

REACH Ukraine: Emergency WASH Assessment

Impact of the Kakhovka Reservoir Depletion

June 2023
Ukraine

Background

On 6 June 2023, the dam of the Kakhovka Hydroelectric Power Plant (HPP) was breached, resulting in the rapid depletion of the Kakhovka reservoir and flooding of settlements downstream. As of 14 June, the Kakhovka reservoir [had reportedly lost 70% of its water mass](#), severely impacting the water supply of settlements in Khersonska, Zaporizka, and Dnipropetrovska oblasts that used the Kakhovka reservoir as a primary source of water. The United Nations [estimated](#) that up to 700,000 could be affected by water shortages. [According to Ukraine's State restoration agency](#), Ukraine will build 87km of new pipeline to restore supply water supply to these communities. While this may provide a long-term solution to restoring the water supply in affected communities in vicinity to the reservoir, severe humanitarian needs related to Water, Sanitation and Hygiene (WASH) will remain in place in the short- and mid-term.

In order to better understand the impact of the depletion of the Kakhovka reservoir on the surrounding settlements in Ukrainian government-controlled areas, REACH conducted 308 key informant interviews (KIIs) covering 100 settlements across Dnipropetrovska, Khersonska, and Zaporizka oblasts. This emergency overview aims to provide rapid, baseline information at the settlement level regarding the impact on water supply, water quality, and water, sanitation and hygiene (WASH) needs in affected rural and urban communities. Interviews were conducted from 20 to 26 June 2023 and should be considered indicative of the overall WASH situation in these settlements.

Key findings

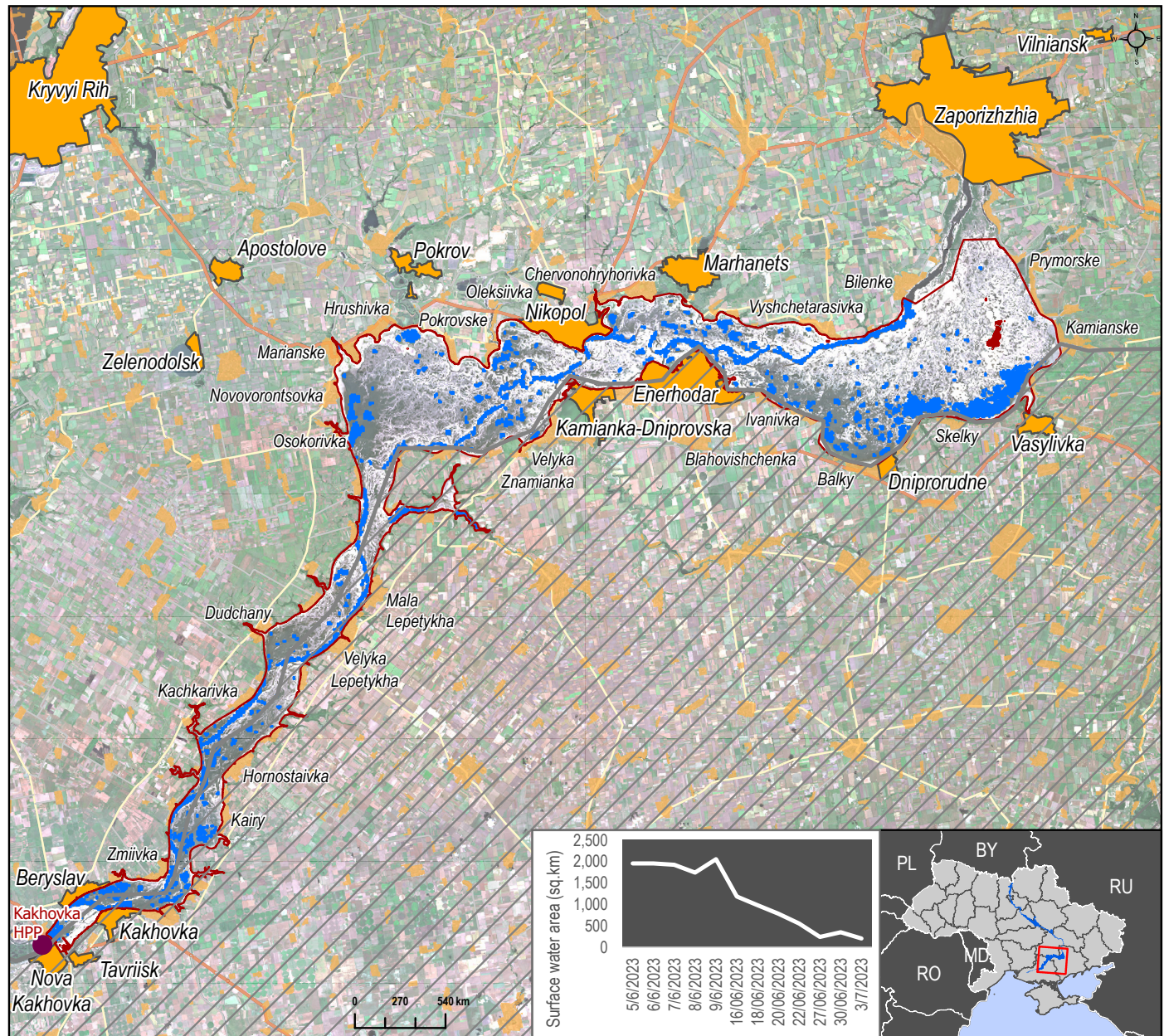
- The depletion of the Kakhovka reservoir has disrupted water supply in nearby settlements, leading to water shortages, agricultural challenges, industrial constraints, and ecological impact. **By 27 June, only 12% of the water remained in the reservoir**, and this figure is expected to further decline – although isolated pockets of water inside the reservoir may experience periodic refilling after rainfall events.
- Settlements in **Nikopolskyi and Kryvorizkyi raions are more heavily impacted from water receding from the reservoir** than those in Beryslavskyi and Zaporizkyi. **Urban settlements generally face more severe impact than rural settlements.**
- Most of the 100 assessed settlements (65%) expect that over the next 4-8 weeks, the impact of the reservoir's depletion on water supplies will remain the same as it was at the time of data collection, with **about a quarter (28%) of settlements expecting a decrease in the proportion of households that are able to meet their daily water needs**. Notable exceptions are Nikopol city and four neighbouring settlements, who expect access to water among households to improve.
- **43 out of 100 settlements reported a negative change in water quality.** Settlements that have been catastrophically or severely impacted¹ in their water supply, as well as urban settlements reported in higher proportion being affected by change in water quality. The remaining 57 settlements reported no change to water quality. Reported changes include strange colour, taste or muddy water.
- At the time REACH concluded interviews (26 June), 13 settlements that were catastrophically or severely impacted reported that they were not yet receiving WASH support.
- **The majority of settlements (57 out of 100) reported they will need (continued) WASH support.**
Hygiene items were reported to be mostly available in local markets and KIs reported not expecting significant shortages in the coming 4 – 8 weeks, although 32 settlements reported an increase in the price of hygiene item, potentially affecting affordability for households.

