AREA BASED RISK ASSESSMENT
YASYNUVATA RAION
DONETSKA OBLAST, EASTERN UKRAINE

August 2020

3P Consortium PREVENT PREPARE PROTECT

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IMPACT Shaping practices Influencing policies Impacting lives

The 3P Consortium: Prepare, Prevent and Protect civilian populations from disaster risks in conflict-affected areas

The 3P Consortium, created in 2019, is funded by the Directorate-General for European Civil Protection and Humanitarian Aid Operations (DG ECHO) and USAID/OFDA

On the occasion of the International Day for Disaster Risk Reduction, the 3P Consortium (ACTED, IMPACT Initiatives, Right To Protection, the Austrian Red Cross, the Danish Red Cross and the Ukrainian Red Cross) launched its programme to reduce vulnerability to disaster risks in Eastern Ukraine by preparing, preventing and protecting civilian populations who are at risk of major disasters.

Civilians continue to bear the brunt of the ongoing conflict in Eastern Ukraine. Shelling, landmines, unexploded ordnances, frequent water and electricity cuts: this is daily life for people living close to the contact line, which splits government controlled areas from non-government controlled areas and where armed fighting continues to take place.

Natural, industrial and ecological hazards present in conflict-affected areas also pose a significant risk to the life and health of millions, and to the resilience of essential service delivery systems. Flooding coal mines, factories exposed to shelling, toxic landfills, chemical spills: these are yet another aspect of daily reality in Eastern Ukraine.

It is to raise awareness about these risks that the 3P Consortium – a group of Ukrainian and international non-governmental organisations (NGOs), was formed in 2019 with financial support from the Directorate-General for European Civil Protection and Humanitarian Aid Operations (DG ECHO) and the United States Agency for International Development (USAID) / Office of Foreign Disaster Assistance (OFDA).

In 2019 on October 13th, celebrated as the International Day for Disaster Risk Reduction, the 3P Consortium introduced its programme which aims at supporting the Government of Ukraine to fulfill its commitment under the Sendai Framework for Disaster Risk Reduction 2015-2030. The 3P programme aims to reduce vulnerability to disaster risks in Eastern Ukraine by preparing, preventing and protecting civilian populations who are at risk of a major disaster.

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KEY FINDINGS

Anthropogenic Hazards

Fire caused by shelling near Avdiivka coke plant, 17.05.2016

By Vlad Voloshin

Repair of a high-voltage power line damaged by shells, 02.02.2017

By The State Emergency Service of Ukraine (SESU)

Shelled and burned-out administrative building of Yasynuvata mine machinery plant, 22.09.2014

By DenTV

Yasynuvata Raion is located in the central part of Donetska Oblast in Eastern Ukraine, extending to within 5km of the contact line (CL). It is one of the largest by-product coke industry areas in Eastern Ukraine. Currently, **7 potentially hazardous facilities are located within Yasynuvata Raion** and **126 within 25km**, with many located in the non-governmental controlled area (NGCA) in Donetsk, Horlivka and Makiivka. These sites include chemical and coke industries, energy and power, mining, water supply infrastructure, tailings dams, spoil tips, machine building, and metallurgy. These facilities are considered to pose both an environmental and human risk due to the hazardous substances present and the threat of disruptions or malfunctions due to conflict or neglect. Whilst there are relatively few spoil tips in Yasynuvata Raion itself, **there are over 500 spoil tips within 25km.**

The settlement of Lozove in the NGCA has the highest exposure to hazardous facilities in immediate proximity. However, the settlements of Yakovlivka, Vesele, Mineralne, Spartak and Pisky have a large number of hazardous facilities and spoil tips within 5km.

Coal mining and coke industries are also considered to be the main sources of air pollution in the region and frequent maximum permitted concentration (MPC) overage are registered, in particular for aerosols, nitrogen dioxide, and sulfur dioxide. Chronic exposure to air pollution increases mortality from stroke, heart disease, chronic obstructive pulmonary disease, lung cancer and acute respiratory infections (WHO, 2020).

With 278 events within 2km, Pisky experienced the most conflict incidents between July 2019 and June 2020. This was followed by Spartak, Kashtanove, Vesele and Opytne, all of which recorded over 200 incidents during the same period. In addition to being an anthropogenic hazard, conflict in Yasynuvata Raion acts as a trigger for other hazards and impacts societies' coping capacity.

The settlements with the highest numbers of satellite-detected fires between 2001 and 2019 were Verkhnotoretske, Pervomaiske, Novobakhmutivka, Novokalynove, Ocheretyne and Pisky. **Significantly more fires were detected in Verkhnotoretske than any other settlement in the raion.** In addition, significant fuel for wildfires was identified within proximity to these settlements through land cover detection from satellite imagery. This is a concern given the number of conflict incidents in the area, which can be a trigger for wildfires.

Natural Hazards

Wildfires in grasslands and agriculture lands near the Kreidova Flora natural reserve, 26.07.2020
By S.Limanskij

Water supply system damage due to shelling, 22.07.2020

By United Nations Children's Fund (UNICEF)

Communal heating points for Avdiivka residents, 02.02.2017

By SESU

According to The Armed Conflict Location & Event Data Project (ACLED) database, **six settlements across the raion have been affected by landmine explosions since 2017.** This includes Verkhnotoretske and Pisky with 4 each and Spartak with 2 incidents. In addition to acting as a potential trigger for wildfires, landmines reduce coping capacity of communities, complicating access by emergency response services. Snow, heavy rains, flooding and smog were mentioned in secondary data review as natural factors increasing the mine-explosion risk with the absence of visible warning signs.

During cold waves and heat waves, there is potential for disruption to water supply, electricity and heating supply infrastructure due to the ongoing conflict. If affected, the coping capacity of the population can be decreased significantly, thus increasing their vulnerability to these extreme weatehr events. Based on data from 2000 to 2019, **Lozove, Zhelanne, Nevelske and Kashtanove each experienced an average of 30 days per year where temperatures exceeded +37°C** and are therefore most at risk from heat waves. Droughts present a further compounding factor. As for cold waves, **Sokil, Voskhod, Vasylivka and Semenivka each experienced 17 days where temperatures fell below -15°C**, meaning they are most at risk from cold waves.

Vulnerability was calculated based on susceptibility and coping capacity, accounting for factors such as conflict exposure, employment, dependency and distance to key services. **Rural settlements were found to be more vulnerable to natural and anthropogenic hazards** than urban settlements, with urban areas > 5km from the CL being the least vulnerable. Pisky, a rural settlement less than 5km from the CL, had the highest overall vulnerability.

Predictably, settlements closer to the CL experienced more conflict events, with **Pisky recording 19% of all conflict incidents**. **Rural settlements <5km from the CL had the highest proportion of the population with disabilities and the highest proportion of vulnerable head of households** including widows, single parents or single females. In addition, distances to key services affects coping capacity and it was found that **rural settlements greater than 5km from the CL generally had to travel further to reach a primary health care facility*.**

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* Data for this overview was gathered from different secondary sources. For more details, please see the methodology section here

INTRODUCTION

Background

Since 2014 Ukraine has been affected by conflict, and civilians continue to experience the negative effects of the crisis. Since April 2014, the United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA) reported that more than 3,000 civilians have died, 9,000 have been injured and an estimated 1.5 million people have been internally displaced. Today, despite the Minsk agreements, the conflict continues to affect 5.2 million people, of whom 3.5 million are in urgent need of protection and humanitarian assistance (UNOCHA 2019). In parallel, the population remains vulnerable to pre-existing natural and anthropogenic hazards such as extreme weather events and hazardous critical infrastructure failure. Systems in place to cope with these hazards are becoming increasingly vulnerable due to lack of maintenance and continued conflict, limiting local capacity to prepare, prevent, and protect their communities.

Populations living closest to the CL also face conflict-related hazards including: regular shelling; high mine and unexploded ordnance (UXO) contamination; and frequent utility cuts, which are particularly dangerous in harsh winters. Moreover, conflict exacerbates risks posed by pre-existing anthropogenic hazards, both directly through shelling of critical infrastructure and indirectly due to poor maintenance, or abandonment.

The conflict also exacerbates the risks of natural hazards. Eastern Ukraine has a humid continental climate characterised by large seasonal temperature differences, with hot summers and cold winters. Extreme weather events are not uncommon in this region. Severe winters coupled with poor or damaged shelter infrastructure or heating services can increase the risk of hypothermia and carbon monoxide poisoning. In 2006, 60,000 residents in the city of Alchevsk were left without heating for weeks due to a heating system failure during a severe cold spell, resulting in the evacuation of all children until heating was restored (2006, February 11, *The Guardian*). This scenario was repeated to a lesser extent in February 2017 when electricity and water infrastructure in Avdiivka was extensively damaged and led to a significant decrease in capacity of the heating system for several weeks, prompting local authorities and humanitarian actors to set up communal heating points (2017, February 1, *UNICEF press release*).

In summer months, heatwaves pose a threat of heat stroke, particularly to the elderly and other vulnerable populations. Due to the conflict, access to safe drinking water may be disrupted if water supplies are damaged or halted. In addition, Eastern Ukraine is susceptible to wildfires during hot summer months and conflict-related explosions only increase the likelihood of wildfires due to proximity to the CL. In 2010, the Luhansk region experienced a 24-day heatwave which triggered hundreds of wildfires.

This Area Based Risk Assessment (ABRA) aims to highlight the multiple hazards settlements are exposed to, both natural and anthropogenic, and their risks to such hazards.

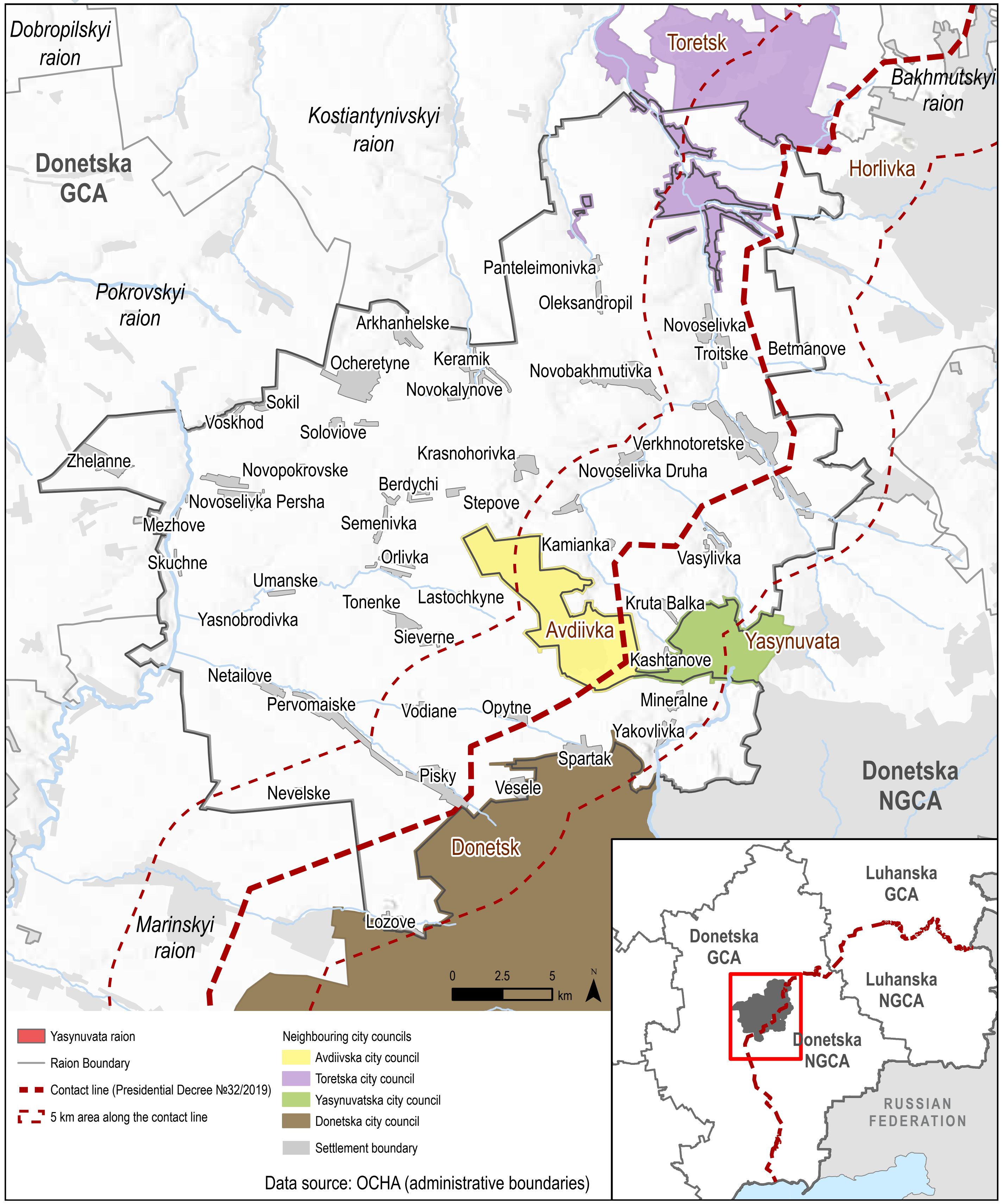
Overview of Assessed Area

Yasynuvata Raion is located in the middle of Donetsk oblast to the north of Donetsk city. It includes 4 urban-type settlements (Keramik, Zhelanne, Verkhnotoretske and Ocheretyne) and 43 villages. Nine settlements have been divided by the CL and are outside of the Government Controlled Area (GCA). Note that the official name is Yasnuvatskyi Raion, to differentiate it from nearby Yasynuvata settlement, the previous center of the raion. However, since the beginning of conflict in 2014, it has been located in the NGCA.

The area of Yasynuvata raion is 809 km2, including 669 km2 of agricultural lands. The total population is 26,165 (2019). Ocheretyne, Verkhnotoretske and Pervomaiske are the most populated settlements in the area. However, the largest urban settlement in the region is Avdiivka with a population of 32,843 (2019). Avdiivka is not officially part of Yasynuvata raion, but serves as an important hub for service provision for settlements in the Yasynuvata area.

The neighbouring city councils (Avdiivka, Yasynuvata and Toretska) have been included for the broader hazard exposure analysis, but the ABRA is focused on the settlements within the GCA of Yasynuvata raion only.

Overview map for Yasnuvata raion



Methodology overview

This ABRA for Yasynuvata raion aims to develop a disaster risk profile by assessing the vulnerability and hazard exposure of communities. This is calculated using a risk equation, which assesses several indicators for hazard, exposure and vulnerability.

The ABRA analyses geospatial data on hazard exposure and community vulnerability to assess both natural and anthropogenic risks. It is conducted at the sub-regional level, and relies on both locally available data and global datasets. As of 2019, there is no centralized and functional platform for open geospatial data access for the region which allows disaster risk practitioners to seek information from a variety of sources.

Global datasets were also used during the assessment wherever possible. However, due to the localised area of the research, it was only possible to use datasets where the resolution was high enough to be appropriate.

Methodological approaches used within this work fall within the framework of The Global Facility for Disaster Reduction and Recovery (GFDRR), which is a global partnership that helps countries better understand and reduce their vulnerability to natural hazards and climate change (GFDRR, 2019).

For anthropogenic hazards, the Flash Environmental Assessment Tool (FEAT) 2.0 Pocket Guide was used to highlight human and environmental exposure to hazardous substances. The FEAT methodology was developed by the National Institute for Public Health and the Environment (RIVM) for the United Nations Environment Programme (UNEP) and UNOCHA. The FEAT Pocket Guide helps to support initial emergency actions and is seen as the entry point for more comprehensive expert assessments. The FEAT process can also be used in preparedness and community awareness efforts, which is the approach taken in this risk profile and the case studies.

The risk profile is based on available secondary data review and it was not possible to include all relevant indicators to determine risk. However, this risk analysis can serve as a useful indication of which settlements to prioritize for implementing risk reduction programmes, as well as evidence for further primary data collection to support DRR initiatives in areas of higher concern.

Risk

According to the United Nations Office for Disaster Risk Reduction (UNDRR), "disaster risk" is defined as "the potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society or a community in a specific period of time, determined probabilistically as a function of hazard, exposure, vulnerability and capacity." (UNDRR, 2019).

The World Risk Index, developed by the United Nations University's Institute for Environment and Human Security (UNU-EHS) and Alliance Development Helps (Bündnis Entwicklung Hilft), calculates disaster risk based on the exposure to key natural hazards as well as social vulnerability in the form of the population's susceptibility and their capacity for coping and adaptation (Bündnis Entwicklung Hilft, 2019). The ABRA takes this approach for assessing disaster risk, through assessing the multiplication of a settlement's hazard exposure and its vulnerability. The specific indicators and their weighting used in the risk calculation is further illustrated in figures 1.1 and 1.2.

It is important to highlight that the objective was to assess risk to the main hazards of the region, but is not inclusive of all natural and anthropogenic hazards. Inclusion was based on consultations with local authorities and 3P Consortium members and hazards exacerbated by the state of industrial objects and conflict dynamics throughout 2019 were prioritized.

Hazard

Hazards refer to the "probability of a potentially destructive phenomenon" (World Bank, 2014). The main hazards that were identified during consultations and secondary data review for Yasynuvata Raion were: hazardous facilities from mine-related and chemical use, conflict, wildfires, and extreme temperature from cold waves and heat waves.

For each hazard, the approach was to identify where geographically there was potential for exposure within Yasynuvata Raion. Exposure is not limited to human population exposure, but also refers to 'the location, attributes and values of assets that are important to communities' (World Bank, 2014).

For hazardous facilities, community exposure is the only component considered in the risk equation, although it is important to further calculate the specific human health exposure and environmental exposure to soil and rivers as highlighted in the FEAT analysis (p.14 -15). However, this requires an individual assessment of each hazardous site, its substances and quantities present. This further analysis is recommended for sites that are close to the CL or have experienced disruptions in maintenance and operations.

As well as posing a direct hazard, conflict is a trigger for wildfires, and also as a variable that hinders coping capacity of the society when coupled with another hazard. Conflict as a hazard looks both at the exposure of the population to conflict incidents, but also exposure of critical infrastructure such as the water network, gas and oil pipelines, and the electricity network.

Cold waves and heat waves are a risk to the population in Yasynuvata Raion. This risk can be exacerbated by conflict-related disruption to gas, electricity and water infrastructure, due to the impact on the affected population's coping capacity.

Vulnerability

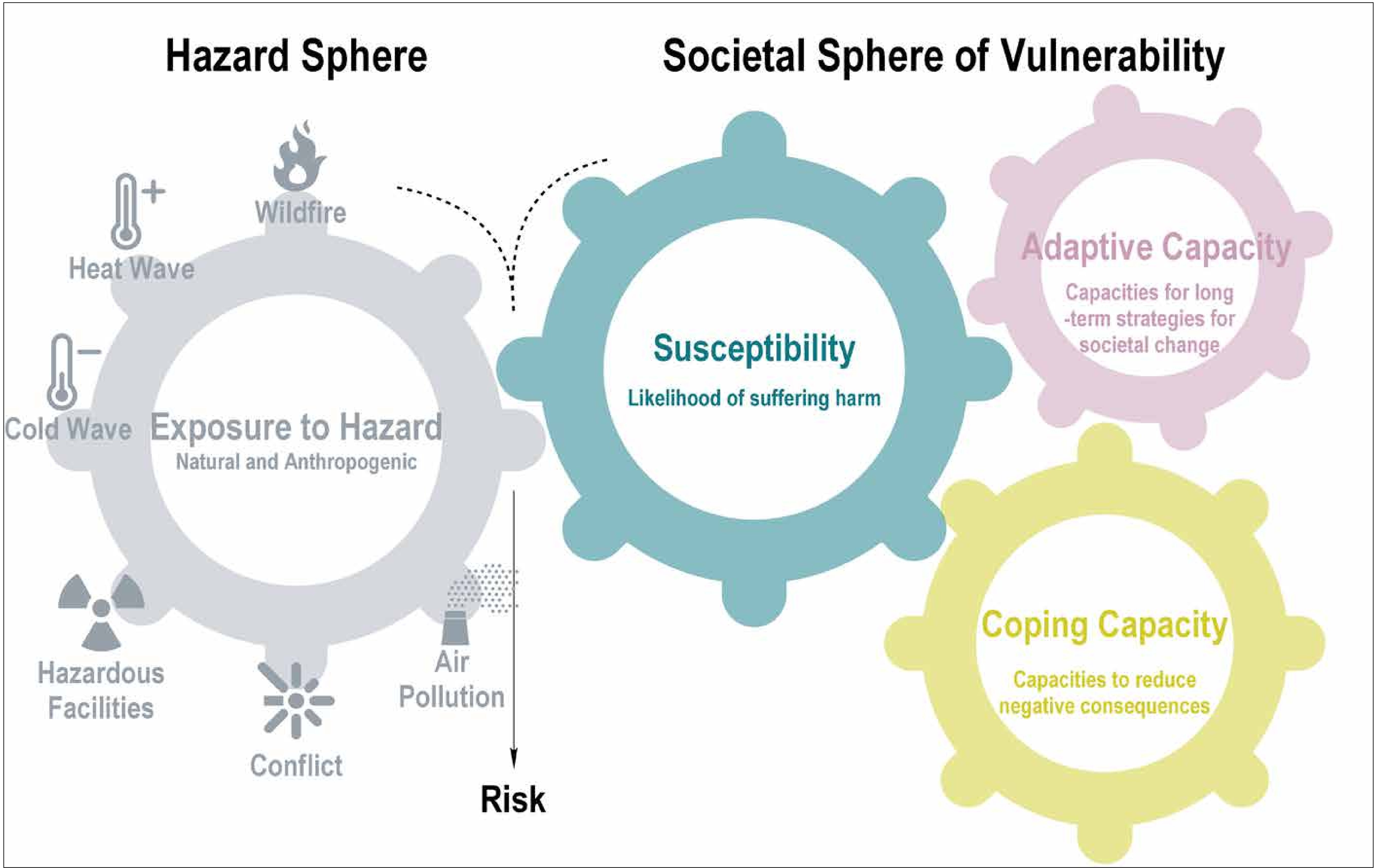
Vulnerability refers to the societal sphere, and its spatial interaction to a hazard is what defines disaster risk. Without societal exposure to a hazard, there is no risk, and where there is exposure to a hazard but low societal vulnerability there is low risk. The societal sphere of vulnerability is a crucial component to defining disaster risk. The societal sphere of vulnerability is comprised of three components that interact with each other; susceptibility, coping capacity, and adaptive capacity as depicted in figure 1.1.

Susceptibility is the likelihood of suffering harm from one of the assessed hazards. Coping capacity refers to the capacities of the society to reduce negative consequences. Lastly, adaptive capacity, or capacity development are the societal capacities in place to develop and maintain long-term strategies to ensure social resilience to hazards and shocks, which includes various types of training, continuous efforts to develop institutions, political awareness, financial resources, technological systems and the wider enabling environment.

The most recent data available for Yasynuvata Raion which assesses vulnerability was a 2018 household Capacity and Vulnerability Assessment (CVA) conducted by REACH (REACH, 2018). Several indicators from this CVA conducted on susceptibility and coping capacity were available to be extracted to calculate vulnerability to the hazards assessed and highlighted further in figure 1.2. Data for adaptive capacities was not accessible, and therefore not included into this analysis for the Yasynuvata raion risk profile. However, it is an important variable and indicators should be further researched to form a more comprehensive picture of societal vulnerability.

The household sample from the CVA for Yasynuvata Raion was based on four stratas, urban settlements within 5km of the CL, urban settlements further than 5km from the CL, rural settlements within 5km of the CL, and rural settlements further than 5km from the CL. Therefore societal vulnerability indicators will be representative not to the individual settlement but to the settlement classification.

Figure 1.1 Risk Diagram



Hazard Exposure

The exposure of communities to these multiple hazards is something that needs to be better understood at the local level with proper response and contingency plans in place. This analysis hopes to raise awareness to hazard exposure at the local level.

Natural Hazards

Indicator 1.1: Wildfire

- Proximity of settlement to fuel (forest landcover); number of satellite-detected fires (2000-2019) from NASA's Fire Information for Resource Management System (FIRMS) which includes all fires in urban, agricultural and forest land cover types; the number of landmine areas still contaminated and number of conflict incidents in 2019 within a settlement or within 2km of a settlement, as a trigger for more frequent wildfires.

Indicator 1.2: Heat wave

- Percent of days settlement experiences land cover temperature of +37°C or higher during June, July and August (2000-2019) using remote sensing methodologies from NASA's Moderate Resolution Imaging Spectroradiometer (MODIS) Land Surface Temperature and Emissivity (MOD11).

Indicator 1.3: Cold wave

- Percent of days settlement experiences land cover temperature below -15°C during December, January and February (2000-2019) using remote sensing methodologies from MODIS MOD11.

Anthropogenic Hazards

Indicator 2.1: Hazardous Facilities

- Number of hazardous facilities within a settlement or within 2km of settlement, using geospatial data from the Donbas Environment Information System (DEIS), and the Water, Sanitation and Hygeine (WASH) Cluster.

Indicator 2.2: Conflict

- Number of conflict incidents within a settlement or within 2km of a settlement. Conflict incidents collected by the International NGO Safety Organization (INSO) for the period of July 2019 - June 2020 were used for analysis.

Indicator 2.3: Air pollution

- 6-month averaged (January-June 2020) satellite data from Sentinel-5P on NO_2, SO_2, CH_4, aerosols.

Susceptibility

Population groups that are more susceptible to a hazard have increased vulnerability. Susceptibility is driven by many components but two components the REACH CVA provides data on that influences susceptibility are dependencies and economic capacity.

