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AREA BASED RISK ASSESSMENT
POPASNA RAION
LUHANSK OBLAST, EASTERN UKRAINE

2020

European Union
Civil Protection and
Humanitarian Aid

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

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 line of contact, 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 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).

In 2019 on October 13th, celebrated as the International Day for Disaster Risk Reduction, the 3P Consortium introduces its programme which aims at supporting the Government of Ukraine 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.

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

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EXECUTIVE SUMMARY

Anthropogenic Hazards

Coal Mine. Vladimir Lapshyn, Heinrich Böll Foundation, 2019

Shelling incident in densely populated areas near Zolote. REACH, 2018

Lysichansk oil refinery burns. 20khvylyn, 2014

Popasna raion located in Luhansk Oblast is divided by the line of contact in Eastern Ukraine. The region is exposed to 45 potentially hazardous facilities. 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 the conflict or lack of maintenance. In 2019 the Popasna raion recorded close to 950 conflict related security incidents in the area, an indication that the conflict is still very active. Geospatial analysis shows that there have been 15 conflict incidents during 2019 within close proximity to the Pervomajs'kvuhillya network of coal mines in Zolote and the surrounding communities. This raises concerns over methane gas and toxic liquid waste from tailings at these facilities being exposed to the surrounding environment and human population. The urban communities of **Zolote**, **Toshkivka**, and **Hirske**, were reported to have the highest exposure to hazardous facilities. With regards to community exposure to conflict incidents in 2019, **Zolote** along with **Katerynivka**, **Novooleksandrivka**, **Novotoshkivske**, **Troitske**, and **Popasna** were reported as the highest. In addition, the surrounding areas of **Toshkivka**, although no conflict has been reported recently, still have significant land mine contaminated areas.

When combined with societal vulnerability indicators, 7 of the top 10 at risk to anthropogenic hazards were communities within 5km to the line of contact. The majority of communities with the **highest exposure to anthropogenic hazards were in urban areas**, this is due to the fact that primarily hazardous facilities assessed were more commonly located within proximity to urban communities. However, rural communities reported higher rates of households relying on agriculture for their livelihoods, and although many rural communities have a greater proximity from hazardous facilities, the potential environmental risk of contamination of soil, groundwater, and rivers is much larger which could impact agricultural livelihoods of those in nearby rural communities. This is only taken into account under susceptibility indicators, but exposure distance impact on the environment for each facility and substance quantity present was not taken into the overall hazard exposure analysis as done for the individual **Zolote case study** (see page 16).

Natural Hazards

Winter along the contact line. ICRC, 2017

Residents of conflict-affected Luhansk oblast collecting drinking water. UNICEF, 2015

Forest fire in Luhansk Oblast. 112 Ukraine, 2019

The Luhansk Oblast is characterized by a humid continental climate that experiences large seasonal temperature differences, with warm to hot summers and severely cold winters in northern areas. Eastern Ukraine is exposed to climatic extremes of cold waves and heat waves, however, Popasna raion is located further north from Donetsk and the Azov Sea where the region experiences more frequent extreme cold days below -15C. The rural communities of **Novooleksandrivka** and **Rai-Oleksandrivka** had the most reported number of extreme cold days during the observed period.

As Eastern Ukraine experiences great variations of extreme temperatures, heat waves also impact the population, with reports of very frequent land surface temperatures during the summer months of above 37C, such as in the urban community of **Maloriazantseve** just west of the industrial city of Lysychansk. The urban communities near to the line of contact of **Novotoshkivske** and **Nyzhnie** also reported higher frequency of extreme hot days.

Conflict in the Popasna raion is considered an anthropogenic hazard, but also a trigger for other hazards, as well as impacting the coping capacity of the society. During natural hazards such as cold waves and heat waves, coupled with conflict incidents that could disrupt water supply infrastructure, electricity, and heating supply networks, increases the risk of the population to such natural hazards.

Popasna raion still has significant forest land-cover, as well as agricultural land, both in use and overgrown and abandoned, providing fuel for wildfires to occur and threaten the population and impact livelihoods. Conflict in this instance, is seen as a trigger, where several cases of wildfires and forest-fires have been the result of conflict activity. **Zolote** has a high record of satellite-detected fires, significant forest and fuel land-cover within proximity to the community, and continued conflict incidents, making it one of the highest exposed communities to wildfire threats.

Novooleksandrivka, **Troitske**, and **Katerynivka**, are rural communities within 5km to the line of contact and have increased susceptibility and more challenges in terms of coping capacity. When taking this societal sphere of vulnerability into account, these three communities which do not have the highest combined natural multi-hazard exposure, are three of the top four communities with highest risk of natural hazards.

INTRODUCTION

Background

Since 2014 Ukraine has been experiencing conflict, and civilians continue to bear the brunt of the subsequent 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 increasingly vulnerable due to lack of maintenance and continued conflict, limiting local capacity to prepare, prevent, and protect local communities.

Populations living closest to the line of contact (LoC) also face conflict-related hazards, regular shelling; high mine and unexploded ordnance (UXO) contamination; and frequent utility cuts which is particularly dangerous in harsh winters. Moreover, the 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. 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 of capacity in the heating system for several weeks, prompting local authorities and humanitarian actors to set up communal heating points.

In summer months heatwaves pose a threat of heat stroke to vulnerable populations coupled with conflict threatening access to safe drinking water due to damages disrupting or halting water supplies. In addition, Eastern Ukraine is susceptible to wildfires during hot summer months and its proximity to the LoC only increases the likelihood for wildfires due to the occurrence of conflict related explosions. 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.

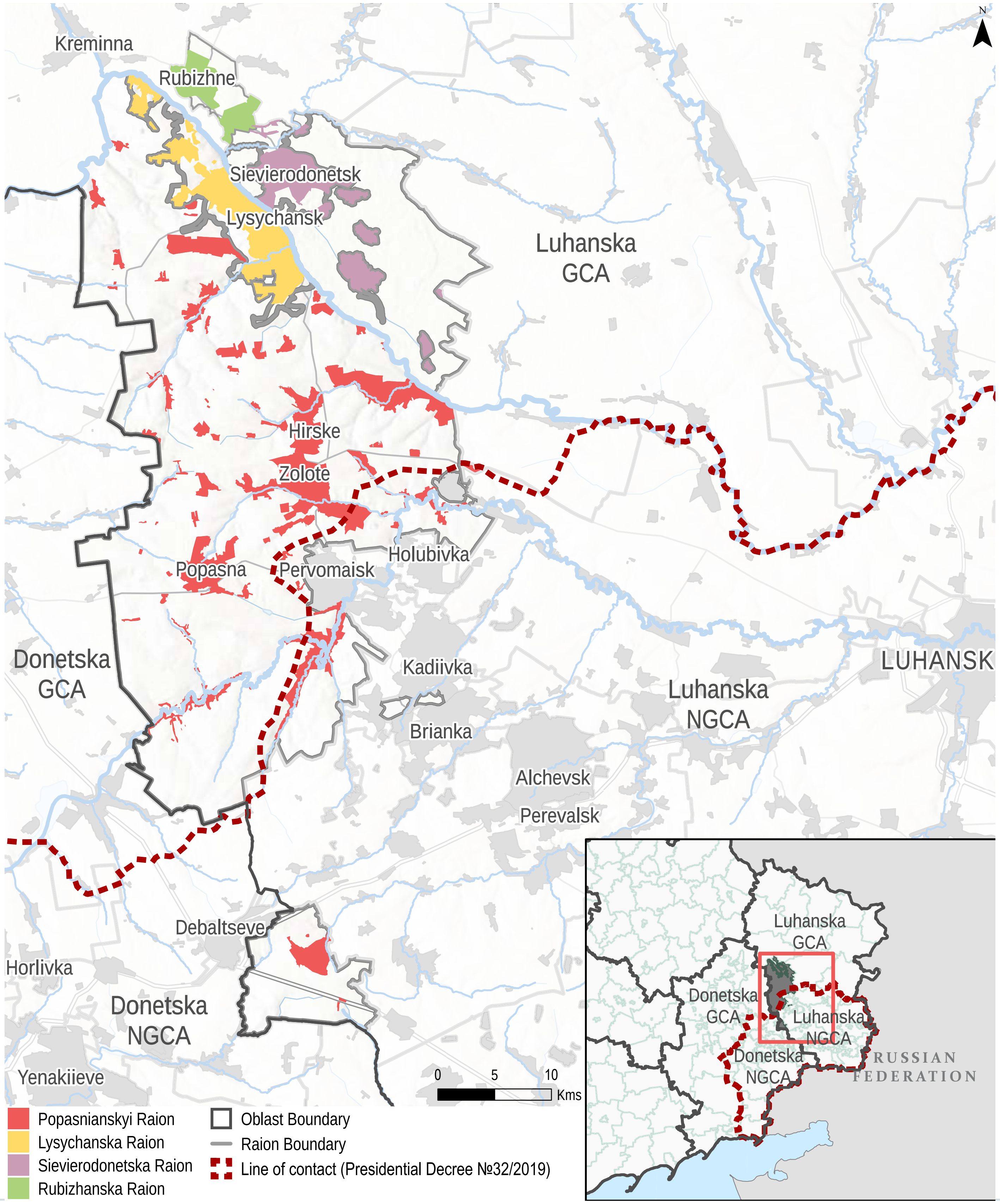
Overview of Assessed Area

Popasna raion is in the south-west of Luhansk oblast and bordering Donetsk oblast. The raion territory include 847 km2 of agricultural land, and 279 km2 forested areas.

The administrative structure includes 44 settlements, which includes 3 cities, 11 urban-type settlements, 12 settlements, and 18 villages. The cities of Zolote, Hirske and Popasna are within 5km of the LoC and the road connecting Zolote to Pervomaisk is the potential location of an official entry and exit checkpoint between Government Controlled Areas (GCA) and Non-Government Controlled Areas (NGCA). As of July 2019 the population was 74,600 of which 10,460 were reported IDPs (Ministry of Social Policy, 2019). The population is mostly urbanized with 88% living in urban areas compared to11% rural residents.

Popasna raion, highlighted in red shows the preconflict administrative area of the raion; however, 10 settlements have been divided by the LoC and are outside of the GCA. The neighbouring city councils have been included for the broader hazard exposure analysis, but the Area Based Risk Assessment will focus on the settlements within the GCA of Popasna raion.

Overview map for Popasna raion



METHODOLOGY

Methodology overview

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

The ABRA aims to analyse 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. In 2019, there is no centralized and functional platform for open geospatial data access which requires 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 is only possible to use datasets where the resolution was low 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 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 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 case studies.

The risk profile is based on available secondary data review, therefore all relevant indicators to determine risk could not be incorporated. 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

Disaster Risk according to the United Nations Office for Disaster Risk Reduction (UNDRR), 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 which were prioritized to those hazards that are exacerbated by the current state of hazardous industrial objects and conflict dynamics throughout 2019.

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 Popasna raion were; hazardous facilities from mine-related and chemical use, conflict, wildfires, and extreme temperature of cold waves and heat waves.

For each hazard, the approach was to identify where geographically there was potential for exposure within the Popasna 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 taken into consideration 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 (pg. 14, 15) and the Zolote Case Study (pg. 16). However, this requires an individual assessment of each hazardous site, its substances and quantities present. This further analysis is recommended for sites that are near to the LoC or have experienced disruptions in maintenance and operations.

Conflict, is both considered a direct hazard, 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 conflict incidents to the population, but also exposure to critical infrastructure of importance 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 Popasna raion, however, extreme temperature conditions, coupled with a potential disruption due to conflict to gas pipelines, the electricity network, or the water infrastructure network can make the risk much higher due to the impacted coping capacity of the affected population's infrastructure.

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 refer 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 Popasna raion which assess 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 Popasna 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 Popasna raion was based on four stratas, urban settlements within 5km to the LoC, urban settlements greater than 5km from the LoC, rural settlements within 5km to the LoC, and rural settlements greater than 5km from the LoC. Therefore societal vulnerability indicators will be representative not to the individual settlement but to the settlement classification.

METHODOLOGY: RISK EQUATION

Figure 1.1 Risk Diagram

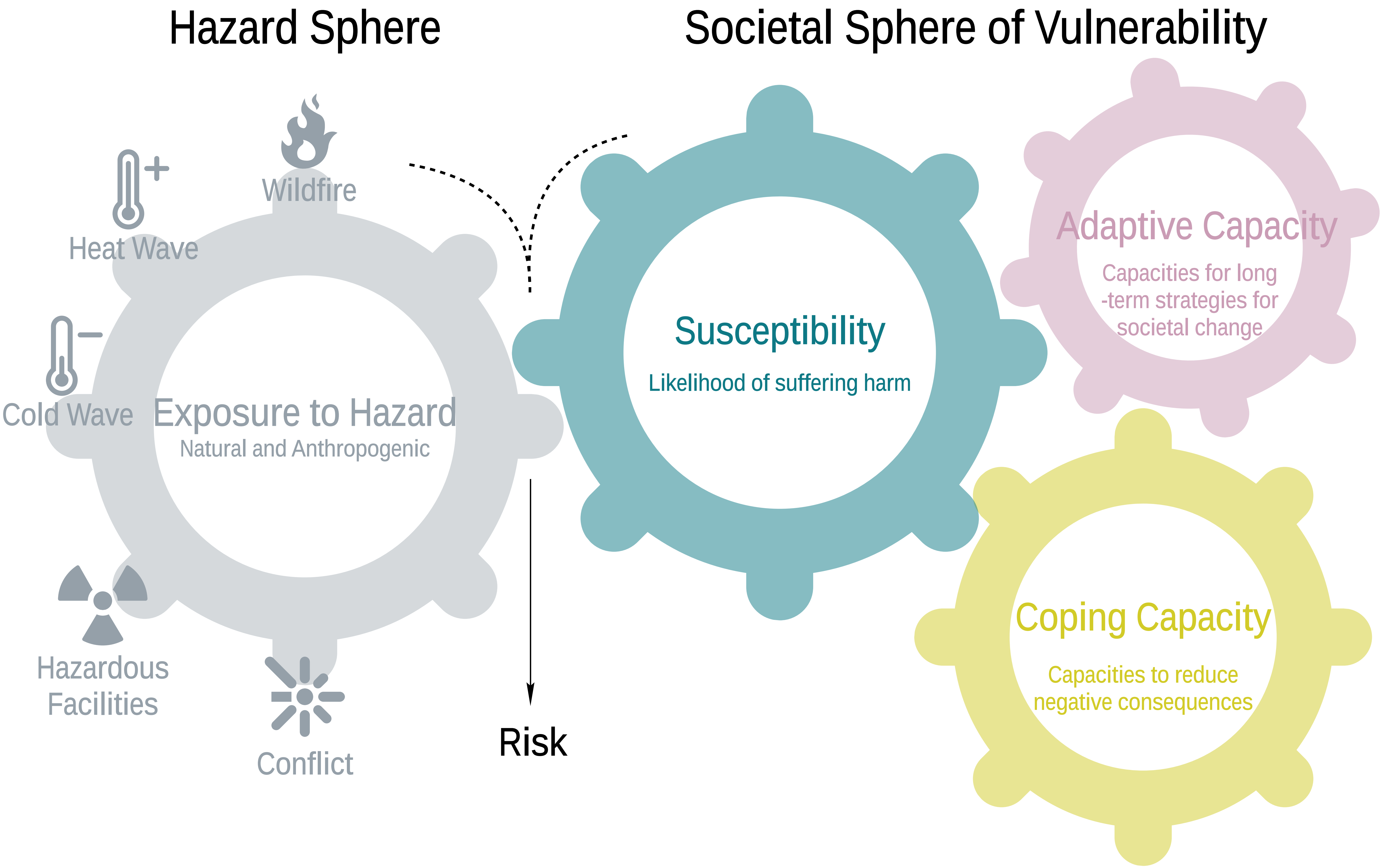
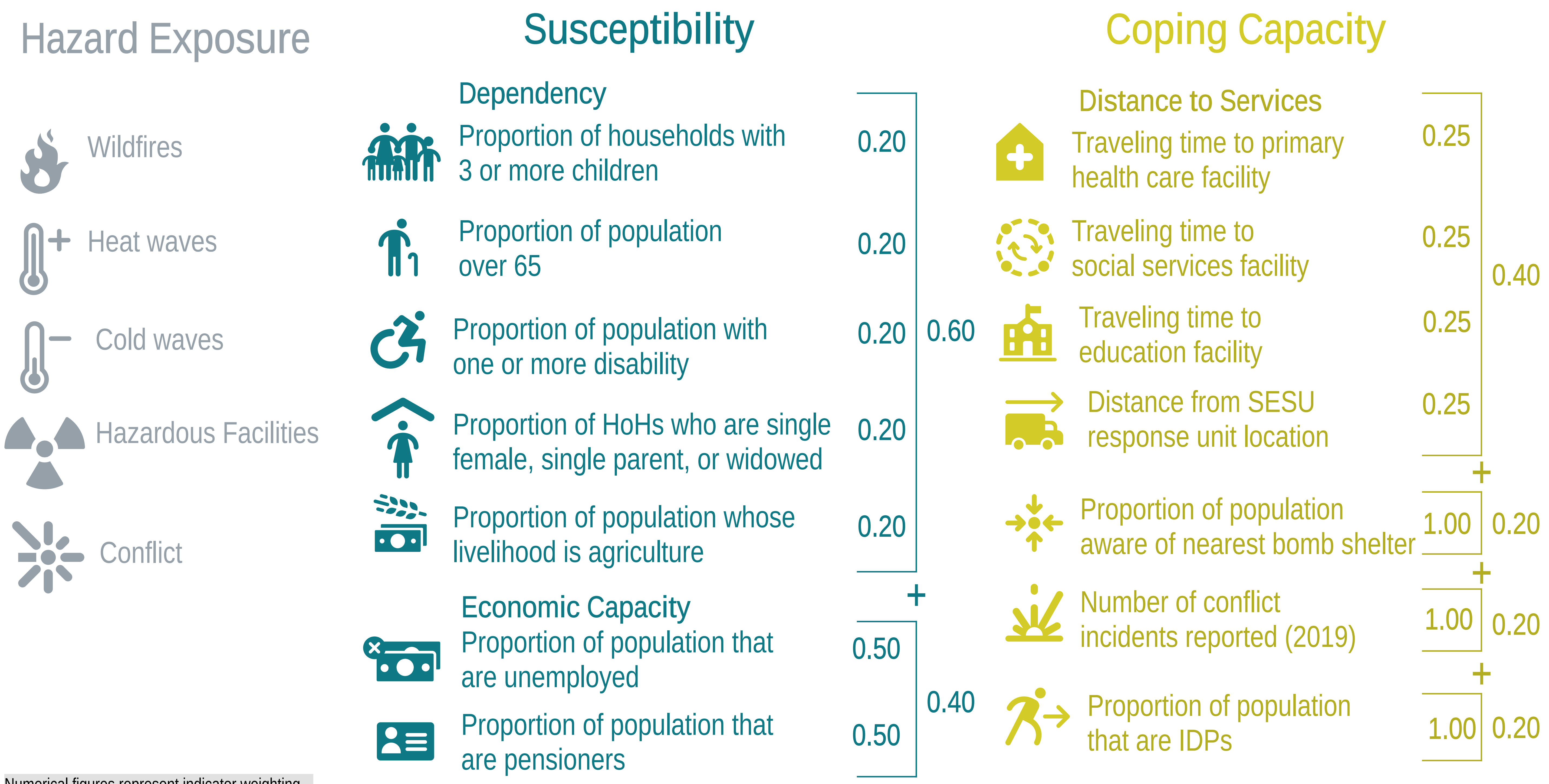


Figure 1.2 Risk Indicator Diagram

Risk = Exposure × Vulnerability



Hazard Exposure

- Wildfires
- Heat waves
- Cold waves
- Hazardous Facilities
- Conflict

Susceptibility

Dependency		
Proportion of households with 3 or more children	0.20	0.60
Proportion of population over 65	0.20	
Proportion of population with one or more disability	0.20	
Proportion of HoHs who are single female, single parent, or widowed	0.20	
Proportion of population whose livelihood is agriculture	0.20	
+		
Economic Capacity		
Proportion of population that are unemployed	0.50	0.40
Proportion of population that are pensioners	0.50	

Coping Capacity

Distance to Services		
Traveling time to primary health care facility	0.25	0.40
Traveling time to social services facility	0.25	
Traveling time to education facility	0.25	
Distance from SESU response unit location	0.25	
+		
Proportion of population aware of nearest bomb shelter	1.00	0.20
+		
Number of conflict incidents reported (2019)	1.00	0.20
+		
Proportion of population that are IDPs	1.00	0.20

Numerical figures represent indicator weighting to a total value of 1 for Susceptibility, and to a total value of 1 for Coping Capacity. Adding these two components together divided by 2 will give the combined Vulnerability index.

