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Disaster Waste Management in West Asia

A Training Manual


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Foreword

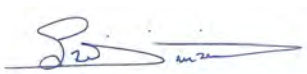
In the West Asia region, a number of countries have grappled with disasters and conflicts in recent years, elevating the management of waste, especially debris, stemming from these crises to a top priority. Following such upheavals, environmentally sound waste management becomes paramount due to the hazardous elements frequently found in the resulting debris, which pose significant risks to both human health and nearby ecosystems. This challenge is particularly acute in the region, where conflict affected countries often lack the necessary capacity to strategize, cultivate, and execute effective measures to mitigate pollution arising from waste generated by disasters and conflicts.

In response to the challenges posed by disasters and conflicts, the United Nations Environment Programme (UNEP) has been actively providing environmental expertise to governments and national partners facing such crises in the region, with the aim to protect human health and the environment, ensuring that national authorities have effective tools to manage waste scenarios effectively. In November 2022, a training session was organized to provide support in managing waste generated during disasters and conflicts. This training manual was subsequently developed, drawing upon the materials and insights gathered from the training.

Having a waste management contingency plan is crucial for countries to handle emergencies such as disasters and conflicts. Tailored to the West Asian context, this training manual was designed to assist West Asian countries in developing and implementing waste management contingency plans with feasible solutions that can be put into practice prior to emergencies. First it introduces the different types of disasters and the waste streams associated with disasters and conflicts, it then delves into planning for disaster and conflict waste management, covering preparatory processes and the key elements of a Disaster Waste Management Plan and finally provides guidance on responding to major explosions, major displacements, and major oil spills.

We hope that this manual will be a valuable resource for waste management authorities and concerned stakeholders in the region, empowering them to enhance their preparedness and response to emergencies, ultimately safeguarding human health and the environment amidst the challenges posed by disasters and conflicts.

I take this opportunity to thank our partners at International Solid Waste Association (ISWA) and participants from line ministries from the region for their contribution in developing this manual.



Sami Dimassi
UNEP Representative and Regional Director for West Asia

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List of Abbreviations

C&D	Construction and Demolition
DWMCP	Disaster Waste Management Contingency Plan
DWMP	Disaster Waste Management Plan
eq	Equivalent
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
GEF	The Global Environment Facility
GHG	Greenhouse Gas
ISWA	International Solid Waste Association
MM	Million
Mt	Megatonne
OCHA	United Nations Office for the Coordination of Humanitarian Affairs
UNDP	United Nations Development Programme
UNDRR	United Nations Office for Disaster Risk Reduction
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations International Children's Emergency Fund
WM	Waste Management
WMO	The World Meteorological Organization
WRI	World Resources Institute
WWF	World Wildlife Fund

Preface

Over the last decade, waste generation across various forms has risen globally. Urbanization, economic development, and unsustainable consumption patterns have significantly contributed to this growth in waste. The West Asia region is no exception, experiencing a surge in waste production, estimated at around 60 million tons of municipal solid waste in 2016, with the informal sector collecting approximately 7.1 per cent and about 16.8 per cent remaining uncollected. Due to inadequate waste management and an increasingly diverse waste composition, large amounts of waste are lost to the environment, leading to pollution.

Disasters and conflicts in the region have generated hazardous, construction, and industrial waste, further worsening pollution. These issues compound the waste management challenges faced by West Asian countries struggling with disasters and conflicts. Additionally, the region lacks sufficient capacity to plan and implement measures to control and prevent pollution from waste generated during such events.

To address this, the UNEP West Asia Office, in collaboration with the International Solid Waste Association (ISWA), conducted a capacity-building workshop from 23-25 November 2022. The focus was on managing waste produced by disasters and conflicts. The workshop aimed to strengthen the capacity of national authorities in West Asia to effectively respond to and treat disaster and conflict-related waste, preventing further pollution. This was accomplished by delivering sound, practical guidelines to help national authorities improve disaster and conflict waste management.

Workshop participants gained:

- Knowledge on developing and implementing a national plan for disaster and conflict waste management;
- An enhanced understanding of practical measures to manage waste from disasters and conflicts.

The workshop targeted policy and technical staff from line ministries and national agencies responsible for waste management and disaster response.

This training manual was created to augment the learning experience of participants at the workshop. In a first step, an overview of the different types of disasters is given in Chapter 1. A distinction is made between natural and man-made hazards. Thereby, the explanation of various definitions regarding disasters, as well as the resulting waste, seems to be helpful.

Chapter 1

Introduction to Disaster / Conflict Waste & Pollution

Introduction

Disaster waste management involves the proper handling, disposal, and recycling of waste generated during and after a disaster or emergency situation. Effective disaster waste management is crucial for several reasons including public health and safety, environmental impact, and recovery and reconstruction. Managing disaster waste efficiently is essential for the recovery and reconstruction process. Accumulated debris can hinder access to affected areas and impede rebuilding efforts. In this chapter, the different types of disasters are explained and the characteristics of the implications they entail are highlighted. Additionally, a distinction is made between the direct and indirect effects of disasters. It is important to consider direct and indirect effects as they occur in different phases of a disaster and require different forms of response. In this context, it is also important to identify the different phases of preparation for, and responses to, disasters.

Types of Disasters

According to UNDRR (2022), a disaster is a "… serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to one or more of the following: human, material, economic and environmental losses and impacts".

There are different forms of disasters, which are mainly divided into natural hazards, and man-made and technological hazards. While the former is naturally occurring physical phenomena, the latter are caused by humans and happen in or near human establishments on land or sea. In this context, natural disasters can have different underlying physical causes (IFRC 2022):

Geophysical
(such as earthquakes, landslides, and volcanic activity)

Hydrological
(such as floods and avalanches)

Climatological
(such as droughts and wildfires)

Meteorological
(such as cyclones and storms)

Biological
(such as disease epidemics and insect/animal plagues)

Man-made and technological hazards often include armed conflicts, nuclear disasters, industrial accidents, train or plane crashes, environmental degradation and pollution. Another category of man-made hazards are armed conflicts. These conflicts create a unique dynamic with major implications on governance and the contamination of debris and waste with ordinance distinguishes them from disaster waste. When a conflict is accompanied by a multitude of additional and often intractable demographic, environmental, social, and economic instabilities, these may be known as complex emergencies. This term is not clearly defined but is often used by humanitarian agencies to describe multi-agency interventions due to the complexity of conflicts. There are four main types of instability that are considered common forms of complex emergencies. These include political instability, economic instability, environmental instability, and demographic instability (Strauss Center 2022).

Table 1 provides an overview of disasters selected by the United Nations and describes their characteristics in terms of the waste they generate. These wastes are thus called disaster wastes and, according to United Nations, are defined as "… the waste that is generated by the impact of a disaster, both as a direct effect of the disaster as well as in the post-disaster phase as a result of poor waste management." (Joint UNEP/OCHA Environment Unit 2013b).

Table 1: Disaster Types and Their Waste Characteristics

	Earthquakes	Structures collapse 'in-situ', i.e. floor slabs collapse on top of each other, trapping waste within damaged buildings and structures. This can lead to challenges in sorting out hazardous waste (e.g. asbestos) from non-hazardous (e.g. general building rubble). Collapsed buildings may overlap across streets, making access difficult for the search and rescue and relief operations. Quantities of waste are high compared to other disaster types since all building contents normally become waste.
	Flooding	Initial damage depends on the structural integrity of the infrastructure while budding contents are normally damaged extensively. Mould may be present and timber may have begun to rot. Buildings are typically stripped by owners and waste is placed on roads for collection. Waste is often mixed with hazardous materials such as household cleaning products and electronic goods. Flooding may bring mud. clay and gravel into affected areas, making access difficult once the floodwater recedes. Removal may be required for relief and recovery operations. The mud, clay, and gravel may be mixed with hazardous materials, requiring further assessment before dumping.
	Tsunami	Strong tsunamis can cause widespread damage to infrastructure, spreading debris over large areas. Debris is often mixed with soils, trees, bushes, and other loose objects such as vehicles. This makes waste difficult to handle and segregate.
	Volcanoes	The damage caused by volcanic eruptions primarily results from the disposal of ash and pumice stone in combination with flows of molten rock (lava). The removal of debris is often obstructed by fine ash particles which cause further strain on mechanical and hydraulic equipment as well as electric and electronic devices.
	Hurricanes Typhoons Cyclones	Strong winds can tear the roofs of buildings. after which walls may collapse. Poorly constructed houses and huts can 'fold' under rooftops. Even brick and concrete walls may collapse. Waste is spread over open land, streets, and marketplaces. This would include roofing materials, small items, and dust carried by the wind. This may cause serious problems where asbestos is present. Ships and boats are often thrown ashore and destroyed, requiring specialized waste management. Vessels that sink in harbors need to be removed. Electrical and telephone grids as well as transformers containing PCBs may be destroyed.
	Conflict - Short Term	Intense, short-term conflicts can involve rockets. missiles and bombs, which, combined with land combat, result in damage to buildings and infrastructure, key strategic installations being bombed and/ or widespread damage to industrial and residential areas. Damaged infrastructure is often built. resulting in the destruction of most internal furnishings and fittings. This reduces the quantities of debris to be managed and leaves primarily non-flammable items such as concrete, bricks, and stones. Bridges, roadways, railway structures, etc. are often targeted. The cleaning requires heavy machinery such as excavators and bulldozers. Waste collection vehicles may be damaged or be commandeered for military purposes. Unexploded ordnance (UXO) including undetonated landmines may be present among waste.
	Conflict - Protracted	Protracted conflicts share similarities with short-term, intense conflicts but there is often more widespread damage to buildings and infrastructure, and increased use of landmines on or near strategic roadways and facilities.

Waste Related Implications

The next subsections focus on both direct and indirect disaster related waste implications and address the short-term, medium-term, and long-term post disaster measures.

Direct / Indirect

Direct disaster losses refer to directly quantifiable losses such as injured or killed people, damage to buildings, and limited infrastructure, while indirect disaster losses can be seen as the broader effects of direct losses resulting from a disaster. These are, for example, disruptions to supply chains, declines in production, or the basic well-being of people. In this context, Figure 1 illustrates the differences between direct measurable/non-measurable and indirect measurable/non-measurable losses. In this respect, measurability is often determined on the basis of the numerical or monetary value (UNDRR 2015).