Dependency

Indicator 3.1: Households with high number of children

- Relevance: Children are more susceptible to hazards as they have higher dependency on others and may be unable to protect themselves or evacuate if necessary. Children are particularly sensitive to changes in climate, because their developing systems limit their ability to adapt to extreme heat and cold.Therefore, households with more children are more susceptible.
- Indicator: Proportion of households with three or more children

Indicator 3.2: The Elderly

- Relevance: Similarly to children, the elderly are more susceptible to hazards as they have higher dependency on others and may be unable to protect themselves or evacuate if necessary.
- Indicator: Proportion of the population 65 years or older

Indicator 3.3: Disability

- Relevance: Apart from the potential physical inability to evacuate during a disaster, their reliance upon others to ensure their evacuation to safety may involve reliance upon public services.
- Indicator: Proportion of the population with one or more disability

Indicator 3.4: Heads of Households (HoHs) who are widows, single parents, or single female HoH

- Relevance: Single female HoHs, widows, and single parents are found to be disproportionately affected by disasters due to their compounded vulnerabilities and thus this group is considered more susceptible to the shocks of hazards.
- Indicator: Proportion of HoHs who are either a widow, a single parent, or single female HoH

Indicator 3.5: Farmers

- Relevance: Farmers are included here as a susceptible group because their livelihood is heavily dependent on agricultural land and the environment, something that is extremely exposed to hazards arising from conflict, hazardous chemical facilities, wildfires, and extreme temperature.
- Indicator: Proportion of the population whose livelihood is agriculture

Economic Capacity

Indicator 4.1: The Unemployed

- Relevance: Unemployment hinders the economic capacity for preparedness mitigation measures as well as the financial ability to cope during and after the shock of the hazard.
- Indicator: Proportion of the population that is unemployed

Indicator 4.2: Pensioners

- Relevance: Those whose economic capacity is dependent on access to their pensions are more susceptible due to the low financial amount and benefits received.
- Indicator: Proportion of the population who are pensioners.

Coping Capacity

The ability of a population to cope after a hazard occurs is crucial in reducing negative consequences and influences one's vulnerability and risk level to a hazard. The REACH CVA and SESU provide data on distances to key services. Data is also available on preparedness awareness, conflict incidents, and displacement status. These are all factors that drive coping capacity.

Distance to Services

- Relevance: Distance to services affect coping capacity, both in terms of accessing important networks of information regarding preparedness and early warning, but also as a response mechanism during the shock of a hazard

Indicator 5.1: Distance to health care facility

- Indicator: Proportion of population that reports greater than 30 minutes traveling time to a primary health care facility

Indicator 5.2: Distance to social services facility

- Indicator: Proportion of population reporting greater than 20km traveling distance to a social services facility

Indicator 5.3: Distance to education facility

- Indicator: Proportion of population that reports greater than 30 minutes traveling time to an education facility

Indicator 5.4: Distance from a SESU unit

- Indicator: Settlement distance from nearest SESU response unit location

Indicator 6.1: Bomb shelter awareness

- Relevance: Bomb shelters are common in Eastern Ukraine and can provide temporary safe shelter during the shocks of the hazard
- Indicator: Proportion of the population who are not aware of the nearest bomb shelter

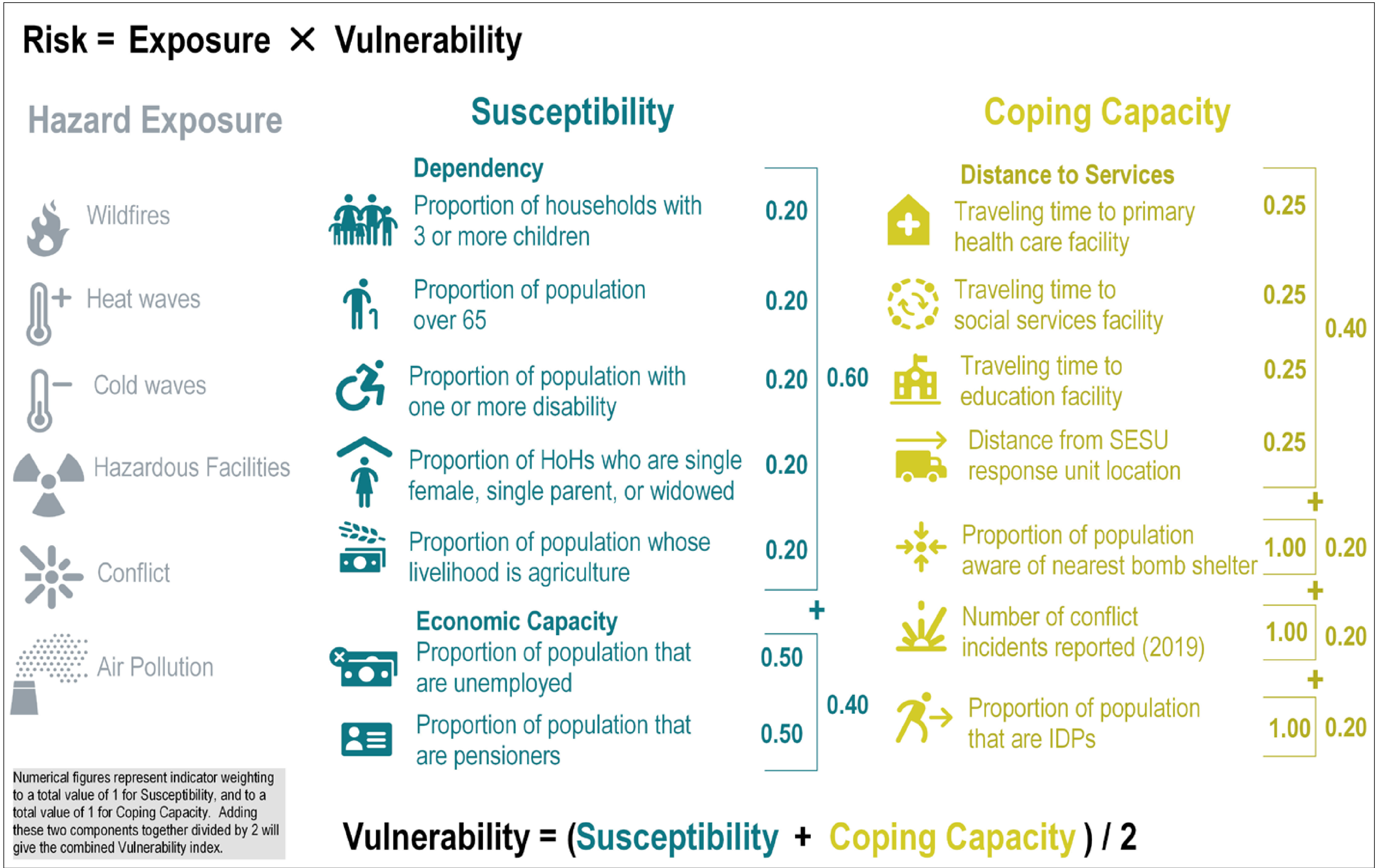
Indicator 7.1: Conflict

- Relevance: Conflict is both relevant as a direct hazard but also something that hinders the coping capacity of communities to other natural and anthropogenic hazards.
- Indicator: Number of conflict incidents reported by INSO in a settlement or within a 2km radius.

Indicator 8.1: Internally Displaced Persons (IDPs)

- Relevance: IDPs depending on their current shelter status are usually more susceptible to the exposure of hazard, but also IDPs lack coping capacities due to limited social networks in their new place of residence.
- Indicator: Proportion of the population that are IDPs

Figure 1.2 Risk Indicator Diagram



HAZARD - WILDFIRES

Hazard Description and Findings

Wildfire and urban fires are a major hazard to the environment, populations and infrastructure. Triggered by a variety of natural and anthropogenic activities, they can lead to both direct (severe burn, smoke inhalation) and indirect mortality (longer term health hazards) and destroy large swathes of natural habitat and manmade structures (houses, factories or utility infrastructure). According to the Intergovernmental Panel on Climate Change (IPCC), rising global temperatures and an increase in the frequency and severity of heatwaves is causing the number of fires to grow every year (IPCC, 2018).

This review contains data on fires in Yasynuvata Raion from two sources: satellite data from NASA FIRMS[1] for the years 2001-2019 and data provided by SESU in Donetska Oblast for the years 2015-2018 (SESU, 2019).

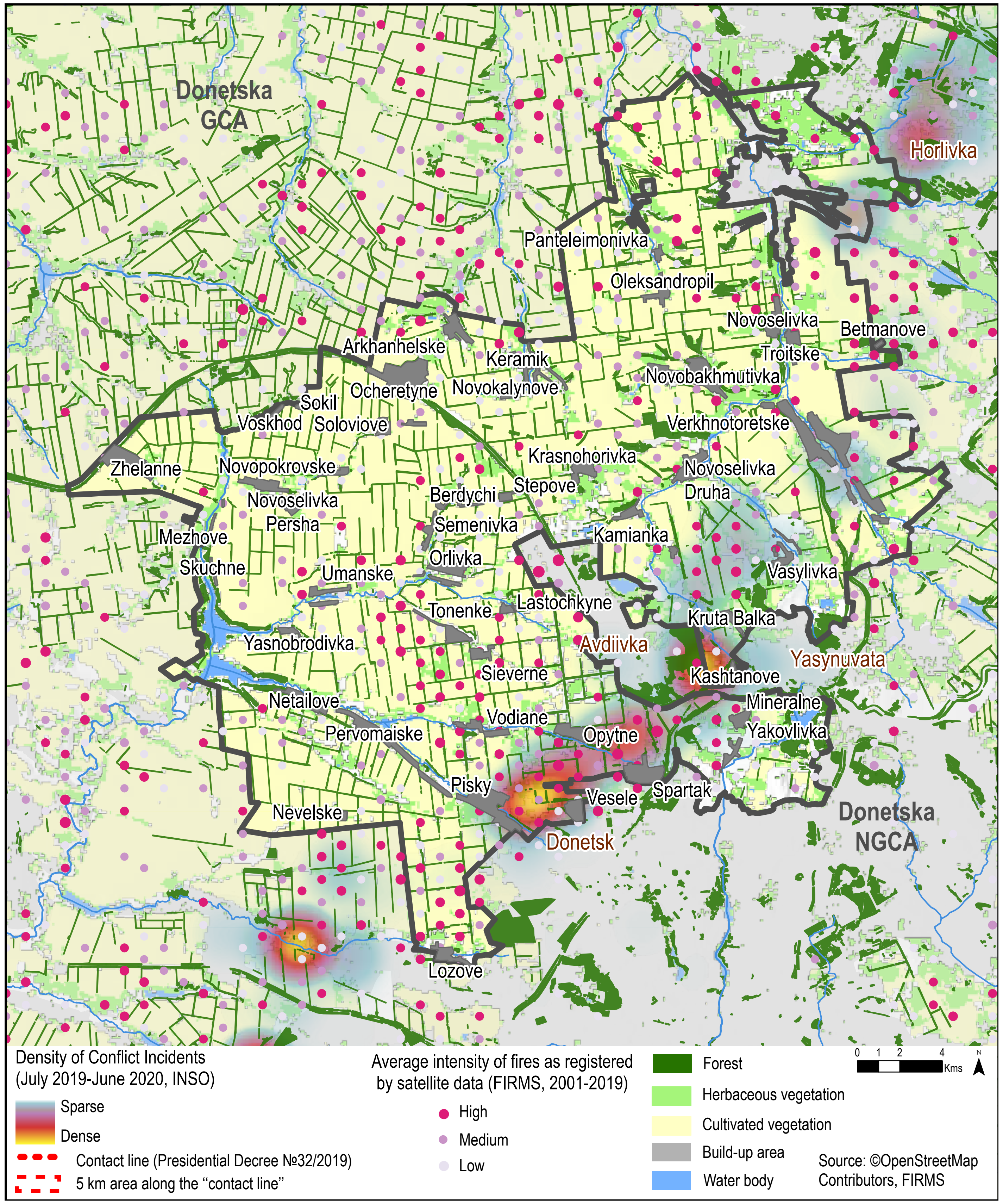
According to FIRMS satellite data, the highest fire frequency was observed near Nevelske, Lozove, Pisky, Opytne, Tonenke, Verkhnotoretske and Vasylivka. Parts of these settlements lay along the CL in an area of high conflict density, which might have resulted in many of the satellite-detected fire events. Conflict incidents and landmine contamination were considered triggers to wildfires, despite only one registered landmine field in the region near Lastochkyne[2]. As this information is considered to be incomplete, ACLED data on landmine explosions within the settlement and its 2km buffer area was included as wildfire indicator component.

According to SESU, most of the fire events were recorded in Novobakhmutivka and Verkhnotoretske. Many satellite detected fire events in the area are located in agricultural lands. This might be a result of the common agriculture practice of stubble burning to prepare a field for sowing, which may lead to the uncontrolled spread of fire, but also leads to soil moisture loss, which is already limited.

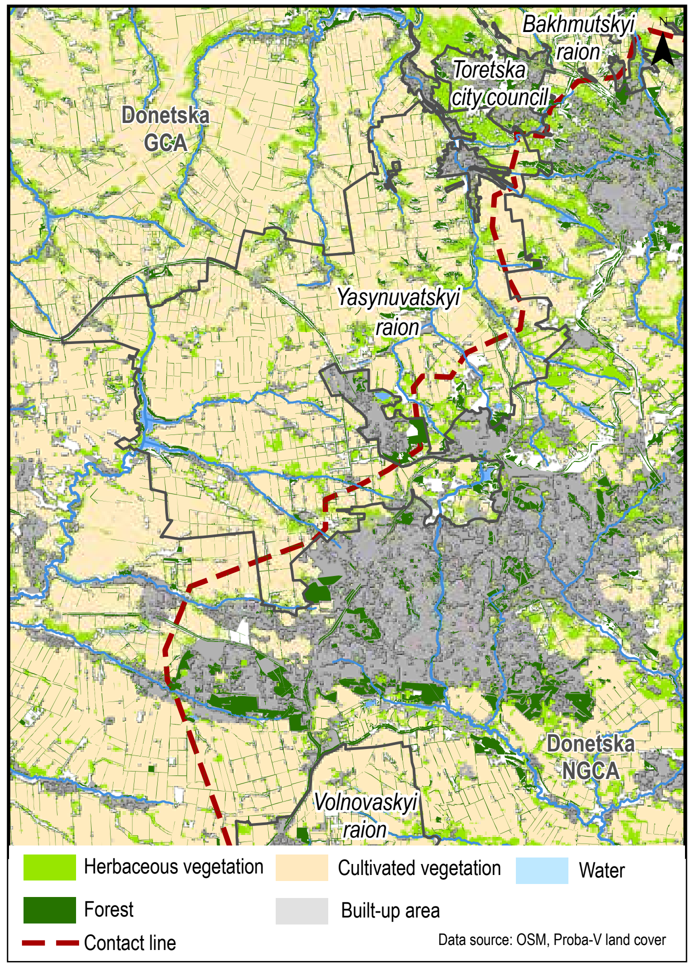
1) FIRMS dataset is based on satellite observations by MODIS and includes data regarding the time, location, and intensity of fires. Dataset excludes fires on industrial land use to avoid conflating the numbers with heat signatures related to process on enterprises.

2) Map of mine-contaminated areas by the Ministry of Defense of Ukraine (https://mod-ukr.imsma-core.org).

Map 1.1 Average Frequency and Intensity of Fires



Map 1.2 Regional Overview of Forest Land Cover



Key takeaways

1. There is a need for an alert system (to be developed) and rapid fire monitoring services, with the increase in wildfire frequency due to climate change.

2. Restoration of forest belts, fire-control measures in the forest areas and firebreak implementation between areas exposed to continuing conflict incidents.

3. Control of agricultural stubble burning.

4. Landmine field detection, marking and the installation of warning signs followed by de-mining activities are needed.

FIRES (all classifications): STATE EMERGENCY SERVICES OF UKRAINE DATA

Map 1.3 SESU trips on reports of fire

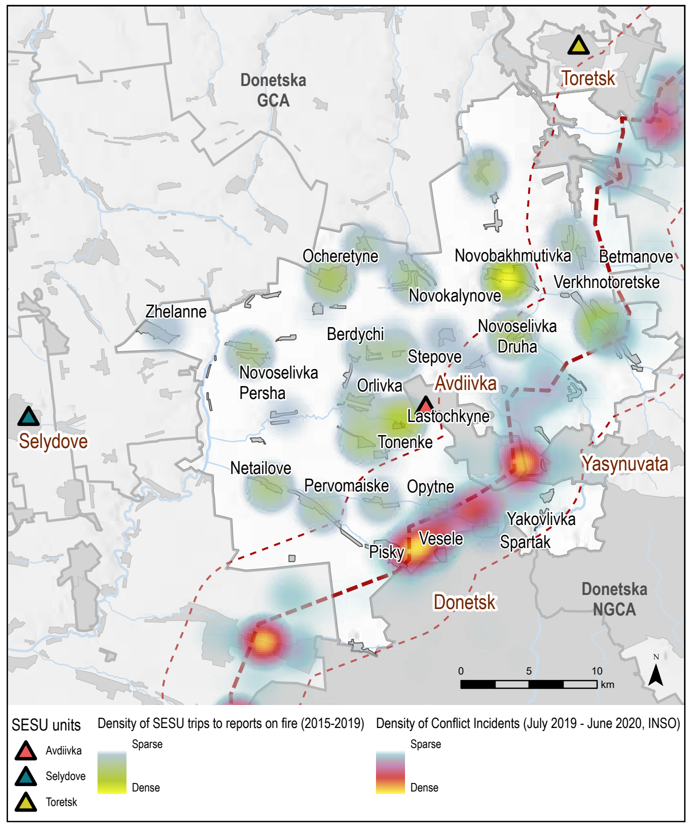
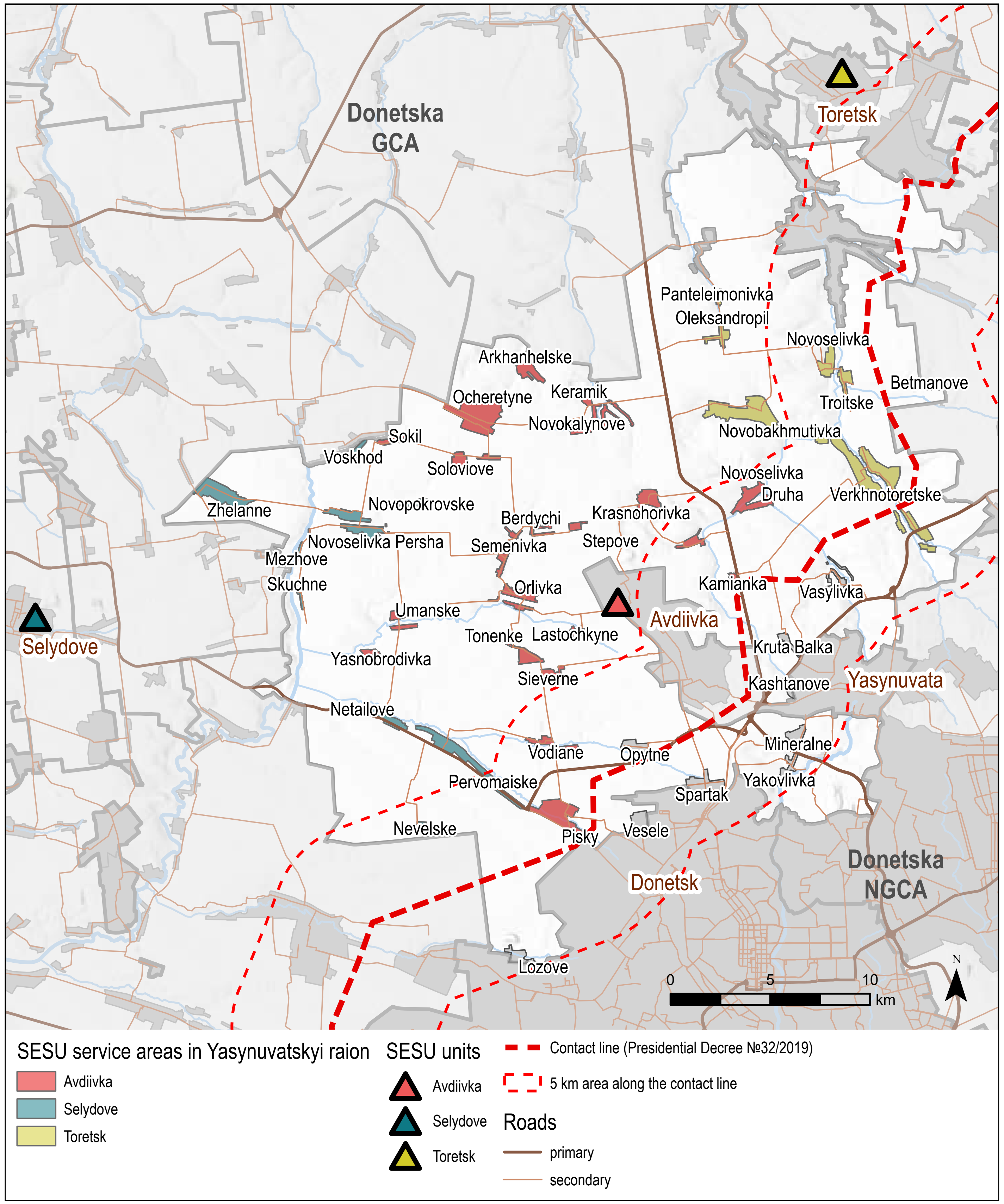


Table 1.1 Annual Number of SESU Trips To Report of Fires

Settlement	2015	2016	2017	2018	Total
Novobakhmutivka	100	117	88	93	398
Verkhnotoretske	23	34	63	56	176
Lastochkyne	24	10	17	26	77
Novoselivka Druha	22	18	19	9	68
Ocheretyne	7	12	7	3	29
Tonenke	2	6	5	7	20
Netailove	1	4	6	2	13
Novoselivka Persha	2	1	2	3	8
Novokalynove	1	5	1	0	7
Orlivka	0	1	3	3	7
Pervomaiske	2	0	2	2	6

Map 1.4 SESU Unit Location and Service Area for Yasynuvatskyi raion



Map 1.5 Regional Overview of Average Annual Number of SESU Trips to Report of Fires

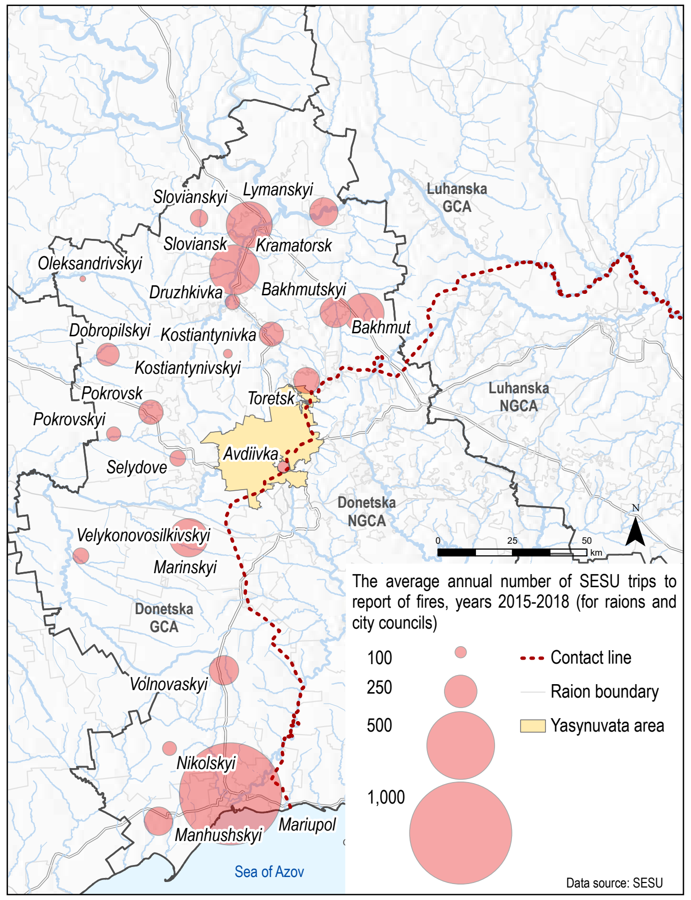
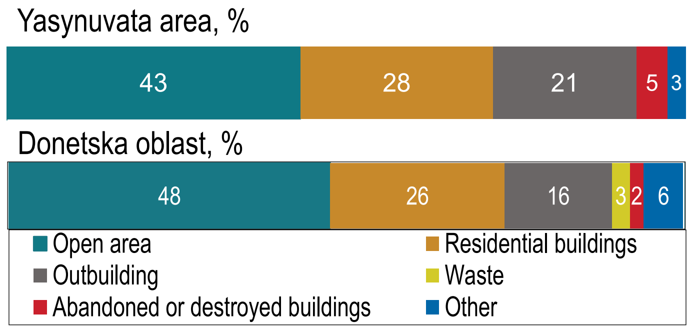


Table 1.2 Most Common Locations of Fires

Affected Area	2015	2016	2017	2018	Total
Open area	7	20	28	32	87
Residential buildings	14	11	22	9	56
Outbuilding	9	10	15	10	44
Abandoned or destroyed buildings	0	0	8	2	10
Municipal buildings and infrastructure	2		1		3



Hazard Description

Prolonged periods of extreme heat are referred to as heat waves (International Federation of Red Cross and Red Crescent Societies, 2011) and are a significant hazard for populations, infrastructure and the environment. Whilst the exact definition varies by country, heatwaves are usually defined by a signifcant and prolonged deviation from the long-term average temperature. They have a significant impact on society, increasing both mortality and morbidity, as well as increasing strain on both infrastructure and ecosystems.

