Rural Landfill Design and Operations

Video Study Guide

Alaska Department of Environmental Conservation

Division of Environmental Health
Solid Waste Program
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Rural Landfill Design and Operations Study Guide

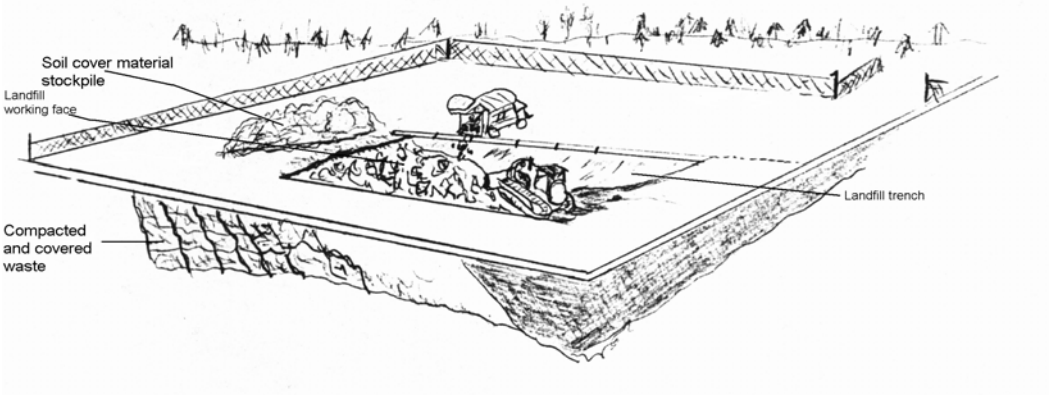
I. *Landfill Designs*

In rural Alaska, there are several basic designs that are used for sanitary landfills.

A. Trench and Fill

The most common landfill type developed in communities where there is little or no permafrost, with upland areas which have thick soil covers over bedrock is the ***trench and fill*** type of design. (Figure 1).

Figure 1. Trench and fill.



In the ***trench and fill*** type of landfill, a trench is dug into the soil using a bulldozer or backhoe. Wastes are placed in one end at the bottom of the trench, compacted, and covered with the soil that was excavated during the landfill construction.

The ***depth of the trench*** will vary, depending on the soil conditions at the landfill site. The base of the trench should be at least 10 feet above the seasonal high groundwater level for that area. (In areas that have shallow groundwater tables, this may not be possible, and different landfill designs should be considered.) If the site has shallow bedrock present, then at least a two to three foot layer of soil should be left on top of the bedrock in the base of the trench, as a best-management practice.

If the trench is too deep and narrow, cave-ins could pose safety problems. The trench should be **a*t least twice as wide as the bulldozer or other compacting equipment used***. Landfill operators should follow good confined space entry procedures in all trenching operations.

The length and width of the disposal trench will vary, depending on the amount of the community's waste. ***At a minimum, the trench should be sized to contain all the waste produced in a community from October to May of each year.*** It is

very difficult to dig a new trench during winter months when soils are frozen in the northern areas of our state.

If a ***trench and fill*** landfill is placed on a hillside, care must be taken to make sure surface water does not flow into the trench. This can be done by building soil berms or digging ditches on the uphill side of the trench to divert surface water away from the excavation. (Figure 2)

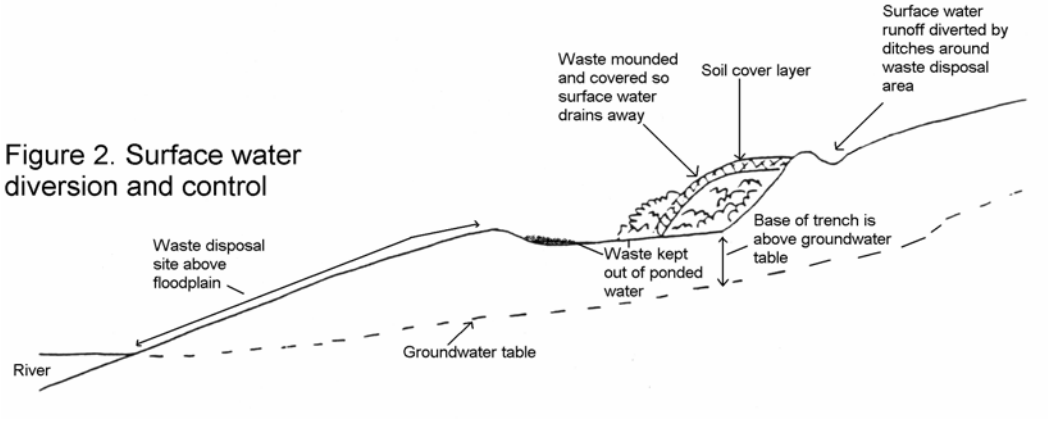


Figure 2. Surface water diversion and control

Trenches should be oriented so that ***the length of the trench is perpendicular to the prevailing wind direction*** at a site. (Figure 3) Otherwise, there will be more potential for blowing litter problems at the landfill.

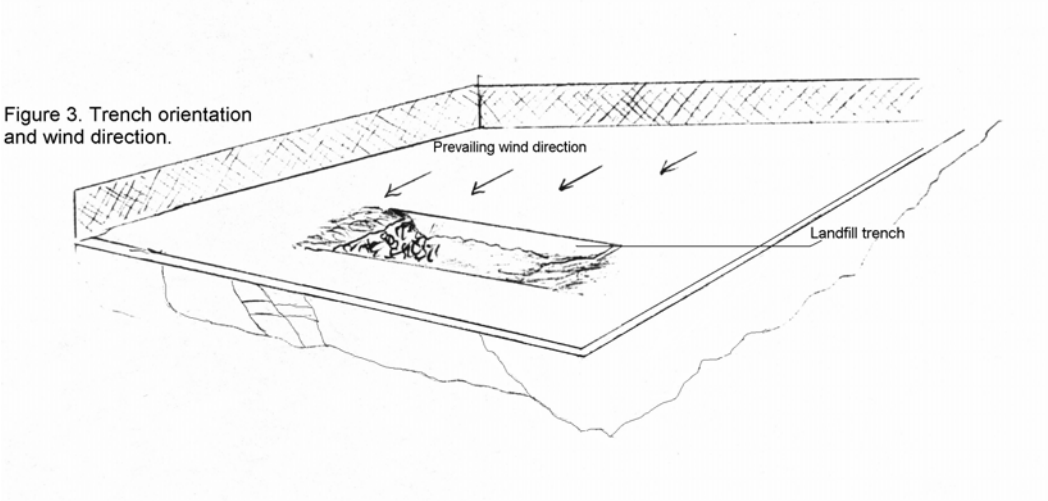


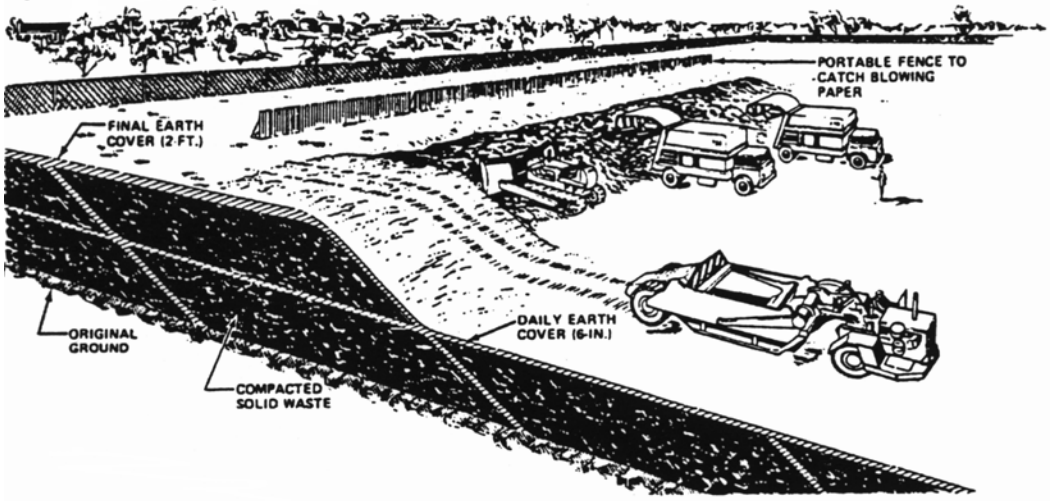
Figure 3. Trench orientation and wind direction.

