

Elements of Proper Landfill Design, Operations and Maintenance

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Overview

- What is a proper disposal site?
- Transforming the dump – simple and cost effective improvements
- Working face management
- Daily cover and alternative cover
- Landfill fires
- Health and safety
- Q&A

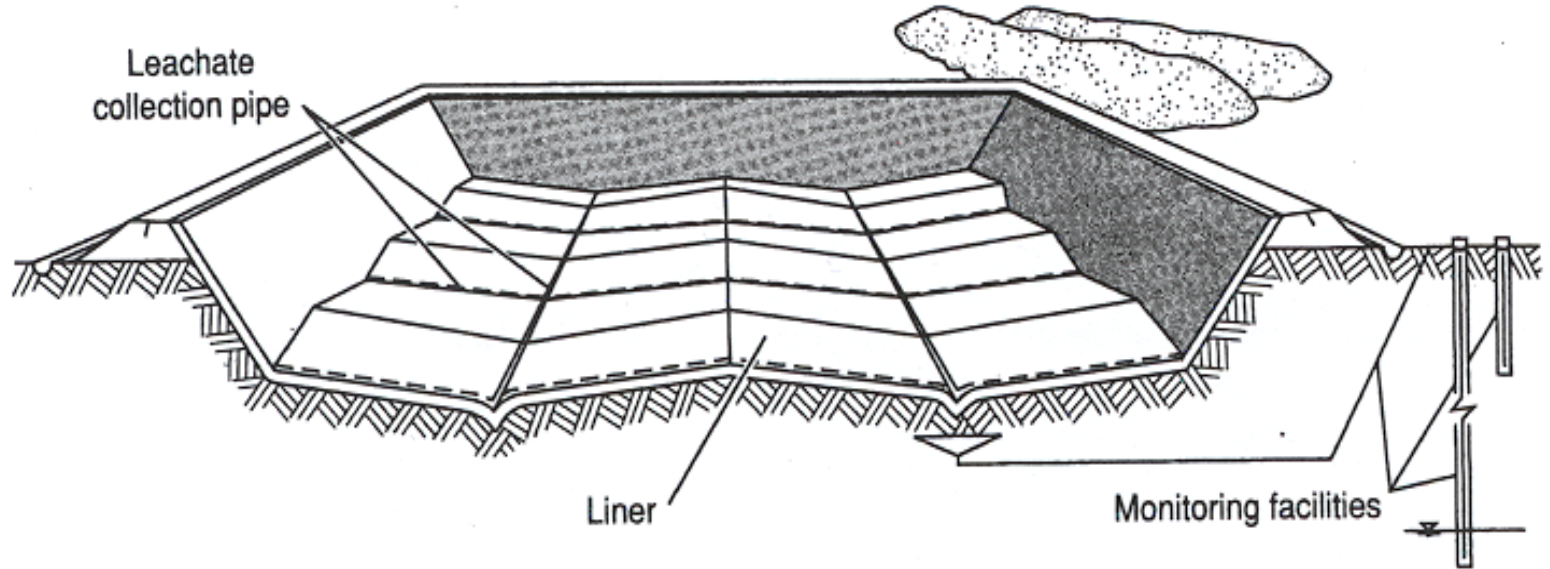
Proper Disposal Site

- Proper disposal sites have measures/programs in place to protect human health and the environment
 - Liners
 - Covers
 - Compaction
 - Leachate management
 - Gas collection