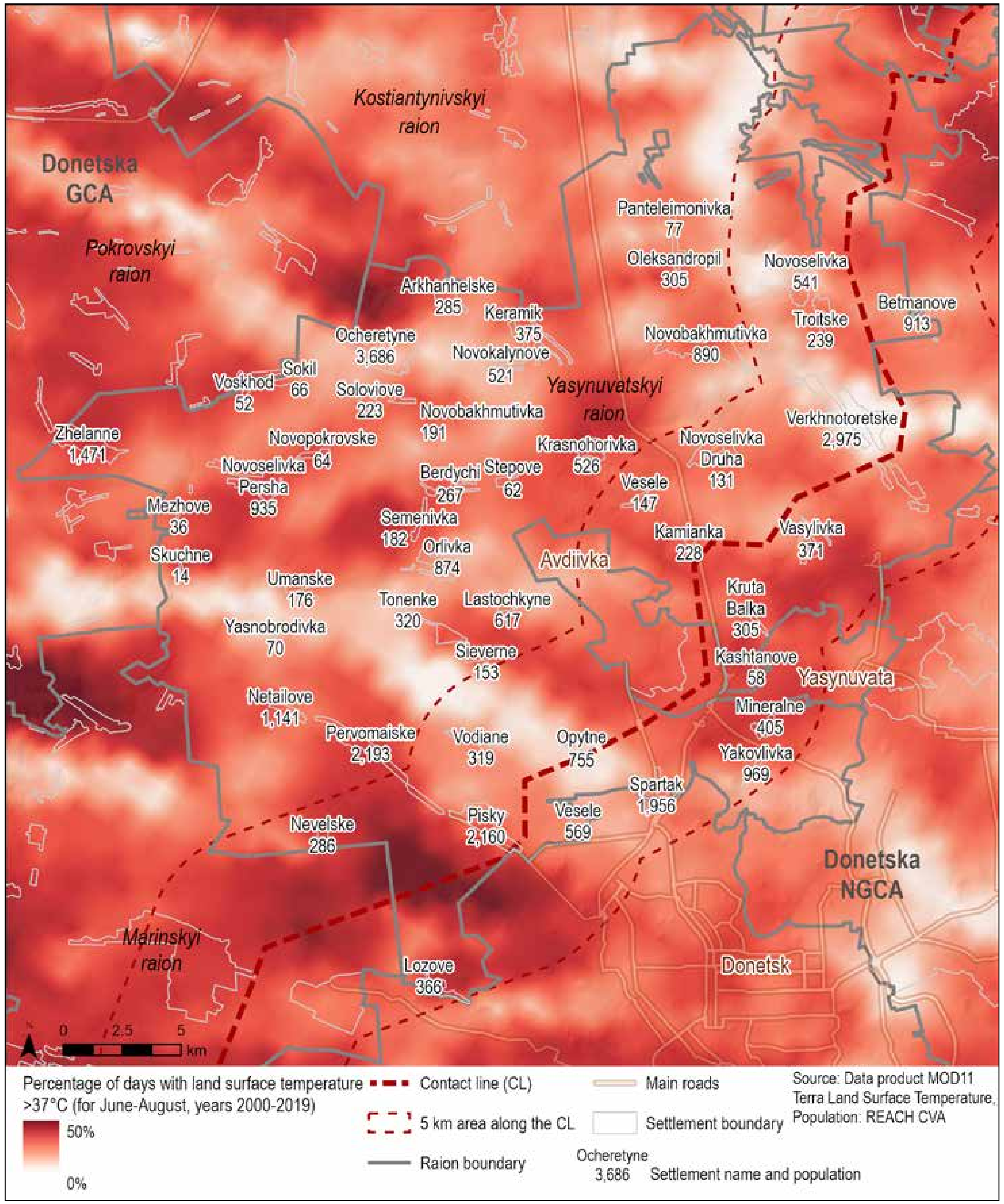
Extreme heat is a leading cause of disaster-related deaths. The 2010 northern hemisphere heatwave led to more than 15,000 indirect deaths globally due to heat stroke and dehydration, particularly affecting susceptible groups. The frequency and severity of heatwaves are also increasing over time (IPCC, 2019) and will become increasingly difficult to address.

Data on abnormally high temperatures in Yasynuvata Raion and adjacent territories was acquired from MODIS[3] (MOD11) (Wan, Z., Hook, S., Hulley, G., 2015), using temperature observations in June, July and August. +37°C was determined as the lower limit for abnormally high temperatures, one standard deviation above the observed mean during the study period (2000-2019). Several heat wave hot spots are visible on map 2.1, to the north of Ocheretyne, between Nevelske and Pisky and around Semenivka and Mezhove.

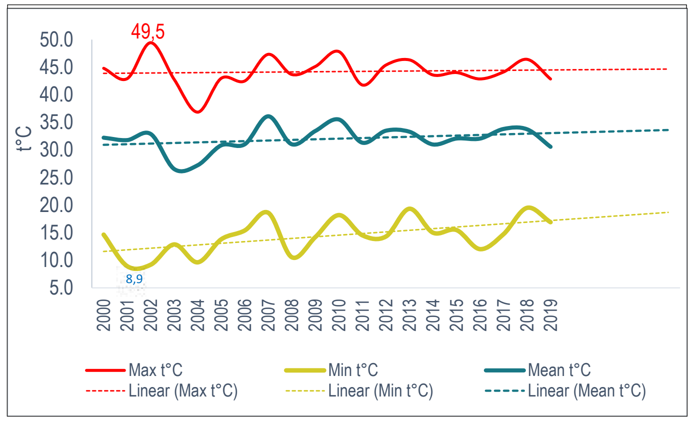
As indicated in Graph 2.1, the highest land surface temperatures (+49.5°C) were observed in July 2002, and +48°C in August 2007 and 2010. The 20-year-averaged land surface temperature during the summer is +32°C. In the last 10 years a continuous gradual increase of mean and maximum temperatures have been observed (with a prognosis of +1°C in the next 5 years) and more rapid increase of minimum land surface temperature (with a prognosis of +3.5°C in the next 5 years according to linear trend).

3) Land Surface Temperature (LST) and emissivity daily data are estimated from land cover types, atmospheric column water vapor and lower boundary air surface temperature are separated into tractable sub-ranges for optimal retrieval.

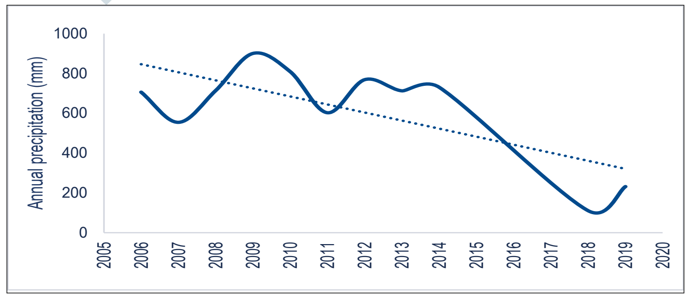
Map 2.1 Percentage of Days in Summer Season with Temperature >37C



Graph 2.1 Mean Temperature in Summer Months



Graph 2.2 Annual precipitation



Heat waves and droughts are often interlinked and extreme temperatures can exacerbate drought impacts. Graph 2.2 shows annual precipitation at Udachnoe Weather Station close to Yasynuvata and a clear decline is visible in recent years, especially in 2018. Drought conditions can dry out vegetation, providing ample fuel for wildfires (Centre For Climate and Energy Solutions, 2019).

The use of land surface temperature products such as MODIS helps authorities identify areas and periods in which abnormally high temperatures can affect the health of residents, in order to support preparedness and response mechanisms. Coupled with societal data on vulnerable groups, particularly those who are more susceptible to heatwaves, authorities can better target risk reduction initiatives within communities with more frequent exposure to abnormally high temperatures.

Key takeaways

1. Inform community and vulnerable groups on WHO recommended practices during heat waves.
2. Ensure warning system is in place to communicate heat forecasts.

Hazard Description

According to the International Federation of Red Cross and Red Crescent Societies (IFRC, 2018), extreme cold or cold waves are weather conditions defined by either a rapid drop in air temperature or a sustained period of excessively cold weather. Severe cold is a threat to human health as prolonged exposure can lead to hypothermia, frostbite and cardiac arrests which tend to lead to increased mortality (Wang, 2016). Deterioration in transport conditions also leads to higher instance of road accidents (Hayat et al, 2013) and affects utility networks such as water and heating systems (Anel et al, 2017). In addition, extreme cold severely damages crops, affecting food production and livelihoods (Massey, 2018).

Ukraine experienced two cold waves in 2006 and 2017. According to the IFRC (IFRC, 2006), 884 people died as a result of the extremely low temperatures. Cold waves most commonly cause fatalities due to hypothermia, but also carbon monoxide poisoning in attempts to heat shelters.

Information on abnormally low temperatures in Yasynuvata Raion and adjacent territories was calculated using MOD11[4], based on temperature observations in December, January and February between 2000 and 2019. Utilizing data from 835 satellite acquisitions, Map 3.1 shows the percentage of days with temperature < -15°C during the study period.

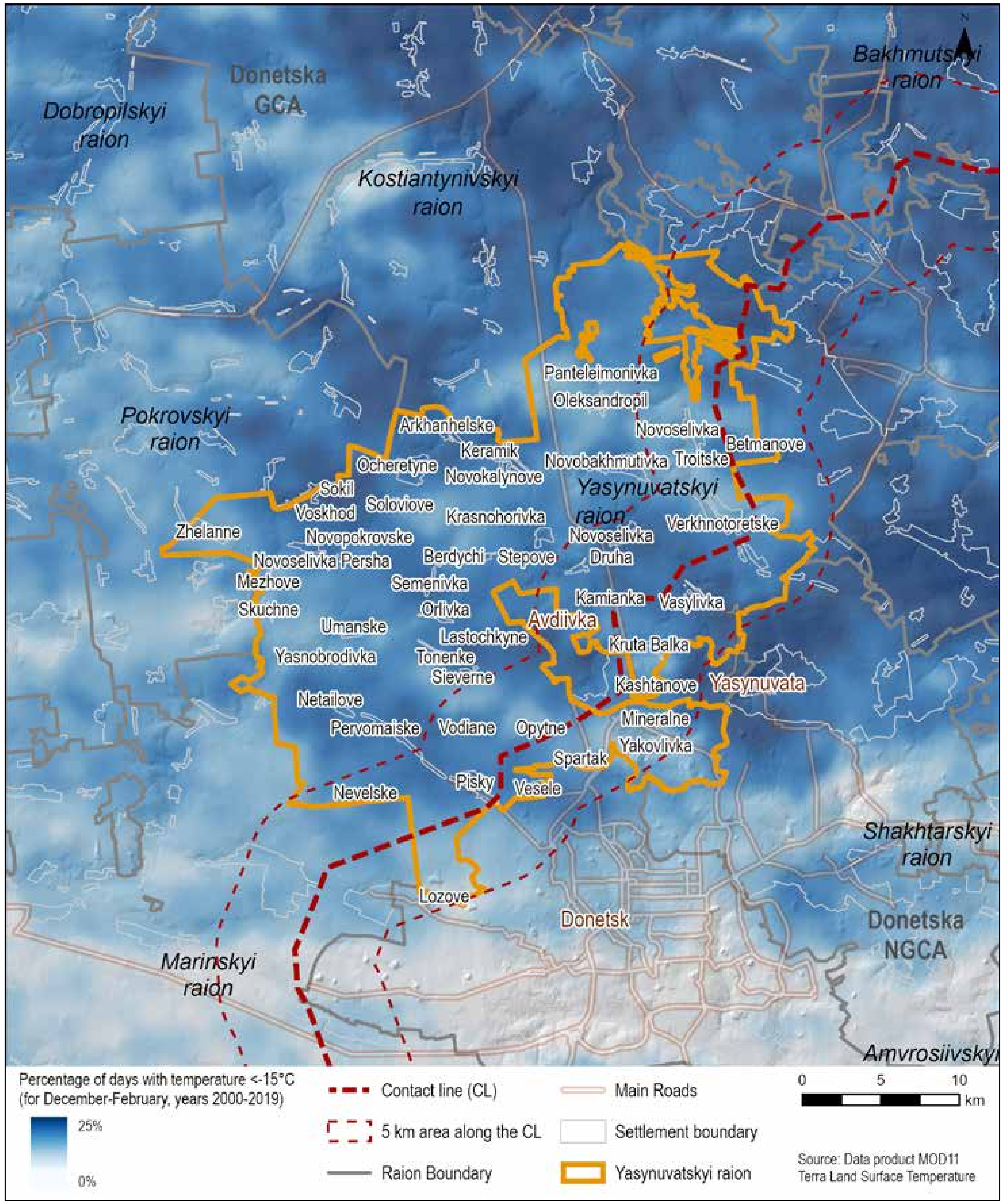
The area around Yasynuvata, Pervomaiske, Netalove, Sokil and the southern part of Avdiivka, are more exposed to cold waves. In the absence of warning signs near landmine contaminated areas, snow cover may be a natural factor increasing the risk of landmine explosions. Frequent fogs are also observed in the area during the winter. However in general, the Yasynuvata raion is less exposed to cold waves than neighboring Kostiantynivskyi and Bakhmutskyi raions.

The lowest temperatures (up to -28°C) were observed in 2006 and 2009. The 20-year-averaged land surface temperature during the winter is -5°C. In the last 10 years a continuous gradual increase of mean winter temperature is observed, but there is no evident trend in maximum and minimum temperatures.

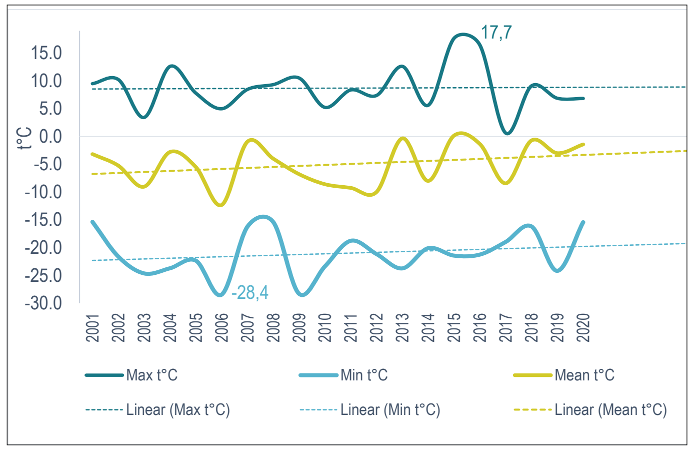
While a range of infrastructure can be affected, the most exposed to low temperatures are water and heating infrastructures. Freezing of water pipes, damage to power lines, and failure of heating systems can cause lasting damage to water access, power, and heating supplies, putting populations at further risk.

4) LST and Emissivity daily data are estimated from land cover types.

Map 3.1 Percentage of Days in Season with Temperature < -15°C



Graph 3.1 Mean, Minimum, and Maximum Temperatures in December-February



Key takeaways

1. Ensure vulnerable groups in areas that experience the most extreme weather can access financial support to cover basic expenses for heating.
2. Increase awareness of initiatives for communal hot spot locations in the case of complete failure of heating supply.
3. Increase awareness on best practices to keep shelter warm and safely heated during disruptions to conventional heating supply.
4. Local responders to identify the most susceptible population groups in the community, especially those that may require assistance and develop contingency plans for this population (the elderly, those with a disability, or young children).

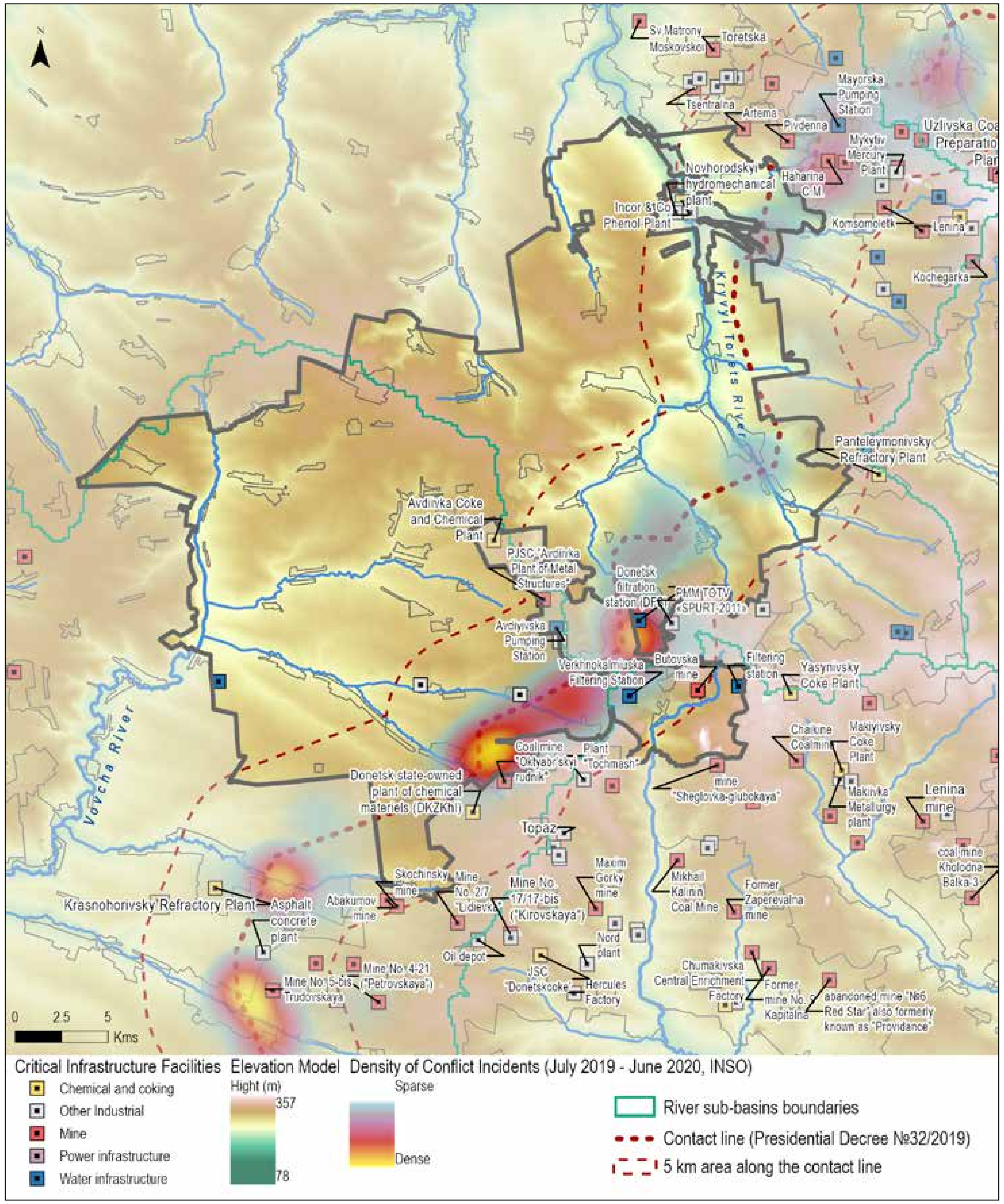
Hazard Description

Based on the Humanitarian Needs Overview (HNO) and the Donbas Environment Information System (DEIS) developed by the Organization for Security and Co-operation in Europe (OSCE) as part of the Environmental Impact Assessment in Eastern Ukraine (commissioned by the Ministry of Ecology and Natural Resources of Ukraine), there are an estimated 14 potentially hazardous facilities in Yasynuvata area (Yasynuvatskyi Raion, Avdiivka and Yasynuvata settlements) and 88 more within 20km of Yasynuvatskyi Raion. These sites include chemical and coke industries, coal mining, water supply infrastructure, machine building, and metallurgy. These facilities are considered to pose both an environmental and human risk due to the hazardous substances present and threat of disruptions or malfunctions due to the conflict.

Table 4.1 Hazardous Facilities within 1000m of Conflict Incidents Reported During 2019-2020 (INSO)

Facility name	Distance to settlement in Yasynuvata area	2019	2020 January-June
Donetsk filtration station	Kashtanove (1km)	333	101
Haharina coal mine	Betmanove (10km)	160	49
Mayorska Pumping Station	Betmanove (12km)	54	38
No. 5-bis Trudovska coal mine	Lozove (9km)	11	28
Horlivska coal preparation plant	Betmanove (11km)	6	20
No. 4-21 Petrovska coal mine	Lozove (6km)	7	13
Avdiivska Pumping Station	Opytne (4km)	20	8
Krasnohorivsky Refractory Plant	Nevelske (8km)	8	7
Donetsk kazenny plant of chemical materials	Pisky (2km)	0	7
Oktyabrskyi rudnik coal mine	Vesele (1km)	11	5
Verkhnokalmiuska Filtering Station	Yakovlivka (2km)	23	3

Map 4.1 Major Hazardous Objects Location



Using the FEAT 2.0 Pocket Guide, key hazardous facilities within the region and their substances were cross-referenced to determine potential human and environmental exposure provided in distances (km) based on low and high substance quantities (kg) to provide insight to a minimum and maximum exposure. The FEAT methodology was developed by the RIVM for UNEP and UNOCHA and based on EU Directives on hazardous substances. Harmonization of Ukrainian legislation with European regulations on handling hazardous substances is one of the priorities in European integration in the field of health and environmental protection.

1. CHEMICAL AND COKE INDUSTRY

• Avdiivka Coke and Chemical Plant

Hazard #1: Industrial site contains **sulfur dioxide**, hydrogen sulfide, hydrogen cyanide, nitrogen oxides, carbon monoxide, phenols, ammonia and benzopyrene (Globally Harmonized System (GHS) classification: Health hazard, STOT SE 1)

Hazard #2: Waste from tailing contains phenols, ammonia and sulfuric acid.

Receptors: air, soil, rivers, groundwater, humans.

Exposure distance table:

Receptor	Distance (km)	Quantity (kg)
Humans (lethal)	> 5	Any quantity has an impact
Humans (health)	> 5	
Environment (soil)	> 10	
Environment (river)	> 10	

This plant was built in 1963 to produce coke primarily for iron ore smelting and fuel. Thirty-five conflict events were recorded by DEIS near the plant between 2014-2017. The plant halted operations more than 15 times as a result of conflict events and was shut down for 3 months in 2017. The main problems are related to water and electricity supply disruption (which may lead to shut-down of cooling systems and accidents), as well as problems with coal supply and coke export from the plant due to shelling of the railway.

• Incor & Co Phenol plant

Hazard #1: Industrial site contains **toluene**, phenol, and naphthalene (GHS classification: Toxic liquid Acute Tox. 1)

Hazard #2: Tailing waste contains phenol, **sulfuric acid**, pyridine (GHS Classification: Toxic liquid Acute Tox. 1)

Receptors: air, soil, groundwater, rivers, humans.

Exposure distance table:

Receptor	Distance (km)	Quantity (kg)
Humans (lethal)	1 - 5	20- 1000
Humans (health)	> 5	20
Environment (soil)	2 - > 10	20 - 5000
Environment (river)	5 - > 10	20 - 1000

The phenol plant was built in 1916 and processes coke-chemical oils (by-products of high-temperature coal coking). It also produces technical and purified naphthalene, coal phenol, orthocresol, dicresol, tricresol, mixed fuels and corrosion inhibitors. The plant is located in Novhorodske settlement (Toretsk city council), but tailing dams of the phenol plant are located in Yasynuvatskyi Raion. The tailing dams contain more than 900,000 tons of liquid waste.

According to secondary data review, there was a dam breakage about ten years ago, which flooded the Nelipivka village (RCUS field data). Ten conflict events were registered within 1km of the facility (INSO data, 2017-2019). On July 25, 2018 artillery shell struck one of the tailing dams, although no chemical leaks were recorded.

Similar enterprises close to Yasynuvata area are **Yasynuvatskyi coke and chemical plant** (reportedly damaged by shelling in August 2014) and **Makiivskyi coke plant**; both plants are located in NGCA. Work at these plants was terminated due to loss of control by management, but satellite images reveal recent operations of blast furnaces.

- **Donetsk state-owned plant of chemical materials**

Hazard: Industrial site and storage contain **ammonium nitrate**, ammonia, oxidizing agents and metal salts (GHS Classification: Explosive, Ox. Sol. 1, STOT SE 1).

Receptors: air, humans.

Exposure distance table:

Receptor	Distance (km)
Humans (lethal)	0.2
Humans (health)	0.4

This plant was built in the mid-1940s and produced ammunition and explosive materials (military and industrial), as well as specializing in the disposal of ammunition. A radioactive waste storage facility is located on the territory of the plant. Since the beginning of conflict in 2014, the plant has been located in NGCA, and was reported to have been damaged by artillery shells in September and October 2014. In February 2017 there was an explosion due to careless handling of explosives.

2. WATER TREATMENT PLANTS (WATER FILTER STATIONS)

Hazard #1: Chlorine (GHS Classification: Toxic Gas, Acute Tox. 1.)

Receptors: air, humans.

Exposure distance table:

Receptor	Distance (km)	Quantity (kg)
Humans (lethal)	0.4 - 1.3	10,000 - >million
Humans (health)	2 - 5	10,000 - >million

Hazard #2: Chlorine (GHS Classification: Toxic Liquid, Acute Tox. 1).

Receptors: soil, groundwater, rivers, humans.

Exposure distance table:

Receptor	Distance (km)	Quantity (kg)
Humans (lethal)	1 - 5	20 - 1000
Humans (health)	> 5	20
Environment (soil)	2 - > 10	20 - 5000
Environment (river)	5 - > 10	20 - 1000

- **Donetska water filtering stations** provide water to Avdiivka, Yasynuvata, Verkhnotoretske, Vasylivka, Betmanovo, Kruta Balka and partly to Donetsk (345,000 people in total). The station has been a constant target for shelling; in 2014, the station did not function for almost 4 months. In 2015-2017, constant supply interruptions lasted from several days to several weeks. In the first half of 2020, 101 conflict events were detected near the station (> 1,500 since 2017) according to INSO data.
- **Karlivska (Pokrovska) filtering station** provides water supply to most of the settlements of Yasynuvata area, as well as Pokrovsk, Selydove and Dobropillya areas. Due to power outages, the station has faced several temporary shut-downs, leading to reduced water supply on a number of occasions. On July 7, 2020 lightning struck the electricity lines near Ocheretyne and water supply was suspended for several days due to restoration works of the power supply line in Yasynuvata raion.
- **Verkhnokalmiuska filtering station** is located in Yasynuvatskyi Raion near Yakovlivka settlement in NGCA and provides water to Donetsk, Yasynuvata and partly Makiivka. Twenty-three conflict events were recorded by INSO in close proximity to the station in 2019.
- **Makiivska filtering stations** is located in NGCA and provides drinking water to Makiivka. In September 2018, more than 100 people were hospitalized due to poisoning caused by failure of water treatment systems (https://mtot.gov.ua).

3. COAL MINES

Hazard substance #1: Methane (GHS classification: Flammable, Flam Gas 1.) Receptors: air, humans.

Exposure distance table:

Receptor	Distance (km)	Quantity (kg)
Humans (health)	0.2 - 0.3	1 million

Hazard substance #2: Waste from tailings (GHS classification: Toxic Liquid Acute Tox 1, Aquatic Acute 1). Receptors: soil, groundwater, rivers, humans.

Exposure distance table:

Receptor	Distance (km)	Quantity (kg)
Humans (lethal)	1 - 5	20 - 1000
Humans (health)	> 5	20
Environment (soil)	2 - > 10	20 - 5000
Environment (river)	5 - > 10	20 - 1000

- **Butivska coal mine** is located near Miniralne settlement in NGCA and was founded in 1928. Several shelling events occurred in 2016-2017, resulting in infrastructural damage.

Seventeen additional coal mines are located within 10km of Yakovlivka, Mineralne, Vesele, Betmanove, Zhelanne, Lozove and Spartak in the Yasynuvata area. Between July 2019 and June 2020, various conflict events were recorded near **coal mines No.5-bis** (32 events); **No.4-21** (15 events); **Zhovtnevyi rudnyk** (8 events); **Komsomolets** (2 events); and **Chekist**, **No. 17/17-bis** and **Kalinin** (1 event each). Disruptions or discontinuation of power supplies, damaged or destroyed infrastructure, and disabled pumping equipment are causing the flooding of sites which contain significant storage of hazardous materials.