B. Area Fill

In an ***area fill*** the waste is placed at a site on the natural surface of the ground or on a prepared pad. Often this type of landfill design is used in areas where there is a gentle slope or grade, with the soil being scraped away on two or three sides to form a level pad. This type of design is also developed in borrow materials

sites, gravel pits, or quarries. The wastes are placed on the ground surface or pad, compacted, and covered with soil. (Figure 4)

Figure 4. Area-fill design



The same design considerations for depth to groundwater and bedrock that apply to the trench and fill design discussed above, also apply to the ***area fill*** design.

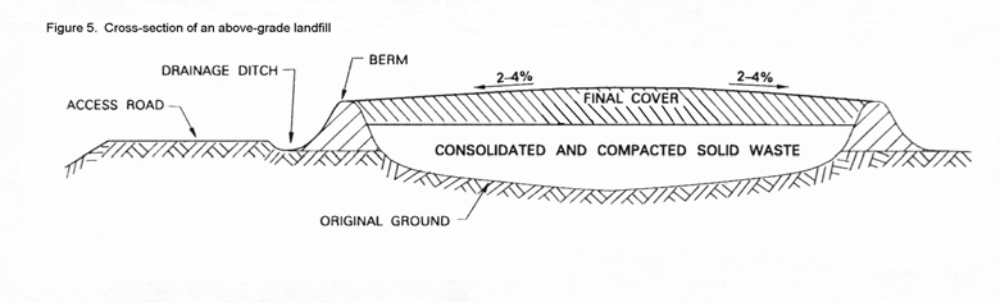
The active waste disposal area in an ***area fill*** should be kept as small as possible in order to minimize the amount of surface water that could come into contact with the waste, to reduce the amount of windblown litter and reduce the amount of soil cover material needed.

The side slopes of an ***area fill*** need to promote drainage without erosion of the surface. ***Side slopes should have a 3:1 ratio or flatter, and the top cover should be graded to a slope of approximately 3 - 5%***.

C. Above-Grade Fill

A variation on the area fill, for those locations where there are wetlands or shallow groundwater, is the ***above-grade fill***. In this type of design, a layer of compacted soil (a minimum of two-feet thick) is placed on a site that is selected to serve as a pad. Soil berms, two to three-feet in height are built around the edges. (Figure 5) Often, a fence is placed on the top edge of the berm to help control site access and litter.

Figure 5. Cross-section of an above-grade landfill



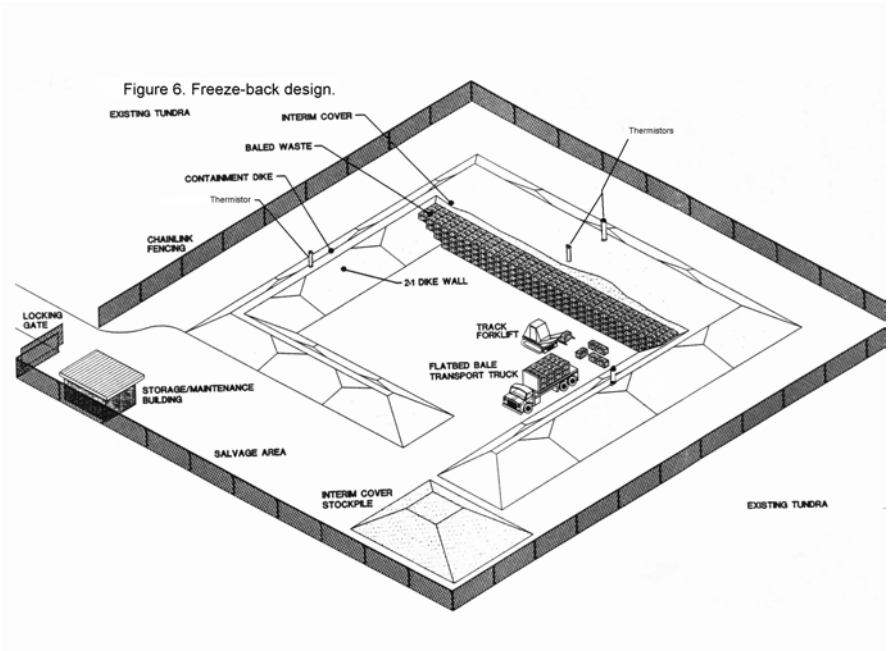
The waste is placed on the pad in a designated area, compacted, and covered with soil, just as it would be in an area fill or trench and fill landfill. The only disadvantage of this type of landfill is that soil cover material must often be imported to the site, so the costs of operation may be greater than with a trench and fill-type of landfill. But for those areas of Alaska where there is shallow groundwater and little high ground to build a landfill upon, this may be one of the better options for landfill design.

The same considerations for the grades of side slopes and top cover as are important for area fills apply to above-grade fills. ***Side slopes should have a 3:1 ratio or flatter and the top cover should be graded to a slope of approximately 3 - 5%***. If side slopes are too steep, they can slide, crack, or erode and will not do an adequate job of containing the wastes.

D. Freeze-back landfill designs

In areas of Alaska where there is continuous permafrost, a variation of the above-grade landfill can be used to contain and freeze-back the wastes. The ***freeze-back landfill*** uses the same kind of design as the above-grade landfill. However, care must be taken not to remove the vegetation layer in the base of the landfill. Disturbance of the insulative vegetation layer can cause the permafrost underneath to melt. A gravel pad can be placed in the disposal area for bulldozers or other equipment to work from when placing and compacting the waste. It is often beneficial to place a layer of geotextile under the gravel to keep it from being compacted into the vegetation layer. This will reduce the amount of gravel needed and make it easier to operate equipment in the base of the landfill. Thermistors are often placed in the berm to monitor the soil temperature and make sure the wastes freeze and remain frozen. (Figure 6)

Figure 6. Freeze-back design.

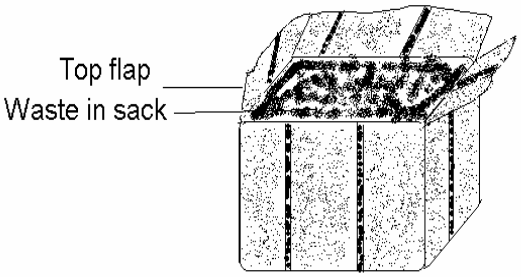


There are some technical and operational concerns to consider with a ***freeze-back design***. First, ***snow and storm water that accumulate in the base of the disposal area need to be removed from the landfill***. Ponded water in the disposal area can cause the permafrost to thaw, and allow for a possible release of contaminants present in the solid waste onto the surrounding tundra. Second, to ensure that the wastes placed in the disposal area remain frozen, ***a soil cap must be placed on top of the wastes that is thick enough to insulate them from thawing.*** A good layer of soil or other insulation on top of the waste will prevent the site from thawing in summer months and releasing potential contaminants to the surrounding lands.