Vulnerability = (Susceptibility + Coping Capacity) / 2

METHODOLOGY: RISK INDICATORS

Hazard Exposure

The exposure of communities to these multiple hazards is something that needs to be better understood at the localized 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 Fire Information for Resource Management System (FIRMS) which includes all fires; urban, agricultural, grassland, and forest, 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 37C or higher during June, July, August (2000-2019) using remote sensing methodologies from MODIS Land Surface Temperature and Emissivity (MOD11)

Indicator 1.3: Cold wave

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

Anthropogenic Hazards

Indicator 2.1: Hazardous Facilities

- Number of hazardous facilities within a settlement or within 2km of settlement (Geospatial data from the Donbas Environment Information System, and WASH Cluster)

Indicator 2.2: Conflict

- Number of conflict incidents within a settlement or within 2km of a settlement (INSO conflict incidents for the period of 2019 were used for analysis)

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 limits 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: Head of Households (HoH) 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 fragile to the exposures of 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 are 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 to cope after a shock from a hazard is crucial in reducing negative consequences and influences ones vulnerability and risk level to a hazard. The REACH CVA and State Emergency Services of Ukraine (SESU) provide data on distances to key services. Data is also available on preparedness awareness, conflict incidents, and displacement status. All components 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 mechanisms 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 that reports 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 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 applicable 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: 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

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), destroy large swathes of natural habitat and human built structures (houses, factories or utility infrastructure). With rising global temperatures and an increase in the frequency and severity of heatwaves, the number of fires overtime is growing every year (IPCC, 2018).

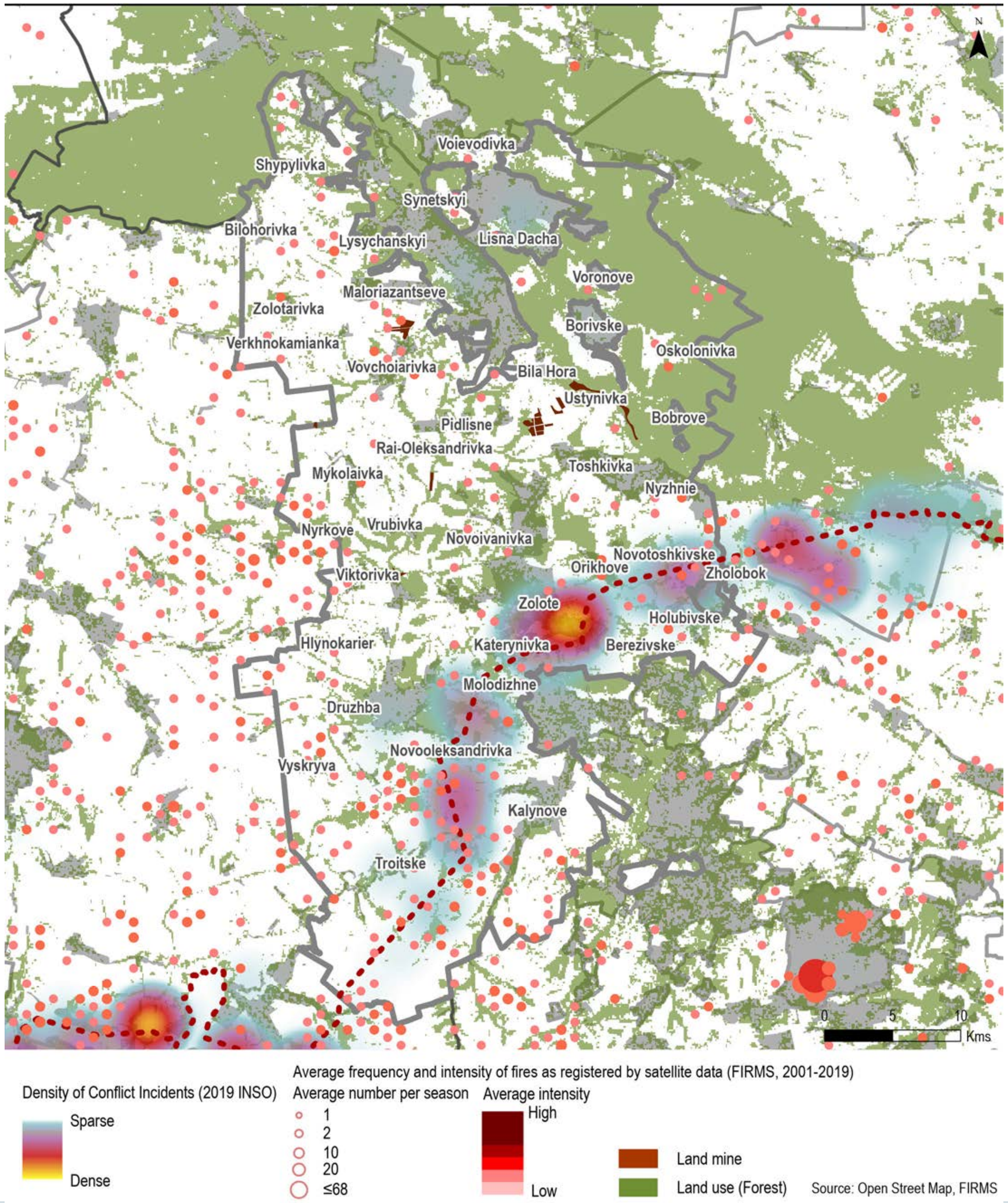
This review contains data on fires in Popasna raion from 2 sources: satellite data from the Fire Information for Resource Management System (FIRMS) from the National Aeronautics and Space Administration (NASA) for the years of 2001-2019 and data provided by the Central Office of SESU in Luhansk oblast for the years 2015-2018[1] (SESU,2019).

The most common source of fires according to SESU is due to careless smoking and handling of fire followed by electric system short circuits and tend to happen in open areas, residential buildings and waste zones.

The majority of FIRMS recorded events are agricultural in nature, however a concentration of fire events south of Popasna city and east of Zolote are likely due to conflict related incidents.

Although Eastern Ukraine is classified in the steppe agro-ecologic zone, the region around the Seversky Donets river basin still has significant forest and overgrown vegetation land cover in and around Popasna raion as shown in the regional land cover overview map 1.2 indicating that the fuel for a hazardous wildfire is present. In the case of a wildfire hazard, conflict and land-mine contamination are considered as potential triggers. When coupled with conditions of increasing heat waves, there is a threat of settlement exposure to wildfires.

Map 1.1 Average Frequency and Intensity of Fires



Source: Open Street Map, FIRMS

Map 1.2 Regional Overview of Forest Land Cover

Key takeaways

1. De-mining activities to reduce the potential of being a trigger to a wildfire but also to reduce access constraints for fire responders over potentially contaminated areas.
2. Implement a Fire Smart community program
3. Firebreak and fuelbreak implementation between areas exposed to continuing conflict incidents

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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.

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

Table 1.1 Most Common Causes of Fires (SESU)

Causes	2015	2016	2017	2018	Total
Smoking carelessness	379	348	791	618	2136
Careless handling of fire	327	99	176	220	822
Short circuit	73	85	91	122	371
Violation of safety rules	19	17	24	21	81
Arson	29	14	15	16	74
Explosion	40	4	2	2	48
Malfunction of household	13	21	14		48
The wasteland with fire	1	5	7	7	20
Lack of heating structures				17	17
Self-ignition of things		2		9	11
Other reasons	0	8	11	6	25

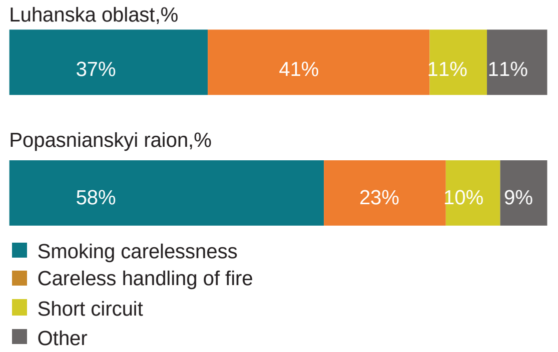
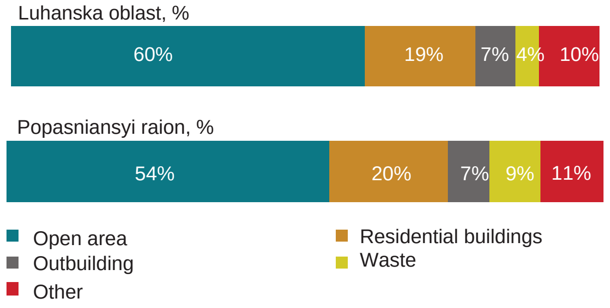
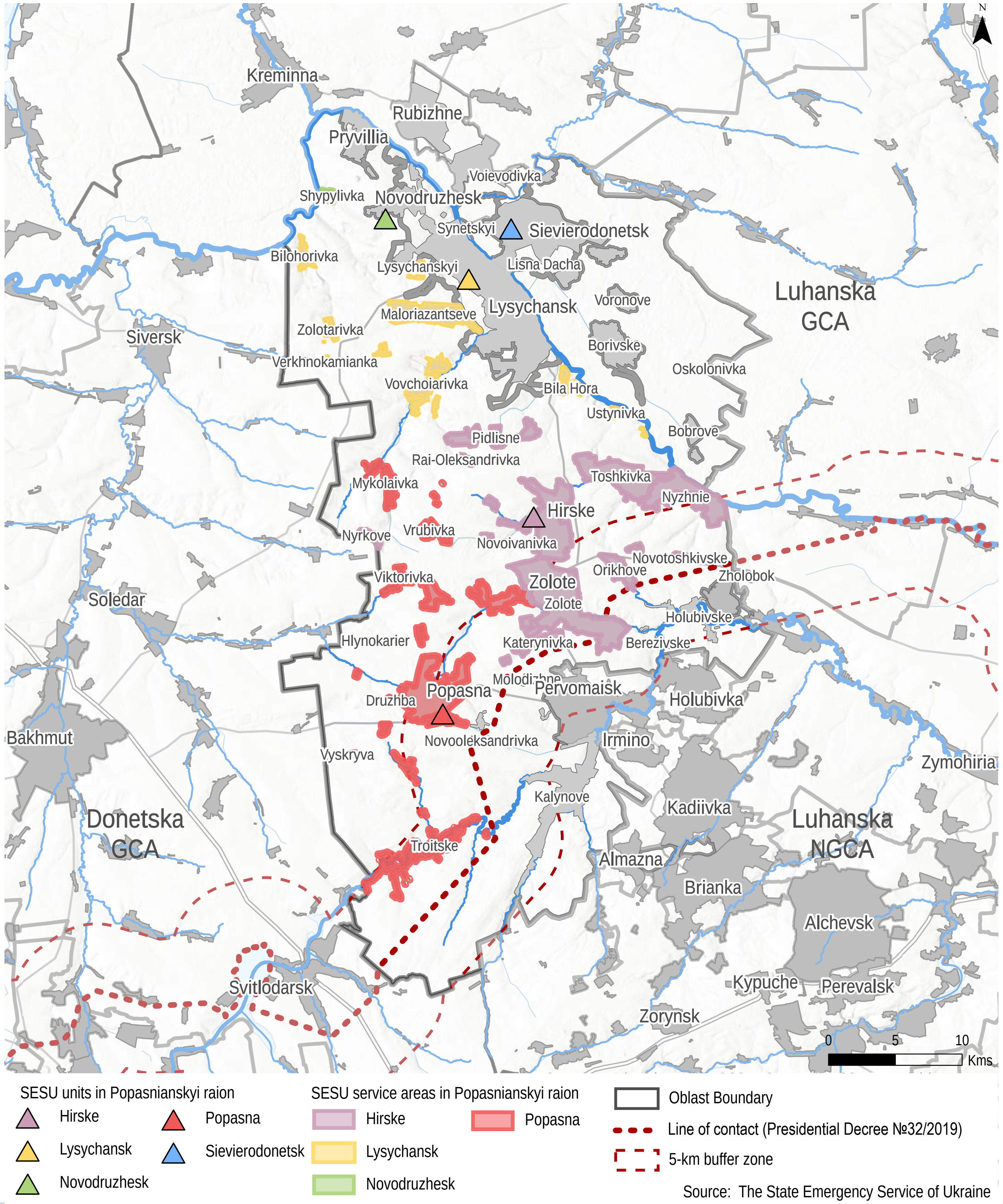


Table 1.2 Most Common Locations of Fires

Fire place	2015	2016	2017	2018	Total
Open area	489	296	817	377	2182
Residential buildings	217	172	154	182	856
Waste	6	4	6	296	450
Outbuilding	52	40	90	71	297
Municipal	24	36	1	28	109
Motor transport	25	14	20	20	90
The roof, the roof	36	13	10	7	69
Balcony	14	9	10	15	57
Entrance	4	7	6	4	27
Utility room	2	3	4	12	26



Map 1.3 SESU Unit Location and Service Area for Popasna Raion



Source: The State Emergency Service of Ukraine

Map 1.4 Regional Overview of Average Annual Number of SESU Trips to Report of Fires

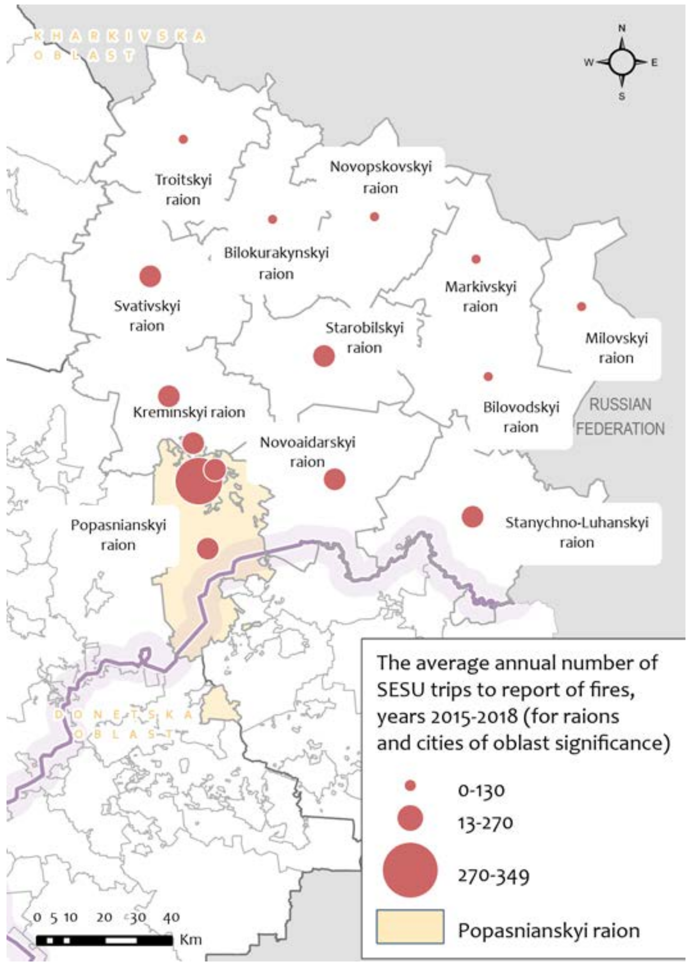


Table 1.3 Annual Number of Sesu Trips To Report of Fires

Raion name	2015	2016	2017	2018	Total
Lysychanska	294	240	377	349	1451
Sievierodonetska	231	165	261	261	1057
Stanychno-Luhanskyi	243	128	294	192	959
Popasnianskyi	202	101	267	241	945
Rubizhanska	154	97	226	187	788
Kreminskyi	137	118	203	200	762
Novoaidarskyi	169	99	220	185	747
Svativskyi	147	78	156	210	697
Starobilskyi	166	77	175	192	682
Novopskovskyi	105	54	132	128	475
Bilovodskyi	109	44	109	76	367
Bilokurakynskyi	67	50	96	89	333
Markivskyi	73	43	108	77	331
Troitskyi	41	41	46	109	258
Milovskyi	43	24	75	52	215

HAZARD-EXTREME TEMPERATURES: HEAT WAVES

Hazard Description

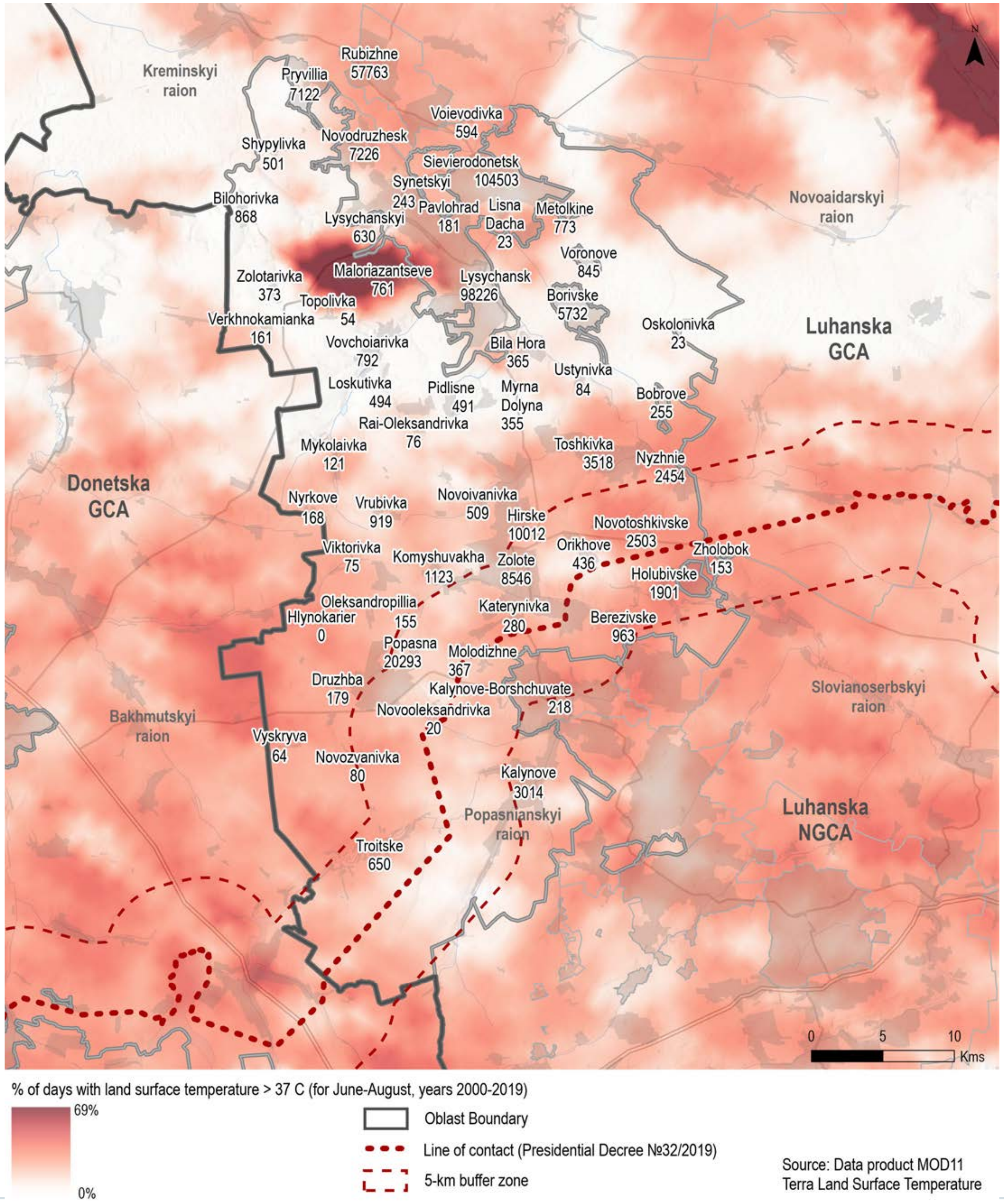
Extreme heat and hot weather over a prolonged period are referred to as heatwaves (IFRC, 2011) and are a significant hazard for populations, infrastructure and the environment. While the exact definition of a heatwave varies by country it is usually measured by analysing temperatures against long term averages and therefore focuses on temperature deviation rather than absolute temperature. They have a significant impact on society as they increase both mortality and morbidity, put strain on both infrastructure (water systems, healthcare) and ecosystems due to droughts and high probabilities of forest fires (C2ES, 2019).

