasses
- Grain screenings
- Asbestos
- Food & household garbage
- Septic tank pumpings
- Oils, greases and machine fluids
- Oil filters or oily waste
- Paint wastes, solvents, etc.

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Asbestos

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Wastes Prohibited From Disposal

- Electronics, fluorescent lighting, ballasts
- Polychlorinated Biphenyls (PCB)
- Mercury containing devices (switches, thermostats, etc.)
- Batteries (all)
- Pesticide containers
- Spray cans, caulk tubes, glues, etc.
- Other waste that may contaminate water or create environmental hazards

27

Landfill Design/Construction

- Need a plan first
- Phased development is important
- Work toward final goal
- Initial planning can save big dollars at closure

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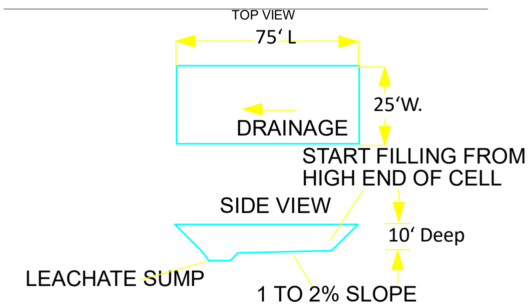
Inert Landfill Typical Dimensions



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Inert Landfill Operations

- Need adequate equipment
  - excavation, compaction, cover
- Identify and segregate suitable plant growth material
- Compaction and covering
  - save space, soil and control fires

31

Performance Standards for the Operation of Inert Waste Landfills

- All wastes deposited at the site must be spread and periodically compacted to promote drainage of surface water
- All wastes must be covered at least two times per year with a minimum of six inches of suitable earthen material

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Waste Compaction

Effective waste compaction:

- 2-foot max lift thickness
- 3-5 passes with heavy equipment is ideal for optimum compaction

Benefits:

- More space = more life for the landfill
- Reduces the potential for permeability through waste
  - reduces potential for groundwater contamination
- Better run-off control
- Reduces landfill settling
  - reduces long-term maintenance
- Reduces windblown waste

33

34

35

Performance Standards for the Operation of Inert Waste Landfills

- Sequential Partial Closure (SPC) must be implemented to minimize the working face of a landfill
- The working face or open area of a landfill must be limited in size to as small an area as practicable

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Landfill trench and cover stockpile
Lack of run-on controls may cause problems

38

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Cover Material Stockpile Calculations Routine Cover and Emergency Cover

Routine Cover Stockpiles: 6 in. on 10,000 sq ft.

- 10,000 sq. ft. x .5 ft = 5,000 cubic ft.
- 5,000 cu. ft/ 27 cu. Ft. per yd. = 185 yds
- Round up to 200 yds Cover Soil Stockpile

Emergency Cover Stockpile: 2 ft on 40,000 sq ft

- 40,000 sq. ft. x 2 ft. = 80,000 cu. Ft.
- 80,000 cu. ft./ 27 cu. Ft. per yd = 2963 yds
- Round up to 3000 yds Stockpile

Save Emergency Cover for Emergencies

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Water Management

- Run-on and run-off must be controlled!
- Berms or diversions around cell
- Sloped cell bottom
- Leachate sump may be necessary
- Keep water away from waste

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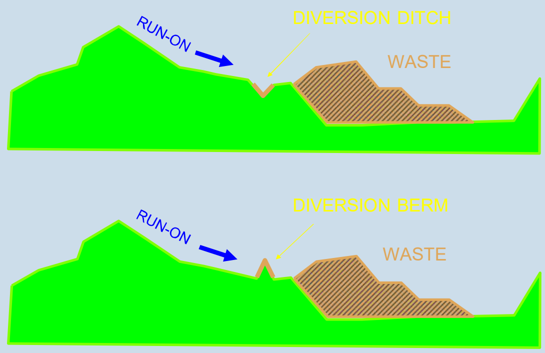
RUN-ON CONTROL SYSTEMS



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Landfill Fires

44

Landfill Fires

- Cover and compaction are key to preventing fires
- Watch for materials that have the potential to be combustible
  - Examples: electronics such as batteries, iPads, cell phones, etc.
- Have a fire prevention plan in place
  - Soil stockpiled for cover?
  - Plan set up with the local fire department?

45


Dec. 12, 2002 “Inert” Landfill Fire

46


Tire debris burning in landfill fire

47


Landfill smoldering, steep face, and metal

48

49

Key Issues That Contribute to a Fire

- Inadequate compaction left air voids in waste
- Inadequate cover
- Lack of cover soil stockpiled near operational area
- Too large an open area
- Partial sequential closure (PSC) not used
  -large open areas = greater fire risk
- Acceptance of unauthorized waste
- Steep slopes in excess of approved grades
- Waste placed outside of operational area

50

Key Issues That Contribute to a Fire (contin.)

- Salvage operations in unapproved areas
- Placement of appliances and metal in operational area
- Inadequate equipment for compaction, cover, and firefighting
- Inadequate contingency plan
- Issues on setbacks from communication cable – right-of-way not protected

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Recycling at Inert Waste Landfills

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Recycling at Inert Waste Landfills

- Stockpile wood for public use as fuel
- Stockpile wood chips for other uses
- Stockpile concrete for crushing
- Stockpile asphalt for grinding
- Yard waste material can be composted
- Metal and appliances can be recycled

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Alternatives to Burning Wood

- Landscaping
- Heating
- Lumber/Crafts
- Bio-mass for generating energy

54

55

Public Fire Wood Piles – Bismarck Landfill

56

Shredded wood has many uses in landscaping, erosion control, traction and fuel

57


Shredded wood for mulch or fuel

58


Concrete Stockpiled for Crushing

59


Concrete Crushed for Reuse

60

Recycled Asphalt

- Usually milled off roadway
- Add to hot mix at 20% replacement
- Placed back onto asphalt roadways
- Work with your county or state DOT

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Recycled Asphalt

- 50/50 Asphalt/Concrete
  1-1/2" Minus

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Compost

- Excellent soil amendment
- Rich in nutrients
- Used to improve soil structure
- Enhances the soil's ability to retain moisture and plant nutrients

63

What Is Composting?

- Composting is the breakdown of plant tissue into humus and usable plant nutrients
- The process of composting is simply a matter of providing soil organisms with food … carbon & nitrogen, water & oxygen

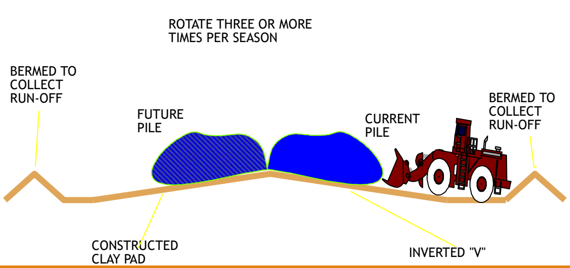
64

Composting

- Windrow method
- Balance nitrogen (grass) with carbon (leaves and straw)
- Maintain piles 5 to 6 feet tall
- Turn 3-4 times per season
- Control moisture content and run-off

65

Composting



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Metal Recycling

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Metal Recycling

- Do not place metal in disposal cell
- Allowed to stockpile metal until the quantity is sufficient for a metal recycler to pick up
- Freon must be properly removed from appliances
- Current metal prices are pretty low ☹

71

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FEDERAL LAW: FREON/REFRIGERANT MUST BE PROPERLY REMOVED

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DAEWOO

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Landfill Closure

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Landfill Closure

- Plan in advance
- Contain solid waste
- Control surface water
- Establish final cover

78

Landfill Closure

- Closure Considerations:
  - -Settlement/Subsidence
  - -Foundation conditions
  - -Vegetation
  - -Final grades

79

Landfill Closure

- Closure Tasks:
  - -Reclaim disturbed areas
  - -Minimum cover of 2 feet
  - -Minimum of 6 inches of topsoil
  - -Reseed with adapted native grasses
  - -5 year post-closure care period
  - -Minimize future maintenance

80

Landfill Closure

- Closure Requirements:
  - -Slope to provide drainage
  - -Apply final cover
  - -Provide erosion control measures
  - -Final grading and seeding
  - -Construct surface water control structures

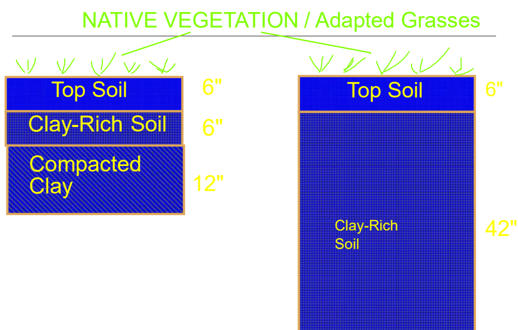
81

Landfill Closure

- Final Cover Objectives:
  - -Minimize infiltration
  - -Promote drainage
  - -Resist erosion
  - -Minimize long-term maintenance
  - -Blend with surrounding terrain

82

SUITABLE COVER SYSTEMS
FOR INERT WASTE LANDFILLS



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Record Keeping & Reporting

- Helps the facility staff analyze costs, trends, needs, & remaining capacity
- Helps assess compliance with ND Solid Waste Management Rules & local ordinances
- Helps with the preparation of the annual report (for permitted landfills) & routine correspondence
- Helps local governments in decision making

89

Notice on Property Deed

- Applies to all landfills
- Filed with County Recorder
- Notation describes the waste disposal area