1. An overview of the *severity 5 index*, used by REACH to assess the impact of the reservoir's depletion on water supply can be found in the methodology section at the end of the document.

Total Surface Water Loss

A series of Sentinel-3 satellite images provide a daily survey of the Earth under cloudless conditions, effectively tracking the dynamics of the reservoir's drying process. Prior to the breach at Kakhovka HPP, the water mirror of the reservoir (open water surface) covered an area of 1,960 km². However, just 10 days after the breach, the area had already decreased by 40%. After 3 weeks, a mere 12% of the reservoir area remained, and this figure continues to decline, as evident in the image captured on 3 July 2023 (marked in blue on Map 1). The image clearly depicts the Dnieper bed and isolated pockets of open water not connected to the bed, which are gradually drying up, though they may experience periodic refilling after rainfall events, as observed on 30 June. Following the rains, the water surface area slightly increased to 17%, but began decreasing again from 3 July. At the time of writing, it stands at covering 205 km².

Map 1: Surface water area of the Kakhovka reservoir as of 3 July 2023



- Surface water area as of 3/7/2023
- Pre-damage Kakhovka Reservoir Area (as of 3/6/2023)
- Urban settlements
- Rural settlements
- Roads
 - primary
 - secondary
 - tertiary
- Out of governmental control of Ukraine

Data sources:

Background image: true-color Sentinel-2 image acquired on 20 June 2023
 Surface water area was calculated based on Water Index from Sentinel-3/OLCI imager of 05 June -3 July 2023, accessed from <https://apps.sentinel-hub.com/>
 Water index is calculated as $NDWI = (B17 - B) / (B17 + B6)$ according to <https://doi.org/10.3390/rs14092172>;
 Permanent water, roads, railways - ©OpenStreetMap contributors;
 Settlements - OCHA;
 Areas beyond the control of the Government of Ukraine as of 18 June 2023: <https://liveuamap.com/uk>