4. MECHANICAL ENGINEERING INDUSTRY

Hazard substance: isopropyl alcohol (GHS Classification: Flammable Flam. Liq. 2). Receptors: air, humans. *Exposure distance table:*

Receptor	Distance (km)	Quantity (kg)
Humans (lethal)	0.4 - 1.3	10 - > 100million
Humans (health)	0.4 - 1.3	10 - 100 million

- **Avdiivka factory for metal constructions** is located in Avdiivka and was founded in 1946 to produce metal structures for construction. In February 2017, a shell struck the plant.
- **Novgorodsky hydromechanical plant** is located in Novgorodske (Toretsk city council) and produces the spare parts and mining equipment for the coal industry. Ten conflict events were recorded near the plant in 2017-2020.

4. LIVESTOCK

Hazard substance #1: Carbamate pesticide (GHS classification: Aquatic Acute 1)

Receptors: soil, groundwater and rivers. Causes serious injury to aquatic organisms in short period of time.

Exposure distance table:

Receptor	Distance (km)	Quantity (kg)
Environment (soil)	2.8 - > 10	100 - 5000
Environment (river)	10 - > 10	20 -1000

- **Pig farm for 12,000 heads** is located near Tonenke settlement. During active hostilities, the pig farm was badly damaged and destroyed, causing one fatality, the death of nearly 200 animals and injury of nearly 50 more. In 2018, the farm completely restored its activities.

Facility Description

Public Join-Stock Company First Investment Bank (PJSC) Avdiivka coke and chemical plant is located to the north of Avdiidka in an industrial area between 2 river basins (Vovcha and Kazennyi Torets rivers).

According to FEAT, the hazardous substances of PJSC Avdiivka coke and chemical plant are classified as toxic liquid acute tox.1 and **lethal to humans at a distance from 1 to 5km**.

The 1km buffer area of Avdiivka coke plant includes a residential zone of Avdiivka (map 4.2).

The 5km buffer area of Avdiivka coke plant includes 12 educational facilities, 8 health facilities and the residential zones of Avdiivka, Orlivka, Krasnohorivka and Lastochkine (map 4.4).

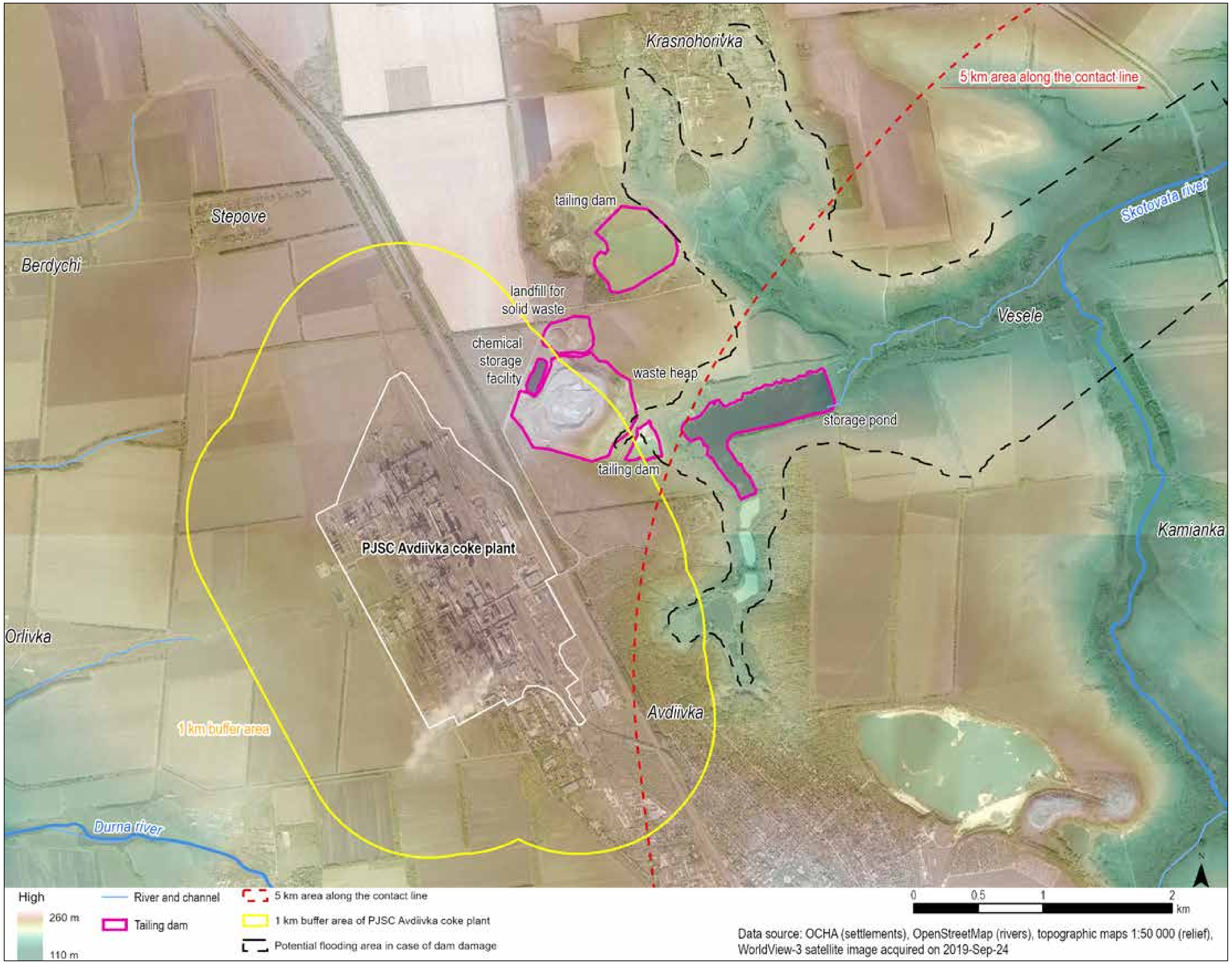
There are 6 storage facilities for hazardous plant waste including a chemical storage facility, waste heap, storage pond, tailing dam and sludge storage facility.

To map a potential flooding area in the event of tailing dam damage, terrain analysis in GIS was applied. The area below the altitude of the tailing dam was extracted and flow accumulation rate was calculated based on the slope length and degree (map 4.3). Results showed the area with flow accumulation rate, indicating the speed of polllution diffusion (highest risk of flooding). The southern part of Krasnohorivka village is located within the area of highest flooding risk.

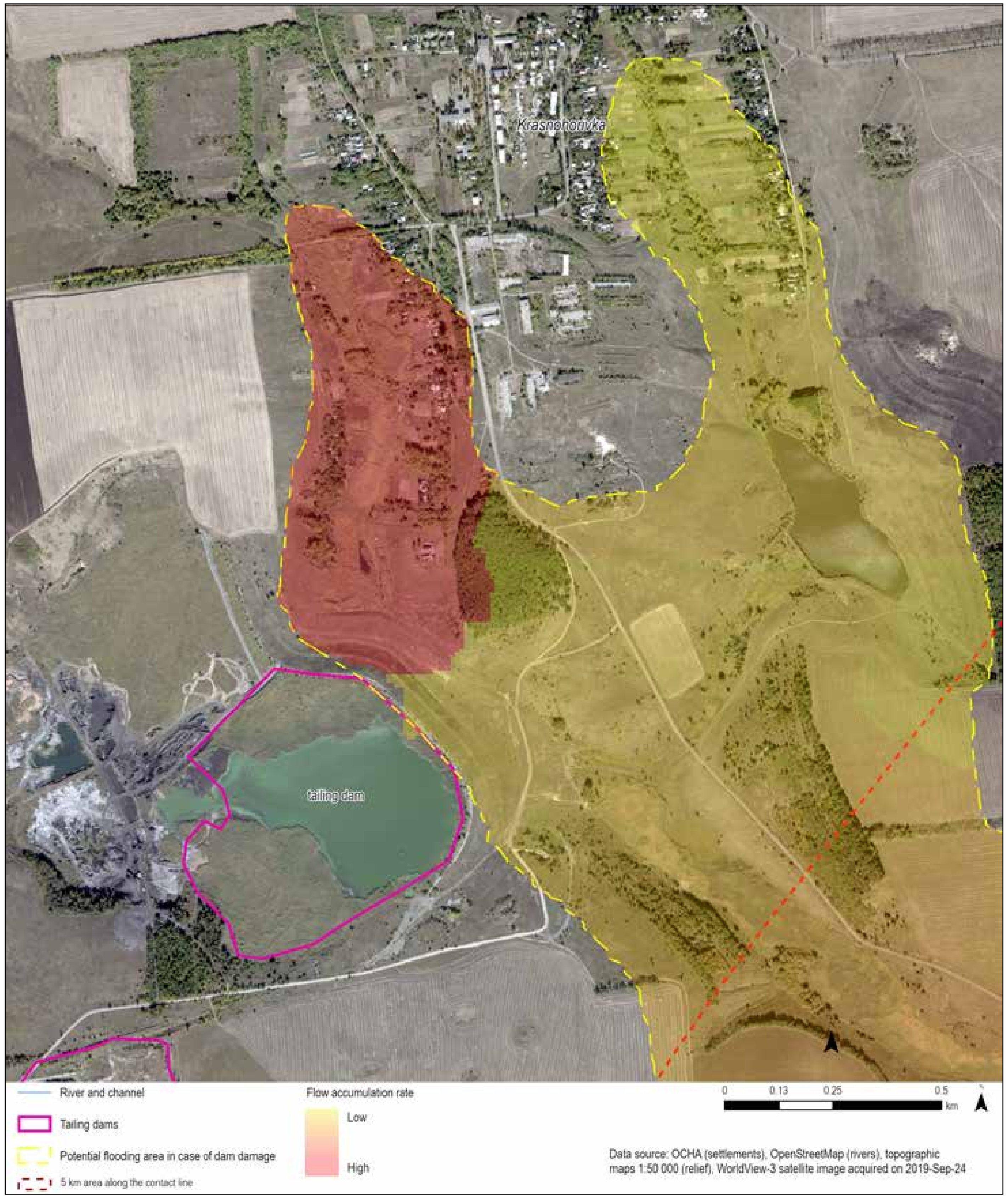
Thirty-two conflict-related incidents occurred near the plant in 2014-2017, which caused the plant termination, accoring to DEIS data.

PJSC Avdiivka coke and chemical plant requires the development of a waste management plan, including hazardous substances utilization from tailing dams, as well as reconstruction and strengthening the walls of storage dams.

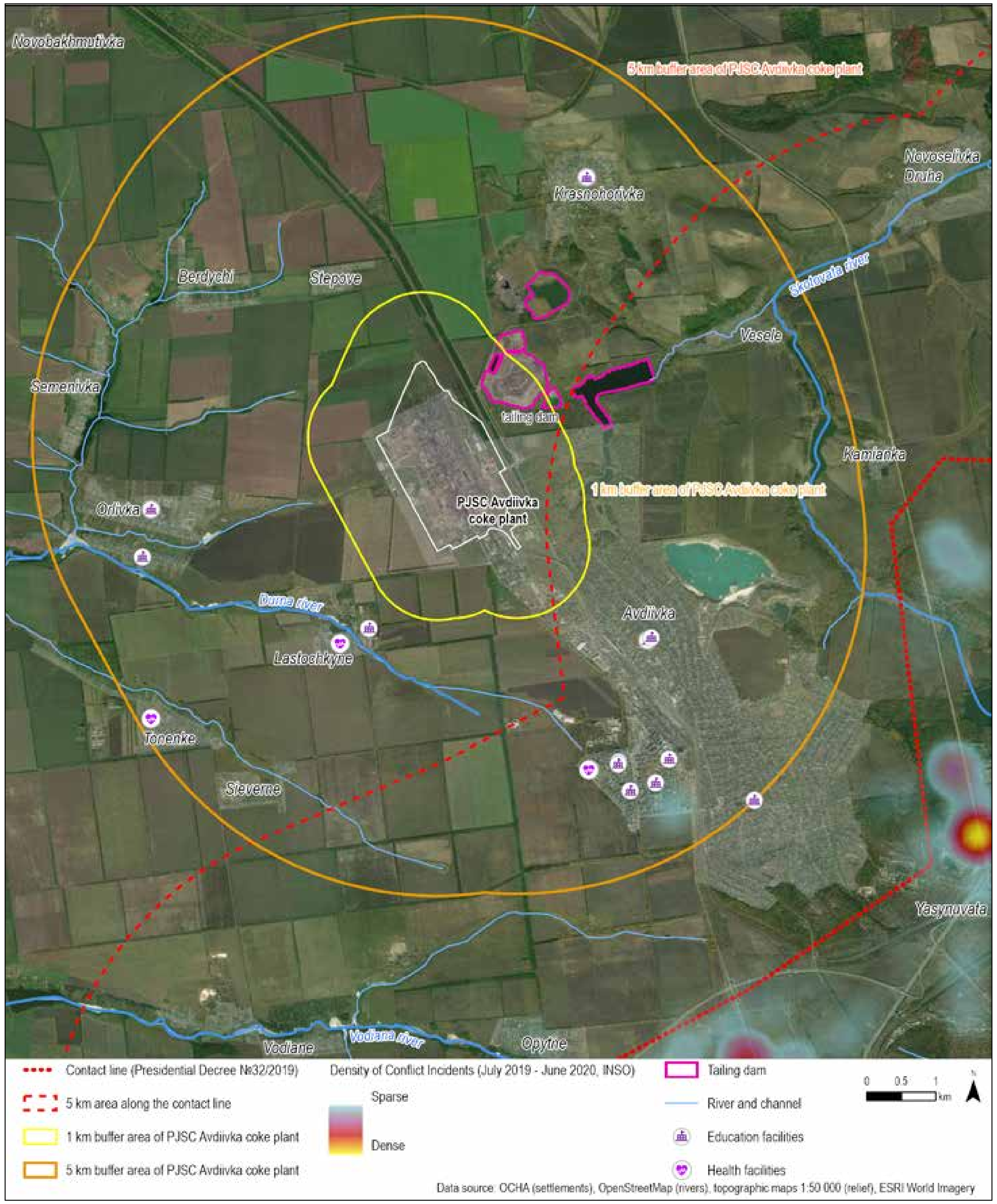
Map 4.2 One-km buffer area of Avdiivka coke plant



Map 4.3 Potential floowing area in cave of tailing dam damage



Map 4.4 Five-km buffer area of Avdiivka coke plant



Hazard Description

Because Donbas is a heavily industrialized region with a large coal and metallurgical industry, it suffers from the highest levels of air pollution in Ukraine.

According to the World Health Organisation (WHO), air pollution poses a major threat to health and climate, causing around seven million premature deaths annually, primarily due to stroke, heart disease, chronic obstructive pulmonary disease, lung cancer and acute respiratory infections. Air pollution sources include gases (e.g. ammonia, carbon monoxide, sulfur dioxide, nitrous oxides, methane and chlorofluorocarbons), particulates and biological molecules. Both human activity and natural processes generate air pollution.

To fulfil Ukraine's obligations in the EU Association Agreement, the Ukraine Cabinet of Ministers amended the Procedure for State Monitoring of Air Quality in August 2019. To implement the requirements of Directive 2008/50/EC & Directive 2004/107/EC, the list of pollutants that must be monitored was defined and maximum permissible concentrations (MPC) of airborne substances was set according to European Commission (EC) Directives.

Donetska Oblast Automated Environmental Monitoring System includes 44 air quality monitoring posts and was established in 2017. It is operated by the Department of Ecology and Natural Resources of the Donetsk Regional State Administration and Donetska SESU Department. On maps 5.3-5.5, locations of monitoring posts are indicated and dot size indicates the number of days during the first 3 months of 2020 when pollution exceeded the MPC. The closest posts to Yasynuvata are located in Novhorodske, Toretsk city council, near Incor & Co Phenol Plant.

Although data from the NGCA is unavailable, satellite imagery (map 5.3) shows that the area around Donetsk has a high rate of nitrogen dioxide (NO_2) emissions, along with the area north of Kramators. Thus, satellite data can effectively contribute to understanding regional pollution dynamics.

Since July 2018, the European Space Agency Sentinel-5P satellite mission has been collecting global atmospheric data on Nitrogen dioxide (NO_2), Sulfur dioxide (SO_2), Carbon monoxide (CO) and aerosol concentrations in the atmospheric column. In combination with on-ground air monitoring posts, it is an effective tool to detect primary pollution sources and assess settlement-level pollution risk. As atmospheric emissions can spread over large areas, 6-month averaged satellite data from January-June 2020 were used as anthropogenic hazard exposure indicator 2.3 to identify protracted emission sources in the region.

SO_2 MPC was exceeded on >50% of days at all observation points in the Donetsk region. At Pokrovsk and Volodymyrivka, SO_2 MPC exceedance was recorded on 100% of days, and on >90% of days in 7 settlements (Svitlodarsk, Mariupol, Soledar, Bakhmut, Mykolaivka, Novotroitske and Kurakhove).

Slovyanska TPS in Mykolayivka experienced NO_2 MPC exceedance all days, whilst exceedance on >88% of days was recorded in Kostiantynivka, Mykolaivka, Novotroitske and Mariupol. Overall, >50% of days with NO_2 MPC exceedance was found at 27/42 of posts.

Regarding pm10 fraction, 32/42 observation points recorded MPC exceedance on > 50% of days. At air monitoring posts in Mariupol and Kostiantynivka, MPC exceedance was recorded on all days, whilst Kurakhove recorded exceedance on >85% of days.

In 14/42 observation points, >50% of days recorded pm25 MPC exceedance. The highest percentage of days with exceedance (77%) was observed at Kostiantynivka and 71% in Yasnohirka.

Map 5.1 NO2 emissions in Ukraine

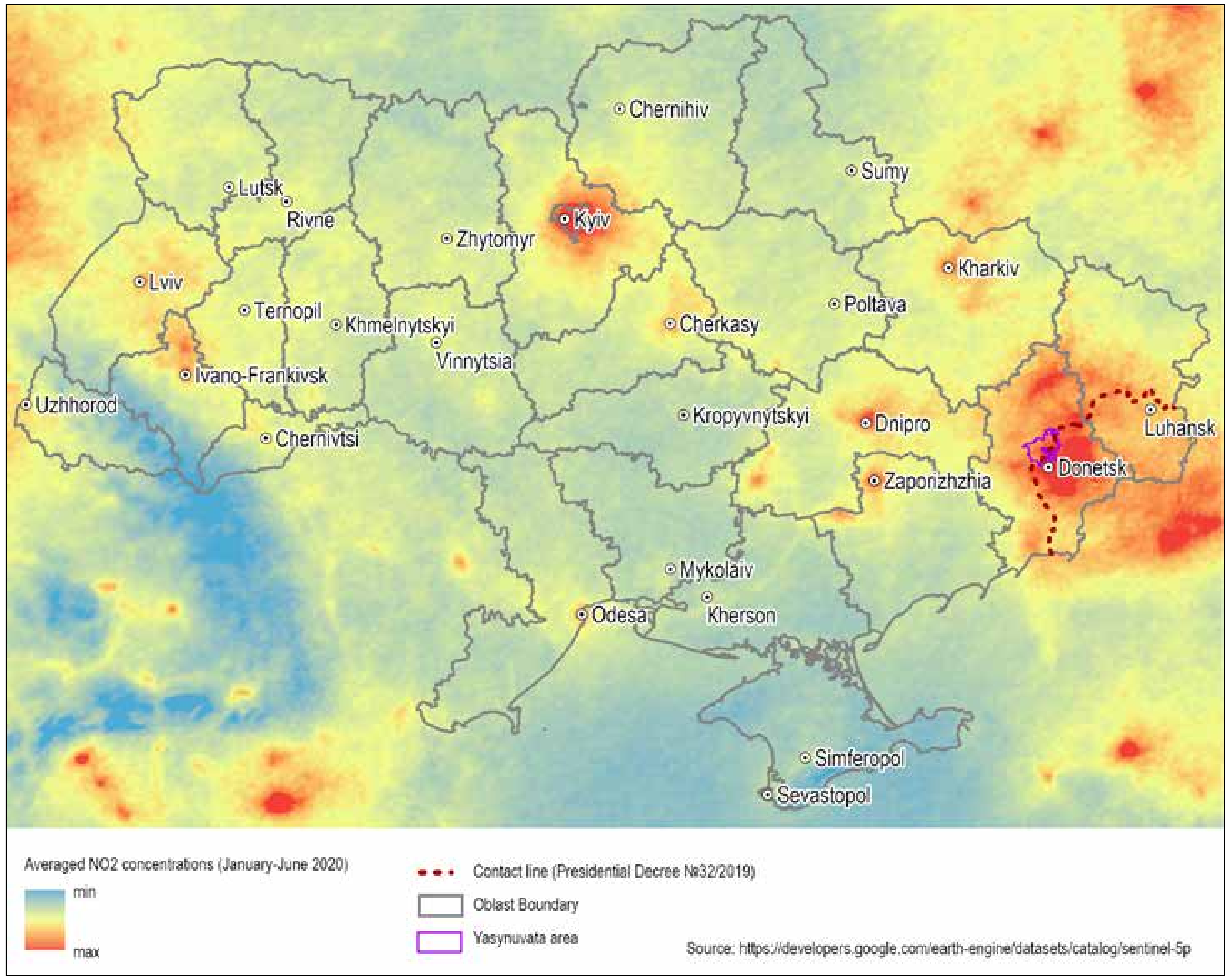
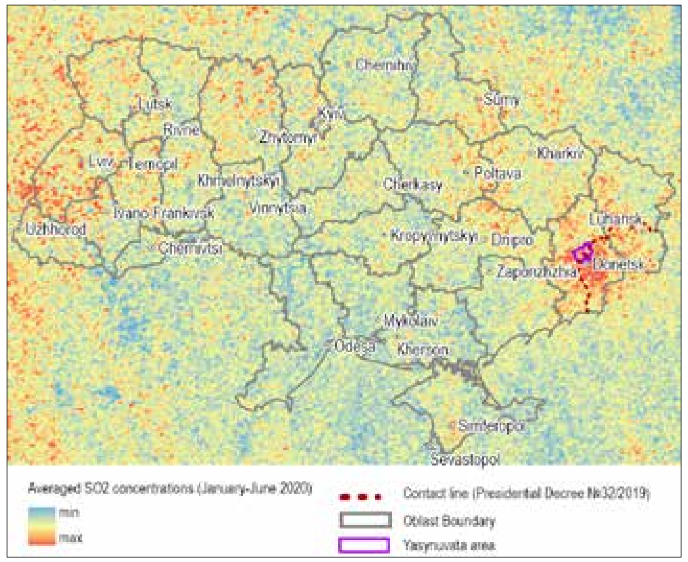


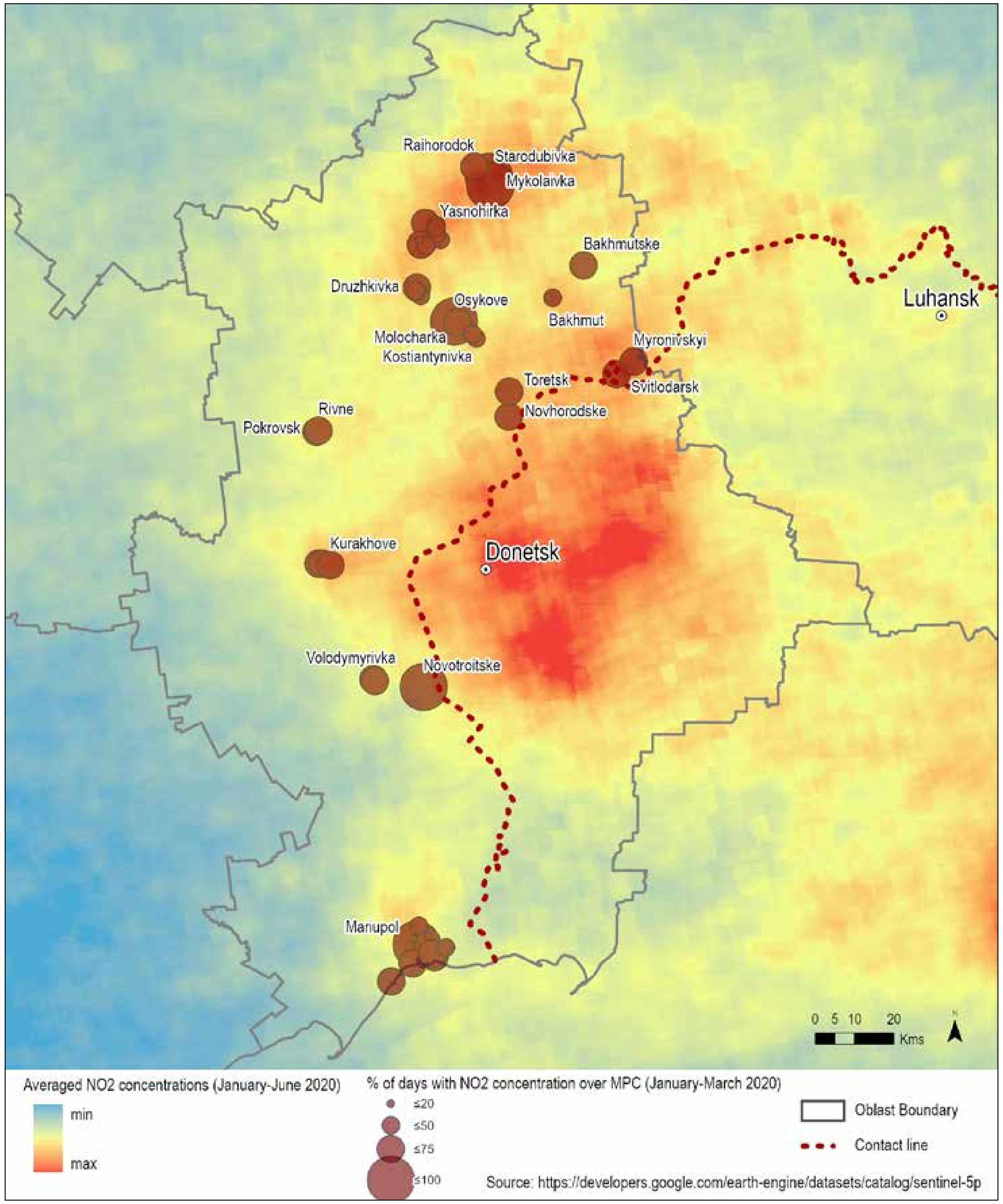
Table 5.1 Seasonal dynamics of NO2 concentration in the air in 2019