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

Information about abnormally high temperatures in Popasna raion and adjacent territories was calculated using remote sensing methodologies from MODIS Land Surface Temperature and Emissivity[2] (MOD11) (Wan, Z., Hook, S., Hulley, G., 2015) based on temperature observations in the months of June, July, and August. The temperature cut off point of +37C was determined as the lower limit for abnormally high temperatures, which is one standard deviation from the observed mean during the study period.

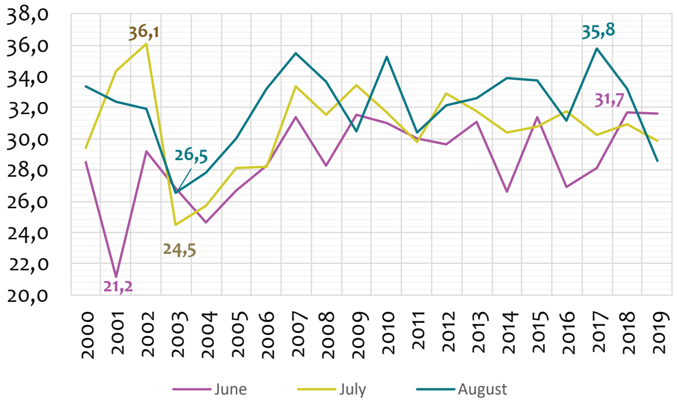
In Popasna raion, the highest land surface temperatures were observed during the summer of 2007 with an average temperature of +33C. The coldest observed average land surface temperatures in summer were observed in the year of 2003 (average temperature of +26C). The map displays average proportion of days during the summer season when the land surface temperature exceeds the marginal value. Hotspots are distinctly evident on the map in areas around Lysychanskyi city and into western settlements such as Maloriazantseve.

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



Source: Data product MOD11
Terra Land Surface Temperature

Graph 2.1 Mean Temperature in Summer Months



Data in graph 2.1 shows that the months of August in the years 2000-2019 tended to have a higher mean temperature than June and July.

Key takeaways

The use of land surface temperature products such as MODIS helps authorities identifying the communities 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 inform targeting of risk reduction initiatives within communities that see more frequent exposure to abnormally high temperatures.

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

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[2] The 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.

HAZARD - EXTREME TEMPERATURES: COLD WAVES

Hazard Description

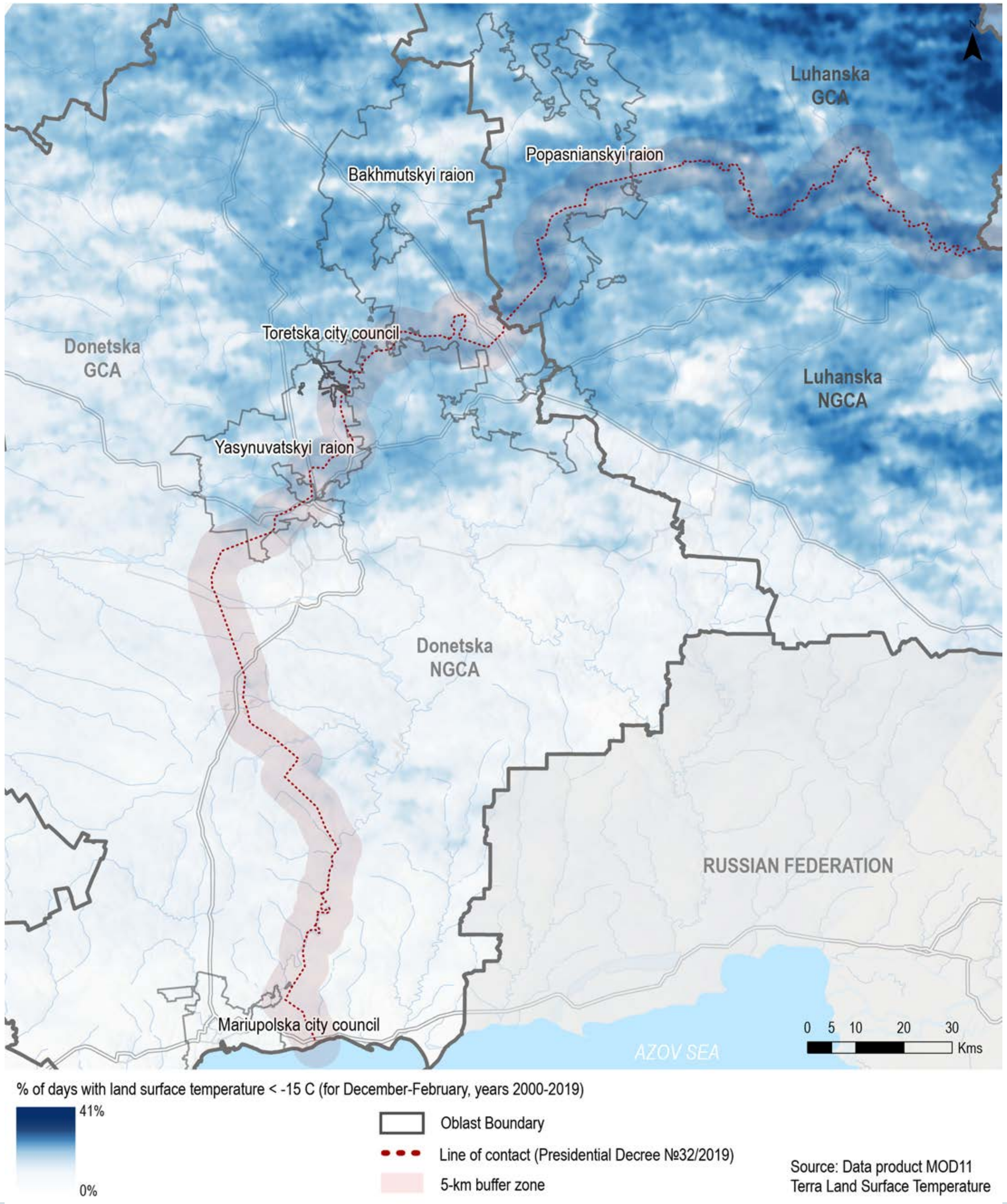
Extreme cold or cold waves are weather conditions defined by either a rapid drop in air temperature or a sustained period of excessively cold weather (IFRC, 2018). Severe cold is a threat to human health as prolonged exposure can lead to hypothermia, frost bites and cardiac arrests which tends to lead to increased mortality (Wang, 2016). Deterioration in transport conditions also lead to higher instance of road accidents (Hayat et al, 2013) and affects utilities 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 in 2006 (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 about abnormally low temperatures in Popasna raion and adjacent territories was calculated using MOD11[3] based on temperature observations in December, January, February. Map 3.1 displays data for the winter season for the period of 2000-2019. It utilizes data from 835 satellite images and shows the percentage of days with temperature below -15C.

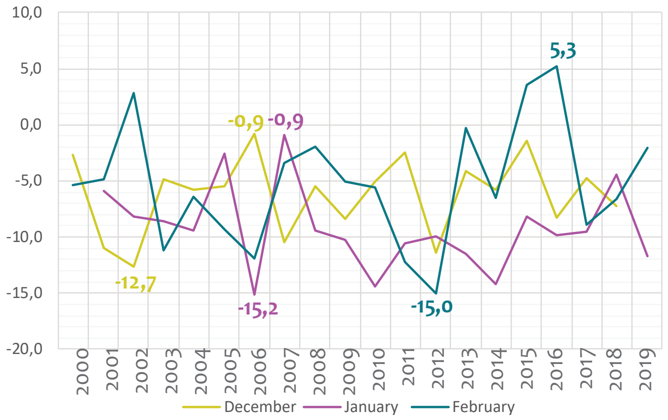
Higher frequency of days with extreme low temperatures can be observed around most of Popasna raion. Compared to other regions along the LoC, Popasna and Luhansk Oblast experience much higher frequencies compared to neighbouring regions in Donetsk Oblast.

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



Source: Data product MOD11
Terra Land Surface Temperature

Graph 3.1 Mean Temperature in Winter Months



Key takeaways

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

Disaster risk reduction practitioners can reduce the risk of cold wave mortality by ensuring vulnerable groups in areas that experience the most severe weather can assess:

1. Financial support to cover basic expenses for heating
2. Increase awareness of initiatives for communal hot spot locations if complete failure to heating supply
3. Increase awareness on best practices to keep your shelter warm and safely heat your shelter during disruptions to conventional heating supply.
4. Local responders to identify the most susceptible populations 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).

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[3] The 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.

HAZARDOUS CRITICAL INFRASTRUCTURE FACILITIES

Hazard Description

Based on review from 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, and Humanitarian Needs Overview (HNO) there are an estimated 45 potentially hazardous facilities in Popasna raion and its neighbouring areas. These sites include chemical and coke industries, energy and power, 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.

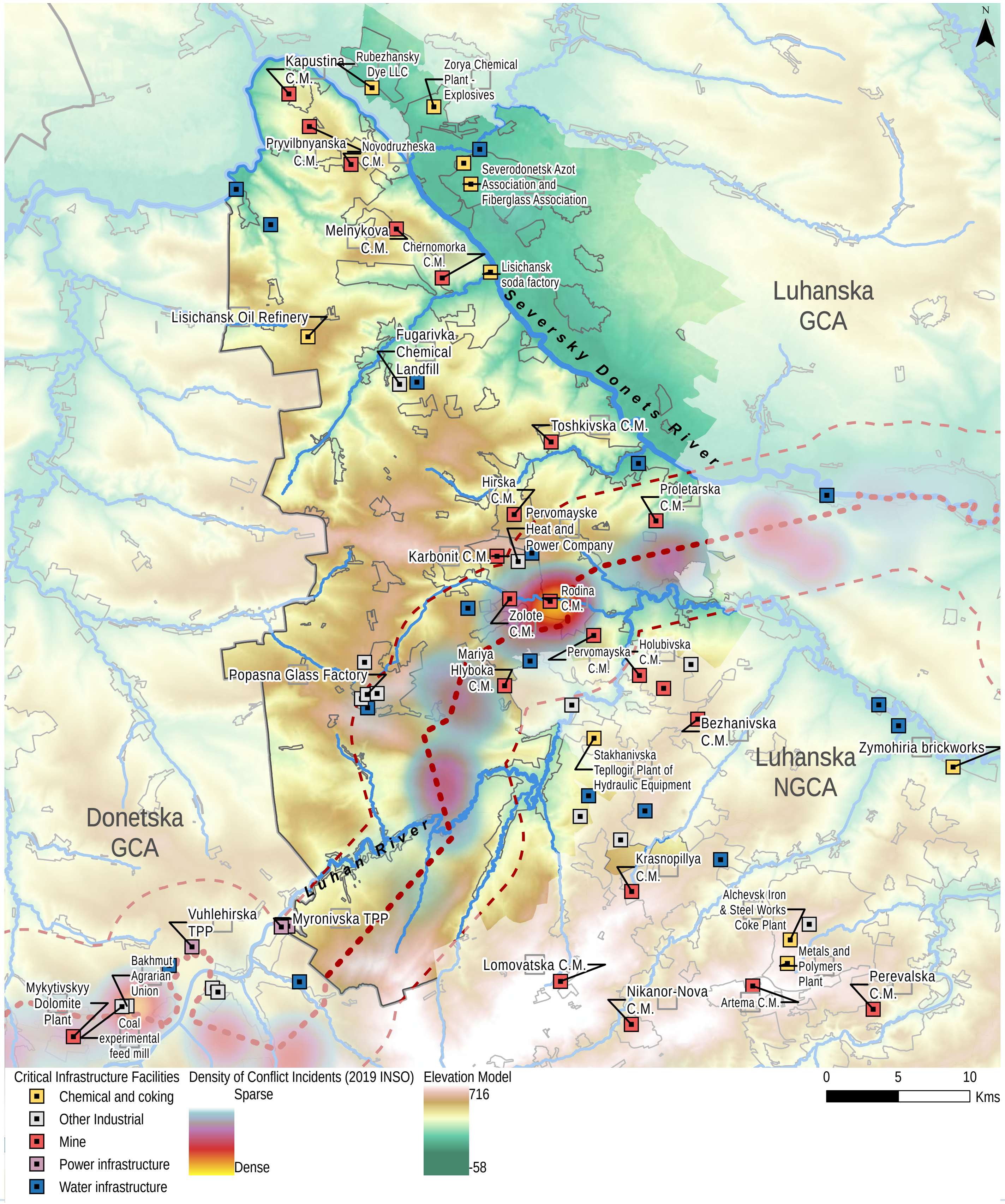
Using conflict incident data from 2019 there were close to 950 conflict related security incidents recorded in the area of Popasna raion with reports of significant increases in the region for 2020. Geospatial analysis shows that five coal mines have been exposed to conflict incidents within $1,000m^3$ of the DEIS identified facility. Rodina Coal Mine has had the most reported incidents within its proximity with a total of 12 being reported for 2019.

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

Hazardous Facility	Number of incidents
Rodina Coal Mine	12
Zolote Coal Mine	2
Pershotravnevyy Electromechanical Plant	2
Pervomayske Heat and Power Company	1
Svitlychan Chlorinator & Pumping Station	1
Popasna Glass Factory	1
Kirova Coal Mine	1
Kapustina Coal Mine	1
Pervomayska Coal Mine	1

3) 1,000m spatial indication is based on the centroid location of the facility and is not based on the facility area perimeter, or key storage locations within the premises and should be used as an estimated exposure indicator to conflict.

Map 4.1 Major Hazardous Objects Location



Using the Flash Environmental Assessment Tool (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 distance (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 National Institute for Public Health and the Environment (RIVM) for UNEP and the UNOCHA.

1. COAL MINES

Hazard substance #1: Methane (Globally Harmonized System (GHS) classification: Flammable, Flam Gas 1.)

Exposure: channeled through air and dangerous to humans and critical infrastructure

- Human Health: 0.2 to 0.3km (1 million kg)

Hazard substance #2: Waste from tailings (GHS classification: Toxic Liquid Acute Tox 1, Aquatic Acute 1)

Exposure: channeled through soil, groundwater, rivers and dangerous to the environment, fishing, agriculture, and human health.

- Lethal to Humans: 1km (20kg) to 5km (1,000kg)
- Human Health: >5km (20kg)
- Environment (Soil): 2km (20kg) to >10km (5,000kg
- Environment (River): 5km (20kg) to >10km (1,000kg)

The coal mine system State Enterprises (SE) “Pervomajs’kvuhillya” near the settlement of Zolote is within 5km of the LoC and comprises of several coal mine sites. The mines are outdated and lack of financing affects mine drainage. Uncontrolled water-levels in these mines can cause toxic substances to be released in densely populated areas, ground and underground water pollution, and land degradation. There are many other typical mine-related hazards including; explosive hazard (methane yield), air pollution with fine dust, and mining waste accumulation (spoil tips).

Mines within the SE “Pervomajs’kvuhillya” network include:

- “Zolote” mine (Zolote). Commencement of operation in 1940, reconstructed in 1943.
- "Rodina" mine (Zolote). Commencement of operation in 1972
- “Karbonit” mine (Zolote). Commencement of operation

in 1908, reconstructed in 1974. This mine is super categorical in terms of methane presence and is at risk of coal dust explosion.

- “Pervomayska” mine (Zolote, NGCA). The mine was created in 1975 through amalgamation of two other mines. This mine is super categorical in terms of methane presence and has danger of coal dust explosion.
- “Toshkivska” mine (Toshkivka). Commencement of operation in 1932, reconstructed in 1974.
- “Mariya Hlyboka”, former mine of Menzhynskyi (Pervomaisk, NGCA). Commencement of operation in 1968. This mine poses a hazard in terms of sudden coal, rock refuse, and methane outbreak, and in terms of explosive coal dust.
- “Hirska” mine (Hirske). Commencement of operation in 1949, reconstruction – 1980. This mine poses hazard in terms of sudden coal, rock refuse, and methane outbreak, and in terms of explosive coal dust.

The SE Lysychanskvuhilla is another mine system of coal mines in the north of Popasna raion in Lysychansk. The enterprise includes the following mines: “Kapustina”, “Melnykova”, “Novodruzheska”, “Pryvilnyanska”

- “Kapustina” mine (Pryvillia). Commencement of operation in 1954. This mine is super categorical in terms of methane presence and has danger of coal dust explosion.
- “Melnykova” mine (Lysychansk). Commencement of operation in 1950, reconstructed in 1964. This mine is super categorical in terms of methane presence and has danger of coal dust explosion.
- “Novodruzheska” mine (Novodruzhesk). Commencement of operation in 1939. This mine is super categorical in terms of methane presence and has danger of coal dust explosion.
- “Pryvilnyanska” mine (Pryvillia). Commencement of operation in 1952. Category II in terms of methane hazard, has danger of coal dust explosion.

2. SVITLYCHAN CHLORINATOR & PUMPING STATION FOR KP POPASNA RAION WATER UTILITY (NYZHNIE)

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

Exposure: channeled through air and dangerous to humans and critical infrastructure

- Lethal to Humans: 0.4km (10,000kg) to 1.3km (>1 million kg)
- Human Health: 2km (10,000kg) to 5km (>1 million kg)

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

Exposure: channeled through soil, groundwater, rivers and is dangerous to the environment, fishing, agriculture, and human health.