E. Supersack Waste Containment

In areas of Alaska where there are boardwalk communities, very limited upland areas, and virtually no soil cover material available, the use of the ***supersack*** to contain and store wastes may be an option to consider. The supersack is a large polypropylene bag that can hold up to 5,000 pounds of dry, free-flowing material. When the sack is empty, it is about the size of a briefcase, but when it is filled, it forms a freestanding block some three-feet square and four and one half feet high. (Figure 7)

Figure 7. Supersack

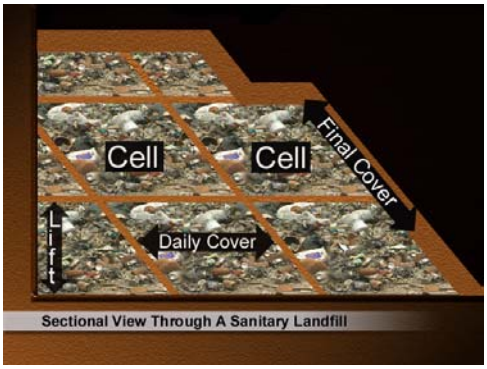


Supersacks can be used for temporary storage of potentially recyclable materials such as aluminum, glass, or plastic. They can also be used for semi-permanent storage of garbage or ash. The bags can be placed to form berm-like barriers around a waste disposal area. Since the bags will eventually break down as they are exposed to sunlight, they should not be considered a permanent solution to a community's waste disposal problem. But, they will help in the clean up or containment of wastes in communities where there is no soil available to cover wastes.

II. *Landfill Cell Construction*

The common building block of any landfill design is the ***landfill cell***. (Figure 8)

Figure 8. Sectional view through a landfill.



All the solid wastes are deposited on the ***working face*** of the ***landfill cell*** for period of time. The ***working face*** is the area where wastes are placed in the ***landfill cell*** prior to their consolidation and compaction. The size of the ***working face*** varies, depending on the specific conditions of the landfill, but it is generally less than one-hundred feet in length, and often smaller if a trench and fill-type landfill is used.

Wastes placed over a specific time period at the landfill are spread and compacted within the ***landfill cell***. The period of time will vary, depending upon the size of the landfill and the amount of waste it receives. The largest landfills in the state will build landfill cells by compacting and covering their wastes on a daily basis. Those rural ***communities that are much smaller may compact and cover their wastes on a daily, weekly, or monthly basis***, depending upon the time of year and the volume of waste received.

Only one landfill cell is operational at a time. When the wastes are compacted and covered with soil, another cell is started next to the previous one. Each cell is about the same size, so that the wastes have similar compacted densities and the landfill space is used most efficiently.

In some landfills, layers of cells are stacked one on top of another, forming what are called ***lifts.*** (Figure 8) The lifts are placed until the landfill reaches its final design height and the disposal trench or area fill is closed. When the design height is reached, a final cover of soil is placed over the waste, graded and revegetated. (*See Section IX on Landfill Closure for final cover (cap) design requirements.*)

III. *Methods for Reducing Solid Waste Volume*

Space for disposal of wastes in a landfill is valuable, when you consider the amount of money spent to build, develop, and operate a site. Landfill operators need to know the amounts and types of wastes that will be coming into the landfill in order to develop and operate the landfill well. Also, ***landfill operators need to work to reduce the volume of waste coming into the landfill in order to conserve the landfill space that is used***. This can be done by waste reduction, treating wastes, compacting them, and covering the wastes in ways that will maximize the amount of landfill space available for actual waste disposal.

A. Consolidation of Waste

Consolidation of solid waste is an important first step in managing a good landfill. ***Consolidation means keeping the size of the areas for solid waste disposal as small and confined as possible.*** By keeping the area of waste disposal small by ***consolidation of waste***, a landfill operator can do the following:

- Decrease the amount of cover material needed to go over the waste (but not the thickness).

- Decrease the potential for a litter problem.
- Increase the compaction efficiency with equipment used to compact the waste in place. Also, the amount of time needed to spread and compact the waste is reduced.

B. Compaction of Waste

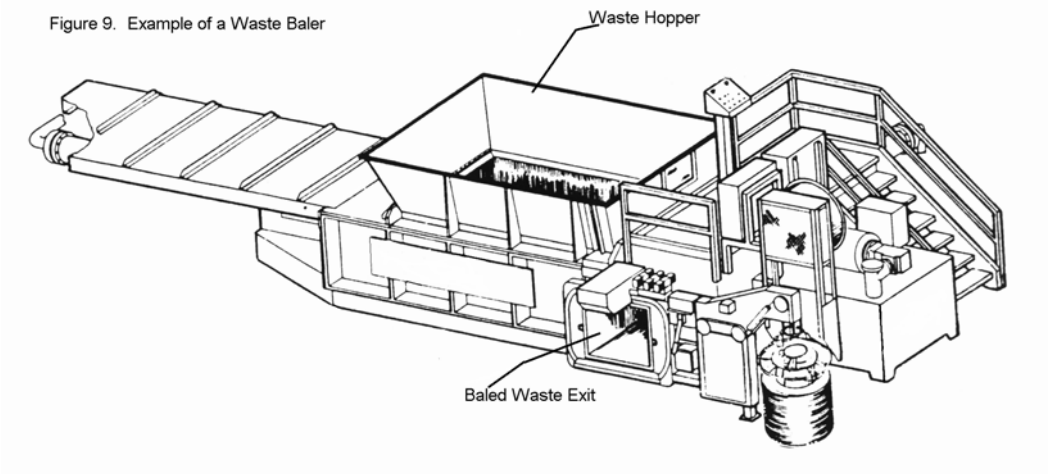
Compaction of waste is a way of reducing the overall volume of trash either prior to its placement in a landfill or after it is disposed of at the landfill.

Good compaction of solid wastes will do the following things for a landfill:

- Minimize the amount of landfill space used and extend the life of the landfill site
- Reduce the amount of water percolating through the waste to produce leachate and increasing surface water run-off
- Reduce the amount of differential waste settlement after landfill closure and therefore reduce the amount of post-closure landfill maintenance
- Require less soil to cover the solid waste due to less sifting of soil materials through the wastes
- Limit the spread of fire if one gets started in the landfill

Prior to taking waste to a landfill, a machine known as a ***baler*** can be used to squeeze the waste into squarish bales, which can be stacked and transported to the landfill for disposal. ***A baler can reduce the waste volume that needs to be taken to a landfill by as much as 30%.*** Balers can also be used to prepare recyclable materials such as aluminum cans, paper, and cardboard for shipment to recycling facilities. (Figure 9)