Water supply and quality since June 6

Water supply

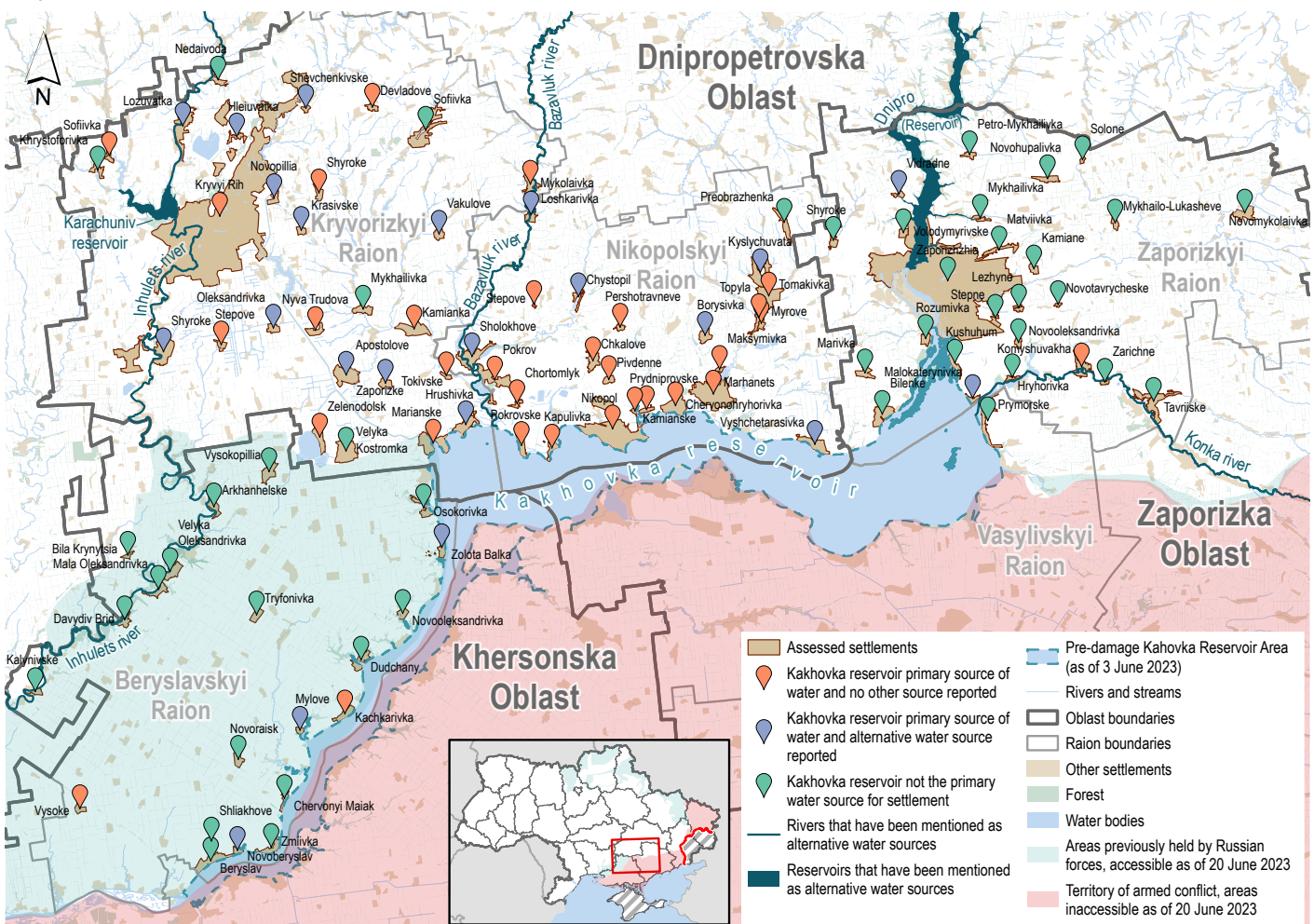
The water supply of settlements in Nikopolskyi and Kryvorizkyi raions is more heavily impacted compared to Beryslavskyi and Zaporizkyi. All of the 24 assessed settlements in Nikopolskyi, and 23 of the 28 in Kryvorizkyi are severely or catastrophically impacted.² In contrast, only one third (seven out of 21) of settlements in Beryslavskyi raion are facing an impact that is severe or worse. In Zaporizkyi, this was six out of 26 settlements. **Urban settlements generally face more severe impact than rural settlements.**

The settlements most impacted share two main characteristics:

Reliance on the Kakhovka reservoir as primary water source: all of the 27 catastrophically impacted settlements and 25 out of 34 of severely impacted reported relying on the reservoir as their primary water source. On the other hand, of the 46 settlements that reported not relying on the reservoir as their primary water source, only 9 experienced a severe impact and none a catastrophic one. In Nikopolskyi, all but one of the 24 assessed settlements reported relying on the reservoir as their primary water source. In Kryvorizkyi, 23 out of 28 reported the same. In Beryslavskyi, where the impact on water supply has generally been lower (see Map 2), only five out of 21 settlements reported relying on reservoir as their primary water source. Similarly, in Zaporizkyi, only three out of 26 settlements reported relying on the reservoir as their primary water source.

No alternative water source reported: about a third of assessed settlements (31 out of 100) reported that the Kakhovka reservoir was their only source of water. Settlements in Nikopolskyi and Kryvorizkyi raions appear most impacted with 90% (47 out of 52) scoring as severely or catastrophically impacted. In Beryslavskyi more settlements reported using groundwater (13 settlements out of 28) or other rivers or ponds (11 out of 28). Groundwater is the most commonly reported alternative water source in raions where severity scores are lower (Zaporizkyi and Beryslavskyi), although in Zaporizkyi settlements also reported relying on water from the Dnieper river.

Map 2: reliance on the Kakhovka reservoir and alternative water sources of assessed settlements



2. REACH defines a catastrophic impact as a situation where all or most households in assessed settlements face serious challenges in accessing their typical water sources and have low capacity to mitigate this impact.

