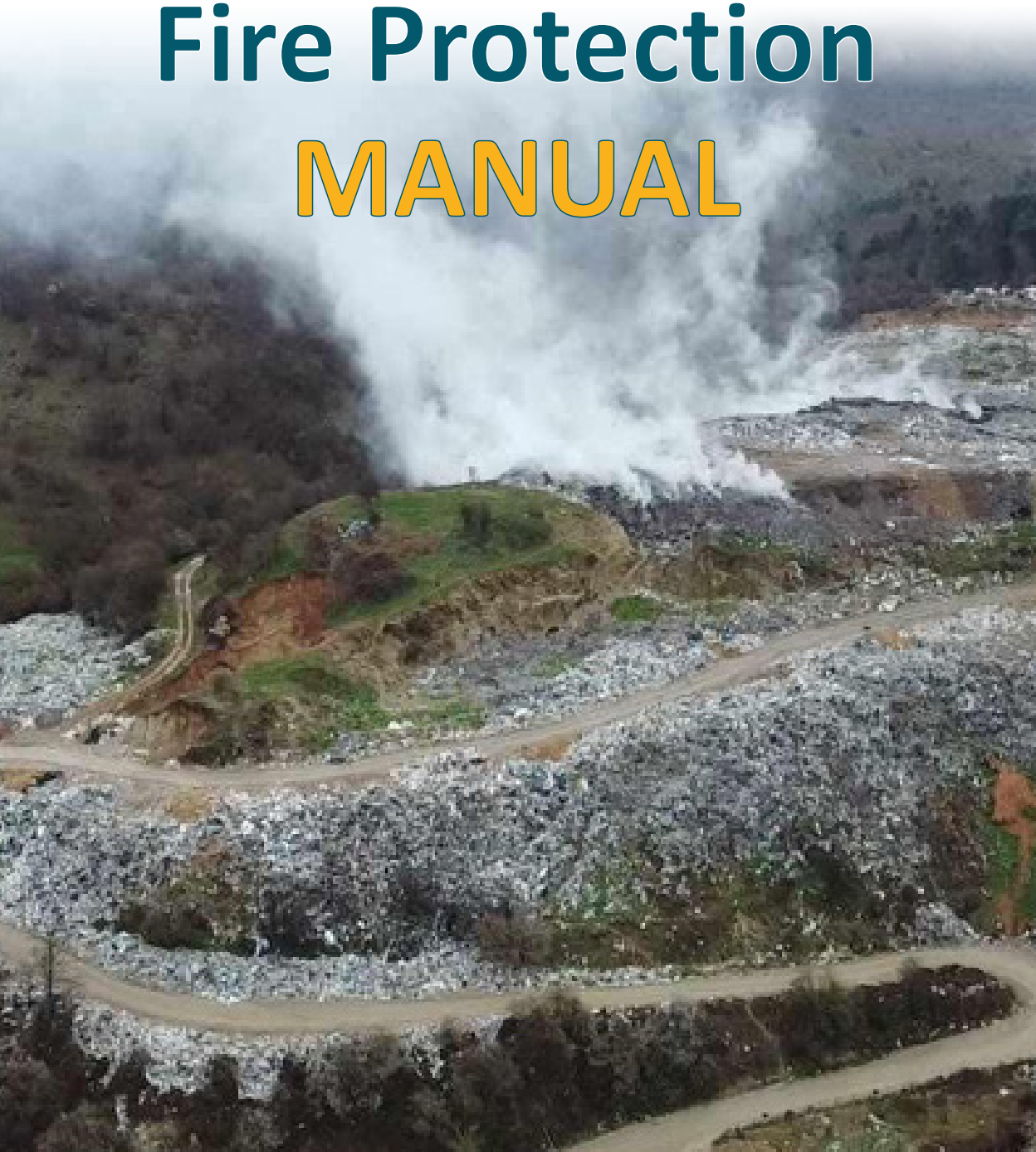
Sweden
Sverige

SALAR International
A part of the Swedish Association of Local Authorities and Regions

Landfill Fire Protection MANUAL



Landfill Fire Protection
Manual

Authors:
Vladimir Simonovski, National Fire Protection Expert
Per-Olof Hallberg, International Waste Management Expert

Editorial team:
Emil Angelov, Martin Nikolikj

Design of the publication:
Brigada design

Cover photos:
Goran Angeloski

SALAR International used reasonable efforts to ensure that data, analysis, opinion, and other information used in the manual are correct. Although gathered from sources believed to be reliable, SALAR International acknowledges that the accuracy of data or information used cannot be guaranteed. The completeness and accuracy of all the data and information used to produce the manual are dependent upon the sources of such data and information, which are outside of SALAR International's control.

