

Risk Assessment of the 'Voda Donbasa' Water System – 2017

RISK ASSESSMENT REPORT

September 2019

МІНІСТЕРСТВО З ПИТАНЬ ТИМЧАСОВО ОКУПОВАНИХ ТЕРИТОРІЙ ТА ВНУТРІШНЬО ПЕРЕМІЩЕНИХ ОСІБ УКРАЇНИ

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Canada

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ABBREVIATIONS

2DWW	2nd Donetsk Water Way
CB	Circuit Breaker
E&M	Electro-Mechanical
GCA	Government Controlled Area
HV	High Voltage
ICRC	International Committee of the Red Cross
JCCC	Joint Centre for Control and Coordination
LS	Lift Station
CADLR	Certain Areas in Donetsk and Luhansk Regions
OCHA	Office for the Coordination of Humanitarian Affairs
OSCE	Organization for Security and Co-operation in Europe
PS	Pumping station
SDC	Swiss agency for Development and Cooperation
SDD	Siverskyi Donets-Donbas Channel
SDR	Siverskyi Donets River
SDWW	South Donbas Water Way
ToR	Terms of Reference
UAH	Ukrainian Hryvnia
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
VD	Public Utility Voda Donbasu Company
VK	Vodokanal
WTP	Water Treatment Plant
WASH	Water, Sanitation and Hygiene
WS	Water Supply
WWC	Wastewater Collection
WWPS	Wastewater Pumping Station
WWTP	Wastewater Treatment Plant

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1 PREAMBLE AND UPDATE 2019

1.1 INTRODUCTION

The "Risk Assessment of the 'Voda Donbasu' Water System" was completed by UNICEF in 2017 with the services of *Posch and Partners* (Innsbruck), led by director Erich Kaschka and team leader Carmen Paradiso. Since finalization, data provided was reviewed by the main stakeholders, within a private setting. In 2019, the report is formally published, however it is appropriate to update some data, for the sake of completeness. This introduction serves as a 2019 addendum to the original report, and contains brief updates on risks experienced by the Voda Donbasu company, with respect to security, the financial situation of the company, governance, technical challenges, and the environment.

In 2019, Ukraine entered in the sixth year of the armed conflict in the East of the country: 3.2 million people still need actual assistance due to inadequate water and sanitation, according to the Humanitarian Needs Overview 2019[1]. Significant challenges for Voda Donbasu and other water companies remain largely unchanged since 2017: decrepit water systems are still at risk of failure due to lack of maintenance, active military actions, and direct shelling around facilities. From January to April 2019 only, 26 dangerous incidents affected critical water infrastructure and staff of Voda Donbasu. The international humanitarian community, including all WASH Cluster partners, aims to promote stable access to safe drinking water in sufficient volume, adequate sanitation and proper hygiene for all of the conflict-affected population, regardless of where people live. In 2019, Voda Donbasu continues to play a key role in delivering stable access to those essential and life-saving services.

1.2 RISKS

1.2.1 Security Risks

Between 2017 and early 2019, the military risks and conflict paradigm remained largely constant, with no significant progress towards peace at the negotiation table and on the ground. Regular shelling and small-arms fire have been affecting water pumps, pipes, and water workers. Ceasefires were sporadic, negotiated and agreed in established formats of negotiations around sessional key moments, but usually short living.

In December 2017 the Russian Federation withdrew its officers from the Joint Centre for Control and Coordination (JCCC), previously consisting of representatives of the Ukrainian and Russian forces, as well as from the Certain Areas in Donetsk and Luhansk Regions (CADLR). In practice this removed the joint mechanism of verification of compliance with ceasefire and the main official recognized effective tool of coordination. Since then, it has been more challenging for the requested "windows of silence" aimed at implementing repairs along the line of contact, on water networks in particular, to be adopted.

The WASH Cluster in Ukraine recorded 222 incidents from January 2017 until 10 May 2019: a small decrease in the number of incidents in 2018 compared with 2017, however, the geographical hot spots, around the Donetsk Filter Station, and the nearby 1st Lift Pumping Station remained constant.

One of the most concerning trends of 2018 was that of increasing cases of injured workers operating or repairing critical water pumps, pipelines or treatment facilities. The last previously reported injuries to water workers of Voda Donbasu were in February 2015 during the Debaltseve flare up, and none reported in 2016 or 2017. Nine Voda Donbasu workers were reported injured in 2018 with three casualties already in early 2019.

1.2.2 Financial and Economic Risks

Since the establishment of the limittions of the trade across the line of contact and the deciosn on the external management of many state and private companies in CADLR in 2017, Voda Donbasu has

[1] https://www.humanitarianresponse.info/en/operations/ukraine/document/ukraine-2019-humanitarian-needs-overview-hno

remained the only sizable company registered in Ukraine that operates on both sides of the Line of contact, a state of affairs necessitated by the cross-line nature of water networks. In broad terms, both sides have taken the view that the risks of disrupting the current arrangements would be too significant.

The key financial risks highlighted in UNICEF's 2017 Risk Assessment report are still valid: the most critical issue for the continued operation of Voda Donbasu remains the much lower applied tariff in CADLR, coupled with the illegality of Voda Donbasu. From 2016, consumers in GCA paid around twice (2.2 x) the prices paid in CADLR; in early 2019, people in GCA were charged almost 3.5 times what people pay in CADLR.

	2016		2019	
	GCA	**CADLR**	**GCA**	**CADLR**
In force since	**01/01/2016**	**01/09/2016**		
Drinking water Cost per m3 (UAH)	8.18	4.17	13.16	4.17
Wastewater collection Cost per m3 (UAH)	7.19	2.81	11.22	2.81
Total Cost per m3 (UAH)	15.37	6.98	24.38	6.98
Comparison factor between CADLR and GCA areas	2.2		3.5	

The disparity in tariffs means that while, in 2019, 56% of all water is used in CADLR (176.2 million m^3 [Mm^3]) and 46% of water is for GCA (151.5 Mm3) only 31% of the water production budget (358.1 million UAH) is needed to provide water for GCA but 69% (810.2 million UAH) is used to produce water for CADLR. In 2019, VD would experience a deficit of 91.8 million UAH monthly from CADLR areas even if full tariff collection is ensured! Of 136.1 m UAH that should be collected in CADLR (according to an "economic tariff" calculation), Voda Donbasu collects only 44.3 million due to the lower tariff in CADLR.

Electricity costs are increasingly more and more critical, and most of the energy is used simply to pump water as far as CADLR areas via the SDD channel. In 2019, of 29,500 Kwh per month used by Voda Donbasu, 19,800 are used to supply water to CADLR and 9,700 to supply water for GCA. Meanwhile the cost of electricity rose from 0.954 UAH per Kwh in 2014 to 1.9224 UAH per Kwh in late 2018. In 2019, one implication of the poor financial situation of Voda Donbasu is the continuous risk of electricity cuts to water facilities in line with recent national energy market reforms in Ukraine.

There is no clear legal mechanism on how Voda Donbasu can deal with Russian Roubles payments. As a result, and coupled with the low tariffs in CADLR, staff are under-paid, and social benefits such as health coverage for staff on CADLR side, also cannot be paid to them.

1.2.3 Governance Risks

In 2019, Voda Donbasu water company continues to operate in a diverging and deficient legal and regulatory setting, where management and staff are exposed to potential legal or reprimanding action from both sides of the conflict, due to their presence on the two areas.

Staff are one of the company's vital assets. In 2019, due to back pay owed, key staff in CADLR areas began to threaten strike action, or to leave the organisation. Experience in other conflict contexts has shown that the loss of staff over time had considerable impact on service delivery.

1.2.4 Technical Risks

In 2017, around 170 million USD of urgent works were identified by engineers of the Voda Donbasu water company, for completion within five years. Humanitarian agencies considered these projects for prioritisation alongside the Donetsk Oblast Water Programme, which advocated for an additional 220 million USD of investment, with the overall aim to ensure water continues to flow to 3.8 million people.

Since the completion of the Water Risk Assessment study, in 2017, UNICEF and ICRC have contributed significantly to keeping water flowing for humanitarian purposes, although the list of urgently needed assistance is still substantial:

- Mechanicals and Electricals (M&E) repairs were completed or are planned at all pumping stations on the Siverskyi Donets Donbass (SDD) channel, South Donbass Water Way and most Pumping Stations on the Second Donetsk Water Way (2DWW).
- Assistance by both agencies was provided for Horlivka Filter Station (FS), Krasnoarmiiska FS, Donetsk FS, and Velikoanadolske FS; Yelenovka FS was restarted altogether with ICRC assistance.
- Distribution pipes were delivered to Selidove vodakanal, Mariupol city, Volnovakha and Vuhledar by UNICEF.
- Four excavators and two trucks were provided by UNICEF, and a minibus and welding equipment was provided by ICRC.

1.2.5 Environmental Risks

Risks of environmental pollution caused by potential and actual release of partially treated wastewater can clearly affect water supply, representing a risk of cross contamination from sewage pipes into the water network, and of the pollution of raw water sources for private users and wells. There was a minor outbreak of water-related disease close to Konstantinivka in April 2019, reportedly due to negative pressures in pipes caused by power cuts.

The above-mentioned risk of power cuts might also lead to the contamination of surface and ground water by sewage. A less explored issue is also the possible impact of flooded mines on underground water sources.

1.3 CONCLUSION

No full technical evaluation of Voda Donbasu water facilities or financial review was possible since the completion of the UNICEF-lead Risk assessment in 2017. It is thanks to humanitarian interventions listed above, as well as continued supply of water treatment chemicals by UNICEF, ICRC and SDC, the leadership of the oblast authorities, oversight by the Ministry of Temporary Occupied Territories and IDPs (MinTOT) and the Ministry of Regional Development and Housing (Min Region), and heroic work of normal workers, that clean water continues to flow to 3.8 million people. However, given the still active conflict affecting water/waste water infrastructure, given the age of the system as well as the difficulty in organising windows of silence; given the lack of more significant maintenance, and additional recent damage of equipment and injuries to staff, it is clear that the Voda Donbasu water supply systems remain fragile and the company still requires considerable urgent assistance. Water is a human right, absolutely essential to all children, women and men and its continued use must be guaranteed in 2019, as before.

UNICEF hopes that further additional financial and technical studies of the Voda Donbasu water company will be facilitated and enhanced by data contained in the 2017 Risk Assessment report. Most analysis and recommendations from 2017 remain relevant in 2019 and still reflect the core challenges faced, in spite of some changes in context. The lack of medium to long-term solutions for Voda Donbasu represents an ever increasing risk for water security in the east of Ukraine and, while backup supplies do not fully exist, any loss or stoppage of Voda Donbasu's water networks would without doubt cause a second emergency in the region.

2 INTRODUCTION

2.1 PROBLEM IDENTIFICATION AND RESEARCH OBJECTIVE

In Eastern Ukraine, the active armed conflict frequently impacts negatively on water supply services, posing serious risks to the health and wellbeing of the affected population – and a number of perils to the providers.

PU Voda Donbasu Company (VD) is managing the bulk water provision for centralized supply in the water-stressed and densely populated Donetsk region. VD serves up to 4 million people, as well as their industrial and commercial activities. Since the beginning of hostilities in this area around mid-2014, the company faces tremendous challenges in its daily operation. Despite best efforts, reliable and safe water supply to the population is regularly severely compromised by the effects of military activity and political impasses.

The humanitarian response community supports VD through the provision of vital supplies and materials in an attempt to 'keep the water running'. Until today, this objective is by and large being achieved thanks to VD's pro-active and careful management, and resourcefulness in the response to emergency situations. There are clear signs, however, that system resiliency is gradually weakening as the armed conflict continues. The water supply of millions of people is under significant threat.

This study presents a systematic review and prioritization of risks for VD's bulk water supply service in late 2016 and early 2017. It has been conducted by UNICEF, in agreement with the Economic Working Group of the Trilateral Contact Group[2].

According to the Terms of References of the study the objective of this Water Risk Assessment study is:

Identify and weigh risks relevant to the safe and reliable supply of water to the population connected to the Voda Donbasu bulk transmission system, and to propose adequate measures of prevention and mitigation

As such, the overall goal of this assessment is to inform decision makers across the political, military and donor spectrum of strategic and prioritized considerations in support of continued water supply to people affected by the conflict.

As this report shows, VD's water supply service is particularly exposed and vulnerable due to its specific infrastructure configuration (outdated technology leading to inefficiencies), condition (aged infrastructure leading to technical failures), geographic location (closeness to the line of contact leading to direct damage of water facilities by shelling), limited access to some locations (due to local military escalations) and delicate financial situation. Economic sanctions, restrictions and insecurity hamper regular maintenance and operation, and put the life and wellbeing of staff at risk.

2.2 SCOPE AND ASSUMPTIONS

The assessment focuses on the centralized drinking water supply service operated by VD in late 2016 and early 2017. Inter-connectivity of services, such as water, electricity and heating is being taken into consideration, but the focus remains on the drinking water service. Environmental issues, and more specifically, wastewater collection, treatment, and disposal, are considered only with reference to their effects on water quality.

The Terms of References call for the identification and assessment of risks from a multi-dimensional perspective inclusive of political, managerial, economic, environmental, security and asset condition

[2] The Trilateral Contact Group provides a platform where issues related to the implementation of the Minsk Agreements are being discussed and negotiated. It is attended by the OSCE, as well as representatives of Ukraine and Russia. Four specific working groups deal with security, politics, economic issues, and humanitarian affairs.

issues. Accordingly, subject matter expertise of the assessment team includes legal, economic, and water and electricity engineering.

Although the results from this conflict and the effects on the population over time has to be seen within the wider geopolitical and historical context, this assessment will focus only on factors directly related to the water supply service in the current situation. An analysis of underlying causes and events leading to the current situation is not subject of this study.

Important analytical assumptions include:

- The status of the military conflict during the time of assessment is maintained, in terms of intensity and frequency of hostilities, location of line of contact, and related sanctions and restrictions;
- The status of the company is maintained, in regard to its registrational status, management structure, and operational capacity.

2.3 METHODOLOGY AND LIMITATIONS

Qualitative and quantitative data were collected through sector-specific desk studies, key informant interviews, visits to relevant infrastructure, and semi-structured discussions with stakeholder. Field data collection by the four sector specialists took place over the course of 2-4 weeks between December 2016 and February 2017.

All Regional Offices and Subdivisions of VD were visited: Sloviansk, Chasiv Yar, Pokrovsk (previously Krasnoarmiysk), Donetsk and Mariupol; as well as selected Vodokanals (VKs) that are part of the VD structure, and independent ones. Interlocutors on both sides of the line of contact were consulted.

The data collection period was limited to only two months, considering to the scale and complexity of the VD system. Travel to the areas under control of armed groups had to be restricted to six days only due to the security situation and logistical constraints prevailing at the time.

Data obtained required thorough cleaning and processing, as records of different sources had limited compatibility. The event and damage data shown in Annex 1 are not complete enough to allow for robust statistical analysis, though they are considered broad enough to serve the illustrative purposes intended.

The assessment of risks is by virtue governed by some level of uncertainty as it tries to predict future events and their consequences. Likelihood and impact severity are speculative, however historic data of past events can give valuable clues and be used as points of reference.

Another possible limitation could be sources of errors arising from translation. Particular attention was given to eliminate the risk of bias existing in the various components from a predominantly qualitative research.

3 CONCEPTUAL FRAMEWORK

3.1 DEFINITIONS OF 'RISK', 'RESILIENCE' AND 'RISK MANAGEMENT'

Risk can be understood in different ways. The United Nations Office for Disaster Risk Reduction (UNISDR) defines risk as the combination of the probability of a hazardous event and its consequences which result from interaction(s) between natural or man-made hazard(s), vulnerability, exposure and capacity.[3] Vulnerability can be understood as the susceptibility to consequences from a perilous event (hazard). Exposure, another key component in this framing of risk, is understood as the presence and quantity of people, infrastructure or services where a specific hazard can occur. Vulnerability and exposure are varying, and have social, economic, environmental and geographical dimensions.

Risk = Hazard x Vulnerability x Exposure

Whilst the above definition does not imply that the consequences are undesirable, literature elsewhere ascribes a negative connotation to the term "risk" by associating it with harmful consequences: *"(…) risk combines attention both to exposure to hazard and to likelihood of loss."* (Mitchell, 2015).

ISO 31000, introduced by the International Organization for Standardization in 2009, gives guidance on risk management, and describes risks as effects of uncertainty in regard to achieving objectives.

Risk Management (see Figure 1) is the process of by which risks are determined, assessed and dealt with. At its broadest level, this assessment follows ISO 31000's elaboration of risk assessment, that is it identifies, analyses and evaluates the risks in accordance to specific criteria.

The concept of resilience is closely related to that of risk. Resilience is generally understood as the capacity to withstand and recover from shocks, therefore limiting negative consequences of events in terms of severity and duration. Chapter 3.3 describes resilience in more detail.

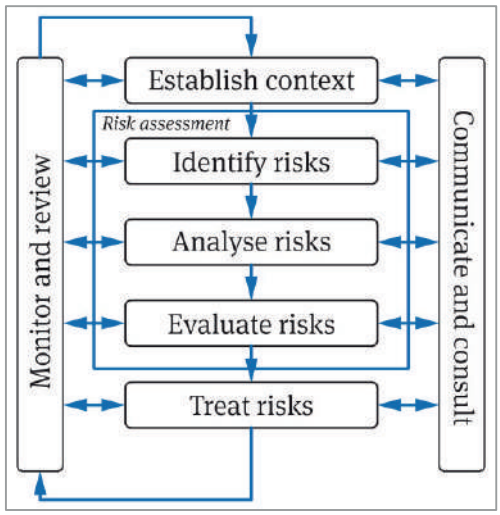

Figure 1: ISO 31000 Risk Management Process

3.2 RISK MANAGEMENT AND WATER SUPPLY

Water supply constitutes an essential service that is critical for the safeguarding of public health, as well as social and economic development. Industry and agriculture are particularly water hungry.

The operation of a sizable water utility in an urban environment is a complex enterprise. It is influenced by a variety of factors, including interdependencies with other essential services. For example, water abstraction, treatment and transportation requires reliable supplies of electricity, whilst water is necessary for specific energy-generating processes. Also, public health and sewage systems require water, and in turn ensure that potentially harmful liquid wastes from hospitals or wastewater treatment plants do not contaminate fresh water sources.

Water quality and reliability thus plays a vital role in the preservation of public health. Insufficiently treated water, or water that was exposed to secondary contamination[4] can cause serious illness, and even outbreaks of infectious diseases such as Hepatitis A, gastroenteritis, and cholera.

Risk management is a prominent business function for water utilities, not least because failures can have grave effects on people either directly, or as a result of failure of other important services (cascading effect).

[3] https://www.unisdr.org/we/inform/terminology

[4] Water can be exposed to contamination after treatment, for example through holes in the transportation pipes when these are not pressurized.

Important water supply failures, such as a major leak in a large-diameter pipeline, are costly not only because of the material and manpower required to repair, but also due to potential loss of business for the duration of repair works. This highlights the critical importance of rapid response capacities: the sooner a rupture is detected and treated, the lesser the financial impact. Risk management thus provides a tool to inform decision-making in regard to preventative action, as well as it supports mitigation mechanisms and processes in response aimed to reduce adverse events.

Many external and internal aspects play a role in a utility's service provision, such as regulation, ability to pay, asset condition, environmental changes, accidents etc. adding further layers of complexity. Indeed, the number of risks that a water utility / provider must manage is impressive at the best of times – and risk management can help to organize and update relevant information in support of sensible decision-making. Risk-management during times of armed conflict becomes even more beneficial.

3.3 EXISTING RISK ASSESSMENT TOOLS AND APPROACHES

The climate change debate has without doubt greatly contributed to increased attention given to the concepts of risk management and resilience: these concepts have received growing attention over the past two decades, and many tools have been developed.

There are numerous definitions of the term resilience. Bocchini et al (2014) considered the resilience and sustainability of civil infrastructure, and stated that *"(…) resilience is usually associated with the ability to deliver a certain service level even after the occurrence of an extreme event (…), and to recover the desired functionality as fast as possible."*

Figure 2: Aspects of resilience considered in the definition by Bruneau et al. (2003)

Bruneau et al (2003) developed a frame that describes three areas of resilience (see Figure 2), and within this, four dimensions that are of particular relevance in the context of conflict-related risk: technical, organizational, economic and social. The technical dimension concerns the set-up and condition of system hard-ware; organizational, the way in which management, maintenance and response are conducted; economic, costs linked to service reduction and restoration; and social, the effects on people and their environment. The main shortcoming of a resilience-based approach in the context of armed conflict is that extreme events are not exceptional but rather recurrent, severely impacting on the ability to withstand and recover over time.

Other approaches to the assessment of risks in water supply centre around specific service delivery functions or processes only, such as Water Safety Plans and Asset Management tools[5]. Generally, however, such tools fail to account for the fluidity of the political and security situation in armed conflict, and so are currently of limited use to VD. In fact, there are no risk assessment tools designed specifically for assessing risks to water supply services in areas of armed conflict.

[5] *Water Safety Plans* are designed to identify and eliminate or reduce opportunities for water contamination.

Asset Management tools aim at strategic decision making concerning infrastructure renewal with a view to minimize service disruption and costs from failures.

The consequences of protracted armed conflict on drinking water services – and so, indirectly, the risks to providers – were detailed by the ICRC in their 2015 report "*Urban services during protracted armed conflict*". It highlights specific examples from Iraq and Gaza and outlines the existence of direct and indirect impact – and highlights the importance of avoiding 'vicious cycles of cumulative impact', when these combine.

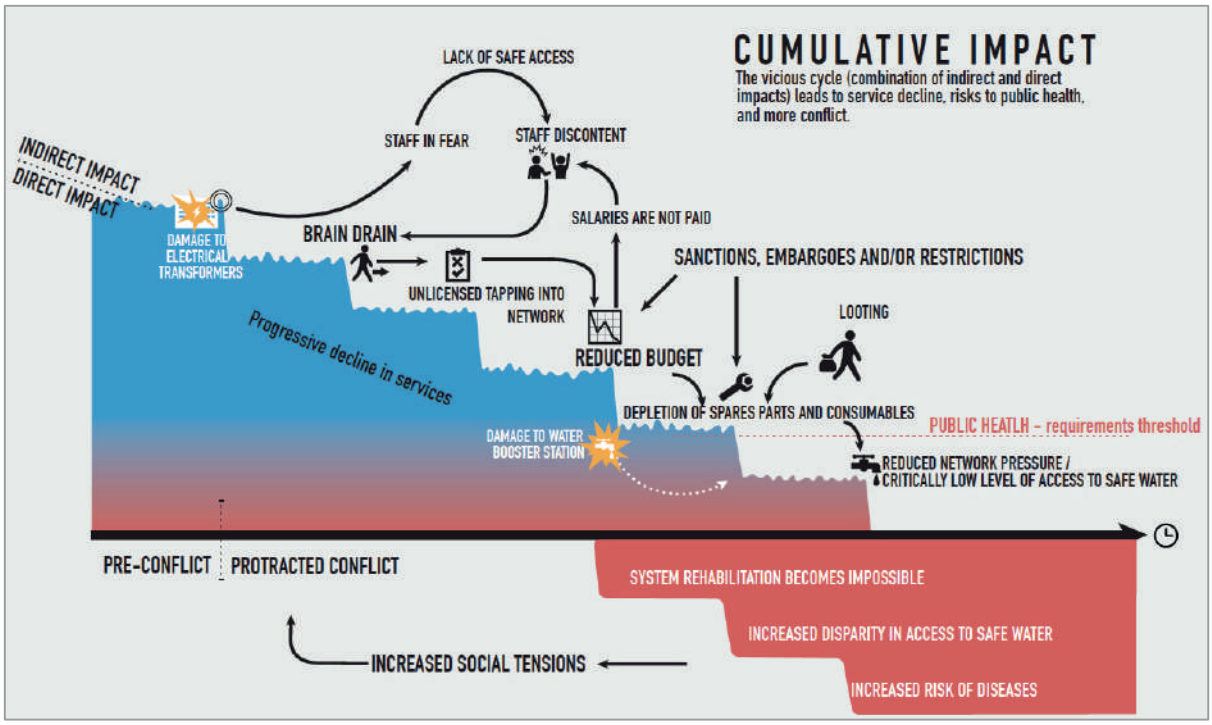

Figure 3: Cumulative impact: the vicious cycle

Figure 3 illustrates cumulative effects that result from various events common during a protracted situation of armed conflict:

- Brain drain
- Financial problems / reduced budget available to service-providers
- Economic sanctions and restrictions
- Direct damage to infrastructure

The final consequence might well be a permanent failure of the supply system when some of its parts become irreparable or irretrievable.