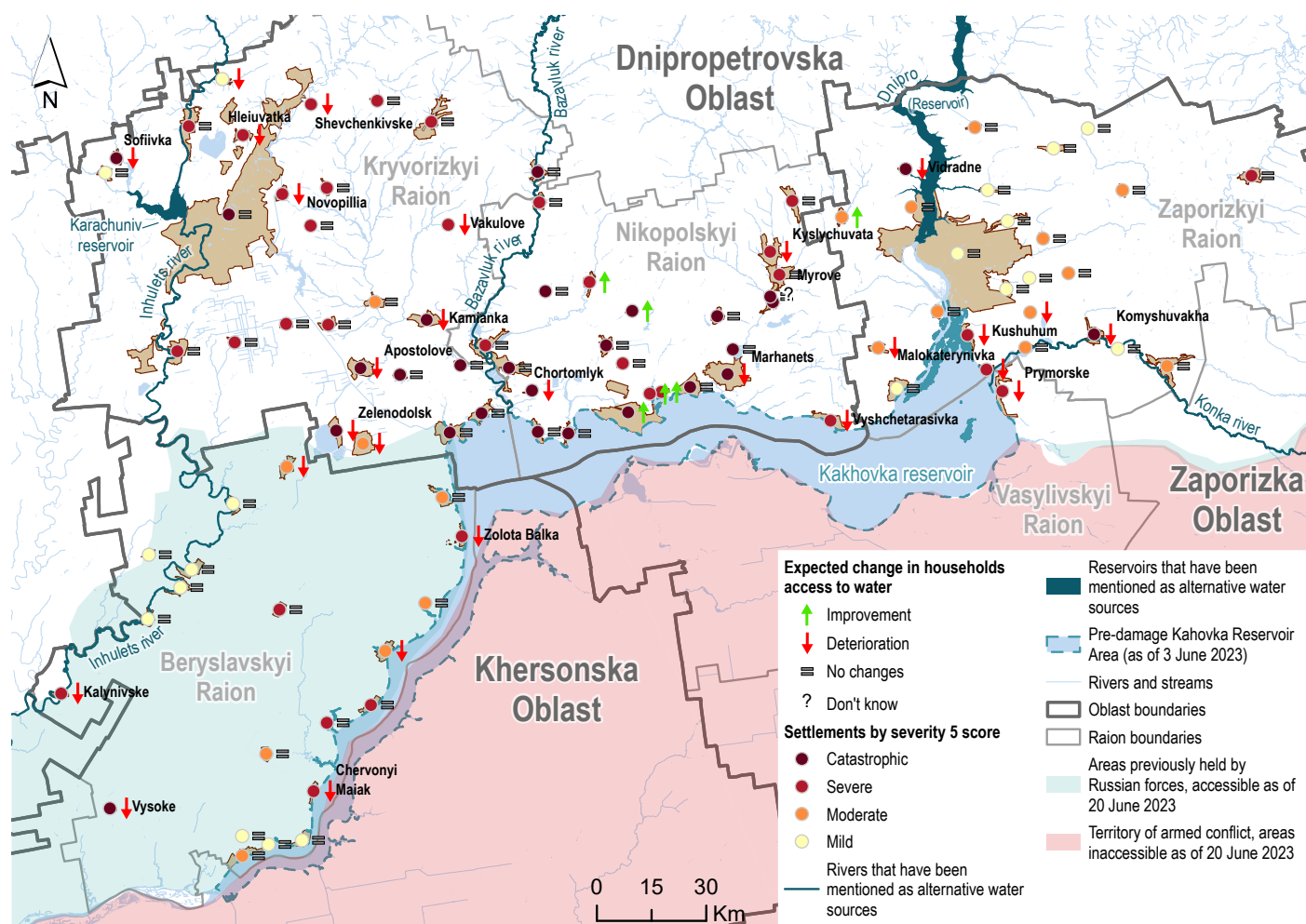
There is no apparent correlation between distance from the reservoir and severity of impact. Although assessed settlements in Kryvorizkyi are on average further away from the reservoir than in other raions (41,1km from the closest shore), they are amongst the most impacted in their water supply – as opposed to closer assessed settlements in Beryslavskyi (on average 15,6km away) but generally less impacted. Some severely impacted settlements are the furthest away from the reservoir, while those moderately impacted are on average at the same distance as those catastrophically impacted.

Anticipated challenges in the next four to eight weeks

When asked about anticipated change in the next 4-8 weeks in the proportion of households able to meet their daily needs for water, most settlements expect the situation to remain the same (65 out of 100), with about a quarter of settlements expecting the situation to get worse (28 out of 100).

Five settlements in Nikopolskyi (Nikopol, Chystopil, Kamianske, Prydniprovsk and Shyrokye) reportedly expect the situation to improve in the next 4-8 weeks. Since these settlements all reported receiving WASH support, this could potentially indicate that the emergency response to Nikopol and its region was sufficient to raise expectations of better times ahead – although a majority of settlements in Nikopolskyi raion still report a need for further WASH assistance, with the notable exception of Nikopol city where a majority of KIs reported no further need for WASH assistance at the time of the interview.