SALAR International would like to thank all the institutions and individuals that participated in the manual for their unreserved support and contribution. ©SALAR International, 2025. All rights reserved.

SALAR International



Why is landfill fire protection important?

Fire prevention in municipal landfills is critical for environmental protection and safe waste disposal. Landfill fires are dangerous, releasing toxic gases and pollutants that harm the environment and public health. Once ignited, they are incredibly challenging to extinguish, consuming resources and causing widespread contamination. Preventing fires protects workers, residents, and the local environment.

Uncontrolled landfills, like most in the country, pose a significant risk due to lack of preventive measures and oversight. Without structured fire prevention, these sites are susceptible to hazards from flammable waste, methane gas, and spontaneous combustion especially during hot summer months. Unchecked and unsegregated waste increases ignition risk, leading to quickly spreading incidents. Climate change and warmer weather exacerbate these risks, creating ideal conditions for landfill fires.

North Macedonia has seen a notable increase in landfill fires recently, attributed to warmer conditions and a lack of controlled waste management. The Pelagonija and South-west planning regions, the focus of this study that led to this Manual, have experienced multiple landfill fires impacting the environment and communities. A new regional landfill is planned to replace approximately 15 existing non-compliant landfills. These current sites often lack adequate fire protection, making them extremely vulnerable.

Implementing fire protection measures is crucial for minimizing environmental and public health risks. This is supported by increasingly larger number of landfill fires in North Macedonia that has sharply risen to over 1,500 incidents reported in 2023 alone. These alarming figures call for an immediate implementation of preventive measures across all landfills in the country.







Assessment Findings

The assessment of the five landfills used by the six pilot municipalities revealed common challenges. All assessed landfills do not comply with EU landfill regulations and should be classified as “dumpsites”.

Overall Challenges Across all Landfills:

- **Unsorted Waste Transport:** The transfer of mixed waste in trucks increases the likelihood of fire due to the presence of combustible materials.
- **Dumping Locations:** The specific locations where waste is deposited contribute to fire hazards, especially since they are not properly managed.
- **Concentration of Waste:** The practice of dumping large volumes of waste in one area leads to the formation of extensive waste piles, heightening fire risks.
- **Evaporation of Flammable Fossil Fuels:** The accumulation of various waste types can result in the evaporation of easily ignitable fossil fuels, further increasing the fire risk.
- **Lack of Monitoring and Preventive Measures:** The absence of effective monitoring mechanisms and fire prevention strategies increase the potential for fire outbreaks.
- **Self-Ignition Risks:** Significant risk due to hot ash, unburnt coal, and daily electronic waste reception (including lithium batteries). Waste decomposition and high ambient temperatures generate heat.
- **Challenges in Extinguishing Fires:** Extinguishing is complex and prolonged; improper management leads to smoldering and re-ignition. Access roads and internal routes are often insufficient and obstructed. Vast water quantities are needed and no specialized ponds or leachate reservoirs exist.
- **Climate Change and Warmer Weather Impacts:** Increased sunny days and rising temperatures contribute to higher ignition frequency and prolonged burning.

- **Insufficient Security Measures:** Most landfills have minimal to non-existent security, lacking fences, gates, monitoring, and personnel.
- **Absence of Risk Assessment Plans:** Fire risk assessment plans are generally missing.
- **Lack of Waste Sorting and Measurement:** Most landfills lack sorting machines, while gas emissions are rarely measured.

Specific Challenges:

- **Municipality of Kichevo:** The old landfill is located in the very center of the town, posing a significant danger to nearby buildings and structures if a fire occurs. It is officially decommissioned but still used. There are also illegal dumpsites, one of which is particularly large and poses a serious danger due to its proximity to a water waste treatment plant, a river, and a mountain.
- **Municipality of Plasnica:** This municipality does not have a firefighting unit, relying on units from neighboring municipalities (Makedonski Brod, 12 km; Kichevo, 18 km) which increases intervention time. However, the employment of a communal warden has led to a decrease in fire incidents (only two in 2023).
- **Municipality of Ohrid:** The Bukovo Landfill is located in a mountainous area 20 km from the city, making access challenging. During the tourist season, daily waste increases significantly (up to 100 tons). The fire risks are significantly higher here due to large waste volumes in summer, high temperatures, and easily flammable waste causing self-ignition. The estimated arrival time for the Ohrid firefighting unit is over 30 minutes due to distance and difficult terrain. Daily fires occur almost every day in summer, and deploying a municipal fire vehicle to Bukovo risks the safety of Ohrid. The landfill is surrounded by massive forest vegetation, increasing the risk of catastrophic forest fires.

