




# Prevention is Key in Managing Landfill Fires



Presented by E3 Environmental



# Introduction



- ▶ From 8,000 to 10,000 landfill fires occur each year in the U.S. and can range from minor surface fires to massive underground blazes that can release tons of harmful emissions.
- ▶ The cost of these fires can run easily in the millions to suppress.
- ▶ Approximately 30 firefighters are injured each year fighting these fires.
- ▶ There are numerous health and environmental dangers due to the toxic smoke, gases and particulates released during a fire.
- ▶ “Distant and cynical observers of landfill fires might be tempted to summarize such occurrences with the sentiment, **“Nothing of value was lost.”** Owners and operators of landfills, however, are keenly aware that a landfill fire is no trivial matter, and that the threats to human health, the environment and adjacent properties are very real.” -Brian Taylor



# Causes of Landfill Fires

- ▶ According to the US Fire Administration, Fire Data Center, National Fire Incident Reporting System (NFIRS)
  - ▶ Over half of the landfill fires reported to NFIRS have no information available as to the primary ignition factor.
  - ▶ Of those fires with reported ignition factors, nearly:
    - ▶ 40 percent are of an incendiary or suspicious nature.
    - ▶ Another 20 percent are attributed to lit or smoldering materials that have been abandoned or discarded, which include cigarettes, matches, or ashes that were discarded without being properly extinguished.
    - ▶ Spontaneous heating accounts for about 5 percent of landfill fires.
    - ▶ Other leading factors influencing fire ignition include rekindling from a previous fire and inadequate control of open fires.

# Landfill Fires Small & Large

- A small-scale landfill fire can lead to nuisance complaints and scrutiny from regulatory agencies. *(Hello I am from MDEQ and I am here to help y'all!)*
- Larger and longer-lasting landfill fires have turned into legal sagas that can stretch over the course of several months or even years.



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# Landfill Fire Characteristics & Emissions

- ▶ When landfill fires occur—particularly on larger scales—harmful emissions can result, including formaldehyde, hydrogen cyanide, hydrogen sulfide, and nitrogen oxides just to name a few.
- ▶ Particulate matter in the smoke created during landfill fires can also exacerbate respiratory and other health complications in those living near a landfill fire as well as those responding to the fire.
- ▶ Tires can pose additional problems, since they produce liberal amounts of oil and smoke that can make a landfill fire much more difficult to extinguish.

# Landfill Fire Characteristics

## ► SURFACE FIRES

- Surface fires involve recently buried or uncompacted refuse, situated or close to the landfill surface in the aerobic decomposition layer, generally 1 to 4 feet in depth.
- These fires can be intensified by landfill gas (methane), which may cause the fire to spread throughout the landfill.





# Landfill Fire Characteristics

- Surface fires generally burn at relatively low temperatures and are characterized by the emission of dense white smoke and the products of incomplete combustion.
- The smoke includes irritating agents, such as organic acids and other compounds. When surface fires burn materials such as tires or plastics, the temperature in the burning zone can be quite high. Higher temperature fires can cause the breakdown of volatile compounds, which emit dense black smoke.
- Surface fires include the following:
  - *Dumping of undetected smoldering materials into the landfill.*
  - *Fires associated with landfill gas control or venting systems.*
  - *Fires caused by human error on the part of the landfill operators or users.*
  - *Fires caused by construction or maintenance work.*
  - *Spontaneous combustion of materials in the landfill.*
  - *Deliberate fires, which are used by the landfill operator to reduce the volume of waste.*
  - *Deliberate arson fires, which are set with malicious intent. (Security Issues)*

# Landfill Fire Characteristics

- ▶ UNDERGROUND FIRES
  - ▶ Underground fires in landfills occur deep below the landfill surface and involve materials that are months or years old.
  - ▶ These fires are generally more difficult to extinguish than surface fires. Underground fires also have the potential to create large voids in the landfill, which can cause cave-ins of the landfill surface.
  - ▶ Further, they produce flammable and toxic gases (such as carbon monoxide) and can damage leachate containment liners and landfill gas collection systems.