90

Post-Closure Care

- Conduct an annual post-closure inspection
- Monitor and maintain facility for five years after closure date

91

TRANSFER STATIONS

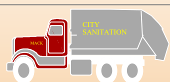
92

Transfer Stations

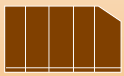
- Are used to transfer solid waste from a vehicle or container, such as a roll-off box or a compactor truck, into another vehicle or container for increased operational efficiency and transport to another facility

93

Types and capacities of solid waste collection and transfer vehicles



Truck and packer
20-30 cubic yards
7-10 tons



Roll-off container
25-40 cubic yards
8-13 tons

Semi-trailer truck
80-125 cubic yards
up to legal limits

94

Transfer Stations

- Opportunity to consolidate screen and process waste more efficiently
- Coordinate composting, inert, recycling & other activities

95

Transfer Stations

- Can be linked to other waste management operations
- Can serve multiple communities
- Permitted and regulated by the NDDEQ
- Should be adaptable for recycling

96

Transfer stations

- Help hold down the costs of managing solid waste
- Must address waste acceptance and screening
- Do not accept dangerous or hazardous waste
- Provide waste reduction and HHW collection
- Can provide recycling services
- Training of operators is required

97

Transfer Stations

- Trained operator
- Air, odor, water, vermin, litter issues must be addressed
- Sign required
- Self inspections
- Plan of Operation must be approved by NDDEQ

98

Transfer Stations

- Waste Acceptance Procedures (Same as MSW)
- Must have contingency provisions for:
  - (1) Fire or explosion
  - (2) Leaks
  - (3) Ground water contamination
  - (4) Other releases (for example, dust, debris, failure of run-on diversion or runoff containment systems)
  - (5) Any other issues pertinent to the facility

99

Transfer Stations

Plan of Operations must include:

- Safety procedures
- A description of industrial waste or special waste management procedures, which include:
    - (1) A procedure for notifying solid waste generators and haulers of the facility operating requirements and restrictions;
    - (2) A procedure for evaluating waste characteristics, liquid content, the specific analyses that may be required for specific wastes, and the criteria used to determine when analyses are necessary, the frequency of testing, and the analytical methods to be used;
    - (3) A procedure for inspecting and for identifying any special management requirements, and the rationale for accepting or rejecting a waste based on its volume and characteristics;

100

Transfer Stations

Required:

- The owner or operator shall inspect the facility to ensure compliance with this article, a permit, and approved plans. The owner or operator shall keep an inspection log including information such as the date of inspection, the name of the inspector, a notation of observations made, and the date and nature of any repairs or corrective action taken.
- Transfer stations and processing systems must:
    - a. Control access and maintain aesthetics with a combination of fencing, trees, shrubbery, or natural features
    - b. Be sturdy and constructed of easily cleanable material
    - c. Provide effective control of birds, rodents, insects, and other vermin

101

Transfer Stations

Also required:

- Be adequately screened to prevent and control blowing of litter
- Provide protection of the tipping floor from wind, rain, or snow
- Minimize noise and dust nuisances
- Provide pollution control measures to protect surface water and ground water including runoff and equipment wash down water control measures
- Provide all-weather access roads and vehicular traffic areas
- Provide any necessary pollution control measures to protect air quality including odor and dust control and prohibit burning;
- Prohibit scavenging
- Have communication capabilities to immediately summon fire, police, or emergency personnel in the event of an emergency; and
- Remove all solid waste from the facility at closure to a permitted facility

102

North Dakota Transfer Stations

BEACH
BEULAH
BOTTINEAU
CAVALIER
CONSOLIDATED (Park River)
DEVILS LAKE
ELLENDALE
HARVEY
JAMESTOWN
KENMARE
LANGDON
MANDAN
NEW SALEM
OAKES
REFUSE DISPOSAL – (Grafton)
RUGBY
STANLEY
VALLEY CITY
WM-DEVILS LAKE
WM-MINOT
WM - MISSOURI RIVER (Underwood)
WM-WAHPETON
WEST FARGO

103

North Dakota Transfer Stations

BALING
BISMARCK (Baler)
DICKINSON (Baler)
GRAND FORKS (Baler)
JAMESTOWN (Baler)

RECYCLING/ELECTRONICS
MINOT VOCATIONAL

INDUSTRIAL WASTE
SAWYER DISPOSAL

MEDICAL WASTE
STERICYCLE

104

105


Stanley Transfer Station

106


WM - Minot Transfer Station

107


WM - Missouri River Transfer Station

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Mandan Transfer Station

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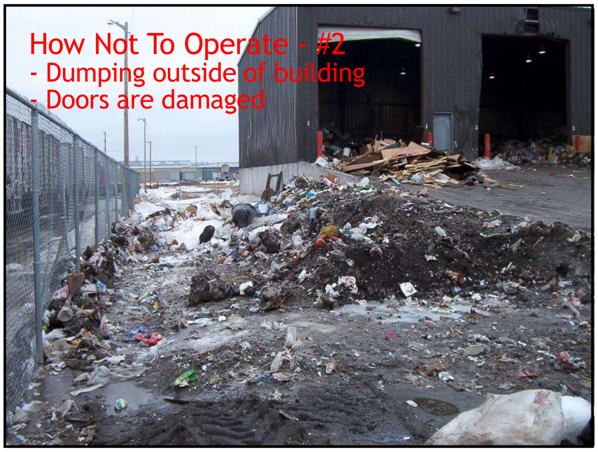
City of Devils Lake Transfer Station

110


How Not To Operate - #1

111


How Not To Operate - #2
- Dumping outside of building
- Doors are damaged

112


How Not To Operate - #3
2005 1 10

113


How Not To Operate - #4

114

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116

Scrap Tires

- Do not stockpile more than **1300 passenger tires or about a semi trailer load**
- Collect a fee for tire management, keep money in separate account
- Make sure transporter has a NDDH permit and that tires are going to an approved disposal or processing center
- Landfill tires if needed

117

Scrap Tires

Disposal Recommendations:

- Cut, shredded or bale if possible
- Place tires in bottom of trench
- Cover with concrete/demolition material
- Compact material over tires
- Avoid standing water in disposal area
- Try to keep voids out of tiers – tire monofills are difficult to fill and control

118

Scrap Tires

- Burial is allowed
- Burial is safer than stockpiling
- Do not stockpile if you have no final plan or provisions for managing tires
- Charge enough to properly manage tires
- If you are cheaper than other outlets, tires will find you
- Tire dealers will try to avoid paying additional fees for proper management

119

Scrap Tires

- Harborage for vermin – rats, mice
  -hantavirus
- Skunks, raccoons, cats, etc.
  -rabies
- Snakes (including rattlesnakes)
- Insect habitat

120

Scrap Tires

Tire Recycling Facilities:

- **Tyre Mart-Waste Not Recycling,** 704 East Bowen Avenue, Bismarck, ND 58504-5626 (701 319-0777 or (701) 255-1077, Email: tyremart2000@yahoo.com
- **New Deal Tire,** 117 W. Highway 12, Groton, SD 57445-2308, (605) 397-8473 or 605-397-8291
- **Liberty Tire Services of Ohio, LLC**, 12498 Wyoming Ave. S., Savage, MN 55378, (952) 894-5280
- **Borderline Tire Industries Inc.**, 404 2nd Ave. E., PO Box 125, Oslo, MN 56744, (218) 695-2099

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2008-Auto Recycler Fire
Spread to tire piles
- Uncontrollable fire and emissions
- Danger for responders and community

125


Skilled responders and significant resources are necessary to fight a tire fire

126

127

Any Questions?

ND Department of Environmental Quality, Waste Management Division

701-328-5166

https://deq.nd.gov/WM/

North Dakota | Environmental Quality

Be Legendary.

128

WATER MANAGEMENT

1

LANDFILL WATER MANAGEMENT

- What are sources of water at the landfill?
- Where does it land?
- Where does this water go?
- How do you control it?
- Where do you control it?

2

LANDFILL WATER MANAGEMENT

- Ground Water Monitoring
- Surface Water Controls
  - Control Run-on
    - Water that runs on the landfill surface
  - Control Run-off
    - Water that runs off of the landfill surface

3

GROUNDWATER MONITORING

- **33.1-20-13-02. Ground water quality monitoring.**

1. "An owner or operator of a resource recovery unit, a land treatment unit, a surface impoundment, or a landfill, except an inert waste landfill, must incorporate a ground water monitoring system into the design of the facility."

2.f. "The monitoring frequency must be semiannual during the active life of the facility and during the postclosure period."

4

STORMWATER RUN-ON

- **RUN-ON** runs <u>towards</u> or <u>onto</u> the active landfill area and <u>originates upslope</u>.
- Controlling Surface Water Run-on
  - Keeps water out of the active cell/working face
  - Minimizes leachate
  - Improves operating conditions
- Control run-on onto the active landfill area for a 25 year, 24 hour storm

5

STORMWATER RUN-OFF

- **RUN-OFF** runs <u>downslope off</u> of the landfill and <u>downslope away</u> from the site.
- Controlling storm water run-off
- Keeps water that comes in contact with waste (leachate) in the active cell
- Control run-off from the active portion of the landfill for a 25 year, 24 hour storm*

6

WHAT CREATES RUN-ON AND RUN-OFF?

- The watershed concept…..
  - A watershed is an area of land defined by a drainage basin
  - All landfills are located in a watershed

7

WATERSHEDS

- They can be various sizes
  - Regional – ex. Rivers
  - Local – ex. Creeks/Lakes
  - Site – swells and swales

8

WHAT HAPPENS IN A WATERSHED?