Raion Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yearly mean
Bakhmutskyi	1.64	1.03	1.01	1.08	0.92	0.95	1.07	0.93	0.94	1.01	0.79	0.85	1.02
Dobropilskyi	1.70	0.95	0.87	1.02	0.90	0.98	0.91	0.93	0.89	0.85	0.73	0.64	0.95
Lymanskyi	2.07	0.94	0.96	0.93	0.93	0.89	0.94	0.90	0.92	0.88	0.76	0.79	0.99
Manhushskyi	0.81	0.70	0.70	0.87	0.81	0.93	0.88	0.89	0.83	0.79	0.67	0.64	0.79
Oleksandrivskyi	1.87	0.92	0.84	1.03	0.90	0.95	0.87	0.93	0.95	0.80	0.71	0.61	0.95
Pokrovskyi	1.47	0.99	0.87	1.09	0.93	1.00	0.92	0.94	0.93	0.89	0.76	0.63	0.95
Slovianskyi	2.12	1.00	0.94	1.13	0.97	0.98	0.94	0.98	1.11	0.95	0.82	0.73	1.06
Velykonovosilkivskyi	1.01	0.85	0.79	0.99	0.86	1.04	0.88	0.88	0.93	0.83	0.70	0.62	0.86
Volnovaskyi	1.00	0.93	0.79	0.98	0.85	0.99	0.92	0.90	0.88	0.88	0.72	0.66	0.88
Yasynuvatskyi	**1.66**	**1.16**	**0.98**	**1.16**	**0.95**	**1.02**	**0.96**	**0.95**	**0.94**	**0.97**	**0.82**	**0.73**	**1.02**

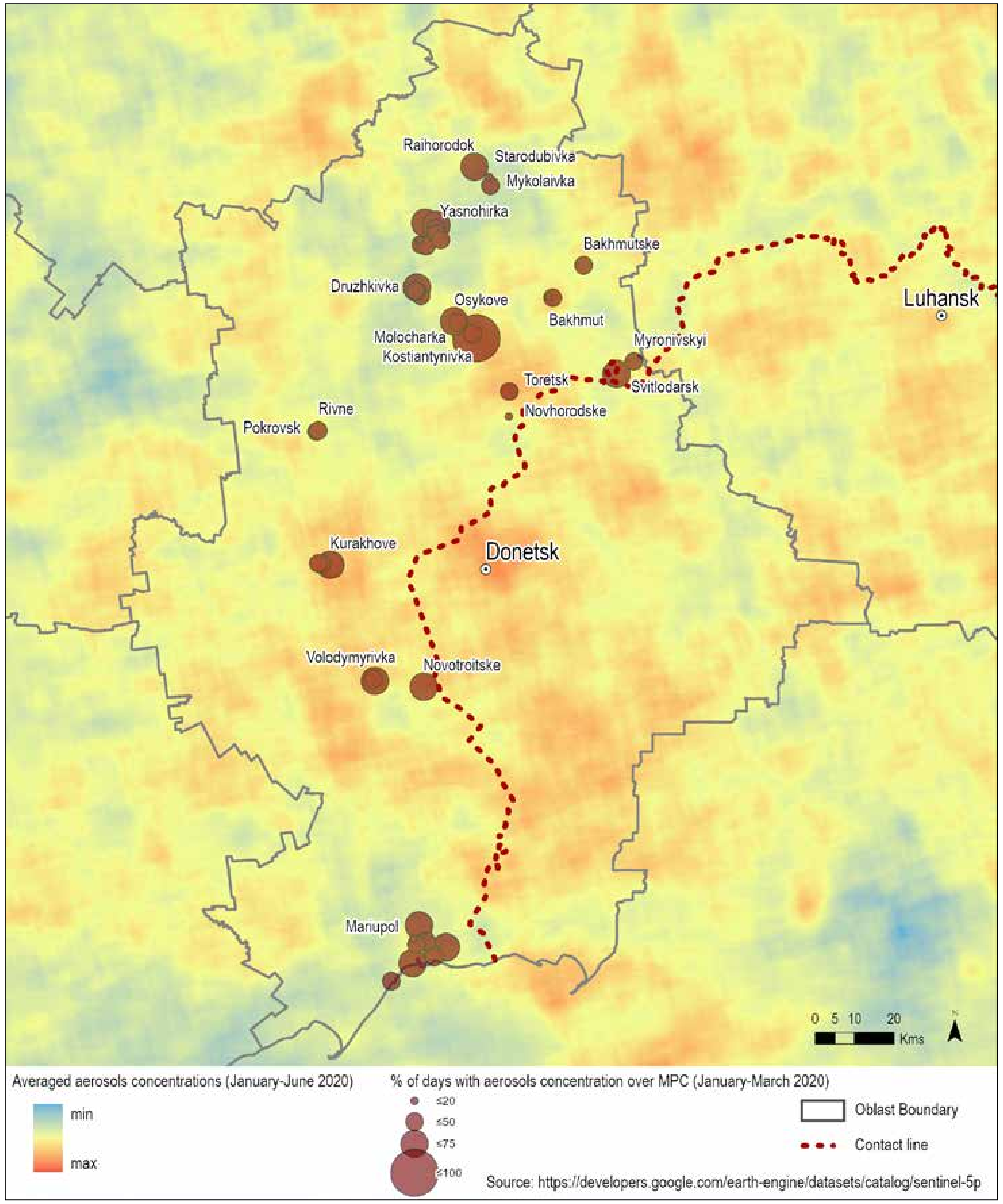
Map 5.2 SO2 emissions in Ukraine



Map 5.3 NO2 emissions in Eastern Ukraine



Map 5.4 Aerosols concentration in Eastern Ukraine



Yasynuvata air pollution

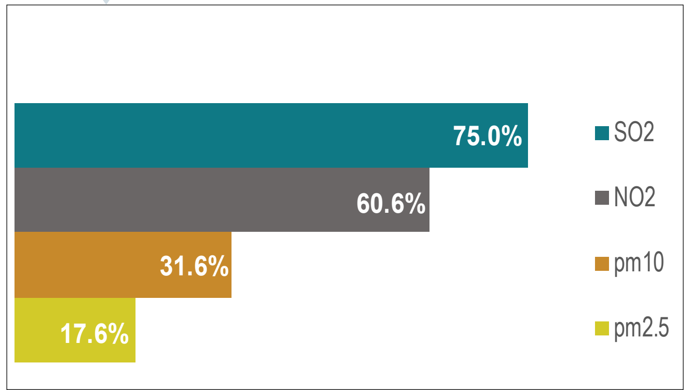
The chemical and coal industries are the primary SO_2 polluters in the area. Plants include Avdiivka coke and chemical plant and Incor & Co phenol plant in Novhorodske, located in the GCA. Additionally, 2 coke plants located in Makiivka in the NGCA contribute to SO_2 emmisions across the region. No official information is available about plant operations and emissions in NGCA, although Sentinel-2 satellite images provide a source of recent information and reveal blast furnace operations at these plants (fig. 5.1-5.2). As seen on the satellite image in fig. 5.1, a dust cloud from Avdiivka coke and chemical plant has spread over a 1km area around the plant.

Another source of air pollution in the area is evaporation from tailing dams, which is especially acute during heat waves or prolonged periods of high temperatures. Evaporation leads to the accumulation of dry residues around tailing dams, which is then distributed by wind over long distances.

Satellite data also confirms more or less even distribution of NO_2 concentration within the research area and higher concentrations compared to other territories of Ukraine. Chronic exposure to NO_2 and SO_2 can cause respiratory or lung diseases.

According to data from the air monitoring post in Novhorodske, the closest post to Yasynuvata area, records indicate 75% of days where SO_2 concentrations exceeded MPC and 60% of days where NO_2 concentrations exceeded MPC during the observation

Graph 5.1 Percentage of days with MPC overage (January-June, 2020)



Map 5.5 SO2 concentration in Yasynuvata area

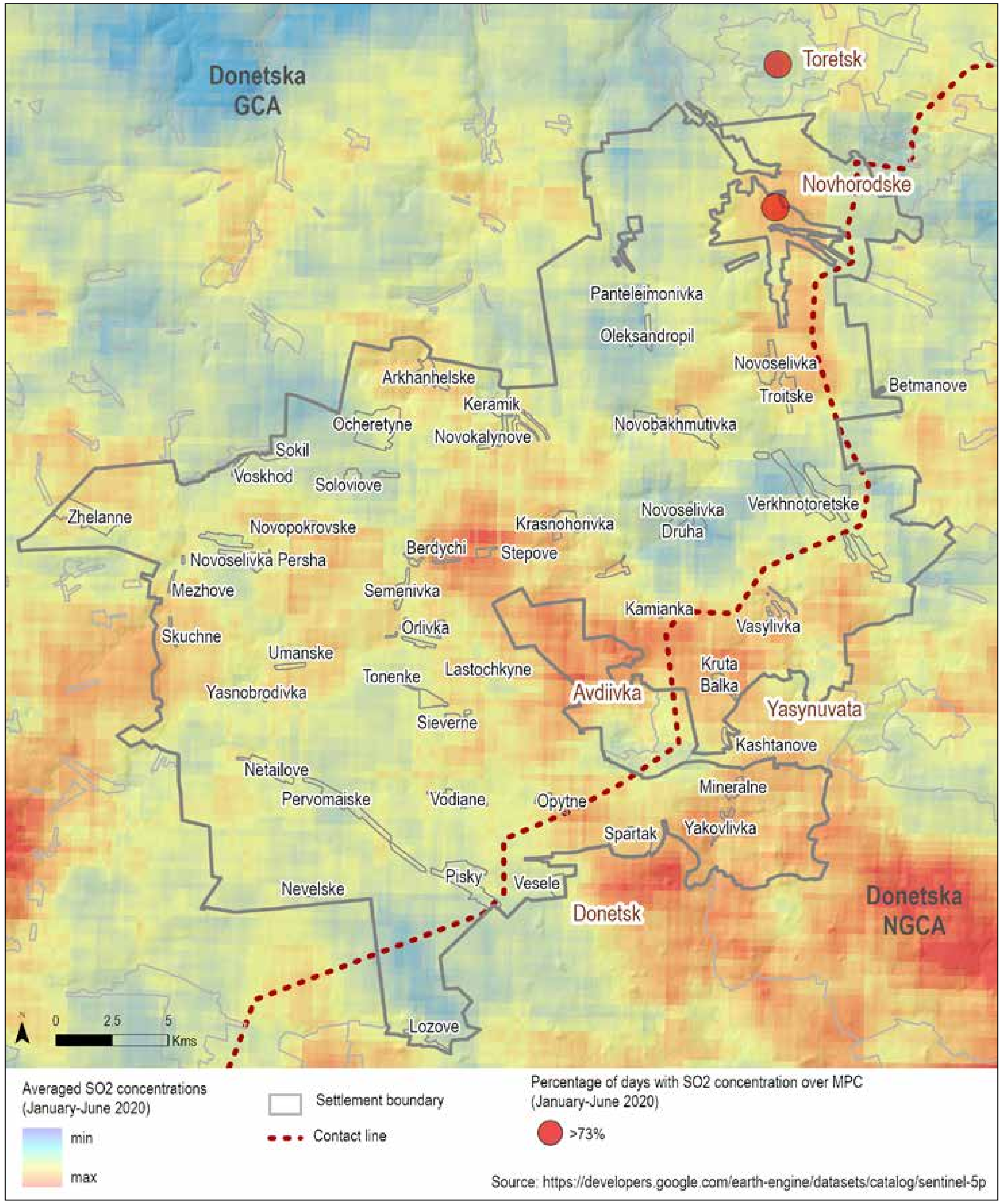
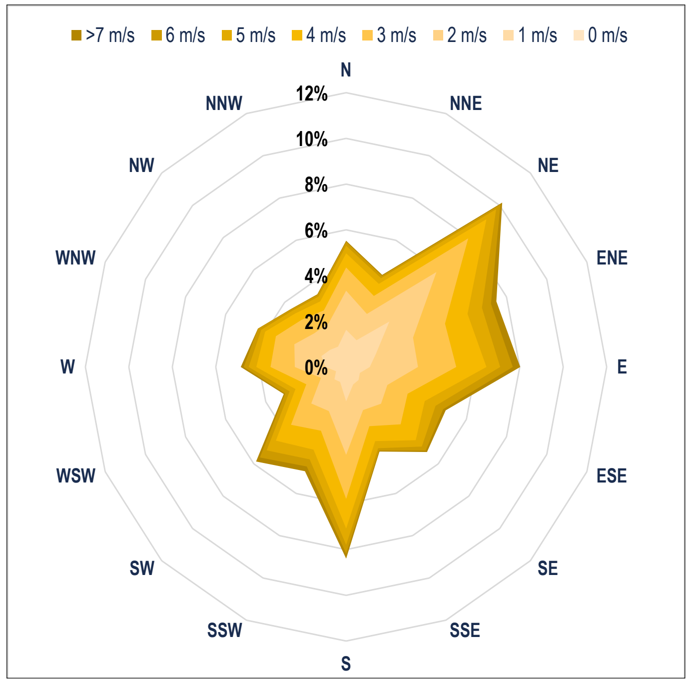


Figure 5.1. Blast furnace operations and dust cloud around Avdiivka coke and chemical plant, on Sentinel-2 image, April 13, 2020

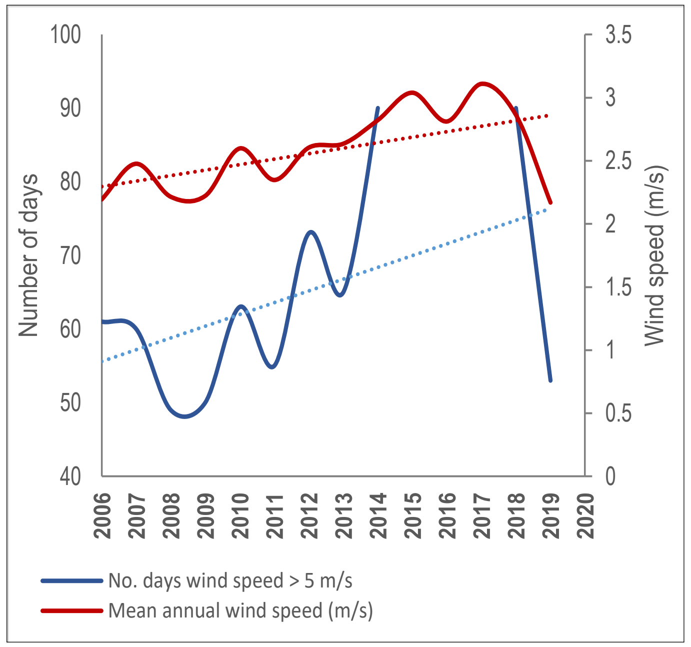
Figure 5.2. Blast furnace operations and dust clouds of Yasynivsky coke plants, on Sentinel-2 image, April 8, 2020

Figure 5.3. Blast furnace operations and dust clouds of Makiivsky coke plants, on Sentinel-2 image, April 8, 2020

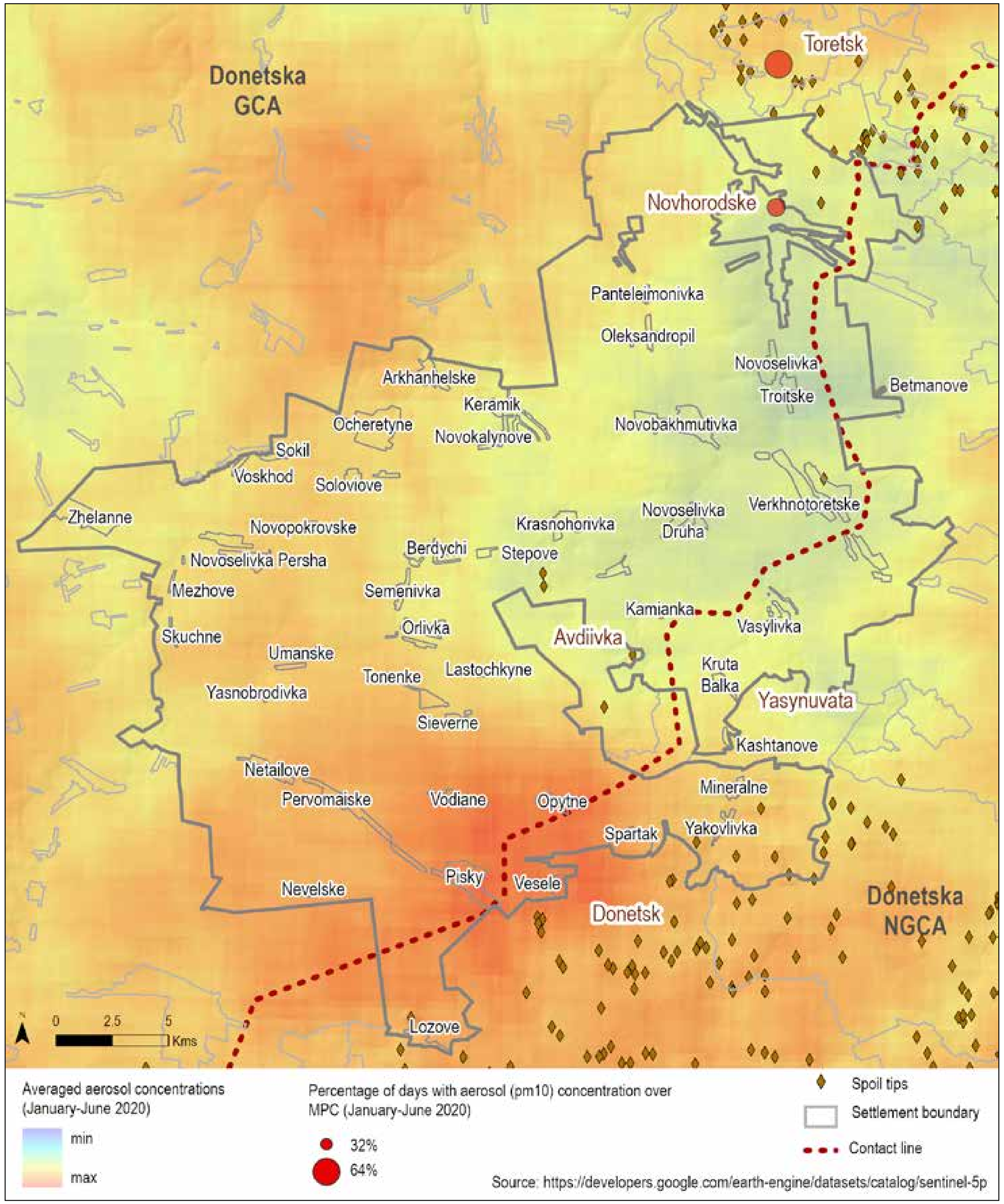
Graph 5.3 Average wind direction



Graph 5.4 Yearly-averaged wind speed dynamic



Map 5.6 Aerosol emissions in Yasynuvata area



period from January 1 to June 30, 2020. Regarding the days with aerosols concentration exceeding the MPC (pm10 and pm25), the rate was lower at - 31.6% and 17.6%, respectively.

Aerosol particles with an effective diameter smaller than 10 µm can enter the bronchi, while those with an effective diameter smaller than 2.5 µm can enter as far as the gas exchange region in the lungs, which can be hazardous to human health. On satellite images, higher aerosol concentrations are evident in the sourthen part of the Yasynuvata raion and in the coal mining area with higher density of spoil tips, especially Horlivka-Toretsk and Donetsk coal mines networks (map 5.5).

Storm winds can trigger the dispersion of aerosol pollutants across a wider area. Above wind speeds of 5 m/s, dust and ash from bare and degraded lands can become disturbed through wind erosion (deflation), potentially polluting nearby soils and water bodies.

Graph 5.3 and 5.4 summarise average wind direction and speed between 2006 and 2019 using records from Udachnoe weather station close to Yasynuvata. Depsite insufficient data in 2015-2017, the number of days with wind speeds above 5 m/s shows an increasing trend, peaking in 2014 and 2018. Average wind speeds also increase over this period, although a notable drop is seen in 2019. Increasing frequency of storm winds is one of the consequences of climate change, especially in the steppe zone, in which Yasynuvata area is located.

Wind direction is important in determining trends in air pollution dynamics. As Graph 5.3 shows, there is a higher proportion of winds from the north east and east, which may lead to more dispersion of pollutants from factories in the NGCA towards Yasynuvata.

Key takeaways

1. Installation or repair of filtration systems and air emission monitoring near hazardous objects is needed.

2. Restoration of vegetation cover on closed mine and spoil tip areas should decrease wind erosion risk.

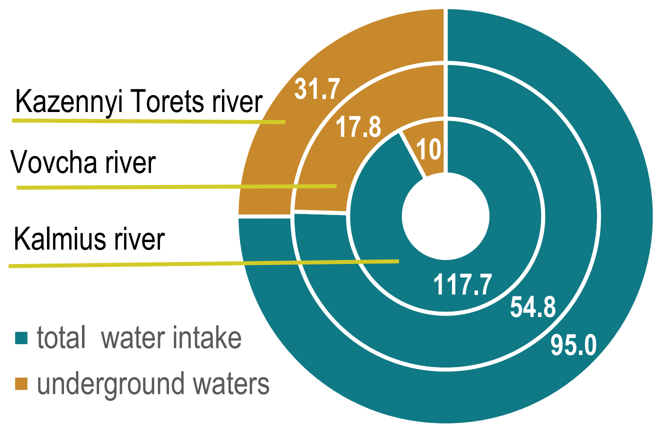
3. Increase the awareness and usage of air monitoring systems, including mobile Apps like IQAir or SaveEcoBot, to plan daily activities, especially outdoor activities in schools.

Hazard Description

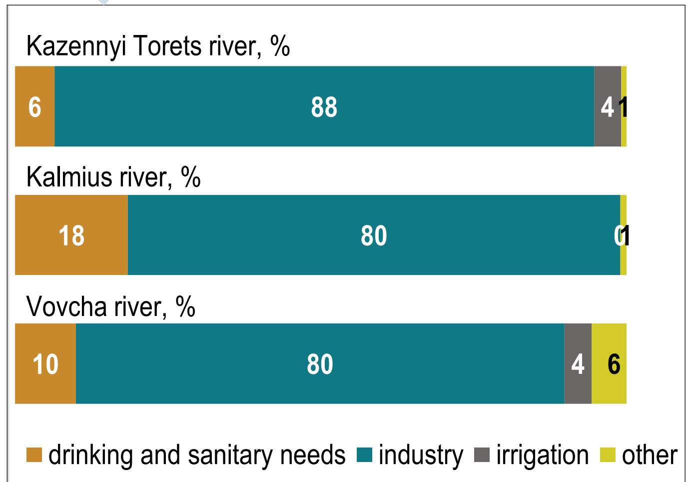
Hydrology and water basin mapping is an important tool to increase understanding of water contamination risks, which may have cascading health consequences for domestic, commercial and industrial activities. Yasynuvatskyi raion is located on the border of the Donetsk Ridge and Azov Upland, with three river sub-basins: Kazennyi Torets river sub-basin of Siverskiy Donets (Don) basin, Vovcha river sub-basin of Dnieper basin and Kalmius river sub-basin of Azov Sea basin.

Siverskyi Donets river is the main source of water resources in Donetska oblast. It collects surface waters, including inflow from Dnieper-Donbas channel, local river runoff, sewage, coal mine and spoil tip waters, and groundwater reserves.

