

Situation overview

The invasion of Ukraine on 24 February 2022 has led to a rapid expansion of conflict-affected areas in the country and an increase in the number of conflict incidents in proximity to hazardous objects, such as industrial sites, critical infrastructure facilities, storage facilities designed to store hazardous substances and fuel, etc. Conflict incidents in the vicinity of these sites and objects increase the risk of damages that threaten the environment and human health.

Methodology

This report provides an overview of the loss, damage, and challenges faced by the various facilities in Ukraine because of the ongoing war. It covers a 6-month period from 24 February to 24 August 2022. Findings are based on a secondary data review of recent, reliable sources (e.g., from the State Emergency Service of Ukraine, oblast administrators, the Ministry of Environmental Protection and Natural Resources, International NGOs, etc.) that were added to an incidents database managed by IMPACT Initiatives. The sources included in the incidents database are available upon request. Geospatial and remote sensing data was analysed to localise recorded incidents and to further triangulate information.

The analysis was carried out using the Flash Environmental Assessment Tool (FEAT) methodology and other tools related to the case. FEAT methodology was developed by the National Institute for Public Health and Environment (RIVM) for United Nations Environment Programme (UNEP) and United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA), based on EU Directives on Hazardous Substances.

FEAT is used to identify existing or potential environmental impacts from hazardous chemicals released from industrial hazardous facilities that pose risks to humans and the environment following sudden-onset disasters. FEAT methodology allows to connect the damaged facility type and hazardous substances which might be potentially released into the environment due to a damage incident (Table 1).

Overview of Key Findings

Based on the review of the incidents at hazardous facilities in proximity to conflicts, military actions which began on 24 February 2022 in Ukraine were the cause of a considerable number of emergency situations placing the civilian population and the environment in danger.

Map and Graph 1 on the second-page shows summarize the number of incidents in hazardous facilities from February to August 2022. All these incidents were related to the release of hazardous substances from different types of industries. The most significant damage to hazardous objects was recorded in Donetska, Luhanska and Kharkivska oblast, which were in the zone of active hostilities in the reviewed period.

The systematic shelling and targeting of critical infrastructure objects, energy, and production facilities increased environmental risks several times. This may result in a cumulative effect spreading far beyond the Ukrainian territory through the atmospheric air and the pollution of water resources.

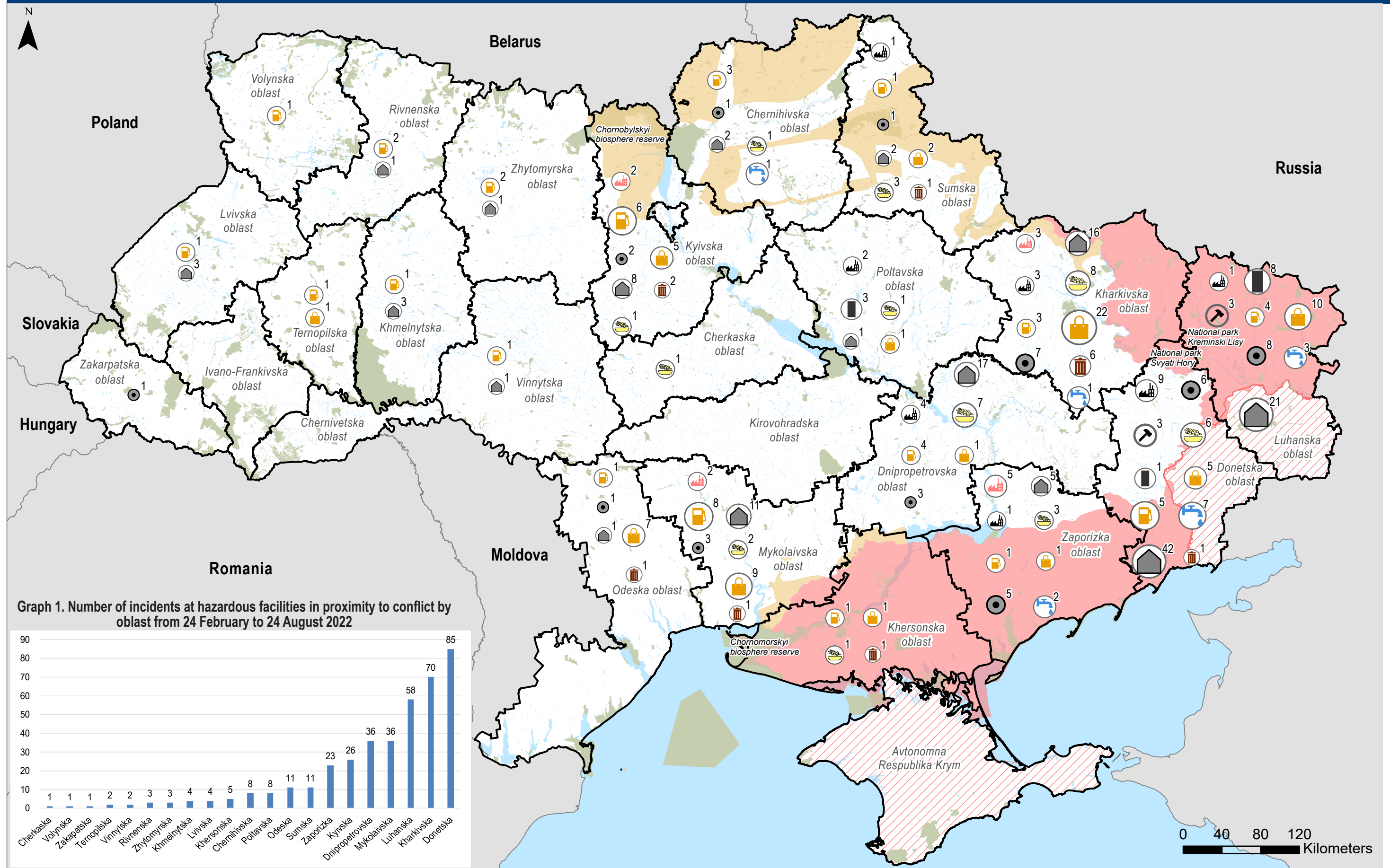
Table 1. Potential impact of industrial accidents on the environment and population according to the FEAT methodology