- Precipitation concentrates and collects
- Areas are formed that generate water run-off or receive surface water run-on

9

LOCAL WATERSHED

10

10

WATERSHED IMPACTS ON LANDFILL LOCATION

- The watershed determines run-on and run-off concerns
- You want to avoid locations that receive concentrated run-on
- You must control water run-off from the landfill

11

11

RUN-ON CONTROL REQUIREMENTS

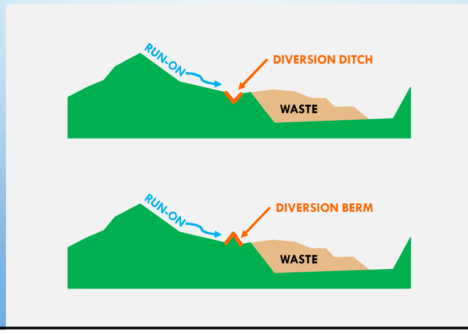
- Control all surface water to minimize contact with waste
- Do not dispose of waste in areas where surface water is concentrated
- Design and operate the landfill to prevent run-on (or run-off) from a 25 year, 24 hour storm.*

12

* Remember this for later! ☺

12

RUN-ON CONTROL SYSTEMS

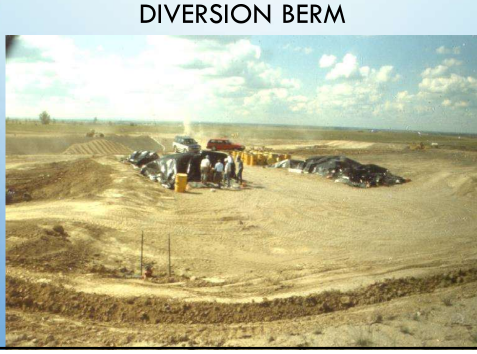


13

RUN-ON CONTROL SYSTEMS – DIVERSION DITCH

14

RUN-ON CONTROL SYSTEMS – DIVERSION BERM



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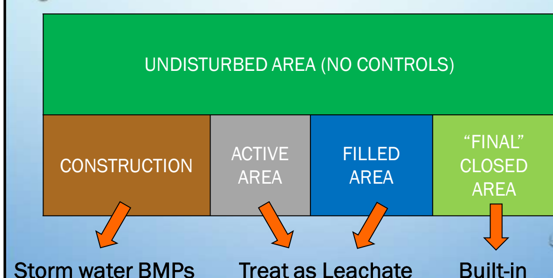
RUN-ON CONTROL SYSTEMS – DIVERSION BERM

16

RUN OFF CONTROL REQUIREMENTS



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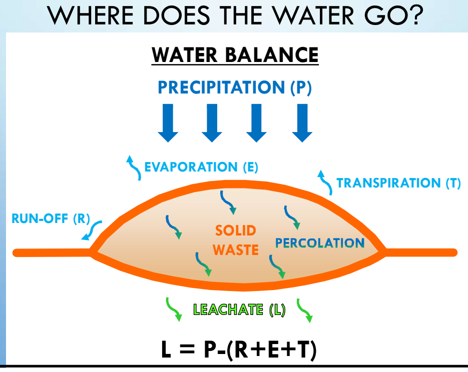
WHERE DOES THE WATER GO?



18

WHAT IS LEACHATE?

- Leachate - liquid that passes through a solid and contains components of that solid.
- Example:

19

19

WHAT IS STORMWATER?

- Water that originates from a precipitation event. (rainfall, snowfall)

20

IS IT STORMWATER OR IS IT LEACHATE?

21

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IS THIS STORMWATER OR LEACHATE?

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IS THIS STORMWATER OR LEACHATE?

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IS THIS STORMWATER OR LEACHATE?

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IS THIS STORMWATER OR LEACHATE?

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25

LEACHATE – BEST TO MANAGE

- FIRST – Minimize the amount produced by good water management! Then…
- Direct discharge to a Publicly Owned Treatment Works (POTW)
- Truck to a POTW
- Evaporation
- Dust control within a lined landfill cell
- Class I or II injection well

26

26

RUN-ON AND RUN-OFF GOALS

- Allow no water except precipitation that falls directly onto active cell. Divert all other water away from areas of waste. Control storm water so that it does not flow onto landfill surface.
- Promote Run-off of surface water away from active area and off of filled areas. Surface water run-off must be controlled.

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WATER MANAGEMENT CHALLENGES
28

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WATER MANAGEMENT CHALLENGES
29

29


WHAT ARE SOME PROBLEMS IN THIS PHOTO?
28 12:01PM
30

30

WHAT ARE SOME PROBLEMS IN THIS PHOTO?

31

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ONE YEAR LATER – CLEANED UP!

32

32

STORMWATER AND EROSION

33

33

LANDFILL OPERATIONS STORMWATER BEST MANAGEMENT PRACTICES (BMPs)

- Minimize disturbed areas
- Straw bales
- Fiber logs
- Silt fences
- Check Dams
- Re-seed stockpiles
- Rip-Rap

34

34

BMPS – STRAW BALES

35

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NEW INERT ROAD WITH BALES & STORMWATER PIPE

36

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BMPs – STRAW LOGS IN A DITCH
37

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BMPs – STRAW LOGS IN NEWLY SEEDED AREA

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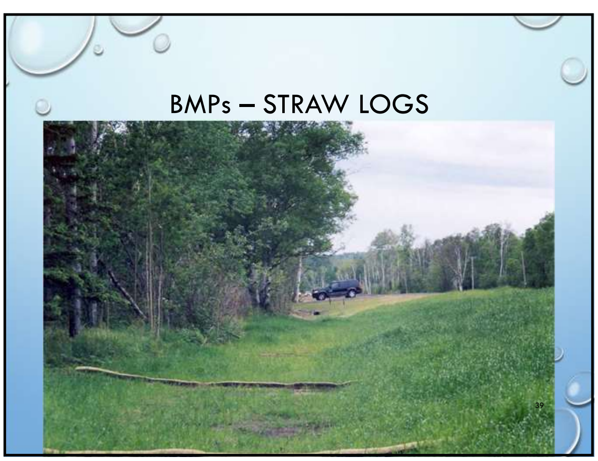
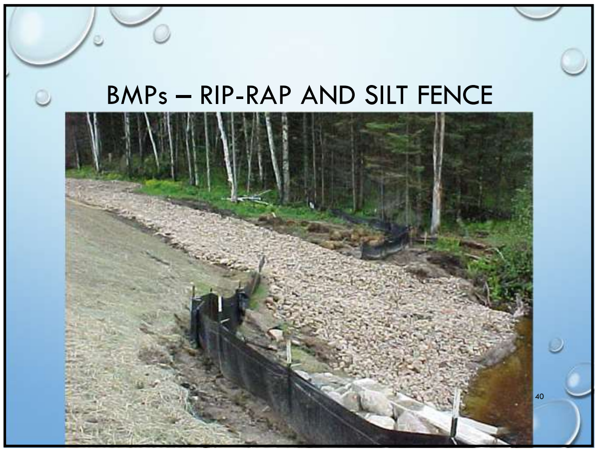
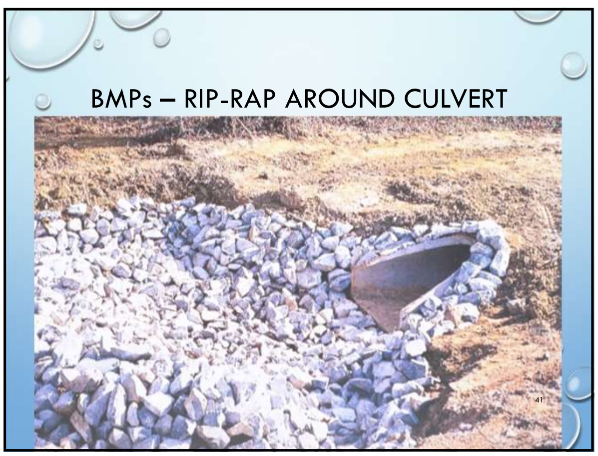

BMPs – STRAW LOGS

39


BMPs – RIP-RAP AND SILT FENCE
40

40


BMPs – RIP-RAP AROUND CULVERT
41

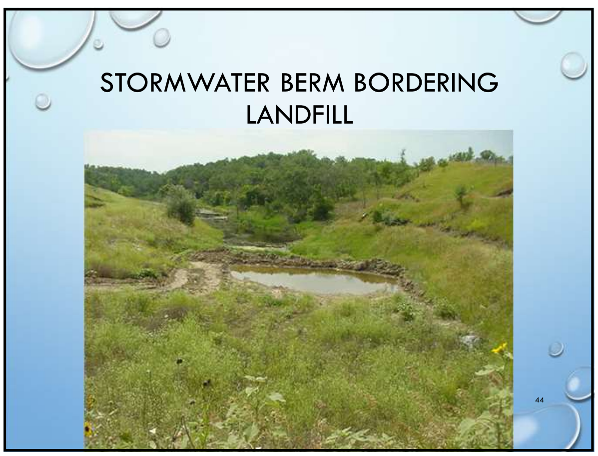
41


MAINTENANCE OF BMPs
PM 3:07 NOV/ 8/2016

42


MAINTENANCE OF BMPs
43

43


STORMWATER BERM BORDERING LANDFILL
44

44


STORM WATER CONTROLS
45

45

STORMWATER BASINS

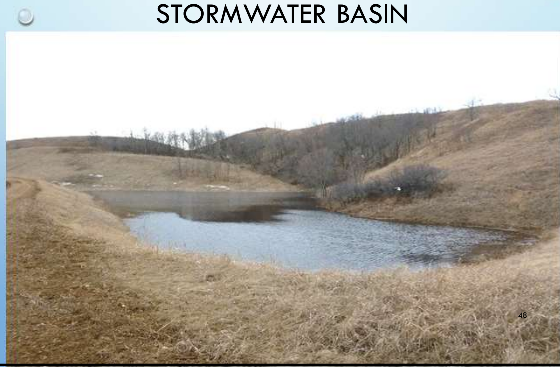
- Ponds to collect and retain run-off
- Prevent soil sediment from leaving the landfill site
- Water evaporates or may be used in operations