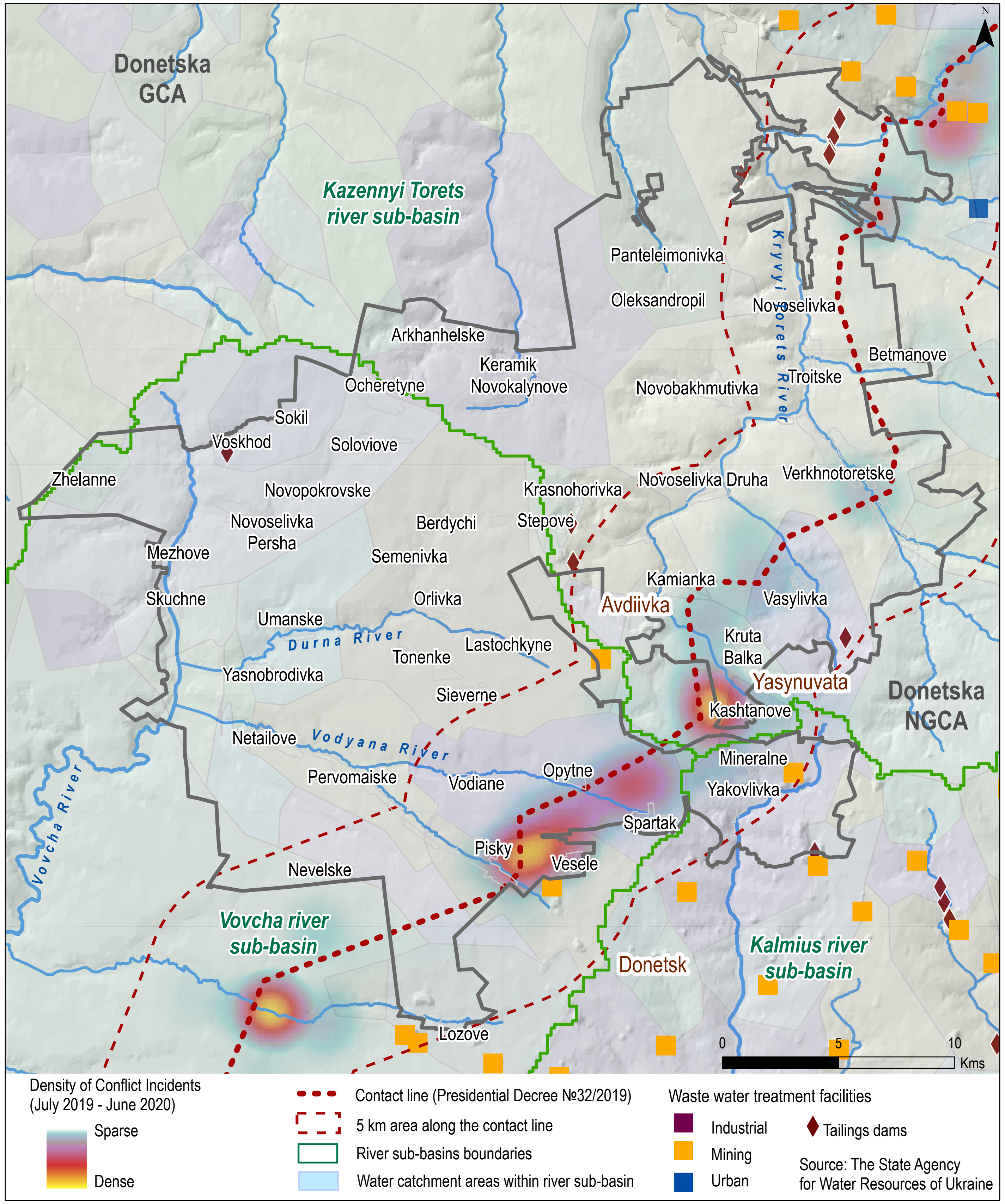
Graph 6.1. Basin water intake in 2018 (mln.m3)[6]



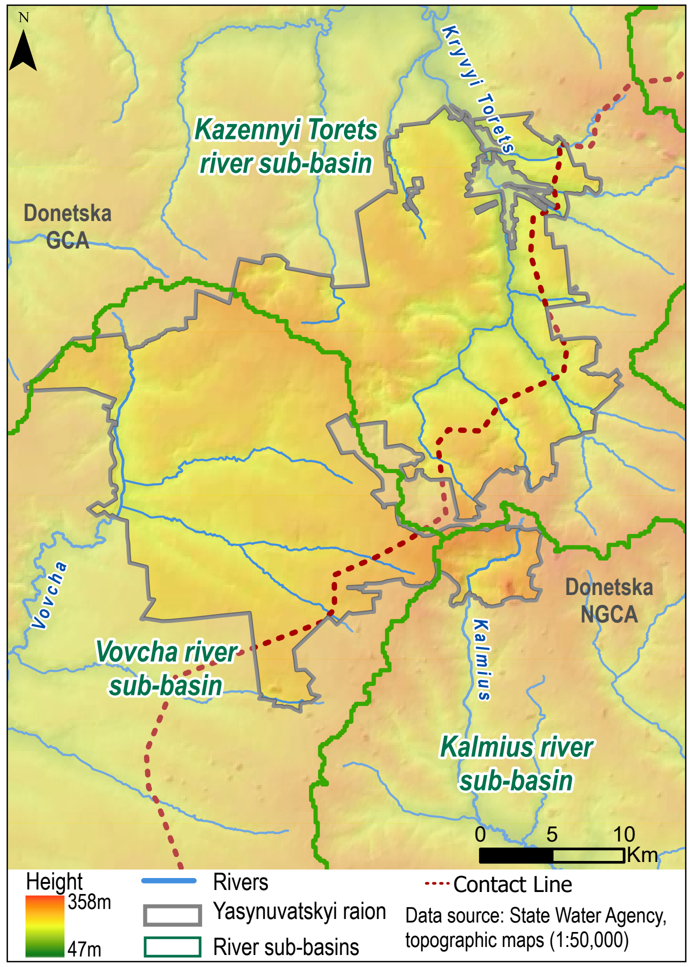
Graph 6.2. Basin water usage type in 2018[6]



Map 6.1 River Basins and Hazardous Facilities



Map 6.2 Regional Overview of Main Rivers



The main rivers in the region are Kryvyi Torets river (Kazennyi Torets sub-basin), Durna and Vodyana rivers (Vovcha sub-basin) and Kalmius river.

More than 80% of water intake of all three river basins is used for industry (88% in Kazennyi Torets river sub-basin).

The proportion of underground waters of total water intake in Kazennyi Torets river and Vovcha river sub-basin is 33%, which is much higher, compared to 8% in Kalmius river sub-basin[6], indicating the importance of groundwater research, especially in coal mining areas.

6) Water intake and quality data from the State water agency of Ukraine (https://www.davr.gov.ua/)

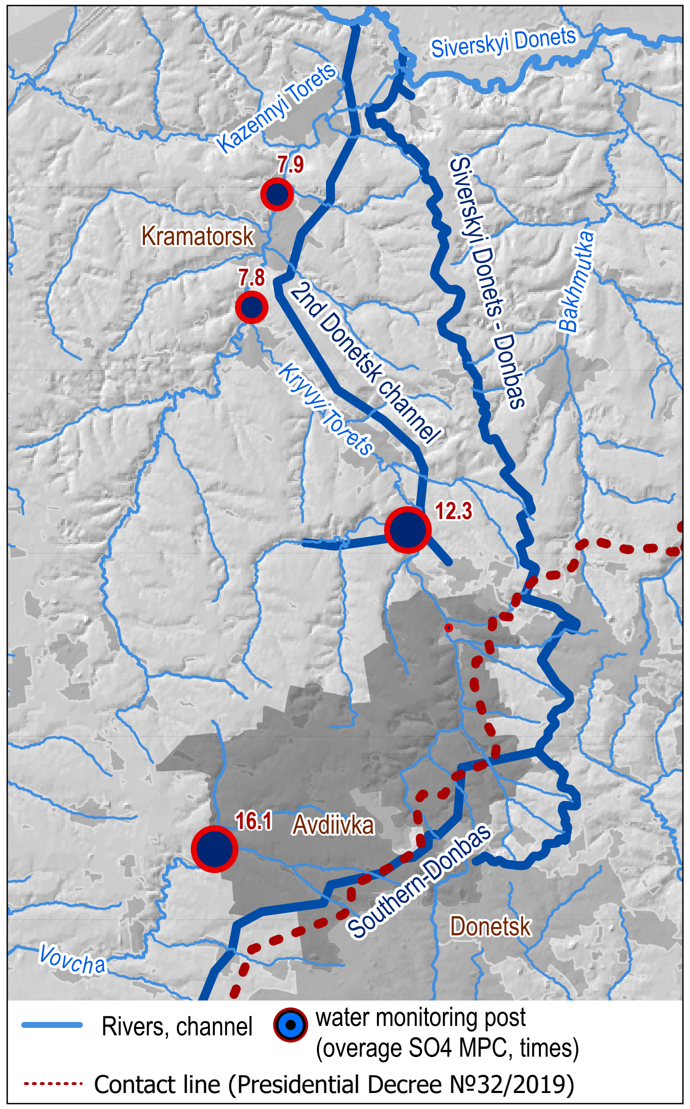
HAZARD - WATER SUPPLY INFRASTRUCTURE EXPOSURE TO CONFLICT

Hazard Description

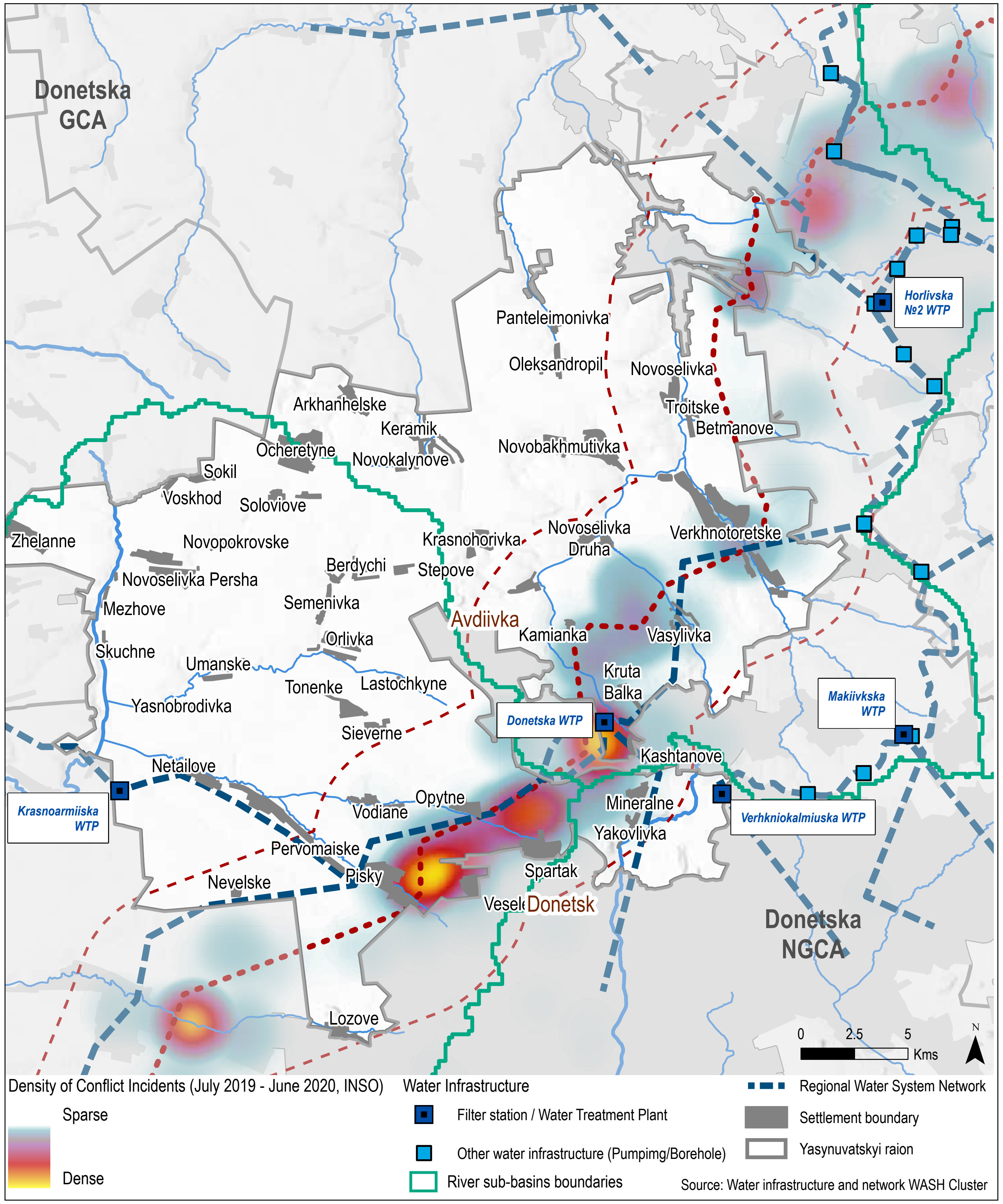
Functional water infrastructure is critical to ensure basic water and sanitation needs. Water is supplied to the region through the Siverskyi Donets-Donbas channel to Donetsk and then through Southern-Donbas channel to Mariupol. It includes 17 water tanks and 18 water filtering stations (water treatment plants or WTPs). Five water filtering stations are located close to Yasynuvata area.

Surface waters along the Siverskyi Donets River in the Donetska Oblast are mainly classified according to the State Water Agency of Ukraine as satisfactory, slightly polluted (class III category 4). The average

Map 7.1 Regional Overview of Water Network



Map 7.2 Water Infrastructure



yearly MPC was exceeded in Siverskyi Donets in 2018 for ammonium nitrogen (up to 2.4 MPC) iron (2.2 MPC), manganese (2.7-11.3 MPC), copper (2.5-4.6 MPC), petroleum products (2.5 MPC), nitrites (5.5 MPC), chromium (3.8-7.7 MPC) and zinc (2.6 MPC).

Close to Yasynuvatsky Raion, water samples were collected on December 10, 2019 at the Kryvyi Torets River. Two water qualtity indicators were tested for - suspended solids and dissolved oxygen, revealing the overage of suspended solids MPC (up to 1.7 MPC).

Additionally, samples were collected in Vovcha River (near Karlivka) and Kazenny Torets River (Grodivka). Significant overage of MPC in terms of sulfates was recorded at these two points (up to 16.14 MPC at Vovcha River and up to 17 MPC at Kazennyi Torets). Excess of suspended solids up to 1.53 MPC and nitrite ions up to 1.05 MPC was recorded on the Kazennyi Torets river. Slight ovarage of suspended solids (up to 1.07 MPC) was recorded on Vovcha River. In 2019-2020, samples were not collected. However, the importance of monitoring water quality in such cases is crucial to ensure access to safe drinking water for the entire population.

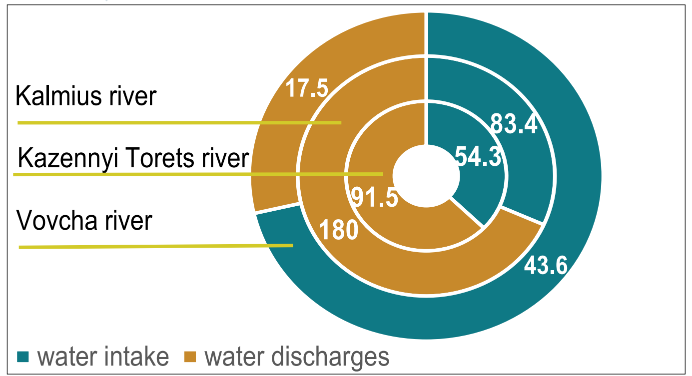
The water supply system crossing the CL is frequently damaged or disrupted due to shelling, obsolete equipment and soil subsidence close to coal mines. Often the water supply can be interrupted for several days or weeks. The Donetska filter station was the most critical facility in the region in terms of conflict exposure (table 4.1); 333 conflict incidents were recorded near the station in 2019 and 101 in the first 6 months of 2020, according to INSO data. Due to security reasons, the operation of Donetska WTP was terminated on March 25-28, 2020. Fifty-four conflict incidents occurred near Mayorska Pumping Station, near Shumy in 2019. Twenty-three conflict events were recorded by INSO in close proximity to the Verkhnokalmiuska filter station in 2019.

On 19 June 2020, as a result of shelling, two main conduits of Siverskyi Donets-Donbas channel were damaged near Shumy. As this site is close to the CL, repair work can begin only after approval, which may cause a delay of several days.

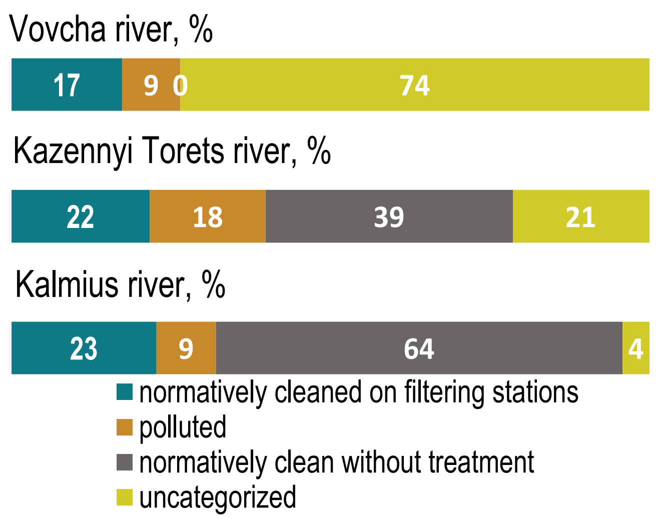
Hazard Description

Wastewater is broadly defined as water that has been contaminated by human use. United Nations Water identifies the following sources of wastewater: domestic water used for sanitation purposes (toilets, kitchens and showers), water from commercial establishments (restaurants) or institutions (hospitals or schools), water from industrial and agricultural activities, storm-water and other urban run-off water. Wastewater management can be potentially hazardous as flammable liquids, acids, and solvents are often used in such facilities (OCHA/UNEP, 2016) and inadequate treatment can lead to contamination of ground water sources.

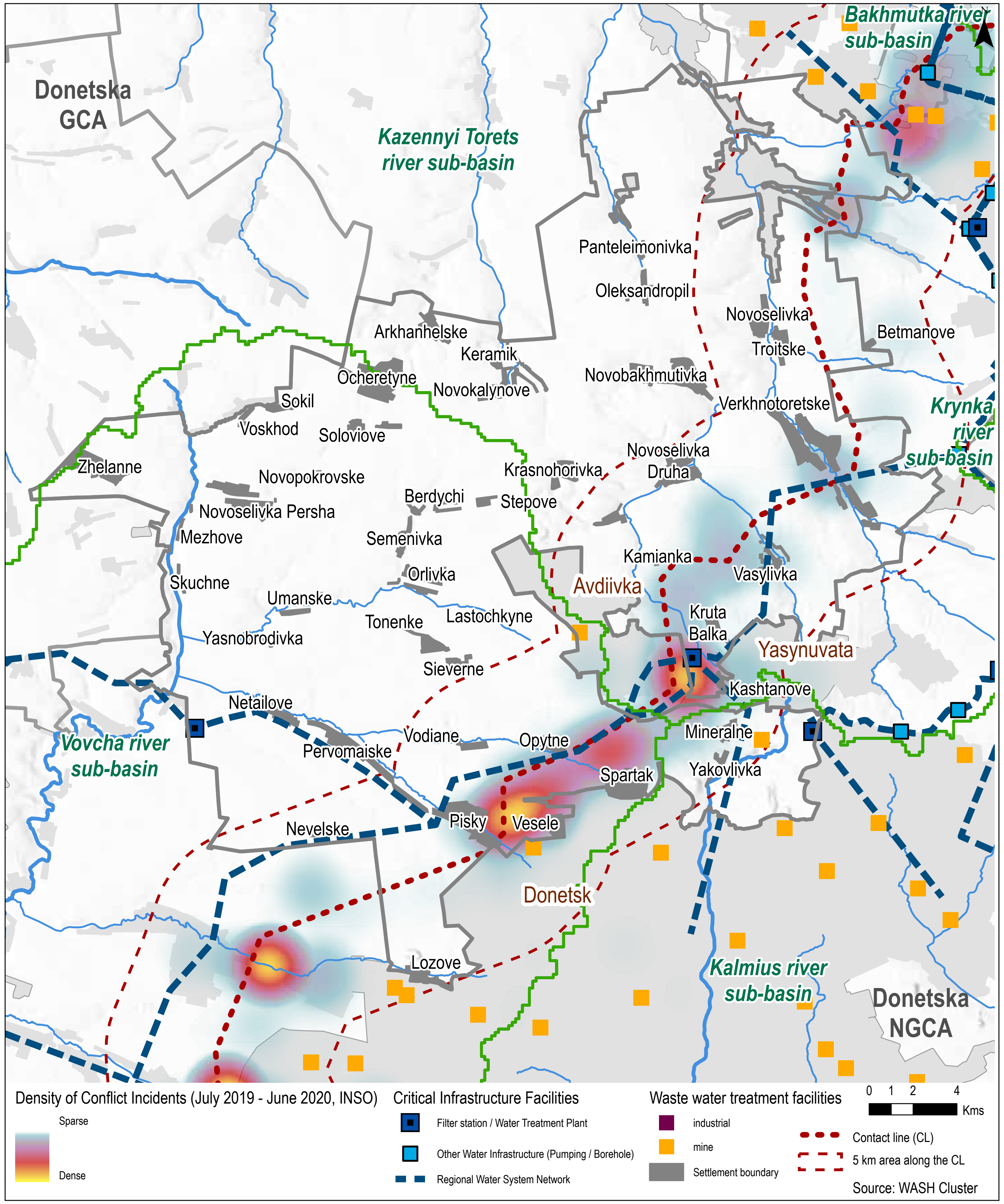
Graph 8.1. Basin water discharges in 2018 (mln.m3)[6]



Graph 8.2. Water treatment in 2018[6]



Map 8.1 Location of Wastewater Treatment Facilities



Water of Donbas Company carries out water extraction, distribution, transportation, supply and treatment in Donetska Oblast within both GCA and NGCA.

Key Takeaways:

1. Military activity in proximity to critical wastewater treatment facilities should be avoided to minimize the risk of wastewater contamination to water sources.

2. Monitoring of water quality at all stages of the water system is important to ensure that contaminated water does not jeopardize access to water or harm the environment.

3. Dialogue on sustainable solutions for the maintenance of these critical water systems should be reinforced.

Hazard Description

Donbas is a coal-producing region mined since the first half of the 19th century. As a heavily industrialized area, industrial waste management from resource extraction is a continuous challenge. Two types of industrial waste storage common in the area are spoil tips and tailings dams. A spoil tip consists of accumulated waste material removed during the mining process, whilst a tailing dam is an earth-filled embankment dam used to store by-products of mining operations. Both are hazardous sites as they are storage locations of chemically dangerous substances.

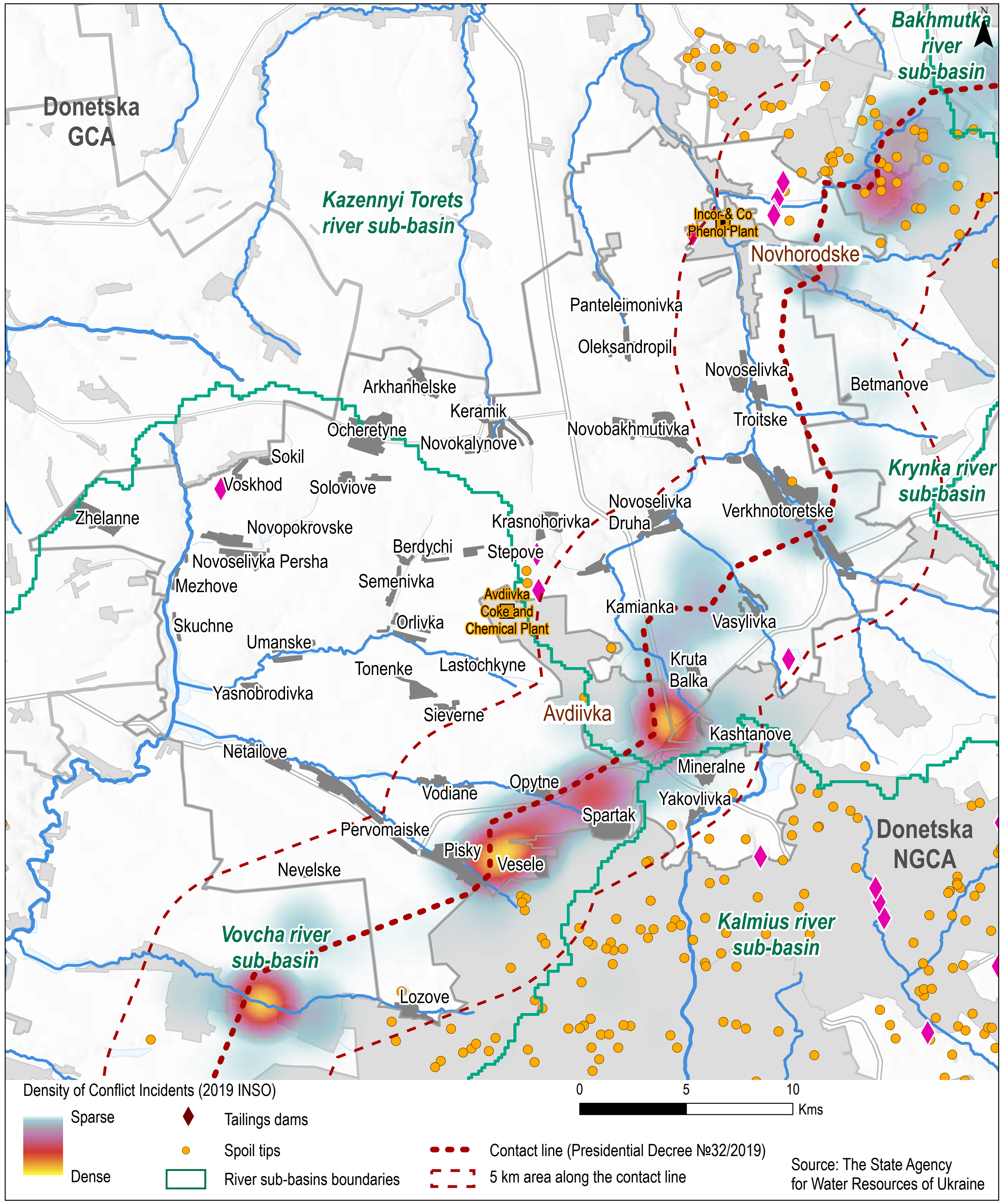
To assess the exposure of the population to spoil tips, their locations were identified in relation to settlements. Since no official geo-database of spoil tips existed, the mapping was carried out by IMPACT using open source data (OSM), cross-referenced with satellite imagery.

According to the Ministry of Health Protections' Decree № 173, spoil tips should be located at a safe distance (300m or 500m depending on spoil tip height) from populated places and be cultivated (such as through planting grass on the slopes) to minimize the impact on the environment and population. Six spoil tips are located in Avdiivka and Verkhnotoretske and 3 additional spoil tips are located within 500m distance from settlement boundaries.

Tailings dams are a special hydro-technical construction designed to store by-products of industrial activity. The main hazards posed by tailing dams are dam failures, which represent low probability high impact events; and diffuse pollution, which has a higher probability but lower impact. Due to the proximity of tailing dams in Yasynuvata area to the CL, there is a concern over regular maintenance and potential damage.

Map 9.1 displays tailings dams, conflict incidents in 2019, and rivers which may be exposed to contamination in the case of liquid waste discharge. Data indicating tailing dam locations was collected by satellite imagery digitization and review of the State Agency for Water Resources of Ukraine. Tailing dams of Avdiivka coke and chemical plant and Incor & Co phenol plant are located in close proximity to residential areas, with a risk of flooding and spreading of hazardous substances in case of dam damage. The 3D terrain analysis of potentially flood-prone areas due to dam failure at Avdiivka coke and chemical plant are shown on page 17.

Map 9.1 Location of Spoil Tips and Tailings Dams



Tailing dams are also in very close proximity to the CL as seen on maps 4.4 and 9.1 (400m from the tailing dam of enrichment plant Dzerzhynska, about 2km from tailing dams of Incor & Co phenol plant and about 5km from tailing dams of Avdiivka coke and chemical plant).

Tailing dams at Incor & Co phenol plant near Novhorodske meanwhile are estimated to host around 900,000 tons of liquid hazardous substances including phenol, sulfuric acid and pyridine. Although not directly connected to the river network, the substances may be channeled through air, soil, and groundwater. In August 2014, as a result of shelling, the tailing dam caught fire, lasting for several hours.

According to satellite-derived land surface temperature datasets (map 2.1), tailing dams near Novhorodske are more exposed to high temperatures in summer season, with a higher percentage of days with land surface temperature exceeding 37°C. Generally, heat waves pose a risk to tailing dams as by increasing the evapotranspiration rate and toxic pollution concentration in the air.

Between 2017 and 2019, 23 conflict events were recorded within 2km of the tailing dams (INSO data, 2017-2019). For example, on July 25th 2018, an artillery shell struck one of the tailing dams, although no chemical leaks were recorded.