In the case of Basrah, Iraq, brain drain and restrictions played a crucial role (Zeitoun et al, 2017), and although active armed conflict in this area ceased in 2008, the road to recovery of the water supply system is still long[6].

[6] Basrah is considered a good example of how drinking water services can go from 'world class' to 'worst class' in a few decades. The impact is due to the UK/US invasion, internal armed conflict, and UN-imposed sanctions. Efforts to rehabilitate the entire drinking water system are currently not a favourable investment, and there is little expectation of returning to pre-war conditions.

3.4 RISK FRAME USED IN THIS STUDY

The approach taken to the assessment of risk in this study borrows from various tools and methodologies mentioned above as follows and is based on the following key considerations and assumptions:

- Risk is a combination of hazard, exposure and vulnerability and impact severity is also a key criterion in the evaluation of risks.
- The overall methodology is anchored in ISO 31000 by following the steps of risk identification, risk assessment, and risk evaluation, before determining prioritized mitigative measures;
- Protracted conflict impacts baseline resilience, as recurrent extreme events do not allow for adequate recovery. Baseline resilience is therefore assumed to be generally degrading over time;
- Reverberating effects, indirect and cumulative impact will be considered alongside direct effects;
- Protection of water in this study is understood relating to the service provision rather than solely infrastructure (i.e. it includes people and institutional factors); This service-focussed approach means the assessment covers political / governance, regulatory, security, financial, and operational context, as well as infrastructure;

A prime challenge in this task is that conflict sharply intensifies the elements of insecurity & uncertainty. The chosen approach will comprise of a thorough context analysis and make use of illustrative data where comprehensive data is not available.

The results of an initial scoping of the situation as it pertains to the water supply operated by VD can be seen in Figure 4 below. It emphasizes a situation that faced particular challenges prior to the start of conflict which are now superimposed by political and military confrontation of opposing sides.

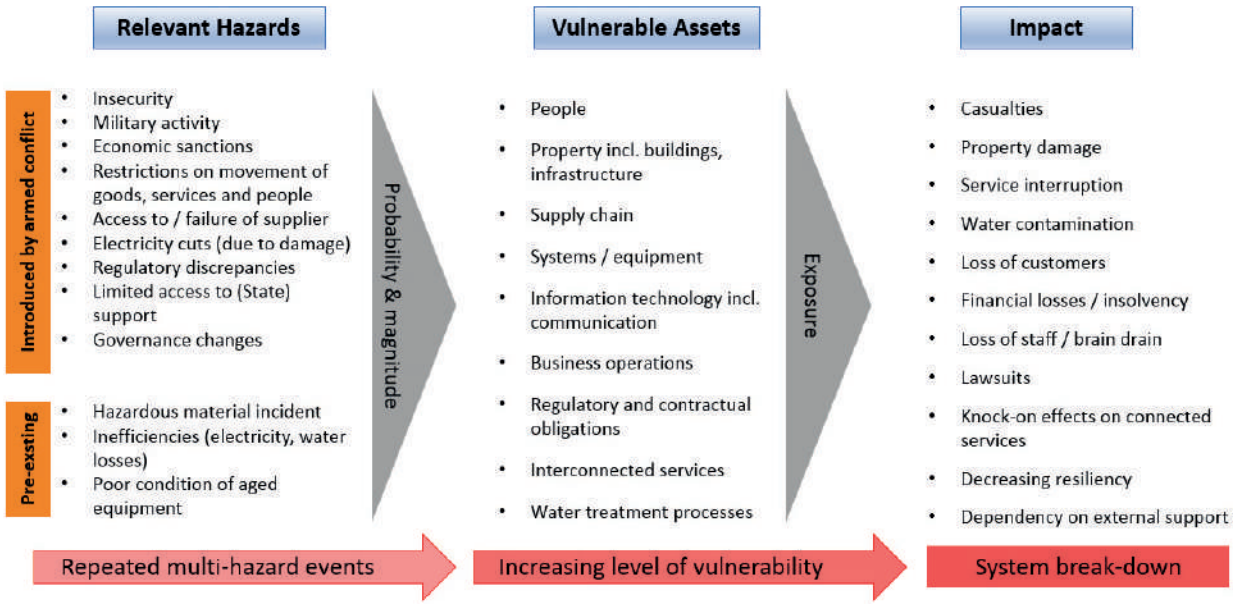

Figure 4: Anticipated risks elements based on initial scoping

4 CONTEXT

4.1 GENERAL BACKGROUND OF THE CURRENT CONFLICT

Armed conflict in the Donbas region of Ukraine is impacting on the daily lives of the affected population since April 2014. Despite the ceasefire provisions agreed to by all sides to in the 'Minsk Protocol' and in the "Minsk Memorandum in September 2014, and again in the "Package of Measures for the implementation of the Minsk Agreements", in February 2015, ceasefire violations continue to occur on a daily basis. Although there has been some progress in regard to the implementation of the "Minsk Agreements", many measures remain to be implemented, including the withdrawal of heavy weaponry, the restoration of the banking system in Non-Government Controlled Area (CADLR), as well as political processes. The Organization for Security and Cooperation in Europe (OSCE) Special Monitoring Mission (SMM) observes and reports on the situation, assists in the negotiation and implementation of local ceasefires (also known as 'windows of silence').

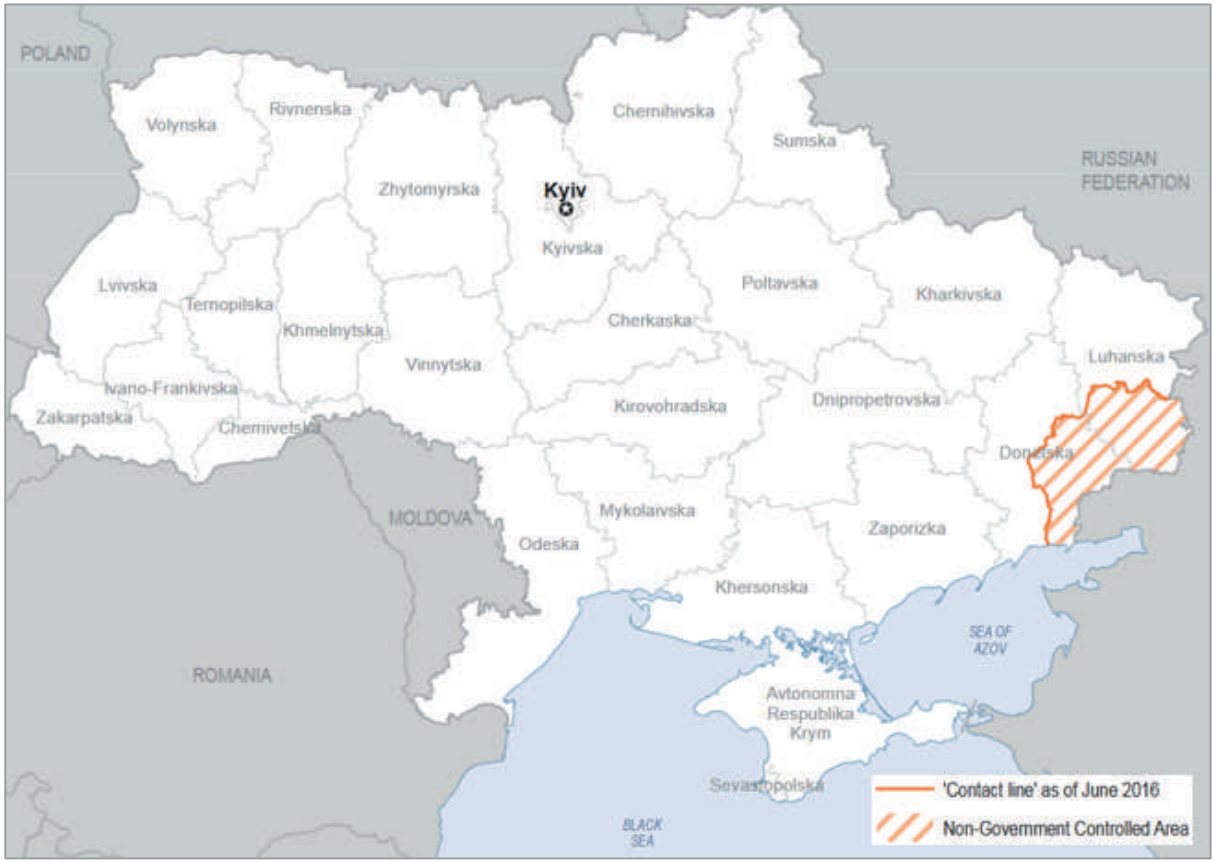

Figure 5: Ukraine –Eastern areas - TAKE OUT THE DATE ABOVE ref. Line of COntact

In its report published on March 15, 2017, the United Nation's Office of the High Commissioner for Human Rights (OHCHR) puts the total number of people killed and injured between April 2014 and February 15, 2017, at 9,900 and 23,246 respectively (OHCHR, 2017). Many people remain displaced.

The population residing in proximity to the fighting has to endure frequent military activity, restrictions of movement, and limitations or disruptions of service provision such as electricity and water supply.

The Donbas basin has considerable coal reserves, particularly in and around the Oblast's capital, Donetsk. The region's industry is centred around coal mining, metallurgy, and related businesses, including power generation. Many of these businesses are owned by one particular oligarch whose interests might be of relevance when it comes to the supply of water.

Since the start of the conflict, livelihood opportunities in the area have decreased due to business reduction or closure. Many people are dependent on humanitarian support.

4.2 LEGAL, REGULATORY AND INSTITUTIONAL ENVIRONMENT

4.2.1 Governance Structure

4.2.1.1 Government Controlled Area

The water and sanitation sector in Ukraine is governed by a set of laws, rules and regulations that are applied against a backdrop of ongoing sector-relevant reforms. The reforms aim to devolve responsibility to the regional and local level, and to create stronger ties with existing European standards of water resource management and water quality monitoring.

There are two key pieces of legislation relating to water supply services in Ukraine:

1) The **Water Code (1995)** which addresses ownership issues and sets out roles and responsibilities regarding water resource management and protection, water allocation and use, licensing and tariff-setting procedures, and the handling of disputes. In accordance with this Code, VD falls under the category of primary user, whereas Vodokanals are secondary users (chapter 9, article 42). Chapter 11 "*Special water use to meet drinking and domestic needs of the population"* deals directly with compliance and monitoring by service providers.
2) The **Law on Drinking Water and Drinking Water Supply** entered into force in **February 2002**. It describes the legal, economic and organizational principles for the provision of drinking water of adequate quality. The State guarantees the protection of consumers' rights, including through the *"(…) satisfaction of the necessities of population in drinking water by priority development of the systems of centralized drinking water supply (…), creation of reserve drinking water supply systems"* (Law of Ukraine of 10.01.2002 No. 2918-III). Infrastructure elements of centralized drinking water supply are classified as "*important objects of life support"*.

Another relevant legal document is the "**Hygienic requirements to drinking water, intended for human consumption**"[7] which establishes the incremental improvement of water quality standards until 2020.

National Targets under the "**Protocol on Water and Health**" were approved by the Ministry of Ecology and Natural Resources in 2011. The Protocol constitutes a social component of the UNECE Water Convention[8], ratified by Ukraine in 1999. The Water Convention aims to improve water management at a regional level, whereby the Protocol establishes specific and measurable targets for the quality of drinking water and wastewater discharge. These differ between urban and rural areas.

There is no specific piece of national legislation concerning the protection of water services in armed conflict. Against the backdrop of recent UN Security Council resolution 2341[9], the Government of Ukraine (GoU) is currently developing a draft law that will set out measures and procedures for the protection of select "critical" infrastructure, limited to threats from potential terrorist activities[10].

It can be argued that due to lack of clarity under national legislation in the current situation relevant instruments of international law are applicable and provide internationally recognized rules for the protection of services indispensable to the survival of the civilian population, including water supply.

Responsibility and authority in the water and sanitation sector is distributed over national, regional (oblast), and local administrative levels:

National: The distribution of legislative powers in relation to water and sanitation lie with the **Cabinet of Ministers**.

[7] Ministry of Health - State sanitary regulations and standards (GsanPiN) 2.2.4-171-10, 01.07.2010
[8] UNECE's "Convention on the Protection and Use of Transboundary Watercourses and International Lakes" entered into force in 1996. It is a legal framework for transboundary water cooperation.
[9] Security Council adopted Resolution 2341 in February 2017. It addresses the danger of terrorist attacks against so-called critical infrastructure, including water supply.
[10] The GoU defines the ongoing armed conflict on its territory as 'Anti-Terrorist Operation' (ATO) until early 2018, and since then as Joint Forces Operation (JFO).

The principal executive authority at national level is the **Ministry for Regional Development, Construction and Housing**. It formulates policies, and sets technical regulations, norms and standards.

In order to close gaps in national legislation and regulation in the situation of armed conflict, the **Ministry of Temporarily Occupied Territories and Internally Displaced Persons** (MinToT) was created on 20 April 2016. The mandate of the Ministry allows facilitating problem resolution in the event of severe issues, including the functioning of critical civil utilities, ensuring proper access to water for people affected by the conflict on both sides of the Line of contact.

The **Ministry of Health** provides quality standards for drinking water.

The protection of the environmental falls within the responsibility of the **Ministry of Ecology and Natural Resources**.

The **National Commission for State Energy and Public Utilities Regulation** is in charge of tariff setting for public utilities.

The **Ministry of Finance** allocates funds from the State Budget for specific programmes such as the State Drinking Water Program.

Regional: Responsibility for the development and management of water resources and supply services are delegated to the **Oblast**. Oblast budgets complement State funding and utility revenues. Donetsk Oblast Administration is the legal owner of Public Utility Voda Donbasu Company. The regional Governor is appointed by the president of Ukraine.

The **State Agency of Water Resources** is subordinate to the Ministry of Ecology. It is in charge of policy implementation on water management, and in particular the monitoring of surface water quality.

The **State Sanitary and Epidemiological Service** (SSES) used to carry out inspection and monitor water quality. This body is currently being dismantled as the health sector undergoes restructuring in the course of the reform process. In some locations, however, the SSES is still performing its functions.

The **State Emergency Service** (SES) is under the jurisdiction of the Ministry of Internal Affairs. Its main purpose is the protection of civilians during emergencies. The SES performs civilian demining, evacuations, and the provision of essential services such as water supply and heating.

Local: Local governments such as **municipalities** and **councils** bear responsibility for water distribution and sanitation services carried out by municipal water utilities.

4.2.1.2 Certain Areas in the Donetsk and Luhansk Regions of Ukraine

The conflict imposes a multitude of legal and administrative challenges in regard to the governance and management of a shared service provider. The following CADLR structures are relevant:

- **so called 'cabinet of ministers'**
- **so called 'ministry of construction and housing'**
- **so called 'ministry of emergencies'**
- **so called 'ministry of coal and energy'**
- **so called 'tariff commission'**
- **so called 'sanitary and epidemiological service'**

All Ukrainian laws and policies that have not been repealed or replaced, remain in force. There is no law, however, that clarifies the roles and responsibilities for the management of water supply in this territory. As chapter 5 shows extensively, there are a number of issues that impede / pose a risk to safe

water supply that stem from legislation or applicable rules or regulations evolve on one side of the line of contact only, as is already the case for drinking water quality.

4.2.2 International Law

In the absence of clarity on and disagreement over roles, responsibilities, mandates, and status around water supply services in the armed conflict in eastern regions of Ukraine, international legal instruments can provide necessary guidance.

UN resolution 68/262 adopted on 27 March 2014, and reaffirmed in November of the same year emphasizes the "territorial integrity of Ukraine". The non-binding resolution, supported by 100 UN member states, affirmed the General Assembly's commitment to the territorial integrity of Ukraine within its internationally recognized borders.

4.2.2.1 Applicable international human rights law

On 28 July 2010, through Resolution 64/292, the United Nations General Assembly explicitly recognized the human right to water and sanitation and acknowledged that clean drinking water and sanitation are essential to the realisation of all human rights. The Resolution calls upon States and international organisations to provide financial resources, help capacity-building and technology transfer to help countries, in particular developing countries, to provide safe, clean, accessible and affordable drinking water and sanitation for all.

In November 2002, the Committee on Economic, Social and Cultural Rights adopted General Comment No. 15 on the right to water. Article I.1 states that "The human right to water is indispensable for leading a life in human dignity. It is a prerequisite for the realization of other human rights". Comment No. 15 also defined the right to water as the right of everyone to sufficient, safe, acceptable andand physically accessible and affordable water for personal and domestic uses.

International human rights law entails specific obligations related to access to safe drinking water. These obligations require States to ensure access for everyone to a sufficient amount of safe drinking water for personal and domestic uses (defined as water for drinking, personal sanitation, washing of clothes, food preparation, and personal and household hygiene). They also require States to progressively ensure access to adequate sanitation, as a fundamental element for human dignity and privacy, and to protect the quality of drinking-water supplies and resources.[11] In its General Comment No. 15[12], the Committee on Economic, Social and Cultural Rights stressed that, under the Covenant, States have the obligation to achieve progressively the full realization of the right to water. While acknowledging resource constraints that may require additional time for the full realization, the Covenant underlines that obligations such as non-discrimination are of immediate effect and not subject to progressive realization.

In General Comment No. 15, the Committee also noted that, during armed conflicts, emergencies and natural disasters, the obligations of States encompass the right to water and the provisions of international humanitarian law relating to water. This includes protecting objects indispensable for the survival of the civilian population, including drinking-water installations and supplies, and ensuring that civilians have access to adequate water. It should also be recalled that the Covenant contains no derogation clause, which means that States cannot suspend their obligations, even if they declared a public emergency.

4.2.2.2 Applicable international humanitarian law

International humanitarian law binds both states and non-state actors. Article 3 common to the Four Geneva Conventions applies to both states and armed groups. Similarly, Additional Protocol II applies to those conflicts between a state and an armed group "which under responsible command, exercise[s]

[11] The Right to Water: Factsheet No. 35, OHCHR. Available at: http://www.ohchr.org/Documents/Publications/FactSheet35en.pdf
[12] http://www.refworld.org/docid/4538838d11.html

such control over a part of its territory as to enable them to carry out sustained and concerted military operations and to implement this Protocol."[13]

Access to water

International humanitarian law also specifically protects access to safe drinking water and sanitation. The Geneva Conventions (1949), their Additional Protocols (1977) and customary international law outline the fundamental importance of access to safe drinking water and sanitation for health and survival in international and non-international armed conflicts. The rules require all parties to an armed conflict to take precautionary measures to protect "objects indispensable for the survival of the civilian population", which includes water and electricity.

Humanitarian access

Article 55 and 56 provide for the unimpeded provision of humanitarian aid to the civilian population, which may include delivery of water and repairing infrastructure indispensable for survival of civilian population. Rule 55 requires party to allow and facilitate rapid and unimpeded passage of humanitarian relief for civilians in need. Rule 56 requires the parties to the conflict to ensure the freedom of movement of authorized humanitarian relief personnel essential to the exercise of their functions. Only in case of imperative military necessity may their movements be temporarily restricted.

Military conduct

International humanitarian law also provides clear rules for parties to an armed conflict concerning military behaviour impacting on essential service provision. This includes the rule of distinction between civilian objects and military objectives, the prohibition of indiscriminate attacks, and the rules of proportionality and precautions.

The most relevant and specific article is that contained in Article 54, Additional Protocol II, which prohibits the destruction of objects indispensable to the survival of the civilian population, including "drinking water installations and supplies and irrigation works". IHL further lists a number of rules that may apply to the case at hand.

- Rule 7. The Principle of Distinction between Civilian Objects and Military Objectives

The fundamental principle underlying the legal framework applicable to conduct of hostilities is that of distinction. Parties to a conflict must at all times distinguish between civilian objects and military objectives, and between civilians and combatants. Operations may be directed only against military objectives and combatants; it is prohibited to target civilian objects or civilians. Thus, any targeting operation directed at a civilian object or civilian is prohibited, unless the protections have been suspended due to the civilian directly participating in hostilities or the civilian object is being used to engage in acts "harmful to the enemy."

- Rule 8. Definition of Military Objectives

Military objectives are those objects which "by their nature, location, purpose or use make an effective contribution to military action and whose partial or total destruction, capture or neutralization, in the circumstances ruling at the time, offers a definite military advantage." All other objectives are civilian.

- Rule 11. Indiscriminate Attacks

Attacks that are indiscriminate in nature are prohibited. Indiscriminate attacks are described in Additional Protocol I as those: (a) which are not directed at a specific military objective; (b) which employ a method or means of combat which cannot be directed at a specific military objective; or (c) which employ a method or means of combat the effects of which cannot be limited as required by international humanitarian law, and are thus of a nature to strike military objectives and civilian or civilian objectives without distinction.

Additionally, an attack is considered indiscriminate and therefore prohibited, if it is an attack by bombardment by any means or methods that "treats as a single military objective a number of clearly

[13] Art. 1, Additional Protocol II

separated and distinct military objectives located in a city, town, village or other area containing a similar concentration of civilians or civilian objects."

- Rule 14. Proportionality in Attack, and Rule 15. Precautions in Attack

International humanitarian law requires an attacker to undertake "feasible precautions" to avoid and/or minimize any incidental loss of civilian life, injury to civilians and damage to civilian objects. Relatedly, parties to a conflict "must do everything feasible to verify that targets are military objectives." Additionally, parties must take "all feasible precautions" in selecting the means and methods they use, "with a view to avoiding, and in any event to minimizing, incidental loss of civilian life, injury to civilians and damage to civilian objects."

Destruction of water supply systems is a violation of the Additional Protocol to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of Non-International Armed Conflicts (Protocol II), 8 June 1977. Article 14 -- Protection of objects indispensable to the survival of the civilian population mentions that starvation of civilians as a method of combat is prohibited. It is therefore prohibited to attack, destroy, remove or render useless, for that purpose, objects indispensable to the survival of the civilian population, such as foodstuffs, agricultural areas for the production of foodstuffs, crops, livestock, drinking water installations and supplies and irrigation works.

- Rule 20. Advance Warning

Parties must also "give effective advance warning of attacks which may affect the civilian population, unless circumstances do not permit." Though these rules do not appear in treaty law regulating conduct of hostilities in non-international armed conflicts, they are widely considered reflective of customary law, and are included in a number of military manuals.

Whereas the decision on whether something is a military objective lies with the party launching the attack, the latter bears the burden of proof in justifying the military nature of an objective when other actors question how this assessment was made and how the rules of proportionality and precautions were factored in.