# Landfill Fire Characteristics

- ▶ Underground fires are often only detected by smoke emanating from some part of the landfill site or by the presence of carbon monoxide (CO) in landfill gas. In the event of an under-ground fire, CO may be present at toxic levels near the landfill's surface. Generally an under-ground fire can be confirmed by:
  - ▶ Substantial settlement over a short period of time.
  - ▶ Smoke or smoldering odor emanating from the gas extraction system or landfill.
  - ▶ Elevated levels of CO in excess of 1,000 parts per million (ppm).
  - ▶ Combustion residue in extraction wells or headers.
  - ▶ Increase in gas temperature in the extraction system (above 140°F).
  - ▶ Temperatures in excess of 170°F.

# Where there's smoke there's fire!

- ▶ A major contributing factor to these fires is the flammable and combustible material that is routinely sent to municipal solid waste (MSW) and other landfills.
- ▶ Landfill personnel should always be on the lookout for these sources of trouble and thus can play a critical role in preventing the chance of a fire-related incident from taking place on a landfill site.
- ▶ Landfill employees should be trained to ask themselves, "As the load comes through the gate or is dumped and spread at the working face, **is there visible smoke? Is there a burning smell?**"
- ▶ Visual inspection also plays a key role: *"Landfill staff also need to keep an eye out for specific types of loads. For example, is the load coming from a campground (potential campfire ash)? Does the load contain a lot of canned chemicals, paints, solvents, etc., that could be flammable or create a spontaneous chemical response that could ignite?"* –Jason Todaro, Blue Ridge Services

# EXTINGUISHING LANDFILL FIRES

- It is important to note that the different dynamics, characteristics, and regulations of landfills and the fires that occur in them suggest that tactics need to be determined on a case-by-case basis depending on the materials buried, which materials have ignited, depth of the fire, and the fire's ignition source.





# EXTINGUISHING LANDFILL FIRES

## ► WIND/WEATHER.

- Wind and inclement weather can increase the health hazards for fire-fighters operating on the fireground (e.g., in extremely hot or cold weather) and can directly affect fire spread.

## ► WATER SUPPLY

- The use of water to suppress landfill fires is controversial. The application of large volumes of water may actually exacerbate a fire by contributing to the process of aerobic decomposition. Further, adding water to the landfill creates additional leachate, which may overwhelm the leachate collection system in the landfill (if one exists).
- If the collection system is overwhelmed, the additional leachate could contaminate ground and surface waters surrounding the landfill.

# EXTINGUISHING LANDFILL FIRES



- Depending on the landfill's location, there might not be an adequate supply of water available for fire suppression. Firefighters may have to establish a water supply using tankers and nearby static water sources (e.g., lakes, reservoirs).
- One tactic is to recirculate the leachate water back onto the fire, this requires extra storage tank space to let the leachate settle out.



# EXTINGUISHING LANDFILL FIRES

- ▶ Foam is an important consideration in landfill fire suppression. There are two primary types of firefighting foam. Class A foam is a special formulation of hydrocarbon surfactants. These surfactants reduce the surface tension of water, which provides for better water penetration and increased effectiveness.
- ▶ Class B foam is used to extinguish fires involving flammable and combustible liquids. It is also used to suppress vapors from unignited spills of these liquids.
- ▶ As with all fires, there are advantages and disadvantages to using foam during fire suppression operations on landfills.
  - ▶ Cost (\$30-\$55 per gal)
  - ▶ Toxicity (Fluorine based AFFF foams)



# EXTINGUISHING LANDFILL FIRES

## ▶ MULTI-AGENCY PUBLIC & PRIVATE SECTOR RESPONSE

- ▶ A major landfill fire will likely require the expertise of personnel from multiple public sector agencies (e.g., the EPA, Department of Natural Resources) as well as private sector contractors.
- ▶ To ensure that all personnel (regardless of their agency affiliation) are operating according to the same plan, landfill fires require a strong Incident Command System.
- ▶ Some fire departments have Standard Operating Procedures in place that define all landfill fires as hazardous materials incidents, which require a specialized response. "If you're not preplanning in advance of a fire with the local agencies, it's not going to be a friendly situation when they show up to your site."