- Lethal to Humans: 1km (20kg) to 5km (1,000kg)
- Human Health: >5km (20kg)
- Environment (Soil): 2km (20kg) to >10km (5,000kg
- Environment (River): 5km (20kg) to >10km (1,000kg)

3. LYSYCHANSK OIL-PROCESSING PLANT (est. in 1976)

Hazard #1: Petroleum (GHS Classification: Flammable, Flam. Liq. 1)

Exposure: channeled through air and dangerous to humans and critical infrastructure

- Human Health: 0.4 to 0.6km (10 million kg)

Hazard #2: Petroleum (GHS Classification: Aquatic Chronic, Aquatic Chronic 2)

Exposure: channeled through soil, groundwater, rivers and dangerous to the environment, fishing, and agriculture

- Environment (Soil): 1km (1,000kg) to 7.3km (50,000kg)
- Environment (River): 1.3km (1,000kg) to >10km (10,000kg)

The oil-processing plant is not functioning since 2012. Extensive repairs started in 2013 and the reopening of the plant was planned for 2014 but failed to materialize due to the conflict. In June 2014 the facility was damaged by shelling which affecting the heat and power station.

4. FUGARIVKA POLYGON OF INDUSTRIAL WASTE (est. in 1969)

Hazard #1: Several types of hazardous chemicals, methane storage and contaminants found in industrial sites (e.g. heavy metals) (GHS Classification: Aquatic Chronic, Aquatic Chronic 3, Aspiration Toxicity 1)

Exposure: channeled through soil, groundwater, rivers and dangerous to the environment, fishing, and agriculture liquid state: Hazardous to the aquatic environment with significant health effects.

Meant for storage of industrial waste from the enterprises of Sievierodonetsk, Rubizhne, Lysychansk. Satellite data shows regular occurrence of fires. The polygon contains 16,105t of PrJSC «Severodonetsk Azot Association» waste (I-IV waste hazard class), 143,486t of waste of “Rubizhanskyi Krasytel” (II-IV waste hazard class), 69,343t of “Zorya” waste (III-IV waste hazard class).

5. POPASNA GLASS FACTORY (est. in 1917)

Hazard #1: Mercury (GHS Classification: Toxic Liquid, Acute Tox 1., Aquatic Chronic 1)

Exposure: channeled through soil, groundwater, rivers and dangerous to the environment, fishing, agriculture, and human health.

- Lethal to Humans: 1km (20kg) to 5km (1,000kg)
- Human Health: >5km (20kg)
- Environment (Soil): 2km (20kg) to >10km (5,000kg
- Environment (River): 5km (20kg) to >10km (1,000kg)

Hazard # 2: Mercury (GHS Classification: Toxic Gas, Acute Tox. 1)Exposure: channeled through air and dangerous to humans

- Lethal to Humans: 0.4km (10,000kg) to 1.3km (>1 million kg)
- Human Health: 2km (10,000kg) to 5km (>1 million kg).

This plant is currently not functional. Mercury is used in the production of glass and can be in both liquid and gas states.

6. PRJSC SEVERODONETSK AZOT ASSOCIATION (est. in 1951)

Hazard #1: Ammonia (GHS Classification: Toxic Liquid; Acute Tox. 2)

Exposure: channeled through soil, groundwater, rivers and dangerous to the environment, fishing, agriculture, and human health.

- Lethal to Humans: 0.3km (100kg) to >5km (5,000kg)
- Human Health: 2km (100kg) to >5km (5,000kg)
- Environment (Soil): 4.3km (100kg) to >10km (1,000kg
- Environment (River): >10km (100kg)

Integrated chemical production that includes ammonia production. The main potential risk is related to a failure in production that could cause leakage of chemicals.

7. ZORYA CHEMICAL PLANT (RUBIZHNE) (est. in 1917)

Hazard #1: Nitric Acid (GHS Classification: Toxic Liquid, Acute Tox. 1)

Exposure: channeled through soil, groundwater, rivers and dangerous to the environment, fishing, agriculture, and human health.

- Lethal to Humans: 1km (20kg) to 5km (1,000kg)
- Human Health: >5km (20kg)
- Environment (Soil): 2km (20kg) to >10km (5,000kg
- Environment (River): 5km (20kg) to >10km (1,000kg)

Currently the plant's products are used in the chemical, pharmaceutical, mining, metallurgical and agrochemical industries. Potential production failure can cause leakage of chemicals into the environment.

8. RUBIZHANSKY DYE LLC KRASYTEL” (est. in 1915)

Hazard #1: Benzene (GHS Classification: Toxic liquid, Acute Tox. 1)

Exposure: channeled through soil, groundwater, rivers and dangerous to the environment, fishing, agriculture, and human health.

- Lethal to Humans: 1km (20kg) to 5km (1,000kg)
- Human Health: >5km (20kg)
- Environment (Soil): 2km (20kg) to >10km (5,000kg
- Environment (River): 5km (20kg) to >10km (1,000kg)

Hazard #2: Dyes (chromium III salts) (GHS Classification: Health hazard, Carcinogenicity 1B)

- Human health: >5km (No quantity threshold)
- Environment (Soil & River): >10km (No quantity threshold)

9. BAKHMUT AGRARIAN UNION (est. 1997)

Hazard #1: Disinfecting agents, antibiotic and hormonal products, pesticides and animal Waste (GHS Classification: Aquatic Acute 1)

Exposure: channeled through soil, groundwater, rivers and dangerous to the environment, fishing, and agriculture

- Environment (Soil): 2.8km (100kg) to >10km (5,000kg)
- Environment (River): >10km (100kg)

Industrial pig farm located in Bakhmut raion. Designed for a capacity of 40,000 pigs but hosting more than 90,000. Regular conflict hot spot with more than 18 recorded incidents. Metabolic byproducts from the livestock can contaminate soil, groundwater and rivers. Based on the hydrology of the area water contamination can affect Bakhmut and other water intake stations in Luhansk region.

CASE STUDY - ZOLOTE COAL MINE

The Pervomajs'kvuhillya network of Coal Mines (C.M.) in the south of Popasna raion located in Zolote and the surrounding communities consists of a network of 7 mines; five of which are located in GCA Zolote, Rodina, Karbonit, Toshkivksa, Hirske, and two Pervomayska and Mariya Hlyboka in NGCA. The network of mines falls on the frontlines and almost entirely within 5km of the LoC. In 2019 a total of 15 conflict incidents were reported to be within a close proximity to such facilities raising the concerns for a potential human and environmental impact from the hazardous substances present at the sites.

According to the Ministry of Energy and Environmental Protection of Ukraine, the OSCE, and the Zoï environment network, one of the major consequences of military activity in Eastern Ukraine is the flooding of coal mines. 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. In Popasna raion, specifically the mine network around Zolote is currently flooding, and others in the raion are suffering operation disruptions. If water drainage processes are disrupted, the contaminated mine water will impact the ground and surface water quality. In addition, coal mine flooding leads to soil subsidence and stability of the earth's surface. This has been reported in the Zolote area.

The two most hazardous substances are methane and the storage and waste from tailings (by-products of mining operations).

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

Exposure: channeled through air and dangerous to humans and critical infrastructure

Hazard substance #2: Waste from Tailings (GHS classification: Toxic Liquid Acute Tox 1, Aquatic Acute 1)

Exposure: channeled through soil, groundwater, rivers and dangerous to the environment, fishing, agriculture, and human health.

To provide an example of risk related to mining operations this section describes some of the key processes that are a threat to people, infrastructure and the environment.

1. To facilitate excavation, mines use explosives. This process results in the release of toxic gases, escaping to the surface through ventilation channels.
2. During coal mining large amounts of fine coal dust are released, escaping through ventilation channels. This leads to continuous atmospheric pollution which is a respiratory hazard for local populations.
3. Mines release methane an explosive gas.
4. Displaced soil is transported to dedicated locations and piled into terricons formations. Terricons pollute the atmosphere in two ways: fine dust that spreads with wind, and particles of coal that in certain circumstances lead to fire.
5. Groundwater accumulates in the mine. Under normal conditions, they are pumped, cleaned at treatment plants and discharged into the river. However, due to conflict, the amount of incoming water has increased significantly. The capacity for pumping and cleaning is not always sufficient. As a result, untreated water can contaminate surface water.
6. As a result of flooding, methane is not pumped out of the mines but accumulates in the voids. This increases the likelihood of explosions. In addition, the gas can rise to the surface, which also poses a health hazard.

In the case of the Pervomaiskvuhillya network of coal mines the main hazard driver is related to power outages. This can happen either as a result of shelling, or electricity cuts because of unpaid electricity bills. In the event of an electricity shortage, pumps will stop evacuating the mine water which will cause the mine network to flood.

A number of sites where mine water pumping was terminated has been reported at the following mines: Rodina since September 2014, Pervomais'ka since September 2015, and Holubovs'ka since October 2016.

These mines have a hydraulic connection with the functioning mine Zolote that is located in GCA. In addition, the Zolote mine is connected to the mines of Karbonit, and Hirska. Therefore, even in the event of flooding in the NGCA mines of Pervomais'ka, Holubovs'ka, and Rodina on the LoC, mines in GCA will be flooded sequentially.

In the event of mine flooding the following is expected:

1. Pervomaiskvuhillya network provides employment for the communities of Zolote, Hirske, and Toshkivske. In case of termination of their activity the socio-economic situation will sharply worsen.
2. Flooding of sites will cause hazardous exposure to industrial and human population
3. Highly mineralized mine water could flow into the Komyshuvakha, Bilenka, Luhan rivers and further into the Seversky Donets
4. Rock displacements, and soil subsidence cause landslides and further subsidence of the earth's surface
5. Excess methane will increase risk of fire and explosion.

Key takeaways

Using high resolution satellite imagery to identify the Zolote Coal Mine facility, and applying the FEAT 2.0 Pocket Guide for hazardous substances exposure, human and environmental exposure was analysed. The minimum and maximum exposure distances were used in the analysis based on the table below due to uncertainties in the specific quantities of the substances present.

For methane gas, it was estimated that around 48 residential structures were within 300m of the Zolote coal mine facility as shown in map 5.1. For toxic liquid exposure, if quantities of 20 kg were released an estimated 185 residential structures fall within 1km and poses a lethal threat to humans. The human health exposure of 5km, would impact Zolote, Komyshuvakha, Katerynivka, Molodizhne, northern parts of Pervomaisk, and southern parts of Hirske communities with a population estimation of 10,000 - 12,000 based on latest sources.

Table 5.1 Hazard Exposure Distance

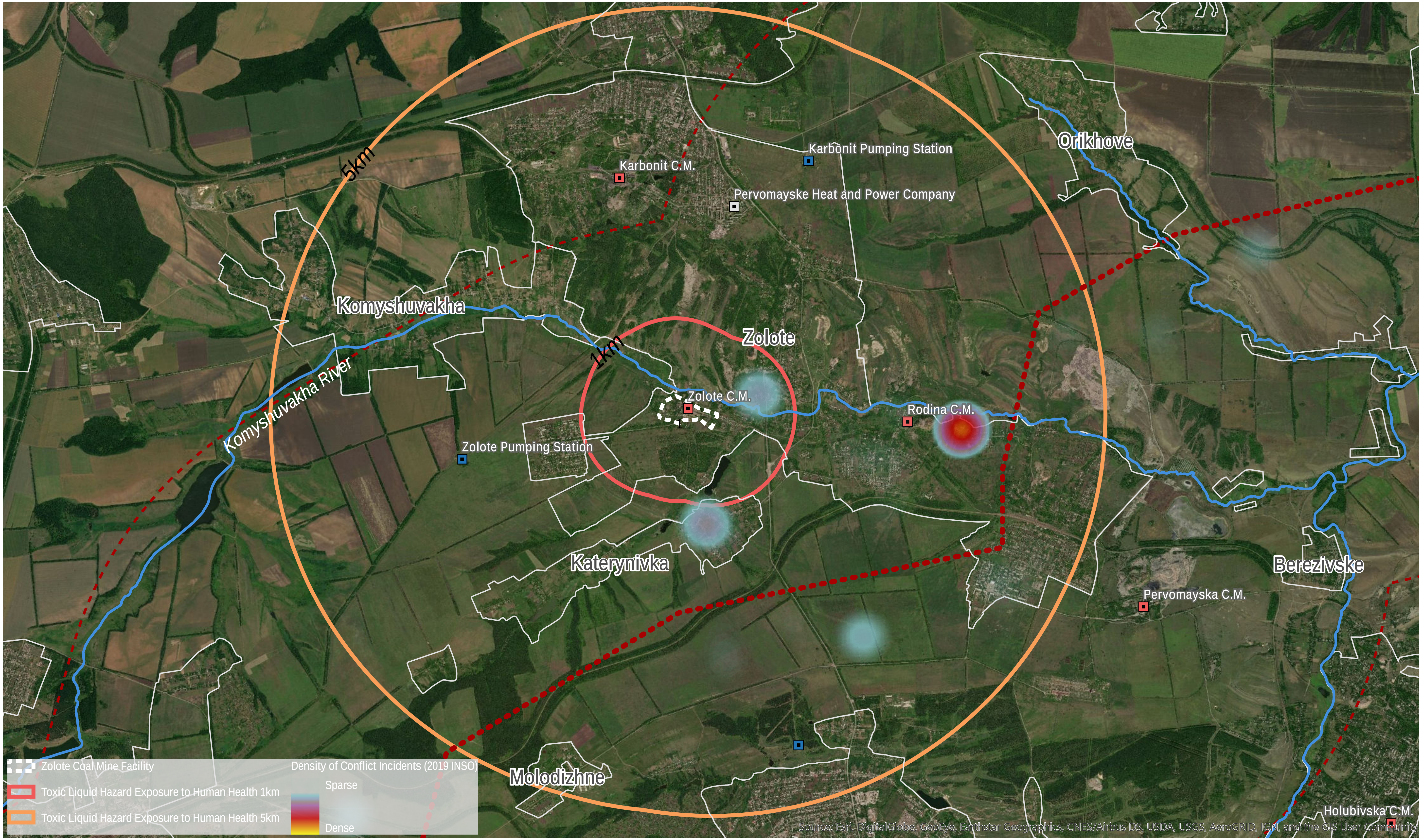
Hazard (GHS Label)	Hazard Classification	Explanation	Quantity (Kg)	Human (Lethal)	Human (Health)	Environment (Soil)	Environment (River)
Flammable	Flam. Gas 1	Extremely flammable	1,000,000	0.2km	0.3km	NA	NA
Toxic Liquid	Acute Tox. 1	Fatal when swallowed	20	1km	>5km	2km	5km
			100	1.6km	>5km	4.5km	>10km
			1,000	5km	>5km	>10km	>10km
			5,000	>5km	>5km	>10km	>10km
Aquatic Acute	Aquatic Acute 1	Causes serious injury to an aquatic organism in short period of time	100	NA	NA	2.8km	10km
			1,000	NA	NA	8.9km	>10km
			5,000	NA	NA	>10km	>10km

Hazard Exposure Distance Table for Methane (Flammable Gas 1), and Toxic Waste from Tailings (Toixc Liquid Acute Tox 1) and Aquatic Acute 1. Adapted from FEAT 2.0 Pocket Guide (UNEP, OCHA)

CASE STUDY - ZOLOTE COAL MINE

Map 5.1 Zolote Coal Mine Methane Hazard Exposure

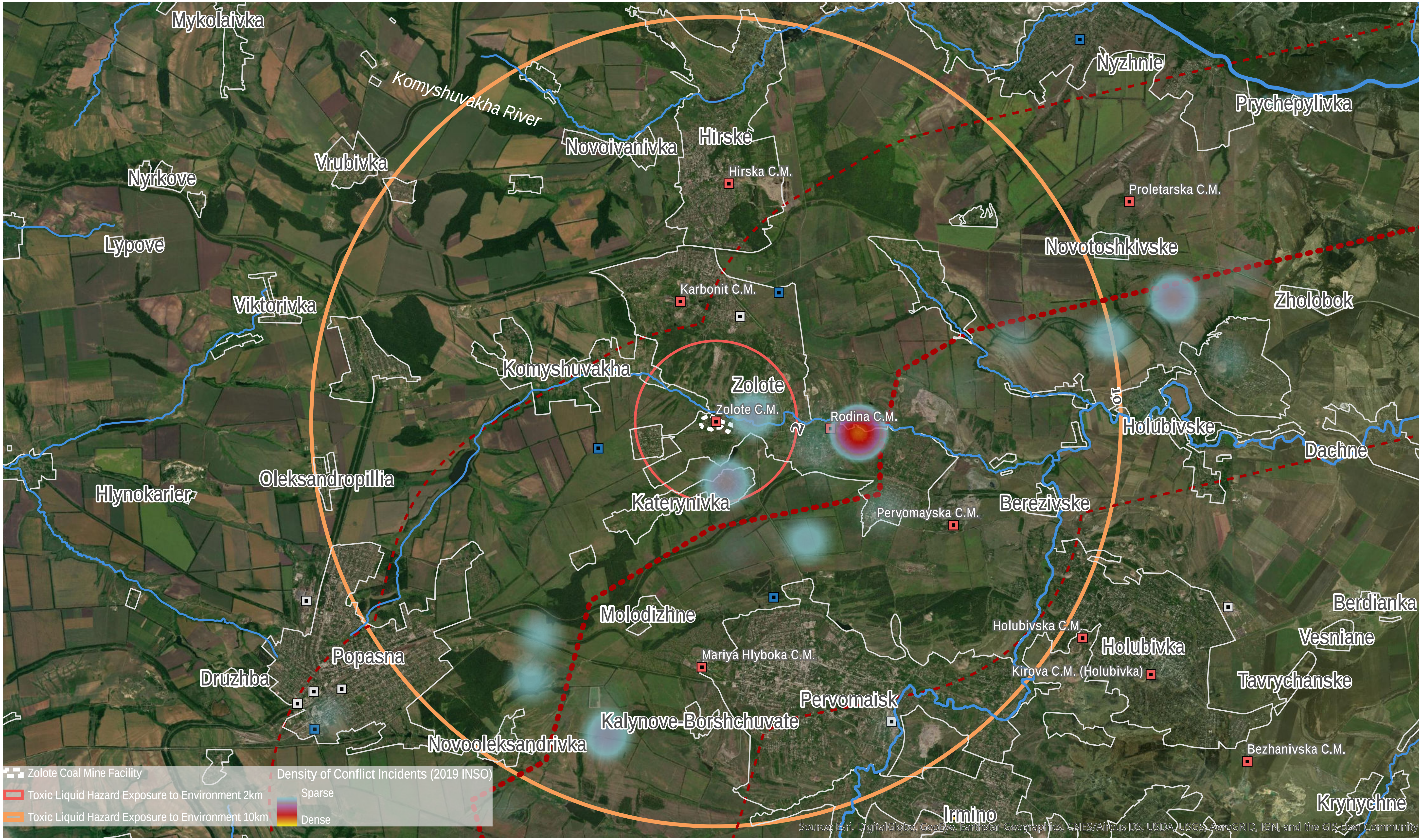
Map 5.2 Human Health Exposure to Zolote Coal Mine Toxic Liquid



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

CASE STUDY - ZOLOTE COAL MINE

Map 5.3 Environmental Exposure to Zolote Coal Mine Toxic Liquid



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

HAZARD - SPOIL TIPS AND TAILINGS DAMS

Hazard Description

Donbass is a coal producing region mined since the first half of the 19th century. As a historically heavily industrialized area, the areas is characterized by the continuous challenge of industrial waste management from resource extraction. Two types of industrial waste storage are spoil tips and tailings dams. A spoil tip is a pile that consists of accumulated waste material removed during the mining process. 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.

This mining activity has generated a high density of spoil tips in the area, particularly in the vicinity of coal mines around Lysychansk and Hirske-Zolote area. To assess the exposure of spoil tips on the population, their location were identified and overlaid with settlements. Since no official geo-database of spoil tips existed, the mapping was carried out by IMPACT using open source data (OSM) and cross-referenced with satellite imagery.