There are also a number of rules in international humanitarian law that provide additional guidance concerning targeting. What follows is a brief, non-exhaustive list of these rules:

- In case of doubt as to whether an object that is normally dedicated to civilian purposes is being used to make an effective contribution to military, that civilian object "shall be presumed" to be civilian and not to be making such an effective contribution.
- The parties to the armed conflict "must take all feasible precautions to protect the civilian population and civilian objects under their control against the effects of attacks." Precisely what reverberating effects can be judged as 'reasonably foreseeable' is the subject of further investigation in general (Robison and Nohle, 2017), and in water systems in particular (Zeitoun and Talhami, 2017).
- The parties to the armed conflict "must, to the extent feasible, remove civilian persons and objects under its control from the vicinity of military objectives."
- The presence of civilians shall not be used to render immune from attack military objectives. Similarly, the parties to a conflict shall not direct civilians to move or congregate in such a manner as to shield military objectives from attack.
- It is important to note that a violation of one of these rules by one party to the conflict does not release the opposing party to the conflict from their legal obligations vis-à-vis the protections owed to civilians and civilian objects.

4.3 VODA DONBASU BULK WATER SUPPLIER

VD is one of the biggest public bulk water supply companies in Europe. Presently, the company has 10,960 staff. Its core business is the transportation and treatment of bulk water: every day, VD supplies up to 1.3 million m^3 of drinking water to 3.9 million people and 0.3 million m^3 of untreated (so-called) "technical" (untreated) water to factories/industry, through the elaborate water system described in the following section.

The company and its infrastructure developed organically. Its history reaches back to the 1930s when the corporate trust "Donbasvodtrust" started to provide centralized water supply in several areas in the region, including Donetsk city. Industry in the Donbas grew around its vast coal reserves, necessitating ever increasing amounts of water; as the area is water stressed, it had to be transported from the Siverskyi Donets River some 130 kilometres north of Donetsk city. Since 1981, water from the Dnieper is channelled to the Siverskyi Donets River[14] to ensure continued supply.

At the end of 2004, the company, since 1975 called "Ukrpromvodchermet", was transferred from State to Oblast ownership. In 2007, the enterprise merged with "Donetskoblvodokanal", a drinking water distributor, and changed its name to "Voda Donbasu". The structure and function of the company changed significantly from this time on through the absorption of numerous corporate water distributers. The Donetsk Oblast Administration remains the legal owner to date.

Through its headquarters, 6 Regional Operational Offices (ROO)[15], 20 Vodokanals (VKs) and various auxiliary departments, VD manages and operates today:

- The Siverskyi Donets-Donbas Channel (SDD) of 132 km length, including 4 Lift Stations (LS);
- The South Donbas Water Way (SDWW)
- The 2nd Donetsk Water Way (2DWW)
- 17 reservoirs with a total storage capacity of 775 million m^3 (incl. 9 reservoirs for drinking water);
- 11,950 km of water supply pipelines;
- 18 water treatment plants (WTPs) with a design capacity of 2.79 million m^3/day;
- 246 water pumping stations (PSs);
- 299 underground water wells (amounting for 6 % of the total water volume);
- 164 wastewater pumping stations (WWPSs);
- 54 wastewater treatment plants (WWTPs).
- 3,346 km of sewers;

Assets and offices of VD are located on both sides of the line of contact, severely impeding operations in extremely difficult times.

VD's headquarters is located in Donetsk city; to facilitate communication with the Ukrainian Donetsk Oblast Administration (now under civil-military responsibility) which is working out of Kramatorsk, VD opened an office for HQ staff in Krasnoarmiysk ROO (Pokrovsk). Several HQ key staff divide their time between these two offices.

The company is registered under Ukrainian law in Mariupol.

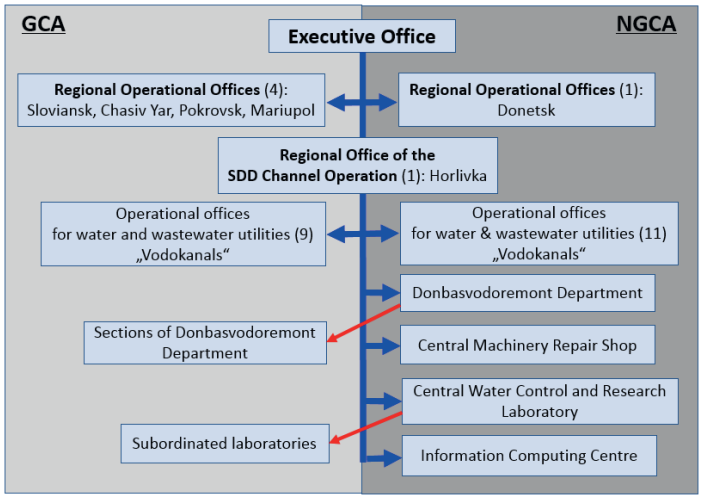

Figure 6: Location of VD assets and offices

[14] The Dnieper-Donbas Channel has a length of more than 260 km
[15] This includes Horlivka-based Regional Office of the SDD Channel Operation

4.4 WATER SUPPLY SYSTEM

The development of VD's water supply system is closely linked to the industrial expansion in the area between the 1930s and late 1970s.

A few factors contributed to the decision to use water from the Siverskyi Donets River for the supply of the region south of it: firstly, the southern Donbas region is water stressed; secondly, the industries in the area, namely coal mining and metallurgy, are extremely water-intensive; and thirdly, the limited groundwater resources in the area are at risk from pollution precisely because of the industries present.

VD supplies water for an estimated 3,9 million people. There are 2 major supply strands running south from the surface water source: 1) the SDD channel that leads to the Verkhniokalmiuske reservoir near Donetsk city after feeding a branch called the SDWW which runs from north of Donetsk city to Mariupol, and 2) the 2DWW which supplies water to settlements between Sloviansk and Toretsk. Figure 7 shows the major infrastructure, including pipelines, in relation to CADLR. It highlights the cross line of contact interdependency– water from the single source located in GCA has to pass through territory under the control of armed groups, before continuing to Krasnoarmiysk area, Volnovakha and Mariupol. None of the major cities on either side can survive on alternative sources of water, due to limitations in ground- and surface-water quantity, quality and system set-up. It may be possible to consider accessing new sources through technology developed since the 1950s, for example deep boreholes or reverse osmosis treatment of seawater, however that would require major system redesign and a cost benefit analysis which is not the focus of the current study.

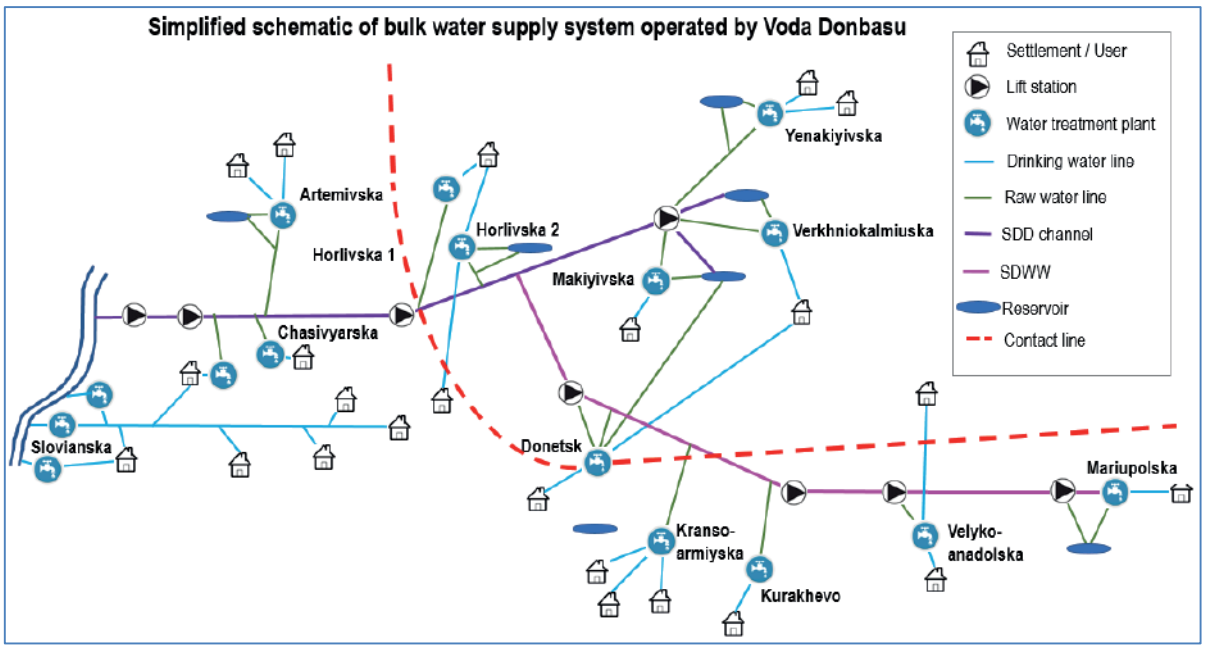

Figure 7: Simplified schematic of bulk water supply system operated by Voda Donbasu

Since the beginning of the conflict, there is clear evidence of its negative impact on proper provision of water services by VD in Donetska oblast. Both direct and indirect factors, related to the conflict, created new risks and exacerbated old issues, which now require urgent actions from parties to the conflict and the international community. Among the direct factors might be listed military actions near the critical civil infrastructure for water supply and sewerage, and casualties and losses among VD staff. Indirect factors include the imbalanced tariff on the CADLR side, which in combination with deteriorated equipment and excessive water losses, led to significant financial losses and limited cash flows, hampering the operationality (payment of wages, payment of suppliers, maintenance costs…), not to speak about improvement investments.

In the short-term, it is technically and financially not feasible to separate the system, nor is it advisable from an operational perspective. Most importantly, effective separation that would guarantee safe water for all would have to be based on agreed modalities and close collaboration.

40% of consumers are located in GCA. The current distribution of offices and staff between GCA and CADLR can be seen in Annex 2. Reservoirs were designed to supplement the water brought by the SDD channel as necessary, and to bridge the supply during times when the SDD would be stopped for maintenance or repair works; most cannot provide sufficient water in the medium- to long-term.

The regional water supply suffered from systemic issues prior to the conflict. As the coal and related business in the region contracted over the past decades, also resulting from the disintegration of the Soviet Union and subsequent transition and economic turmoil, water demand fell significantly. Further demand decrease was driven by the installation of meters that encouraged water conservation particularly of private consumers. Tariff levels have historically been too low to provide sufficient capital for investment in system adaptation or modernization, meaning the system continues to be plagued by inefficiencies. Appropriate asset management is not possible under these circumstances.

4.4.1 Water Conveyance

In the following, the 3 major water conveyance components of the VD system are described. These are the SDD and the SDWW, transporting water all the way from the main source some 260 km to Mariupol at the Azov Sea; as well as the 2nd Donetsk Water Way (2DWW) for the settlements between Sloviansk and Toretsk (previously named Dzerzhynsk).

4.4.1.1 Siverskyi Donets-Donbas Channel

The SDD was built in the 1950s (completion 1958) to meet the growing demands of the industrially developing Donbas region, and to ensure reliable water transmission to water scarce areas. Its capacity was expanded in 1978 to reach 1.1 billion m^3 of water per year or 43 m^3/s. Today, between 13 and 15 m^3/s (30.2 – 34.8%) of water are being transported.

Initially, the channel was supposed to supply mainly technical water to the large industrial complexes in the region; soon enough however, WTPs were added for drinking water production[16].

A total of 200 m elevation over the 135 km distance are overcome with the help of 4 Lift Stations (LS). LSs consist of 2 pump houses – one from the original construction, and one added during the capacity expansion in 1978. The system set-up requires that one pump – covering over 50% of current demand - should be in operation at any given time. It is not possible to operate only parts of the channel.

Between lifts, water runs by gravity. The slope of the channel is 1:10,000. 7 inverted syphons – typically built as 4 parallel steel pipelines of DN 2100 – 2400 with a flow control valve – guide the water through gullies in the topography (see Figure 8).

The channel ends at the Verkhniokalmiuske reservoir, providing water to Chasiv Yar, Bakhmut (previously Artemivsk), Horlivka (and Toretsk which is supplied from Horlivska WTP 2), the SDWW, Yenakiyeve and the area to its east, and Makiyivka on its way. A road runs parallel to the channel for inspection and maintenance. Specialized dredging equipment maintains the channel between April and November.

Table 1: Overview of lift stations at SDD

Lift station	Section	No of pumps	Pump capacity (each)	Volume pumped in 2016 in m^3	Distance from upstream lift station
1	Semenivka	9	23-25,000 m^3	438 million	
2	Chasiv Yar	9	23-25,000 m^3	477 million	24 km
3	Mayorsk	8	23-25,000 m^3	379 million	46 km
4	Makiyivka	7	11-18,000 m^3	154 million	46 km

Water levels in the channel differ in accordance with seasonal demand (see cross-section in Figure 8). A minimum depth of about 3.5 meters must be maintained to ensure structural stability. The top layer of water in the SDD freezes during winter. Water levels have to be maintained to support this ice layer, as breaks could lead to blockages at the intakes of pumping stations and syphons, and damage pumping equipment.

[16] Chasivyarska and Artemivska WTPs completed in 1958, and Verkhniokalmiuska WTP in 1959.

Since the operation of the SDD is largely done manually, effective communication between the LSs is required. This is typically done through dispatchers who monitor levels at specific sites and instruct pump and gate operators. When operations stop at a particular lift station, timely communication with the upstream facilities is of utmost importance so to avoid flooding events. LS 1 – 3 have to be operated together; a halt of operations at any LS will necessitate a stop of the other two.

Water losses of the SDD are not known in detail, but estimated at about 30% - according to VD, the design loss rate was maximum 15%. Large sections of the open channel are said to require very costly rehabilitation[17]. For example, a pipe section damaged by military activity in 2015 near Horlivka[18] led to losses of approximately 600,000 m^3 per day, reducing the overall downstream supply by 50%.

The continuous functioning of the SDD is of critical importance to the system / region, given the dependency of downstream supply facilities.

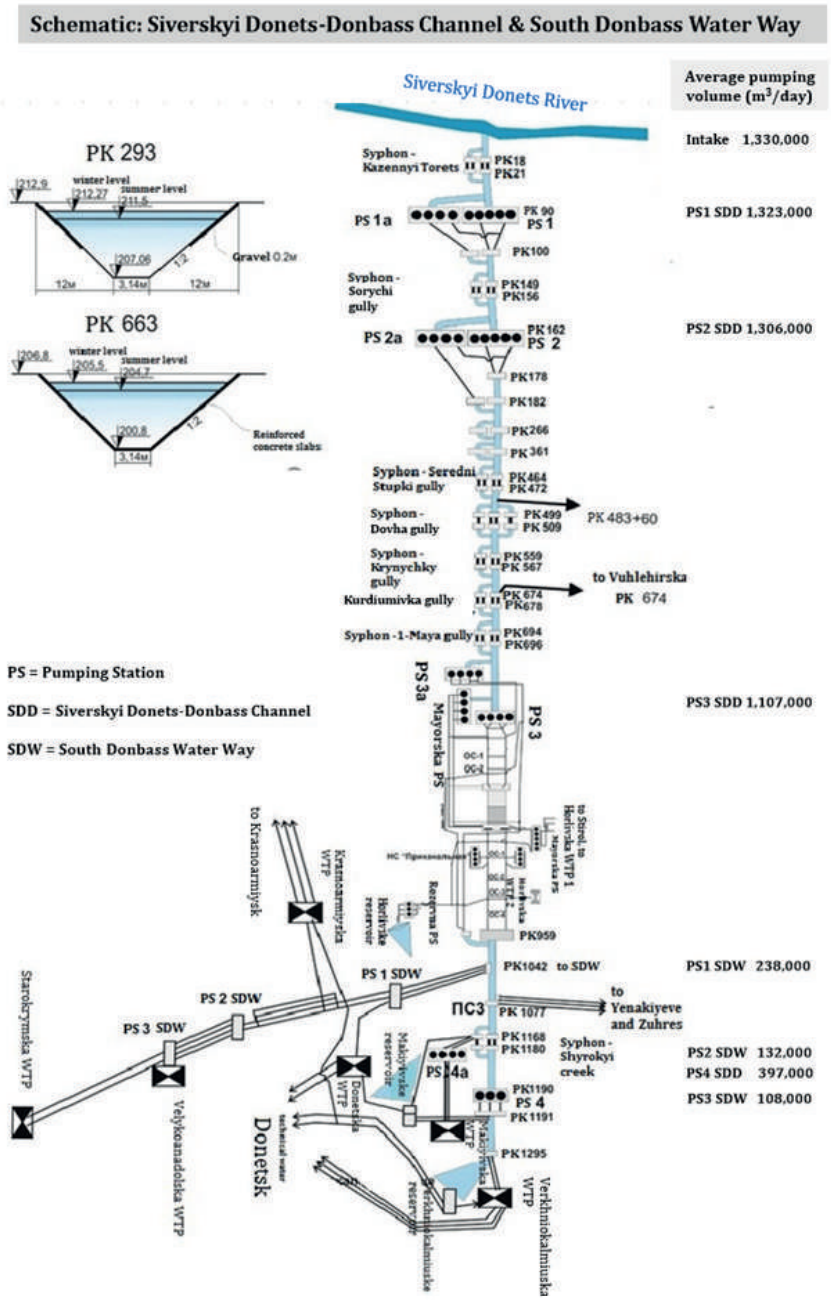

Figure 8: Schematic of SDD and SDWW

The channel runs on GCA territory until just after the 3rd LS at Mayorsk. Its management and operation is under the responsibility of Horlivka Regional Office; this requires regular information exchange and the ability to move across the line of contact. Related challenges are further discussed in later chapters.

4.4.1.2 South Donbas Water Way

The 130 km long SDWW takes water from the SDD at Panteleymonivka, and transports water via three LS southwards to Mariupol. It consists of between two and four parallel steel pipes DN 1200 – 1500, and supplies Donetska, Krasnoarmiyska, Velykoanadolska and Starokrymska WTPs, which in turn provide drinking water for an estimated 1.3 million people on both sides of the line of contact.

[17] A section near Horlivka was rehabilitated some years ago, at about 1 million USD per kilometre; it reduced water losses through the channel base to a degree where nearby wells dried up completely.
[18] 1 pipe of DN 2100, and 2 of DN 2300

Much of the initial 40 km of the SDWW is located in the so-called "grey area" close to the line of contact. The pipelines as well as the 1st lift station have been damaged by military activity numerous times; access for inspection to some sections has not been granted for many months.

The SDWW is managed by three ROOs: from the intake up to Pervomaysk by Donetsk ROO; between Pervomaysk and Velykoanadolska WTP near Volnovakha by Krasnoarmiysk ROO; and from there Mariupol ROO takes charge. Monitoring is carried out through dispatchers who instruct operators at the different hydraulic facilities. Since the SDWW is directly dependent on the SDD, operational irregularities have to be communicated in a timely manner. This is of particular importance since the Krasnoarmiyska and Velykoanadolska WTPs are currently not connected to back-up reservoirs[19].

4.4.1.3 2nd Donetsk Water Way

The 2DWW was constructed in 1954. It supplied water through a pipeline DN 1000 initially from 95 (but now 22) infiltration wells along the banks of the Siverskyi Donets River. Growing industrial productivity in the area necessitated additional water supply, and in 1976 an additional DN 1400 pipeline was laid. The initial WTP chlorinating well water was complemented with a second WTP that treats surface water taken directly from the river. Today, about 25,000 m^3 of water is provided from wells, and 80,000 m^3 from the river.

The two pipelines are pressurized by 9 pumping stations that have small reservoirs attached. There are no further reservoirs connected to the 2DWW. Drinking water is transported to Sloviansk, Kramatorsk[20], Druzhkivka, Kostiantynivka and surroundings, and reaches the outskirts of Toretsk city. The total distance is approximately 75 km, with a total length of mains of 230 km. Transmission and network pipe material is steel (71%), galvanized iron (16%), reinforced concrete (11%) and asbestos cement (1%).

Total water losses amount to nearly 33%. Whilst the 2DWW sustained only limited direct damage during the period of fighting in and around Sloviansk and Kramatorsk in 2014, the system suffers from frequent breaks and leaks due to aged materials and equipment – which as discussed below are considered in part to be indirect effects of the armed conflict. Supply is halted during the repair of more substantial breaks. The first 20 km of the pipeline DN 1400 are said to be in particularly fragile condition.

Treatment and pumping facilities, as well as pipes are located in relative safety as relating to the line of contact: the pipeline running closest is still at 10 km distance.

The 2DWW is operated by Sloviansk ROO.

4.4.2 Water Treatment

4.4.2.1 Prevailing raw water quality

All WTPs in VD's system receive and treat the same raw water from the Siverskyi Donets River, except Slovianska WTP 1 which treats groundwater.

Under normal operating conditions the raw water quality delivered to homes and factories is therefore similar at all WTPs, with slight deviations resulting only from extended retention periods in the transmission system. Most WTPs are connected to back-up reservoirs (Annex 3). Their raw water composition differs from that of the Siverskyi Donets River, mainly because of direct human impact from nearby settlements.

Raw water from the Siverskyi Donets River can be characterized as follows[21]:

[19] Plans are progressing to connect Krasnoarmiyska WTP to the Karlivske reservoir with the support from the ICRC.
[20] Kramatorsk VK, which is not part of the VD structure, also operates a 19 km long gravity pipe from the SDD to a VK-owned WTP. This covers about 65% of the city's demand. The rest is provided through the 2DWW.
[21] Based on analysis carried out by VD in 2015 at Donetska and Verkhniokalmiuska WTPs

- High hardness (typically around 6 to 8 mmol/l which corresponds to 350 mg/l Ca or 49°dH)[22]
- Elevated sulphate concentrations
- Low turbidity ranging between 5 and 25 NTU[23] (but still requiring reduction)
- Seasonal (spring and autumn) increased levels of phytoplankton[24] resulting in colour, smell and taste issues,
- Increased $KMnO_4$[25] consumption (up to 7 mg/l, whereas 5 mg/l are allowed) as well as COD and BOD[26]
- Slightly increased values of zinc were documented temporarily.

Bacteriological parameters, heavy metals, pesticides etc. are reportedly unproblematic and within the range typical of surface waters used for drinking water production.

An additional analysis for a Feasibility Study prepared in 2014[27] showed considerable concentrations of persistent organic substances, and high levels of phenol[28]. The latter may point to a (temporary?) discharge of industrial wastewater into the river or channel.

Climatic changes seem to result in fewer peaks of turbidity and increased levels of phytoplankton and related organics in the raw water. In general, however, the quality of water from the Siverskyi Donets River is acceptable for treatment through conventional technology, and suitable for drinking water. The main goals for the treatment of this are a) reduction of turbidity, b) reduction of organics and removal of phytoplankton, c) improvement of organoleptic parameters, and d) disinfection.

4.4.2.2 Water treatment process and operation

All WTPs from the Siverskyi Donets River are designed according to standards for surface water treatment and apply the following main treatment steps:

- Pre-chlorination
- Coagulation and flocculation
- Sedimentation
- Filtration
- Post-chlorination

Where and as needed, specific parameters (such as pH, smell and taste) might be corrected through adapted dosing of certain chemicals.

The process steps are more or less similar at each WTP, however, technical details differ depending on the year of construction: In older plants filtration is still performed without backwashing with air. Also, the specific coagulation and flocculation process has different designs. Finally, plant based powder activated carbon (PAC)[29] dosing is not implemented at all WTPs.