# EXTINGUISHING LANDFILL FIRES

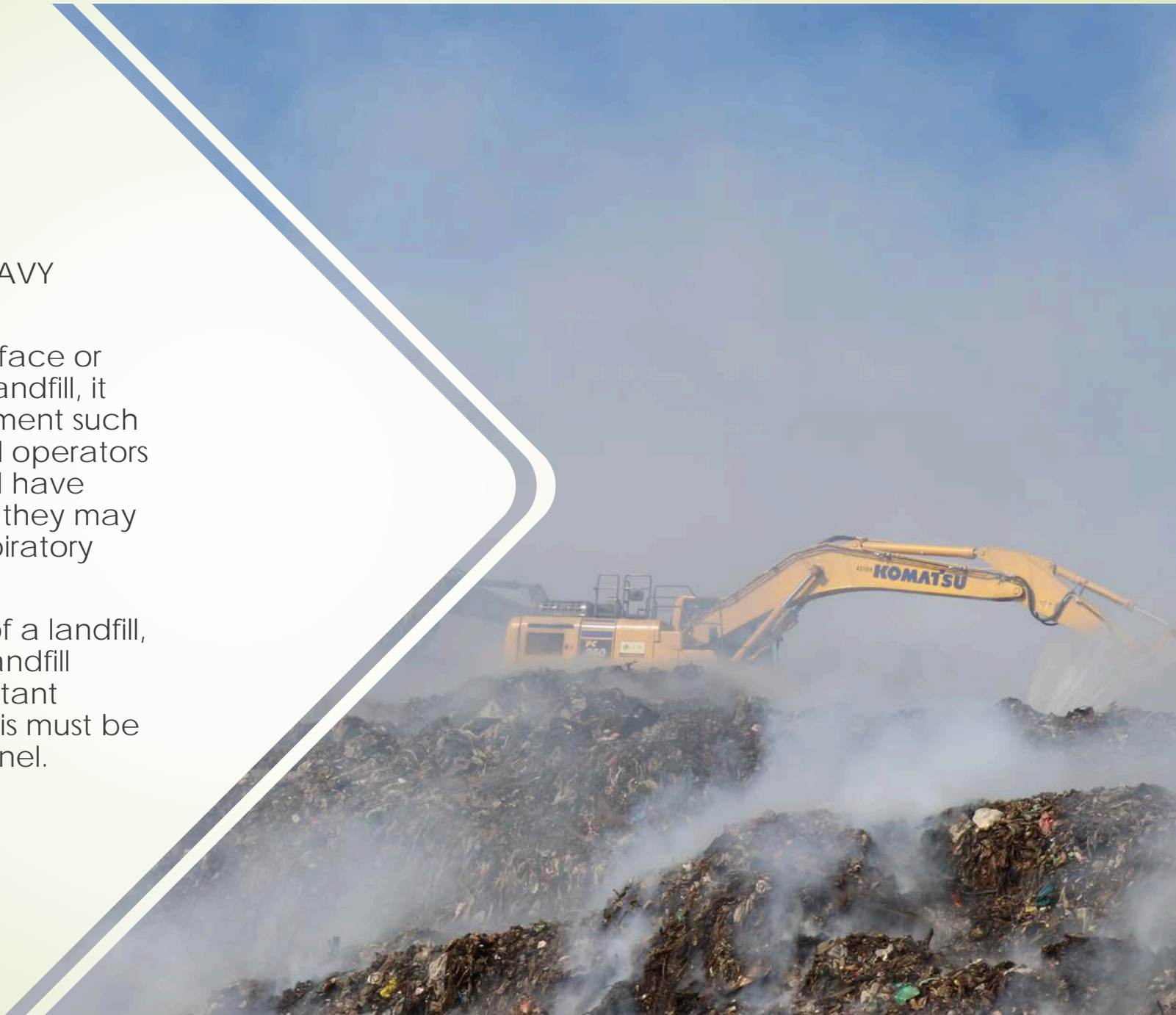
## ▶ PERSONNEL SAFETY

- ▶ Fires, particularly those underground, can undermine the integrity of the landfill, which could cause a collapse under the weight of landfill employees, firefighters, or heavy equipment.
- ▶ Such a collapse could necessitate a confined space, trench, or other type of technical rescue operation in addition to fire suppression.
- ▶ Given the potential adverse effects of exposure to burning landfill contents or the smoke produced by a landfill fire, personnel may have to use specialized personal protective equipment, including mounting “breathing air” on heavy equipment. Standard fire fighting turnout gear can be used but will require decontamination/cleaning or replacement.
- ▶ *“While there are situations where landfill staff can fight fires, it’s important to have very clear guidelines about when staff should and shouldn’t [do so],”*  
*–Jason Todaro, Blue Ridge Services*



# EXTINGUISHING LANDFILL FIRES

- ▶ ACCESS TO AND MANEUVERABILITY OF HEAVY EQUIPMENT
  - ▶ To access waste below the landfill surface or move burning waste away from the landfill, it will be necessary to use heavy equipment such as bulldozers and excavators. Landfill operators may already own this equipment and have staff trained in its use on site however they may not be qualified to operate using respiratory equipment.
  - ▶ If a fire affects the structural stability of a landfill, operating heavy equipment on the landfill surface would be dangerous. A constant assessment of the stability of the debris must be done by competent response personnel.





# EXTINGUISHING LANDFILL FIRES

## ▶ LOGISTICS

- ▶ As with any protracted fire suppression operation, Incident Commanders at landfill fires must address a variety of logistical concerns to facilitate operations. These include:
  - ▶ Having enough personnel to staff the site for 24/7 operations
  - ▶ Feeding and sanitary needs for personnel
  - ▶ Equipment fueling & maintenance
  - ▶ Water supplies, long hose lays, skid-mount fire pumps that can be moved off-road



# EXTINGUISHING LANDFILL FIRES

## ▶ ENVIRONMENTAL IMPACT

- ▶ The smoke and runoff from landfill fires can be dangerous to those living in the area and to the environment. It is important that air and water quality issues be addressed early in a fire suppression operation to prevent contamination as much as possible.