Map 3: Anticipated change in the proportion of households facing challenges in accessing their typical source of water



Water quality

Overall, a slight majority of assessed settlements reported no change to water quality (57 out of 100). **Settlements in Nikopolskyi and Kryvorizkyi raions were more likely to report a decrease in water quality, as were urban settlements across all raions.**

In Beryslavskyi, only one out of 15 rural settlements reported a decrease in water quality, while three out of six urban settlements reported the same. In Zaporizkyi, five out of 19 rural settlements reported a change in water quality and five out of seven urban settlements. In Kryvorizkyi and Nikopolskyi raions, half of rural settlements (20 out of 40) reported issues with water quality, and nine out of twelve urban settlements. The types of changes reported by KIs included strange colour (23 out of 43 settlements), strange smell (17), and muddy water (21).

Emergency needs and support received related to water, sanitation and hygiene

Estimated Population of Assessed Settlements by Severity Scoring ³

| Raion (# of settlements assessed) | Mild | Moderate | Severe | Catastrophic | Overall |
|-----------------------------------|----------------|---------------|---------------|----------------|------------------|
| Zaporizkyi (26) | 748,750 | 38,628 | 13,810 | 8,600 | 809,788 |
| Kryvorizkyi (28) | 2,343 | 13,557 | 33,407 | 684,480 | 733,787 |
| Beryslavskyi (21) | 7,738 | 9,896 | 2,638 | 4,000 | 24,272 |
| Nikopolskyi (24) | 0 | 0 | 37,659 | 206,603 | 244,262 |
| Vasylivskyi (1) | 0 | 0 | 2,317 | 0 | 2,317 |
| Total | 758,831 | 62,081 | 89,831 | 903,683 | 1,814,426 |

Based on population estimates provided by KIs, approximately half of the population (903,683 people) in assessed areas are living in catastrophically impacted settlements. The above table displays the combined population size of settlements based on the severity of the impact of the Kakhovka reservoir depletion on water supplies. The total population of the covered settlements estimated by KIs is approximately 1.81 million. The two most populous urban settlements in assessed areas are Zaporizhzhia (population est. 725,000), which according to the severity 5 index has been mildly impacted, and Kryvyi Rih (population est. 635,188), which has been catastrophically impacted.

Ongoing and requested support

At the time of data collection, ongoing WASH support was reported in 72 out of 100 settlements, indicating a high level of coverage. However, a majority of KIs in **7 settlements whose water supply had been catastrophically impacted reported they were not receiving support, along with 6 severely impacted settlements**. These include both urban and rural settlements, meaning over 700,000 people could be in need of emergency WASH assistance.

Catastrophically impacted settlements which may not be receiving WASH support include: Pokrov and Chortomlyk (Nikopolskyi raion); and Vidradne and Komyshuvakha (in Zaporizkyi raion). Further, in Mykolaivka, Kamianka and Sofiivka (in Kryvorizkyi raion) no consensus was reached by KIs as to whether there was ongoing WASH support, so it is possible these settlements are also in need. It should be noted that KIs reported the situation as of 26 June and response may have taken place since. REACH was not always able to triangulate the reports made by KIs in the timeline from data collection to publication of this output.

As shown in Map 3, all five key informants in Kryvyi Rih reported that the city was not receiving any type of WASH support despite the city's water supply being heavily impacted. In this case, REACH was able to follow up with contacts in Kryvyi Rih and the Deputy Mayor reported that as of 4 July, the city was receiving assistance from UNICEF (who is installing drinking water tanks) and from the Ukrainian government (who sent money to build a pipeline to provide alternative water supplies). Importantly, **the situation in Kryvyi Rih reportedly remains concerning as the scope of needs exceeds the level of support**, according to the KIs. Specifically, it was reported the city needs more water containers and powerful filters to treat the water from newly drilled wells.

Severely impacted settlements which may not be receiving WASH support include Stepove and Krasivske (Kryvorizkyi raion); Loshkarivka (Nikopolskyi raion); Ternuvate, Malokaterynivka, and Kushuhum (Zaporizkyi raion). The below map indicates the severity indexing of assessed settlements, alongside whether KIs reported ongoing WASH support in each settlement.

WASH support is being provided primarily by civil society organizations (mentioned by KIs in 47 out of 72 settlements) and international organizations (42 out of 72), followed by the national government (31), and national NGOs (29). The majority of settlements (57%) reported a continued need for WASH assistance over the next 4 – 8 weeks. This includes settlements which are already receiving assistance, and settlements ranging from mild to catastrophic levels of impact.