- **Municipality of Prilep:** This landfill is in better condition regarding preventive measures. It has a 24-hour security service at the gate, and two service roads have been constructed for fire department access. Activities for a risk assessment plan have begun, and easily flammable waste like textiles are being selected. The municipality has started construction of a waste selection facility at the landfill entrance, which is expected to significantly reduce waste volume and fire risks once operational.

- **Municipalities of Bitola and Novaci (Meglenci Landfill):** The most serious security risk is the crossing of electricity transmission lines from REK Bitola over the landfill at a height of no more than 15 meters, posing significant fire and safety risks. The landfill is shared by three municipalities (Bitola, Novaci, Mogila) and also used by a private company from REK Bitola for waste disposal, with no mechanism to determine the amount of waste they dispose. Security service is only available until 2 PM.





Recommendations

General Recommendations

Actions During Landfill Fires

When addressing fires at landfill sites, it's crucial to identify effective response strategies and acknowledge any gaps in skills or resources that may hinder efforts. It is recommended that municipalities implement the following:

- **Prevent Environmental Damage**: Develop strategies to minimize negative impacts on the environment.
- **Risk Assessment**: Evaluate the hazards associated with rescue operations.
- **Event Sequence Management**: Implement measures to disrupt and control the progression of the fire.
- **Initiate Rescue Operations**: Establish clear protocols for commencing rescue efforts.
- **Resource Utilization**: Understand how to effectively deploy available resources and what specific efforts are required.

Preventive Measures and Preparedness:

- Ensure thorough knowledge of landfill layout, collaborate with operational personnel, and provide comprehensive training.
- Engage rescue services (fire brigades) in planning to organize the landfill into distinct cells/zones for effective firefighting.

Environmental Impact Assessment: Engage environmental inspectors or regional authorities to discuss potential fire risks and conduct post-fire evaluations of effects and rescue operation effectiveness. Key considerations include:

- Methods for Fire Extinguishment: Determine appropriate techniques for putting out the fire.
- Necessary Training: Identify training requirements for personnel involved in firefighting efforts.

- **Access to Emission Monitoring Equipment:** Fire brigades and landfill operators should have access to tools to track fire gas fluctuations and determine when conditions are too hazardous for personnel.

- **Secure Equipment and Personnel:**
  - Ensure machinery and trained operators are readily available for swift containment and extinguishment.
  - Conduct collaborative preparations and regular training scenarios with landfill owners (utility companies) and fire rescue teams (firefighting services).

- **Reuse Extinguishing Water:** Investigate the potential for reusing water used in extinguishing fires to reduce remediation challenges.

- **Availability of Covering Materials:** Assess the sufficiency of on-site soil, sand, or other materials to smother fires and reduce oxygen flow. Implement daily cover practices for exposed waste for fire prevention.

- **Regulatory Compliance and Collaboration:** Landfills must operate under appropriate permits and adhere to national legislation. Effective fire protection requires cooperation among fire brigades, landfill operators, utility companies, and environmental inspectors, with efforts tailored to each facility.

- **Continuous Improvement:** Conduct evaluations after each landfill fire incident to improve future response efforts and involve all stakeholders who participated in rescue operations to identify areas for enhancement.





Specific Recommendations

Fire Protection and Management:

- Equip landfills with adequate firefighting equipment.
- Provide comprehensive training for all landfill employees responsible for security, focusing on fire management and extinguishing procedures.

Proactive Fire Prevention Measures:

- Develop tailored landfill risk management plans for managing companies/legal entities.
- Clearly define and segregate landfill areas (cells/zones) for specific waste types.
- Install gas detection systems to measure gas concentration levels, especially during high temperatures.
- Prohibit disposal of easily flammable materials in high gas concentration areas.
- Ensure multiple access roads to the landfill and internal routes for unobstructed movement of firefighting vehicles.
- Foster greater responsibility in landfill management, emphasizing controlled entry and access protocols.
- Introduce monitoring systems, including lighting and perimeter fencing, to prevent unauthorized access and potential arson.
- Deploy a security team with patrol vehicles for continuous 24-hour monitoring of landfill perimeters.
- Acquire machines for sorting easily flammable waste like plastics and paper.
- Designate specific sectors for waste disposal, ensuring timely access for interventions to prevent fire spread.
- Construct waste sectors as deep pits that can be quickly covered with soil when filled (rapid-cover holes).
- Install thermal monitoring systems (thermal cameras) to detect smoke and trigger alarms when heat is detected.

Guidelines for a Simplified Fire Management Plan: Regulate individual movement on site and prevent intentional ignitions to reduce fire incidents (potentially by up to 80%). Implementing a municipal warden for regular patrols and monitoring, as seen in Plasnica Municipality, can significantly reduce fires by enforcing penalties for illegal dumping.