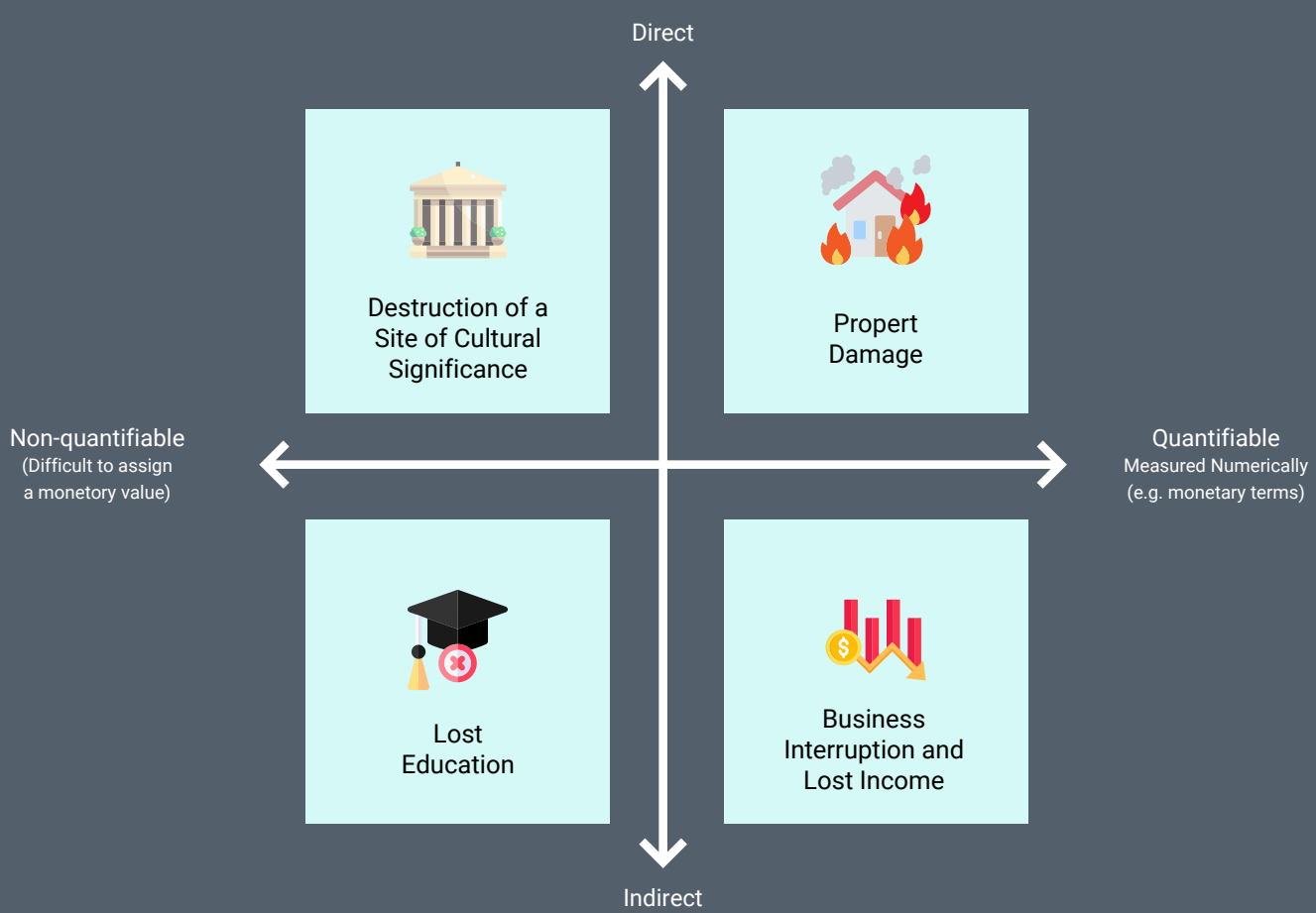

Figure 1: Visual representation of direct/indirect and quantifiable/non-quantifiable losses (UNDRR 2015)

With regard to the waste implications of a disaster a differentiation can be made between waste that is a direct consequence of a disaster, as it is directly generated through the disaster itself, for example construction and demolition (C&D) debris or waste from buildings destroyed by an earthquake or during a bombing, or waste that is indirectly linked to a disaster. The latter could for example be waste from refugee camps that are a consequence of people displaced by a man-made or a natural disaster such as a war or an earthquake. If waste is not managed appropriately from the beginning, negative waste related effects such as biohazards might occur.

As described by the State Emergency Management Committee in Section 9(1)(b) of the South Australian Government Emergency Management Act 2004 (2018), direct and indirect waste types may include (Green Industries SA 2018):

- Debris resulting from damage to property and infrastructure caused by the event, after it has been released by first responders;
- Materials used during the disaster response phase (e.g., sandbags used during flooding);
- Relief waste generated during the response and recovery phases (e.g., unwanted donated goods, medical waste);
- Waste from demolished buildings and structures;
- Agricultural wastes (including animal carcasses) generated during the disaster.

According to United Nations, for waste to be considered a risk to human health or the environment, three specifications must be met (Joint UNEP/OCHA Environment Unit 2013b):

- **Waste must be classified as hazardous -** This means, for example, hazardousness to human health or the environment must be identified. A precise classification of what constitutes hazardous waste is given by the definition of the European Waste Framework Directive (WFD) (European Commission 2018). It states, "A hazardous waste is defined as a waste that exhibits one or more of the fifteen hazardous properties listed in Annex III of the Waste Framework Directive (WFD).";
- **There must be a route or "pathway" for the hazardous waste to impact a recipient;**
- **The hazardous waste must act on a " receptor" -** This can be of different types, for example, a human being or a water body can be considered as a receptor.

Table 2: Hazardous properties of wase as defined by the European Waste Framework Directive (WFD) (European Commission 2018)

HP Code	Title	Description
HP1	explosive	substances and preparations which may explode under the effect of flame, or which are more sensitive to shocks or friction than dinitrobenzene
HP2	oxidising	substances and preparations which exhibit highly exothermic reactions when in contact with other substances, particularly flammable substances
HP3	highly flammable	liquid substances and preparations having a flash point below 21 °C (including extremely flammable liquids), or
HP3	highly flammable	substances and preparations which may become hot and finally catch fire in contact with air at ambient temperature without any application of energy, or
HP3	highly flammable	solid substances and preparations which may readily catch fire after brief contact with a source of ignition and which continue to burn or to be consumed after removal of the source of ignition, or
HP3	highly flammable	gaseous substances and preparations which are flammable in air at normal pressure, or
HP3	highly flammable	substances and preparations which, in contact with water or damp air, evolve highly flammable gases in dangerous quantities
HP3	flammable	liquid substances and preparations having a flash point equal to or greater than 21 °C and less than or equal to 55 °C
HP4	irritant	non-corrosive substances and preparations which, through immediate, prolonged, or repeated contact with the skin or mucous membrane, can cause inflammation
HP5	harmful	substances and preparations which, if they are inhaled or ingested or if they penetrate the skin, may involve limited health risks

HP Code	Title	Description
HP6	toxic	substances and preparations (including very toxic substances and preparations) which, if they are inhaled or ingested or if they penetrate the skin, may involve serious, acute or chronic health risks and even death
HP7	carcinogenic	substances and preparations which, if they are inhaled or ingested or if they penetrate the skin, may induce cancer or increase its incidence
HP8	corrosive	substances and preparations which may destroy living tissue on contact
HP9	infectious	substances and preparations containing viable micro-organisms or their toxins which are known or reliably believed to cause disease in man or other living organisms
HP10	toxic for reproduction	substances and preparations which, if they are inhaled or ingested or if they penetrate the skin, may induce non-hereditary congenital malformations, or increase their incidence
HP11	mutagenic	substances and preparations which, if they are inhaled or ingested or if they penetrate the skin, may induce hereditary genetic defects, or increase their incidence
HP12	-	Waste which releases toxic or very toxic gases in contact with water, air or an acid
HP13	sensitising	substances and preparations which, if they are inhaled or if they penetrate the skin, are capable of eliciting a reaction of hypersensitization such that on further exposure to the substance or preparation, characteristic adverse effects are produced
HP14	ecotoxic	waste which presents or may present immediate or delayed risks for one or more sectors of the environment
HP15	-	waste capable by any means, after disposal, of yielding another substance, e.g. leachate, which possesses any of the characteristics listed above

Immediate, Mid-term, Long-term

When it comes to managing disasters, the processes of preparation and response can be divided into different phases, see Figure 2 below. These are immediate and short-term actions, medium-term actions, and long-term actions, as well as contingency planning. The first three phases are different periods of time after the occurrence of an emergency, while contingency planning can take place either during the long-term phase or as a separate preparatory measure (Joint UNEP/OCHA Environment Unit 2013b). Preferentially a basic contingency planning is done before any disaster occurs.

Phase 1	**Immediate and short-term actions** • 0-72 hours: immediate actions • 72 hours onwards: short term actions
Phase 2	**Medium-term actions** • Assessments • Operations • Planning • Communication and reporting
Phase 3	**Long-term actions**
Phase 4	**Contingency planning**

Figure 2: Disaster preparation and response phases (Joint UNEP/OCHA Environment Unit 2013b)

Phase 1

Phase 1 begins immediately after a disaster and addresses the first 72 hours, during which the most pressing issues must be identified. For this purpose, a hazard ranking is to be created that includes the following points:

- Identify waste issues;
- Clearing of waste for search and rescue;
- Identify temporary debris and waste disposal sites;
- Understand the normal waste management system prior to the disaster;
- Understand the waste characteristics;
- Map the waste generated;
- Gain an understanding of the regulations applicable;
- Map different stakeholders including the various ministries and government agencies to be involved in the disaster waste management;
- Prioritize actions.

Within the first few days (after the first 72 hours), short-term actions should be taken care of. These include collecting household waste from people who have remained in the disaster areas and establishing a rapid disaster waste assessment.

Phase 2

Phase 2 will lay the foundation for the disaster waste management programme. For this purpose, further assessments of disaster waste and temporary deposits will be made. It is recommended to create checklists for the different types of waste in order to classify where and in what condition the waste can be found. Reference should also be made to the hazardousness and handling requirements of the waste. At this stage, it is also necessary to involve surrounding waste disposal and recycling facilities and consider any need for additional assistance.

On the operational side, in addition to establishing temporary storage facilities for debris and regular waste, their collection and transportation should be made possible. In this context, it is important to provide the local authorities with practical assistance and guidelines in order to minimize the negative effects of the disaster as much as possible.