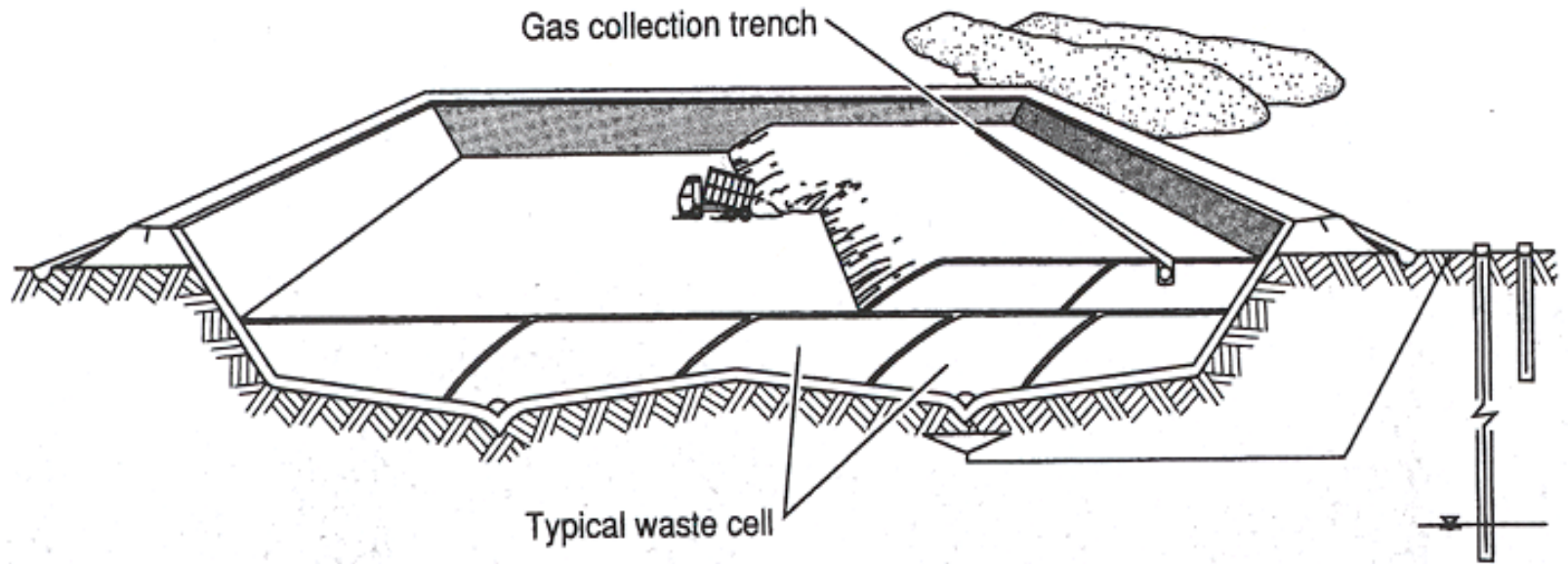
Modern Sanitary Landfill



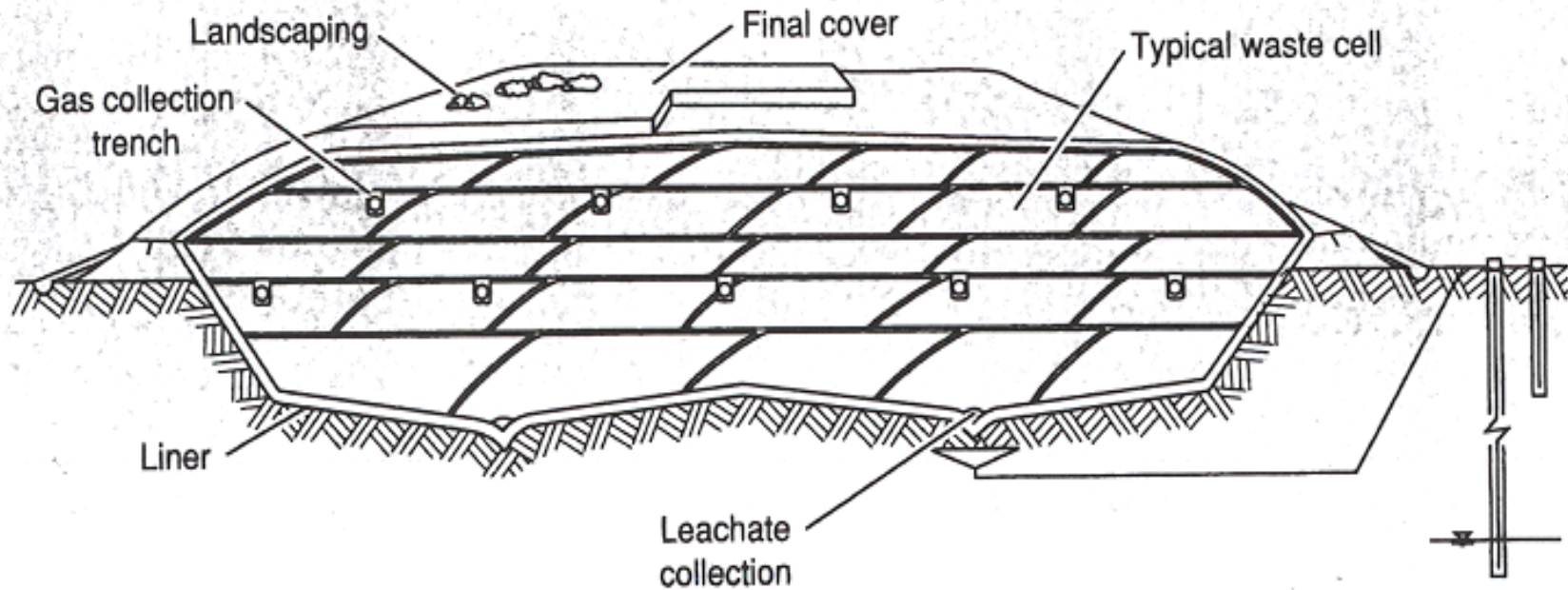
Development of a Landfill



Landfill During Operations



Completed Landfill



Landfill Liners

- Liners help to:
 - Provide containment of contaminants
 - Reduce groundwater contamination
 - Reduce landfill gas migration
- Liners may be composed of:
 - Clay
 - Composite (clay and geomembrane)

Landfill Covers

- Provides protection for human health and environment
- Promotes stormwater runoff
- Reduces stormwater infiltration
- Provides protection against fire
- Improves landfill gas generation
- Improves ability to collect landfill gas
- Reduces odors
- Provides vector control



Final Cover Components

- **Constructed Soil Cover**
 - Clay or low permeable soil (60 cm)
 - Vegetative layer – soil to support vegetation (15 to 30 cm)
- **Geomembrane**
 - Can be used to further reduce infiltration
 - If used should be above clay cap
 - Should be in direct contact with clay

Final Cover Components

- Stormwater controls
 - Object is to promote stormwater runoff before it infiltrates and becomes leachate
 - Prevent erosion of final cover
 - Benches can be used on steep slopes
 - Rip rap and gabions can be used in high erosion areas
 - Top of landfill graded to promote runoff (i.e., dome shape)

Compaction

- Extends the life of the landfill
- Decreases settlement
- Reduces voids
- Discourages wind-blown litter
- Discourages insects and rodents
- Reduces the possibility of waste run-off
- Reduces the amount of cover needed
- Provides a more solid surface for travel
- Reduces leachate

Leachate Management

- Prevent stormwater from running onto the working face
- Improve stormwater run-off controls in areas around working face
- Reduce infiltration
 - Avoid ponding on landfill
 - Maintain vegetative cover
- Once in contact with waste – best to prevent stormwater run-off (contaminated stormwater)

Leachate Collection

- Perimeter Ditch - can be used to drain leachate and carry it to treatment system
- Subsurface Perimeter Gravity Drain - can be built around landfill
- Vertical Well Pumps – pumps are effective but expensive



Leachate Treatment

- Evaporation ponds
- Leachate evaporation using landfill gas
- Wetland treatment



Gas Collection

- Prevents gas build-up which may lead to combustion
- Passive or active systems may be used
 - Passive systems consist of collection wells (constructed of perforated piping) which are vented to the surface
 - Active systems also have collection wells but also include valves and vacuums or pumps

Transforming the Dump

- Simple and cost effective improvements can transform an open dump into a proper disposal site
- First,
 - Ensure the site is appropriate for proper disposal site (well drained, not in proximity to groundwater reservoir, adequate space, etc.)