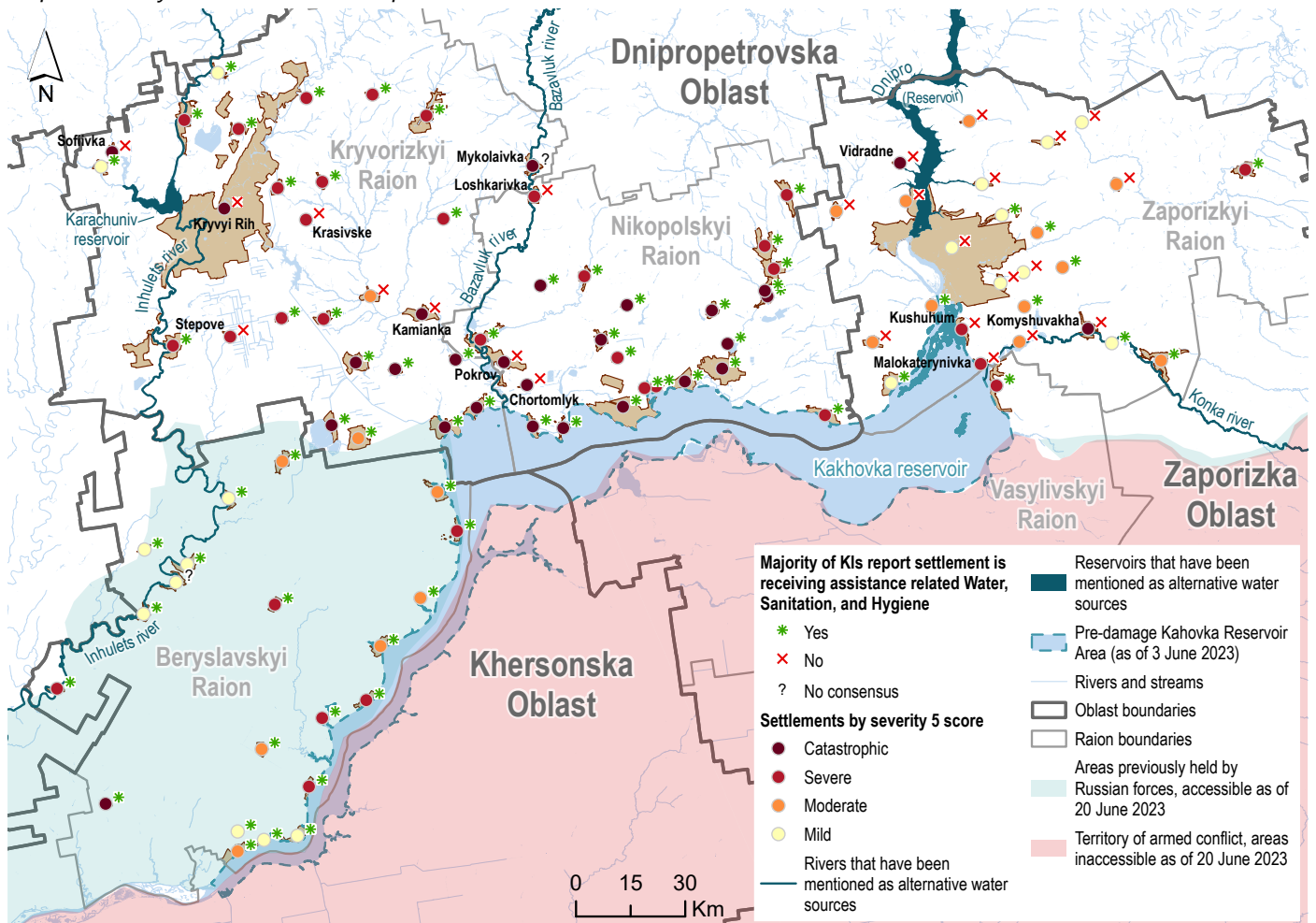
Twenty-eight out of 100 settlements reported currently receiving support, but not needing further assistance:

- 10 of those settlements are in Beryslavskyi, with one cluster around the reservoir (Zolota Balka, Novooleksandrivka, Kackarivka, Mylove, Shliakhove and Novoberyslav).
- 4 in Zaporizkyi
- 5 in Nikopolskyi, including Nikopol city (who also reported expecting the water supply situation to get better)
- 9 in Kryvorizkyi, a cluster of which can be found on or very close to the Inhulets river (Nedaivoda, Lozuvatka, Hleiuvatka, Khrystoforivka and Shyroke)

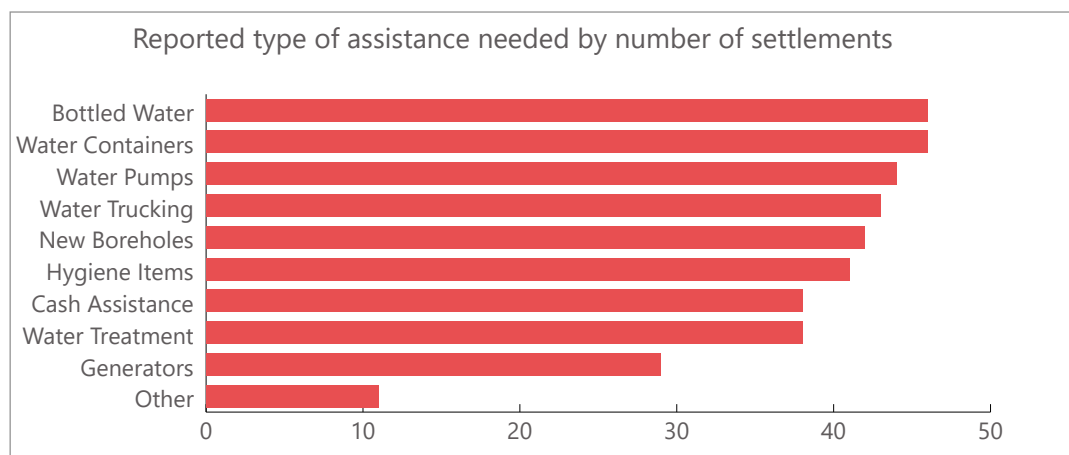
3. The estimated population of assessed settlements was calculated using the mean value of figures provided by individual KIs. While REACH triangulated answers with pre-war population data figures and found consistency, REACH was not able to verify figures reported by KIs.