It is essential to have structured plans for:

- Communications for affected communities with a focus on opportunities, risks and collection schemes;
- Safety notices to returning public;
- Public dissemination on waste and the risks thereof, public awareness around asbestos;
- Public information on risks from collapsing buildings and structures;
- In conflict situations reference to unexploded ordinance;
- Health care waste;
- Collection and treatment of hazardous waste;
- Supporting affected communities on issues related to public health, waste, living conditions, etc.;
- Exit strategies and handover options.

During the execution of all the points already mentioned, communication and reporting must not be forgotten. Both should take place quickly and purposefully both in the direction of the local authorities and the federal competent authorities. Therefore, a comprehensive documentation of the assessment results in electronic (written) form should be given from the very beginning. The results of these planning efforts involve providing data from Phase 1 and supplementary information to design a disaster waste management programme to be implemented during the recovery phase.

Phase 3

In the implementation of the disaster waste management projects designed by Phase 2, monitoring and evaluation of the waste situation will also continue in Phase 3. The following points should be considered:

- Develop and implement a communications plan for key stakeholders;
- Provision of waste management facilities, machinery, and equipment;
- Training of Waste Management Operators and waste carriers;
- Support of local authorities and waste management operators in implementing the Disaster Waste Management System.

The result of this phase should be that all disaster waste will be handled effectively by disposal, incineration, reuse, or recycling.

Phase 4

Phase 4 helps bridge the gap between response, recovery, and longer-term development and is therefore an important contingency planning investment. It can be carried out during the long-term phase or as a preparatory activity prior to a disaster. The goal is to develop a Disaster Waste Management Contingency Plan (DWMCP) to help communities identify appropriate disposal options in advance of a disaster.

Chapter 2

Planning for Disaster & Conflict Waste Management

The following section discusses the planning steps related to disaster and conflict waste management. For this purpose, individual preparatory processes, and the stakeholders to be involved are explained in more details. It also focuses on pre-incident training. Subsequently, the key elements of a disaster waste management plan are highlighted.

Figure 3 shows possible steps for preparing a coordinated response. This should include a description of who is responsible for what, when and where. Relationships between relevant authorities and/or departments should also be identified. This is necessary to prepare lists of names and emergency contact details of relevant persons. The appointment of a waste manager and support team also seems helpful (Grampians Central West Waste & Resource Recovery Group 2017).

Figure 3: Suggested preparing steps for coordinated response (Grampians Central West Waste & Resource Recovery Group 2017)

Preparatory Processes

The preparation phase, as described in Phase 4 of the previous chapter, serves to develop a sophisticated Disaster Waste Management Contingency Plan, which can consist of many possible components. It should in any case include, as a minimum, the following considerations (Joint UNEP/OCHA Environment Unit 2013b) (Grampians Central West Waste & Resource Recovery Group 2017):

- Pre-planning activities;
- Coordination of external assistance at government level;
- List of applicable environmental regulations and determination of risks;
- Identification and recommendations of harmful and hazardous materials;
- Identification of disposal sites for debris and waste;
- Identification of equipment and administration needs;
- Addressing the issues of debris removal and disaster waste reduction;
- Emphasize the need to separate and avoid mixing of different waste streams (e.g. rubble, solid waste, hazardous waste including asbestos);
- A robust communications plan;
- Recycling options;
- Waste-to-energy options;
- Disposal options, including managed landfill or small-scale incineration with pollution abatement;
- Open burning options (in principle not recommended and requires justification that other options have been adequately exhausted);
- Communication with the public.

The execution of the individual steps can take place differently depending on the disaster. What they have in common, however, is the integration of the stakeholders involved.

Actors to be Involved

Preparations and clean-up work after disasters and conflicts are often time-consuming and costly. Disaster debris management therefore usually requires the "whole community". This is described by The National Preparedness Goal 2nd Edition (2015) "… as a focus on enabling the participation in national preparedness activities of this wide range of players in order to foster better coordination and working relationships" (US EPA 2019) (US Homeland Security 2015).

According to the EPA (2019), the following groups can benefit from DWMP and associated training programmes (US EPA 2019):

Communities…

- … at risk of significant damage from a natural disaster;
- … at increased risk from natural disasters due to climate change;
- … currently without an existing or comprehensive debris management plan;
- … with emergency response plans that overlook disaster debris clean-up or consider only a limited number of debris management options;
- … in the beginning stages of the debris management planning process;
- … with existing debris management plans that have not been updated with new information, such as reductions in existing disposal capacity or innovative reuse or recycling opportunities.

Stakeholder management respectively the involvement of all affected individuals should therefore include the following interest groups (Joint UNEP/OCHA Environment Unit 2013b):

- Beneficiaries/target groups;
- Local level administration;
- Administrators;
- Practitioners;
- Civil society organizations, women organizations and volunteer groups;
- Regional administration;
- Donors.

Communicating and coordinating effectively with those involved is a must. The tool "Who does what where" on http://humanitarianresponse.info/ may be useful in this regard. It’s a dashboard showing a worldwide overview where humanitarian actors are working by sector and location (OCHA 2022).

Pre-incidence Planning

Before starting on a contingency plan, the following activities are recommended (Joint UNEP/OCHA Environment Unit 2013a):

(a) Understanding the national requirements for eligibility for public support and possible approval procedures for international assistance.
(b) Assemble a team of people who will work together to prepare the plan. Involved should be planning officers, emergency management officers, environmental officers, logistics consultants and first responders and haulage companies. To the extent possible, the team should also consist of officials from communities with a history of disasters. In some areas, it may be beneficial to invite officials from neighbouring countries that have experienced disasters.
(c) Design a method for review and further development. The team should determine on how the plan will be prepared. In addition, it should be defined who other than the team should review the plan, such as neighbouring communities and NGOs, civil society organizations, waste transporters and other stakeholders.

Figure 4 depicts the pre-incident waste management planning process according to Office of Resource Conservation and Recovery in EPA's Office of Land and Emergency Management (2019). (US EPA 2019) It should be noted that this is an ideal planning process from the United States of America, which assumes a controlled environment with a regulatory framework. Whereas for some disaster waste management situations there is often a lack of regulations and clarity on roles and responsibilities within the different ministries. And the governance situation is significantly worse in conflict affected areas/regions.

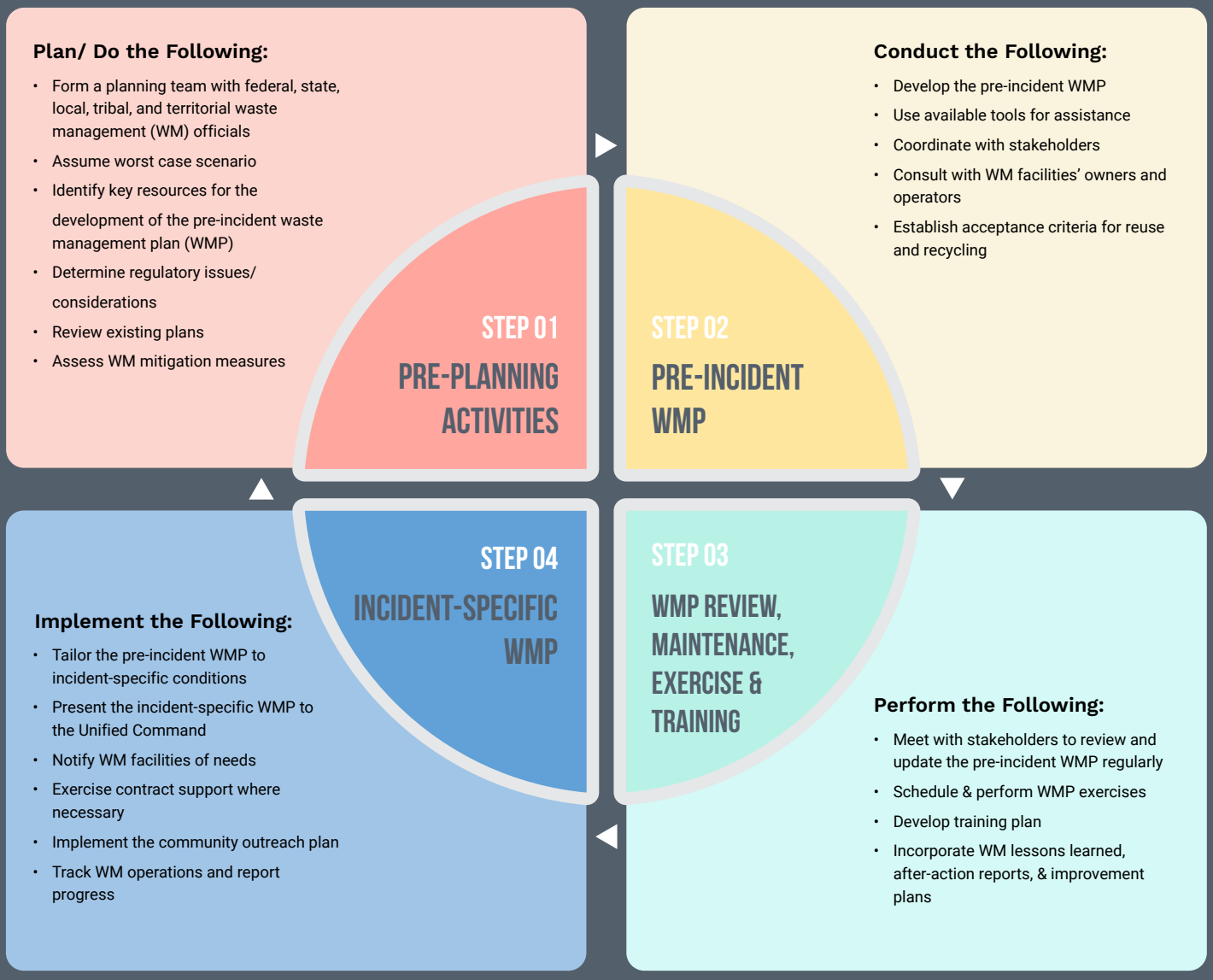

Figure 4: Pre-incident Waste Management (WM) Planning Process (US EPA, 2019)

The figure shows four stages that are interrelated and interdependent. Step 1 can be understood as the planning stage, within which a team is formed, worst case scenarios are developed and among other things, existing plans are reviewed. Step 2 involves communication with stakeholders, existing facility owners and operators. In addition, a pre-incident WMP shall be developed, which includes the use of existing tools.

While Step 3 involves meetings with stakeholders and the development and execution of training plans, Step 4 involves the implementation of incident-specific items. Firstly, pre-incident WMPs are to be tailored to incident specific WMPs. Secondly, WM facilities should be notified, and a community outreach plan should be implemented. Furthermore, the progress of WM operations should be documented.