Figure 9. Example of a Waste Baler

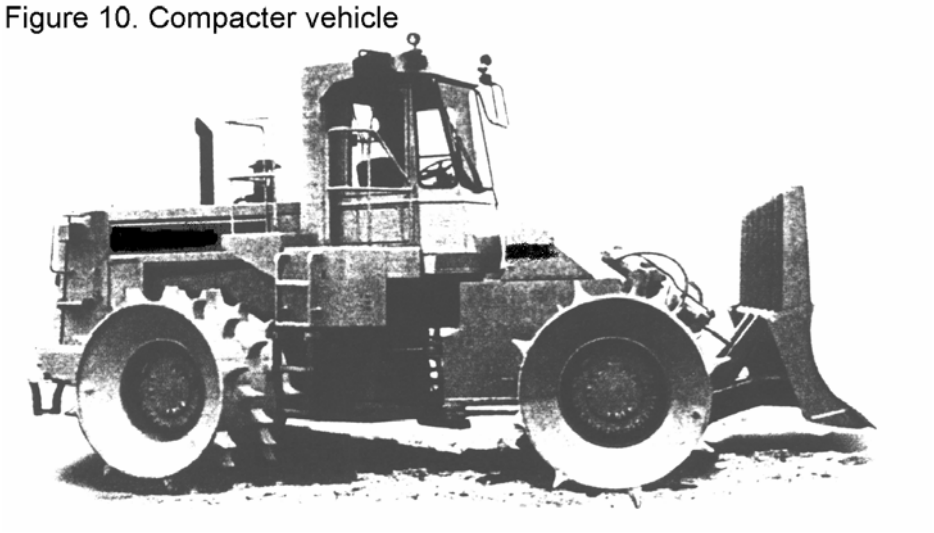


There are many sizes of balers available, and a community needs to determine the size that will best meet their needs. However, ***all balers require a support system in order to function well. This includes an indoor working space, power and***

water sources, trained operators, and a regular maintenance plan. Balers can be an expensive waste volume reduction method for some communities. However, they will also give a community a good means to significantly reduce the volume of waste being transported to the landfill and make it easier to deal with litter problems.

Compaction of solid waste can also occur at the landfill using construction equipment such as bulldozers or specifically designed landfill compactors. (Figure 10)

Figure 10. Compacter vehicle



When using equipment such as a compactor or bulldozer to compact the waste, the ***waste should be spread out in layers of no more than two-feet thick at the base of the working face***.

Wastes should be pushed up-slope with the compactor or bulldozer. If the wastes are pushed down-slope, this results in the wastes tumbling down to the bottom of the slope, so there is less effective compaction of wastes.

Maintaining the ***proper slope*** of the waste during the compaction process is necessary to achieve the best in-place density of the waste. Track vehicles can work on slopes greater than 3:1 (or 33 1/3%) slope. Exceeding this slope by very much is not recommended. Wheeled compaction vehicles work best on gradual slopes of much less than a 3:1 ratio.

Good compaction of the waste is achieved by making three to five passes over the layers of garbage. Studies have shown that compaction efficiency does not increase much with the number of passes. Controlling the number of passes over the waste helps reduce the amount of fuel used as well as the amount of operator time.

C. Burning Waste:

Burning or incineration of solid waste is an effective method of reducing the volume of waste going into a landfill by 80-90%. It has other advantages as well, including the reduction of windblown litter from the landfill and the reduction or elimination of animal attraction (bears, foxes, birds, etc.) to the landfill. Open burning can be done in several ways:

- Burning waste materials in an open, designated shallow trench area away from the landfill working face.
- Burning waste in a burn box or burn cage. (Figure 11)

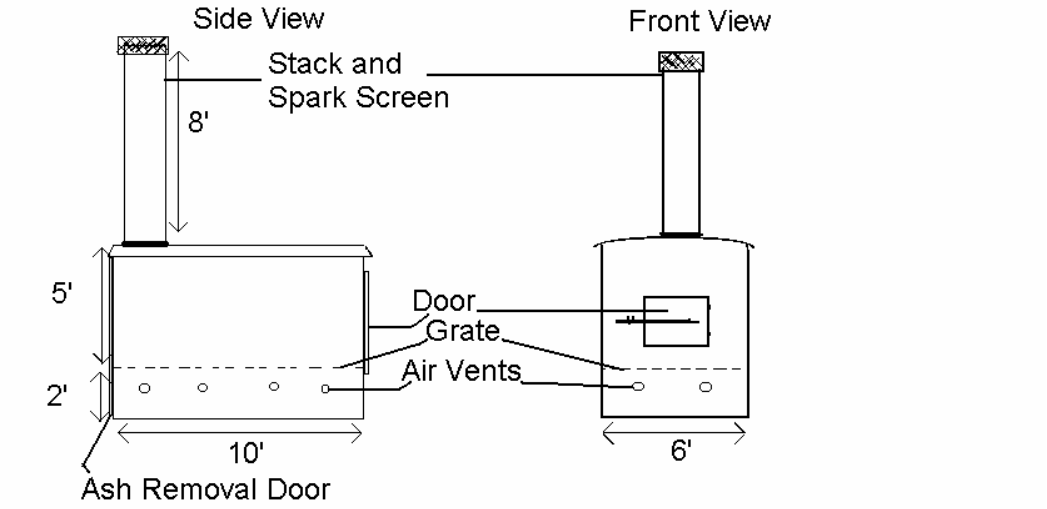


Figure 11. Burn box design.

Under the State of Alaska Solid Waste Regulations, small, remote, and rural Class III landfills may open burn the waste. (Larger landfills are prohibited from open burning wastes within their landfill boundaries.) However, this means that there should be the best possible combustion of the waste. There should not be any black smoke and the waste must not smolder. There should also be a person on-duty during the burning operation, to make sure the fire does not get out of hand. Uncontrolled open burning at dumps in rural Alaska has caused forest fires.

Burnboxes are a safer and more efficient method of open burning as they contain the fire to an enclosed area and have improved airflow during the burn, allowing for better combustion of the wastes.

Complete incineration of solid wastes occurs only in specially designed and operated incinerators. These devices control both the airflow to the waste and the emission of chemicals coming out of the smokestack. Often, incinerators require an additional fuel source such as oil or natural gas to make sure the waste is completely burned. Depending on the size of the incinerator, an Air Quality Permit may be required by ADEC before the incinerator can be built or operate. Landfill owners and operators should check with the

ADEC Air Quality Program before selecting a municipal waste incinerator to determine its regulatory status. (Figure 12)

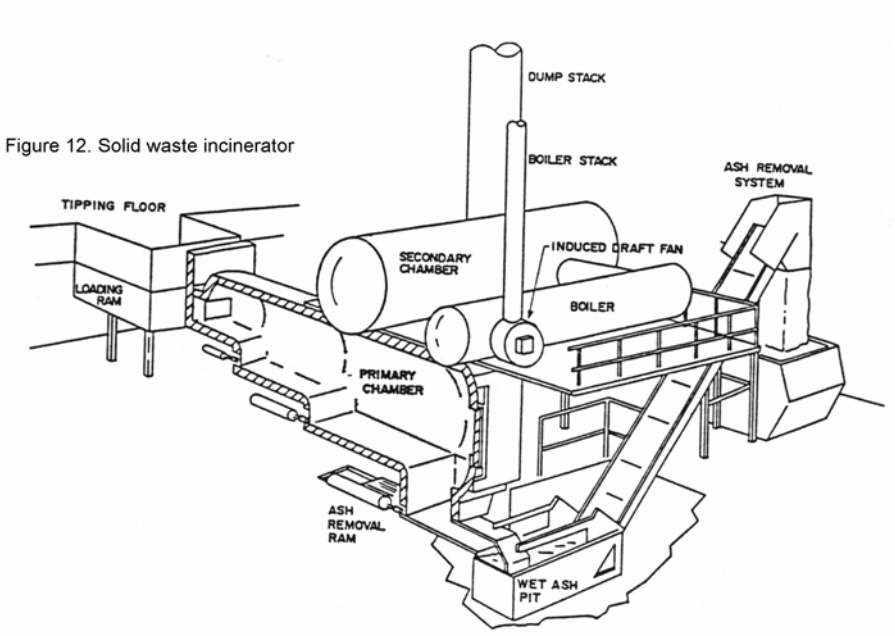


Figure 12. Solid waste incinerator

If a community is thinking about either open burning or incinerating its solid waste, the following things need to be considered:

- Since open burning of solid wastes can create smoke that is possibly toxic and unhealthy to breathe, it is important to place burn boxes, cages, or burn trenches away from the village or from places where people congregate. ***It is preferable to have the burn area located down-wind of the community and any residences.***

- Wastes should be sorted prior to open burning or incineration to make sure that only appropriate combustible wastes are burned. ***Items such as lead-acid batteries, tires, PVC plastic pipe or materials, and anything that might explode when heated (such as aerosol cans) should not be burned.*** (Table 1. Items prohibited for open burning at landfills.)