46

STORMWATER BASIN

47

STORMWATER BASIN



48

STORMWATER BASIN DREDGING

49

AVOIDING NATURAL RUN-ON/RUN-OFF

- Landfills should not be sited within a 100 year floodplain (or any floodplain)
- Not on the edge of or in channels, ravines, or steep topography
- Not within woody draws
- Not closer than 200 feet horizontally from a wetland or other natural water body
- Avoid former surface mined areas

50

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STORMWATER CONCLUSIONS…

- Clean stormwater can drain into a site by overland flow or be discharged from ponds
- Proper stormwater run-off/run-on management is the key to avoiding leachate surface drainage issues

51

51

WATER MANAGEMENT CONCLUSIONS…

- Leachate and stormwater are handled differently. Minimize leachate by minimizing water that comes in contact with waste. Understand the difference between the two!
- Have adequate stormwater controls to stop erosion and to keep clean water out of the active cell areas.
- Design and operate the landfill to prevent run-on (or run-off) from a 25 year, 24 hour storm

52

52

QUESTIONS………………..?

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53

Groundwater

NORTH Dakota | Environmental Quality
Be Legendary.™

1

Water Sources

- 70% of the earth's surface is covered in water
- The majority of water is contained in the oceans as saltwater, but the rest is stored in rivers, lakes, ice caps, and groundwater (mostly as freshwater).

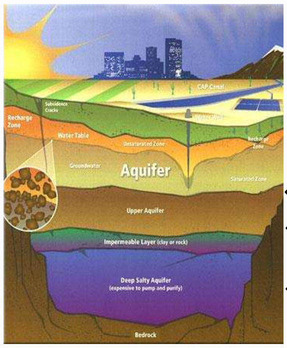
2

What is Groundwater?

- Groundwater is water found underneath the ground in cracks and spaces in soil, sand and rocks.
- Groundwater is not found in "underground rivers or lakes", but is found in **aquifers**.
  - ***Aquifer*** – *An underground bed or layer of permeable rock, sediment, or soil that yields water.*

3

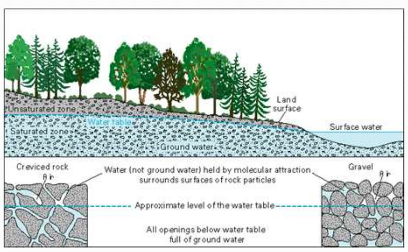
Aquifers



4

The Flow of Groundwater

- The study of the flow of water in aquifers and the characterization of aquifers is called hydrogeology.



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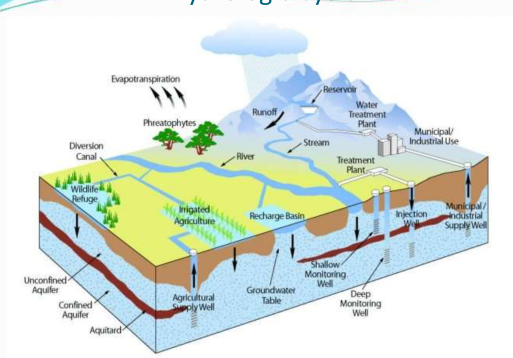
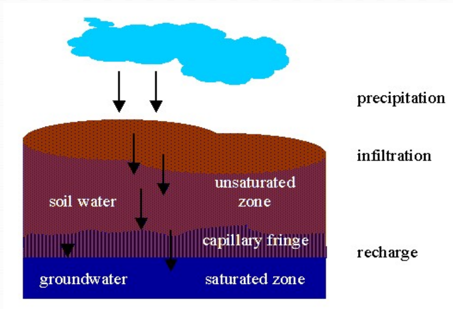
Hydrologic Cycle



6

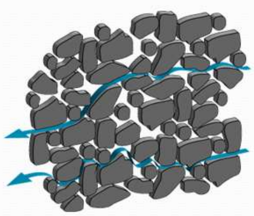
Groundwater Infiltration

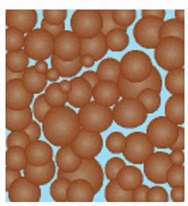


7

Groundwater Movement

- Through porous media:



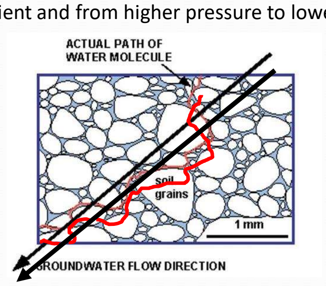


DISPERSION

8

Groundwater Movement

- Groundwater movement depends on rock and sediment properties and moves from upgradient to downgradient and from higher pressure to lower pressure.



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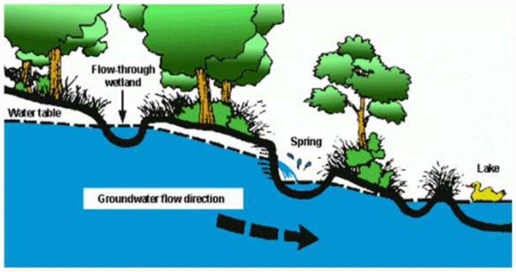
Groundwater Movement

- The water table is the level below which the underground sediments are completely saturated with water, and controls GW flow in aquifers.



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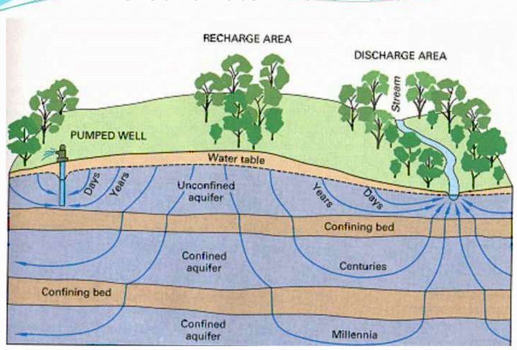
Groundwater Movement

- Groundwater typically moves very slowly from an aquifer’s recharge areas to its discharge areas, depending on the formation’s porosity and resulting hydraulic conductivity (more later).
  - *Recharge area - Water seeps into an aquifer from rain, snowmelt, etc.*
  - *Discharge area – Streams, springs & lakes*

11

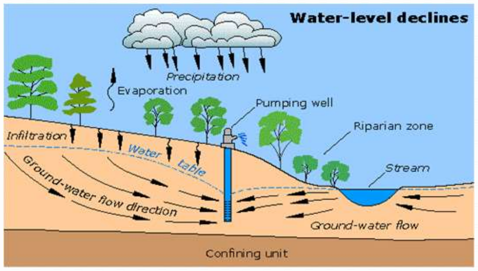
Groundwater Movement



12

Groundwater Movement

- Water pumped from an aquifer may alter the flow of the groundwater.



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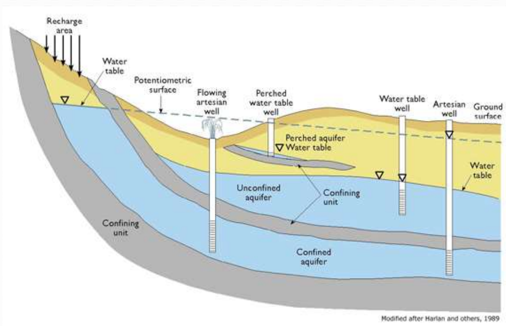
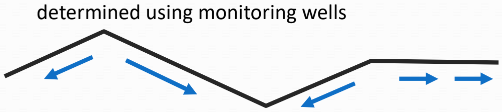
Groundwater Movement



14

Groundwater Movement

- Groundwater generally moves:
  - With the topography
  - Very slowly
  - Upgradient to downgradient
- Groundwater flow direction and rate can be determined using monitoring wells



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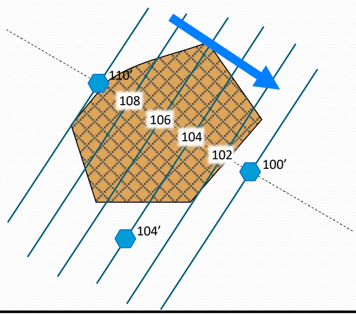
Groundwater Movement



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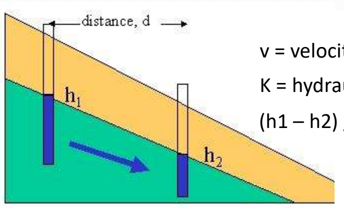
Groundwater Movement

DARCY'S LAW (flow velocity and rate)

$$v = K(h1 – h2) / d$$



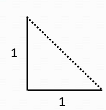
v = velocity

K = hydraulic conductivity

(h1 – h2) / d = hydraulic gradient

17

Groundwater Movement



- What is hydraulic conductivity?
  - Velocity under gradient of 1.0 ("Grade" = 100%)
- Groundwater moves:
  - Faster with a steeper gradient
    - The water table gradient is normally low (i.e. feet per mile)
  - Faster in coarse materials
    - Faster in sand vs. clay

18

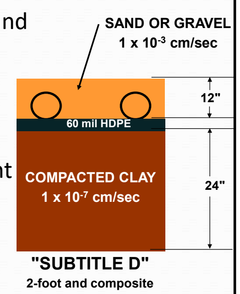
What is hydraulic conductivity?

