

# Urgent action is needed to restore the water sector in Ukraine

The Russia–Ukraine armed conflict has caused far-reaching damage to freshwater resources and water infrastructure, with immediate and long-term consequences for the environment and human health. This analysis of the type, distribution and potential consequences of the water-related impacts of the conflict provides a basis for future rebuilding and restoration.

## This is a summary of:

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## The problem

Fresh water is an essential and irreplaceable resource for all life on Earth. At the same time, water and its related infrastructure can be triggers or casualties of armed conflicts<sup>1</sup>. Unlike previously reported conflicts in countries in the Global South and those with emerging economies<sup>2</sup>, the current Russia–Ukraine armed conflict is in a region with a heavily modified and industrialized water sector. Military actions threaten the critical water infrastructure of Ukraine, which includes large multi-purpose reservoirs, hydropower dams, cooling facilities for nuclear plants, water reservoirs used for industry and mining, and extensive water distribution canals and pipelines for irrigation and household purposes<sup>3</sup>. The consequences for the civilian population, as well as for food and energy production, are immense and far-reaching. For example, the number of people in Ukraine without safe access to clean water and sanitation increased from 6 million to 16 million between April and December 2022 (ref. <sup>4</sup>).

It is important that the nature and extent of the effects of the armed conflict on the water sector are quantified and well understood to help plan post-war rebuilding and prevent water-related damage in future conflicts.

## The observation

We compiled information from governmental and media sources with Ukrainian, Russian and international origins. We then identified the location, characteristics and status of reported incidents (Fig. 1) and defined the drivers, related pressures on ecosystems and society, and outcomes of each incident. Although we focused on the first three months of the conflict, our analyses are still relevant because intense military actions are mostly confined to the same areas.

Our results show that many freshwater resources and water infrastructures have been negatively affected or destroyed by military actions. The armed conflict has caused severe environmental pollution within and beyond the territories affected by active ground combat due to the release of untreated domestic and industrial wastewater, damage of water infrastructure and the underwater decomposition of sunken ammunition. Eastern and southern Ukraine have experienced some of the worst water-related damage. In the south, military actions threaten the extensive network of irrigation channels, while in the east, attacks have prevented the pumping of water in mines leading to the uncontrolled rise of polluted mine water, which

affects groundwater and surface-water sources. Reduced access to safe drinking water also has negative consequences for human health and increases the risk of epidemic outbreaks.

## The implications

Despite multiple international protocols and conventions that oblige warring parties to protect civilians and civilian infrastructure, freshwater resources and water infrastructure continue to be damaged. The implications of such damage spread beyond political and geographical borders, including threats of radioactive pollution owing to potential damage to the cooling ponds of nuclear power plants; risks to global food security due to damaged irrigation systems and restricted regional agriculture; trans-boundary water pollution; and threats to biodiversity.

Our analysis remains restricted because of limited access to the affected sites and possible biases and discrepancies in the available reports. However, retrospective analysis of the effects of historical events on the water sector gives an indication of the potential scale of the long-lasting consequences of the conflict. For example, the catastrophic flooding caused by damage to the Dnieper hydroelectric station during World War II and the spread of radionuclides through the Dnieper River to the Black Sea after the catastrophe at the Chernobyl nuclear power plant.

Rebuilding water infrastructure and restoring damaged ecosystems must become an integral part of international peace-making processes. A solid data and knowledge base, cross-sectoral collaboration and innovative management strategies must be established to support people and nature alike. To improve this knowledge base, future studies could use spatial mathematical and cartographic modelling with remote-sensing data to simulate various situations within and beyond the areas of active ground combat such as flooding caused by dam breaches; spread of pollutants from sunken military ammunition; effect of land mines on surface water and groundwater; change in the quality of subsurface mine water and its overflow to connected areas; change in the quantity and quality of water available for drinking and irrigation purposes; and the effect on freshwater biodiversity.