Pre-incident Training

To ensure that all actors involved are trained in dealing with disasters and conflicts, it is important to undertake extensive training in the various sectors of preparedness and response in addition to the implementation of a DWMP. Any training should include the following aspects (Cadri Partnership 2022):

- Identification of the different types, compositions, and sources of disaster waste;
- Prioritisation of the types of disaster waste to focus on immediately, in the short, medium, and long term;
- Selection of the most appropriate waste management options based on the specific context of the disaster;
- Explanation of the opportunities that successful post-disaster waste management can provide, including ways to ensure the sustainability of projects;
- Listing the specific ways of preparing for disaster waste considering the variety of types of disasters that may occur.

Annex 2 and Annex 3 show examples of a decision support tool as well as a waste hazard ranking tool.

Key Elements of a Disaster Waste Management Plan

The figure lists the key elements of a disaster waste management plan according to United Nations (Joint UNEP/OCHA Environment Unit 2013b)

Suggested Contents for a Disaster Waste Management Contingency Plan

(a) Coordination
- Governmental coordination
- Coordination with other stakeholders
- Coordination with international assistance

(b) Types of waste and debris after a disaster

(c) Disaster debris and rubble prevention strategy

(d) Forecast of amounts of waste and debris

(e) Harmful materials identification — potential hazardous waste

(f) Applicable national and local environmental regulations

(g) Current capacity for waste and debris management. Determine waste and debris tracking mechanisms

(h) Equipment and administrative needs

(i) Hazardous waste management
- Industrial HW
- Household HW

(j) Healthcare waste management
- Infectious waste
- Hazardous substances
- Conventional waste

(k) Clean-up and Debris removal strategy
- Street clean-up priority
- Other open space priority
- Business and work clean-up priority
- Implementation of pre-negotiated contracts

(l) Selection of temporary waste and debris storage sites

(m) Management of temporary waste and debris storage sites

(n) Recycling options
- Steel and other metals
- Concrete, bricks, and other construction material
- Wood and board
- Paper, plastics, glass, and other packaging material
- Composting and biogas production

(o) Disposal options
- Temporary disposal
- Landfilling (permanent)

(p) Incineration options

(q) Open burning options

(r) Communication plan

Figure 5: Suggested contents for a disaster waste management contingency plan

Chapter 3

Major Explosions

An explosion is a sudden and rapid increase in pressure between two areas, resulting in the violent disassembly of structures, vehicles, or other items in the vicinity. While explosions can occur naturally, most are linked to human activity, such as fires, equipment failures, and intentional actions like demolition or terrorism. Regardless of the cause, the effects are typically destructive and far-reaching.

How Explosions Occur

Explosions happen when the pressure in a contained space rises faster than the system can handle or safely dissipate. If the pressure exceeds the container's capacity, the structure ruptures, leading to what is known as a "rapid unplanned disassembly."

Some containment systems, such as propane tanks and railcars, are equipped with safety mechanisms like pressure relief valves. These valves help release pressure gradually, reducing the risk of an explosion even under extreme conditions, such as exposure to fire.

Causes of Explosions

- Fire-Induced Explosions: Fires generate radiant heat, causing substances inside a container to expand and increase pressure. If the pressure rises too quickly and relief mechanisms fail, the container may rupture violently.
- Containment System Failures: When systems such as tanks, pipelines, or hazardous material vessels fail, explosive reactions can occur. For instance, a ruptured pipeline may mix combustible fumes with oxygen, creating a highly volatile combination. A spark can then trigger an explosion. Similarly, hazardous materials can mix and react violently if containment barriers break, rapidly increasing pressure.

Intentional Explosions

- Demolition: Controlled explosions involve specialised materials like plastic explosives, designed to detonate under specific conditions (e.g., electrical currents).
- Improvised Explosive Devices (IEDs): these include pipe bombs and car bombs, often constructed with re-purposed munitions or volatile homemade mixtures, such as ammonium nitrate combined with fuel oil.

Safety Measures

Proper design and maintenance of containment systems can minimise the risks of explosions. For example, relief valves in tanks and pipelines allow controlled pressure release, preventing catastrophic failures. Awareness and regulation of volatile substances further reduce the chances of accidental or intentional explosions.

By understanding the causes and mechanics of explosions, we can implement safety measures and respond effectively to mitigate their devastating effects.

Introduction

Maintaining an efficient solid waste management system is essential for the protection of public health and the environment. This becomes more crucial when a large-scale disaster occurs. For instance, when a major explosion occurs, the health and environmental risk increases, and the citizens become more vulnerable. Poor waste management would add to the already numerous sources of risk, including but not limited to: hazardous pollutant leakage due to improper storage of waste, air pollution due to waste burning or emissions from open dumps, public health risks upon direct or indirect exposure to mishandled wastes and attraction of insects, pests and rodents due to inappropriate piling or dumping of waste.

Upon an explosion, the resilience of the solid waste management (SWM) system is challenged. The explosion creates a “shock” to the system because of:

- The large quantities of waste generated;
- The very short generation period;
- The generation of non-common types of waste (rubble, demolished cars, shattered glass, etc.).

With this in mind, a “contingency plan” for this type of disaster is highly recommended, as a proactive approach. Yet, irrespective of the availability or not of a contingency plan, “immediate response” actions are always key for efficient planning and implementation of the “recovery” phase.

Phase 1:
Immediate Response and Short-term Actions

Immediately after an explosion or a blast, there's an "emergency" phase where the main goal of waste management is to facilitate rescue actions and keep the people safe and alleviate their suffering.

Waste Mapping

The locations and spread of the waste should be identified using a combination of remote investigation (e.g. satellite imagery, GIS maps, media news, etc.) and on-ground surveys.

To the best extent possible, the waste should be characterized: source, type, composition, toxicity, etc. This may be accomplished in two phases:

- Analysis of the site conditions, to anticipate the type and contents of waste;
- Field sampling and analytical testing, to confirm and further quantify key constituents.

The compiled data is best presented on GIS layered maps and disseminated to all stakeholders involved in on-site activities. The map allows not only easier movements and logistic actions, but also prevents the spread of contaminants and allows on-ground teams to take proper protection measures.

Types of priority waste to be considered:

- Glass waste;
- Rubble (and other demolition waste);
- Damaged vehicles and vessels (if the explosion is close to the shore, even inland if there are river and canal vessels);
- Industrial and chemical residues;
- Healthcare waste;
- Electrical and Electronic waste;
- Specific organic (fermentable) wastes;
- MSW and putrescible waste.

The waste types should be grouped under waste streams, depending on their method of treatment. Treatment and disposal destinations should be identified.

Hazard Prioritization

For each waste category, the potential of posing human health risks should be assessed. Four conditions need to be considered:

1. Does the waste contain toxic components?
2. What is the level of hazardousness (or not) in the waste stream?
3. Are there "receptors" (e.g. people, water sources, food sources, animals) that might be affected by the toxic materials?
4. Are there pathways for the toxic components to reach those receptors?

The waste categories/sites should be prioritized, based on the following criteria:

- Location of the waste and the need to be moved to clear the way for rescue activities;
- Ease of waste movement and availability of needed equipment;
- The requirement to separate specific types of waste (e.g. medical, rubble, glass, chemical, etc.) from regular waste.

Availability of a disposal site and its compliance to environmental standards is important. When no compliant site is available, an engineered dumpsite should be designed and constructed according to legal standards (which can often take years to plan and deliver).

Operational conditions of the collection vehicles and treatment infrastructure should be taken into consideration.

Waste samples should be collected and sent to specialized laboratories for detection of asbestos and other hazardous material. International safety protocols and hazardous waste sampling procedures should be adopted.

If hospitals or clinics were affected by the explosion, separation of infectious and health care wastes must be implemented. The waste must be stored separately and transported to the appropriate mode of treatment or disposal if possible.

Establishing a ranking system of hazardous waste and the action that should be implemented to manage them:

- Chemicals and hazardous waste: planned collection, safe temporary storage, and suitable disposal locations.
- Demolition waste: collection and transfer to a safe storage location, analysis for hazardous components, processing and recycling or disposal.
- Vehicle waste: sorting into
  (a) Vehicles that can be sent to facilities treating end-of-life vehicles (where present), where some of the reusable parts may be recovered for selling;
  (b) Vehicles that are totally demolished and should be transferred directly to metal scrap yards or bulky waste landfills (where present).


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Expanding Recycling and Disposal Capacity

The next step is to identify recycling destinations and disposal sites for the different types of waste collected from the emergency phase. However, if the already existing recycling facilities or landfills are not sufficient the following aspects should be taken into consideration:

- Recycling of the largest amount of recoverable material should be a priority target; disposal means shall be adopted for the components that are contaminated or cannot be locally recycled;
- Temporary storage spaces, near a landfill or vacant lands, should be identified and prepared to receive the huge volumes of waste that exceed the capacity of the local recycling sector;
- Whenever possible, existing recycling or disposal facilities should be upgraded to handle the increased load of waste;
- National and local environmental agencies should aid local authorities in selecting environmentally safe sites (away from water bodies, wells or rivers, suitable soil, etc.). Also, transportation cost and impacts should be taken into consideration by selecting a location close enough to the affected area, yet still has no health impacts on the residents;
- Various aspects of safety and well-being of the general public and the environment should be considered: propagation of hazardous materials, air pollution and odours, leaching and leakages, cross-contamination, fire hazards, noise and visual pollution, etc;
- Quick containment of the identified (or suspected) hazardous materials should be considered a priority need – based on the precautionary principle.

Assessment and Decision Making

It is crucial to have ONLY ONE designated committee in charge of the decision making to avoid miscommunication, duplication of efforts and mutually counteractive decisions/actions – which are highly probable in the case of emergencies.

An on-site control/operation room should be developed, with clear executive tasks.

The current condition of the waste should be assessed, based on waste mapping and prioritization exercises (addressed in previous sections), and discussed with the decision makers. Priority wastes should be agreed upon and logistics for the most urgent actions should be defined.

The capacity of local authorities to handle the situation should be assessed and the needed international support should be identified.

National and legal authorities should be involved to apply laws and regulations relevant to construction and demolition waste and any hazardous wastes.

For better future decision-making, during this phase, an assessment report of the type of waste and its status should be carried out as this can aid local authorities to handle the waste and ask for the needed international assistance.

Phase 2: Recovery

This phase builds on the findings of Phase 1, aiming at developing a plan for recovery with longer term actions.