Facilities	Environmental and Health Impact
Nuclear power plants (NPPs) and radioactive stores	Damage to the NPP is fraught with the release of radioactive substances, causing health problems, soil and water pollution. As of 24 August, Zaporizhska NPP was operating at the risk of violating radiation and fire safety standards. Over the past month, it has lost connection with power lines several times. As of 24 August, the radiation background in the area of Zaporizka and Chornobyl NPPs was reported not to pose a threat to human life and health.
Thermal and solar power plants (TPP, SPP)	TPPs operate on coal. When TPPs are shelled and a fire breaks out, burning coal releases enormous amounts of carbon dioxide into the atmosphere. Coal ash exposure is extremely dangerous to human health, leading to various health problems as well as contaminating soil and water. Damage to solar panels can be accompanied by the leakage of dangerous concentrations of metals such as lead and cadmium.
Oil terminals, fuel depots, and gas stations	Oil terminals, fuel depots, and gas stations are sites at which petroleum is stored. Hazard classification according to the Global Harmonized System (GHS) is flammable liquid class 1. Damage to these facilities causes a threat to life for people living within 400 m of the facility, as well as health risks to people living within a 600 m range. There is an environmental threat to soil and water when the liquid substance dissolves. Oil pollution has a devastating effect on the marine environment.
Industrial facilities and technical service stations	Damage to plants can lead to the leakage of nitric acid, phenol, formaldehyde and methanol (GHS: acute toxic liquid class 3). Methanol sulfide is lethal to human life within a 500 m radius and to human health within a 1.5 km radius from the incident site. Of note, a damaged woodworking enterprise can lead to the leakage of benzene (GHS: flammable liquid class 2, flashpoint < 23 °C). This poses a threat to human life within a 400 m range and to human health within a 600 m range. Damage to the Avdiivka Coke Plant can lead to the leakage of coke oven gas with a high content of benzene, toluene, naphthalene, hydrogen sulfide, mercaptan, hydrocyanic acid and ammonia. Damage of chemical storages in the Azot plant and ammonium pipeline threats ammonia (GHS: acute toxic gas class 2) leakage into groundwater and then into the local rivers. When inhaled, it causes a threat to human life and health within a 200 m and 3 km range, respectively (if the released quantity > 1,000,000 kg).
Storage facilities and malls	Facilities can store several types of hazardous chemicals. The release of these chemicals threatens the air, soil, and water with contamination in the area in which they are located. It should be noted that damaged warehouses and shopping centers where food products are stored can lead to the release of ammonia (GHS: toxic gas class 2). This would pose a threat to life within 100 m, to health - 800 m.
Gas pipelines	Gas pipelines transfer flammable substances - natural gas (GHS: flammable gas class 1). When a pipeline is damaged, the fire itself and heat radiation cause a threat to life within radius - 200 m, to health - 300 m.
Water treatment facilities	Water filtering facilities contain chlorine (GHS: aquatic acute class 1). Incidents at such facilities cause serious injury to aquatic organisms in a short period of time. Soil, lake and river contamination range is 2.8 km, 400 m and 10 km, respectively. Wastewater treatment plants contain methanol. GHS classification: flammable liquid class 2. This poses a threat to human life within a 400 m range and to human health within a 600 m range. When released into open water bodies, untreated wastewater can aggravate the quality of drinking water and the local marine environment.
Agriculture and food production facilities	The most common hazardous substances in livestock farms include disinfecting agents, antibiotics, hormonal products, pesticides, and carbamate pesticides (GHS classification: aquatic acute solid class 1). When released into groundwater, pesticides cause serious injury to aquatic organisms in a short period of time. Poses risks of contaminating soil, lakes and rivers within a range of over 10 km, 2.8 km and 10 km, respectively. If not properly and timely utilized, poultry waste (poultry carcass, feathers, and manure) threatens soil and water contamination. A recent damage to the ammonia plant machinery room at a food processing plant in Chernihiv resulted in an ammonia leak (GHS: acute toxic gas class 2). Even in small quantities, when inhaled, it causes a threat to human life and health within a 100 m and 800 m range, respectively.
Landfills	Landfills store methane (GHS: flammable liquid class 2), which poses life and health risks within a 400 m and a 600 m range, respectively. When exposed to fire, these stores may result in massive explosion. When burning, landfills release benzopyrene and dioxins, which are carcinogenic and can be poisonous. Toxic substances may cause acid rain and burn plants and winter crops.
Coal mines	Coal mine hazardous substances include methane (GHS: flammable gas class 1), which can be transferred by air and is dangerous to human health within 200 to 300 m (1 mln. kg) and critical infrastructure. There are many other typical mine-related hazards including explosive hazards (methane yield), air pollution with fine dust, and mining waste accumulation (spoil tips).
Nature reserve fund of Ukraine	The total area of landscape fires related to hostilities in the territory of Ukraine exceeds 2.4 million hectares. The most catastrophic situation is in the Kharkivska, Khersonska and Luhanska oblasts. National parks Svyati hory (Donetska oblast), Kreminski lisy (Luhanska oblast), as well as Chornomorskyi (Khersonska and Mykolaivska oblasts) and Chornobylskyi (Kyivska oblast) biosphere reserves are among those most affected by fires. At least 20 species of endemic rare plants in Ukraine are endangered by the war.