Key takeaways

1. The FEAT 2.0 guide and the Ministry of Health Protection Decree should be utilized to better understand the human and environmental exposure for each site concerned.

2. Further investigation must be undertaken to ensure proper maintenance of tailings dams and spoil tips and mitigation of their hazardous exposure.

Electricity

Electricity is critical for both domestic and industrial activities. Because of the linkages between electricity, heating and water supply systems, electricity shortages can have cascading consequences on households, inhibiting their ability to heat themselves and access water. This section provides a short overview of the electricity network and the main electricity-related risks in the raion. The dataset was created from digitized satellite imagery, secondary data sources and OSM contributors.

The electricity network of the area is a part of the Unified Energy System of Ukraine, which unites 8 regional power systems (including Donbas power system), interconnected with domestic and interstate high-voltage power lines.

The main energy sources in the Donbas region are thermal power stations (TPS), which utilise fossil fuel and heating power plants (HPP), based on water vapor (graph 10.1). Kurahivska TPS is the closest power station to Yasynuvata area (located 20km from Yasynuvaskyi raion). In 2014-2015 several disruptions were recorded at the station connected to conflict.

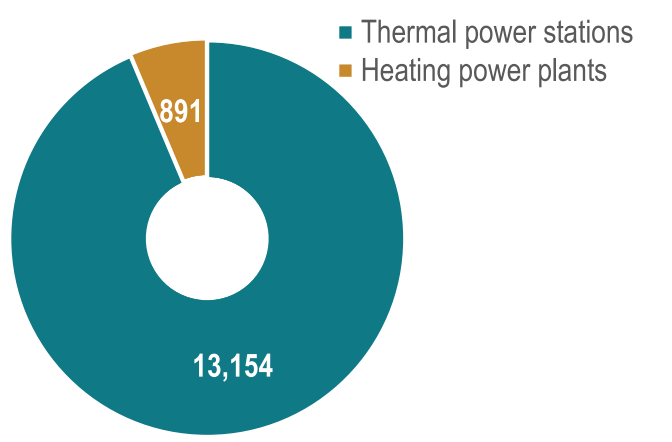
There are 46 electricity substations located within 25km of Yasynuvata area, with 164 conflict incidents recorded by INSO in the period July 2019-June 2020, near substations or within 1km of power related objects.

As a result of hostilities in the Donetska Oblast on February 12 2015, 74 settlements (in particular, settlements in the Yasynuvata area), with a total population of over 180,000 were left without electricity. By July 2020, the electricity line to Opytne settlement in Yasynuvata area remains totally destroyed. Restoration of the electricity line passing from Avdiivka along the contact line remains impossible.

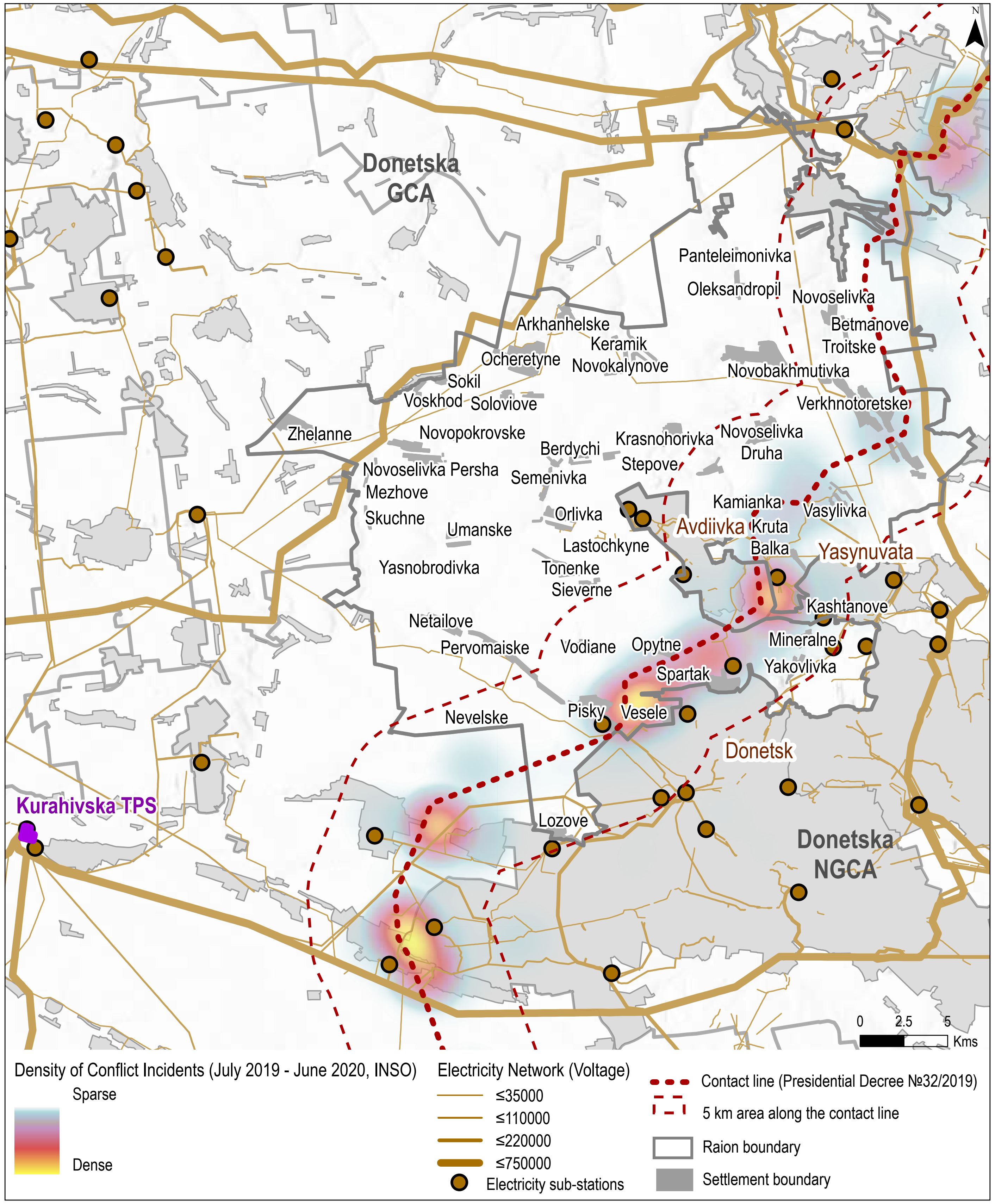
Interruption of electricity supply was the cause of disruption to other dangerous facilities, coal mines, water filtration and water pump stations and more. This increases the risk of emissions of pollutants and hazardous substances into the environment.

About 30 incidents of electricity failure have been recorded at Donetska filter station since June 2014 as a result of damage to electricity lines due to shelling. This has led to repeated water supply shortages for 345,000 people in Avdiivka, Yasynuvata, Donetsk, Verhnotoretske, Betanove and Kruta Balka[8].

Graph 10.1 Production and source of energy in 2018[7]



Map 10.1 Electricity Network



Key takeaways

1. Due to the conflict and the possibility of network damage, diversification of power sources or improved connection for communities to the Ukrainian network would minimize the risk of large scale power outages.
2. Considering that an electrical critical infrastructure failure will induce several severe cascading effects, a multi-stakeholder risk assessment must be conducted by local authorities for specific response planning.
3. Finding methods to support and develop projects on solar panel installation by private households.

7) Data provided by the Main Department of Statistics in Donetska Oblast, http://donetskstat.gov.ua/statinform1/energy.php)

8) Data collected by The Donbas Environment Information System (DEIS), https://deis.menr.gov.ua

Gas & Oil Pipelines

Similar to the electricity network, gas and oil pipelines are located in close proximity to the CL, with some 50 km of pipeline passing directly along the CL. According to INSO data, 111 conflict incidents have occurred in several locations within a 500m radius of the pipelines over the past year (July 2019 - June 2020). This infrastructure represents a disaster risk as damage can lead to oil or gas spills which can pollute both water and the atmosphere. In addition, both fuels are a major source of heating for the region, so damage could have critical consequences in the winter months.

The gas pipeline, which supplied gas to Avdiivka and seven other nearby settlements, was damaged on June 7, 2017 as a result of shelling. With the onset of cold weather, the situation deteriorated, as most of the households were using gas for their household heating systems. In November, the temperature in many households did not exceed +6°C and the voltage in the electricity network was too low to use electric heaters. In August 2017, the construction of a new primary gas pipeline from Ocheretyne to Avdiivka began and on July 31, 2018, it was completed[9].

In 2015, a shell struck a Mariupol-bound gas pipeline between the villages of Krasnohorivka and Novokalynove. This caused a large fire and the entire village of Krasnohorivka was covered by combustion by-products. Due to minefields in close proximity, emergency services had difficulties extinguishing the fire and there was a risk of further damage[10].

In addition, the Horlivka-Odesa branch of ammonia pipeline intersects the CL and is within 12km of Panteleimonivka settlement.

Key takeaways

1. Prioritize the demining operations along the pipeline routes.
2. Raise awareness of residents on risks related to ammonia exposure and natural gas leaks.

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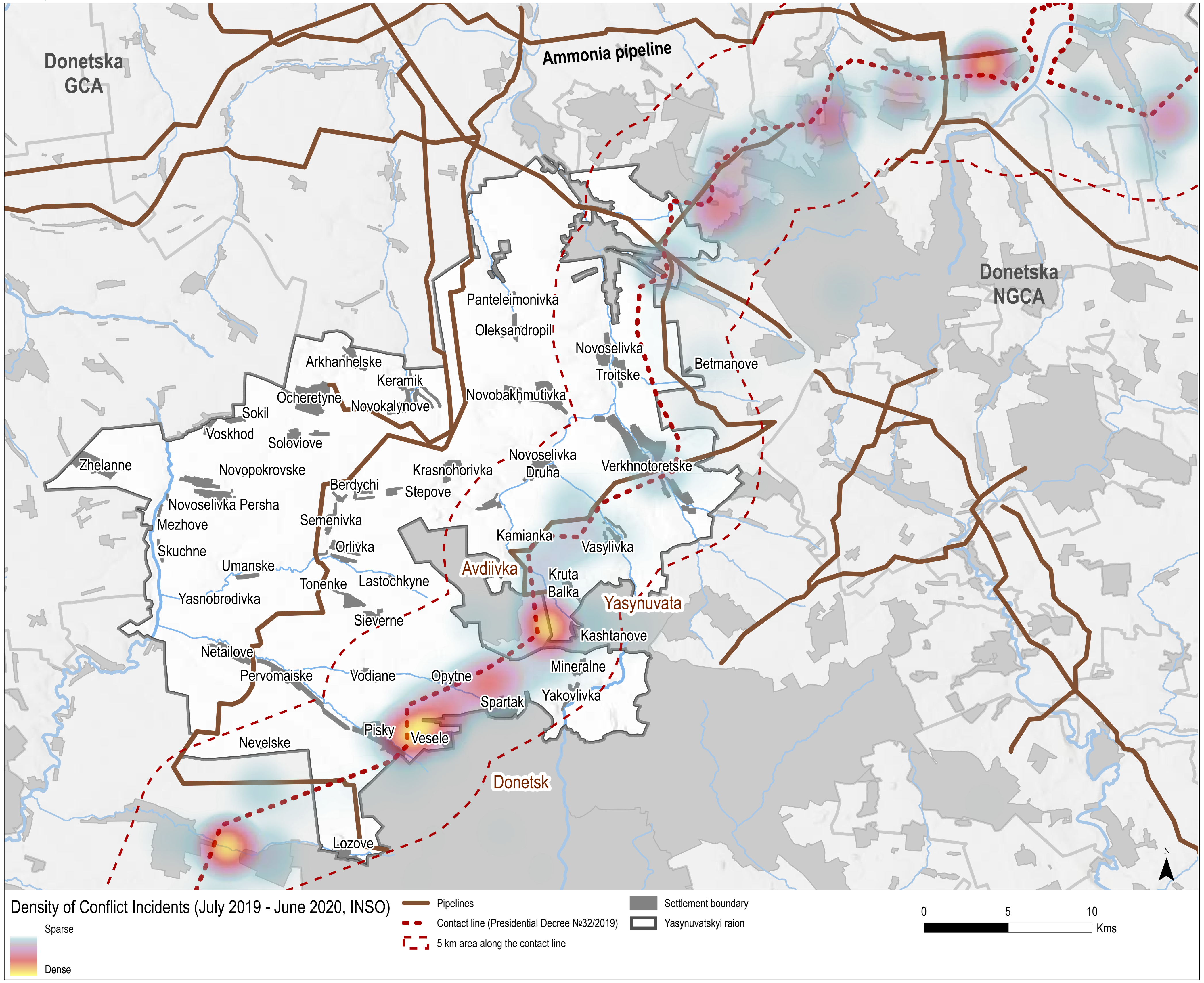
9) PJSC Donetskoblgaz, http://oblgaz.donetsk.ua/hazoprovid-ocheretyne-avdiivka

10) Ukrainian Red Cross Society field reports

Map 11.1 Gas and Oil Pipeline Network



Susceptibility & Coping Capacity

Based on the indicators derived from the REACH 2018 CVA, the most susceptible settlements were Vesele, Vodiane, Kamianka, Nevelske, Opytne, Novoselivka Druha, Novoselivka, Pisky, Pervomaiske and Troitske. These are all rural settlements <5km from the CL. In terms of the factors contributing to susceptibility, these settlements have the highest dependency, but higher economic capacity than urban settlements and rural settlements >5km from the CL.

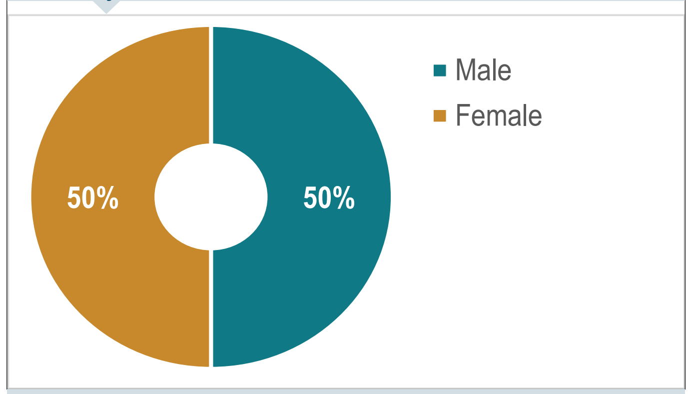
Economic capacity is calculated based on employment and proportion of pensioners. Whilst these settlements had the highest proportion of pensioners (50%), they also had the lowest unemployment rates (10%), compared with 30% in urban areas >5km from the CL, leading to a higher economic capacity overall. These areas also had the greatest proportion of households whose livelihood is agriculture (25%).

Despite hosting the highest proportion of pensioners, rural areas <5km from the CL had a lower proportion of population over 65 (23%), compared with urban settlements (25-26%). These settlements did however have a high proportion of households with disabilities (12%), which may explain the high number of pensioners in these settlements. The highest proportion of the households with disabilities was in Verkhnotoretske, the one urban area <5km from the CL (13%). Beyond 5km, the difference between rural and urban areas was negligible, ranging from 9-10% respectively.

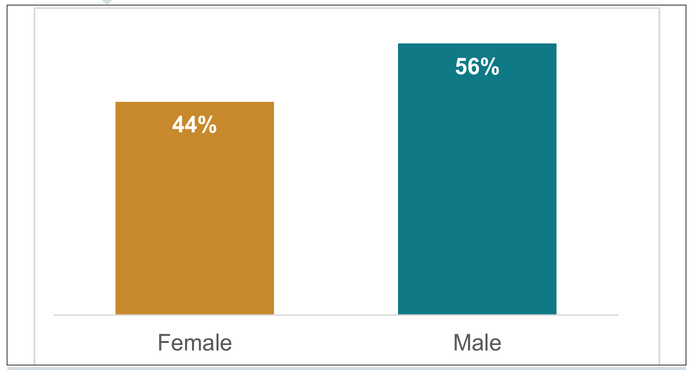
Rural settlements <5km from the CL have the highest proportion of head of households who are widows, single parents or single female (35%). This is slightly greater than in urban areas. Rural areas >5km from the CL had a relatively lower proportion (29%).

Distances to key facilities such as primary health care, social services, education and SESU response units influence a settlement's coping capacity. Keramik, Zhelanne, Ocheretyne (urban >5km); Pervomaiske and Nevelske (rural <5km); and Verkhnotoretske (urban <5km) had the worst access to services. Urban settlements >5km from the CL had the highest coping capacity, followed by urban <5km. Rural settlements meanwhile have lower coping capacity and Pisky, <5km from CL, had the lowest coping capacity overall.

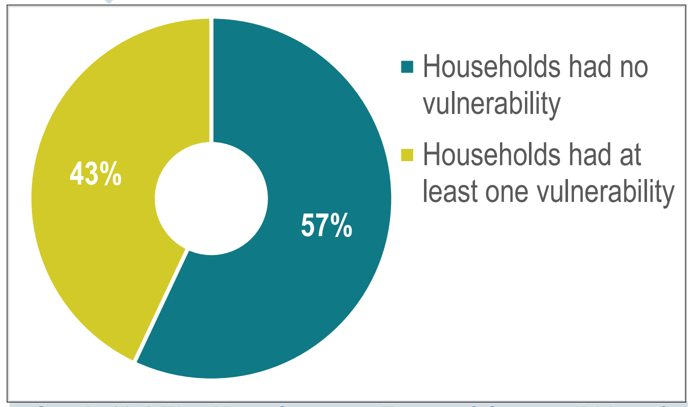
Graph 12.1 Gender Distribution of Heads of Households for Yasynuvata area



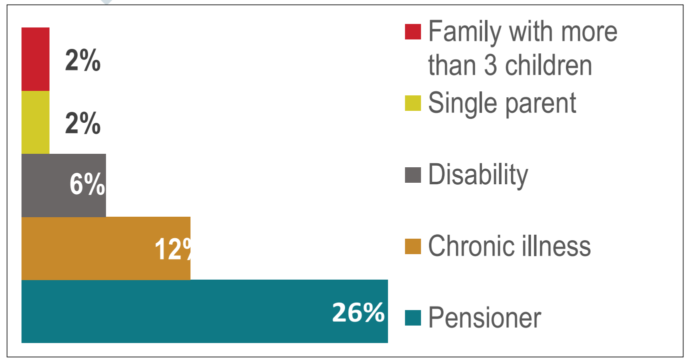
Graph 12.2 Gender Distribution of Heads of Households with Vulnerability for Yasynuvata area



Graph 12.3 Distribution of Households that had at Least One vulnerability for Yasynuvata area



Graph 12.4 The Most Common Types of Susceptibility of the Population for Yasynuvata area



Schools provide opportunities to communicate hazard preparedness/response and are often used for shelter and aid distribution following disasters. Urban areas <5km from the CL had the greatest proportion of households >30 minutes from a school (50%), whilst households in rural settlements <5km had the lowest (6%).

Social facilities provide services to the elderly, persons with disabilities, those with limited financial means and other vulnerable groups. They can also be used to communicate disaster preparedness and response information (REACH, 2018). The greatest proportion of households >20km distance from a facility were in Verkhnotoretske, compared with 0% in urban settlements >5km from the CL, indicating good access to social services facilities in these areas.

Sixty-seven percent of the households in rural settlements >5km from the CL were >30 minutes from a primary health care facility. Rural settlements > 5km from the CL recorded the lowest proportion (45%). As for SESUs, Nevelke, a rural settlement <5km from the CL, was the furthest from a SESU (21.8km). Lastochkyne, a rural settlement >5km from the CL was located the closest (2.1km).

Predictably, there were more conflict incidents <5km from the CL, with Pisky recording the most. Beyond 5km, only Panteleimonivka and Oleksandropil recorded incidents. The highest number of IDPs meanwhile is found in rural settlements >5km from the CL. Urban settlements have the lowest proportion of households unaware of the nearest bomb shelter, at 22% beyond 5km and 65% within 5km of the CL. Rural settlements >5km from the CL have the highest (81%).

As mentioned in the methodology, vulnerability was calculated based on susceptibility and coping capacity. Rural settlements were more vulnerable overall than urban areas, with urban areas >5km from CL having the lowest vulnerability. Pisky had the highest vulnerability.

The majority of the vulnerability indicators are derived from the REACH CVA, which is representative of households stratified by urban, rural and within and beyond 5km from the CL, as shown in map 12.1 (confidence level 90%, margin of error 7%). Therefore, settlements across the research area have similar vulnerabilities based on the settlement stratification. However, SESU response unit distance and 2019 INSO conflict incidents provide insights into individual community-level findings. For example, whilst Pisky and Vesele are both rural settlements <5km from the CL, Pisky recorded the highest number of conflict incidents out of all of the settlements at 19%, whereas there are 0 recorded events in Vesele.

Table 12. 1 Travel Time to Education Facilities reported by Households

Time	>5km Rural	>5km Urban	5km Rural	5km Urban
< 30 min	85%	92%	93%	50%
30 min - 1 hour	15%	8%	3%	50%
1 - 1.5 hours	0	0	3%	0

Table 12.2 Travel Time to Primary Health Care Facilities reported by Households

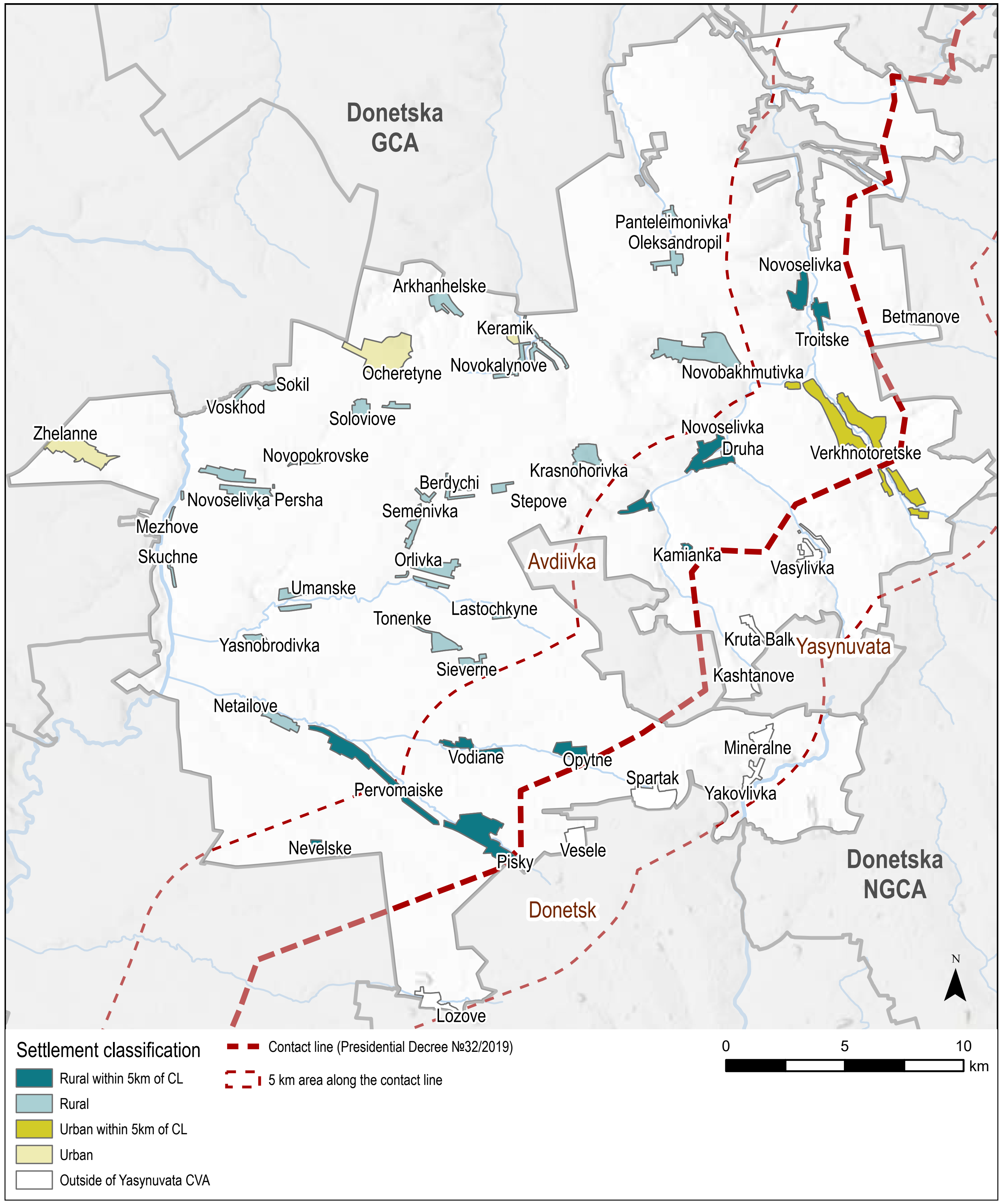
Time	>5km Rural	>5km Urban	5km Rural	5km Urban
<30 min	33%	55%	43%	50%
30 min -1 hour	32%	22%	35%	0
1-1.5 hours	21%	19%	15%	0
1.5 - 3 hours	10%	4%	6%	25%
> 3 hours	4%	1%	1%	25%

Table 12.3 Distance to Social Facilities reported by Households

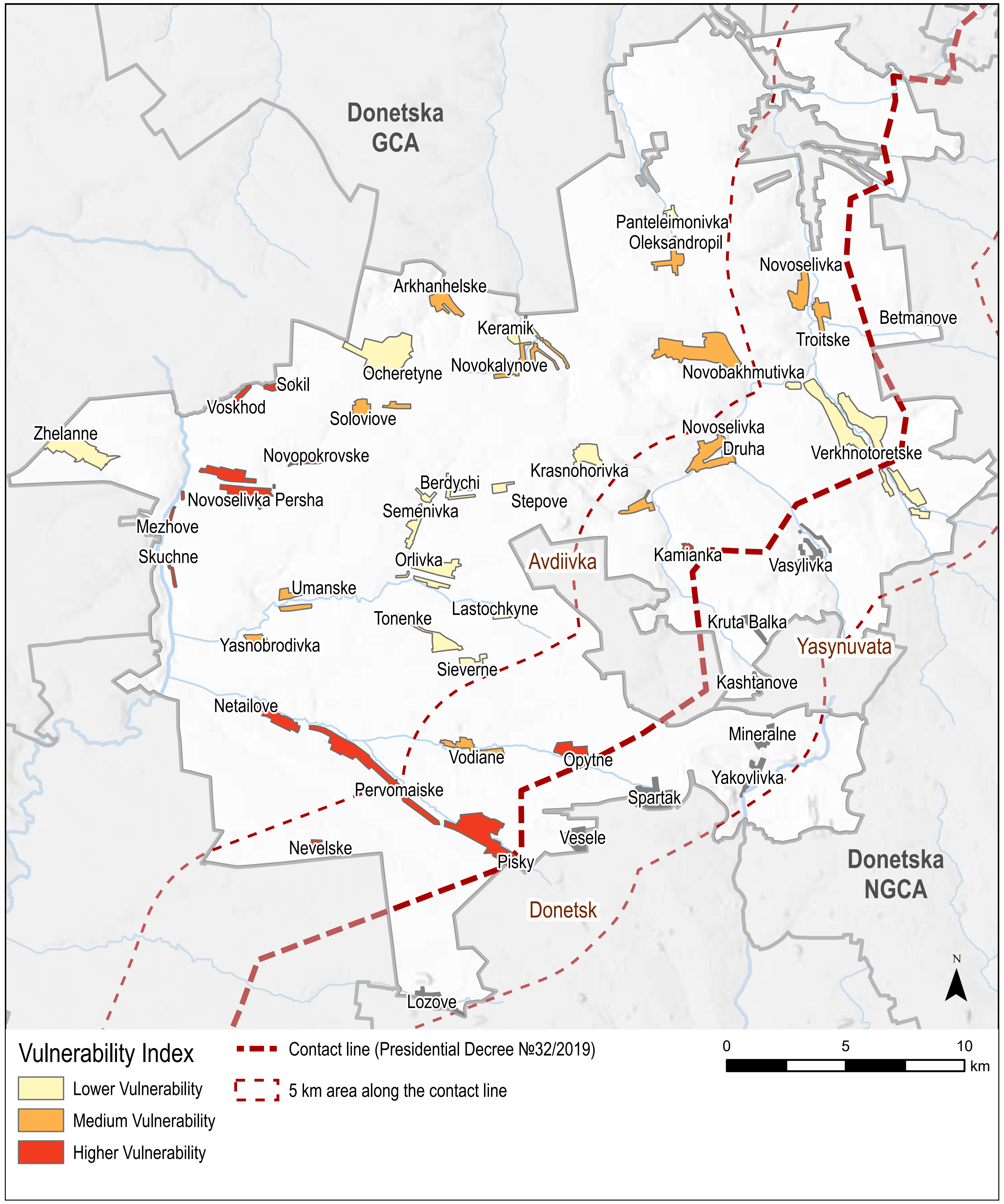
Time	>5km Rural	>5km Urban	5km Rural	5km Urban
< 1km	1%	0	0	0
1-5km	21%	35%	7%	25%
5-20km	59%	31%	26%	50%
>20km	11%	31%	52%	0
Don`t know	8%	4%	15%	25%

VULNERABILITY - SUSCEPTIBILITY AND COPING CAPACITY

Map 12.1 Yasynuvata Raion Settlement Classification from CVA Sampling Stratification



Map 12.2 Vulnerability Map



Anthropogenic Multi-Hazard Exposure

The anthropogenic multi-hazard exposure analysis was calculated from the combination of hazard indicators 2.1 hazardous facilities, 2.2 conflict incidents and 2.3 air pollution.