## ▶ LANDFILL CONTENTS

- ▶ Fires occurring in landfills where hazardous wastes are buried can be particularly difficult. In past years, illegal dumping of hazardous and toxic materials in landfills and other dumping sites was relatively common.
- ▶ When a fire occurs and response personnel have wrong or misleading information about the buried contents (e.g., illegal or unknown toxic or industrial wastes, tires, etc.), the fire suppression operation can become extremely dangerous.
- ▶ Not unusual to see propane cylinders or old drums in landfill fires explode and throw debris several hundred feet away.

# LANDFILL FIRE PREVENTION

- Fire prevention can reduce property damage, injury, health, and environmental hazards of landfill fires.
- The cost of prevention is usually much less expensive than the cost of fighting and cleaning up a fire.
- In many cases, particularly for larger landfills, fire prevention activities are required by law.





# LANDFILL FIRE PREVENTION

- ▶ LANDFILL MANAGEMENT
- ▶ Effective landfill management is a vital key to efficient landfill fire prevention tactics. Management measures include:
  - ▶ prohibiting all forms of deliberate burning
  - ▶ thoroughly inspecting and controlling incoming refuse
  - ▶ compacting refuse buried to prevent hot spots from forming (less O<sub>2</sub> circulation)
  - ▶ prohibiting smoking onsite
  - ▶ maintaining good site security measures to prevent suspicious fires is also key



# LANDFILL FIRE PREVENTION

- ▶ **Methane Gas Detection and Collection:**
- ▶ Landfill gas emissions can be a hazard to the environment and to the health of residents surrounding landfill sites. Methane gas, a flammable gas, can present a fire hazard. Federal regulations require all MSW landfill operators to monitor the emission of methane on a quarterly basis.
- ▶ Methane gas collection systems actively remove landfill gas using gas recovery wells and vacuum pumps with an interconnected pipe network. Operators must take care to ensure the system is not overdrawn, which can lead to fire ignition.
- ▶ Once the gas is collected, landfill owners/operators have two choices:
  - ▶ (1) burn off the gas (flaring); or
  - ▶ (2) convert the gas to an energy commodity.