- **Hydraulic conductivity** is basically the measurement of how quickly GW flow passes in underground sediment between two or more GW wells in the same aquifer.
- **Hydraulic 'head'** refers to the elevation to which GW will naturally rise in a well (static level) within an **unconfined aquifer**. So, **head (h)** is actually the elevation depths of standing water in a GW well, typically measured above sea level. The '**hydraulic gradient**' is the slope between two or more GW wells—flowing from higher to lower elevations.

19

Groundwater Movement

- EXAMPLE: Clean Medium Sand
  - 1 x 10^{-3} cm/sec =
    ~ 2.83 feet/day =
    ~ 1,035 feet/year
- EXAMPLE: Liner Requirement
  - 1 x 10^{-7} cm/sec =
    ~ 0.00028 feet/day =
    ~ 0.1 feet/year



20

Landfills and Monitoring Wells

- ND has regulations for groundwater monitoring
  - NDAC Chapter 33.1-20-13 Water Protection Provisions
- Early detection of contaminants is critical to minimizing their impact
  - Contaminants move with groundwater flow!

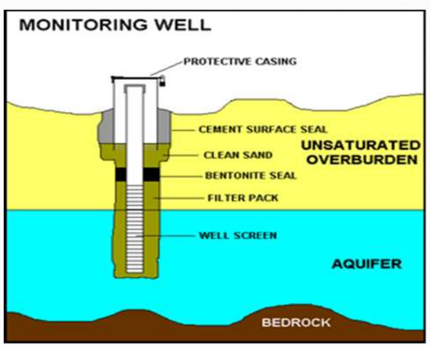
21

Groundwater Monitoring

- Determine the presence and amount of any contamination
  - Groundwater analyzed for a variety of constituents
- Detect the migration of contamination
- Evaluate the performance of the liners and leachate collection system
- Determine if the landfill is being operated correctly

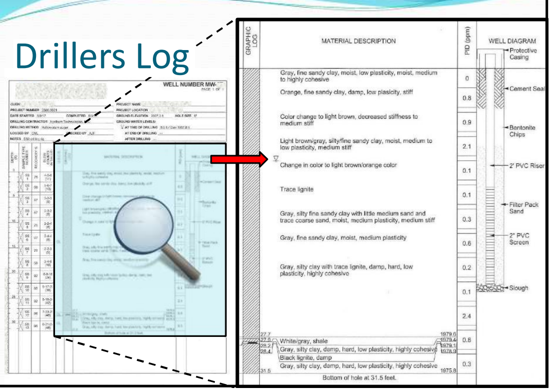
22

Typical Monitoring Well



23

Drillers Log



24

Landfills and Monitoring Wells

25

Groundwater Monitoring

- Considerations:
  - Well location and numbers
  - Well design and construction
  - Well protection
  - Sample collection, preservation and analysis
  - Interpretation of results

26

Steps in MW sampling

- The collection of water samples from groundwater wells occurs in **several steps, including:**
- (1) gathering all needed equipment prior to trip;
- (2) locating/accessing well sites before sampling;
- (3) measuring GW elevation levels;
- (4) purging the wells;
- (5) pumping the GW into sample containers for temporary storage/transport/delivery; and
- (6) securing the wells after sampling (lids, locks, etc).

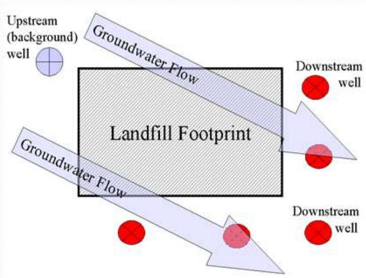
27

GW Elevation Testing

28

Typical Well Placement

- Minimum one upgradient & two downgradient

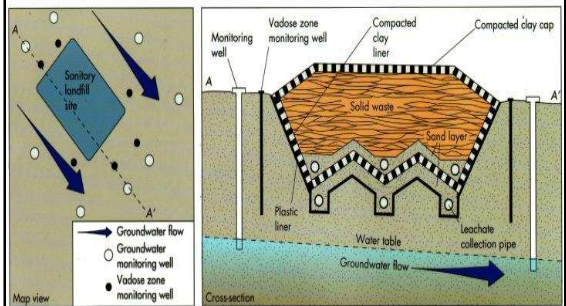


29

Taking Groundwater Samples, Purging, etc.

30

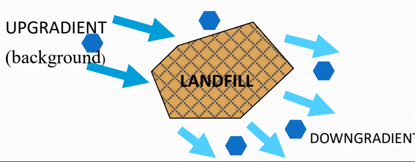
Typical GW Well Placement



31

Monitoring Well Networks

- Monitor uppermost aquifer and all hydraulically connected aquifers
- Represent up – and down – gradient water conditions
- Well nests
- <u>Keep locked </u>(Prevent damage and vandalism)



32

Lock on monitoring well

33

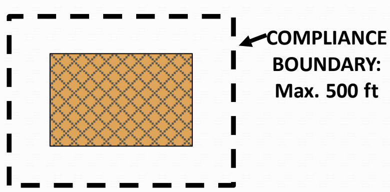
Compliance Boundary

- A **compliance boundary** is defined as
- a boundary in and around an aquifer MW system where groundwater maximum constituent measurement limits may not be exceeded.

34

Compliance Boundary

- Must be no more than 500’ from landfill or landfill disposal cell
- Always on landfill property!



35

Groundwater Sampling Plan

- Needs to include information on:
  - Sample collection
  - Sample preservation
  - Analytical procedures
  - Chain of custody
  - Lab Quality Assurance/Quality Control (QA/QC)

36

Groundwater Sampling

- Samples at MSW landfills must not be filtered prior to analysis
- Sample frequency and numbers must be consistent with statistical procedures for evaluating groundwater data
- Monitoring frequency should be semi-annual during the active life of facility and during the post-closure period
- Department may specify alternate frequency

37

Groundwater Monitoring

- Potential problems:
  - Seasonal variability: (GW Elev. levels vary, etc.)
  - Poor sampling, collection, and analysis
  - False positive
    - Shows contamination where none exists
  - False negative
    - Doesn't show contamination when it does exist
    - MW can be damaged above or below ground

38

Monitoring Well Sampling

39

Groundwater Monitoring

- Routine 
- Costly 
- Highly technical 
- Inaccurate results can be disastrous

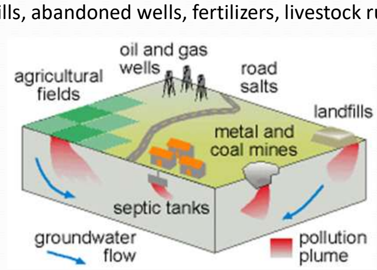
40

Groundwater Contamination

41

Groundwater Contamination

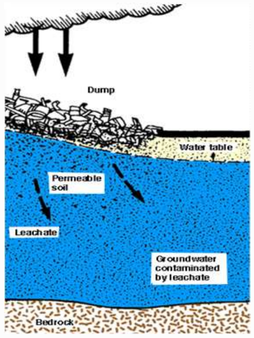
- Groundwater can be contaminated by many different sources, such as leaking tanks, poorly constructed landfills, abandoned wells, fertilizers, livestock runoff, etc…



42

Groundwater Contamination

- Landfills are a potential source of groundwater contamination!



43

Groundwater Contamination

- Groundwater contaminated with bacteria, chemicals, pesticides, gasoline or oil can result in serious human health problems.
- Cleanup of contaminated groundwater can cost a community millions of dollars and increase the cost of drinking water.
  - *Example: $55 million for cleanup of the Agricultural Street Landfill in New Orleans, LA.*
- **Prevention** of contaminated groundwater costs less than cleanup!

44

Groundwater Contamination

- Landfills are now designed to prevent the contamination of groundwater by:
  - Construction using dense HDPE liners and layers of clay to prevent liquids (leachate) from passing into the groundwater.
  - Leachate is collected at the bottom of landfills and pumped/hauled into evaporative ponds.
    - *Leachate can include heavy metals (such as lead & chromium), soluble salts(such as chloride, nitrate, sulfate), and organic compounds.*

45

What Does HDPE Consist of?

- High density polyethylene, often abbreviated to HDPE, is a polymer (string of similar molecules or monomers) whose monomer is **ethylene**. It is a **thermoplastic** with a very high strength to density ratio. It is not 'dense rubber' as is sometimes stated.
- This kind of geomembrane is typically made of finest quality HDPE with specially formulated, virgin polyethylene resin, combined with specified quantity carbon black, antioxidant, anti-aging agent and UV resistance components.

46

Help keep our groundwater safe for drinking!

47

Any Questions?

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48

DAY 3

tab (1/3 cut – black ink)

Landfill Gas

1

Why are we discussing it?

"The turning point that resulted in the need to monitor and control offsite migration was an incident that occurred in 1969 at Winston-Salem, N.C. An explosion at a national guard armory killed three guards, seriously injured 12, and caused minor injuries to another 25. The cause of the explosion was traced to landfill gas migrating from a landfill approximately 100 feet from the armory."