- It is not a good idea to include a lot of glass or metal in with the waste to be burned, as these items don't burn well, and tend to fill up the ash collection area in a burn box or incinerator. ***Open burning should be limited to paper, cardboard, and organic matter (such as food waste)*** that will burn in a hot fire and produce less potentially toxic smoke and ash.

Table 1: Items prohibited for open burning at landfills.

Any wastes that will give off black smoke, unless specific approval is given by the ADEC Air Quality Program. For example:

Asphalts
Rubber products (e.g., tires)
Plastic
Tars
Oily wastes
Spill absorbents and contaminated soils that are classified as hazardous waste

Any wastes that produce toxic and acid gases or particulate matter. For example:

Pesticides
Halogenated organic compounds
Cyanic compounds
Polyurethane products

Any putrescible garbage, animal carcasses, or petroleum-based materials that causes odor or black smoke that has an adverse affect on nearby persons or property.

Household garbage can be open burned as long as it does not produce black smoke and does not create a nuisance for neighboring property.

Other items that should not be open burned include (but are not limited to):

Electrical batteries
Fertilizers
Paints and Glues (except those applied and dried on solid wastes)
Solvents (except those that are water and soap/detergent solutions)
Household cleaners
Linoleum flooring
Insulated wire
Plastic (PVC) piping
Urethane or other plastic foam insulation
Aerosol cans
Asbestos containing materials
Electrical or electronic lamps and components (e.g., fluorescent lights, high-pressure sodium, mercury vapor and metal halide lamps)

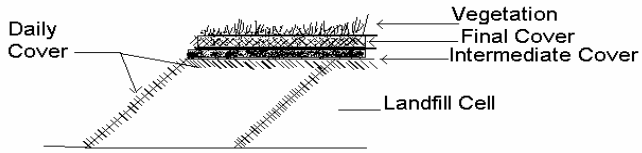
III. Soil Cover Material

There are three types of soil cover material used in the operations of a landfill. These include:

- ***Daily Cover***
- ***Intermediate Cover***
- ***Final Cover***

The main functions of ***daily cover*** are to reduce odors, reduce the attraction of wildlife and flies to the wastes, and control windblown litter. Usually ***six inches of soil or gravel is spread over the top of compacted wastes*** as daily cover material in the disposal cell. In larger landfills (those which take in more than five tons of waste per day) the six inches of cover material is placed over the waste on a daily basis. (Figure 13)

Figure 13. Types of Cover at Landfills



In the smaller, remote, rural landfills, how often the placement of daily cover occurs may vary. ***The frequency of placement of soil cover depends on the quantity of waste being received, whether the waste was open-burned or incinerated, and the time of year.*** In communities where there are large number of summer workers or visitors producing more solid waste than usual, or if there are severe animal attraction problems, the wastes may need to be covered daily. However, in winter months, when the waste volume is reduced and soil cover is more difficult to obtain, the frequency of placement of soil cover may be reduced to weekly or monthly. In other communities that produce very small volumes of solid waste, weekly, bi-weekly, or monthly placement of soil cover is needed.

Intermediate cover is applied to those areas of a landfill that will be inactive for long periods of time or will not be accepting more waste within the next year. The depth of the intermediate cover is usually at least ***12 inches***. When intermediate cover is placed over the compacted waste in the landfill, it should be graded to promote surface water run-off (approximately a 3-5% slope). If the area will be inactive for more than one growing season, the area should be seeded with a grass seed mixture appropriate to the geographical area. ***Proper grading and revegetation of the area where intermediate cover is placed will reduce the amount of water passing though the wastes in the landfill***. (Figure 13)

Final cover is applied over the disposal area when the landfill is closed. In trench and fill design landfills, final cover is placed over the top of the waste disposal

trench when it has been filled to its designed capacity, so that closure of the site is done in increments.

The depth of the ***final cover is a minimum of two feet of soil material***. The soil material is compacted and graded to promote surface water run off without erosion. ***Soils such as clays or silts make the best final cover material,*** since they will reduce the amount of water that may percolate through the waste disposal area. Gravel-type soils are less effective as final cover material, but in some locations in Alaska, that is the only type of soil available.

The top six inches of final cover should be organic soil that will help retain moisture and provide nutrients for the support of plant growth over the top of the landfill. (See Section IX on Landfill Closure for a discussion on the landfill cover (cap) design.)

IV. Recycling and Reusing Wastes

Another way of reducing the amount of waste that goes into a landfill is to develop a recycling and reuse program. Many groups in rural communities have started recycling aluminum cans to earn money for local projects. Through the ***Flying Cans*** program, some airlines will carry crushed and bagged aluminum cans on a space-available basis to larger communities where recycling centers are located. ***Alaskans for Litter Prevention and Recycling (ALPAR) at (907) 274-3266 or P.O. Box 231231, Anchorage, AK 99523*** can provide communities with information on how to participate in this program. An agreement will need to be worked out between the community and an airline serving the community, regarding each party's responsibilities under this program.

Old lead-acid vehicle batteries can be collected, stored, and recycled. There are a number of recyclers in larger communities that can take these batteries and then ship them out for recycling into new batteries. People can work with the local stores that sell new batteries to develop some kind of arrangement for back-haul of the old, used batteries. The ADEC offices also have informational handouts available on the collection, proper storage, and shipment requirements for spent lead-acid batteries.

Used oil collection and reuse facilities can be found now in many rural communities. Used oil from power plants, residential vehicles, boats, and airplanes can be collected and burned for energy recovery. This can provide a valuable energy resource. The used oil is burned in a specially designed burner and the heat that is produced be can be used for public or private buildings, garages, and storage areas. ***There are special regulatory requirements for a used oil collection and burning operation, and it is a good idea to contact your local ADEC office to find out what requirements apply to your community.***

Another way to reduce the waste volume going into a landfill is to reuse items that would normally be thrown away. These can include things such as:

- Plastic grocery bags
- Paper with printing on one side
- Coffee cans
- Plastic gallon jugs
- Waste lumber and building materials
- Tires
- Machinery, appliances, and furniture

Recycling and reuse programs require additional efforts and planning on the part of the community, but there are also benefits. Residents need to separate possible reusable items from their regular trash. These can include items such as furniture, appliances, used clothing, toys, and building supplies. ***A separate area should be set up for the salvage area. It should be located away from the working face and disposal areas of the landfill for health and safety reasons.*** The salvage area can be as simple as a separate gravel pad, or as elaborate as a platform covered with a shed roof. The area should be supervised to prevent dumping of regular garbage. All of the unwanted items will need to be removed periodically (at least annually) and disposed of in the landfill cell.