Transforming the Dump: Open Dumping to Controlled

- Site preparation:
 - Level and grade existing waste
 - Relocate any structures (such as storage areas for recyclables or shanties) outside the disposal area

Transforming the Dump: Open Dumping to Controlled

- Operation:
 - Establish operating hours
 - Develop disposal plan (no toxic or hazardous wastes)
 - Register, weigh and check vehicles entering site
 - Supervise unloading of waste
 - Deposit waste in thin layers
 - Compact waste
 - Cover surface daily
 - Install movable litter barrier downwind of site
 - Maintain records

Transforming the Dump: Open Dumping to Controlled

- Additionally:
 - Install gas collection and rainwater diversion
 - Maintain access roads
 - Install access walls and gates
 - Provide staff for landfill operation
 - Perform environmental monitoring (from simple visual inspections to sample collection and laboratory analysis)

Working Face Management



- **Access to Working Face:**
 - **Access roads need to be all-weather roads.**
 - **Drainage is key.**

Access to Working Face



- Tipping area needs to be accessible during wet weather operations.
- Keep equipment pushes to cell as short as possible.
- Have a contingency plan.

Working Face

It all starts on the tipping area!



Working Face



- Trash dumped on tipping area-pushed to open face
- Tipping area can be made of gravel, crushed asphalt, concrete, clay, or fill dirt.

Working Face



- Keep vehicles off the working face, minimizing damage and increasing unloading time
- Built to accommodate several vehicles at once and divert water away from the working face

Working Face

- Trash is pushed by a dozer to the working face-closer is better!
- Two basic types of cell construction methods-build from the top or from the bottom



Working Face Building from the Bottom

- Push trash from the bottom of the slope and work it up the face towards the top
- Provides greater compacting effort when using a track-type equipment



Working Face Building from the Bottom



- Easier to maintain
- “Waterfalling” garbage is eliminated
- Equipment must work harder
- All garbage has to be pushed uphill

Working Face Building from the Bottom Sloping Lifts

- No need to judge the starting footprint size of the cell
- Uniform, square cornered cells are easier to build



Working Face Building from the Top

- Garbage can be pushed downhill
- Much easier for dozers, less wear on machines



Working Face Building from the Top

- Increased potential for “waterfalling” garbage
- Less compaction when using a track type piece of equipment



Daily and Alternative Cover



Benefits of Daily Cover

- Provides protection against fire
- Reduces stormwater infiltration
- Promotes stormwater runoff
- Improves landfill gas generation (creates anaerobic conditions)
- Improves ability to collect landfill gas
- Reduces odors
- Provides vector control
- Controls access of waste scavengers & recyclers
- Controls litter

Daily Cover Application

- Any soil material suitable for cover
- Source should be close to site
- Spread in 15 cm lifts to achieve even layers



Daily Cover Application

- Usually stripped off each morning
- Leave close to working face for reuse
- Able to reclaim air space



Alternative Daily Cover

- Other inert materials can be used for daily cover
 - Shredded tires
 - Ash and residues
 - Stormwater system residues and sediment
 - Compost
 - Shredded C&D (not wallboard)
 - Tarps



Alternative Daily Cover

- Advantages
 - Use of material that would require disposal anyway
 - Save on expense of excavating soil
 - Covers such as tarps save on landfill air space

Bird Control – Simple Solutions

- U.S. law: existing landfills no closer than 10,000 ft (3 km) for turbojet only...landfills have to demonstrate no bird hazard to aircraft. New landfills prohibited within 5 miles (~8 km) of a turbojet airport

So what can I do...?

- Applying daily cover
- Air/sound devices
- Visual devices
- Bird v. bird

Landfill Fires

Two types:

- Surface
- Sub-surface



Surface Fires

Causes:

- Usually result from off-site source - “Hot” loads
- Can be started by equipment
- Smoking on landfill
- Can be started by waste-pickers/scavengers



Surface Fires

“Hot” loads could include

- Brush
- Leaves
- Construction debris
- Fireplace coals
- Burn barrel residues



Surface Fires

- Observe all loads at working face
- If load is suspected to be hot
 - Spread it thin
 - Isolate load
 - Wet it down



Surface Fires

Smoking is most common cause of surface fires.

- No Smoking!
- Smoke in designated areas only



Surface Fires

Waste pickers....