2

Landfill Gas

- Explosive
- Poisonous
- Asphyxiate
- Methane and carbon dioxide can pollute the atmosphere
- VOCs can pollute groundwater
- Odor Issues
- Renewable energy resource

3

Landfill Gas

- How is landfill gas produced?
  - It is produced from the decay of organic materials in both aerobic and anaerobic conditions
- What are the two major components of landfill gas?
  - The two major components are:
    - Methane CH_4
    - Carbon dioxide CO_2

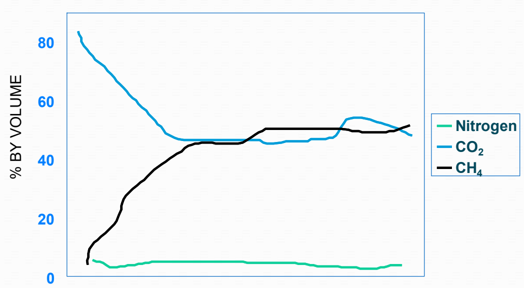
4

Landfill Gas Composition

COMPONENT	AMOUNT
Methane	45-50%
Carbon Dioxide	45-50%
Nitrogen	0.4%
Oxygen	Trace
Volatile Organic Compounds (VOCs)	Trace
Hydrogen Sulfide (H_2S)	Trace
Moisture content	Saturated
Heating Value	500 BTU/ft^3

5

Gas Composition Over Time



6

Methane

- Colorless, Odorless, Tasteless
- Relatively Insoluble in Water
- Highly Explosive
- Lower Explosive Limit (LEL) = 5% in Air
- Upper Explosive Limit (UEL) = 15% in Air
- Lighter than Air = Rises

7

Hydrogen Sulfide (H_2S)

- Poisonous
- Flammable Gas
- Rotten Egg Odor
- Colorless
- Heavier than air, collects in low areas
- Anesthetizes your sense of smell

8

Landfill Gas

- North Dakota Administrative Code (NDAC) 33.1-20-06.1-02(4) states:
  - Landfill gas may not be allowed to migrate laterally from the landfill so as to endanger structures, environmental resources, or adjacent properties.

9

Methane Gas Concentrations

- The concentration of CH_4 gas generated by landfills on the facility must not exceed twenty-five percent (25%) of the lower explosive limit (LEL) for CH_4 in structures or appurtenances on the facility.

10

Methane Gas Concentrations

- The concentration of CH_4 gas must not exceed the lower explosive limit (LEL) for methane at the facility boundary.

11

Landfill Gas Generation

- Conditions that affect LFG generation:
  - Waste composition
  - Amount of waste
  - Age of refuse
  - Presence of oxygen
  - Moisture content
  - Temperature

12

Landfill Gas

- Potential for movement depends on:
  - Depth and age of fill
  - Type of wastes in fill
  - Soil characteristics
  - Soil moisture

13

Methane Control

- Active Control
  - Uses one or more mechanical devises such as pumps or blowers to move landfill gas
- Passive Control
  - Relies only on pressure gradients to vent landfill gas

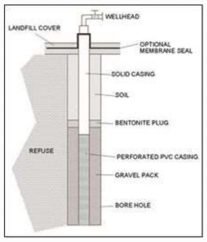
14

Landfill Gas Controls

- Examples of active and passive controls:
  - Venting to atmosphere
    - Passive
  - Flare burning
    - Active
  - Incineration
    - Active
  - Recovery as an energy source
    - Active

15

Landfill Gas Extraction Well



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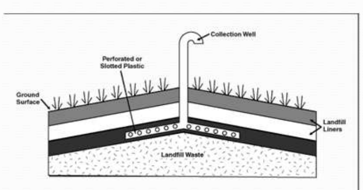
Passive Landfill Gas Vent



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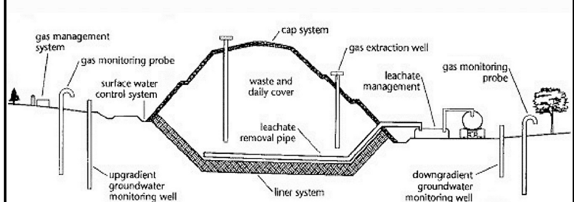

gas management system
gas monitoring probe
surface water control system
cap system
waste and daily cover
gas extraction well
leachate management
gas monitoring probe
leachate removal pipe
upgradient groundwater monitoring well
liner system
downgradient groundwater monitoring well

23

24

Methane Testing

- Done on-site
- No sample container
- Sampling equipment is portable
- Obtain immediate results

25

Methane Testing

- Monitoring locations:
  - On-site structures
  - Basements
  - Crawl spaces
  - Trenches
  - Manholes
  - Conduits
  - Vegetative stress areas

26

Methane Testing

- Monitoring Wells:
  - Allow for easy routine gas testing
  - Provides uniform testing location
  - Verify results with repeated testing

27

28

Methane Testing

- Monitoring Equipment:
  - Audio Alarms
  - Visual Alarms
  - 0-100% LEL
    - Measures the % of gas related to LEL
  - 0-100% Gas
    - Measures total concentration of gas as a percentage of all gas

29

Methane Testing

- Monitoring Frequency:
  - Systematic and regular
  - Based on soil types
  - Based on proximity to facility structures
  - Increased when:
    - Landfill gas is detected
    - Frost and/or wet soils are present

30

Gas Recovery Factors

- > 1,000,000 tons in fill
- Closed < 5 years
- Waste Depth > 35 feet
- Landfill Area > 35 acres
- > 1 million cubic feet per day
- Impermeable soil cover

31

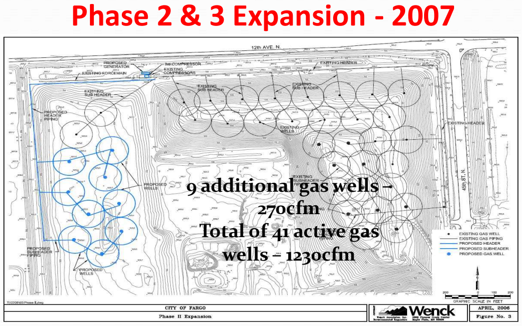
Landfill Gas to Renewable Natural Gas (RNG)

- RNG is a "term of art" used to describe biogas that has been upgraded for use in place of traditional fossil natural gas.
- Biogas for RNG production can come from MSW landfills, and digesters at water recovery facilities, livestock farms, food production facilities and organic waste management operations.
- RNG has many end uses: in thermal applications (e.g., heating, drying, steam, hot water), to generate electricity, for vehicle fuel or as a bioproduct feedstock.

32

Fargo Landfill Gas Collection

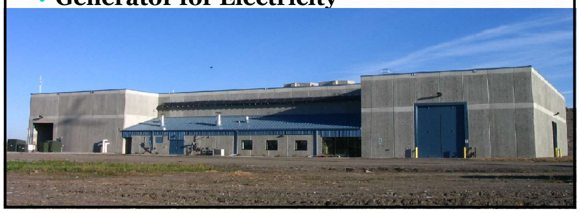
Phase 2 & 3 Expansion - 2007



33

Fargo Landfill Gas Product

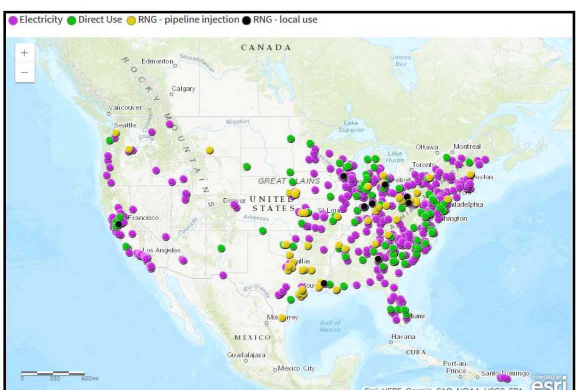
- **City sells to Cargill for Thermal Processes**
- **Transfer Station Boilers for Heating**
- **Generator for Electricity**



34

Landfill Gas Generator

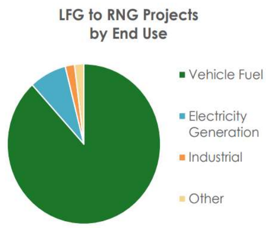
35



36

Landfill Gas to RNG End Uses

- As of September 2018, there are 51 operational LFG to RNG projects
- The majority of those projects are producing RNG for use as vehicle fuel
  - 38 inject the RNG into natural gas pipeline
  - 7 use the fuel locally (at or near the site)

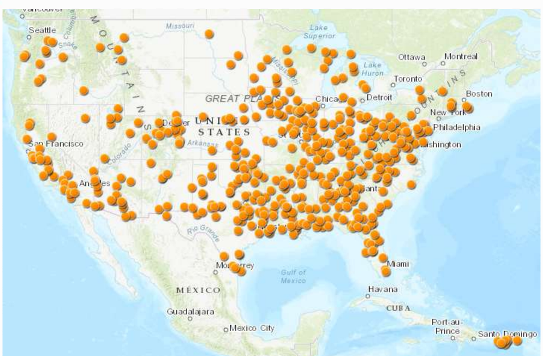


Example uses of RNG as vehicle fuel:
- Waste hauling and collection trucks
- County vehicles
- City buses

9 LMOP and Renewable Natural Gas

37

LMOP Candidate Landfills



38

Questions

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Be Legendary.