V. Hazardous Items

What wastes are considered to be hazardous? Hazardous wastes are defined in federal and state regulations as any waste that has the following characteristics:

- Is easily combustible (a flashpoint of less than 140^{o}F)
- Is corrosive (dissolves metals or burns the skin and has a pH of less than 2 and greater than 12)
- Is reactive (unstable and undergoes a violent chemical reaction when mixed with water or other chemicals)
- Has the potential to leach out certain hazardous heavy metals, pesticides or chemicals above regulatory maximums established for the Toxicity Characteristic Leaching Procedure (TCLP test)
- Or is specifically listed in the Environmental Protection Agency regulations

Examples of hazardous wastes that are commonly found in communities include strong acids and bases, solvents, explosives, lead-acid batteries, and used oil. These wastes should not be disposed of in the landfill. They should be stored carefully in a separate collection area and then arrangements made for their proper disposal that needs to be done according to specific state and federal regulations. Careful storage of these wastes means that incompatible items that can cause fires or explosions should not be stored together. Also, any ***liquid wastes must not be mixed together*** and need to be stored in containers that do not leak.

Asbestos containing materials may also be hazardous, and must be handled according to specific regulations and disposed of only in approved landfills. (The requirements for handling asbestos are found in EPA regulations that are different from those dealing with hazardous wastes.) The major human health hazard from asbestos containing materials

comes from breathing in asbestos fibers. This is why there are special requirements for removing, packaging, handling, tracking, and disposing of these wastes under both EPA and state rules. If you have questions about asbestos disposal (both regulated and non-regulated types) contact the nearest ADEC office, Solid Waste Program for additional information.

VI. Landfill Management and Safety Issues

There are a number of management and safety issues that a landfill needs to deal with on a day-to-day basis.

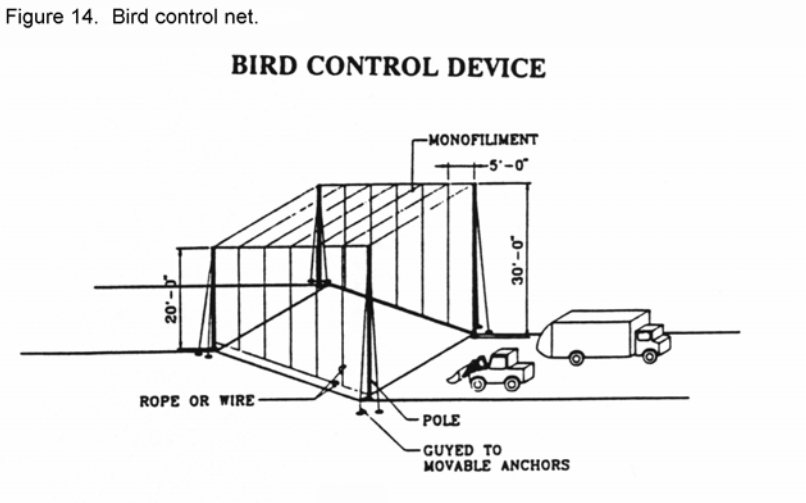
A. Controlling Insects, Animals, and Litter:

When landfills are not managed well, they can become a major breeding ground for insects such as flies and mosquitoes. Flies are a special concern as they can directly transmit food-borne diseases such as *Salmonella* by contact with the food we eat. ***The best method for insect control at a landfill is to cover the wastes regularly with a minimum of six inches of soil***.

In rural communities of Alaska, animals such as bears and foxes are attracted to landfills as food sources, causing both health and safety problems. ***The frequent placement of soil cover material, thorough burning or incineration of food-type wastes, and erecting well-designed fences and gates around a landfill will prevent or reduce the potential for animal attraction to the wastes.***

Controlling bird attraction to landfills presents unique challenges. When landfills are located too close to airport runways, there is an increased potential for bird-aircraft strike hazards. ***Methods for controlling birds at landfills include the frequent placement of soil cover material, thorough burning or incineration of food-type wastes, and using loud noises to scare them off.*** Larger landfills may need to construct a wire net over the active disposal area to prevent the birds from landing in the landfill. (Figure 14)

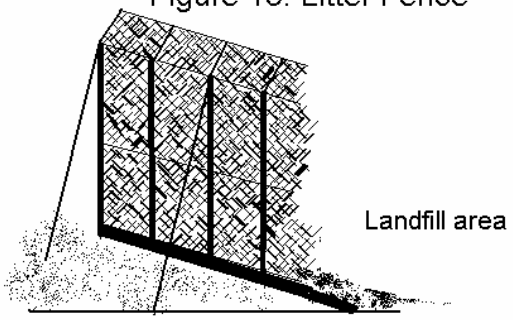
Figure 14. Bird control net.



Litter is a major source of complaints about a landfill since it is so visible. Litter is often caused by uncovered loads of waste coming into the landfill, windy-day operations, and how the waste is dumped or handled within the landfill. Ways to prevent and reduce the amount of litter at a landfill include:

- Making sure waste is covered while being transported to the landfill.
- Changing or stopping operations on very windy days.
- Keeping the working face as small as possible.
- Following good daily cover placement practices at the landfill.
- Using both permanent and temporary litter fencing to contain the majority of the windblown wastes on landfill property. (Figure 15)
- Designating someone to be responsible for picking up and disposing of litter that collects in fences and along access roads to the landfill.

Figure 15. Litter Fence



B. Management of Water and Snow:

Controlling the water that is often present in a landfill is important to both the efficiency of the operation and the health of the community. The water that is present in landfills comes from several sources: snowmelt, rain, and from within the waste itself. ***Solid wastes can contain as much as 20 – 25% moisture when delivered to the landfill.*** As wastes settle and are compacted, the moisture present flows slowly through the waste, dissolving many of the chemicals or compounds that are present in the garbage. Water containing the dissolved chemicals and compounds from solid waste is called ***leachate***. ***Leachate contains both organic and inorganic compounds as well as microbes that could be harmful to human health if they enter a community's water supply.***

Leachate control is a big problem in areas where there is high rainfall, such as Southeast and South-central Alaska. But, it can be a problem in other communities as well. So, all landfill operators and owners need to be aware of what leachate is. The best methods to help control water in a landfill, and the amount of leachate being produced include:

- Maintaining a small working face
- Placing six inches of cover material over the wastes on a regular basis and grading it to shed water.

- Maintaining a surface water control system such as proper grading, drainage ditches, culverts, and berms to channel water to safe areas.
- Removing snow that collects in the disposal area over the winter and placing it so that as it melts in the spring, water drains away from the waste disposal area.

A good surface water control system for a landfill will minimize the amount of water coming in and maximize the amount of water going out of the landfill. Landfills should also be located in areas removed from surface water sources and well above the level of the groundwater in an area.

One way to minimize the amount of snow accumulating in the landfill over the winter is to erect snow fences outside the landfill fence. These should be oriented perpendicular to the prevailing winter wind direction, to catch and drift the snow before it gets to the landfill area.

C. Worker and Public Safety:

Well run landfills develop procedures and practices to promote the safety of workers involved in operations at the landfill. It is important that landfill workers have the appropriate personal protection gear available to them. (Figure 16)

Figure 16. Worker safety gear

These include:

- Hard hats
- Safety Bright or Fluorescent-colored vests or jackets worn over work clothes
- Steel-toed work shoes or boots
- Work Gloves
- Hearing protection and/or respirators for dust, as needed

Security and public safety at the landfill are improved by setting regular operating hours when the landfill will be open, and having an attendant there when people drop off wastes. If a community chooses not to have strict public access controls to prevent unauthorized dumping, it should at least post signs that identify what wastes can or cannot be accepted for disposal, and where wastes should be placed within the landfill. A public education program on landfill rules and conditions for use should be developed.