- Set fires to recover metals
- Limit access to working face
- Provide separate sorting area



Sub-Surface Fires

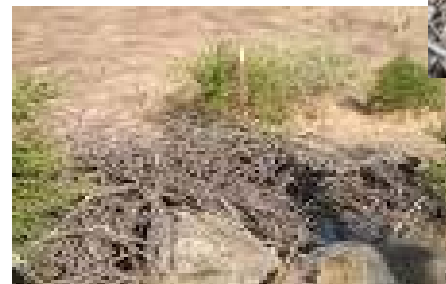
- Result from air infiltration in landfill
- Fire is below the surface
- Difficult to extinguish
- Need to know the signs of such a fire



Sub-Surface Fires

Fuel is abundant:

- Any waste in place is fuel!
 - Municipal solid waste
 - Construction debris
 - Leaves
 - Brush
- Landfill gas



Sub-Surface Fires

Signs of a sub-surface fire include:

- Sudden subsidence and depressions
- Fissures
- Venting Holes
- Rills



Sub-Surface Fires



Sub-Surface Fires

If there is Sub-Surface Fire Burning?

- Confirm the fire-carbon monoxide testing, temperatures, etc
- Identify the source of oxygen
- Cut off the oxygen supply
- Reseal the cover in the affected area
- Monitor the area



Sub-Surface Fires

Prevention:

- Limit all air/oxygen intrusion
- Monitor site conditions regularly
- Maintain all cover on closed portions of site
- Balance LFG system
- Check well temperatures and oxygen readings regularly

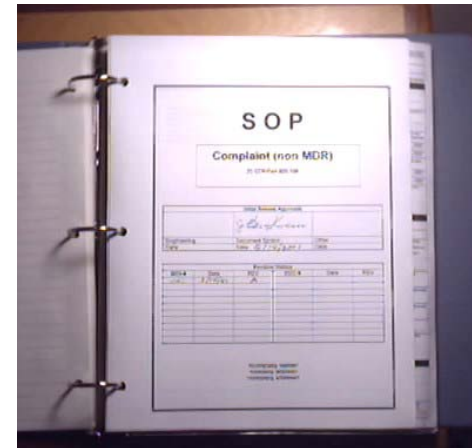
Health & Safety Basics

- Standard Operating Procedures
- Site safety plan
- Equipment training
- Personnel protective equipment (PPE)
- Chemical & natural hazards
- Confined spaces
- Hazardous waste



Standard Operating Procedures

- Established safe work practices
- Team Understands Safety
- “How-to” Manual on how to perform tasks



Site Safety Plans

- Resource for Health & Safety Topics
- Should include:
 - What to do in an emergency
 - Location of the closest hospital
 - Potential site hazards
 - Required personal protective equipment (PPE) for tasks
 - Emergency procedures