Reporting, Communication, and Dissemination of Guidelines:

- **Engage Municipalities and Utilities**: Increase collaboration with municipalities and public utility companies to inform residents and businesses about safe waste disposal practices through official channels and social media.
- **Organize Clean-Up Events**: Plan initiatives for the collection of construction and bulky waste, clearly outlining collection schedules to minimize illegal dumping.
- **Increase Waste Container Availability**: Install more waste containers and sorting bins across municipalities to encourage proper disposal practices.
- **Conduct Awareness Campaigns**: Implement regular campaigns to educate local communities about the risks associated with uncontrolled fires in bins, containers, and landfills, using flyers and billboards for outreach.







Landfill fire protection self-assessment checklist

(steps that the landfill operator must go through to assess its capacity to legally and safely operate the landfill)

Thematic area	yes/no	comment
Advisory support and Consultations		
Are you familiar with any fire safety regulations at your landfill?		
Do you have access to a fire safety or risk assessment consultation person?		
Have you consulted the firefighting unit/service for any advice regarding fire safety/protection at your landfill?		
Have you consulted the environmental inspector regarding fire safety/protection at your landfill?		
Are advices received from responsible authorities/persons included in the fire safety plan?		
Assessments and Plans		
Have you conducted a fire risk assessment for your landfill?		
Does the assessment include protection of people, the environment and property?		
Based on the assessment, have you developed a fire risk control plan? If yes, are you using the plan?		
Does the plan include aspects such as firefighting equipment and employee instructions?		
Does the plan include fire safety guidelines that the fire department should follow in the event of a fire?		
Does the plan include all flammable sources (tanks, gas cylinders, etc.)?		
Location and nearby structures		
Are there any schools, hospitals, residential buildings or other infrastructure facilities in the vicinity of the landfill that could be affected by a landfill fire?		
Could a landfill fire have a catastrophic effect on a nearby location (gas station, combustible material warehouse)?		
What is the response time of the nearest fire department in the event of a landfill fire?		
What happens if the nearest fire department cannot answer the call?		

Thematic area	yes/no	comment
Common causes of fire and precaution measures		
Have all possible sources of landfill fire been identified including lighting, heating and cooking appliances?		
Is smoking prohibited at the landfill and is this prohibition enforced?		
Do you conduct routine fire inspections at the landfill?		
Do you have adequate landfill safety measures in place to reduce the risk of arson?		
Do you have control over the type of waste that goes to landfill? Do flammable materials such as paint, thinners, batteries, etc. end up in the landfill?		
Are landfill employees familiar with fire safety precautions?		
Are there fire extinguishers and other fire protection equipment at the landfill?		
Do the employees know how to use it?		
Does the landfill have access to water (mains or tank) and is it adequate to the potential fire risk?		
Can the fire truck easily access all parts of the landfill?		
Do employees know what to do in case of fire?		
Is there an information board at the landfill (facility name, emergency number, opening hours, list of acceptable waste)?		







Daily landfill fire protection checklist

(steps that the landfill guard/staff needs to go through every day while on site)

Perimeter Security:	Mark if checked
1. Ensure there are no unauthorized access points or breaches in the perimeter where a fence would typically be.	
2. Set up temporary barriers or signs at the entrance prevent unauthorized entry and daily check if signs/barriers are at place.	
Monitoring and Surveillance:	
3. Conduct a regular patrol (at least twice a day) to monitor any unauthorized movement of persons within the landfill.	
4. Maintain a daily log of any suspicious activities or individuals around the landfill.	
Access and Routes:	
5. Ensure the access road is clear of obstructions and allows easy movement for vehicles.	
6. Regularly clear pathways around the landfill to ensure they are accessible for emergency vehicles.	
Waste Sorting:	
7. Identify and separate easily flammable materials to designated areas, ensuring they are away from potential ignition sources.	
8. Check for any signs of uncontrolled gas emissions and address them immediately.	
Fire Prevention Measures:	
9. Ensure any available water sources are functional and accessible for fire extinguishing purposes.	
10. Ensure there is enough quantity of soil, sand or other covering material.	
11. Verify that any firefighting equipment on-site is in good working order.	
Daily Safety Protocols:	
12. Conduct a daily briefing with all landfill staff to review safety protocols and any new observations.	
13. Ensure the emergency contact list is up-to-date and easily accessible to all staff members.	
Surroundings:	
14. Inspect the surrounding area (forest, trees, vegetation, flammable material) for any signs of fire hazards or potential threats.	
15. Regularly clear any flammable vegetation near the landfill perimeter to reduce fire risk.	





Republic of North Macedonia
Ministry of Environment and Physical Planning

Republic of North Macedonia
Ministry of Local Self Government

ZELS