Maintaining good access roads to the landfill also provides a way to control where people place the waste. The landfill operator needs to make the necessary roads and turn-arounds so that traffic is controlled in the disposal area.

D. Recordkeeping:

The landfill manager is responsible for keeping up-to-date records of the operations at the landfill. This is known as the ***landfill operating record***. The manager is also responsible for any visual monitoring of landfill operations and submitting reports that are required by the state or federal permitting authorities. Items that should be included in a landfill operating record include:

- A copy of the community's solid waste management plan
- A copy of the landfill's permit and permit application. If the landfill does not have a permit, then a copy of ADEC's letter of non-objection to the community's solid waste management plan should be included.
- Copies of inspections done of the facility by state or federal agencies as well as any correspondence about the inspections
- Copies of any training received by the landfill staff related to health, safety, or operations of landfills
- Any demonstrations, certifications, or monitoring data required by a permit issued by ADEC
- The landfill operating plan
- As-built drawings of the landfill, updated annually
- Any documents that show the landfill meets the location restriction requirements in the regulations, such as distances to airport runways and landfill locations in flood plains
- Copies of the visual monitoring inspection reports that show the operator has inspected the landfill each month for signs of damage to landfill structures, erosion, violations of permit conditions, settlement of wastes, ponding of surface water, leachate leakage, and frost action on fences, gates, and access roads

The operating record should be kept in a place that is readily accessible in the community. If there are no offices at the landfill itself, then the operating record should be kept in a secure location in the landfill association, city or tribal government offices.

E. Routine Maintenance:

Landfills and the equipment used to operate them are major investments for any community. This is why all equipment and any structures or fences should be maintained on a regular basis, and repairs completed, as they are needed.

An example of an equipment maintenance checklist is presented in Table 2. Maintenance charts should be kept on each piece of landfill equipment. Also, operators should be required to fill in daily report forms, noting the condition of the equipment.

Table 2: Example Checklist for Equipment Maintenance (From: Manager of Landfill Operations Training and Certification Course: Course Manual. 1998. Solid Water Association of North America (SWANA) Pub. # MS-D 2360, Silver Spring, MD)

A. Daily Program

- Check safety and lock bars used during maintenance to insure proper position.
- Check radiator area for refuse. Check for worn hoses and cracked or loose fan belts.
- Check hydraulic system for worn hoses or damaged lines.
- Check covers and guards for damage and loose or missing bolts.
- Check engine compartment for oil and fuel leaks.
- Check the water trap in the bottom of the fuel tank and drain any accumulated water.
- Close the air cylinder drain.
- Check the track for broken or missing shoes or bolts and waste accumulation.
- Check sprockets for wear.
- Check the tire-to-vehicle clearance to prevent rubbing (rubber tire).
- Check tires for cuts, damage, and proper inflation (rubber tire).

B. Premounting

- Check all water, hydraulic fluid, oil, and fuel levels.
- Lubricate all moving parts as per manufacturer's handbook.
- Brush or blow out air precleaner/radiator.
- Check indicators and gauges for damage.
- Check battery electrolyte level.
- Walk around the equipment once to ensure that everyone is clear of the equipment.

C. Operating

- Observe equipment gauges.
- Properly handle difficult and abrasive wastes.
- Clean machine of hanging or attached debris.
- Check for oil and fluid leaks.

Table 2: Example Checklist for Equipment Maintenance (cont.)

D. Shutdown Procedure

- Fill fuel tank to prevent condensation.
- Before stopping engine, idle at 800 – 1000 rpm for 3 – 5 minutes to let it cool off evenly and to allow turbo-chargers to adjust.
- Don't turn off the master switch with the engine running – if you do, you can seriously damage parts of the electrical charging circuit.
- If no shelter facilities are provided, park away from potential fire hazard, preferably on a level grade to prevent rollaway. This will prevent oil leakage from roller seals on crawler equipment.
- Ground all blades, buckets, scrapers or other movable parts.
- Set brakes and transmission locks.
- Report the condition of equipment at the end of each shift or work period and complete equipment logs.

E. Periodic Maintenance Program

Every 125 hours:
- Change motor oil and filters
- Clean main air cleaner

Every 250 hours:
- Change oil in master clutch.
- Change transmission filters.
- Clean transmission magnetic filter.

Every 500 hours:
- Grease the main U joint

Every 1000 hours:
- Change oil and filter in final drive.
- Change hydraulic oil.

VII. Collecting Wastes

A workable waste collection system is a key to the success of any good community solid waste management plan. The waste collection systems can be simple or elaborate, but a decision on the type of system that will work best for the community needs to be made. When selecting the type of system, the following questions should be considered:

- Should each person or residence be responsible for bringing waste to the landfill or is a residential waste pick up program needed?
- Should one or more centralized collection sites be located around the community, eliminating the need for everyone to travel to the landfill?
- Should separate containers be provided for recyclable materials or for storage of household hazardous wastes?
- Should the community provide areas to store items for salvage or reuse?

A. Residential Pick Up:

If the community determines that a ***residential waste pick up*** service is best, then a plan needs to be developed that will determine several items:

- How frequently the wastes will be collected
- If this service will be provided to all residential, governmental, and business customers
- The type of vehicle needed to do the waste collection and hauling.
- The number of staff needed for the job

B. Self-Haul:

If a community determines that a ***self-haul system*** will work best for their needs, the following items need to be considered:

- How will illegal or random dumping be prevented?
- How will hazardous, recyclable, or special wastes be handled?
- Will regular hours of operation be established? Will someone supervise people at the site and control access when the landfill is not open?

It is important to remember that ***in self-haul systems, everyone who takes wastes to the landfill is an operator, and must be responsible for following proper landfill use and procedures***. So, it is a good idea to have a public education and landfill user program in place if self-haul is the waste transport system chosen.

C. Centralized Collection System:

A waste collection option that is gaining in popularity in some communities is the development of a ***centralized collection system***. In this type of system, residents haul wastes to one or more central sites (often dumpsters) located in the

community. From those collection sites, wastes are transported to the landfill. Advantages to a ***centralized collection system*** include:

- Since the sites are usually convenient, residents readily make use of the system.
- It may be less costly to operate than a residential collection system.
- Access to the landfill is controlled, reducing improper waste disposal and reducing the potential for human contact with the waste.

D. Recycling and Waste Separation:

Any waste collection system selected by a community should also ***look at options for developing a waste sorting, separation, and recycling policy***. Because many of us are sensitive to wastes that can harm the environment, communities are trying harder to recycle and reuse potentially harmful items such as:

- Freon from refrigerators and freezers
- Lead-acid batteries
- Used oil

These wastes can be harmful when released into the environment, but can be valuable resources when recycled or reused.

VIII. Selecting a New Landfill Site

In the past, not much attention was paid to where landfills were placed around communities. They often ended up wherever there was open land or on lands that were undesirable for building upon. Today, more attention is focused on selecting a good landfill site that will allow for the safe and sanitary disposal of solid wastes for many years into the future.

In selecting a new landfill site for a community, a number of questions need to be answered. These include:

- What are the types and volumes of waste that will be disposed of at the landfill?
- How much land will be needed for now and to take care of future needs?
- Is the site located in an area that won't pollute drinking water or surface water sources?
- Can a landfill be developed in the types of soils present at the site?
- Is the location downwind from the community?
- Is the location at least one mile from the center of the airport runway (for piston driven aircraft) and 10,000 feet from runways that are designed for jet aircraft?
- Does the site have good year-round road access, or must some road be built?
- Are there any historical or archaeological sites nearby that should not be disturbed by landfill operations?