[22] Hardness describes essentially the amount of dissolved calcium and magnesium in water. High hardness is not of public health concern, however of concern to industrial and domestic water users is that solid deposits of calcium carbonate can reduce the life of equipment, and raise the cost for heating, or clog pipes.
[23] Nephelometric Turbidity Units
[24] Diatomaceous, blue algae and water weed
[25] Potassium permanganate
[26] Chemical and Biological Oxygen Demand
[27] Feasibility Study "*Improvements in Drinking Water Supply and Wastewater Collection and Treatment in the City of Donetsk*" from 2014, financed by KfW.
[28] Phenol content in the raw water was atypically high at 0.008 mg/l compared to a standard of 0.001 mg/l for treated water.
[29] Powder activated carbon is used to adsorb dissolved organics (reduce colour), to reduce smell and improve taste.

Each WTP has a laboratory attached that tests water quality daily according to a strict national protocol. Chemical dosing is adjusted to the actual raw water quality following jar tests carried out at each plant. Dosing is then performed as follows:

- In case of elevated organics or phytoplankton concentrations in the raw water $KMnO_4$ is added prior to chlorine in order to oxidise algae and minimise THM formation[30] and consequent taste and odour problems.
- Pre-chlorination is routinely applied.
- Aluminium-sulfate, a coagulant that settles suspended material, to lower turbidity and allow more effective treatment, is usually dosed permanently. When high dosing is required, lime is added to stabilize the pH level.
- When turbidity exceeds 10 NTU, when flocculation is ineffective or when there are higher concentrations of phytoplankton, polymers are added for example polyacrylamides. This supports better coagulation than aluminium-sulphate alone however is more expensive.
- If smell and taste problems arise, PAC is dosed.

Optimization of the treated water quality beyond the legal requirements is not systematically pursued due to associated costs.

4.4.2.3 Monitoring of water treatment, monitoring of water quality

The quality of the Siverskyi Donets River water is monitored by the Water Resource Agency.

All Voda Donbasu WTPs reportedly monitor the quality of the received raw water, as well as the treated water. The laboratories located at WTPs can test physical, chemical and bacteriological parameters but not heavy metals or organic parameters (phenols, chloroform, BOD and COD etc.) which require more sophisticated analysing methods. These parameters are analysed in the central VD laboratory in Donetsk only, typically on a monthly basis. An additional function of the central laboratory is the monitoring of the WTP laboratories. However, there have been challenges to bring samples across the line of contact.

Water delivered to consumers used to be monitored by the Sanitary and Epidemiological Services (SES) whose responsibilities in GCA are being transferred to the Ministry of Health since 2015. As the process is taking time, monitoring is to a large degree fulfilled by the water respective utility (VD or VK).

A reform of Ukrainian water quality standards started in 2010 with the aim to eventually conform with EU standards.

In the CADLR the equivalent to the previous SSES is still performing this responsibility.

4.4.3 Water Distribution

The set-up of water distribution differs between locations. In most municipalities, the drinking water delivery is under the responsibility of so-called Vodokanals (VK). 20 of such entities are imbedded in the VD structure. 3 of the 17 independent distributors are Donetsk VK, Mariupol VK, and Kramatorsk VK.

Most VKs are facing similar issues as VD in regard to aged and inefficient equipment and fragile materials. Losses of close to 50% and upwards (both technical and commercial) were reported. The tariff considers losses around 30% only. VKs are attempting to reduce losses through pressure regulation and rapid response; in the medium-term, however, rehabilitation or replacement will be necessary.

Pipe perforations can be an entry point for secondary contamination when pipes are not pressurized, for instance during repair work or power cuts.

[30] Trihalomethanes are formed when chlorine reacts with naturally occurring organic and inorganic matter in water. It is suspected to cause cancer.

4.5 WASTEWATER

The centralized wastewater disposal systems operated within the VD structure cover 33 cities, 34 urban-type settlements, and 12 rural-type settlements, serving over 1.5 million people[31]. In total, the various utilities operate 54 WWTPs with total design capacity of 699,500 m^3/d (actual inflow: 197,250 m^3/d), 165 WWPSs, and 3,358 km of sewer networks. Of the latter, more than 2,000 km, or almost 60% are in a severely dilapidated state.

The reduction in wastewater discharge has impacted on the hydraulic condition of gravity sewers and extends hydraulic retention time of wastewater in the system. As a result, siltation of collectors and H_2S formation exposes pipes (typically concrete) to gas corrosion leading to breaks and collapse of collectors. Also, the unbalanced flow of wastewater into receiving tanks of WWPSs is turning these into sedimentation basins.

Most WWTPs were commissioned in the 1960 and 70s. Wastewater treatment technologies are outdated and plants are in urgent need of rehabilitation and upgrading. 20 out of 54 facilities no longer perform biological treatment (aeration), resulting in discharge not conforming to the comparably strict standards by the environmental inspection.

Treated wastewater is discharged into the river basins of the Dnieper, the Siverskyi Donets, and the basin of the Azov Sea. During power cuts, however, the effluent remains untreated.

Sludge treatment and disposal poses a significant problem. Most WWTPs have accumulated huge volumes of partially dewatered and insufficiently stabilized sludge.

Most of the 165 WWPSs lack back-up pumping equipment, ventilation, and experience structural collapse. Often, screens are missing, resulting in failures of pumping equipment. 227 of 448, or 51%, pumping units have exceeded their service life.

Financial constraints do not allow for the procurement of much needed specialized machinery (flushing trucks, suction trucks, vacuum barrels, excavators for works at the depth of 5-7 m, etc.).

Currently, only minor repairs are undertaken, and important emergencies responded to with the aim to prevent pollution of the natural environment.

4.6 POWER SUPPLY

4.6.1 General

As noted above, the Donbas bulk water supply system mainly depends on water transported from the Siverskyi Donets River. The supply of water is hence directly contingent on the availability of electrical power for pumping.

The total annual power production in Ukraine was approx. 183 TWh in 2014, approx. 48% of which was nuclear power, 39% coal, 7% natural gas and 5% hydropower. 4% of this amount was exported to Europe, the rest was domestic consumption[32]. In 2015 the production was less due to the crisis and military conflict in the Donbas region.

The transmission and distribution grid comprises of overhead lines and substations with voltage levels of 750, 550, 330, 220, 110 and 35kV. The electricity supply via the Ukrainian grid is fairly stable; power cuts or blackouts are the exception.

Since early 2017, however, Ukraine is lacking sufficient coal supplies due to the limitations ofof railway operations between GCA and CADLR[33]. Coal from CADLR is the primary source of energy for thermal power production. In response, the Cabinet of Ministers adopted an instruction on "*Temporary emergency measures in the electrical energy market*" in mid-February 2017. Should power generation

[31] This number does not include people provided with wastewater collection services by VKs.
[32] Energy in Ukraine – Wikipedia, February 2017
[33] The cross line of contact trade restrictions started in mid-February 2017 and was initially organized by activists claiming that the coal business is supporting the oligarchic system and is contributing to the conflict. See http://www.reuters.com/article/ukraine-crisis-blockade-idUSL8N1G15LA

have to be restricted and this instruction be enforced, power cuts can be expected all over Ukraine. It is unclear if and to what extent power supply to the VD facilities would be affected.

Another incident undermining the reliability of Ukraine's power supply was an ICT hacker attack on the grid in December 2015. It left an estimated 230,000 people in Kyiv without electricity for several hours. Irrespective of whether this incident was related to the conflict in the East or not, this experience is troubling, as similar incidences could severely affect the reliability of the country's power supply.

4.6.2 Power Supply for Voda Donbasu

The power supply of VD comes almost exclusively from the main power supply company of Donetsk Oblast, DTEK Donetskoblenergo (in the following: DTEK). The total power consumption of VD was 648,803 MWh in 2015 and 645,879 MWh in 2016.

The power grid in Donetsk Oblast primarily consists of about 10 substations of 330kV, and numerous 110kV and 35kV substations owned and operated by DTEK. The number and distribution of substations and power lines are forming a stable functioning grid. VD confirms the network's general reliability.

However, the military conflict creates serious problems. Most of the main transmission power lines between the GCA and the CADLR are destroyed. Continued military engagement along the line of contact are frequently destroying and/or damaging the remaining powerlines in this area. For example, Avdiyivka city was originally supplied by 4 lines of 110kV. Today, two of them are partly destroyed and out of operation since 2014. The damages are located in the so called 'grey zone' where repair teams do not have access due to insecurity, making reconditioning of the lines impossible. According to DTEK, the remaining 2 lines were repaired over 180 times since 2014, highlighting the vulnerability of power lines in this location.

For all VD sub-divisions operating close to the line of contact the amount of destruction by military activity exceeds regular technical failures and break-downs; for sub-divisions located away from the line of contact the opposite is true. For example, Donetsk Regional Operational Office experienced a total of 96 damages between 2014 and January 2017, of which 75 were caused by military activity (78%). At Chasiv Yar Regional Operational Office, 0 of a total of 29 damages reported were caused by direct effects from armed conflict.

Direct impact caused by explosives to power lines and HV equipment at outdoor substations from military actions is the primary problem for the power supply of water facilities close to the line of contact, and therefore one main source of disruption of the water supply.

Figure 9 shows the quantity of damage of some representative VD Regional Operational Offices by type.

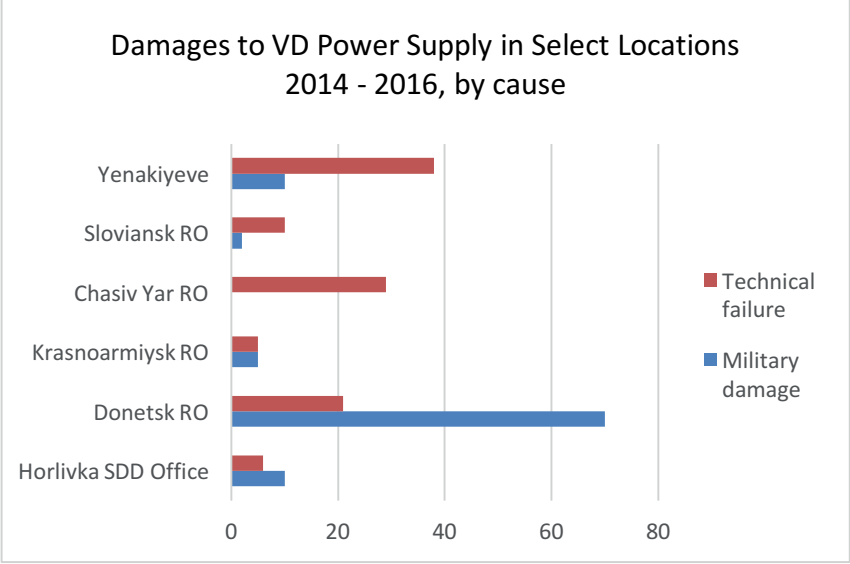

Figure 9: Damages to VD power supply in select locations 2014-2016

In addition to frequent damage there is a serious economic issue related to the power supply. VD has accrued significant debts vis-a-vis DTEK. Until today, no serious power cuts to pumping or treatment facilities have been effected by DTEK, and hence have not affected VD's operation at a larger scale. However, several electro-chemical corrosion control stations are no longer supplied with electricity, contributing to an accelerated deterioration of pipe conditions. It is therefore unclear how these mounting debts will potentially impact on the supply of power to VD, and this is seen as one of the main risks to VD as discussed in the next section. Further details on the economic situation are provided in chapter 4.1.

5 RISK IDENTIFICATION AND DESCRIPTION

As briefly described in chapter 2.4, key risks faced by the centralized water supply service in Donetsk region are to a large extent a determined by specific pre-existing conditions, and compounded by the situation of armed conflict. Though the company has responded to the new challenges, it finds itself in an extremely vulnerable position, in a number of ways, on both sides of the line of contact. A politically highly charged and volatile environment, conflicting interests, and disagreement concerning responsibilities over a shared essential service provider are just some of several important threats to the company, and, by extension to the supply of safe water to the population.

The reliable, sufficient and safe supply of water to the population is central to this assessment. Such provision of essential services is dependent on three elements of critical importance: people, consumables, and infrastructure (ICRC, 2015). Considering these elements within the risk frame (of hazard, vulnerability, exposure – see Chapter 2.4), the main risk dimensions to VD are:

1. VD's core service components of **people, infrastructure and consumables**;
2. VD's **financial situation**;
3. **Military activity**, including location and intensity thereof;
4. The **political and institutional environment**, including company status and economic sanctions;

The first two reflect the company's operational capacity, and thereby its resilience. The latter shape the current operational context introduced by the situation of armed conflict, and impacting on VD's capacity to operate and respond.

The interlinkages between the risk dimensions are illustrated in Figure 10. The hazards come from the top and are realized as risks, depending on the vulnerability and exposure of the components in the operational capacity. Increasing vulnerability can aggravate existing or create new risks, leading to cascading effects and vicious cycles. This will be further discussed in chapter 5.

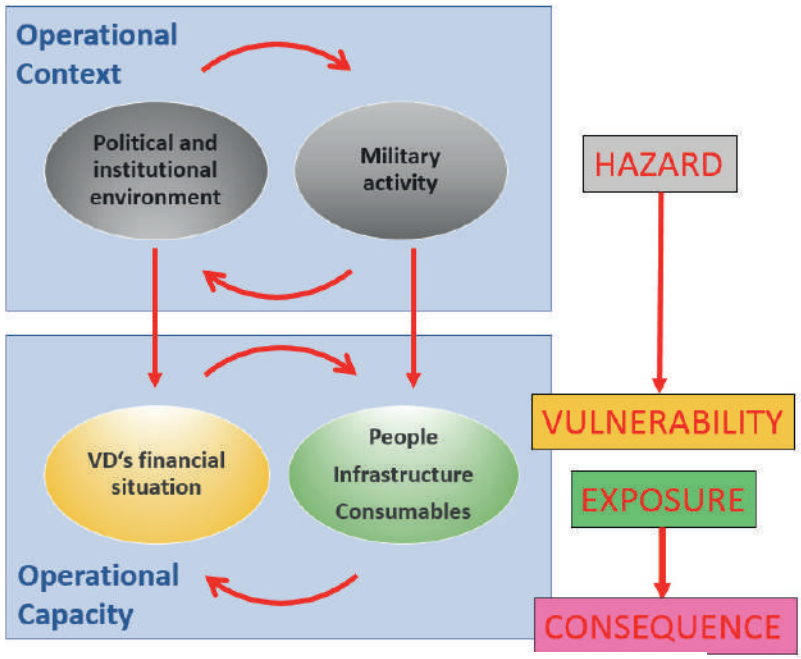

Figure 10: Interlinkages between the risk dimensions

The realized risks are assessed following initially through an analysis of VD's financial situation. In this setting, specific risks related to company finances, the political environment and the activity of military / armed groups will be identified. Their assessment is based around a description of how key risks in the current situation impact on operations. This includes some illustrative examples of events that occurred since the start of the armed conflict.

5.1 ANALYSIS OF VD'S FINANCIAL SITUATION

5.1.1 Key financial indicators of VD 2012-2016

Key points:

- VD financial indicators are alarming and have aggravated since beginning of the conflict
- VD has since 2013 been financially dependent on its creditors of which the electricity supplier DTEK group is the main trade creditor

Roughly three-quarters (78%, or UAH 700 Mio in 2012) of Voda Donbasu's sales intake come from water supply (WS) and 14% from wastewater collection (WWC) and treatment services. The company also provides hydro-power (6% of total sales) and other services (2% of sales), such as pipeline construction, machinery and equipment production and research engineering.

The main financial indicators of VD are presented in below Table 2.

Table 2: Key financials of PU VD for 2012-2016 (based on official accounting data)

UAH tsd	2012	%	2013	%	2014	%	2015	%	2016	%
Balance sheet total	1,256,111	100%	1,359,333	100%	1,589,411	100%	1,892,412	100%	2,577,417	100%
Non-current assets	869,209	69%	997,871	73%	998,305	63%	992,499	52%	1,007,697	80%
Current assets	386,902	31%	361,462	27%	591,106	37%	899,913	48%	1,569,720	125%
Equity	503,405	40%	294,982	22%	-114,743	-7%	-433,289	-23%	-1,202,407	-47%
incl. Statutory fund	751,023	60%	626,498	46%	626,498	39%	626,498	33%	626,498	24%
Longterm liabilities	0	0%	0	0%	0	0%	0	0%	0	0%
Financial debt	0	0%	0	0%	0	0%	0	0%	0	0%
Current liabilities	751,759	60%	1,060,967	78%	1,700,760	107%	2,320,708	123%	3,774,832	147%
incl. trade payables	636,015	51%	918,375	68%	1,411,209	89%	1,774,547	94%	2,954,627	115%
Assets turnover	0.2		0.2		0.1		0.1		0.1	
Operating cycle, days	156		128		189		291		299	
Payables period, days	259		228		346		368		476	
Financial GAP, days	-102		-100		-157		-77		-178	
Working capital > 0	**-364,857**		**-699,505**		**-1,109,654**		**-1,420,795**		**-2,205,112**	
Equity Ratio (ER) ≥ 25%	**40.1%**		**21.7%**		**-7.2%**		**-22.9%**		**-46.7%**	
Current Ratio (CR) ≥ 1	**0.5**		**0.3**		**0.3**		**0.4**		**0.4**	
Net sales	894,257	100%	899,798	100%	803,374	100%	756,643	100%	1,133,884	100%
Gross profit	-286,466	-32%	-378,555	-42%	-450,754	-56%	-845,505	###	-702,394	-62%
EBITDA	211,272	24%	-311,031	-35%	-413,318	-51%	-313,154	-41%	-762,277	-67%
EBIT	157,240	18%	-370,010	-41%	-480,331	-60%	-384,184	-51%	-826,316	-73%
Net profit/loss	173,165	19%	-354,102	-39%	-456,692	-57%	-358,732	-47%	-800,888	-71%
Net sales growth ratio	**n/a**		**1%**		**-11%**		**-6%**		**50%**	

The following inidicators describe how the alarming economic situation of VD has been aggravated since the start of the conflict:

- Increasing negative equity ratios since 2014 as a result of accumulated losses;
- A continuous (except 2013) increase of current assets due to increase of receivables impacting on incoming operating cash flow;
- Massive and rapidly increasing trade payables, from 68% of total assets in 2013 up to 115% in 2016. The company is effectively dependent on its creditors. Trade payables have exceeded trade receivables by more than by 3 times on average, since 2013;
- Very low assets turnover (0.2x – 0.1x); annually every UAH 1.0 spent on assets (invested in the business) results in UAH 0.2 – 0.1 of income only;
- Negative financial GAP, meaning VD invests in their business at the expense of their trade creditors. The main creditor of VD is DTEK group companies[34] with 96% of total trade payables (see Annex 4, Table 2);

[34] PES Energougol, Donetskoblenergo, Vysokovoltnye seti

- VD had negative working capital throughout the observed period, negative equity ratio since 2014 and very low current ratio during 2012 - 2016. In other words, VD has actually been financially dependent on its main creditors since 2013;
- Gross profit of VD was negative during the full observation period. In other words, the income (net sales) of the company is not enough to cover operating costs[35].

The present situation is of course not only the result of the conflict, but some factors have clearly been aggravated by the conflict. These are:

- A significant reduction in water volume sold since the start of the conflict when the population and enterprises were left without water over longer periods after damages to water supply infrastructure (detailed figures see Table 3);
- A long pending increase of tariff could finally only be implemented in GCA but not in CADLR. This led well to an increase in sales but still costs per m^3 water sold are higher than the tariffs charged (see Table 5);
- A shift in the company's sales structure towards bulk supply to independent VKs and the inability of these Vodokanals to pay for bulk water;
- A reduction in collection rate;
- An increase in losses;
- Huge electricity costs resulting from an inefficient extremely power consuming system setup, combined with steadily over-proportional (to water tariffs) increasing electricity tariffs.

In the following these factors are highlighted and also the company's fixed asset value and cash flow situation are analysed in more detail.

5.1.2 Reduction in water sales volume

Sales significantly decreased since the start of the conflict in 2014 when the population and enterprises were left without water after damages to water supply infrastructure (see Table 3). The volume of drinking water sold decreased constantly down to 69% of the 2012 volume in 2016 (or by 143 Mio m^3/year).

Surprisingly, VD's client base remained relatively stable over the observed period. Assuming that one domestic connection represents on the average 2.2 persons, still more than 1.6 million people are supplied with drinking water directly from VD, and significantly more through VKs. This may be explained by the fact that numerous domestic consumers may have been internally displaced but as long as they are registered at their original homes they remain VD's customers.

Table 3: Dynamic of water volume sold

		2012	2013	2014	2015	2016
Water sold	tsd m3	468,108	428,382	350,454	325,997	324,755
dynamic to 2012	%	100%	92%	75%	70%	69%
dynamic year to year	%	-	92%	82%	93%	100%

[35] This does not include administrative and distribution and sales costs.

5.1.3 Insufficient tariffs

Key points:

- In 2016 alone the tariff for drinking water increased by 2.4 times for domestic consumers and by 2.8 times for Vodakanals in the GCA
- The so-called tariff commission has preserved the tariff in CADLR at the same level as 2015 without major changes
- With the average tariff VD's costs per m^3 of sold water are higher than the tariff charged per m^3 of water

VD's main customers are VKs, who buy treated or untreated water for further supply to individual consumers. VD has also several VKs (and networks) in its structure where it also distributes water to individual consumers. During the previous 4 years, tariffs did not change significantly although they had never been cost covering. Only in January 2016, the tariff for drinking water increased by 2.4 times for domestic consumers and by 2.8 times for VKs in the GCA (Table 18).

Table 4: Tariffs for Water Supply and Wastewater Collection services approved for Voda Donbasu by National regulator and the so-called "Tariff Commission" on CADLR, UAH /m3

	GCA					NGCA	
	2012	2013	2014	2015	2016	2015	2016
is in force since	01/03/2012		01/03/2014		01/01/2016	01/09/2015	
Drinking water supply							
for population	3.47	3.47	3.47	3.47	**8.18**	4.17	4.17
for vodokanals	1	1	1.47	1.47	**4.09**	1.77	1.77
for others (in range)	2,37 - 5,30	2,37 - 5,40	2,37 - 5,50	2,37 - 5,60	**8.18**	2,85 - 6,36	2,85 - 6,37
Raw water (technical water)							
for further treatment	0.66	0.66	0.66	0.66	0.66	0.79	0.79
for agriculture	0.8	0.8	0.8	0.8	0.8	0.96	0.96
for others	1.89	1.89	1.89	1.89	1.89	2.27	2.27
Raw dischaged water							
for agriculture	0.071	0.071	0.071	0.071	0.071	0.085	0.085
for industries	0.131	0.131	0.131	0.131	0.131	0.160	0.160
Raw recycle water	0.071	0.071	0.071	0.071	0.071	0.085	0.085
Waste water collection services							
for population	2.34	2.34	2.34	2.34	**7.19**	2.81	2.81
for budget organization	3.64	3.64	3.64	3.64	**7.19**	4.37	4.37
social services, charity organization	3.45	3.45	3.45	3.45	**7.19**	4.14	4.14
other	4.49	4.49	4.49	4.49	**7.19**	5.39	5.39
Waste water treatment	1.03	1.03	1.03	1.03	**3.71**	1.235	1.235

This 2016 tariff increase could unfortunately only be applied in GCA. Consumers in CADLR still pay as per tariffs from September 2015 which are close to two times lower than those in GCA. However, (untreated) raw water tariffs are slightly higher in CADLR than in GCA.