In-depth Assessment

At this stage, the assessment of the waste should be extended into a detailed description of the prevailing conditions: location, types, sources, composition, toxicity, regulations, stocked quantity, post-explosion generation, etc.

A comprehensive inventory of disposal sites should be developed, including potential locations for medium-term storage/disposal and sorting activities. Preparations and upgrading options of the sites should be identified and assessed logistically and financially. Also, the need to close current disposal sites that pose threats on the nearby community should be addressed.

An in-depth understanding of the local waste-related infrastructure (storage, collection, treatment, recycling, disposal) should be developed. This is followed by the definition of gaps in local capacity to manage the disaster waste. A detailed financial analysis and identification of financial and technical support sources should be completed.

A detailed preliminary study of the waste and respective impacts on the environment, health and occupations safety of the workers as well as people living there should be prepared. A rapid environmental impact assessment should be conducted to have a further understanding of the appropriate mitigation measures and to be able to develop an effective monitoring plan.

Implementation

The detailed step-by-step action plan should be implemented to clear out the damaged area and facilitate recovery and rehabilitation.

A site clearance strategy should be put in place. This requires a detailed assessment of the amount, type and locations of waste and will be based on surveys and assessments of the waste made earlier in the process. Safety protocols should be identified by now (based on the results of the waste analysis) as per locally approved standards and guidelines.

In-place segregation initiatives should be put in place to recover valuable items (metals, steel, concrete, etc.) that can be reused or repurposed and to avoid excessive disposal.

Establishment of temporary storage sites, with minimum environmental and health risks, are to be considered a priority. These secondary sites are needed to move the waste that was stored during immediate actions into “safer” locations. The pre-assessment performed during the response phase for the selection of suitable disposal sites should be implemented. Safe packaging and storage of chemical and hazardous wastes (as a containment method) may be needed.

A well-structured programme of collection and transportation of waste should be put in place. Also, at this stage, the need to export some types of wastes should be considered and if required appropriate checks made of any options.


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Planning

It is important to develop ONLY ONE entity (committee, agency, etc.) to coordinate the planning exercise to reach an effective plan with limited redundancy or discrepancies.

A participatory approach should be adopted to involve local communities including women in solutions planning.

The plan should prioritize the separation, confinement, and treatment of contaminated (healthcare and hazardous) waste. In some cases, on-site treatment (e.g. rendering safe or incineration) is preferred to avoid the risks associated with transportation of hazardous materials.

A handover strategy should be provided within the plan, identifying any needed capacity building and transfer of knowledge and knowhow to local waste management authorities.

A demolition and hazardous waste management plan, specific for the area surrounding the explosion site, should be developed.

A communication plan should be developed, focusing on sorting of wastes based on local management and recycling options.

Documentation

Documentation is a means to improve the performance of the management system in place and to pass the learned lessons to other nations and future generations. Thus, it is recommended to:

- Document all findings, actions and outcomes through reports, databases, synthesis notes, etc;
- Share the documentation with involved stakeholders in the form of lessons learned and future recommendations;
- Support agencies and environmental companies on waste and debris quantifications.

Phase 3: Contingency Planning

The purpose of contingency planning is to make sure that the community is prepared to handle the waste in case of a major explosion, with the least damage possible. This has the purpose of limiting the negative impacts of waste mismanagement and alleviate the financial, environmental, and public health burdens associated with such disasters in the future.

Data, Infrastructure, and Outreach

The potential types of waste should be identified, and the expected volume should be approximated. The priority waste types to be addressed are:

- Demolition wastes from damaged buildings and other structures;
- Hazardous materials, including asbestos and chemicals;
- Healthcare waste;
- Damaged vehicles;
- Other site-specific items, e.g. containers and damaged vessels (if the explosion is close to water bodies).

Suitable temporary storage or disposal sites should be pre-selected. The list of sites should be reviewed and updated periodically. The frequency of updates depends on the dynamics of the city/country.
A communication plan should be put in place:

1. Horizontally, i.e. to optimize governmental coordination, and;
2. Vertically, i.e. to engage the community, NGOs and environmental companies.

The available options for recycling, treatment and disposal should be mapped and their capacity should be specified. The options to manage and dispose of hazardous wastes are of major importance.

Stakeholders and Authorities' Engagement

As part of the contingency planning process, the following must be kept in mind to secure the preparedness and involvement of stakeholders:

- Develop a system to involve different groups upon the occurrence of an explosion. The targeted groups may include solid waste management service companies, environmental organizations, hospitals and clinics, affected property owners, waste pickers among others;
- Local authorities should be engaged in the development of all plans and systems and kept informed of any update. They will be the decision makers at the time of the disaster; engaging and informing them may be considered as a capacity building exercise to improve their preparedness to handle an explosion case;
- Donors and international agencies should also be engaged and informed of any plans. They have a major role in allocation of funds and donations and implementation of disaster waste management practices.

Health and Safety

A health and safety protocol, for the case of explosions, should be put in place. It should cover:

- Major safety threats that need to be recognized by:
  - The citizens in the vicinity of the explosion;
  - Anyone who will enter the explosion site;
- Requirements for Personal Protective Equipment (PPEs), such as closed footwear, safety helmets, gloves, and masks, for the people visiting or working at the explosion site;
- Hygienic measures for the collection of waste, e.g. proper cleaning and washing facilities for the workers during handling and processing works;
- Adoption of dust suppression practices and use of low-noise machinery;
- Requirements for an impermeable bottom layer (e.g. geomembrane) for any disposal site to prevent contamination by leachate or infiltration into the soil and water;
- Requirements for an adequate cover of the waste on disposal sites to avoid air contamination and/or insects and rodents' attraction.

Chapter 4

Major Displacements

Including All Stakeholders

Displacement associated with disasters is a global issue.

When a major displacement takes place, the solid waste infrastructure of the hosting community may be severely impacted. Not only the host country government and authorities will feel the burden, but also all solid waste stakeholders, including the waste generators as much as all entities involved in the waste management value chain. Women and men experience and respond to disasters differently due to varying roles, responsibilities, and vulnerabilities.

The displaced population will also be under major threats (from health, social and economic perspectives) if the adequate implementation of waste management action is delayed. However, if proper waste management is planned and implemented on time, the community will be at reduced risk of harm and may even make revenue, and employment opportunities might be created.

Accordingly, waste management solutions should be put in place as fast as safe water supply and sanitation. This chapter aims at devising an approach to allow fast response of the host community through “immediate response & short-term actions” and providing a recommendation framework for subsequent “intermediate to long-term planning” and the final “phase-out and closure” stage. In addition, it introduces the basics of “contingency planning” to improve the resilience of potential hosting countries. This is considered the most efficient means to reduce the extent and intensity of the impact on the waste management system and stakeholders and the surrounding environment.

Immediate Response and Short-term Actions

Immediate Actions

Upon hosting a large, displaced community, immediate actions are key as they pave the road to long-term solutions. In case the first emergency actions are not well-structured, the transition to the post-emergency stage will become challenging. To ensure timely, yet steady, response, the following should be considered:

Management and planning

Authorities responsible for environmental, municipal, health and other related aspects should develop a team structure that facilitates:

- Understanding of the environmental and health challenges;
- Informed decision making;
- Implementation of initiatives;
- International agencies and NGOs should work collaboratively with local authorities, service providers and waste management companies, since local authorities may be overwhelmed by the sudden spike in service demand and infrastructure load;
- Environmental specialists should be included in the emergency team to conduct a rapid environmental assessment and to ensure that environmental impacts are being mitigated (or at least controlled). This preliminary assessment of the impacts should identify the threats and provide a concrete plan of remedial activities during current and following phases;
- Ensure that there are translators available where necessary and the cultural norms of the displaced communities are recognised and respected.

Waste Assessment

To the best extent possible, the waste should be characterized in terms of its source, type, composition, hazard properties, etc. This would require field data surveys because the generated waste will most likely have different characteristics (e.g. generation rate, composition, hazard properties, etc.) compared to that of the hosting community – and possibly different from other refugee camps in other areas of the world.

The following most common domestic waste constituents in refugee camps should be assessed:

- Organic waste;
- Packaging waste, mostly from food and goods donations;
- Recyclables (glass, paper, metals, etc.);
- Other waste such as clothing, rags, ash, floor sweepings, rubber, etc;
- Special wastes, in small quantities, such as batteries, electrical and electronic waste, vehicle oil, paints, solvents, etc;
- Healthcare waste – to note that international agencies and donors should make sure that medical waste is segregated at the source.

The types and volumes of solid wastes vary depending on the refugee setting, country of origin, culture, and economic development; therefore, one of the immediate actions would be direct sampling of the wastes. Waste sampling is recommended in multiple collection points (commonly 5 to 10) over a representative period (e.g. one month). This allows the establishment of a baseline for waste generation.

Based on the above, basic storage (i.e. waste bins) and collection systems should be designed and implemented. A frequency of less than twice a week is not recommended as it might result in piling of waste and attraction of insects and disease vectors.

With time, the setup of the camp and the conditions of the refugees would change. Therefore, it is recommended to repeat the waste surveys systematically (e.g. once or twice a year). If considerable changes are observed, the waste management programme would require updating.

As a first emergency response, authorities might construct temporary waste pits. Those should be placed in locations far from the camps, where they do not pose a threat to public health. Also, the waste pits should be isolated from ground and surface water sources and the surrounding environment (for example, through lining systems) to prevent leachate contaminating local water bodies and to avoid leakages or contaminations into the environment.

Unlike illegal open dumps, waste pit sites should be designated and closely monitored by local authorities. They should respect, to the best extent possible, local legislation and disposal standards. They should be adequately sized and covered daily to prevent odours, air pollution and littering.

Shortly after that, it is crucial to close the loop of the solid waste programme with an engineered disposal destination. Otherwise, a large part of the waste may end in open dumps or stockpiles. In this respect, illegal dumping should be prevented from the onset of the camp to avoid expensive clean up actions at a later stage. Waste management activities should be carried out in compliance with national solid waste and environmental legislations.

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Donation Packing

At the onset of a refugee camp, food supplies, medicines and clothes are donated in individual packages to facilitate transportation and distribution. As a result, a large volume of packaging waste is generated, especially during the early stage of the settling process. Those can cause fire (for example, if people set fire to them to reduce waste volumes) and other hazards and may attract rodents and insects. To minimize these impacts, the following should be considered:

- Based on the anticipated type and content of the donations, a plan should be devised to reduce the need for packaging;
- The donors should be asked to close the loop by providing, not only packaged donations, but also means to re-collect the packaging and properly dispose of them (or ideally reuse them);
- Potential alternatives to “physical” distribution of donations should be considered. Examples include electronic vouchers and cards.