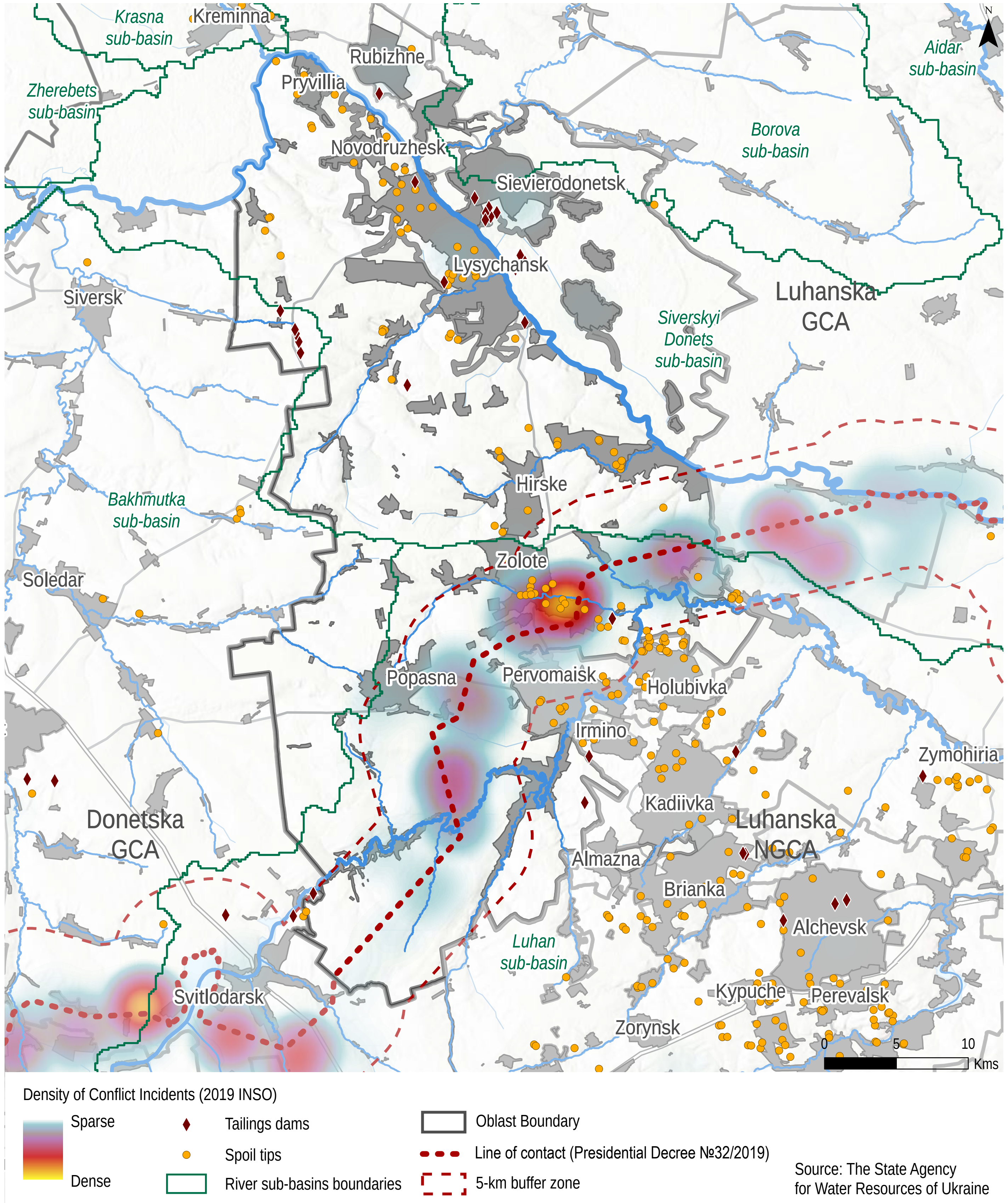
Challenges in accessing detailed local-level data put constraints on the extent and depth of the analysis that can be conducted. According to the Ministry of Health Protections' Decree №173, spoil tips should be located at a safe distance (300m or 500m depending on spoil tip height) from populated places and be cultivated (such as planting grass seeds on the slopes) to minimize the impact on the environment and population.

However, due to historical and economic reasons, spoil tip locations often violate existing protection standards and therefore, may be hazardous for people`s health due to dust and smoke if the spoil tips are not maintained properly. As an example, according to data from SE "Pervomaiskvuhillya", which operate coal mines in Zolote, Karbonit, Hirska, and Toshkivska, over 50% of managed spoil tips are located closer to residential areas than recommended.

Tailings dams are a special hydro-technical construction designed to store by-products that occur during industrial activity. In the territory of Popasna raion most tailings dams are located near industrial facilities in cities, including Lysychansk, Rubizhne, and Sievierodonetsk.

The main hazards posed by tailings dams are a dam break, which is a low probability but carries a high impact, and diffuse pollution which has a higher probability but lower impact than a dam break. Due to the proximity of tailing dams in Popasna raion to conflict there is a concern over regular maintenance and potential damage. The map displays tailings dams, recent conflict incidents from 2019, and rivers which may be exposed to contamination in the case of liquid waste discharge. Data indicating tailings dam locations was collected by satellite imagery digitization and review of the State Agency for Water Resources of Ukraine.

Map 6.1 Spoil Tips and Tailings Dams Location



Source: The State Agency for Water Resources of Ukraine

Key takeaways

1. The FEAT 2.0 guide and the Ministry of Health Protections' Decree should be utilized to better understand the human and environmental exposure for each site of concern
2. Further investigate to ensure proper maintenance, mitigation, and contingency plans are in place for the hazardous exposure posed by tailings dams and spoil tips

Hazard Description

Hydrology and mapping water basins are important tools to increase understanding of risks related to water contamination which has cascading health consequences for domestic, commercial and industrial activities.

For the purpose of the ABRA and the level of analysis of this assessment first-level stream basins were used. Information about river basins, water in-take stations location and potentially dangerous objects allows to forecast which surface water areas will be contaminated and which settlements will be supplied with contaminated water.[4]

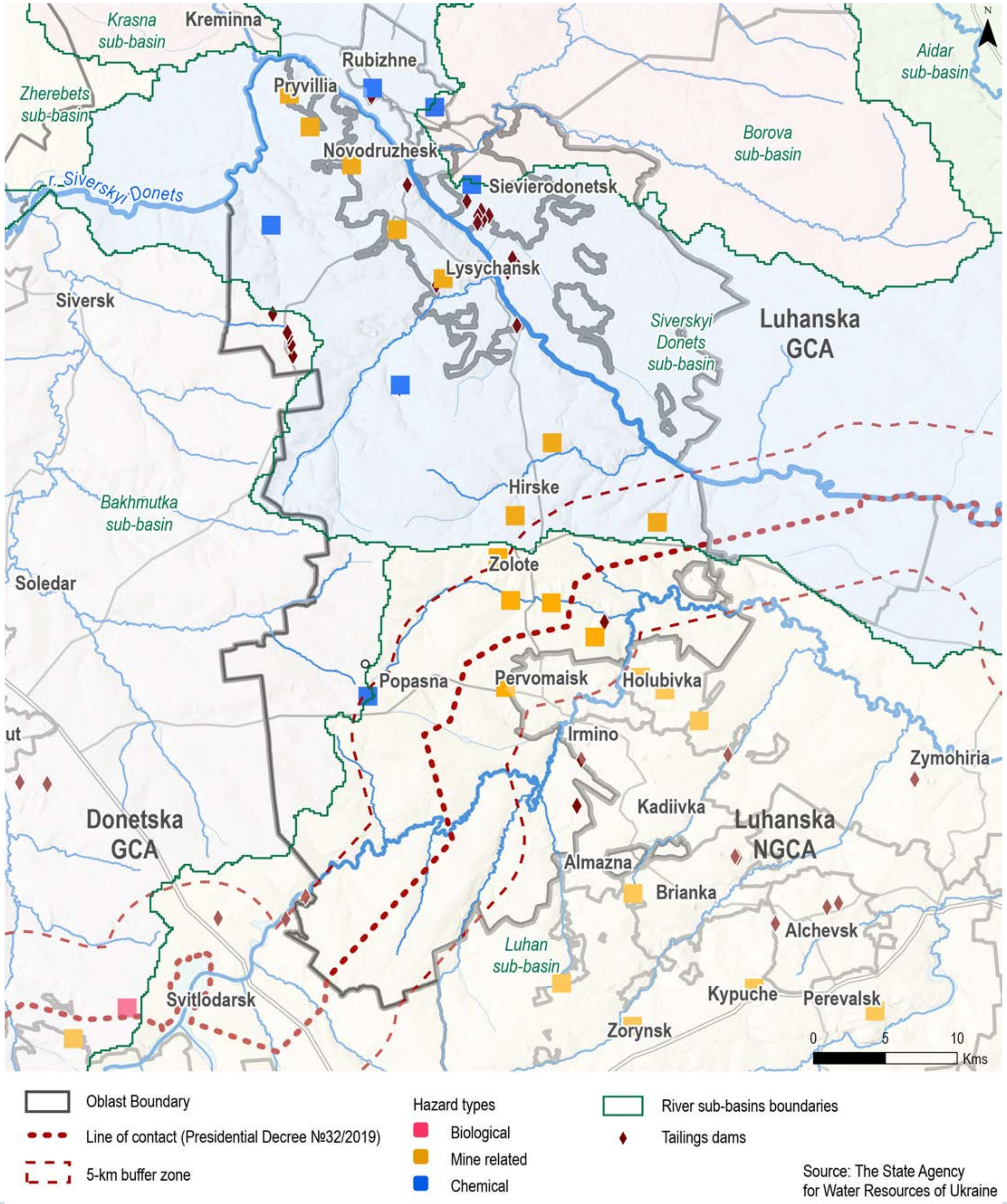
All rivers of Popasna raion belong to the basin of Siverskyi Donets river, which includes three sub-basins of first-level streams: Bakhmutka (along the western border of the raion), Luhan river (South of the region), and Siverskyi Donets itself.

The sub-basin which hosts the highest proportion of potentially hazardous sites is the Siverskyi Donets due to the high concentration of mines and chemical plants in the vicinity of Rubizhne, Sievierodonetsk, and Lysychansk urban cluster.

Southern Popasna (Zolote, Hirske, Toshkivka settlements) and the Luhan sub-bassin is where the SE “Pervomajs’kvuhillya” mines are located (see case study). The main threat relates to lasting disruption to pumping activities that could contaminate the drinking source for an estimated 80,000 residents of the towns of Kirovsk, Pervomaisk, Zolote, Hirske and Karbonit (OSCE, 2017)

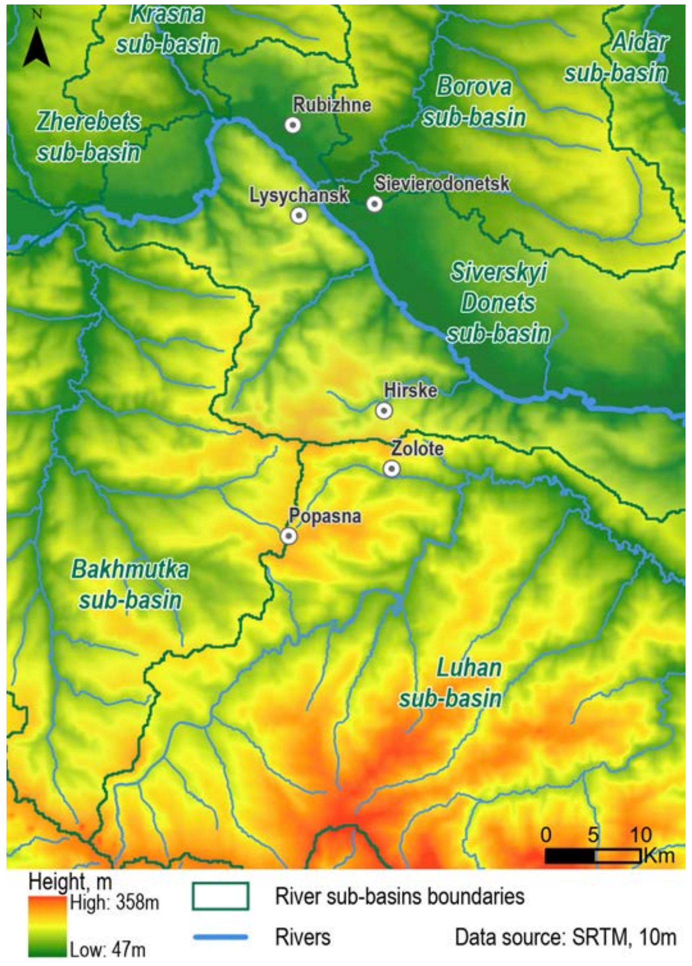
Amplification of these problems can cause pollution of surface and ground water and heighten the risk of subsidence. Water treatment facilities at SE “Pervomajs’kvuhillya” are in the first-level stream basin of Komyshuvakha river that flows directly into Siverskyi Donets river. “Zolote” mine is situated on the other side of the watershed and if water pumping stopped polluted water from the mine would flow into Luhan’ river, which in its turn flows into Siverskyi Donets river nearby the city of Luhansk.

Map 7.1 River Basins and Hazardous Facilities



Source: The State Agency for Water Resources of Ukraine

Map 7.2 Regional Overview of Main Rivers



Data source: SRTM, 10m

South of Bakhmut region is characterized by the presence of industrial pig farms, located in the upper part of Bakhmutka river, which can expose population living downstream to biological hazard, in case of tailing pond damage.

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4) Open and freely accessible data sources used for this review are listed below:

- River basins – State Water Cadastre Accounting of Surface Water Objects
- Elevation – Shuttle Radar Topography Mission (SRTM), NASA
- Settlements – UNOCHA
- Sub basins and hydrogological analysis – IMPACT

Hazard Description

Wastewater is broadly defined as water that has been processed for human purposes. United Nations Water identifies the following sources of wastewater: domestic water used for sanitation purposes (toilets, kitchen and showers), water from commercial establishments (restaurants) or institutions (hospital 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 use in such facilities (OCHA/UNEP, 2016) and inadequate treatment can lead to contamination of ground water sources. In Popasna raion, treated water is released back into the environment. The importance of monitoring water quality in such cases is crucial to ensure access to safe drinking water for the populations.

There is no official register of geospatial data on wastewater treatment stations. Therefore, the locations of Popasna raion's wastewater treatment station was acquired from satellite imagery digitization.

The map has categorized water treatment stations by source type including municipal, mines and other industries. There are currently only two river monitoring posts in the study area.

The map shows that most treatment facilities are in the urban areas of Severodonetsk, Lysyshansk, and Hirske with limited connection between facilities in NGCA and GCA.

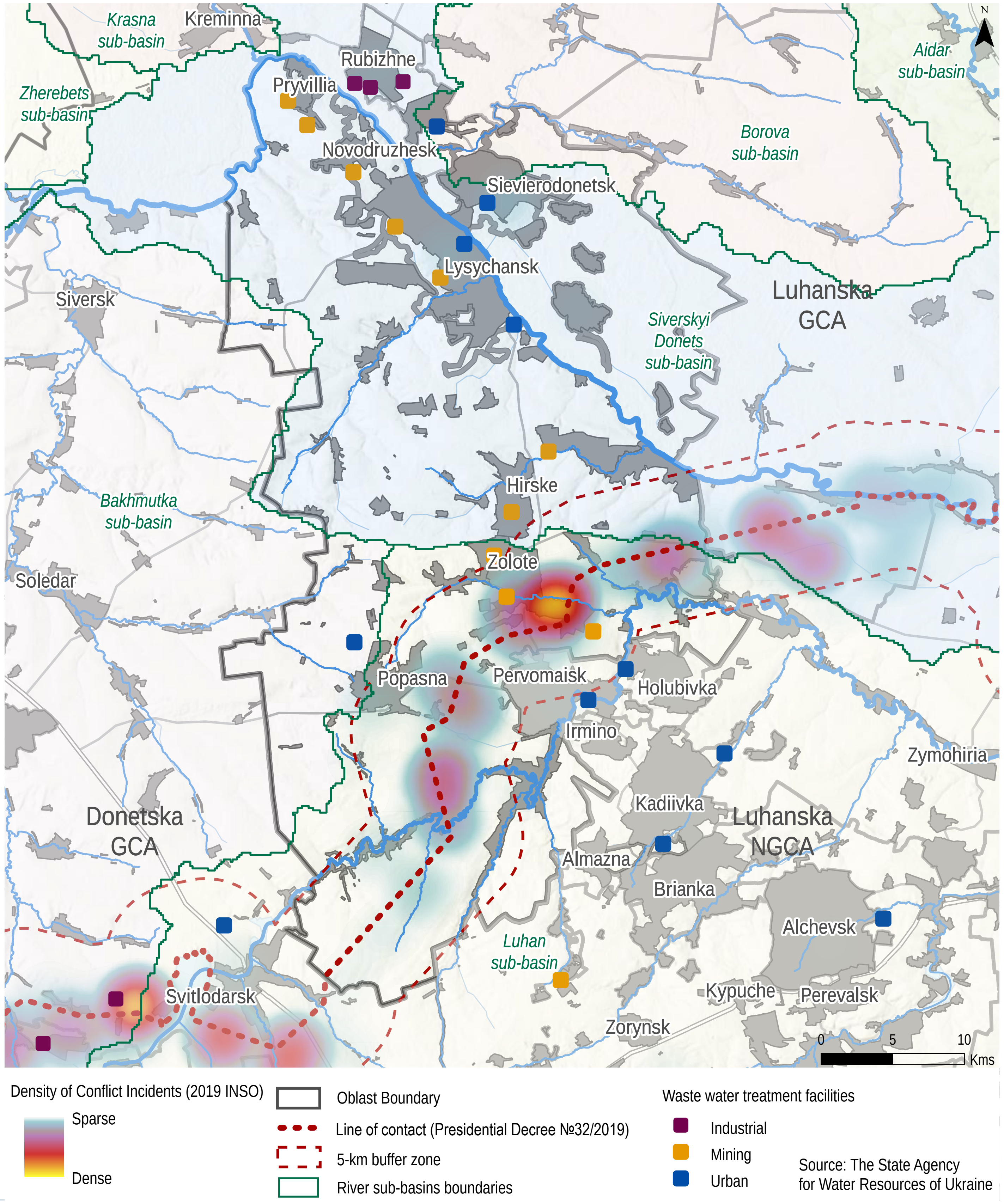
In addition, due to the geological profile of the region, substantial amounts of wastewater are generated from mining activities as a result of 'dewatering'. Mine dewatering refers to the process of removing ground water from mines. This poses two main environmental threats: acid mine drainage and dispersal of contaminated water which leads to water pollution. Both threats are a hazard for the environment and resident's dependent on water that is downstream from this waste. In general, this water needs to be treated correctly before being released, however, due to the conflict and economic constraints (lack of funds to pay for electricity for pumps) this process is not systematically implemented.

Key takeaways

As of December 2019, power supply instability driven by economic problems and outdated equipment remains a major structural challenge for wastewater treatment in the region.

It is very important to continue developing ground and underground water monitoring systems in Donbas, particularly at water streams that are located downstream of wastewater treatment stations.