39


Landfill
Closure and
Post-Closure Care
4 9:58 AM

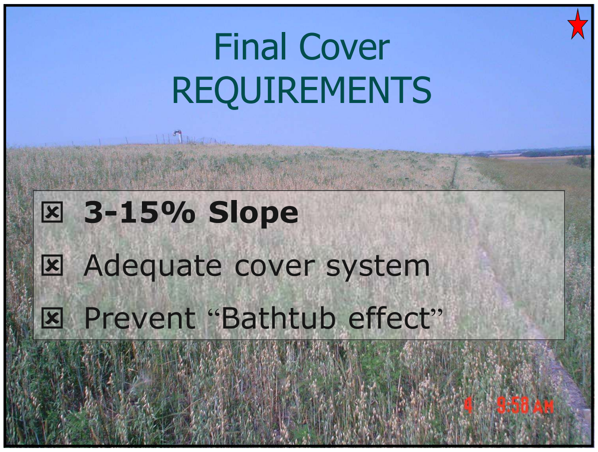
1


Final Cover
Minimize water infiltration
Promote surface drainage
Resist erosion
Control gas migration
Control vectors

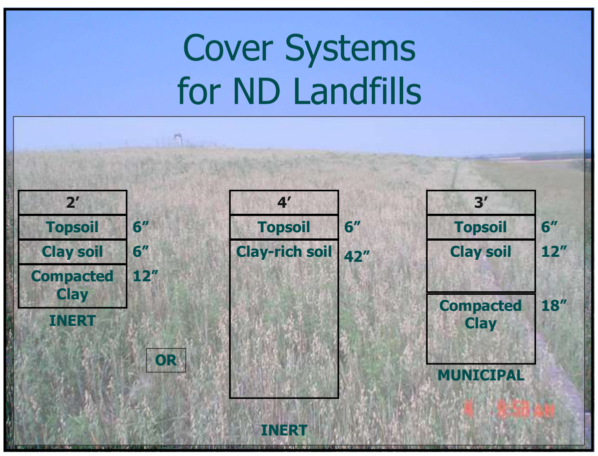
2


Final Cover
Minimize long-term maintenance
Improve aesthetics
Protect human health and the environment
Consider final use

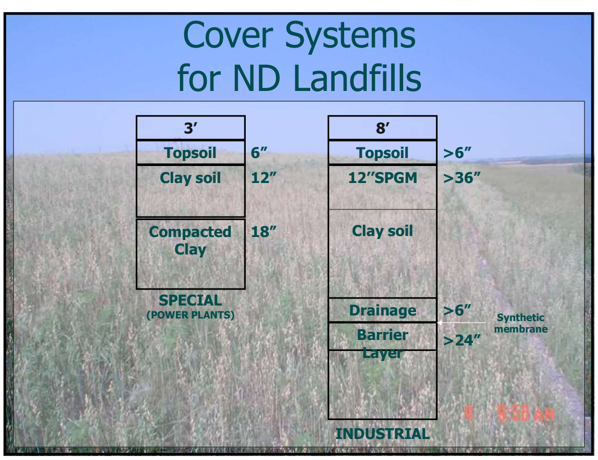
3


Final Cover
REQUIREMENTS
3-15% Slope
Adequate cover system
Prevent "Bathtub effect"

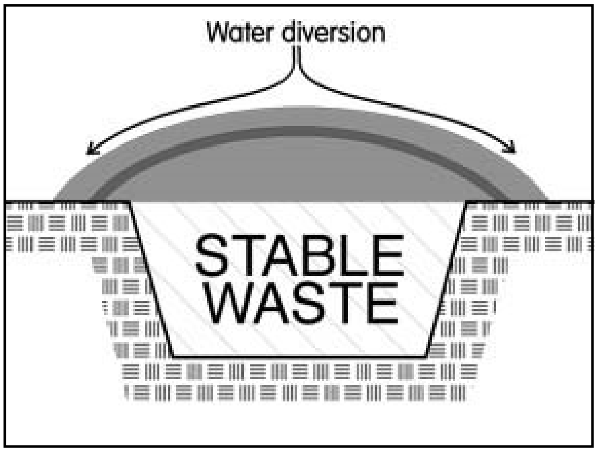
4


Cover Systems
for ND Landfills
2′
Topsoil 6″
Clay soil 6″
Compacted Clay 12″
INERT
OR
4′
Topsoil 6″
Clay-rich soil 42″
INERT
3′
Topsoil 6″
Clay soil 12″
Compacted Clay 18″
MUNICIPAL

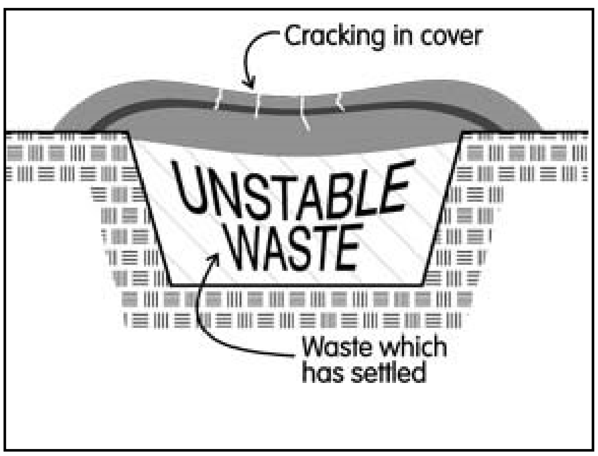
5


Cover Systems
for ND Landfills
3′
Topsoil 6″
Clay soil 12″
Compacted Clay 18″
SPECIAL
(POWER PLANTS)
8′
Topsoil >6″
12″SPGM >36″
Clay soil
Drainage >6″
Barrier Layer >24″
Synthetic membrane
INDUSTRIAL

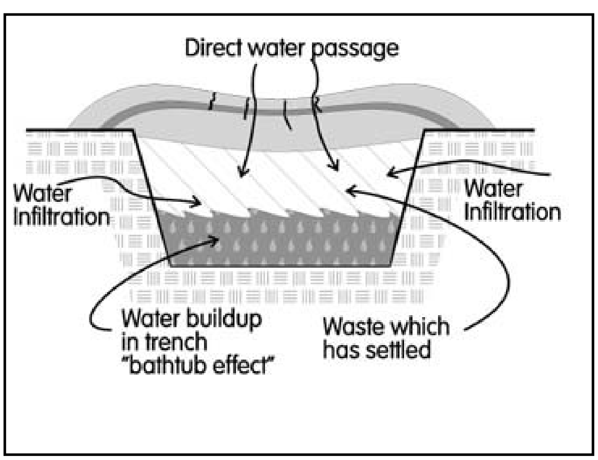
6


Water diversion
STABLE
WASTE

7


Cracking in cover
UNSTABLE
WASTE
Waste which
has settled

8


Direct water passage
Water
Infiltration
Water
Infiltration
Water buildup
in trench
"bathtub effect"
Waste which
has settled

9

Closure Considerations

- Settlement/Subsidence
- Foundation conditions
- Control of gas and leachate
- Placement of gas control system
- Vegetation
- Final grades

10

Settlement and Subsidence Concerns

- ☹ Ponding on cap
- ☹ Disruption of gas collection pipes
- ☹ Fracturing of low permeability soil layer
- ☹ Failure of geomembranes

11

Safety Issues?

12

13

HELP Model

- **H**ydrologic **E**valuation of **L**andfill **P**erformance
- Uses **facility design** and **climate data** to estimate leachate production and leakage

14

Erosion Effects

- ☹ Removes soil from closed areas
- ☹ Hinders grass growth
- ☹ May expose waste
- ☹ Loss of topsoil/cover
- ☹ Leachate/sediment pollutes run-off
- ☹ Creates unstable slopes

15

Revised Universal Soil Loss Equation (RUSLE 2)
WATER EROSION
$$A_s = Re \times K \times LS \times C \times Pc$$

As = avg. annual soil loss by sheet and rill erosion (tons/acre/year)

Re = rainfall energy/erosivity factor

K = soil erodibility factor

LS = slope length and steepness factor

C = vegetative cover and management factor

Pc = conservation support practice factor

16

WIND EROSION EQUATION (WEQ)
$$E = f(I\ K\ C\ L\ V)$$

E = estimation of avg. annual soil loss (tons/acre/year)

f indicates equation functional relationships

I = soil erodibility index

K = ridge roughness factor

C = climatic factor

L = field length factor

V = vegetative cover factor

17

Soil Suitability

- pH
- Electrical conductivity (EC)
- Sodium adsorption ratio (SAR)
- Organic matter
- Soil color, horizons, texture, structure, salts (if any) and vegetation (field observations)
- Guideline 26 – Soil Surveys and Management of Suitable Plant Growth Material and Plant Rooting Soil for Solid Waste Disposal Facilities

18

Soil Suitability

- Suitable Plant Growth Material (SPGM)- the soil material (normally the A and the upper B horizon which are dark colored due to organic staining) which, based upon a soil survey, is acceptable as a medium for plant growth when respread on the surface of regraded areas.
  - Commonly referred to as "topsoil"
- Clay-rich soil material suitable to serve as plant root zone material ("subsoil") (12 inches or more, under SPGM)