Health and Safety

As in all emergency cases, the safety and health of the people (both the displaced and the hosting communities) is the first priority. Accordingly, the following should be secured:

- The refugees should be treated according to human right standards and principles;
- Upon arrival to the host country, the refugees should pass through a health screening process to: (1) confirm the absence of infectious diseases, and (2) check the health status and needs of the refugees. Those have direct implications on healthcare (and infectious) waste generation;
- Individuals involved in picking and collecting wastes should wear gender appropriate Personal Protective Equipments (PPEs) considering the different sizes and fittings needed by women workers to ensure their safety and comfort;
- Adequate water, sanitation, electricity, and heating infrastructures should be put in place prior to constructing the camp;
- A proper fire-fighting system should be installed, with fire extinguishers all over the camp site. Provisions should be made for potential fires at disposal sites. The camp residents should be trained on how to deal with a fire accident.

Intermediate-to-Long-Term Planning

Also, when the “immediate” phase ends, the capacity of the existing (local) solid waste management infrastructure to accommodate the additional (displaced) population should be investigated. Upgrades should be considered where necessary. Awareness campaigns are needed to inform and train the refugee community, offering flexible training schedules or childcare services to accommodate women who may have household responsibilities and facilitate their adaptation to the prevailing waste management methods. Following are approaches to limit the impact on the local waste system and allow faster integration.

Storage and Collection

The size and type of waste bins should be compatible with local practices and collection techniques.
Waste generation quantities (assessed during the emergency phase) should be used to size the bins and decide on the total number needed. Suitable locations should be defined, taking into consideration the collection methods and refugees wellbeing.

A collection plan, including frequency and routing, must be designed. The collection frequency should be accurately selected (and re-assessed periodically) to avoid over-capacity storage, attraction of animals and insects, and generation of odours and leachates. Since there might be organic waste in these containers, it is essential to collect the waste twice a week as a bare minimum.

Depending on the size of the containers, agencies must ensure that they are emptied and cleaned on a regular basis. The collection should be scheduled during the low traffic time.

Sorting

Source separation reduces the effort needed at the central sorting facility. Therefore, it is important to train the camp residents on proper waste sorting methods. Common recommended categories for source separation include paper, plastics, glass, and metals. Also, “wet” or “organic” waste, typically fruits and vegetable peelings and other non-edible components of food, may be collected separately.

A simplified two-bin system (recyclables and residual waste) is recommended, with a pair of bins for every eight to nine households/tents.

Afterwards, a “clean waste” sorting point may be designated to further sort the recyclables. Simple equipment might be used (e.g. a sorting table and large sorting containers). People from the camp community might be hired to run the manual sorting. This would improve the quality of the recyclables and provide job opportunities.


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Adequate PPE (gloves, protective boots, and face masks) should be provided to staff working on collection and sorting of waste. Adequate training on infection control standard precautions is needed, along with awareness sessions on the importance of wearing PPE and following safety instructions.

Handcarts and wheelbarrows should be available at the camp to transport the waste (e.g. from the source or storage bins to manual sorting station) with minimal direct contact. Scales should be also provided to allow weighing of the wastes (to calculate daily generation) for documentation purposes.

In some refugee camps, some people may be earning a living from waste picking, and it can be difficult to prevent that. It is recommended to incorporate them in the waste management system and train and help them toward safer activities. Examples of support actions include:

- Designate a location for waste pickers to operate in order to reduce littering and the associated public health implications;
- Formalize waste picking activities;
- Create an attractive management system that provides benefits to waste pickers;
- Prohibit picking of infectious healthcare waste and sharps as well as other hazardous types of waste;
- Train them on safety measures and provide PPE and educate them on the importance of wearing them.

Reduction, Reuse, and Recycling

It is economically and environmentally beneficial to introduce the concept of reusing goods and reducing wasting. Usually, repairing or reselling items (such as bottles, jars, boxes, etc.) is easy to introduce.

Some of the items recovered (on-site) during sorting (or via picking) can be checked for potential reuse. Also, a drop-off area may be allocated for reusable items.
Recovered materials can be transported to nearby recycling facilities. Common recoverable recyclables include:

- **Glass:** can be easily recovered and infinitely recycled, if not contaminated, into new bottles;
- **Metal:** metal (tins, cans, etc.) selling is commonly profitable;
- **Paper:** should be separated by grades to produce good quality sellable output;
- **Plastic:** various types of plastics (e.g. PVC, polypropylene, and polyethylene) may have local recycling markets;
- **Organic wastes:** organic waste is the most problematic component of MSW because it is putrescible. The best waste reduction approaches would be:
  - composting, for the production of fertilizers that can be sold or used for land application; or
  - anaerobic digestion in small setups for the generation of cooking gas.

In order to avoid social barriers, these activities are best planned and implemented following a participatory approach. The refugees including women, men and people of diverse identities should be involved at every step of the planning, decision making and implementation.

Disposal

It is common to witness uncontrolled and illegal open dumps and open burning of waste in refugee / displacement camps. It happens as a result of poor communication and lack of collaboration with the displaced community. To avoid the associated public health and environmental risk, the following should be considered:

- The availability of a disposal site that complies with environmental practices should be checked;
- Alternatively, a “legal” dumpsite (with reduced impacts compared to open dumping) should be designated. Proper siting is important – mainly distance to water bodies and sources. An impermeable layer (e.g. geomembrane) is a must in order to protect the surrounding water and soil. The waste should be covered daily (with soil, compost or reusable cover) to prevent littering, odours and insects attraction and reduce rainwater percolation to the waste;
- The dumpsite should be properly fenced and secured to prevent access of people (mainly children) and waste pickers. Enough space should be provided on the site to allow adequate movement of collection equipment;
- Regular sampling and analysis of the surrounding soil and water sources is necessary as means to monitor environmental impacts.

Waste Incineration

Incineration may also be applied to refugee waste, considering the following:

- It is important to select a suitable location for a waste incinerator (not open burning). Environmental consultants and engineers should be assigned the job;
- The types of waste going to the incinerator should be assessed to avoid an inflow with a calorific value that is too low to ensure continuous burning;
- An adequate air pollution control system should be included;
- Adequate means to collect and dispose of the ashes should be applied.

Healthcare Waste

Donors often provide healthcare equipment and medication. In addition to increasing the volume of waste arising from the delivery of healthcare and disease surveillance, contaminated equipment and unused medication (if not properly handled) constitute a health hazard to the community and the waste management staff. The following should be considered:

- The involved organizations should ensure that medical waste is collected, handled, treated, and disposed of without posing risks to healthcare staff, waste management staff or the general public;
- The involved donors, NGOs and authorities should ensure that medical waste is segregated at the source. Designated collection containers must be provided at the refugee camps and monitoring should be conducted to prohibit mixing medical waste with other types of wastes;
- Collection and treatment of healthcare waste should be done through recognized service providers or in nationally approved treatment centres;
- The handling of healthcare waste should be performed according to national standard methods (WHO protocols). Commonly, healthcare waste is sorted into infectious, non-infectious, sharps and hazardous medicinal or chemical waste.

Phase-out and Closure of Waste Disposal Sites

When a refugee camp is about to be closed, the phasing-out stage of the disposal sites should be planned with the purpose of minimizing the environmental impacts associated with the management of the resulting waste. The refugee setting is often located in a vulnerable environment (e.g. rural areas, agricultural regions, etc.), thus the urgency of minimizing the risks. Following closure, environmental restoration and rehabilitation should be initiated. Below is a list of actions to be considered:

- A plan for waste sites closure should be established during the phase-out period to ensure full preparedness of the community, authorities and other stakeholders;
- Upon closure, the emphasis is on stopping/removing existing threats, then repairing any damage to the environment, and restore (to the best extent possible) the pre-displacement conditions;
- The authorities are encouraged to seek the support of community-based organizations and local NGOs to manage post-closure impacts;
- The closure planning requires adequate characterization of the expected waste: infrastructure parts, deteriorated tents, installations, unwanted furniture, etc. The best available solutions should be defined: reuse, recycling, disposal, etc;
- A camp layout map is needed to identify the location of the different types of waste: pipes, electric wires, shelter parts, toilets, water tanks, etc;
- Disposal sites / areas and waste burial pits should be identified. Environmental experts are needed to decide on the best approach to close them rehabilitate the site;
- Environmental impacts should be assessed, and a mitigation and management plan should be developed;
- Camp clean-up activities should include:
  - Rehabilitation and maintenance (or total removal) of the infrastructure to prevent leakages into the soil and water;
  - Collection and proper removal of any chemicals or medical waste, followed by soil remediation where needed;
  - Proper and systematic demolition of shelters and proper separation of waste;
  - Reconditioning of the roads;
  - Sending demolished components to construction & demolition waste facilities;
- A long-term rehabilitation plan should be developed and implemented (e.g. reforestation, alternative use of permanent structures, etc.).

Contingency Planning

Contingency planning is a necessity for any disaster or emergency cases. It consists of setting a comprehensive plan to assess the situation, define immediate objectives and set longer term goals and the needed activities to achieve them.

Planning

The prerequisite of planning is defining key stakeholders: local and international organizations (including United Nations agencies), NGOs, women groups, governmental and local authorities, etc. A clear and simple communication and coordination system is mandatory. It should aim at connecting the individuals to organizations, but also connecting individuals (host and displaced communities) to each other and clarify the interrelations between different organizations and institutions.

An emergency team should be designed for the purpose of acting quickly and efficiently in the case of a major displacement. The team should be multi-functional and be able to provide full response when the emergency takes place. The roles and responsibilities of the individuals should be clear, with a well-structured communication and information flow using translators where necessary.

The different stages of waste management in refugee camps should be well understood – acknowledging that in some cases these stages would overlap. A prior knowledge of expected types of waste and potential management solutions is needed and should be documented.

A community-based approach should be adopted to devise durable and publicly accepted short-term and long-term solutions.

The time span of the “emergency” actions should be kept as short as possible to allow for fast planning and earl kick-off of longer-term actions.

Emergency Preparedness

Along with planning, the preparedness for emergency response should be checked, in terms of:

- Availability of resources and supplies;
- Capacity to provide fast training schemes;
- Extent and duration of aid delivery (and the associated waste production and management);
- Readiness of international organization, NGOs and authorities to respond fast.