Map 8.1 Wastewater Treatment Facilities Location



Source: The State Agency for Water Resources of Ukraine

CONFLICT EXPOSURE TO ELECTRICITY NETWORK

Electricity

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

Luhanska power station (located in Shchastia map 9.2) is the main power supply source of Popasna raion producing the majority of power supply for Luhansk oblast. Another source of power supply for the region is Sievierodonetska power station that serves as an additional power supply source in the winter season. Alternative energy sources, such as wind and solar, add a insignificant portion to the power supply. Currently, around 96% of the power grid equipment has been in use for over 30 years and needs modernization.

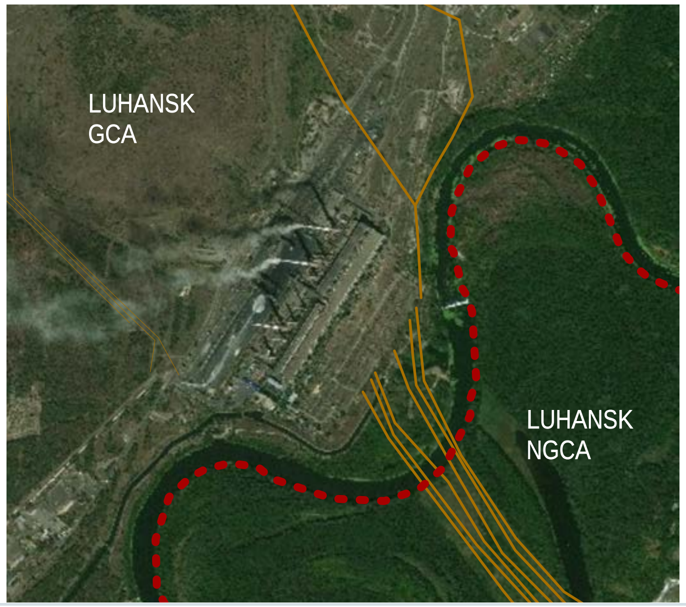
Popasniansa raion is connected to the unified power supply system of Ukraine through two transit lines “Kurylivka – Svatove” and “Bakhmutska – Yuvileyne”, which have low power transfer capacity and low level of reliability increasing the risk of power shortage. An emergency shut-down of one of the transit lines could lead to a blackout for a large part of the population. Worn-out equipment and financing shortages are the most acute problems for power provision.

In addition, a large part of the power supply infrastructure is located in NGCA. Conflict has damaged power supply equipment which causes capacity deficiency in the emergency operations. In map 9.1, the electricity network is overlaid with recent conflict incidents from 2019 to highlight the potential impact on connections of communities across the raion and broader region. Effectively, the Luhansk region is located on an energy island with only one viable source of power supply, the Luhanska power station. This station is located on the territory controlled by the government of Ukraine. However, the region is over-reliant on this network and it crosses lines of conflict.

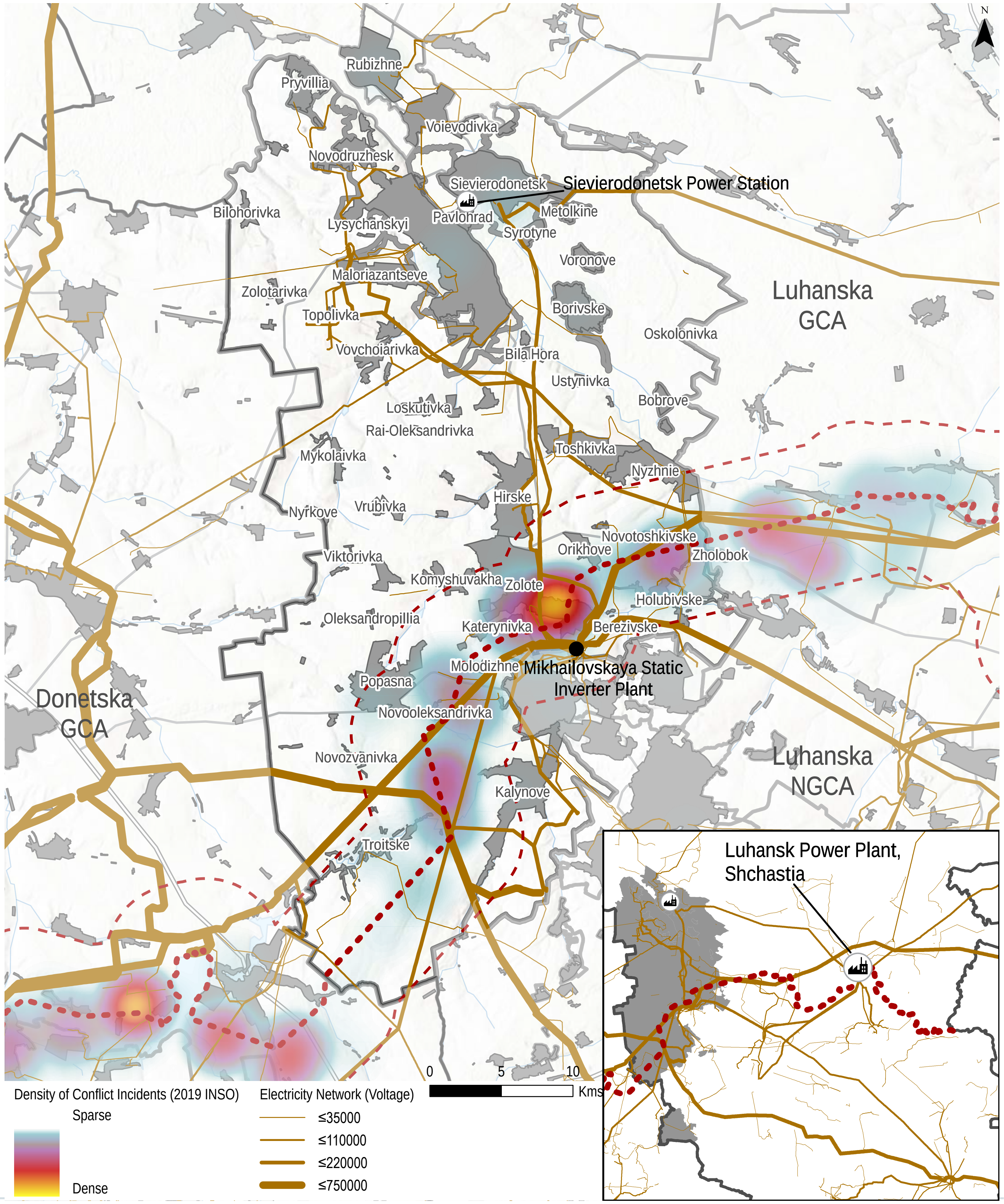
Key takeaways

Due to the conflict, and the possibility of network damage, a diversification of power sources or improved connection for communities to the Ukrainian network would minimize the risk of large scale power outages.

Map 9.2. Locational Map for Luhansk Power Plant, Shchastia



Map 9.1 Electricity Network



CONFLICT EXPOSURE TO WATER, GAS, AND OIL SUPPLY INFRASTRUCTURE

Water Network

Functional water infrastructure is critical to ensure basic water and sanitation needs. In Luhansk the primary source of water is the Seversky Donetsk river which runs from Belogorod oblast (Russian Federation) to the Don river on Rostov oblast (Russian Federation). In Luhansk it is a primary source of water for the large urban settlements of Severodonetsk, Rubizhne and Lysyschansk before separating the GCA and NGCA east of Zolote. The main water intakes are Belogorovskaya and Svetlichanskaya intaking stations.

Water in Popasna is under the responsibility of the Popasna Vodakana. While Popasna Vodakana controls the water utility infrastructure in GCA, 90% of their estimated 1.3m consumers are in NGCA (OSCE, 2018).

Most of the water in the city of Popasna comes from the western filtration station through a pipeline in Zolote-2. Frequently exposed to conflict related damages due to its proximity to the LoC the system suffers from lack of maintenance which creates frequent water leakages. From January to October 2019, the WASH cluster recorded 83 security incidents affecting civilian water infrastructure (OCHA, 2019).

Key takeaways

While Zolote has been identified as one of the disengagement areas under the Normandy talks of December 2019, there is still ongoing fighting close to water infrastructure. These incidents coupled with lack of infrastructure investments created significant water shortage risks for the population living in the area. Map 10.1 highlights the water supply infrastructure for Popasna raion overlaid with the LoC and reported conflict incidents for 2019 (INSO).

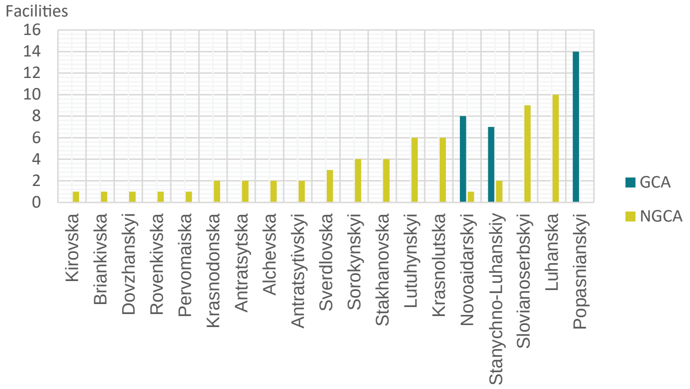
Gas & Oil Pipelines

Popasna raion has both oil and gas transit infrastructure within its boundaries as shown in map 10.2. This infrastructure represents a disaster risk as damage to infrastructure can lead to oil or gas spills which can pollute both water and air. In addition both fuels are a major source of heating for the region.

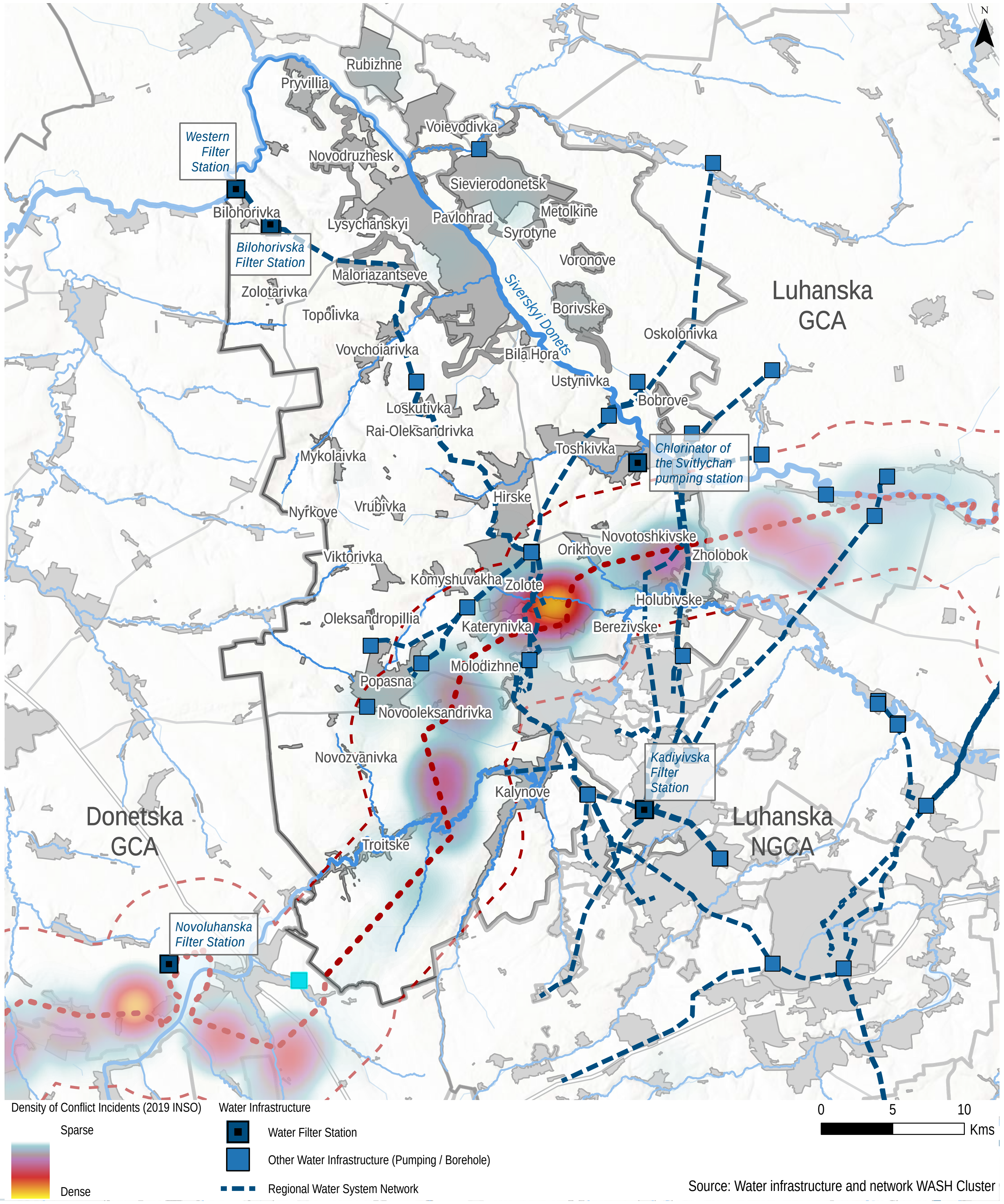
There is some 62 km of oil pipeline which transits from Bakhmut raion to the southern part of Lysychansk, which then separates into two branches. The southern section of the 28 km line transits east of Hirske and Zolote before going into NGCA north of Pervomaisk. This means that leaks can affect both the Luhan and the Siverski Donetsk sub bassins. Approximately 11 kilometers of pipeline are within 5km of the LoC and 98 incidents have occurred within a 500m radius.

There is some 220 km of gas pipelines which connects the entire raion. As gas is used as a major source for heating, the network is more dense and connects all major settlements. The section that connects Hirske to Popasna and the NGCA is almost entirely within 5km of the LoC, as for the Pervomaisk – Nyzhnie sections. Damage to these lines could cause explosions, air pollution and heating shortages for all residents connected to central heating systems.

Graph 10.1 Water Facilities

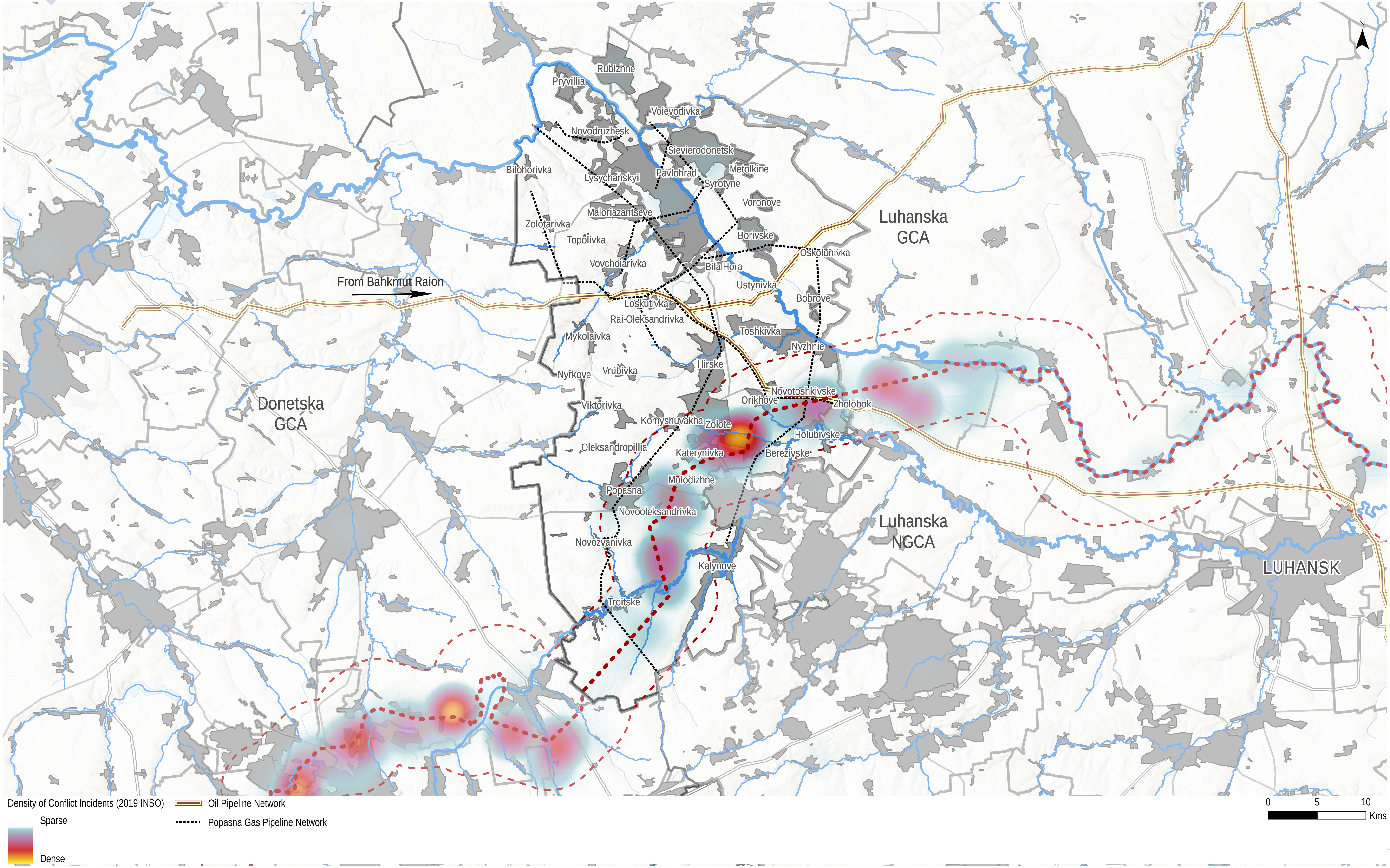


Map 10.1 Water Infrastructure



Source: Water infrastructure and network WASH Cluster

Map 10.2 Gas and Oil Pipeline Network



Susceptibility & Coping Capacity

Based on the susceptibility indicators available from the REACH 2018 CVA, the most susceptible communities were Katernyivka, Novooleksandrivka, Troitske, **Orikhove, and Novozvanivka**. These are settlements classified as rural, and within the 5km proximity from the LoC.

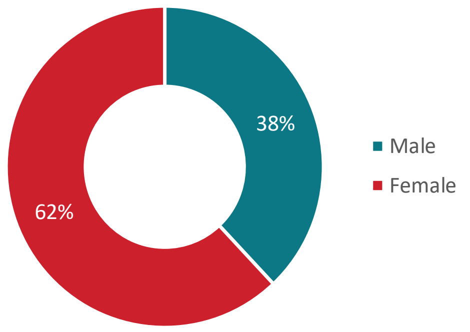
These communities ranked higher for susceptibility in both dependency and economic capacity. Findings show that in rural communities within 5km from the LoC 29% of the assessed population are 65 years or older, slightly higher than other settlements in the raion. Ten percent (10%) of the assessed household members **within the 5km proximity to the LoC reported to** have one or more disability. The proportion was the same for both urban and rural communities in the area. However, outside of the 5km LoC zone, the proportion of assessed household members in urban areas was 6%. Similarly the proportion of HoHs who are single females, widows, or single parents was slightly **higher in communities closer to the LoC (44%)** of HoHs falling within this category as compared to 37% in Urban areas outside of the 5km LoC zone. The proportion of population with 3 or more children was negligible across the assessment. Rural communities **within the 5km LoC zone reported the highest** proportion (12%) of households where agriculture was the main livelihood source.

Regarding economic dependency, rural communities within the 5km LoC zone also reported the highest proportion of pensioners, at 45%, and unemployment at 18%.