Also tariffs for WWC services for domestic customers in GCA are more than double compared to CADLR, for other customers the discrepancy is less.

Table 5: Difference between the sum of the average tariffs (established by the so called "National Commission for State Energy and Public Utilities Regulation" tariff on CADLR) and total cost per unit for WS and WWC services of VD

		2012		2013		2014		2015		2016	
		WS	WWC	WS	WWC	WS	WWC	WS	WWC	WS	WWC
Average tariff	UAH/m3	1.585	2.748	1.649	2.820	1.814	2.821	1.833	2.683	2.712	4.120
Total cost per unit	UAH/m3	2.357	3.993	2.737	3.916	3.247	4.938	4.504	6.192	5.229	6.430
Difference / losess	UAH/m3	-0.772	-1.245	-1.088	-1.096	-1.433	-2.116	-2.671	-3.509	-2.518	-2.311

The income from these tariffs (net sales) is in average still not enough to cover operating costs[36] under the prevailing cost structure of VD, as demonstrated by below comparison of costs per m^3 sold water and tariffs per m^3 [37] (Table 5).

About 60% of VD's total income used to be obtained in CADLR and 40% in GCA before the tariff increase. Since the tariff increase in GCA in 2016, this situation is reversed.

5.1.4 Changes in VD sales structure towards increased supply to independent Vodokanals who are not able to pay their bills to VD

Key points:

- Since 2012, the customer structure has slightly changed with more independent Vodokanals as bulk water customers and less business customers
- The Vodokanals as customers however suffered most from the conflict, being less solvent, resulting in less income of these Vodokanals and finally not being able to pay their bills to VD
- Independent Vodokanals suffer from too low tariffs in CADLR (established by the so-called "Tariff commission), increase in tariffs on GCA for bulk water from VD, increase in losses in their networks and decrease in collection rate as result from overall economic situation
- Independent Vodakanals registered in GCA and operating in CADLR have to pay all taxes and bank's fees according to Ukrainian legislation while at the same time paying additional financial taxation and banking costs on CADLR side

70% of the total water sold by VD is treated drinking water and 30% is raw water.

More than 90% of the treated drinking water is supplied to domestic consumers, thereof only 15 - 20% directly by VD through their vodakanals, and 74 - 77% through independent vodakanals to whom VD only supplies treated bulk water.

In monetary terms, the main customers for VD in 2012 were businesses (39%) and VKs (30%).

By 2016 this had changed to more Vodokanals as customers (44%) which are supplied by bulk water and an increase of directly supplied domestic consumers (30%). In turn, the more attractive business customers (which usually pay higher tariffs at much higher collection rates) reduced (see Figure 11).

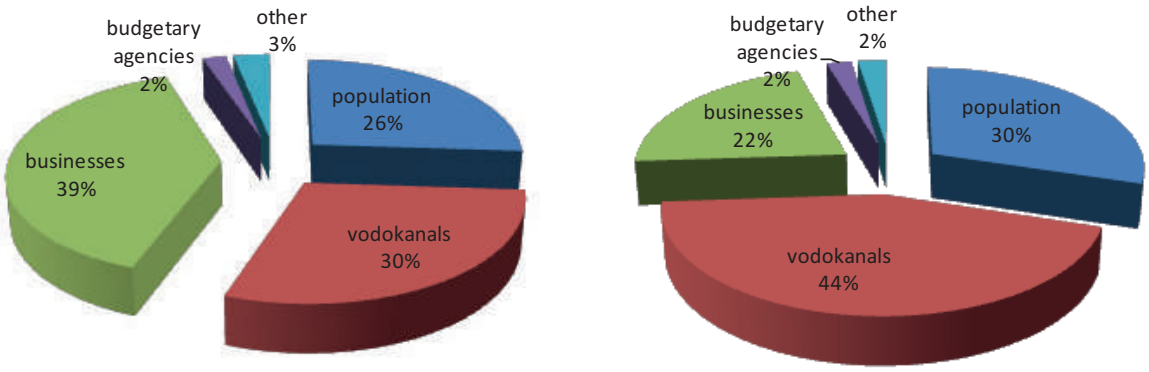

Figure 11: WS and WWC services of VD by the consumer structure in 2012 (left) and in 9m 2016 (right)

Today, VD is hence more dependent on payments from VKs and the population and it is exactly these groups of customers that appeared less solvent in 2014-2015 as demonstrated by the decrease in collection rate (Table 8).

[36] This does not include administrative and distribution and sales costs.
[37] Incomes and costs of other services provided by VD are not considered.

An additional problem is that tariffs for raw water have remained at low levels even after the tariff increase. Since more Vodokanals buy this untreated raw water the respective sale volumes decreased accordingly (by 36% from 2012 to 2015).

Hence the Vodokanals have become the main debtor of VD and one reason for the disastrous financial situation of VD. The Vodokanals' inability to pay their bills to VD is also caused by the following:

Table 6: General factors resulting in accounts receivable of VD growth

VKs located in GCA	From the side of VKs located in CADLR
Water losses are above the loss rate accepted by the tariff regulator.	Water losses above the loss rate accepted by the tariff regulator *
Largely increased tariff for bulk water purchased from VD	Low tariff for water sold to consumers, not covering increased costs for water treatment and other consumables, and electricity costs.
Decreased collection rates from domestic consumers (for VD domestic consumers it was a decrease from 90% to 73% in 2015)	Decreased collection rates from domestic consumers
Over-projected water sales volume. As a consequence, actual costs per 1.0 m3 become higher than projected, hence tariff becomes too low	There is no scheme of benefits and subsidies (from the CADLR budget toward population), or scheme of reimbursement of difference in tariff since 2015

Note: VKs as well as VD can in their tariff calculations apply only typical standard loss rates which are accepted by the regulator, but which are usually lower than actual losses, e.g. 23% standard loss rate versus up to 50% (or higher) real loss rate

** No data from VKs located in CADLR could be obtained, however, high losses are assumed as this is a feature common across all VKs examined. Donetsk VK presents an exception: water losses decreased from about 50% in 2012 down to 33% in 2016 due to measures taken prior to the conflict.*

Donetsk VK is a positive exception with regards to losses (reduction of losses) but suffers from the following additional problem: It is registered in GCA and therefore credits taxes according to Ukrainian fiscal legislation. Being located in CADLR it has to pay taxes there, as well. To pay salaries the company has to pay 31% from the amount to get money from the so called "Donetsk Republic Bank" in taxes.

5.1.5 Increase in water losses

Key points:
- Overall water losses in VD's system increased from 36% to 46% since the end of 2013.
- VD's total water losses reached 50% in 2015 as a result of the conflict damages
- The losses for VD increased with the number of networks (VKs) taken over by VD.

Water losses are a pressing challenge for VD Company (see Table 7).

Table 7: VD water losses during 2012-2016

	units	2012	2013	2014	2015	2016
Water obtained	tsd m3	700,183	680,480	617,744	677,830	626,325
Water discharged to reserv.		8,754	6,880	33,266	28,919	26,740
water losses	tsd m3	223,321	245,219	234,024	322,914	274,830
water losses	*%*	*32%*	*36%*	*40%*	*50%*	*46%*
Water sold	tsd m3	468,108	428,382	350,454	325,997	324,755

VD overall water losses grew up to 50% in 2015 as a result of damages to the SDD channel (pipes DN 2100 – 2800), water mains and networks. Water loss levels differ among VD ROOs (see Annex 4, Table 31).

Average water loss across all ROOs is about 23%. Higher VD water losses are resulting from the huge losses in the networks operated by VD Vodokanals. For example, water losses of Horlivka VK reached 77% in 2016. (see Annex 4, Table 32 and 33).

5.1.6 Decrease in collection rates

Key points:
- The overall collection rate decreased in average from 103% to 66% between 2012 and 2016.
- Collection rates are generally lower in CADLR than they are in GCA

An overview on the development of the collection rate is given in below Table 8.

Table 8: VD bills paid by customers during 2012 - 9m 2016

Bills paid	2012	2013	2014	2015	9m 2016
incl. population	90%	94%	74%	73%	80%
vodokanals	120%	100%	49%	75%	37%
businesses	100%	100%	99%	93%	97%
budgetary agencies	99%	99%	75%	76%	96%
other	86%	93%	86%	83%	106%
Total bills paid	**103%**	**98%**	**74%**	**80%**	**66%**

The overall collection rate decreased from 103% and 98% before the start of the conflict to 74% in 2014, and 66% for the 9 months of 2016. This of course considerably impacts VD's incoming operating cash flow.

The highest collection rate is experienced with business customers with not less than 93%. This may be explained by the fact that businesses can legally be much easier cut off from supply if they do not pay.

The collection rate for domestic consumers dropped from 90% in 2012 to 74% and 73% in 2014 and 2015, respectively, and only slightly increased to 80% in 2016.

The most significant drop is experienced with independent Vodokanals where the collection rate dropped from 120% in 2012 down to 37% in 2016 (the 120% result from payments out of the state budget for differences between the tariff and real costs as explained further below).

The reason for low collection rates for VKs is simply that their customers are mainly domestic consumers who can legally not easily be cut from supply and whose income as well as service conditions were most severely affected by the conflict.

Collection rates are generally lower in CADLR than they are in GCA. However, the higher collection rates in GCA are not necessarily the result of more payments by customers, but the result of benefits and subsidies paid until May 2016, as well as from reimbursement of 'the difference in tariffs' paid from the state budget.

5.1.7 Power consumption, the driving cost factor for Voda Donbasu

Key points:
- Due to the system's topography and overaged inefficient pumping equipment, electricity costs for pumping make up more than 50% of overall operation costs
- These costs are distributed unevenly among the ROOs and the separated supply areas
- Till 2016 tariffs never allowed a positive operating profit
- From 2016 on, at least a positive Operating Profit (EBIT) is possible if the new (increased) tariffs are applied in both supply areas and if the legally foreseen compensation of pumping costs from the state budget is regularly applied.
- The positive Operating Profit (EBIT) however does not reflect the liquidity situation of the company

The highest share of operating costs for WS services stem from energy costs, which made up 53% of total operating costs in 2012–2014 and reached 62% in 2015-16 (see Annex 4, Table 11).

These high costs result from extremely high power consumption for pumping, combined with high, steadily increasing electricity tariffs.

Any m^3 of water finally conveyed to consumers, needs first to be lifted to more than 200 m by numerous pumping stations which are partly older than 45 years, technologically outdated and hence far from operating at maximum possible efficiency. The company's liquidity situation also hardly allows investment to improve the efficiency.

As a result, the specific power consumption for transported raw water is above 1000 kWh / 1000 m^3 for the entire company. It differs according to topographic conditions and distributed volumes, with the highest power consumption for Sloviansk ROO, Regional Office of the SDD Channel Operation (RO SDD CO), Chasiv Yar ROO and Krasnoarmiysk ROO (see Table 9).

Power consumption for pumping is higher in GCA, simply for topographic reasons and since water is originally abstracted there[38].

As a result, all of the ROOs suffer financial losses, except for Krasnoarmiysk ROO in 2016. RO SDD CO suffers the largest losses since it operates the largest pumps (4 MW one pump!). Donetsk ROO and Mariupol ROO traditionally make profit for the company since here the water is at the top of the cascade, and huge volumes can be sold to consumers without any pumping costs (see Annex 4, Table 14 and 15).

Table 9: Specific power consumption of WS services provided by VD (by ROOs)

	uint	2012	2013	2014	2015	9m 2016
Krasnoarmeysk/ Pokrovsk ROO						
Water obtained	tsd m3	86,483	84,842	54,672	58,351	60,021
Energy consumption	tsd kWh	37,735	35,227	23,205	24,303	25,737
Specific energy consumption	kWh/tsd m3	482	457	482	482	480
Slavyansk ROO						
Water obtained	tsd m3	33,610	33,858	33,813	33,587	26,541
Energy consumption	tsd kWh	36,618	37,160	36,547	38,687	29,169
Specific energy consumption	kWh/tsd m3	1,070	1,080	1,060	1,130	1,100
Chasov Yar						
Water obtained	tsd m3	26,176	25,867	22,866	21,742	16,546
Energy consumption	tsd kWh	11,754	11,049	10,800	11,057	8,231
Specific energy consumption	kWh/tsd m3	744	707	779	780	842
RDCO*		**2012**	**2013**	**2014**	**2015**	**2016**
Water obtained	tsd m3	538,360	528,121	441,540	513,212	496,012
Energy consumption	tsd kWh	463,411	445,970	363,898	430,909	417,311
Specific energy consumption	kWh/tsd m3	866	849	829	844	846
Donetsk ROO						
Water obtained	tsd m3	257,582	240,751	194,754	186,536	218,658
Energy consumption	tsd kWh	65,484	58,310	51,791	54,527	54,586
Specific energy consumption	kWh/tsd m3	260	248	273	299	255
Mariupol ROO						
Water obtained	tsd m3	104,389	98,080	88,751	81,199	72,814
Energy consumption	tsd kWh	39,901	36,476	35,541	31,280	27,303
Specific energy consumption	kWh/tsd m3	383	373	402	386	376
VDB in total						
Water obtained	tsd m3	700,183	680,480	617,744	677,830	626,325
Energy consumption, WS**	tsd kWh	751,310	724,363	612,283	687,524	685,093
Specific energy consumption**	kWh/tsd m3	1,117	1,114	1,031	1,047	1,127

RDCO* - Regional Department of the SDD Channel Operation; ** the data could be clarified

In addition to huge power consumption, electricity tariff continues to increase from year to year - unlike the tariff for water.

[38] Although the SDD is operated by RO SDD CO with a base in CADLR, the three first lift stations are located in GCA from where they receive power supply.

Presently the electricity tariff is higher in CADLR, and tariffs for WS and WWC services lower than they are in GCA. In GCA tariffs for power supply, WS and WWC services need to be approved by the National regulator (National Commission for State Energy and Public Utilities Regulation).

Due to the different frame conditions for providing water in different regions, Ukrainian legislation actually foresees that power costs on "water pumping into water scarce regions" are compensated from the state budget[39]. Also VD would by legislation benefit from that compensation, but which in reality was obtained only for 2 months in 2012! It goes without saying that this compensation would be a substantial relief to the company's financial situation.

However, even if these costs were regularly compensated, the low tariffs from 2012 to 2015 would never have fully covered costs for the WS and WWC services.

For that reason, VD received also additional compensation from the state budget for the discrepancy in accepted tariffs and real operating costs (as accepted by the regulator). These payments from the state budget are summarized in below Table 10.

Table 10: VD state budget financing during 2012 – 2016, UAH tsd

	2012	2013	2014	2015	2016
Budget financing, incl.:	**706,992**	**188,917**	**127,056**	**564,380**	**83**
difference in tariff	653,979	164,129	105,510	563,563	0
water transferring costs	42,523	0	0	0	0
other	10,490	24,788	21,546	817	83

This very important budget financing for low tariffs ceased in 2016 after tariffs were more than doubled.

If the new increased tariffs (as effective from January 2016), could be applied to all consumers on both sides of the line of contact, and under regular compensation of the pumping costs for water transfer from the state budget,- as initially foreseen by legislation-, the company could manage a positive Operating Profit (EBIT) as demonstrated in Table 11.

However, the Operating Profit does not reflect the liquidity situation of the company which is definitely suffering from the conflict with a reduction in collection rate, volume of water sold and extra burdens like costs for repair of damages.

Table 11: Difference between average tariff and cost per unit presuming power costs for water transferring is compensated and considering difference between GCA and CADLR

	unit	2016 VDB total			2016 NGCA			2016 GCA		
		WS	WWC	Total	WS	WWC	Total	WS	WWC	Total
Water sold	tsd m3	324,755	39,779		138,310	26,730		186,445	13,049	
Sales (net income)	tsd UAH	880,577	163,878	1,044,455	289,808	65,083	354,892	590,769	98,794	689,563
Direct operating costs	tsd UAH	487,276	167,405	647,863	258,817	114,569	367,056	228,460	52,835	280,808
General operating costs		368,631	63,964	432,595	200,654	37,368	238,022	167,977	26,596	194,573
Operating costs		855,907	231,369	1,080,458	459,471	151,937	605,078	396,436	79,431	475,380
Gross profit	tsd UAH	24,670	-67,491	-36,003	-169,662	-86,854	-250,186	194,332	19,363	214,183
gross profit margin	*%*	*3%*	*-41%*	*-3%*	*-59%*	*-133%*	*-70%*	*33%*	*20%*	*31%*
Administrative costs	tsd UAH	79,466	13,375	92,841	43,311	8,265	51,576	36,155	5,110	41,265
D&S costs	tsd UAH	37,533	11,049	48,582	21,943	5,941	27,884	15,591	5,108	20,698
Operating profit (EBIT)	tsd UAH	-92,329	-91,915	-177,426	-234,916	-101,060	-329,645	142,587	9,145	152,219
Total costs		972,906	255,792	1,221,880	524,724	166,143	684,537	448,182	89,649	537,343
Average tariff	UAH/m3	2.712	4.120		2.095	2.435		3.169	7.571	
Total cost per unit	UAH/m3	2.996	6.430		3.794	6.216		2.404	6.870	
Difference	UAH/m3	-0.284	-2.311		-1.698	-3.781		0.765	0.701	

[39] Directive of the CMU on the List of Water Utilities that are Pumping Water to the Water Scarce Regions No. 524, dated May 30, 1997.
[39] Directive of the CMU on Use of Funds Provided for Partial Compensation of Energy Consumption Costs Involved in Pumping Water to Water Scarce Regions No. 280, dated March 19, 2012

5.1.8 Reduction in water sales volume

Key points:
- VD's operating cash flow is kept positive due to the huge support of humanitarian organisations and the Russian Federation
- Cash flow from investing activities is negative.

VD's cash flow, based on official accounting data is presented in Table 12.

VD's main business resulted in negative cash flow in 2013 - 2016 (see EBITDA). Positive EBITDA in 2012 is the result of additional financing from the state budget. Net cash flow from operating activity became positive because of changes in working capital, a huge increase of trade, other accounts payable, and other non-operating revenues. Negative net cash flow from investing activity means VD kept increasing fixed assets (FA). These investments in FA (non-current assets) comprise of:

- new FA introduced into operation,
- rehabilitation and modernization of available assets,
- increase in the value of the available FA.

Table 12: VD cash flow for 2012-2016

Cash flow, UAH tsd	2012	2013	2014	2015	2016
Cash flow from operating activity:					
EBITDA	211,272	-311,031	-413,318	-313,154	-762,277
Changes in working capital	-195,137	333,954	406,873	314,776	790,036
Operating cash flow	16,135	22,923	-6,445	1,622	27,759
other revenue/expenses	15,927	15,908	23,639	25,452	25,428
Net operating cash flow	**32,060**	**38,831**	**17,194**	**27,074**	**53,187**
Cash flow from investing activity	-146,548	-187,641	-67,447	-65,224	-79,237
total changes in FA	-146,548	-187,641	-67,447	-65,224	-79,237
Cash flow from Equity & subdebt activ.	99,047	145,679	46,967	40,186	31,770
Net cash flow from investing act.	**-47,501**	**-41,962**	**-20,480**	**-25,038**	**-47,467**
Cash flow from financing activities	0	0	0	0	0
changes in ST&LT interest bearing debt	0	0	0	0	0
Net cash flow from financing act.	**0**	**0**	**0**	**0**	**0**
Net changes in cash position	-15,441	-3,131	-3,286	2,036	5,720
Cash at the beginning	27,000	11,559	8,428	5,142	7,178
Cash at the end	11,559	8,428	5,142	7,178	12,898

The latter is not the result of real investments but rather a formal way to avoid a FA with zero value in the balance sheet. This is done by re-evaluating the technical condition (by a group of experts) and giving the asset a new value.

Given the fact that VD does not have separate accounting reports for GCA and CADLR, Table 13 presents an example for the better understanding of the cash flow situation in CADLR.

Table 13: Incoming and outgoing cash flow from operating activity in CADLR (example)

	unit	2014	2015	2016
Sales (net income)	tsd UAH	456,171	407,354	354,892
Rate of the bills paid	%	70%	51%	67%
Bills paid (incoming cash)	tsd UAH	319,320	207,750	237,777
salary and wages		163,536	199,403	221,726
taxes on salary and wages		59,938	73,084	81,265
rehabilitation and maintenance		19,427		
services obtained		17,873		
primary materials		10,879		
fuel		17,095		
Rest of the incoming cash		30,573	-64,736	-65,214

This area has lower WS and WWC tariffs, a higher power tariff and lower collection rate. Actual sales data, collection rates and some groups of costs, ranked by priority, are considered in the calculations.

Due to the higher sales and collection rates in 2014, operating incoming cash in CADLR amounted to UAH 319.3 million. This cash was sufficient to pay salary and wages as well as related taxes; to carry out rehabilitation and maintenance works during the year; and to pay for services obtained, primary materials and fuel. The remaining amount after expenditures was positive for 2014. Incoming cash, however, did not cover all costs of UAH 780 million. In 2015 and 2016, the incoming cash could cover salary and wages and, in part, taxes on salary and wages. The example considers yearly amounts only rather than cash flow by month, therefore does not take into account delays in incoming cash during a year. Money could be obtained not by equal parts within a year, but partly at the end of a year only. This was particularly true for 2014, when there was shortage and delay with payments obtained.

The cash flow between CADLR and the GCA is significantly restricted as there are very limited options to transfer cash between these areas. An additional burden in transferring cash is the fact that the circulating currency in CADLR is the Russian ruble.

Due to cash flow shortage, VD has been and is still fully depending on supply of services and primary materials from humanitarian organizations, including the Swiss Agency for Development and Cooperation, the ICRC, UNICEF, People in Need, and also the Russian Federation.

Humanitarian assistance in the form of water treatment chemicals, fuel, machinery and equipment, spare parts, construction materials, pipes and fittings, personal protective clothes etc. amounted to UAH 53.8 million in 2015 and UAH 96.5 million in 2016 (see Annex 4, Table 23).

All water treatment consumables in CADLR come from humanitarian support. Humanitarian support makes up about 40% of all costs for treatment materials, fuel, machinery and equipment, other inventory of VD in 2015-2016. 84% of the support has been provided in CADLR and 16% in GCA.

5.1.9 Low asset value

Key points:

- The residual value of VDs fixed assets is presently only 32% of its initial value, for some regional offices it is even 8% (Chasiv Yar).
- WS assets will be 100% depreciated within 8 years if no investments are carried out
- Conflict related damages are NOT considered in any asset value considerations

The initial value of VD's FA at the end of 2016 was UAH 2.99 billion; its residual value is UAH 0.96 billion or 32% of the initial value. This is the average ratio across the company. The FA residual value ratio of select ROOs at the end of 2016 was as follows: Krasnoarmiysk ROO – 32%, Sloviansk ROO – 35%, Mariupol ROO – 18%, Chasiv Yar ROO – 8%. Artemivska WTP and Chasivyarska WTP, built in 1958, are depreciated by 93%. The oldest asset is the WPS in Mykolayivka village, which was put into operation in 1885.

WS assets are generally more deteriorated than WWC assets. Residual value of WS FA was 30% as of the end of 2015 (Table 14).

Any increase in FA value is rather the result of value increase (by indexation) than by real investments into the system (Table 15). Also adding of some more (not new) assets (e.g. taking over networks from VKs) managed to increase the overall asset value.