- Who owns the land at the proposed landfill sites, and can either a land transfer, purchase, or lease agreement be obtained?

There are some of the technical aspects of site selection for which a community may need the help of experts or specialists. However, local interested community residents can do much of the fact-finding. Residents know best where potential development will take place, so that landfills are not located in the middle of residential or industrial areas at some point in the future. ***New landfills should be located well beyond or to the side of potential residential or industrial development areas.*** In the community planning process, residents need to realize the need for good waste disposal practices and proper site selection.

Once two or three potential landfill sites have been identified, taking into account the questions listed above, they should be reviewed and compared. Sometimes there is not a clear-cut decision, and it will be up to a selection committee to determine which option will have the least impact on a community. ***It is very important through the entire site selection process to keep the public well informed.*** Learn of the resident's concerns and remember that there are probably no sites that will satisfy everyone. The success of siting a new landfill depends upon everyone being heard during the selection process.

When a community has developed a solid waste management plan, selected a site for a new landfill, and agreed upon a collection plan to get the wastes to the landfill, ***a public education program is essential to make sure that everyone knows how to make the best use of the new solid waste management system.***

Public education programs can include sending flyers to all landfill users describing the new system, including how and where wastes will be collected and disposed of. It should also include any other special information about the operations of the new landfill. Posters can be placed in public places, describing the importance of following the solid waste plan and highlighting the benefits. Recycling programs and community clean-up days can be organized, and can involve the schools. ***For a solid waste management program to be successful, everyone must be a part of the process, recognizing the successes, and discussing the problems.***

IX. Landfill Closure

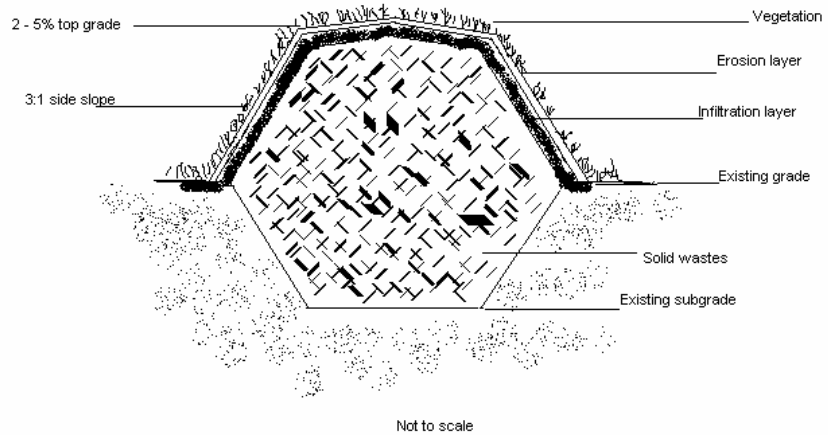
While most landfills are built to last many years (15-20 or more), the time to begin planning for landfill closure is when the site is designed. ***The way the landfill is designed and operated will have a major impact on the costs for closing the facility*** and any other possible uses for the area in the future. In the landfill planning process, a community needs to:

- Consider the requirements for final cap design and construction
- Identify what the final grades will look like at the site
- Prepare a site drainage plan
- Develop a revegetation or landscaping plan

- Create long-term visual monitoring plans and site maintenance procedures

The exact process for closing the landfill once it is filled will depend upon how the landfill was built and operated. For example, if individual disposal areas or trenches were closed and revegetated as each one was filled, then final closure may simply mean closing out the last area used. Otherwise, the whole area used for waste disposal will need to have final cover placement and revegetation.

Figure 17. Landfill cover (cap) design.



A. Infiltration Layer:

When the landfill is full and ready to be closed, a layer of soil called the ***infiltration layer*** is placed over the waste disposal area. (Figure 17) The ***infiltration layer*** should be:

- A soil that has low permeability, if at all possible. Clay is best, if available; then tight silts or sandy soils. Gravel and shot-rock can be used if nothing else is available in the community.
- A soil layer that is at least 18 inches to two feet thick. It should be compacted in six-inch layers as the soil is placed over the landfill.
- Graded with a slope of 2-3%, up to 5% (depending upon the soil type used) to allow surface water to drain off the site without erosion.

B. Revegetation Layer:

The top layer of soil on the closed landfill needs to be one that will support and promote plant growth. The ***revegetation layer*** should be:

- At least six-inches thick
- Soil material that has enough organic matter in it to hold moisture and allow plant roots to grow

Once the revegetation layer is in place, the area needs to be seeded with an appropriate

mixture of grass seeds for the geographical location of the landfill. ***Contact the Alaska Plant Materials Center in Palmer, AK (907-745-4469) to find out what is the best seed mixture for your area.*** They can also provide information on any special requirements for fertilizers that should be included with the seed varieties to make sure that the revegetation of the old landfill site is effective.

If the landfill cap is not properly compacted and graded, depressions in the top cover can occur, creating areas where surface water collects and forms ponds. Over time, this ***standing water can percolate through the wastes, creating more leachate that could pollute community water sources***.

X. Landfill Costs

Landfills require careful planning, proper construction, orderly operation, and regular maintenance. All of this, of course, requires money. Just how much money depends on a number of factors. Key items to consider when projecting landfill costs include:

- Landfill design and construction costs
- Daily, weekly, monthly and annual operation costs
- Costs for landfill closure
- Long-term care, inspection, and maintenance costs after landfill closure

There are additional publications available from the Alaska Department of Environmental Conservation, such as the Alaska Health Project's *Trash Management Guide* that can help a community work through the cost analysis process.

While looking at the costs of the landfill, a community also needs to consider the types of funding and revenue sources available to them for landfill construction, maintenance, and daily operations. ***Grant money for planning, design, equipment, and construction of the landfill may be available from state and federal agencies.*** Communities should check with the state ADEC Village Safe Water Program, and the federal Indian Health Service or Bureau of Indian Affairs to find out about current landfill improvement grant programs.

However, the community usually must pay the costs for daily operation and maintenance of the landfill itself. Sources for landfill revenue can come from charging all users a "tipping fee" for disposing wastes at the landfill. It can be a ***variable rate fee,*** based on the weight, volume, or number of containers of waste being disposed. Or, it can be a ***flat fee***, based on the average cost of disposal and charged to everyone in a service area. The way user fees are charged or collected can be highly variable from community to community. A community must decide during the planning process which method is best for them.

General community taxes can also be used to subsidize solid waste management. These can come from general property or sales taxes imposed by a community. The disadvantage to funding solid waste management in this way is that there is no financial incentive or reward for reducing the amount of waste that goes to the landfill. The costs to the individual are indirect and somewhat hidden in the overall community budget.

XI. Additional Resources and Contacts

If you would like to know more about solid waste management options, ways to improve conditions at the landfill so that it is operated in a safe and sanitary manner, and other resources available to community solid waste management, ***please contact the Alaska Department of Environmental Conservation, Solid Waste Program in the office nearest to your community:***

ADEC (Juneau)
410 Willoughby Ave.
Juneau, AK 99801-1795
Phone: (907) 465-5350
FAX: (907) 465-5164

ADEC (Fairbanks)
610 University Ave.
Fairbanks, AK 99709-3643
Phone: (907) 451-2108
FAX: (907) 451-2187

ADEC (Anchorage)
555 Cordova St.
Anchorage, AK 99501
Phone: (907) 269-7653
FAX: (907) 269-7655