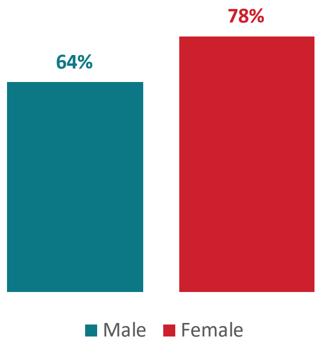
Distances to key services such primary health care facilities, social services, education facilities, and SESU response units influence the coping capacity of a community. Popasna raion has 62 education, 35 health and 12 social facilities within its territory. Most of them are in the larger cities of Popasna and Zolote, both within 5km of the LoC.

From an education perspective, schools provide opportunities to communicate natural and anthropogenic hazards and best preparedness and response mechanisms to follow. Schools are often used as a communal shelter or meeting point in the aftermath of a disaster to provide information or distribute aid. If a disaster strikes during a school day, they will also often be responsible for evacuating children to safe locations to ensure that they are not exposed to further hazards. Social facilities are primary providers of services and information to vulnerable groups such as persons with disabilities, elderly and households with limited financial means. They are a primary source of information on the needs of vulnerable groups and can be used to communicate disaster preparedness and response information (REACH, 2018).

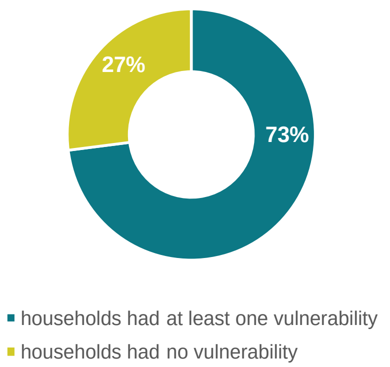
Graph 11.1 Gender Distribution of Heads of Households for Popasna Raion



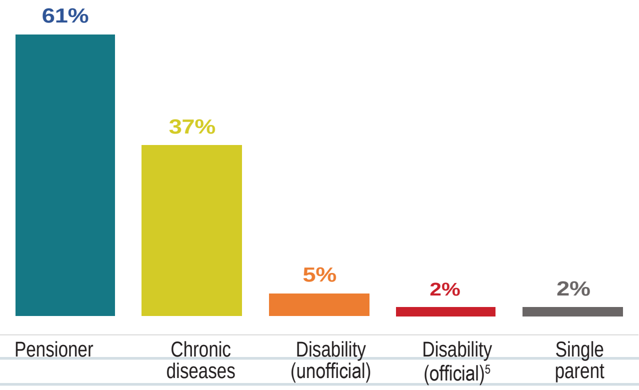
Graph 11.2 Gender Distribution of Heads of Households with Vulnerability for Popasna Raion



Graph 11.3 Distribution of Households that had at Least One vulnerability for Popasna Raion



Graph 11.4 The Most Common Types of Susceptibility of the Population for Popasna Raion



Rural communities across the raion regardless of proximity to the LoC reported longer distances to four key services and therefore have a slightly lower coping capacity. When taking further indicators into consideration such as proportion of population aware of nearest bomb shelter, number of conflict incidents (2019), and proportion of IDPs, communities of concern for lack of coping capacity were; Vyskryva, **Troitske, Nyrkove, Rai-Oleksandrivka, and** Novooleksandrivka. Four of the five which are within the response service area of the Popasna SESU.

Key takeaways

The majority of the 14 vulnerability indicators combined and weighted come from the REACH CVA, which is representative not at the individual settlement level but at the stratification of Urban, Rural and 5km LoC zone differentiation as shown in map 11.1. Therefore, settlements across the raion have similar vulnerabilities based on the settlement stratification class, however, indicators on SESU response unit location distances, and 2019 conflict incidents from INSO, provide further individual insight into the community level findings to distinguish further vulnerability within their strata. For example, although Zolote, and urban settlement within 5km would report similarly to Hirske and Popasna, the community of Zolote has reported 44% of the conflict incidents the raion has witnessed in 2019, and thus driving its vulnerability higher. While rural settlements outside the 5km zone like Vyskryva, Nyrkove, Rai-Oleksandrivka, and Mykolavia have not reported any conflict incidents, their distance to a SESU response unit are all 20km or greater, which is increasing their vulnerability. The most vulnerable communities as seen in map 11.2 are Troitske, Vyskryva, Novooleksandrivka, Katerynivka, **Nyrkove, Rai-Oleksandrivka, and Mykolaivka.**

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5) Official, designating whether registered with authorities

Table 11. 1 Traveling Time to Education Facilities

Time	5km Rural	5km Urban	>5km Rural	>5km Urban
< 30 min	67%	94%	63%	92%
30 min -1 hour	28%	3%	37%	8%
1,5-3 hours	6%	0%	0%	0%
> 3 hours	0%	3%	0%	0%

Table 11.2 Traveling Time to Primary Health Care Facilities

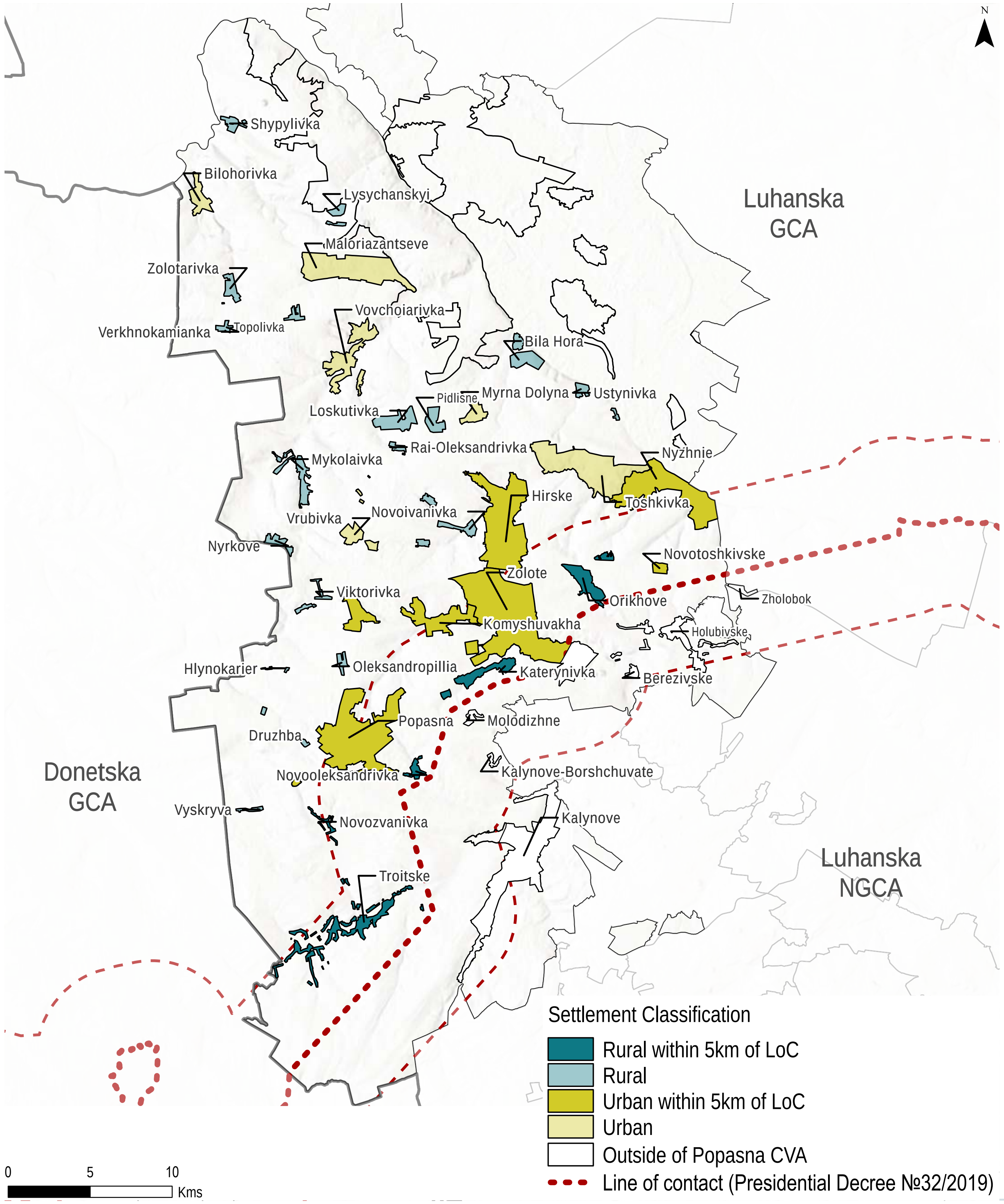
Time	5km Rural	5km Urban	>5km Rural	>5km Urban
1-1,5 hours	13%	6%	10%	5%
1,5-3 hours	7%	1%	6%	0%
30 min - 1 hour	56%	19%	36%	41%
Don`t know	0%	0%	1%	0%
< 30 min	24%	72%	44%	53%
> 3 hours	0%	2%	2%	1%

Table 11.3 Traveling Distance to Social Facilities

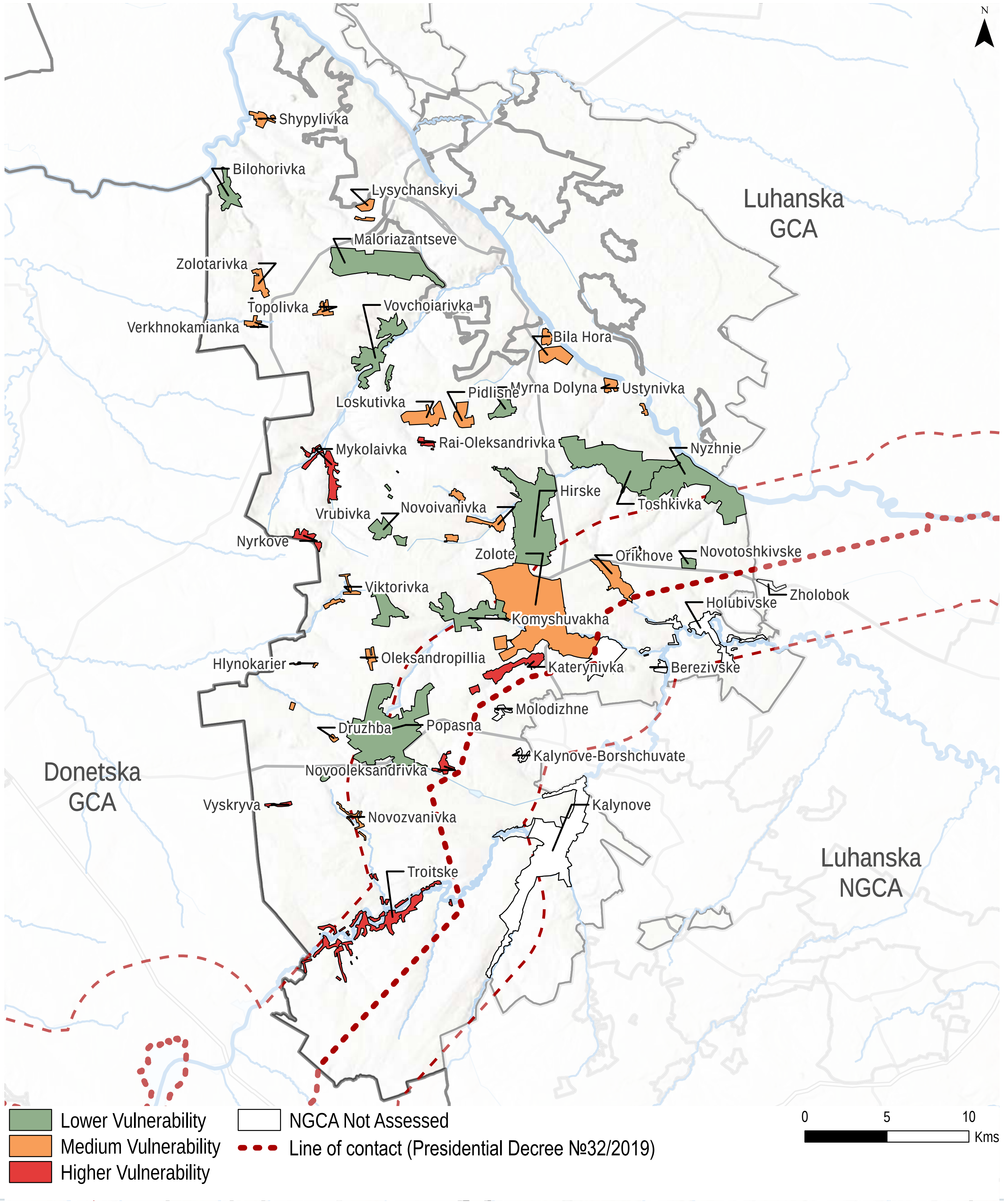
Distance	5km Rural	5km Urban	>5km Rural	>5km Urban
< 1 km	6%	20%	3%	4%
1-5 km	5%	15%	7%	3%
5-20km	38%	17%	12%	14%
>20km	43%	43%	69%	72%
Don`t know	8%	5%	10%	7%

VULNERABILITY - SUSCEPTIBILITY AND COPING CAPACITY

Map 11.1 Popasna Settlement Classification from CVA Sampling Stratification



Map 11.2 Vulnerability Map (Popasna Raion Settlements Only)



ANTHROPOGENIC MULTI-HAZARD EXPOSURE

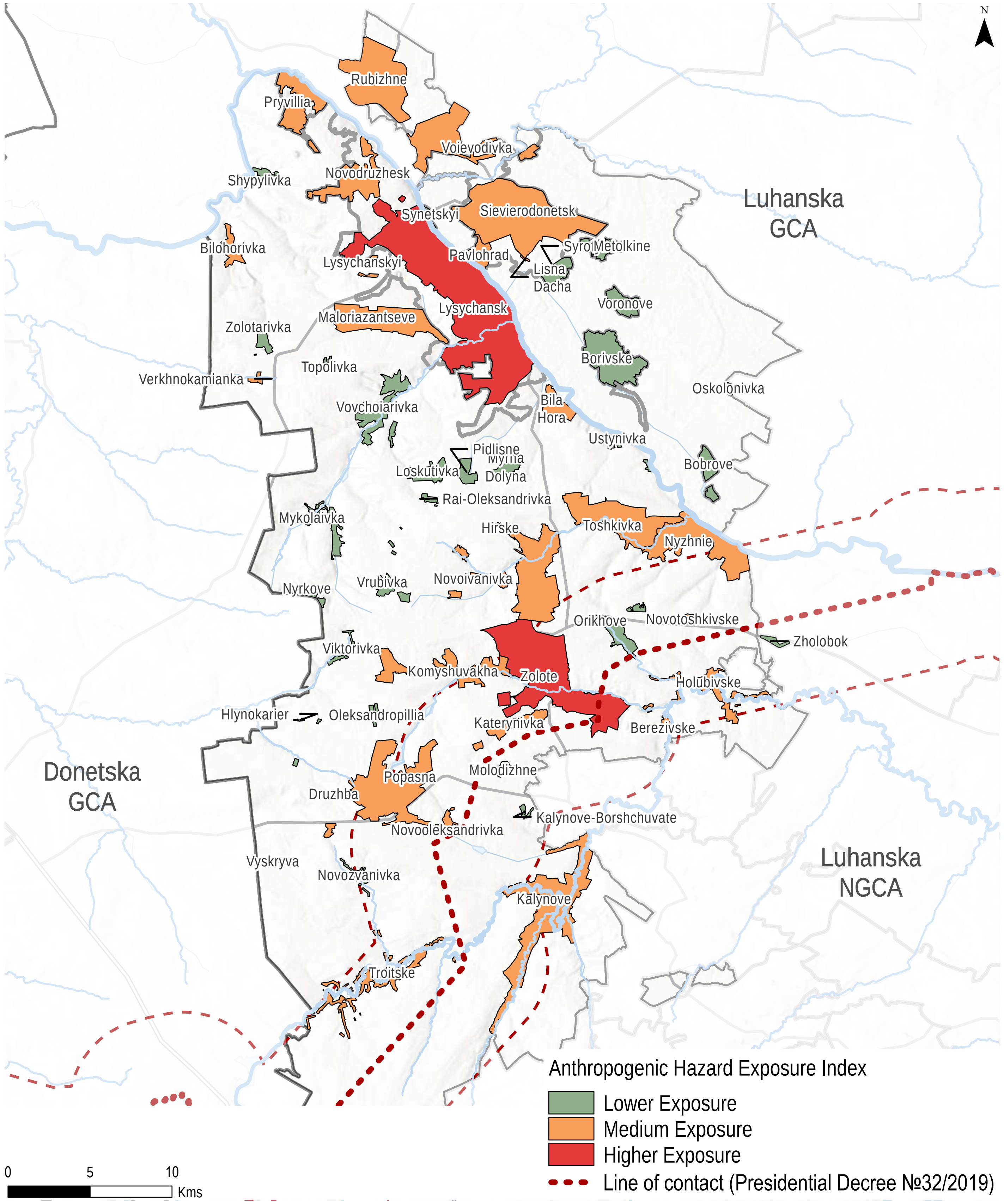
Anthropogenic Multi-Hazard Exposure

The multi-hazard exposure analysis was calculated from the combination of hazard indicator 2.1, hazardous fac The multi-hazard exposure analysis was calculated from the combination of hazard indicator 2.1, hazardous facilities, and hazard indicator 2.2 conflict incidents. The number of hazardous facilities within the settlement or within 2km proximity was calculated for each settlement. This includes the DEIS identified hazardous critical infrastructure facilities, tailings dams, spoil tips, waste management, and filtering stations. The geospatial analysis was applied for 2019 reported INSO conflict incidents for each settlement.

As multiple hazardous objects may have cumulative effects on the environment and population, the analysis takes into account the number of hazardous objects with a 2km radius of a settlement. The distance of 2km was applied for all facility types as a rough indicator for human and environmental exposure. To better calculate hazard exposure, each facility should be assessed to determine present substances and quantity and apply the FEAT 2.0 Pocket Guide to have a better understanding of the exposure radius as shown in the Zolote Case Study.

Tables 12.1, 12.2, and 12.3 list the top most exposed settlements in Popasna raion to potentially hazardous facilities within a 1km and 2km distance of a settlement. The analysis shows clearly that **Lysyschansk has the highest exposure to the assessed hazards**, with Zolote also recording a substantial number of facilities. This is due to their function as centres of economic and social activity of the raion. When coupled with conflict incidents from 2019 where **Zolote witnessed the majority of conflict incidents**, 44% of the total recorded in the raion which is significantly higher than any other settlement, therefore increasing **Zolote's anthropogenic hazard exposure to be the highest in the region** surpassing Lysychansk. Mainly rural communities located outside of the 5km LoC zone had the lowest anthropogenic hazard exposure. A detailed analysis of each hazardous facilities, their substances, their exposure, and transfer pathway through soil, groundwater, and rivers, is needed to highlight whether exposure would increase.