Table 14: VD Fixed assets for water abstraction, treatment and water supply, UAH tsd

UAH tsd	2012	2013	2014	2015
FA at initial value, beg. of the year	1,918,690	2,053,811	2,197,368	2,237,557
Residual value, end of the year	623,077	724,019	698,018	682,842
FA residual value ratio, end of year, %	32%	35%	32%	30%
100% depreciated FA	33,362	48,721	94,004	86,213
100% depreciated FA to resid.value ratio	5%	7%	13%	13%
Net FA value increase for the year, incl.:	**22,597**	**38,015**	**15,402**	**16,036**
due to new FA, considering liquidat.	-2,869	-1,731	-2,244	-54
due to rehabalitation, modernization	13,156	6,968	1,323	1,998
due to increase in the value	12,310	32,778	16,323	14,092

Fully depreciated WS FA reached 13% relative to residual value in 2015. This figure is 19% for WWC FA. If there is no investment done into WS FA, these will become 100% depreciated within the next 8 years. For WWC FA this point will be reached in 5 years!

Table 15: VD Fixed assets for sewerage, waste water collection and treatment, UAH tsd

UAH tsd	2012	2013	2014	2015
FA at initial value, beg. of the year	221,432	302,838	352,529	395,571
Residual value, end of the year	119,212	151,516	160,926	159,928
FA residual value ratio, %	54%	47%	45%	40%
100% depreciated FA	5,653	25,805	21,376	29,678
100% depreciated FA to resid.value ratio	5%	17%	13%	19%
Net FA value increase for the year, incl.:	**-1,755**	**21,152**	**4,730**	**2,519**
due to new FA, considering liquidat.	-3,198	9,780	197	-225
due to rehabalitation, modernization	610	9,276	442	569
due to increase in the value	833	2,096	4,091	2,175

The conflict related damages and weakening of assets is not considered in the asset value calculation.

5.2 RISKS RELATED TO MILITARY ACTIVITY

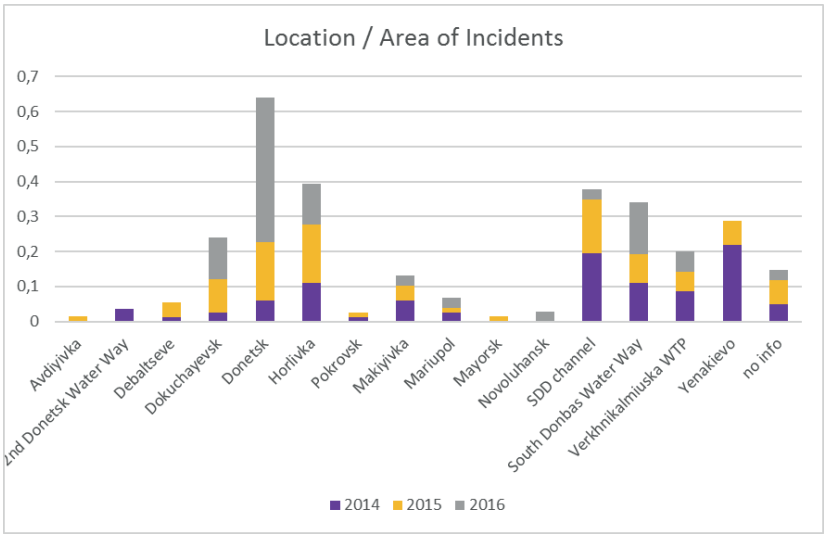

Figure 12: Geographic distribution of 188 conflict-related incidents recorded 2014-2016

During the initial period of the conflict, fighting was spread across the entire Donbas. Sloviansk, Pokrovsk, Horlivka and Mariupol and surroundings experienced battles in 2014, and particularly heavy fighting occurred in Debaltseve and Donetsk in early 2015. Since the first half of 2015, the line of contact on the ground has remained relatively static (NOTE: there are still divergences on where the line of contact should be placed, in some areas), with periods of localized intensified fighting. Specific hot-spots are around Novoluhansk / Svitlodarsk, Horlivka / Mayorsk, Avdiyivka / Yasynuvata, western Donetsk city to Maryinka, and smaller settlements east of Volnovakha and Mariupol.

Figure 13 shows the geographic distribution of 188 conflict-related incidents recorded (including evacuations & staff casualties; direct damage to water and wastewater infrastructure, due to shelling, explosions & small-arms fire; power supply cuts) for considerable time periods between 2014 and 2016.

It should be noted that water industry experts do not have appropriate knowledge, skills and experience to determine the origin of shell fire, which damaged critical water infrastructure. Therefore, this report focuses on identifying potential humanitarian and technical consequences of damage and destruction by military actions.

Annex 1 lists conflict-related incidents and their impact on VD's water supply, including known shelling and explosions, based on data from various sources over certain time periods. It gives an impression of the type and frequency of damages, and their consequences, which can be grouped into staff safety issues, direct damage, increasing equipment failure, compromised response and compromised water quality.

5.2.1 Risks to human life

VD staff work close to the line of contact where the situation is dominated by the presence of military / armed groups, and frequent shelling and exchange of fire of varying intensity. The danger to get injured by armed hostilities, a resulting chemical incident, or explosive remnants of war is extremely high.

(1) Staff at water treatment plants (WTPs), lift stations (LSs) and pumping stations (PSs) near the line of contact (Chapter 5.1) work in a very insecure environment and are frequently exposed to the possibility of nearby fighting. During pauses in hostilities, unexploded ordnance in the area continues to threaten staff.

Table 16: VD´s staff killed and injured since June 2014

	2014	2015	2016	Total
Killed	6	2	1	**9**
Injured	7	4	1	**12**
Total	**13**	**6**	**2**	**21**
	62%	29%	10%	

Tragically, 9 of VD's staff were killed and 12 injured on duty from June 2014 to December 2016 (Table 16). The majority of staff casualties occurred during the first 6 months of the conflict. The location of the line of contact has been more or less static since the spring 2015, limiting the dangers from fighting to specific geographical areas and therefore more predictable.

However, the threat is very real to those working at facilities in proximity to the line of contact, as well as those crossing the line regularly for work purposes.

Active fighting near water infrastructure continues to necessitate staff to seek cover in bomb shelters, or evacuate the facility completely. This typically requires a stop of operations.

(2) Liquidized chlorine gas used for water and wastewater treatment is a hazardous material. It is typically stored in bottles of 900 kg; depending on quantity of drinking water produced and raw water quality, up to 2,600 kg are used per day (around 3 containers). In the current situation, VD is careful to limit the number of containers stored at risky facilities, however, a hazardous incident in case of a direct hit remains a likely risk.

Such an incident could have serious direct consequences for staff and nearby residents. Immediate emergency response would likely trigger an evacuation of the site, resulting in a halt of operations with further indirect impacts and knock-on effects.

Although emergency procedures and protective measures are generally in place, many sites lack chlorine gas detectors and personal protective equipment (PPE); also, meteorological stations required to determine the potential level of exposure of the population residing in proximity are not functional. The safety installations in place (sprinklers, scrubbers for neutralization, and air extraction systems) are partly defective.

PPE for a potential hazardous material situation at particularly risky locations has been procured in Ukraine with the support of a humanitarian organization, but the approval for transporting it across the line of contact has not been given so far. In conflict situations, there can be issues related to the so-called supplies or materials of "dual use" – meaning that an item might have utility for not only civilians but also military purposes (Zeitoun, 2016).

(3) Military and armed groups are located at or near water infrastructure on both sides of the line of contact which *"(…) not only endangers the lives of the employees, but puts several millions of people at risk."* (OHCHR, 2017). The presence of armed groups at or near water supply facilities might render the location a military target; also, often landmines are placed, posing a risk to staff, equipment and infrastructure. IHL clearly obliges armed groups to protect objects indispensable for the survival of the civilian population.

(4) Repair crews in the so called "grey zone" are particularly exposed. Access to these locations is granted by the Joint Centre for Control and Co-ordination (JCCC)[40]. Once permission has been received, demining takes place prior to physical access by the repair crew. Frequently, the OSCE SMM monitors the so-called 'windows of silence' which are known to have been broken on several occasions (OSCE, 2015). VD has only a limited number of safety equipment such as flak-jackets and helmets for personal protection, and little opportunity to access additional due to the "dual use" restrictions.

Although demined access corridors are provided, threats continue to persist: in January 2017, an explosive device was set off by a pheasant outside the provided safe corridor at about 50 m distance from the repair team in the Mayorsk area. Ambulances cannot access the grey area, so skills and equipment to respond to trauma are also vital in regard to risk management.

[40] The JCCC was active between Sep. 2014 and Dec. 2017, and consisted of generals from Ukraine and the Russian Federation.

5.2.2 Direct damage of infrastructure and equipment

As fighting continues to occur on a daily basis, infrastructure close to the line of contact is most susceptible for repeated damage, leaving little to no time for recovery, and severely decreasing their capacity to withstand over time.

Power and water supply equipment and infrastructure sustained considerable damage from military activity. VD's cost estimate for direct damages to its key assets until the beginning of 2017 reaches UAH 350.5 million (close to USD 13 million).

Damages to power supply are frequent and of particular criticality because without electricity, water and wastewater can no longer be treated nor transported. Of 188 separate conflict-related incidents[41] recorded over substantial time periods in 2014 – 2016, about 47% concerned power supply (see Figure 13). Water and wastewater infrastructure such as pipes and buildings made up 23%.

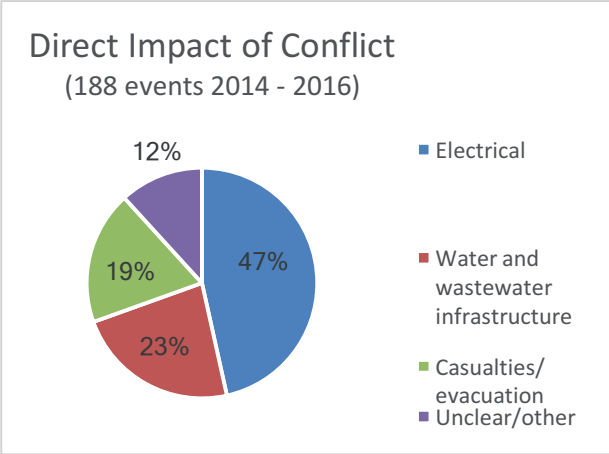

Figure 13: Direct impact of 188 conflict events

The risks identified in the following have occurred in the past, and continue to do so repeatedly. For example, the WASH Cluster recorded 14 separate incidents at Donetska WTP between November 2016 and March 2017. Most incidents were power supply failures. Due to lack of power and constant insecurity at this location, the site was evacuated 9 times, and the water supply from this facility stopped for a total of 33 days.

Pictures of power supply infrastructure and electro-mechanical equipment at VD's facilities are shown in Annex 5.

- Damages of overhead power lines supplying water supply facilities

This kind of damage is very common. Either the power cables get cut, or the pylons of an overhead line get bent or completely broken. Such damage causes an earth fault or a direct short circuit between the phases, resulting in an instantaneous switch-off of the line by the next upstream circuit breaker.

The impacts on the water supply system vary. In the best case, the second independent power supply line which all facilities are supposed to be equipped with takes over, and the PS or WTP can continue operations. However, until repaired, this facility will now be without standby capacity.

Should there be no back-up line in the first place due to previous unrepaired damage, the impact on the facility is serious. All pumps and auxiliary systems stop and operations are disrupted instantaneously. The abrupt halt places high operational stress on the equipment and hydraulic structures.

When any LS of the same main water transferring lines (SDD, SDWW) is affected, immediate reaction at all other lift stations is likely to be required since the SDD and the SDWW constitute one operational system. All parts of the system have to be operated in a coordinated and concerted way.

The duration of interrupted power supply is critical in terms of consequence for water supply to the population. There is a range of possible scenarios. Where only cables are broken and repair teams can safely access the location, damage might be repaired within hours, provided that required staff, vehicles, equipment and materials are available. Frequently, access permission is delayed or not granted by the JCCC. Some powerlines have not been restored since the start of hostilities. Costly and time-consuming erection of a completely new power line is at times required.

[41] Semi-structured data obtained from different sources, including information on evacuation of facilities, staff casualties, direct damage to water and wastewater infrastructure, and electricity cuts (Annex 4).

- Damages of outdoor HV (high voltage) equipment at substations

The biggest and most sensitive components of HV equipment installed at outdoor substations that can be damaged are the main transformers and the circuit breakers which are both are oil filled. Damages to the bushing insulators or a perforation of the outer steel tank will cause oil leaks. In both cases the insulation fails and a short circuit will cause additional serious damage to the equipment. This failure must be cleared by the next upstream circuit breaker, which normally leads to a switch-off of the part of the substation where the damage is located. The power cut will also affect the water facility supplied by this substation.

The 1st LS of the SDD was shelled in June 2014, causing casualties and destruction. The transformer sustained heavy damage, and oil leaked into the water intake chamber, posing an immediate health risk to thousands of people. The station did not operate for 12 days following this particular incident.

At most substations, there is a back-up power supply line. Where this is the case, power supply can usually be restored. This option however depends on the maximal capacities the remaining part of the substation can provide, and what particular piece of equipment failed at which position in the substation. The specific consequences have to be analysed on a case-by-case basis.

Possible impacts on the water supply facility range from a reduction of stand-by capacities only to a complete stop of operations due to lack of power.

Damage to rather simple components such as cables of the bus bar, insulators, disconnectors, or voltage or current transformers can be repaired within hours if the required resources are available. The replacement or repair of an oil circuit breaker is more complicated. If the transformer is hit, there is no quick solution. Because of the complexity and size of these transformers repair or replacement takes a few days at a minimum. Also, if there is no transformer on stock, it can take several months to acquire a new transformer due to delivery times for large equipment. If available, a spare transformer may possibly be borrowed from DTEK and installed, however even this takes several days up to weeks.

- Damages of indoor HV equipment (e.g. 6kV switch gears) and E&M equipment (e.g. motors and pumps)

Damage to indoor equipment can only happen in case of a direct hit to the building, as was the case at Horlivska WTP 2 in July 2015. A 152 mm shell damaged the wall and the 6kV indoor switchgear cell behind. The cell was irreparably damaged, and the entire switchgear had to be taken out of operation. A spare cell was installed, and the entire switch gear cleaned during emergency work shifts. Power supply could be restored a couple of days after the incident. However, the facility is now left without a spare cell.

Consequences of damages to indoor equipment depend on facility and equipment affected. The complete destruction of key components can cause a total blackout of a facility for a prolonged period of time.

- Damages to water distribution and wastewater collection infrastructure

Water supply and wastewater collection infrastructure such as pipes, equipment and buildings in the "hot spots" have sustained much direct damage since the start of the conflict. Overground pipes are particularly exposed, but buried ones are also affected.

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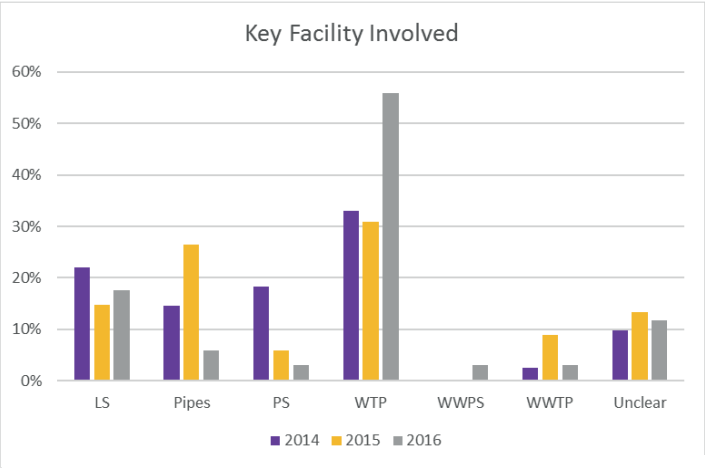

Figure 14: Distribution of recorded incidents 2014-2016

Figure 14 shows the distribution of recorded incidents between 2014 and 2016 by type of infrastructure affected. Incidents include direct damage, staff evacuation, casualties, and power cuts. 5 out of the 8 LSs of the SDD and SDWW, and more than half of the 18 WTPs operated by VD were directly hit. LSs 3 and 4 of the SDD, LS 1 of the SDWW, as well as Donetska, Verkhniokalmiuska, Makiyivska, Novoluhanska and both Horlivska WTPs are located in areas that experience frequent fighting even today.

The consequence of a direct hit to a WTP or pumping facility depends on which part of it is damaged. Damage to power supply and E&M equipment has been discussed above. Of particular concern are damages to chlorine gas containers and pipelines, as described in 4.2.1. Depending on the facility lay-out, damaged tanks, filters, and valves can often be substituted since most WTP have spare capacities due to decreased production.

Important damage to pipes of the SDD and SDWW has caused widespread service disruption in the past. RO SDD CO recorded 38 holes of a diameter or length larger than 500 mm in the SDD pressure pipes DN 2100, and 26 of this size in pipes DN 2300. The count of damages of smaller size at these pipes are in the hundreds. Rapid response is needed to pipe leaks of a certain scale so to limit water losses over time, and avoid possible further damage.

Also, perforations particularly of buried drinking water pipes can cause secondary contamination when the supply is interrupted and negative pressure conditions prevail.

Drinking water pipes near the Donetsk airport remain out of operation since 2014, resulting in the supply of untreated water only to parts of Maryinka, Krasnohorivka (GCA), and Pisky (CADLR) settlements.

According to VD records, 46% of the costs for main damages to water and wastewater infrastructure assets including VD-owned bridges are in CADLR, and 54% in GCA.

- Damage to communication lines

Prior to the conflict, VD used land lines for communication between the Dispatch Centre in Donetsk and the facilities. These lines now being partly destroyed, communication is based on mobile phones and VoIP (internet telephone). Both ways of communication can be switched off at any given time, and particularly during active military operations. This however is precisely the time when emergency situations for the water supply might arise, requiring rapid coordination across the line of contact. There have been several instances when operational staff sought shelter in a bunker and were out of reach at critical times.

All operations have to be performed manually on site, such as the switching of HV equipment, launch/stopping of pump units, or closing/opening of hydraulic valves or gates. When orders cannot be communicated, the required electrical and hydraulic operations are not performed. Operations of the SDD and SDWW have to be coordinated in a timely fashion though as otherwise the system can run dry, or flooding can occur. Both scenarios have the potential to seriously damage the E&M equipment and hydraulic structures.

5.2.3 Increasing failure of equipment from indirect impact of military action

Materials and equipment have a limited operational life from continuous wear and tear. Operational conditions play a crucial role in how long particular items last. In the situation of conflict, operations often stop abruptly, each time adding stress to materials, machinery, and parts thereof.

- Failure of HV and E&M equipment due to elevated operational stress

Frequently damage to important equipment results in sudden disruption or disturbance of the normal mode of operations at an affected facility. Sometimes this has a knock-on effect on other facilities. Such recurrent extraordinary operational conditions, including unplanned shut-downs of equipment and systems, put increased mechanical and electrical stress on E&M and HV gear. Materials and parts wear out more quickly, contributing to a gradual decrease in system stability. This indirect consequence only becomes apparent with time, and impacts on the overall level of resilience. Breaks and failures can be expected to become more common as the protracted situation carries on.

- Wear-down of pipes and valves due to elevated operational stress, and lack of protection

Sudden changes in the flow rate of water, occurring as a result of pump stop and start or after rapid closing a valve or gate, can cause so-called 'water hammers'. These can cause pressures peaks beyond the design pressure of pipes, valves and pumps. In a situation of increased pump stops due to power failures as described above, the frequency of water hammers accelerates wear and tear of materials and equipment that often are already close to the end of their useful life, and severely increases the leaks, if not obliges replacing the valves and related accessories.

VD's water mains are mostly made of steel. Electrochemical corrosion control protects these pipes. In some areas close to the line of contact, however, these are no longer functioning. Pipes without protection from corrosion can be expected to deteriorate at an increased pace.

5.2.4 Compromising response to infrastructure damage and equipment failure

When infrastructure and equipment fall into disrepair, speedy action is required to limit adverse consequences.

Freedom of movement of people and goods in the so called "grey zone" is restricted due to presence of military and armed groups, and insecurity. The windows of silence required for inspection and repair of infrastructure often take days or weeks to obtain from the JCCC. Unrepaired pipe leaks (either one or a few large damages from a direct hit, or many small ones from shrapnel) can result in significant loss of water, and therefore, financial losses.

When the piped section of the channel in Horlivka was damaged in late 2014 and early 2015[42], losses at times amounted to 600,000 m^3 per day, half of the overall supply of water from the SDD. The delay of repair works due to lack of access resulted in additional challenges whereby the ground below the pipes was washed away, necessitating extra work and resources. The situation was finally resolved more than 6 months later in July / August 2015.

There have been instances when simply the processing of requests for access took 2 weeks and longer; particularly during emergency situations, when quick action is critical, restrictions hamper rapid response and recovery, with negative consequences for system resilience.

Some areas remain entirely inaccessible to VD, such as parts of the SDWW between the 1st and 2nd LSs. Inspection and repair works have not been carried out since the start of the conflict.

5.2.5 Compromising water treatment

There is no effective substitute for the chemicals necessary for the disinfection of water. Without disinfection, disease-causing agents remain present in water, putting people's health at risk.

The transportation of chlorine gas to facilities close to the line of contact is sometimes prohibited by the military or armed groups, as was the case for Novoluhanska WTP in 2016. This WTP is comparably small serving only 3,800 people and hence requiring only limited amounts of chlorine. To date, these situations were resolved before the facility ran out of this important treatment chemical.

[42] One pipe DN 2100, and 2 pipes DN 2300 sustained major damage.

The transport of liquidized chlorine gas across the line of contact is prohibited; as are further supplies and materials for water treatment and testing. For the time being, VD is managing to maintain a safe level of water treatment, supported by delivery of water treatment chemicals and other key water treatment and testing consumables by SDC, UNICEF and the ICRC, however if these stopped or if delays are experienced on either side of the line of contact this would significantly impact drinking water quality.

The treatment process at most WTPs is reliant on old and outdated dosing equipment and leaking mixing tanks; urgent replacements and rehabilitation cannot be completed because of the lack of finance. Water quality monitoring by an external overseeing body is no longer carried out systematically.

5.2.6 Loss of operational data and institutional memory

Paper documents are largely used by VD. They are easily damaged or destroyed by fire or water – events that are more likely to occur in the situation of armed conflict.

VD's water supply service evolved over many decades. Historic records of system modifications and upgrades are important documents for current operation and future planning. The company started to introduce a digitalized information management system prior to the conflict, and progressed to various levels across the different offices. Much of the company's archive, however, remains in paper form only. The safe storage of paper records requires space in a secure location.

Horlivka-based Regional Office of the SDD Channel Operation has transferred its paper files, which contain a lot of important information about technical details of the system and previous events, to the 3rd lift station of the SDD where it is perceived less unsafe at this time.

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5.3 RISKS RELATED TO THE POLITICAL AND INSTITUTIONAL ENVIRONMENT

5.3.1 Relevant contextual issues

Conflicting legislation and significant legal gaps can put the operating service provider VD in a risky situation. The company is registered in Ukraine and as such operates under Ukrainian law. However, its headquarters is located in Donetsk[43] city and in order to remain operational, VD has to carry out business with economic entities in CADLR and cooperate with those in control in certain areas. Under current legal provisions in Ukraine, continuing to deliver safe water to people could actually be illegal[44].