19

Cover Vegetation Selection

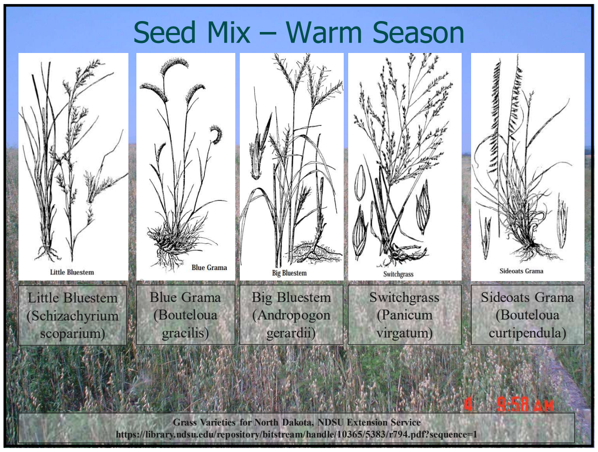
- Indigenous to area
- Shallow rooted
- Quick growing
- Gas resistant
- Drought resistant
- Hardy
- Extensive (fibrous) root system to help prevent erosion

20

Seed Mix

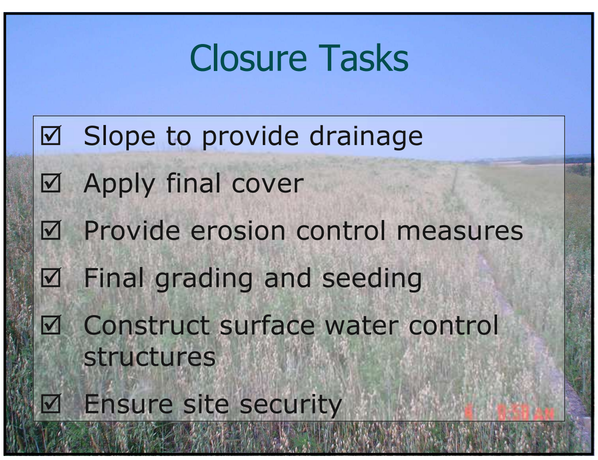
- Mixture of warm and cool season grasses
- Mixture of bunch and sod forming grasses
- Refer to Guideline 24 – General Native Grass Seeding on the Department website (may be an attachment in your permit)
- Consult the Natural Resources Conservation Service (NRCS)

21


Seed Mix – Warm Season
Little Bluestem
Blue Grama
Big Bluestem
Switchgrass
Sideoats Grama
Little Bluestem (Schizachyrium scoparium)
Blue Grama (Bouteloua gracilis)
Big Bluestem (Andropogon gerardii)
Switchgrass (Panicum virgatum)
Sideoats Grama (Bouteloua curtipendula)
4 9:58 AM
Grass Varieties for North Dakota, NDSU Extension Service
https://library.ndsu.edu/repository/bitstream/handle/10365/5383/r794.pdf?sequence=1

22

23


Closure Tasks
☑ Slope to provide drainage
☑ Apply final cover
☑ Provide erosion control measures
☑ Final grading and seeding
☑ Construct surface water control structures
☑ Ensure site security

24

Water Erosion Control

- Minimize disturbed area
- Reseed disturbed areas quickly
- Minimize slope steepness and length: **3 %–15%**
- Use erosion control practices (terraces, diversions, grassed waterways, hydromulch, erosion control blankets)

25

26

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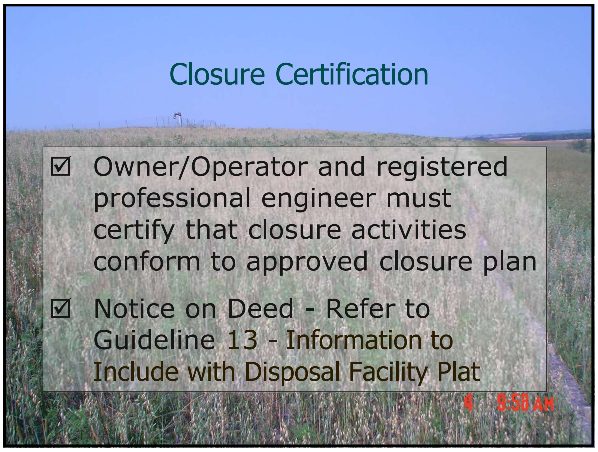
Straw Bales used for Final Cover Erosion Control

29

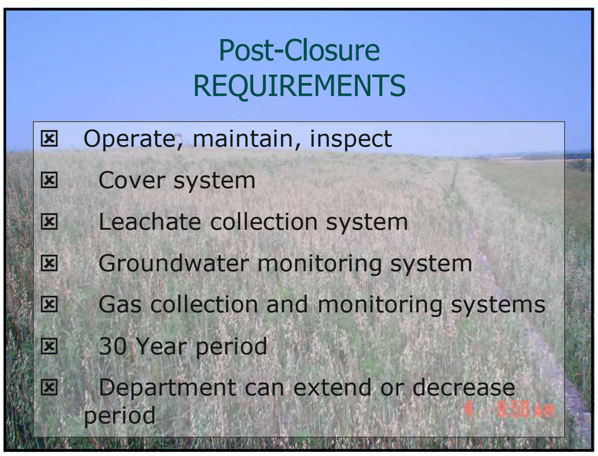
Closure Plan REQUIREMENTS

- Schedule sequential partial closure
- Describe final cover
- Estimate of largest area, ever requiring cover
- Estimate of maximum inventory of waste
- Identify closure cost estimates and provide financial assurance mechanism
- Guideline 20 – Closure and Postclosure Care Cost Estimates for Publicly and Privately Owned Landfills
- Guideline 18 – Financial Assurance Mechanisms for Closure and Post-Closure for Publicly and Privately Owned Landfills

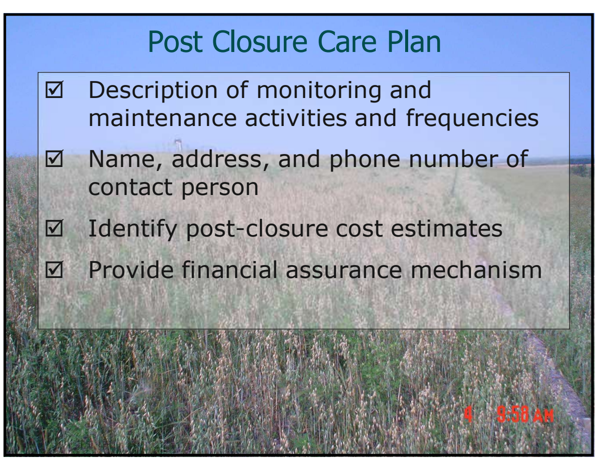
30


Closure Certification
☑ Owner/Operator and registered professional engineer must certify that closure activities conform to approved closure plan
☑ Notice on Deed - Refer to Guideline 13 - Information to Include with Disposal Facility Plat

31


Post-Closure REQUIREMENTS
☒ Operate, maintain, inspect
☒ Cover system
☒ Leachate collection system
☒ Groundwater monitoring system
☒ Gas collection and monitoring systems
☒ 30 Year period
☒ Department can extend or decrease period

32


Post Closure Care Plan
☑ Description of monitoring and maintenance activities and frequencies
☑ Name, address, and phone number of contact person
☑ Identify post-closure cost estimates
☑ Provide financial assurance mechanism

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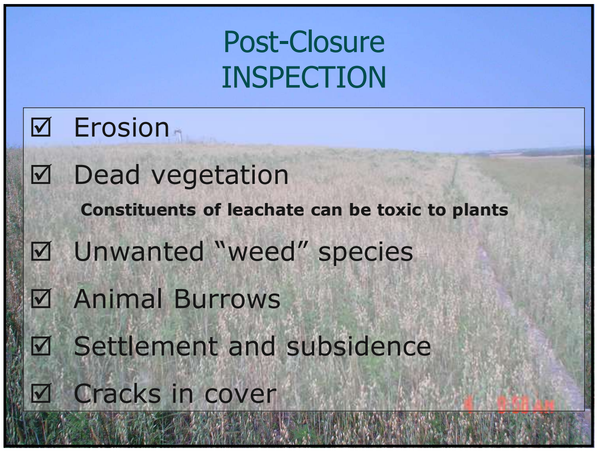
Post-Closure
INSPECTION
☑ Erosion
☑ Dead vegetation
Constituents of leachate can be toxic to plants
☑ Unwanted "weed" species
☑ Animal Burrows
☑ Settlement and subsidence
☑ Cracks in cover

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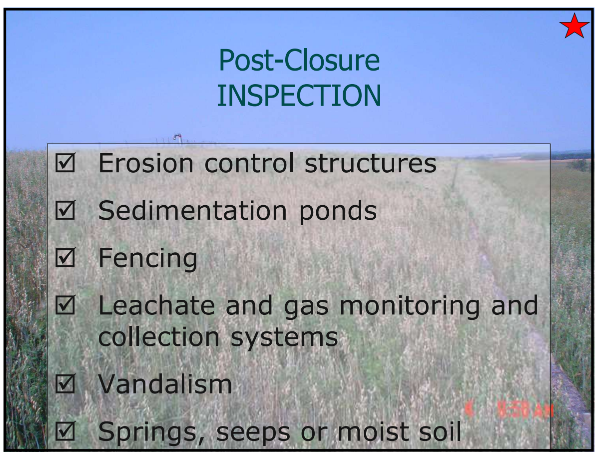
Post-Closure
INSPECTION
☑ Erosion control structures
☑ Sedimentation ponds
☑ Fencing
☑ Leachate and gas monitoring and collection systems
☑ Vandalism
☑ Springs, seeps or moist soil

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Potential Uses for Closed Landfills
Wildlife Habitat
Sledding Hill
Hayland
Light Rotational Grazing (with Department approval)
Target Range

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