Map 12.1 Anthropogenic Multi-Hazard Exposure by Settlement



Anthropogenic Hazard Exposure Index

🟩 Lower Exposure
🟧 Medium Exposure
🟥 Higher Exposure
- - - Line of contact (Presidential Decree №32/2019)

Table 12.1 Top 5 Communities with Hazardous Objects

Community	Within 1km	Within 2km
Zolote	12	14
Lysychansk	7	9
Hirske	2	9
Popasna	6	7
Komyshuvakha	2	6

Table 12.2 Top 5 Communities with Spoil Tips

Community	Within 1km	Within 2km
Lysychansk	28	31
Zolote	20	22
Berezivske	5	17
Toshkivka	9	10
Novodruzhesk	6	10

Table 12.3 Top 5 Communities with Tailing ponds

Community	Within 1km	Within 2km
Lysychansk	5	12
Sievierodonetsk	4	6
Pavlohrad	5	6
Lisna Dacha	1	5
Verkhnokamianka	2	4

NATURAL MULTI-HAZARD EXPOSURE

Natural Multi-Hazard Exposure

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

The urban community of **Maloriazantseve** ranked the highest for exposure to the three natural hazards assessed. The community located just west of Lysychansk, reported a high frequency of extreme heat and extreme cold days, in addition has moderate exposure to forest fuel, historical fires recorded, and proximity to contaminated land-mine areas for potential wildfires in the areas. The urban communities of **Zolote**, **Toshkivka** and **Nyzhnie** also reported higher frequencies of extreme heat, and more so extreme cold days, and in addition have significant exposure to land-mine contaminated areas, forest land cover, historical fires recorded, and conflict incidents thus increasing the potential for wildfire hazards.

These 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. Tables 13.1, 13.2, and 13.3 present lists of settlements that historically were most exposed to the environmental hazards (during years 2001-2019).

Map 13.1 Natural Multi-Hazard Exposure by Settlements

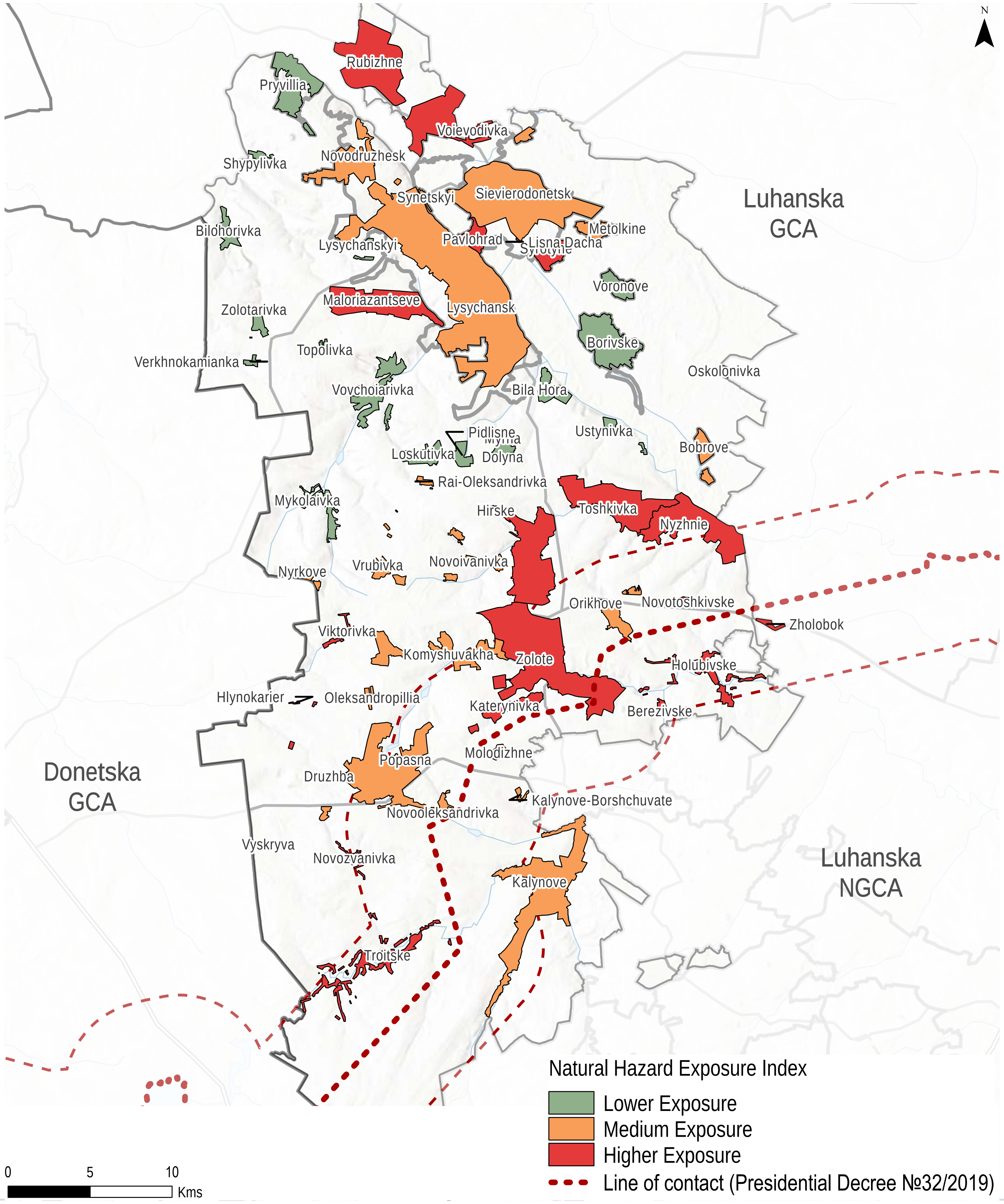


Table 13.1 Settlements with Highest Observed Frequency of Abnormally Low Temperatures

1	Troitske	9	Voronove
2	Syrotyne	10	Toshkivka
3	Rubizhne	11	Nyrkove
4	Voievodivka	12	Maloriazantseve
5	Sievierodonetsk	13	Synetskyi
6	Vrubivka	14	Popasna
7	Hirske	15	Zolote
8	Bobrove		

Table 13.2 Settlements with Highest Observed Frequency of Abnormally High Temperatures

1	Maloriazantseve	9	Rai-Oleksandrivka
2	Druzhba	10	Viktorivka
3	Zholobok	11	Nyzhnie
4	Berezivkse	12	Novozvanivka
5	Novooleksandrivka	13	Rubizhne
6	Novotoshkivkse	14	Vyskryva
7	Holubivske	15	Kruhlyk
8	Novoivanivka		

Table 13.3 Settlements with Highest Observed Frequency of Fires

1	Kalynove	9	Mius
2	Zolote	10	Chornukhyne
3	Troitske	11	Lysychansk
4	Nyzhnie	12	Popasna
5	Orikhove	12	Komyshuvkha
6	Vovchoiarivka	14	Toshkivka
7	Zholobok	15	Holubivske
8	Sievierodonetsk		

MULTI-HAZARD RISK

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 takes into consideration the vulnerabilities of the settlements assessed.

Zolote and **Katerynivka** reported the highest multi-hazard risk out of the 44 settlements with both hazard and vulnerability data for Popasna raion. This is rooted in the fact that these settlements have a significant presence of hazardous facilities coupled with close proximity to the LoC and high number of conflict incidents. Four of the top six highest communities at risk are within 5km of the LoC. Since conflict in this analysis is considered as a hazard, a trigger for other hazards, and a reduction of coping capacity to the societal sphere, these variables significantly increase the risk of these communities.

The third and fourth highest communities at risk were the urban communities **Maloriazantseve and Toshkivka** outside the 5km LoC zone, although lower societal vulnerability reported, the high exposure to both natural hazards and their combined exposure to several hazardous facilities is why these communities have been flagged for high risk.

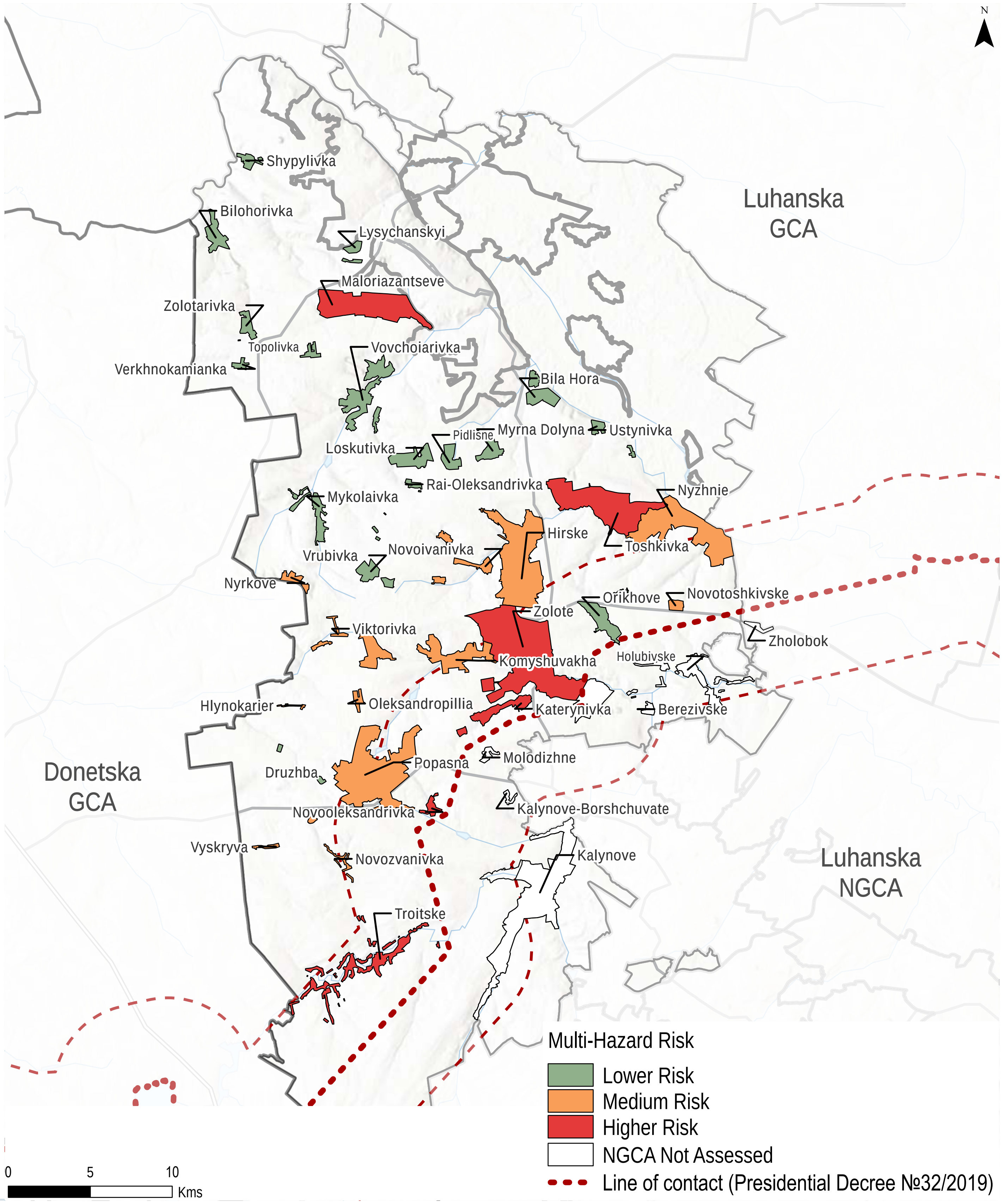
The remaining two settlements in the classification of high risk, is **Troitske** and **Novooleksandrivka.** Although not reporting the highest of anthropogenic or natural hazard exposure, the exposure is still moderate, however, it is the high vulnerability reported in the societal sphere for these rural communities located within the 5km zone to the LoC that is raising their risk. In the event of a hazard, rural communities within the 5km zone are extremely vulnerable and will feel the impacts greatest.

Table 14.1: Community Multi-Hazard Risk

Community	Typology	Multi-Hazard	Vulnerability	Risk
Zolote	Urban5K	27.29	23.52	6.42
Katerynivka	Rural5K	13.66	26.45	3.61
Maloriazantseve	Urban	15.17	21.07	3.20
Toshkivka	Urban	13.74	22.41	3.08
Holubivske	Rural	12.21	25.14	3.07
Troitske	Rural5K	9.65	28.02	2.70
Novooleksandrivka	Rural5K	9.37	27.36	2.56
Novotoshkivske	Urban5K	11.47	21.39	2.45
Berezivske	Rural	10.31	23.64	2.44
Hirske	Urban5K	12.00	19.29	2.31
Nyzhnie	Urban5K	10.20	21.39	2.18
Zholobok	Rural	8.20	23.84	1.95
Komyshuvakha	Urban5K	9.78	19.62	1.92
Viktorivka	Rural	7.26	24.48	1.78
Novoivanivka	Rural	7.43	23.48	1.74
Vyskryva	Rural	6.29	27.48	1.73
Popasna	Urban5K	8.59	19.82	1.70
Molodizhne	Rural	7.07	23.74	1.68
Novozvanivka	Rural5K	6.95	24.05	1.67
Kalynove-Borshchuvate	Rural	6.96	23.64	1.64
Oleksandropillia	Rural	6.83	23.98	1.64
Hlynokarier	Rural	6.89	23.64	1.63
Nyrkove	Rural	6.22	26.15	1.63
Kalynove	Urban	8.14	19.44	1.58
Orikhove	Rural5K	6.42	24.52	1.57
Druzhba	Rural	6.52	23.65	1.54
Verkhnokamianka	Rural	6.17	24.82	1.53
Bila Hora	Rural	6.39	23.82	1.52
Kruhlyk	Rural	6.40	23.64	1.51
Lysychanskyi	Rural	6.24	23.32	1.45
Rai-Oleksandrivka	Rural	5.39	25.98	1.40
Vrubivka	Urban	6.35	21.74	1.38
Ustynivka	Rural	5.42	25.32	1.37
Mykolaivka	Rural	5.25	25.82	1.35
Bilohorivka	Urban	5.78	22.07	1.28
Topolivka	Rural	5.43	22.65	1.23
Mius	Rural	5.19	23.64	1.23
Loskutivka	Rural	4.89	24.98	1.22
Shypylivka	Rural	4.85	23.48	1.14
Myrna Dolyna	Urban	4.58	22.07	1.01
Vovchoiarivka	Urban	4.57	22.07	1.01
Chornukhyne	Urban	4.81	19.04	0.92
Pidlisne	Rural	2.94	24.98	0.74
Zolotarivka	Rural	2.89	25.32	0.73

*5km refers to being within 5km proximity to the LoC

Map 14.1 Multi-Hazard Risk By Settlements



HROMADAS - A NEW WAY FORWARD?

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 part of powers, resources, and responsibility from the executive branch of the government to the bodies of local self-government (hromadas).

Since the beginning of the implementation of the decentralization reform by the Government of Ukraine, which envisages the creation of hromadas, the Perspective Plan for the Formation of Community Territories has been approved. According to the plan depicted in map 15.1, in the territory of Popasna raion territories it is envisaged to form four amalgamated territorial communities of Popasnianska, Hirska, Lysychanska, and Sieverodonetska amalgamated territorial communities.

As for now the administrative-territorial structure of Popasna raion includes 17 local councils (3 city councils, 11 town councils and 3 village councils), which consists of 3 towns of Hirske, Zolote and Popasna, 11 townships, and 30 villages.

However, the formation of amalgamated territorial communities of Popasna raion in territories is complicated by the proximity to the conflict line, the presence of discontinuities in the territory, and the location of a part of the Popasna raion within the territory which is not controlled by the Government of Ukraine.

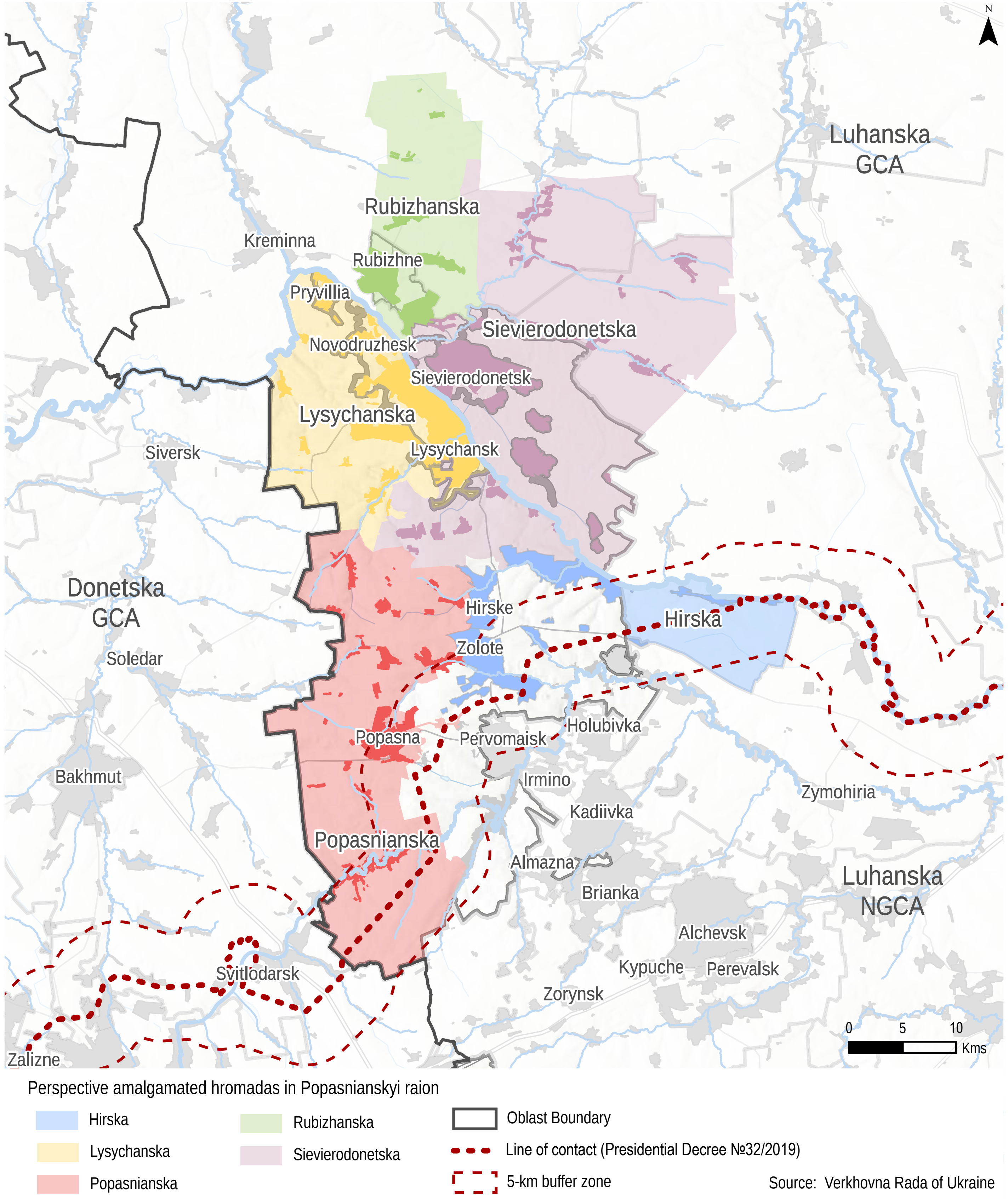
The 2015 law on "Voluntary Amalgamation of Territorial Communities" provides voluntary association to form a capable basic level of local self-government. As of March 2020, no communities have been formed in the Popasna raion. Hirske city council has begun the process of association with the Toshkivska and Nizhnenska township councils. The future amalgamated territorial community will include 5 settlements with a centre in the town of Hirske.

According to the requirements of the Methodology for Formation of Able Territorial Communities, the new administrative-territorial level - amalgamated territorial communities, should be formed taking into account the accessibility of public services, in particular the time of arrival of ambulance and fire aid in urgent cases should not exceed 20 minutes. Such measures might necessitate the relocation or creation of new station and sub-station of emergency services and should be guided through strong understanding of risks.

These changes will impact primarily the distances to access services for settlements that would see a change in administration. This expected to have a positive impact on the coping capacity of communities 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 15.1 Overview Map for Proposed Hromadas



Source: Verkhovna Rada of Ukraine