# LANDFILL FIRE PREVENTION

- *Flaring*
- Burning landfill gas is the method most large landfills use (as opposed to the more costly waste-to-energy projects). Burning the landfill gas converts methane to carbon dioxide, which not only is less harmful to the environment, but also destroys the components of land-fill gas that cause odor, stress vegetation, create smog, and increase the risk for fire or explosion.



# LANDFILL FIRE PREVENTION

- *Converting Landfill Gas to Energy*
- The conversion of landfill gas to energy turns this landfill byproduct into a marketable resource. The converted gas can be used to generate electricity, heat, or steam.
- According to the EPA, landfill gas is the only renewable energy source that, when used, removes pollution from the atmosphere.







# LANDFILL FIRE PREVENTION

## ► **Compacting:**

- Adequate compacting of waste ensures there is less air or methane pockets formed that could lead to subsurface fires at landfills.
- Waste must be thoroughly compacted during placement. Each cell should be covered with at least 2 feet of inert soil cover prior to placing of the next overlying lift.
- Proper compaction can reduce the refuse volume by more than 40 percent.
- A landfill that has been compacted properly beforehand, a fire may not even get started or spread as quickly thereby making it easier to control, and the operator can generate more revenue from his operation.



# LANDFILL FIRE PREVENTION

- ▶ **What about “Spontaneous Combustion?”**
- ▶ The mechanics of spontaneous combustion in refuse are not well-understood.
- ▶ Wood starts to burn with an open flame once temperatures rise above 600 degrees Fahrenheit.
- ▶ Pyrolysis, the process by which wood chemically oxidizes, can start at temperatures of 200 degrees Fahrenheit. The reaction becomes exothermic (heat-producing) and self-sustaining at temperatures as low as 300 degrees Fahrenheit.
- ▶ But temperatures approaching the 300 degrees Fahrenheit ignition point seldom are reached in properly operated landfills where refuse decomposition is occurring under anaerobic conditions.

# LANDFILL FIRE PREVENTION

- ▶ Thus, heat released during rapid oxidation of pyrophoric substances in the landfill is believed to be the triggering mechanism that elevates internal temperatures above the 300 degrees Fahrenheit required to create spontaneous combustion in wood.
- ▶ Common pyrophoric substances include rags soaked in vegetable oils, linseed oil, low-grade coal, grass, straw and certain metal compounds such as lithium-ion batteries.





# LANDFILL FIRE PREVENTION

## ► SECURITY:

- Security is necessary for the health and safety of both the landfill employees as well as the surrounding community.
- Sadly, incidents of worker harassment have been on the rise at our Waste Disposal Sites. There have been increased incidents of illegal dumping, failure to pay applicable fees, dumping without authorization, damage to property, theft, and other infractions like trespass. In an increasing number of situations, attempts by landfill employees to manage these situations are met with verbal abuse, harassment and threats.
- There is a concern for possible arson fires set by people who don't like having a landfill in their "backyard".
- Then there is the fun loving, rat shooting "tacticool" folks who don't pay close attention to what is down-range putting waste-site workers at risk of being shot.



# CONCLUSION

- ▶ Landfill fires are not common occurrences. When they do occur, however, they tend to attract a great deal of public attention and challenge the fire service. Illegal dumping continues to be a problem for regulatory agencies and the fire service. Illegal sites are particularly hazardous to firefighters, because the firefighters may be unaware of the presence or nature of chemicals or other toxic substances involved in the fire. Landfill fires in regulated facilities also challenge Incident Commanders, who must make a series of tactical decisions in a situation far different from that found at a “normal” structure fire or even an “industrial” fire situation.



# Questions?

Thank You for Your Attention



# References/Resources

- ▶ Landfill Fires-US Fire Administration
  - ▶ Prevention is the Key in Managing Landfill Fires-Rachael Zimlich
  - ▶ Preventing Landfill Fires-Brian Taylor
  - ▶ Fighting a Landfill Fire-Tony Sperling
  - ▶ E3 Environmental Training Division
  - ▶ E3 Environmental Industrial/Marine Fire Suppression Team
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