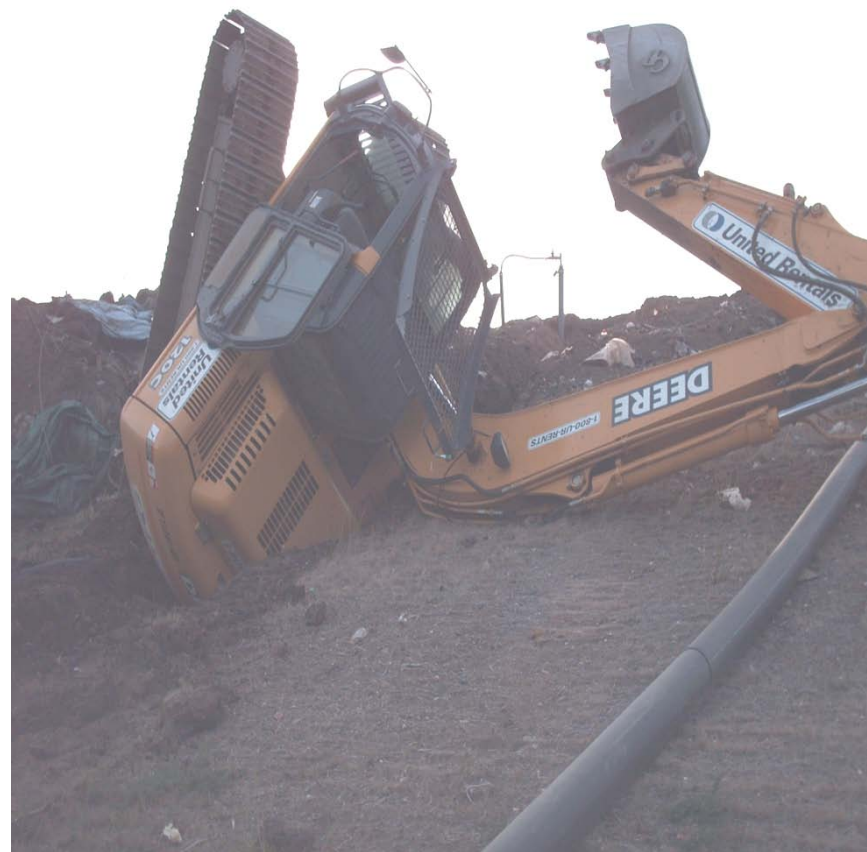
Equipment Training

- Personnel should be properly trained
- Use equipment for its intended purpose



Equipment Training

- Maintain equipment
 - Safety pre-checks
- Use caution when operating
- Examine your work area and look for hazards before working



Personal Protective Equipment (PPE)

Should include:

- Hard hat
- Steel toe boots
- Safety vest
- Gloves
- Hearing protection
- Eye protection



Personal Protective Equipment

- Job required PPE
- Choose the proper gear for your job
- Know the limits of each piece of PPE



Personal Protective Equipment

- Safety Vests-Used for visibility
- Hearing protection-loud working environments
- Hard hats- falling objects
- Glasses to protect eyes



Chemical Hazards

- Chemical Hazards include:
 - Gasoline
 - Acid
 - Batteries
 - Oil
 - Chemicals
 - Pesticides
- Use caution
- Limit exposure to material
- If it must be handled, use PPE



Natural Hazards

- Natural Hazards Include:
 - Insects
 - Arachnids
 - Snakes
 - Mammals
 - Poisonous plants
- Be aware
- Learn to recognize the hazards



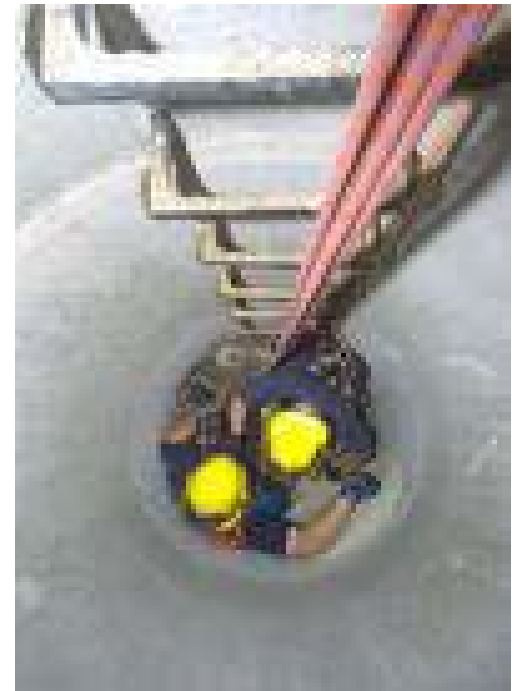
Confined Spaces

- Limited means of entrance and exit
- Can be bodily entered
- Not designed for continuous occupancy



Confined Spaces

- Manholes
- Chemical storage bins
- Trenches
- Utility closets
- Railcars
- Pump Stations



Confined Spaces

- Potential Dangers:
 - Engulfment
 - Oxygen deficiency
 - Oxygen enrichment
 - Flammable gases
 - Combustible dusts
 - Toxic substances
 - Physical hazards



Confined Spaces

- If entry is required, special training is needed
- Requires three person team with specialized safety equipment



Bloodborne Pathogens

- Exposure:
 - Medical waste
 - Needle sticks (most common)
 - Cuts from other contaminated sharps (scalpels, broken glass, etc.)
 - Contact with the eye, nose, mouth or broken skin with contaminated blood or body fluids
- Types:
 - Hepatitis B virus (HBV), and the hepatitis C virus (HCV)
 - HIV – the virus that causes AIDS



Bio-hazards

- Diapers
- Animal carcasses
- Rotten wood
- Sludge
- Wear gloves, wash hands before eating, drinking or smoking
- Clean, disinfect and bandage cuts



Questions?