Environmental and Health Considerations

Environmental impacts are better identified in advance and taken into consideration in all contingency planning aspects. Similarly, health hazards should be identified and considered in all planning activities. Environmental and health protection awareness should be considered as one of the keys of success of any plan implementation encouraging gender equity in disaster waste management. National (and sometimes international) regulations and standards for environmental and health protection should be respected.

Chapter 5

Guidelines for Oil Spill Response

Oil spills can cause significant environmental damage and pose a major threat to aquatic life, as well as human health and livelihoods. When dealing with an oil spill, it is essential to consider its impact on waste management and disposal. Disaster waste management involves the proper handling, transportation, and disposal of waste generated during a disaster. In the case of an oil spill, the waste generated can include contaminated soil, oily debris, and waste from clean-up operations. Below are some key considerations for oil spill response in disaster waste management:

- Prevention is better than cure: It is essential to take all possible measures to prevent oil spills from occurring in the first place. This can include regular maintenance of oil tankers and pipelines, using spill prevention equipment, and having emergency response plans in place;
- Prioritize safety: Safety is a top priority during an oil spill response. All personnel involved in the clean-up operation should be trained in safety procedures and have access to personal protective equipment;
- Containment and recovery: The first step in an oil spill response is to contain the spill and prevent it from spreading. This can involve using booms and other containment measures. Once contained, the oil can be recovered using skimmers, vacuums, and other equipment;
- Waste handling and disposal: Waste generated during the clean-up operation should be properly handled and disposed of to prevent further contamination. This may involve separating waste into different categories, such as oily debris, contaminated soil, and hazardous waste. The waste should then be transported to a licensed facility for proper disposal;
- Environmental monitoring: It is essential to monitor the environmental impact of the oil spill and the clean-up operation. This can involve sampling water and soil to determine the extent of contamination and tracking the movement of the spill.

Overall, effective oil spill response requires a comprehensive disaster waste management plan that prioritizes safety and environmental protection.

The guidelines issued by the International Petroleum Industry Environmental Conservation Association (IPIECA) on Contingency Planning for Oil Spills on Water are the reference to be used in this field. Figure 6 shows the main steps of oil spill planning and response. It is a risk-based approach with the following key elements:

- Response organization;
- Mobilization and notification;
- Equipment and resources;
- Training and exercises.

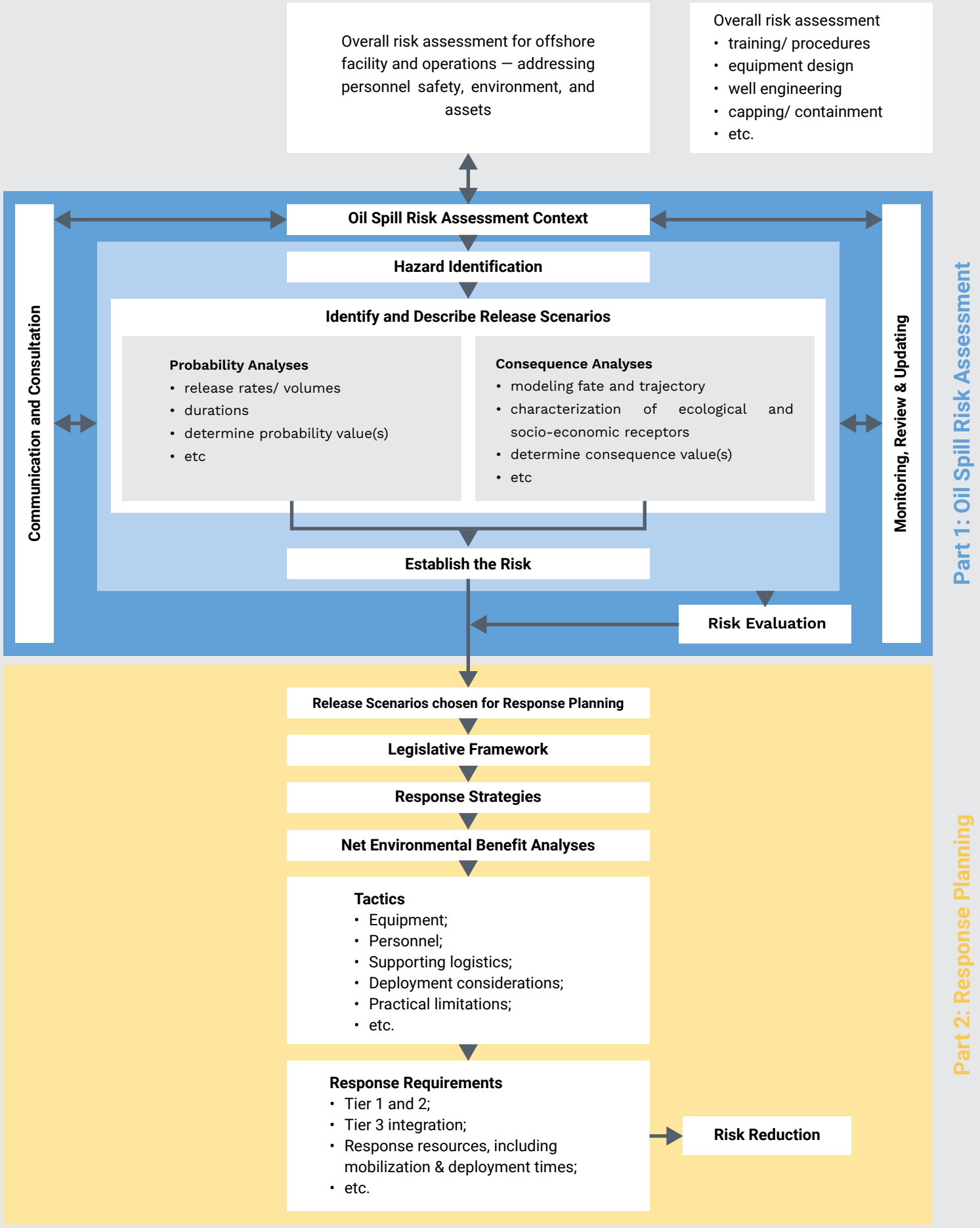

Figure 6: Main Steps in Oil Spill Contingency Planning and Response (IPIECA)

The Key elements of oil spill response planning include:

- Prevention: Outline of legal requirements of facilities to prevent oil pollution;
- Preparedness: Tiered response planning framework, response organization;
- Response: Notification & Activation, mobilization, response strategy;
- Recovery: Environmental, organizational and cost recovery.

There is a recognized tiered response to planning:

- Tier 1: response capability held locally;
- Tier 2: response capability held regionally;
- Tier 3: response capability held nationally/internationally.

Tiers 1 to 3 vary generally in size from smallest to largest.

For Tier 1 and 2 planning:

- All facilities are required to have an Oil Spill Contingency Plan to cover the oil spill risk from their operations;
- Tier 1 spills are managed on site with resources and expertise available. Reporting to affected ministry (for example Ministry of Oil);
- Tier 2 spills typically require additional resources. This may include from:
  - Contractor, other local industry, the regional Governorate;
  - Local authorities.

TIER 1 Plans

- Risk analysis
- Tier definition
- Incident reporting
- Response time frames
- Spill response organization
- Plan implementation and response strategies
- Waste management
- Decontamination
- Demobilization and Termination of Response
- Contingency plan testing and updating

Figure 7: Tier 1 Plans

Governorates and local authorities need to have the resources to address oil spills that could be of Tier 2. For instance, in coastal areas, these could include:

- Provision of manpower for beach clean up;
- Provision of facilities for waste management;
- Logistical support including – responder welfare, transport, PPE;
- Response management facilities;
- Simple oil spill training.

Tier 3 response is more complex and requires significant capacity and organization. The figure below shows the Tier 3 response organization proposed for Lebanon's National Oil Spill Contingency Plan. A major requirement for an effective implementation of such plans is capacity building and establishment of a clear mechanism with well-defined roles and responsibilities.

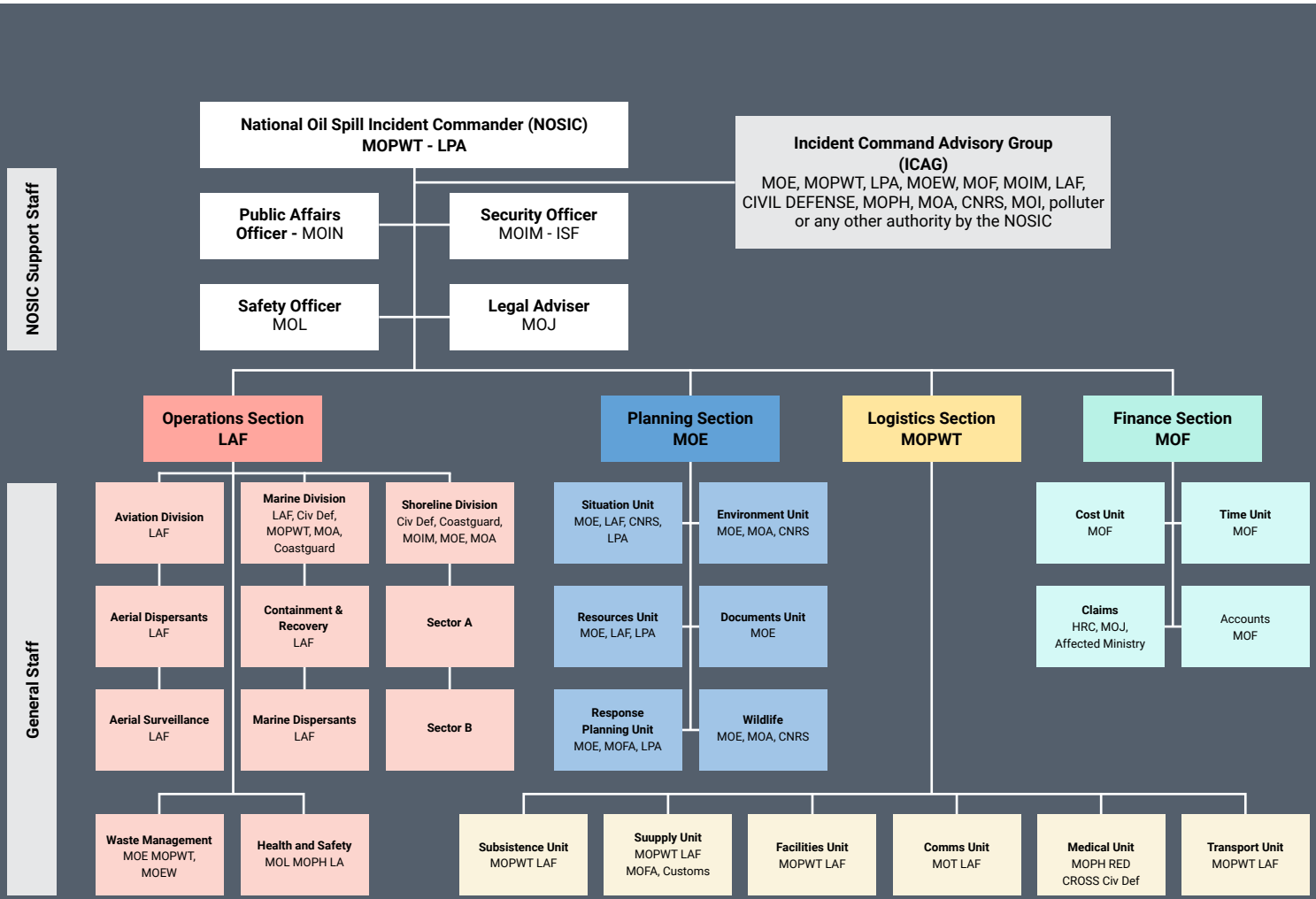

Figure 8: Tier 3 response organization proposed for Lebanon's National Oil Spill Contingency Plan