Currently, there are several areas of concern, including:

- The Government of Ukraine enforced legislative frameworks which have led to the closure of financial services in those areas, and criminalized any business activity with entities in these areas that are not registered in Ukraine.
- The legal owner of VD is the Donetsk Oblast Administration, which is now of a civil-military character. This may lead to conflicts of interest in regard to the execution of ownership powers over a resource essential for the population on both sides of the line of contact.
- A draft law on the "Temporarily Occupied Territory of Ukraine, No 3593", of 19 July 2016, provoked strong criticism over several issues. Article 13 suggests the *"termination of energy and water supply to CADLR"* which, according to OHCHR would *"(…) contravene both customary rules of international humanitarian law concerning relief and human rights law requiring the Government to ensure minimum essential humanitarian supplies for the civilian population."* (OHCHR, 2016)
- International and national humanitarian actors are required to "register" with the entities in control in CADLR before being allowed to operate. Most international agencies have not been able to receive "approval", or operate under temporary agreements that can be revoked by the armed groups at any time. Rapid access to those in need is (thus) impeded by the process currently in place for the delivery of humanitarian assistance to affected civilians.
- Freedom of movement of goods and people through crossing points is restricted on both sides of the line of contact, and / or subject to the payment of fees or taxes.
- Water tariffs have risen by 409% since 2014 in GCA but not in CADLR. This not only increases VD's financial burden but also provokes anger on the other side.

In the present set-up, drinking water is a shared common good that is of equal importance to users on either side. It originates from the same source, and is processed and delivered by the same service provider through an intricate, physically practically indivisible system. A clear common interest in these services, and a reciprocated acknowledgement of their critical importance is underlined by the fact that issues around water provision featured repeatedly at meetings of the Economic and Humanitarian Working Groups of the Trilateral Contact Group. Tangible results, however, have yet to be achieved.

In the present climate of mutual distrust, however, effective collaboration is still required to avoid duplication or lack of clarity of mandates for agencies and organisations on either side of the line of contact.

[43] An office with headquarter functions has been established at Krasnoarmiysk Regional Operational Office located in Pokrovsk (previously Krasnoarmiysk) to facilitate access to the Donetsk Oblast Administration.

[44] GoU ordered relocation of all state institutions and enterprises from the territory controlled by armed groups. It was stated in the Decision of the Security and Defense Council on Immediate Measures for Stabilization of the Economic and Social Situation in Donetsk and Luhansk Regions as of 4 November 2016 and Decree of the President of Ukraine No. 875/2014 on 14 November 2014, enacted on 18 November 2014, and resolution of the Cabinet of Ministers of Ukraine No. 595 as of 7 November 2014, however resolution No. 109, 11 March 2015 states that enterprises only need to remove from NGCA areas if it is feasible for them to continue elsewhere.

5.3.2 Company operating in diverging or deficient legal and regulatory setting

The lack of clarity around primary duty bearers in this context prevents much needed coordination over the use of a shared resource. Legislation in support of the provision of essential services to the affected population is deficient. Service providers, who operate in a largely unregulated and uncertain setting, are exposed to potential legal or reprimanding action. It also adds further uncertainty to decision-making in risk management and emergency response. Clarity about duty bearers is essential to create a results-oriented dialogue between parties to the conflict, and counter discord.

Without clear enabling legislation, questions around the specific roles and responsibilities in the governance of water and water supply services on both sides of the line of contact remain unanswered. A situation where the differing tariffs between the two sides fuel divisive political arguments; previously predictable subsidies and financial support can no longer be accessed; and operational conditions continue to deteriorate rapidly puts enormous strain on a fragile system.

Specific issues that require urgent resolve in respect to secure reliable water supply in Donetsk region include: status of PU Voda Donbasu Company, payment mechanisms, governance (including regulation and monitoring), and management and operation of the water supply service (including composition of senior management, staff salaries and benefits, access to finance, and exemptions from restrictions). As there is a clear need to find solutions to the financial situation of the service provider, both sides could consider putting a neutral and mutually trusted external entity in place to oversee appropriate control measures, and should consider whether a special status can be awarded to the company to allow it to continue.

5.3.3 Limited access to humanitarian assistance

At the start of 2017, VD relies on humanitarian organizations for many of its consumables for effective water treatment, as well as spare parts, materials and equipment for repair. These, however, do not have unhindered access to areas in the so called "grey zone" and to CADLR, where registration is subject to timely scrutiny, and often rejected. In March 2017, only one national (supported by international) and one international organization supporting water and sanitation services had been accepted to work in CADLR, with a few additional one-off deliveries organised, for example by SDC.

Reliable and rapid access in response to humanitarian needs is thus impeded by the process currently in place for the delivery of humanitarian assistance to service providers and affected civilians.

5.3.4 Compromising company operations

The ability for VD to provide water supply services to the population at a minimum level is severely diminished through the presence and actions of military and armed groups in their area of operation:

(1) There are only 4 crossing points in operation between GCA and CADLR. Long queues at the check points and restrictions in the movement of staff across the line of contact pose a serious problem to VD's daily operation. Despite the existence of special passes for some VD staff, travel across the line of contact is time-consuming and dangerous[45]. It typically takes around 3 hours to cross the line of contact in a VD car. Some staff commute across the line of contact by walking, which takes them about 1.5 – 2 hours each way.

(2) The transfer of certain supplies, material and equipment, including VD's own assets such as valves and machinery, is prohibited. Specialized machinery and equipment that is not available in accessible markets such as Russia cannot be brought across the line of contact into CADLR. As a consequence, some work has to be improvised or carried out with either more expensive, or lower quality material and equipment, with predictable cumulative negative effects (witnessed after similar dynamics in Iraq

[45] According to UN OCHA, 9 serious security incidents occurred at crossing points (2 at Mayorsk, 1 at Novotroyitske, 6 at Maryinka) between November 2016 and March 2017. 4 of the 5 resulting casualties were civilian.

and in Gaza (ICRC, 2015)). Some otherwise necessary maintenance and repair work might be delayed or not effected at all, due to missing parts and equipment, which finally impacts on the technical condition of water supply facilities and equipment. The probability of technical failures rises, and the reliability and resilience of the water supply system decreases over time.

(3) Restrictions in freedom of movement also impact on water quality testing. VD's central laboratory is located in Donetsk city. The transport of temperature-sensitive samples across the line of contact can be problematic. Further, specific parameters such as phenols, specific heavy metals and THMs are not included in the standard testing regime at WTPs as this requires sophisticated equipment. When samples cannot be brought to the central laboratory on a frequent basis, changes in raw water quality might go undetected.

(4) VD staff have limited access to professional development opportunities because of restrictions in movement across the line of contact. The company cannot afford the time necessary for staff to access relevant training, both internal and external. This might lead to decreasing capacities and capabilities, and lead to staff dissatisfaction contributing to future brain drain.

(5) In Ukraine, staff of some companies are exempt from military conscription. These are usually companies working in infrastructure or military supply sector. VD staff, however, are not exempt as a renewal application was not submitted as required some years ago. Male staff have received conscription notes on several occasions. Solutions could be found to avoid actual drafting thus far, however the possibility of staff required to join the military service remains.

5.4 RISKS RELATED TO VD'S FINANCIAL SITUATION

5.4.1 Deteriorating finances

Reliable, predictable and sufficient finances are required to counter adverse consequences to the situation of armed conflict, and continue to provide vital services to the population. However, halted subsidy payments, insufficient tariff to cover actual costs, taxation issues, and a changed business situation are amongst several hazards negatively impacting on VD's financial situation:

- Insufficient support provided by the state and local governing bodies

Power cost compensation from the Ukrainian state budget for the SDD operation (which amounts to approximately 70% of VD's total electricity costs) were not realized. In 2012, this compensation was paid over the period of 2 months only. If these costs were regularly reimbursed the current tariffs of VD in GCA would be cost covering and could lead to profit for the company.

The state shall reimburse the 'difference in tariff' if the actual tariff is not economically justified. Tariffs of VD were not cost-covering during the observed period until 2016. Significant compensation of difference in tariff was effected in 2012 and 2015. In 2013/14, only part of the difference was covered. The state scheme has not worked in CADLR since 2015, and in GCA since 2016. It has not been foreseen in GCA for 2016 because of the increase in tariff.

The Ukrainian state budget is supposed to subsidize the payment of WS and WWC services for people on welfare benefits. The scheme has not been applied in CADLR beyond 2015, and in GCA after May 2016.

Whilst the Ukrainian state had to support VD subdivisions located in CADLR during 2014, neither the 'difference in tariff', nor the benefits and subsidies scheme was practiced in CADLR since 2015. VD subdivisions located in GCA obtained 'difference in tariff' until 2015, and benefits and subsidies until May 2016. Currently there is no state support of the water supply provider in both areas.

There is also no alternative mechanism for supporting water suppliers in CADLR.

The national regulator seems to revise tariffs for water supply / VD differently from those for power supply / DTEK. VD and DTEK apply to the National Commission for State Energy and Public Utilities Regulation for tariff approval. Whilst the power supply tariff has been revised and approved on a regular base, that of water supply has not (Figure 15 and Figure 16).

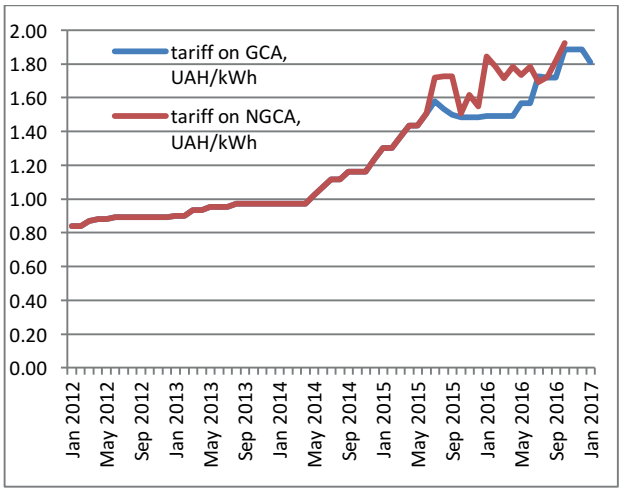

Figure 15: Power tariff for VD in dynamic in view of GCA and CADLR

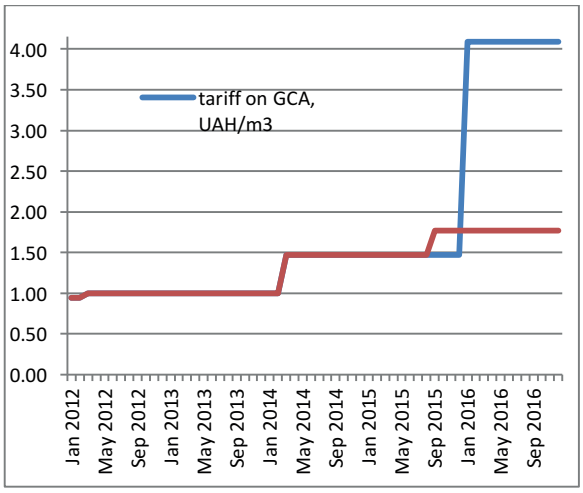

Figure 16: VD drinking water tariff for VKs in dynamic in view of GCA and CADLR

The electricity tariff is revised almost on a monthly basis. The National Commission for State Energy and Public Utilities Regulation has postponed tariff revision application from VD several times since 2012.

VD has to organize and cover the costs for demining and repair of their facilities without support from the state or other entities in power.

- Inadequate tariff for WS and WWC and WWT services

Tariffs are insufficient to cover the costs for service provision. 70% of VD's water is sold as drinking water and 30% as raw (untreated) water. Tariffs for raw water vary by type (pumped, discharged, recycled) and consumer (for further treatment, for agriculture, for industries etc.); these tariffs have not been revised since 2012. In March 2014, the tariff for drinking water for VKs increased from 1 UAH/m^3 to 1.47 UAH/m^3. This increase still did not cover costs. The tariff for drinking water and wastewater services established in 2016 in GCA is cost covering if power supply costs for the SDD channel are compensated; this state compensation, however, has not been effected since 2012.

Tariffs within one company differ between GCA and CADLR. The above mentioned economically justified tariffs are applicable for 47% of VD's total water volume sales and for 33% of total wastewater volume only (GCA). In September 2015, tariffs in the CADLR were fixed at about 20% above the tariff in GCA at the time. They have not been revised since. Today, tariffs for WS and WWC services are on average 2 times, and for waste water treatment 3 times higher in GCA as compared with CADLR. Thus, VD sells less water at the justified tariff in GCA, and more water in CADLR at low tariffs.

The decrease of water consumed is aggravated by the conflict. Volume of water sold declined during the observed period, with a particularly considerable reduction in 2014 (25% less than in 2012) and in 2015 (30% less than in 2012). The lower the volume of water sold, the higher the total cost per unit, all other conditions being equal.

Water losses increase due to infrastructure damage. VD's water losses reached 50% in 2015 when SDD pipes DN 2100 – 2800 were damaged among other important water mains and distribution pipelines. In 2016, water losses amounted to 46%. The water loss level accepted by the regulator for tariff calculation is however only 28% since 2012, and has not been revised since. This means that only 28% of water losses are taken into account in the current tariff.

According to Ukrainian regulation (Statement No. 302), the WS tariff calculation for the following year can at a maximum take into account only 50% of the statistic price increase for fuel, reagents and water pumping costs. Thus, the WS tariff initially does not consider the full possible increase of cost component.

- Deficient cash flow of VD (as background before the conflict)

Threats of VD's reduction of cash flow include: cumulative losses over time, declining pay levels, absence of the state or local governing bodies' support, deficient humanitarian aid, seizure of accounts in the GCA in favour of DTEK, seizing of monetized humanitarian support.

- Other additional financial burdens from the conflict-related situation

Inter-bank transactions between GCA and CADLR are not possible at this time. Money cannot be transferred from the account of a subdivision in GCA to an account of another subdivision in the CADLR, or vice versa.

The company has to operate in two currency areas (RUR and UAH). Payment for VD services in the CADLR is made in RUR and at the tariff levels approved there.

There are difficulties in the transfer of money across the line of contact.

Being a Ukrainian company, VD is to credit taxes following Ukrainian legislation, and to get cash for salary payment in CADLR, VD has to pay unified social tax, as well. The relevant tax rate in CADLR is 31%, and in GCA 22%. Effectively, VD is subject to double taxation.

Also, all companies located in CADLR are to pay all taxes in favour of the CADLR budget since March 2017. In case of non-compliance, company management is replaced by administration pro tempore. This measure has been effected on various occasions, however to date VD has been exempted.

- Macroeconomic changes (these hazards are not aimed at VD directly, but still affect its business)

The minimum official wage in GCA has increased by 2 times to UAH 3,200 since December 2016. VD has to increase wages and salaries in accordance with this requirement. In order to avoid these extra costs, VD has to reduce the number of working days per week, to shorten working time, or to decrease staff numbers.

Tax rates might grow. For example, land tax rate increased by 10 times, from 0.03% to 0.3% in 2016. As a result, the payable amount just to cover this tax increased by 10 times.

Any changes in tax payment on both areas can impose additional financial burdens. For example, a system of electronic enumeration of VAT invoices was introduced in January 2015. According to the system, credit against VAT is valid within 6 months from the date when the goods/services are obtained only. This means if VD cannot pay for these goods/services, it will also not be in position to compensate their VAT debts against the state budget with these VAT credits. During the first half of 2015 VD could not pay power costs and lost VAT credits in the value of about UAH 89,0 million.

VAT is a consolidated tax to be paid by VD into Ukrainian budget in the total amount regardless of the location of offices. So far, no additional or separate taxes have been imposed on VD in CADLR.

Lately a number of companies registered in GCA have been nationalized in CADLR. It is not clear which consequences this would have for VD but it is definitely a risk for the functioning of the company.

5.4.2 Impact on staff

Staff is one of the company's vital assets. Experience in other conflict contexts has shown that the loss of staff over time had considerable impact on service delivery (Zeitoun, 2016). Though the staffing level at VD in 2016 (11,027) is similar to that of 2013 (11,035 people), there are reasons to be concerned about a debilitating 'brain drain' in the future:

(1) During 2014/15, payroll payments were delayed by up to 4 months due to a number of factors: the SDD channel stopped in 2014 because of damages to infrastructure; water supply decreased; and payments for water supplied were delayed and reduced. VD prioritized available income for infrastructure repair and rehabilitation. The payment delay was resolved in 2016, essentially covered from increasing debts towards DTEK, higher tariffs in GCA, and state and humanitarian support.

(2) VD's average salary is low as compared with the average salary in Donetsk region, and Ukraine on the whole. Whilst in 2012, VD paid on average 89% of the national average salary, it decreased to 69% in 2016. Compared with average salaries in Donetsk region, VD paid 77% in 2012, and 59% in 2016.

VD's average salary is not competitive, even when compared with other water supply companies in the region. Table 17 does not include average salaries in CADLR as no data was obtained.

Table 17: Salary comparison of water supply companies

		2012	2013	2014	2015	2016
VDB Company	UAH	2,710	2,800	2,899	3,200	3,561
Mariupol VK	UAH	2,725	3,130	3,590	4,098	4,731
Slavyansk VK	UAH	2,477	2,619	2,888	3,459	3,772
Krasnoarmiysk VK	UAH	2,516	2,602	2,455	2,977	3,586

(3) VD staff in CADLR is not able to make use of social security benefits, such as payments related to sick leaves, injuries, maternity leaves etc. Therefore, the Social Insurance Fund of Ukraine does not affect payments for the approximately 7,000 staff (or 64%) working for VD in CADLR.

(4) Inability to organize pension payments or to recalculate pension payments in CADLR.

(5) Female staff miss work during shelling when schools and nurseries do not operate. During excessive military action near Yenakiyeve in 2014/15, about 30% of staff were not working, many of whom were women looking after their children.

5.4.3 Impact on water infrastructure, equipment, and power supply services

Unrepaired damages and inefficiencies of infrastructure and equipment may lead to important water losses, and even a stop of supply services. Deficiencies in asset management existed prior to the conflict, however the situation is deteriorating as damages and failures related to the conflict continue to occur. Relevant hazards include:

(1) Depreciation of FA is 70% on the average throughout the company. Some infrastructure is depreciated by 95 - 100%. This economic parameter is also reflected in the poor condition of E&M equipment, and pipes needing urgent replacement.

The overall asset value has decreased from UAH 2.7 billion in 2012 to 0.9 billion in 2016. There is insufficient re-investment in the infrastructure. Applications for the inclusion of investment costs in the tariff structure are often not approved by the regulator.

(2) Within VD, asset maintenance is reactive rather than pro-active, and there is an absence of strategic asset management.

Due to a lack of funds, standard preventive maintenance and overhauls of the E&M and HV equipment is not performed to the extent required by manufacturers for reliable operation of the items. Poorly maintained equipment is more likely to fail, and the operational life time of this equipment is reduced.

Some replacements or improvements regarding HV and E&M equipment planned before hostilities started had to be cancelled due to a necessary shift of priorities. Once a piece of equipment exceeds its service life, the risk of a technical breakdown increases. Timely replacement of strategic equipment is a useful approach to reduce the risk of costly failure.

Until today, no particular HV and E&M equipment or equipment group shows a significantly elevated failure probability than expected under given conditions. Failure of more complex components such as oil circuit breakers of the outdoor substations and the 6kV indoor switch gears, power transformers, pump motors and some protection relays is more likely than that of other equipment.

In addition to HV and E&M equipment, old 6kV medium voltage power cables are starting to fail, as reported at Mariupol ROO and Artemivska WTP.

(3) The functioning of the water infrastructure is fully depending on availability of power supply. The system was designed in times when large volumes of water were required by a water-hungry industry, and population was growing. Energy being cheap then, the power demand of equipment not an issue.

Since Ukraine's independence in particular, water demand continuously decreased and now only 50% of the system's design capacity is used. As a consequence, energy efficiency decreased further whilst energy costs increased significantly. Costs for power made up 52% of operating costs in 2012. In 2016, this share increased to 62% because of a power tariff increase in 2016.

Due to VD's poor financial situation, the company's indebtedness toward DTEK has been growing during recent years, and today reaches 100% of total asset value of the company. There is a risk that due to these huge debts DTEK might cut power supply. Thus far, this has happened only to one of the two power lines to SDWW lift station 3 and Velykoanadolska WTP.

5.4.4 Compromising drinking water quality

Dosing equipment at most WTPs requires servicing and/or replacement to counter inefficiencies. Prior to the conflict, plans were in place for the gradual modernization, particularly of chlorinators. Chlorination at facilities dealing with relatively low water volumes were switched to hypochlorite which is less hazardous than liquidized gas[46]. The dosing of chemicals 'on the safe side' accelerates the depletion of supplies that are costly and at time difficult to access due to restrictions and sanctions, as well as enhances the formation of chlorine by-products which are suspected to cause cancer.

Increasing pipe leaks can occur due to insufficient or absent corrosion control, water hammers from emergency operations and soil movement from military activity or decommissioned coal mines. Such tears in drinking water pipelines can introduce secondary contamination during the loss of pressure in the pipes.

[46] The same volume of water requires higher quantities of hypochlorite as compared with chlorine gas, therefore less efficient at facilities processing high water volumes.

6 RISK ANALYSIS AND EVALUATION

All identified hazards threatening the provision of water supply services are imposed by the operational context (military activity and political environment), whereby vulnerability and exposure are implicit in VD's operational capacity (finance, people, consumables and infrastructure). None of the hazards identified come to occur in isolation. Rather, the consequences of one risk event contribute to cumulative effects that increase specific vulnerabilities, or eventually lead to another risk event. Chapter 5.3 will describe this effect of inter-linked risks further.

Given that VD's water supply service operates as one system, all of the core service components of infrastructure, staff, and consumables are exposed to risks related to the political and institutional environment, and the company's financial situation, regardless of their location. In contrast, only service components located in proximity to the line of contact are exposed to direct effects of risks related to military action. These, however, can have far wider-reaching impact.

Major risks are repeated direct hits from shelling and exchange of fire, damaging infrastructure, threatening staff, and diminishing VD's ability to withstand and recover; legislative and regulatory gaps and discrepancies obstructing the company's operation and response; and the lack of funding to implement measures ensuring reliable and safe service provision to the population.

The main undesired consequences relevant to this study are:

1. Casualties amongst the service provider's staff and the population,
2. A complete or partial halt of water supplied to the population, and
3. The supply of untreated water, or drinking water of compromised quality.

The impact of the risks identified in chapter 4 can be direct or indirect (Table 18).

Table 18: Overview of direct and indirect risks

		Casualties	Water quantity	Water quality
Risks related to military activity				
	Staff health and safety issues	direct		
	Direct damage of infrastructure and equipment		direct	direct
	Increasing failure of equipment		direct	direct
	Compromising response to failures		direct	direct
	Compromising water treatment			direct
	Loss of operational data and institutional memory		indirect	indirect
Risks related to the political and institutional environment				
	Company operating in legal and regulatory void / vacuum	indirect	indirect	indirect
	Limited access to humanitarian assistance	indirect	direct	direct
	Compromising company capacity	indirect	direct	direct
Risks related to VD's financial situation				
	Impact of staff		indirect	indirect
	Impact on infrastructure, equipment, and services		direct	direct
	Compromising drinking water quality			direct

The provision of adequate water quantity is important not only for the health and wellbeing of the civilian population, but also for other essential services such as centralized heating, wastewater disposal, and power generation, as well as livelihoods in industry and commerce.

The adequate functioning of water supply infrastructure and equipment has the most immediate effect on the production of sufficient quantity of adequate quality water. There are four key factors that cause the stopping of clean water production at Water Treatment Plants, Lift Stations and Pumping Stations (with similar effects on wastewater infrastructure).

1. Staff evacuation due to insecurity;
2. Power cuts or stoppage of other key inputs such as treatment chemicals;

3. Upstream halt of water flow; and
4. Specific damage to / failure of operational components such as valves, pumps, pipes.