The number of hazardous facilities within 2km was calculated for each settlement and are shown in Tables 13.1, 13.2 and 13.3. This includes the DEIS identified hazardous critical infrastructure facilities, tailings dams, spoil tips, waste management, and filtering stations.

The tables indicate all settlements with facilities within 2km as a rough indicator for human and environmental exposure. As multiple hazardous facilities/objects may have cumulative impacts on humans and the environment, the number of facilities are shown, also within 5km to represent the wider-reaching impacts.

Within 2km, Kashtanove, Kruta Balka and Lozove each have 2 hazardous facilities; Lozove has 6 spoil tips and both Krasnohorivka and Voskhod each have 1 tailing dam within 2km. In some cases, there are multiple facilities between 2 and 5km from a settlement that are excluded from the tables as they include settlements with facilities within 2km; namely these are Yakovlivka, with 6 hazardous facilities between 2 and 5km distance, Spartak with 5 hazardous facilities, Pisky with 7 spoil tips and Kamianka with 4 spoil tips.

Concerning conflict, Pisky, Spartak, Kashtanove, Vesele and Opytne experienced considerably more incidents than other settlements, according to INSO data from 2019. Additionally, many settlements face high levels of air pollution due to industrial activities and spoil tips.

Settlements closest to the CL had the highest anthropogenic hazard exposure overall, whilst urban settlements generally had lower exposure. The analysis shows that Pisky, Vesele, Spartak, Yakovlivka, Mineralne, Kashtanove, Kruta Balka, Vasylivka, Verkhnotoretske, Opytne, Vodiane, Krasnohorivka, Lozove and Voskhod had the highest overall exposure to anthropogenic hazards.

A detailed analysis of each hazardous facility, their substances, their exposure, and transfer pathway through soil, groundwater, and rivers, is needed to highlight whether exposure would increase. To improve calculations of hazard exposure, facilities should be individually assessed to determine types and quantities of substances and The FEAT 2.0 Pocket Guide can also be applied.

Map 13.1 Anthropogenic Multi-Hazard Exposure by Settlement

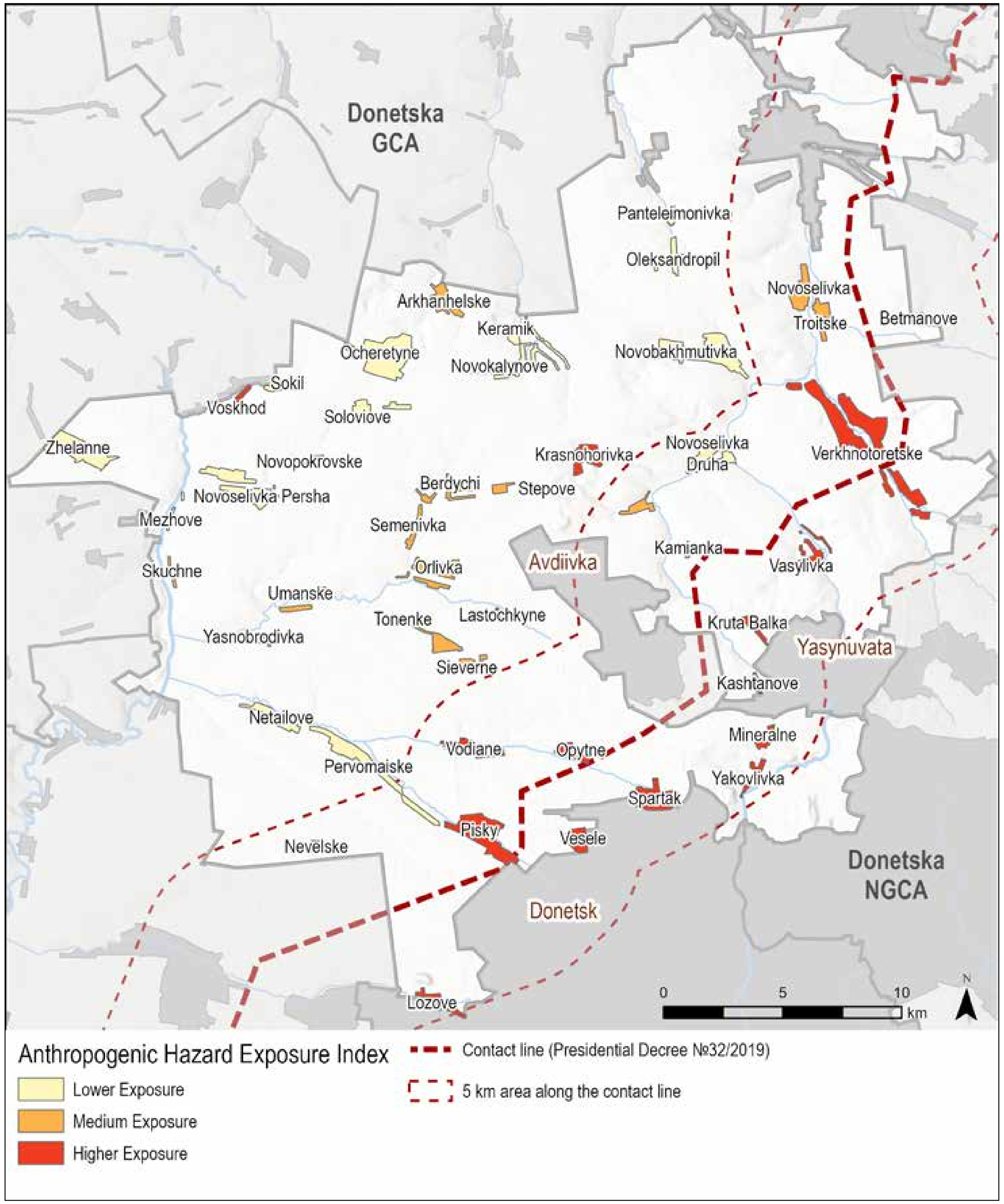


Table 13.1 Settlements most exposed to Hazardous Facilities

Settlement	Within 2km	Within 5km
Lozove	2	4
Kashtanove	2	4
Kruta Balka	2	3
Vesele	1	6
Mineralne	1	5
Pisky	1	3
Vodiane	1	2
Opytne	1	5

Table 13.2 Settlements most exposed to Spoil Tips

Settlement	Within 2km	Within 5km
Lozove	6	12
Vesele	4	10
Yakovlivka	3	14
Spartak	2	12
Mineralne	1	7
Krasnohorivka	1	2
Verkhnotoretske	1	1

Table 13.3 Settlements most exposed to Tailing Dams

Settlement	Within 2km	Within 5km
Krasnohorivka	1	2
Voskhod	1	2

NATURAL MULTI-HAZARD EXPOSURE

Natural Multi-Hazard Exposure

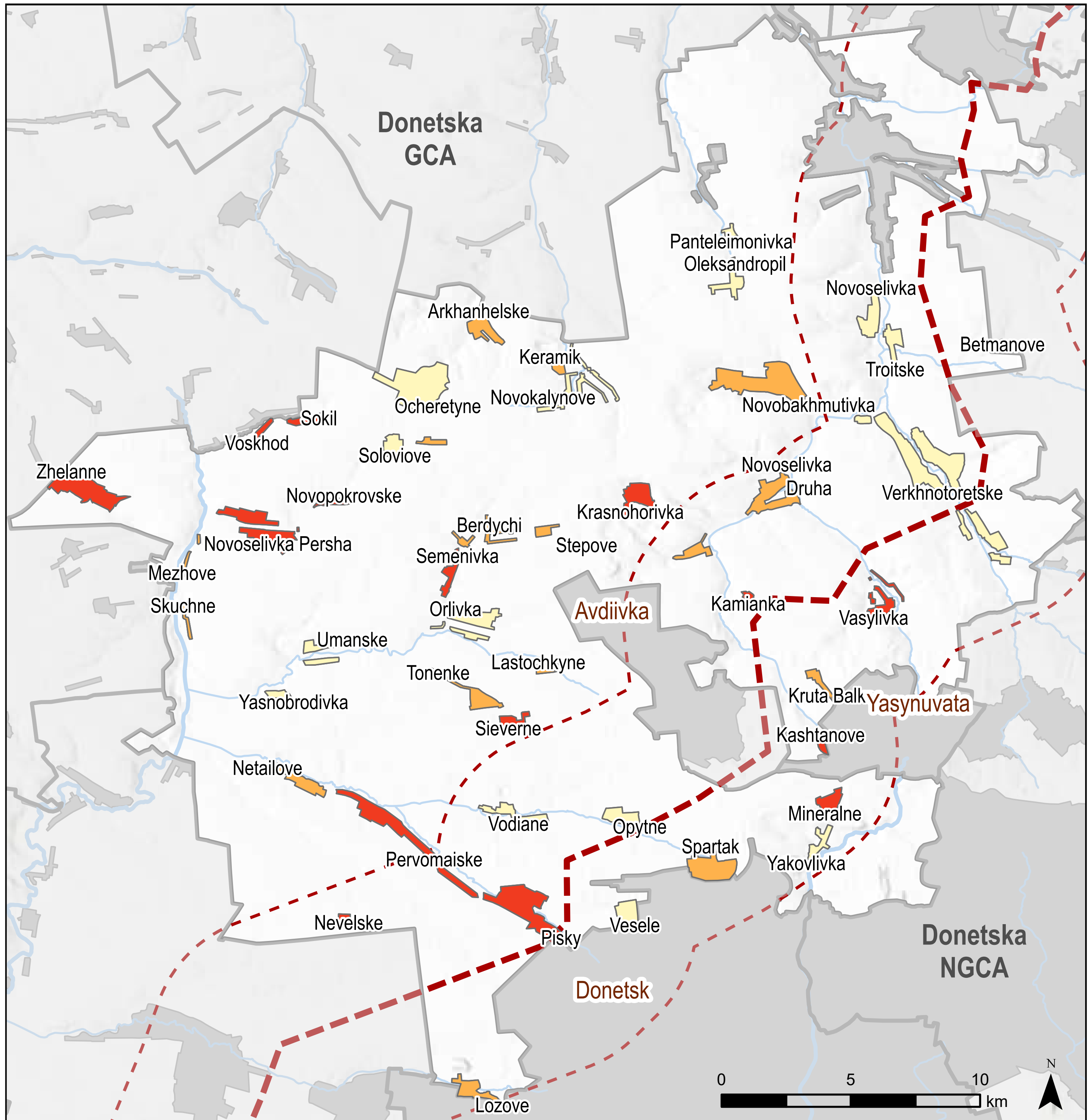
The natural multi-hazard exposure analysis was calculated from the combination of hazard indicators 1.1 wildfires, 1.2 heat waves and 1.3 cold waves.

Tables 14.1, 14.2, and 14.3 present lists of settlements that historically were most exposed to the environmental hazards (during years 2001-2019).

Pisky, Pervomaiske, Mineralne, Kashtanove, Vasylivka, Krasnohorivka, Semenivka, Sieverne, Novoselivska Persha, Zhelanne, Voskhod and Sokil had the highest natural multi-hazard exposure. Whilst many of these settlements also had the highest anthropogenic hazard exposure, there was less focus on the contact line zone and most of these settlements are rural and greater than 5km from the contact line. Many of these settlements were particularly affected by cold and heatwaves, whilst Pisky was the most adversely affected by wildfires. The settlements with the highest number of historical fire records according to FIRMS satellite data are Verkhnotoretske and Pervomaiske.

Natural hazards are also considered as triggers for failure of infrastructure such as power supply, water supply, heating, as well as social infrastructure which makes these hazards a significant threat to the population.

Map 14.1 Natural Multi-Hazard Exposure by Settlements



Natural Hazard Exposure Index

- Lower Exposure
- Medium Exposure
- Higher Exposure
- Contact line (Presidential Decree №32/2019)
- 5 km area along the contact line

Table 14.1 Settlements with Highest Observed Frequency of Abnormally Low Temperatures

	Settlement	Mean number of days per year with cold waves
1	Sokil	17
2	Voskhod	17
3	Vasylivka	17
4	Semenivka	17
5	Novoselivka Druha	16
6	Lastochkyne	16
7	Pervomaiske	15
8	Arkhanhelske	15
9	Ocheretyne	15

Table 14.2 Settlements with Highest Observed Frequency of Abnormally High Temperatures

	Settlement	Mean number of days per year with heat waves
1	Lozove	30
2	Zhelanne	30
3	Nevelske	30
4	Kashtanove	30
5	Mineralne	29
6	Krasnohorivka	29
7	Pervomaiske	29
8	Semenivka	29
9	Voskhod	29

Table 14.3 Settlements with Highest Observed Frequency of Fires during years 2001-2019

	Settlement	Number of fires (FIRMS data)
1	Verkhnotoretske	48
2	Pervomaiske	38
3	Novobakhmutivka	29
4	Novokalynove	27
5	Ocheretyne	26
6	Pisky	26
7	Novoselivka Persha	25
8	Zhelanne	24
9	Orlivka	22

Multi-Hazard Risk (Anthropogenic & Natural)

Multi-hazard risk was calculated based on the equal weighting of the five hazard exposure indicators of wildfires, heat waves, cold waves, hazardous facilities, and conflict incidents, against the societal vulnerability indicators applied to the settlements. This provides insight not just to multi-hazard exposure, but also considers the vulnerabilities of the settlements assessed.

Pisky, Voskhod, Krasnohorivka, Opytne, Pervomaiske, Nevelske, Semenivka, Novopokrovske, Kamianka and Sokil had the highest multi-hazard risk out of the 47 settlements of Yasynuvata raion, based on both hazard and vulnerability data. This is explained by the fact that these settlements have a significant presence of hazardous facilities, exposure to wildfires and extreme weather, as well as close proximity to the CL and high number of conflict incidents.

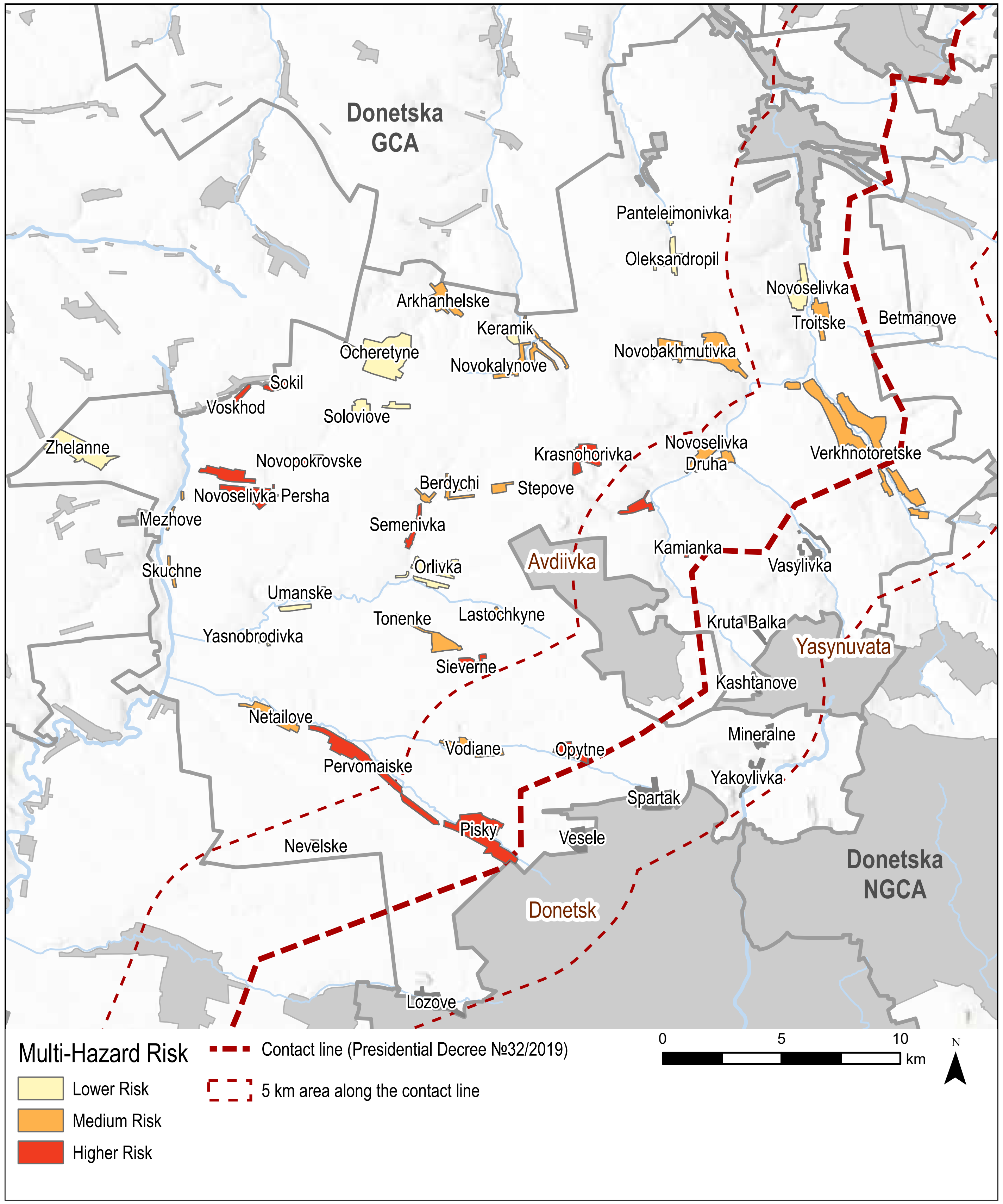
The majority of the settlements at greatest risk are located within 5km of the CL. All were rural settlements.

Conflict is considered both a hazard and a trigger for other hazards in this analysis, as well as a factor reducing the coping capacity of communities and significantly increasing multi-hazard risk.

Table 15.1: Settlement Multi-Hazard Risk

Settlement	Population	Multi-Hazard Exposure	Vulner-ability Index	Multi-Hazard Risk
Pisky	2160	16.27	27.29	4.44
Voskhod	52	13.84	25.53	3.53
Krasnohorivka	526	14.20	24.86	3.53
Opytne	755	12.12	26.23	3.18
Pervomaiske	2193	10.83	25.84	2.80
Nevelske	286	10.75	25.94	2.79
Semenivka	182	11.17	24.94	2.79
Novopokrovske	64	10.81	25.59	2.76
Kamianka	228	10.89	25.30	2.75
Sokil	66	10.88	25.31	2.75
Novoselivka Persha	935	10.55	25.40	2.68
Vesele (Krasnohprivka village council)	147	10.64	25.04	2.66
Sieverne	153	10.68	24.85	2.65
Arkhanhelske	285	10.50	25.22	2.65
Lastochkyne	617	10.70	24.75	2.65
Skuchne	14	10.46	25.30	2.65
Novoselivka Druha	131	10.44	25.24	2.63
Stepove	62	10.60	24.84	2.63
Tonenke	320	10.57	24.88	2.63
Netailove	1141	10.29	25.48	2.62
Vodiane	319	10.39	25.23	2.62
Berdychi	267	10.41	24.87	2.59
Novobakhmutivka (Novobakhmutivka village council)	890	10.19	25.13	2.56
Mezhove	36	10.07	25.31	2.55
Troitske	239	10.05	25.25	2.54
Novokalynove	521	10.05	25.07	2.52
Verkhnotoretske	2975	11.28	22.27	2.51
Novobakhmutivka (Soloviove village council)	191	9.97	25.10	2.50
Umanske	176	9.96	25.11	2.50
Soloviove	223	9.81	25.14	2.47
Panteleimonivka	77	9.87	24.92	2.46
Orlivka	874	9.84	24.83	2.44
Oleksandropil	305	9.49	24.98	2.37
Novoselivka	541	9.41	25.18	2.37
Yasnobrodivka	70	8.67	25.24	2.19
Zhelanne	1471	10.52	20.11	2.11
Keramik	375	10.13	20.10	2.04
Ocheretyne	3686	9.61	20.13	1.93

Map 15.1 Multi-Hazard Risk By Settlements



Hromada Proposed Administration

The state policy of Ukraine in the area of local self-government is based primarily on the interests of residents of territorial communities. The decentralization reform provides for significant and systemic changes through decentralization of power - that is, transfer of a significant proportion of power, resources, and responsibility from the executive branch of the government to the bodies of local self-government (hromadas).

Currently, Yasynuvata Raion includes 3 urban-type village councils (Verkhnotoretsk, Zhelanne and Ocheretyne), and 9 village councils. There are 47 settlements in total. Nine settlements have been divided by the CL and are outside of the GCA. Avdiivka, the largest urban settlement in the region but not officially part of the raion, serves as an important hub for service provision for settlements in the Yasynuvata area.

The formation of amalgamated territorial communities of Yasynuvata raion is still complicated by the proximity to the CL. Yasynuvata settlement, which used to be the raion center before the beginning of the conflict in 2014, is now located on the contact line in NGCA, and the Yasynuvata Raion administration center is located in Ocheretyne. According to the prospective plan, most of the Yasynuvata Raion settlements are planning to form Ocheretynska Hromada, except for Opytne, which is expected to join Avdiivska Hromada, and Yasynuvata with several neighbouring settlements (Spartak, Yakovlivka, Mineralne, Kashtanove, Kruta Balka, Vesele) are forming Yasynuvatska Hromada.

According to the new administrative division, Donetska Oblast will include 8 raions, with Ocheretynska and Avdiivska Hromadas to become part of Pokrovskyi Raion, and Yasynuvatska Hromada to become part of Donetskyi Raion.

There are 20 educational facilities and 16 health facilities in the prospective Ocheretynska Hromada, including 39 settlements with a total population of around 24,450. According to the REACH 2018 CVA, 55% of households in Yasynuvata Raion reported longer than 30 minutes travel time to the nearest primary health care facility. More than 90% of households in rural settlements of Yasynuvata Raion reported longer than 30 minutes travel time to school. There is no SESU unit in Yasynuvata Raion; the raion is served by SESU units in Avdiivka, Selidove and Toretsk. These facts should be considered to ensure that all community members have access to services. For example, establishment of a SESU unit in Ocheretynska Hromada center would have a positive impact on communities' coping capacity to ensure no settlement is too far from their respective service area.

To ensure comprehensive protection of the civilian population in newly-created amalgamated communities, strong inter-departmental preparedness and mitigation planning process led by a Civil Protection specialist is recommended. In line with global best practices and guidance (such as the Sendai Framework), newly-created hromadas should pay particular attention to developing data-driven Disaster Risk Reduction strategies, for which this analysis can serve as a first step.

Map 16.1 Overview Map for Yasynuvata Area Hromadas

Conclusions

This ABRA for Yasynuvata area aimed to analyse geospatial data on hazard exposure and community vulnerability to assess both natural and anthropogenic risks for each settlement in the area.

It is expected to be used by communities and local authorities as a background for risk management plan development that will address the local communities' vulnerability and needs to respond effectively to hazards.

It is conducted at the sub-regional level, and relies on both locally available data, global datasets, and satellite imagery. Most of these datasets are open access and constantly updated, so may be used to reproduce the analysis for other areas or time frames. Thus, this ABRA also serves as a demonstration tool for environmental and industrial risk on a local settlement level.

Community prioritization according to the hazard exposure and vulnerability is important for increasing awareness about the actual risks and a step in building capacity to the exposed hazards.