A majority of these (17 out of 28) did experience a severe impact on their water supply, although only 5 out of 28 expected the situation to deteriorate. This could potentially indicate the need for a more targeted approach in delivering assistance, as certain types of assistance may be more needed than others. REACH maintains a list of KI contacts that can be shared upon request.

Map 4: Severity 5 index score and reported assistance



In terms of the types of assistance needed by settlements, the below chart illustrates the most frequently reported items. While there is no clear preference toward any one specific item, responses show a need for both short-term, emergency WASH response (i.e. bottled water, water trucking, water containers), alongside longer-term, technical solutions (such as water pumps and new boreholes). Forty-one settlements reported needing hygiene items – a high figure considering the reported availability of hygiene items in local markets (see section 2.2). This could be explained by the fact that 32 out of 100 settlements reported an increase in hygiene item prices, potentially indicating low affordability of hygiene items in settlements requesting them.



Availability of hygiene items

86% of settlements reported that all essential and non-essential hygiene items were available in local stores. This assessment classifies “essential” items as hand and body soap, baby diapers, incontinence, and menstrual materials; and “non-essential” items as laundry soap and washing powder, shampoo, toothpaste, toothbrushes, hairbrushes, and water containers. At least one essential item was unavailable in 7% of settlements. A smaller percentage of settlements (4%) reported that while essential items were available, some non-essential items were unavailable. Urban and rural areas reported shortages at similar rates.

The raions where settlements indicated highest rates of hygiene item unavailability are also the most impacted by the depletion of the reservoir: the settlements of Sofiivka, Vakulove and Lozuvatka in Kryvorizkyi raion and the settlements of Marhanets, Kyslychuvata and Preobrazhenka in Nikopolskyi raion reported lacking essential hygiene items.

86% of settlements reported they did not expect a shortage of hygiene items in the coming 4 – 8 weeks. However, settlements in rural areas expected shortages of essential and non-essential items at higher rates (11 of 75, or 15%) than settlements in urban areas (two of 25, or 8%). The three raions in which settlements most expected shortages were Beryslavskyi (Dudchany, Novoberyslav and Zmiivka), Kryvorizkyi (Oleksandrivka and Vakulove) and Nikopolskyi (Preobrazhenka).

Utilities

Overall, electricity and gas were reported fully functioning in 74% of assessed settlements and 71% of assessed settlements respectively, though 11% had not had gas prior to 6 June. Of the five assessed raions, electricity and gas conditions were reported to be the worst in Beryslavskyi, where nine out of 21 assessed settlements had partially or not functioning electricity and four had non-functioning gas. This is likely due to Beryslavskyi being a former frontline area heavily affected by ground hostilities.

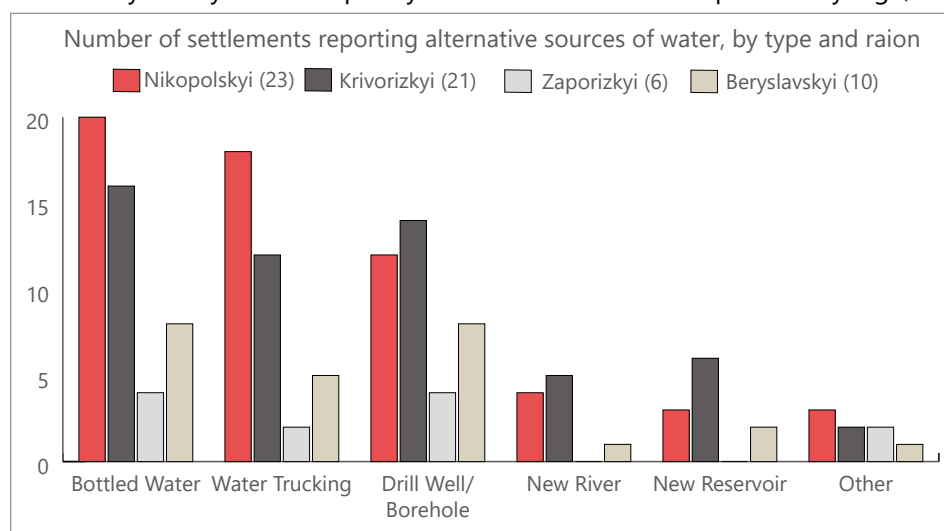
Assessed settlements reported that solid waste management was fully functioning in 47% of settlements. Of the assessed raions, most challenges around solid waste management were found in Beryslavskyi. Seven out of 21 settlements reported solid waste management was not functioning and six out of 21 reported it was partially functioning.