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Annex 1:
All-hazards Waste Management Decision Diagram

Background: Waste management (also referred to as debris management) is a critical part of the response to and recovery from a homeland security incident, such as an act of terrorism involving chemical, biological, or radiological agents, a largescale natural disaster, and an animal disease outbreak. Waste is generated immediately by the incident itself and continues to be generated by the characterization, decontamination, and clean-up processes. More efficient and effective management of the amounts and types of waste generated can result in a quicker and less costly recovery from an incident.

Purpose: This waste management decision diagram is intended to assist emergency planners and managers in the public and private sectors with the waste management decision making process after a homeland security incident occurs. It includes considerations that aid in making waste management related decisions and identifies areas where pre-incident waste management planning can be useful.

Notes about this Decision Diagram:

- This decision diagram is divided into three stages – initial activities, onsite activities, and offsite activities, at which waste management decisions are typically made during an incident. The diagram is intended to be a guide only. While many of these considerations and decisions are part of every response, differences in the waste management decision making process exist but are not accounted for in this all hazards decision diagram. Also, many of the steps may occur concurrently during an incident, as well as in a different order. The needs and specifics of the response should guide the decision-making process.
- Planning for waste management, including waste staging, sampling, characterization, packaging, transportation, reuse, recycling, treatment, and disposal, before an incident occurs is very important. Pre-incident planning facilitates the decision-making process during an incident response, assisting with the steps in this flowchart. More information about pre-incident planning can be found in EPA's Pre-incident All hazards Waste Management Plan Guidelines: Four step Waste Management Planning Process document, which can be found at https://www.epa.gov/homelandsecuritywaste.
- This diagram does not discuss the Federal Emergency Management Agency's (FEMA's) Public Assistance Program and Policy Guide. Review FEMA's eligibility requirements at https://www.fema.gov/medialibrary/assets/documents/111781 in the event of a federal emergency or major disaster declaration.
- Different waste management requirements may apply to different types of wastes. For example, solid waste that is non-hazardous under the Resource Conservation and Recovery Act (RCRA) would likely take a different route than RCRA hazardous waste, as well as from waste that falls outside RCRA's scope. Alternatively, all waste may be managed under the more stringent requirements for hazardous waste. In addition, states may have more stringent requirements for waste than the federal regulations.
- Reuse and recycling opportunities are potentially available for many different waste streams, including hazardous waste. Legitimate reuse and recycling options, if applicable, should be considered before other waste management options (e.g., landfills) to help lessen the environmental and economic impacts of the incident. Hazardous waste being legitimately recycled still needs to meet the RCRA hazardous waste management requirements, unless specifically excluded from regulation.

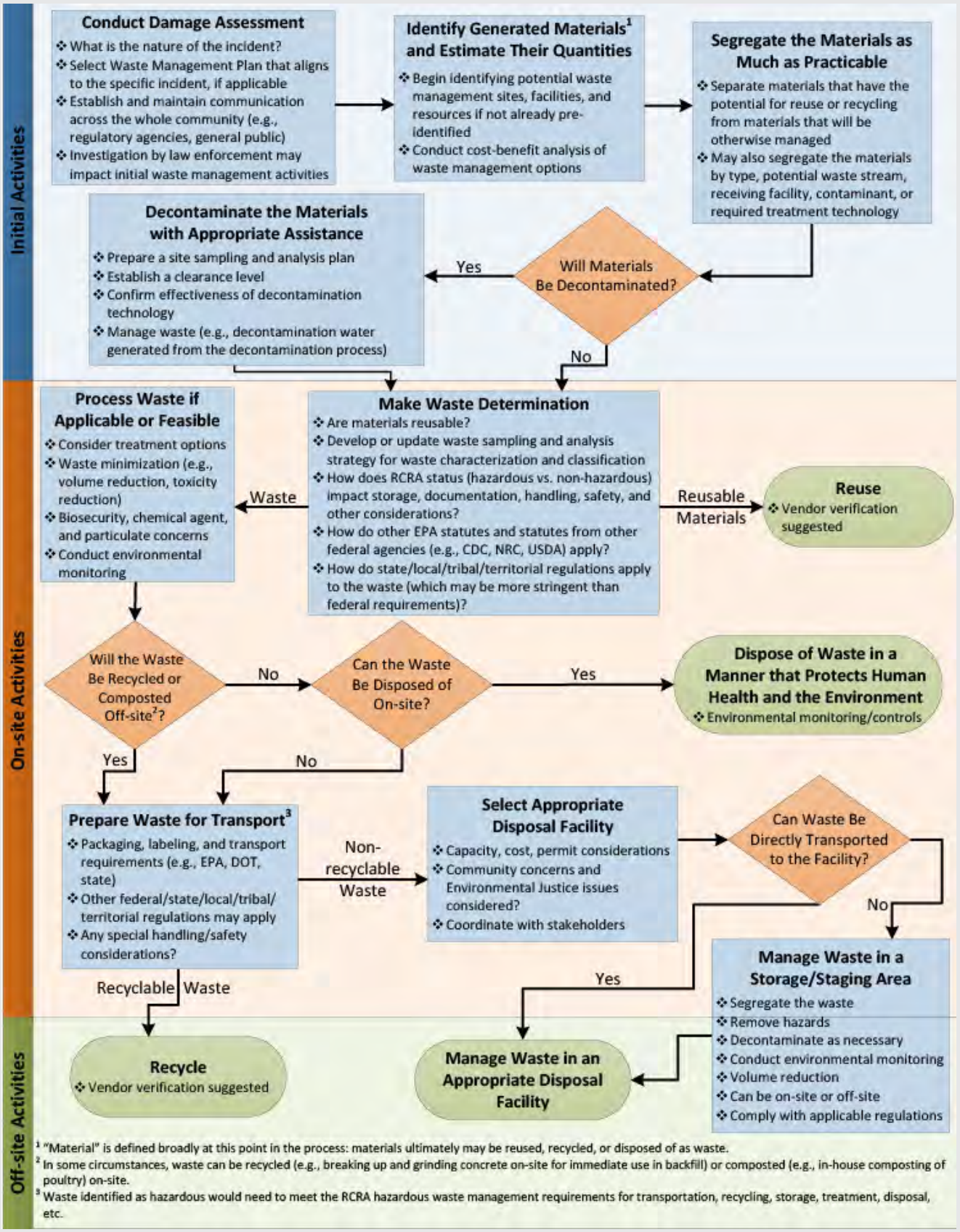

Figure 9: All-hazards Waste Management Decision Diagram for Homeland Security Incidents

Annex 2:
United Nations Office for the Coordination of Humanitarian Affairs Emergency Preparedness Section – Waste Hazard Ranking Tool

This table presents typical disaster waste streams with corresponding possible hazards and respective priorities for immediate and short term actions as well as medium term actions.

Table 3: Waste hazard ranking tool (Joint UNEP/OCHA Environment Unit 2013b)

Waste stream	Is it old waste, e.g. more than one week?	Is the waste close to residential areas?	Is the waste close to streams, rivers or other water sources?
Ordinary domestic waste and waste from IDP camps and shelters			
Food waste			
Packaging materials			
Excreta			
Wastes from relief supplies			
UN/military/NGO waste			
Debris			
Concrete/bricks			
Household furnishings and belongings			
Other wastes such as plastics, cardboard, paper			
Timber			
Cables, etc.			
Soils and sediments			
Bulky items			
Hazardous materials and substances			
Waste with potential hazardous properties			
Hydrocarbons such as oil and fuel			
Paint, varnishes and solvents			
Pesticides and fertilizers			
Household cleaning products			
Medical waste in debris			
Healthcare risk waste			
Healthcare waste (from clinics and hospitals - not considered as risk waste)			
Other potential infectious waste			
Food waste and packaging material etc.			
Commercial and industrial waste			
Commercial wastes			
Industrial wastes			
In post-conflict areas			
Unexploded ordnance (UXO)			
Landmines and ammunition within the debris			
Military vehicles			
Phosphorus and other weapon contamination			

Low Priority

Medium Priority

High Priority

Annex 3:
Definitions, Scope, and Country Classification

Definitions and Scope

Definitions of waste vary, depending on local conditions and on data collection methods. In this report, waste generally refers to municipal solid waste (MSW) that is produced by the residential, commercial, and public services sectors and most often collected by local authorities for treatment, recovery and/or disposal. Industrial, agricultural, construction and demolition (C&D), hazardous, medical, radioactive, and electric and electronic waste (e-waste) are not included in this definition and will be presented in separated subitems according to the availability of updated and reliable information. However, MSW may contain waste from some of these waste streams depending on local conditions.

Country Classification

This report uses the country classification data from the World Bank for the 2023 fiscal year, as presented in the table below, according to the GNI[2] per capita, calculated using the World Bank Atlas Method (World Bank, 2022). Elaboration of country names and other data can be found at: https://data.worldbank.org/.

Table 4: Country classification based on WB GNI per capita
Source: World Bank, 2022

Country Classification from WB for 2023 Fiscal Year	Gross National Income (GNI) per Capita in 2021
Low-income Economies	< US$1,085
Lower middle-income economies	US$1,086 – US$4,255
Upper middle-income economies	US$4,256 – US$13,205
High-income economies	> US$13,205

[2]Gross National Income (GNI) per capita is the dollar value of a country's final income in a year divided by its population using Atlas methodology. (World Bank, 2022)


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