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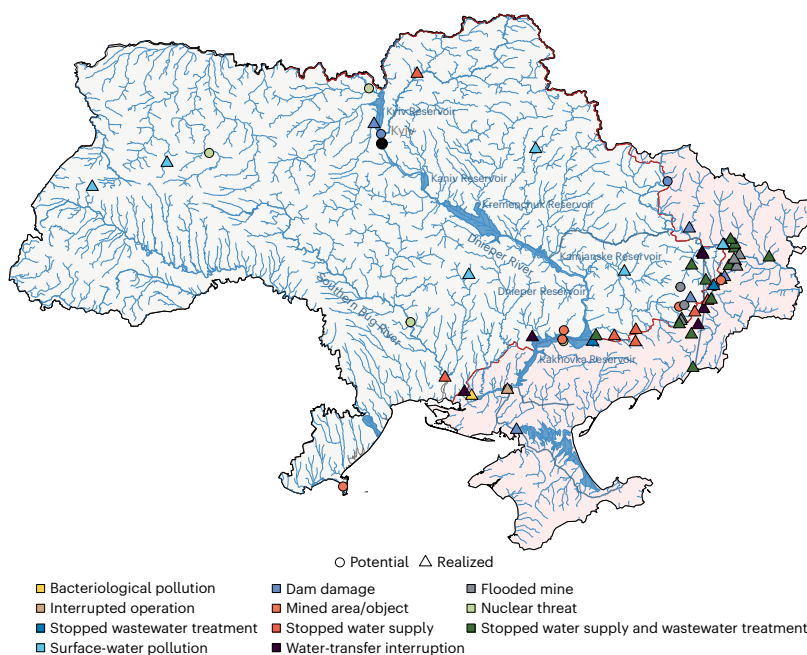
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## EXPERT OPINION

"This manuscript is a shocking, broad survey that rigorously documents and analyses the impact of the armed conflict in Ukraine on water resources. Although documenting the first three months of the conflict, the report brings well-grounded real concerns about

potential risks such as the collapse of water infrastructure, food crisis, and biodiversity loss due to increased pollution, in the case of a continued conflict." **Carlos Galvão, Federal University of Campina Grande, Campina Grande, Brazil.**

## FIGURE



**Fig. 1 | The effects of conflict on the water resources and infrastructure in Ukraine.** The triangles and circles indicate the realized effects (those with documented evidence) and the potential effects (those with documentation suggesting a high likelihood that the event occurred, but with no reported evidence of irreversible damage), respectively, that occurred between 18 February 2022 and 24 May 2022. The red line marks the location of the front line of the armed conflict three months after it began. The red area shows the parts of Ukraine that are not under the control of the Ukrainian government. © 2023, Shumilova, O. et al., [CC BY 4.0](https://creativecommons.org/licenses/by/4.0/).

## BEHIND THE PAPER

This paper was written by a team of researchers from Ukraine, Germany, Belgium and the USA working in the field of freshwater science. This international team was able to get access to and evaluate information from 'inside' and 'outside' sources with Ukrainian, Russian and international origins. This approach helped us to avoid potential biases and make our analysis as comprehensive as possible. While working on the paper we were surprised that despite a lot of attention to the conflict

itself in international media, information on the effects of the conflict on the water sector was sporadic and mostly related to impacts on large-scale infrastructure. We are convinced that our work will shed light on the large extent of the effects of the conflict on the water sector, facilitating scientific collaboration, humanitarian help and post-conflict repair. **O.S.**

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## FROM THE EDITOR

"The authors were able to rapidly put together available data from the initial three months of the ongoing war in Ukraine to analyse the intentional and unintentional impacts of the conflict on water resources and water infrastructure. While more data will become available over time, the results powerfully showcase the complex socio-environmental burden of this war on water resources, and the wider negative ramifications for energy and food security globally." **Angelos Alamanos, Associate Editor, Nature Sustainability.**