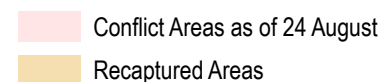
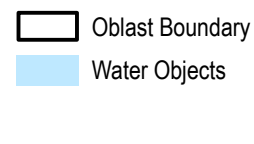
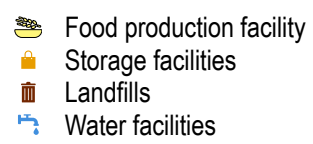
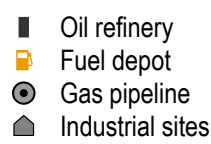
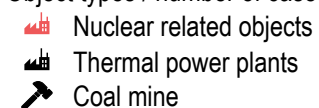
UKRAINE

Hazardous Facilities in Proximity to Conflict - 24 February 2022 to 24 August 2022

For humanitarian purposes only
Production date: November 2022



Object types / number of cases per oblast



Data sources:

Administrative Boundaries and Population: The United Nations Office for the Coordination of Humanitarian Affairs (OCHA) Ukraine; Conflict Areas: liveuamap.com as of 31/08/2022; Incidents at Hazardous Facilities based on multiple reliable sources - The State Emergency Service of Ukraine (SESU), oblast administrations, Ministry of Environmental Protection and Natural Resources of Ukraine, International NGO Safety Organisation (INSO) Alert
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