A variety of toilets are used in urban and rural settlements, predominantly pit latrines (84 out of 100). Flush toilets are also commonly reported: in rural areas, they are in majority piped to an individual septic tank (50 of 75 settlements) where in urban areas, they are in majority piped to drain inside the home (19 of 25). Heavy usage of pit toilets in both rural and urban areas may mitigate potential challenges posed by lessened access to technical water necessary for utilization of flush toilets. Of the 82 settlements that reported utilization of flush toilets (either piped to drain inside the home or to septic tanks), 14 reported that their capacity to treat wastewater has been impacted since June 6. Impacted settlements are all located in Nikopolskyi and Kryvorizkyi raions and include an even mix of urban and rural settlements.

Alternative sources of water and long term impact

Settlements in all assessed raions reported the need to find alternative sources of water since 6 June with the greatest proportion in Nikopolskyi (23 out of 24 settlements), and Kryvorizkyi (21 out of 28 settlements). Settlements in urban areas had to find alternative sources of water at higher rates than rural areas. This was particularly the case in Zaporizkyi, where 90% (17 of 19) of rural settlements reported not needing to find an alternative source of water, in comparison to urban settlements in that area, where 71% (five of seven) did report the need to do so.

The top three most used alternative sources of water were bottled water, water trucking, and new wells. In raions such as Kryvorizkyi and Nikopolskyi where WASH needs are particularly high, emergency contingencies such as water



trucking and bottled water have been necessary, but longer-term solutions such as use of new wells has also been utilized in such areas.

Among settlements that reported water trucking as an alternative source, the distance needed to travel varied significantly. While the median was 25 km, the smallest distance was 2km and the largest 110km. The three largest distances were reported in Nikopol (100km), and in Beryslavskyi raion (Tryfonivka, 110km) and Kalynivske (102km).

Additional impacts of the Kakhovka reservoir depletion

As the water in the Kakhovka reservoir continues to decrease, the availability of water sustaining agricultural and industrial production [will be severely affected](#). Farmers who rely on the reservoir for irrigation purposes will face challenges in sustaining their crops and maintaining agricultural productivity, livestock breeding and fishery. Manufacturing processes, power generation, and other industrial activities that require a significant amount of water in industrial cities such as Nikopol, Marhanets and Kryvyi Rih, may be constrained due to the diminishing water resources. Additionally, the drying reservoir may have ecological consequences, affecting the local ecosystem and biodiversity. The decrease in water levels disrupted the habitats of aquatic plants and animals in particular of national parks such as Kamianska Sich and Velykiy Luh, leading to imbalances in the ecosystem and potential loss of local species.

Methodology

Between 20 and 26 June, REACH, in collaboration with the Kyiv International Institute for Sociology (KIIS) conducted 308 key informant interviews by phone covering 100 settlements. REACH acknowledges the geographic coverage of this assessment is limited to areas under the control of the Government of Ukraine (GCA) on the right bank of the Kakhovka reservoir and REACH could not assess settlements in areas under the temporary military control of the Russian Federation. Settlements were selected by meeting 3 criteria: relative proximity to the reservoir; pre-war population of at least 400; and administrative status to include all raion and hromada centres within the four raions closest to the reservoir (Beryslavskyi, Kryvorizkyi, Nikopolskyi, and Zaporizkyi) within GCA. For each settlement, 3 KIIs were conducted including administrative and municipality authorities and representatives from water and utility companies. In the four raion centres, 5 KIIs were conducted to account for the higher population. KI responses were subsequently aggregated to the settlement level according to majority-rule in the case of single-choice questions and accumulating in the case of multiple-choice questions. Findings included in this brief are based on key informant interviews collected from 20 to 26 June 2023 and should be considered indicative only. The aggregated dataset is public and available [here](#). The disaggregated dataset is available upon request.

Assessing the severity of impact at settlement level: the Severity 5 index

In order to assess and compare the impact of depletion of the Kakhovka reservoir on the water supply per settlement, REACH developed an index referred to in this brief as the severity 5 index. The index uses five indicators and weights responses to determine level of severity:

- 1) reported impact of the reservoir's depletion on water sources,
- 2) challenges accessing water since 6 June,
- 3) the scale of reported challenges in the settlement,
- 4) the need for alternative water sources and
- 5) expectations for the next 4-8 weeks.

Each settlement is assigned a score of "none/minimal" impact, to "mild", "moderate", "severe", or "catastrophic." REACH defines a catastrophic impact as a situation where all or most households in assessed settlements face serious challenges in accessing their typical water sources and have low capacity to mitigate this impact.

Maps 3 and 4 provide an overview of the severity 5 index scores of all assessed settlements.

ABOUT REACH

REACH Initiative facilitates the development of information tools and products that enhance the capacity of aid actors to make evidence-based decisions in emergency, recovery and development contexts. The methodologies used by REACH include primary data collection and in-depth analysis, and all activities are conducted through inter-agency aid coordination mechanisms. REACH is a joint initiative of IMPACT Initiatives, ACTED and the United Nations Institute for Training and Research - Operational Satellite Applications Programme (UNITAR-UNOSAT).