Military action has a direct effect on all four factors, and the political and institutional environment and the financial situation indirectly effect all except staff evacuation (?). In this section, key infrastructure that is at risk from partial or complete technical failure is discussed, with causal linkages and potential mitigating actions identified.

Structures that supply raw water to the whole network are of primary importance. The SDD and the SDWW, and their LSs fall under this category. In case of a complete failure of the conveyance system, back-up reservoirs can cover the supply of raw water to WTPs for some areas. There are currently three plants that do not have such back-up capacities in the VD system: Chasivyarska (serving 16,767 people), Krasnoarmiyska (serving 331,252 people)[47], and Velykoanadolska (serving 92,356 people) WTPs.

Pump Stations and pipe mains such as the 2DWW and pipes crossing the line of contact, are also of relevance as they ensure the transportation of treated water to a location close to the population.

In case of a stop of operations of individual WTPs, back-up reservoirs at settlement level can be used for emergency water supply. Transportation to a larger population, using water trucks, is logistically extremely challenging and resource-demanding.

In sections 5.1.1 and 5.1.2, key water supply infrastructure that is at risk of being affected directly by military action or likely to stop working due to the political and institutional environment and the financial situation is evaluated in relation to:

- The likelihood of direct damage from military action,
- Technical condition (likelihood of technical failure), and
- The scale of impact of a potential operational failure (number of people affected).

The possible duration of adverse effects constitutes another important criterion in the evaluation of risks. However, this depends on a multitude of variables in a specific scenario at each infrastructure element, such as the extent of damage, availability of redundancy, access to resources, and the security situation, and hence requires case-by-case consideration.

[47] The connection of the Karlivske lake to Krasnoarmiyska WTP is in planning with international support.

6.1 AT-RISK INFRASTRUCTURE

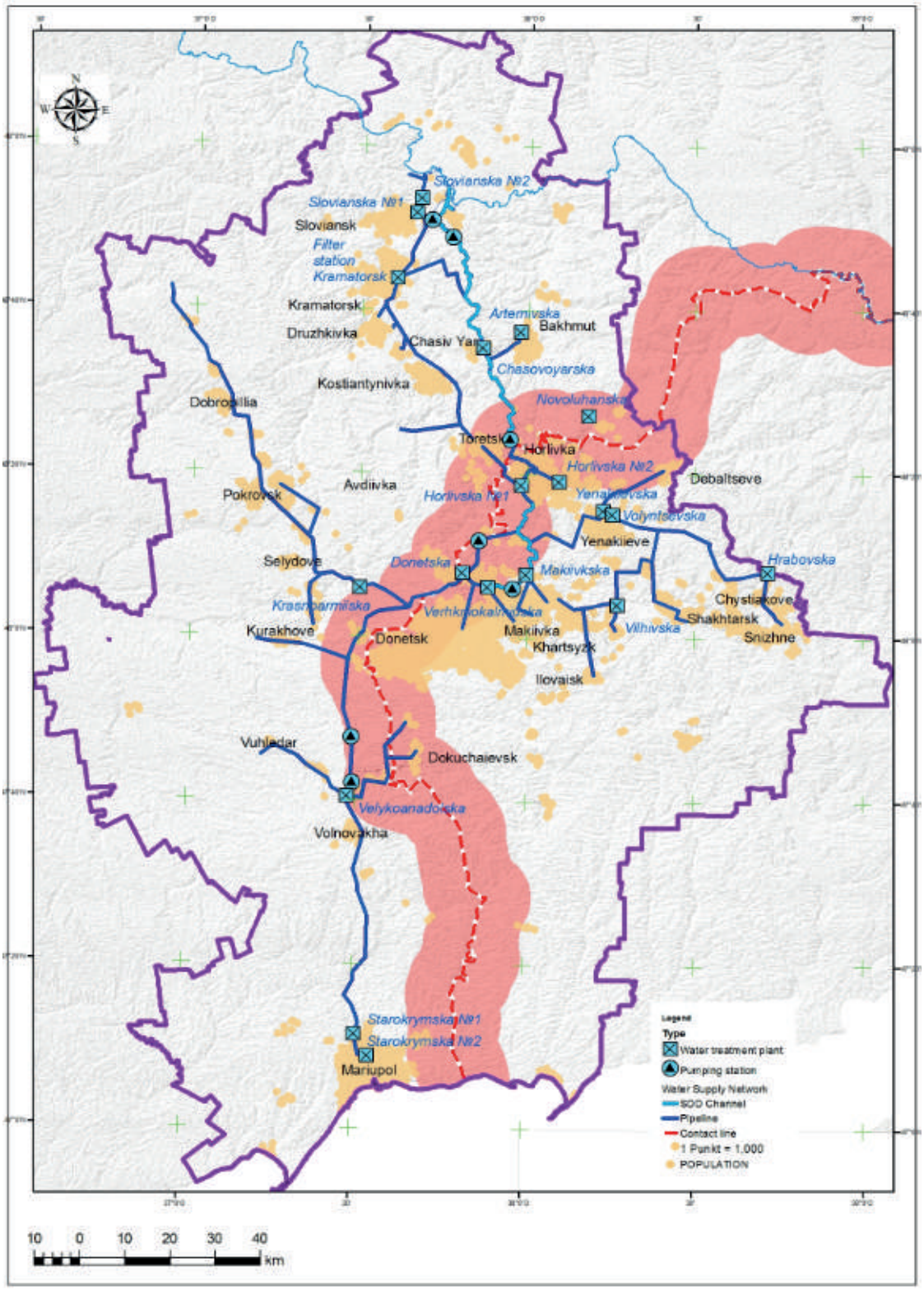

Figure 17: Map showing water infrastructure at risk

6.1.1 Infrastructure at risk from direct conflict damage

In this section, technical aspects of the water supply infrastructure in proximity of the line of contact, and consequences of an important operational break-down due to a direct hit and/or technical failure are briefly evaluated.

3rd Lift Station of the SDD channel

Function: Elevation of raw water for further transfer to business consumers, VKs, and the following WTPs of VD: Horlivska 1 & 2, Makiyivska, Yenakiyivska, Volyntsevska, Verkhniokalmiuska, Donetska, Krasnoarmiyska, Velykoanadolska, and Starokrymska 1 & 2. The total population served is about 3.2 million.

Technical aspects: Currently only one of the two 110kV power supply lines is in the operating condition. Without a functioning second power supply line, the facility is at risk of blackouts.

The insulation value of both main transformers of the sub-station is too low which can cause a total breakdown of the transformers. **A major overhaul of the transformers to recondition the insulation is urgently required.**

The pump motor No. 1 of PS 3 has a cracked motor shaft and is not functional. Although the current water demand can be handled by the remaining pump sets, stand-by capacity reduced.

1st Lift Station of the SDWW

Note: This facility was not visited due to the security situation.

Function: Elevation of raw water for further transfer to business consumers, VKs, and the following WTPs of VD: Donetska, Krasnoarmiyska, Velykoanadolska, and Starokrymska 1 & 2. The total population served is about 1.3 million.

Technical aspects: No particular problems in regard to power supply and E&M equipment were reported, apart from power cuts due to conflict damage.

Novoluhanska WTP

Note: This facility was not visited due to the security situation.

Function: Treatment of raw water from the reservoir, and local groundwater sources. It supplies Novoluhansk and surrounding settlements. The total population served is about 3,830.

Technical aspects: No particular problems in regard to power supply and E&M equipment were reported, apart from power cuts due to conflict damage. A direct hit might cause important damage.

Donetska WTP

Note: This facility could not be visited due to the security situation.

Function: One of the two WTPs for the supply of Donetsk City including Avdiyivka, parts of Yasynuvata and smaller settlements on both sides of the line of contact. For emergency periods only, much of the supply from this plant can be substituted by Verkhniokalmiuska WTP. It treats raw water received from the 1st LS of the SDWW, the SDWW directly, and the Makiyivske reservoir. The total population served is about 345,000.

Technical aspects: The plant has sustained several direct hits from explosive weaponry since 2014. Structural damages are said to have been repaired. Due to its location on the line of contact, the WTP is highly exposed to military actions resulting in direct damages and/or power supply blackouts, interrupting the water supply of this facility.

There is an elevated risk of technical failures due to the age of the equipment and indirect impact from conflict damage.

Table 19: Infrastructure at risk from military activity or direct damage

Infrastructure at risk from military activity / direct damage			
Location	**Consequence**	**Population affected (*)**	**Remark**
Lift Stations ***Most critical risk: full stop of operation due to evacuation, direct hit or technical failure to power supply or water infrastructure***			
3rd LS of SDD	Downstream without reliable source of water, affecting Horlivska 1 and 2, Yenakiyivska, Volyntsevska, Makiyivska, Verkhniokalmiuska, Donetska, Velykoanadolska, Krasnoarmiyska, and Starokrymska WTPs.	650.000 immediately 1,6 million after 1 mo 3,2 million after 6 mo	Horlivska 2, Yenakiyivska, Volyntsevska, Makiyivska, Verkhniokalmiuska, Donetska and Starokrymska can connect to back-up reservoirs of different capacities
1st LS of SDWW	Downstream without reliable source of water, affecting Verkhniokalmiuska, Donetska, Velykoanadolska, Krasnoarmiyska, and Starokrymska WTPs.	523.000 immediately 1,3 million after 6 mo	Donetska and Starokrymska can connect to back-up reservoir
Water Treatment Plants ***Most critical risk: Full stop of operation due to evacuation, direct hit and/or chlorine incident, or technical failure of power supply or water infrastructure***			
Novoluhanska	People without piped potable water after a few days (when clearwater tanks are empty)	3.830	Raw water available in back-up reservoir
Horlivska (No.2)	People without piped potable water after a few days (when clearwater tanks are empty)	215.800	Raw water available in back-up reservoir located in NGCA; cannot be used for consumers in GCA
Donetska	People without piped potable water after a few days (when clearwater tanks are empty)	100.000	Verkhniokalmiuska WTP can cover some areas but not consumers in GCA, nor parts of Donetsk
Verkhniokalmiuska	People without piped potable water after a few days (when clearwater tanks are empty)	516.739	Raw water available in back-up reservoir
Pipes ***Most critical risk: Pipe collapse due to direct hit of technical failure***			
Pipe DN 900 Horlivska WTP No.2 to Toretsk	People without piped potable water after a few days	50.000	
SDD south of the 3rd LS	Downstream without reliable source of water, affecting Horlivska 1 and 2, Yenakiyivska, Volyntsevska, Makiyivska, Verkhniokalmiuska, Donetska, Velykoanadolska, Krasnoarmiyska, and Starokrymska WTPs	650.000 immediately 1,6 million after 1 mo 3,2 million after 6 mo	Horlivska 2, Yenakiyivska, Volyntsevska, Makiyivska, Verkhniokalmiuska, Donetska and Starokrymska can connect to back-up reservoirs of different capacities
SDWW between Panteleymonivka and Maryinka	Downstream without reliable source of water, affecting Verkhniokalmiuska, Donetska, Velykoanadolska, Krasnoarmiyska, and Starokrymska WTPs	523.000 immediately 1,3 million after 6 mo	Donetska and Starokrymska can connect to back-up reservoir
(*) these are estimates only as actual back-up capacities vary by season and climatic conditions.			

Verkhniokalmiuska WTP

Function: Treatment of raw water received from the SDD channel and the Verkhniokalmiuske reservoir. The plant can, for a limited time period, cover most of the supply from Donetska WTP. The total population served is about 516,739.

The chlorine rebottling station is adjacent to this WTP.

Technical aspects: The plant is in bad structural condition and technologically fairly outdated. The two independent outdoor substations are at risk of direct damage from military action in the area.

The PS is generally in fairly good working condition. However, pump motor no. 5 is out of operation and in need of repair. **The back-up capacity of the PS is reduced.**

Chlorine rebottling station: In case of a power supply blackout the protective 'water curtain' activated in response to chlorine leakages will not operate.

Horlivska WTP 2

Function: Treatment of raw water received from the SDD. It supplies Horlivka city and surrounding area. The total population served is about 215,800.

Technical aspects: In July 2015, the building of the 6kV indoor switchgear was directly hit, destroying parts of the building and one CB cell. The switchgear was out of operation for 3 days, and all available spare parts were used for repairs. **The facility is now without any spare parts for future repairs.**

Most of the pump motors at the PS are in acceptable working condition. Some motors are equipped with frequency converters, allowing for a more efficient energy consumption.

Pipeline DN 900 from Horlivska WTP 2 to Toretsk

Function: Transport of drinking water to about 50,000 people in Toretsk city.

Technical aspects: The reinforced concrete line DN 900 crosses the line of contact, and is exposed to direct damage. The pipes were damaged in November 2016, putting the city supply under severe strain, including the centralized heating system. Access for repairs was granted after 5 days.

Pipelines DN 2400 and 2100 of the SDWW between Panteleymonivka and Maryinka

Function: Transfer or raw water from the SDD to business consumers, VKs, and the following WTPs of VD: Donetska, Krasnoarmiyska, Velykoanadolska and Starokrymska WTPs. The total population served is about 1.3 million.

Technical aspects: The steel pipelines are located in the grey area close to the line of contact. Access for inspection and repair is limited, and in certain locations impossible. Large-diameter damages were sustained on numerous occasions in 2014 and 2015, leading to significant losses and downstream supply disruptions. **Means of corrosion control are partly not functional.**

6.1.2 Infrastructure at risk from technical failure

In this section, technical aspects of key water supply infrastructure further away from the line of contact, and consequences of material and equipment failure due to old age are evaluated.

1st and 2nd Lift Stations of the SDD

Function: Elevation of raw water for further transfer to business consumers, VKs, and the following WTPs of VD: Chasivyarska, Artemivska, Horlivska 1 & 2, Makiyivska, Yenakiyivska, Volyntsevska, Verkhniokalmiuska, Donetska, Krasnoarmiyska, Velykoanadolska, and Starokrymska 1 & 2. The total population served is about 3.2 million.

Technical aspects: No particular problems were reported at this time.

4th Lift Station of the SDD

Function: Elevation of raw water for further transfer to business consumers, VKs, and the following WTPs of VD: Makiyivska and Verkhniokalmiuska WTPs. The total population served is about 905,000.

Technical aspects: The power supply consists of 2 incoming overhead lines and 2 transformers. No particular problems with the power supply were reported.

Pump no. 2 is dismantled and the runner removed, due to excessive vibrations. Progress of repair is unclear. Pump no. 2 represents 1/3 of the total pump capacity of PS 4. Given the risk of technical failures due to age, this facility is vulnerable to blackouts and/or breakdowns.

Table 20: Infrastructure at risk from technical failure

Infrastructure at risk from technical failure			
Location	**Consequence**	**Population affected (*)**	**Remark**
Lift Stations			
Most critical risk: full stop of operation due technical failure to power supply or water infrastructure			
1st LS of SDD	Downstream without reliable source of water, affecting Chasivyarska, Artemivska, Horlivska 1 and 2, Yenakiyivska, Volyntsevska, Makiyivska, Verkhniokalmiuska, Donetska, Velykoanadolska, Krasnoarmiyska, and Starokrymska WTPs.	650.000 immediately 1,6 million after 1 mo 3,2 million after 6 mo	Horlivska 2, Yenakiyivska, Volyntsevska, Makiyivska, Verkhniokalmiuska, Donetska and Starokrymska can connect to back-up reservoirs of different capacities
2nd LS of SDD	Downstream without reliable source of water, affecting Chasivyarska, Artemivska, Horlivska 1 and 2, Yenakiyivska, Volyntsevska, Makiyivska, Verkhniokalmiuska, Donetska, Velykoanadolska, Krasnoarmiyska, and Starokrymska WTPs.	650.000 immediately 1,6 million after 1 mo 3,2 million after 6 mo	Horlivska 2, Yenakiyivska, Volyntsevska, Makiyivska, Verkhniokalmiuska, Donetska and Starokrymska can connect to back-up reservoirs of different capacities
4th LS of SDD	Downstream without reliable source of water, affecting Makiyivska and Verkhniokalmiuska WTPs.	905.000 after 1 mo	Makiyivska and Verkhniokalmiuska can connect to back-up reservoirs
2nd LS of SDWW	Downstream without reliable source of water, affecting Velykoanadolska and Starokrymska WTPs.	92,000 immediately 597.621 after 6 mo	Starokrymska can connect to back-up reservoir
3rd LS of SDWW	Downstream without reliable source of water, affecting Starokrymska WTPs.	505.621 after 6 mo	Starokrymska can connect to back-up reservoir
Water Treatment Plants			
Most critical risk: Full stop of operation due chlorine incident, or technical failure of power supply or water infrastructure			
Horlivska (No.1)	People without piped potable water after a few days	142.371	Raw water available in back-up reservoir of Horlivska WTP 2
Velykoanadolska	People without piped potable water after a few days	92.356	No back up reservoir, and only limited local sources
Krasnoarmiyska	People without piped potable water after a few days	331.252	Raw water available in Karlivske reservoir, but at distance from end users
Makiyivska	People without piped potable water after a few days	388.717	Raw water available in back-up reservoir
Starokrymska 1 & 2	People without piped potable water after a few days	505.621	Raw water available in back-up reservoir
Slovianska 1 & 2 (and intake)	People immediately without piped potable water	490.281	Kramatorsk and Sloviansk VK operate small WTPs, otherwise no back-up reservoir
Pipes			
Most critical risk: Pipe collapse due to technical failure			
DN 1400 of 2DWW	People immediately without piped potable water	490.281	Kramatorsk and Sloviansk VK operate small WTPs, otherwise no back-up
(*) these are estimates only as actual back-up capacities vary by season and climatic conditions.			

2nd and 3rd Lift Stations of the SDWW

Function: Elevation of raw water for further transfer to business consumers, VKs, and the following WTPs of VD: Velykoanadolska and Starokrymska 1 & 2. The total population served is about 597,621.

Technical aspects: At the 2nd LS, the oil CB of the incoming feeder cell to the 6kV switchgear from the main transformer was removed in January 2017 for replacement scheduled for February 2017. Until then, there is no back-up capacity for the transformer.

In 2016, a pipe burst (due to water hammer following abnormal operating conditions) caused the flooding of the pumping hall of this facility. All pumps and motors and the lower part of the 6kV switch gear were under water, putting the entire pumping station out of operation. VD managed to re-start the LS in an emergency mode after only 3 days.

In case the PS is stopped, all incoming and outgoing valves have to be closed. So to enable the quick closing of the valves in the case of a power cut an emergency diesel generator is now installed.

The risk of technical failure due to the age of the equipment exists. In particular, **the 110kV outdoor sectional oil CB and two load breakers for the main transformers at the 2nd LS are in poor conditions and should be replaced in the medium term.**

During the time of visit in January 2017, one out of the two power supply lines at LS 3 was switched off by DTEK because of payment issues.

Intake Structures at the 2DWW

Function: From the two intakes and successive WTPs, drinking water is being pumped through two main pipelines DN 1200 and 1400. The 2DWW provides water for the greater areas of Sloviansk, Kramatorsk, Druzhkivka, Kostiantynivka and Toretsk. The total population served is about 490,281.

Technical aspects: The latest two power black outs at these facilities took place in 2014 (shelling) and 2010 (technical issue). **A failure of the entire supply of the 2DWW could be caused by a power supply cut due to the age of equipment. The DC battery systems for emergency power supply of the control systems at the river intake (220VDC / 288Ah) and the WTP1 and WTP2 (220VDC / 80Ah each) are out of operation and need urgent replacement.** Without emergency power supply, uncontrolled pump starts could occur under extraordinary operational conditions, causing pump damages or pipe bursts due to water hammers.

Krasnoarmiyska WTP

Function: Treatment of raw water received from the SDWW after the 1st LS. It supplies Pokrovsk, Dobropillia and surrounding areas. The total population served is about 331,252.

At this time, there is no back-up water storage. There are plans to (re-)connect the Karlivske lake, adjacent to the WTP, in cooperation with an international humanitarian organization.

Technical aspects: The power supply line coming from the Donetsk area was destroyed in the conflict and not operational. Repair is not possible because of insecurity. As a consequence, the operation of this WTP depends on one single 35kV line. Upstream of the substation for this facility are another four substations. **Every failure at this outgoing line or at any of the substations can provoke a switch-off of the line, bringing operations at the WTP to a halt.**

Makiyivska WTP

Function: Treatment of raw water received from the SDD after the 4th LS, as well as the Makiyivske reservoir. It supplies the city of Makiyivka and surrounding areas. The total population served is about 388,717.

Technical aspects: Motors with frequency converters installed in 2013 can adapt capacity to the current demand, allowing for efficient pumping.

Due to its relative proximity to the line of contact, the WTP is at risk particularly due to power supply blackouts from damages to supply lines.

The circuit breakers of the 35kV outdoor substation and the 6kV indoor switchgear are at the end of their operational life time, and reportedly facing some problems.

Velykoanadolska WTP

Function: Treatment of raw water received from the SDWW 2nd LS. It supplies Volnovakha, Dokuchayevsk, and Vuhledar . The total population served is about 92,356.

There is no back-up water storage.

Technical aspects: Velykoanadolska WTP is located on the same compound with the 3rd LS of the SDWW. One outdoor substation with two main transformers 35/6kV with 10MVA each supplies both facilities. Two incoming 35kV supply overhead lines are feeding the substation. During the time of visit in January 2017 one of these two supply lines was switched off by DTEK because of payment issues.

Starokrymska WTPs 1 and 2

Function: Treatment of raw water received from the SDWW after the 3rd LS. It supplies Mariupol and surrounding areas. The total population served is about 505,621.

The Starokrymske reservoir contributes about 30% of the total raw water during normal operations.

Technical aspects: Starokrymska WTPs 1 and 2 are located on the same compound. The outdoor substation of two main transformers 35/6kV with 10MVA each supplies both facilities. A major overhaul of both transformers is overdue.

Pipeline DN 1400 of the SDWW

Function: This is one of the two pipelines transporting drinking water from WTP 1 and 2 to about 490,000 people.

Technical aspects: The pipeline was built in 1976. According to VD, it requires replacement over a distance of 20 km following the WTP as it experiences important leaks frequently. When one of the 2 pipelines is offline, such as for repair work, water cannot be supplied further than Druzhkivka, leaving up to 200,000 people without supply.

6.2 DISABLING OPERATIONAL CONTEXT

In the current volatile political environment, VD faces old and new challenges every day. Compliance with current legislative and regulatory provisions makes business practically impossible: as a Ukrainian company, the GoU does not allow VD to conduct business with entities in CADLR. However, some services cannot be rendered from outside of CADLR; such as power supply. The decision by the entities in control in CADLR to not apply the same tariff as in GCA is a blatant break with the pre-conflict practice of a common tariff structure across one system, creating understandable discord. These are but two examples of how the provision of essential services to conflict affected civilians is conducted in a disabling rather than an enabling setting. VD staff, and ultimately the population, remain unnecessarily exposed.

Having to deal with various levels of decision making on both sides of the line of contact of contact in order to be able to operate, VD is under constant pressure and suspicion due to the prevailing atmosphere of deep mutual distrust. The absence of a common understanding of roles and responsibilities, and how these are to be exercised on either side of the line of contact puts the company management in a precarious situation.

Internally, VD's staff cooperate across political divisions and territorial disagreements, thereby providing an impressive example of coordination over common interests. A potential split of the company into two economic entities along the line of contact would likely be detrimental to service provision. An additional layer of complexity would be added by the situation of two economic entities of different operational capacities working in two diverging operational contexts, trying to manage a single system and service. The question of responsibility for operation and maintenance of infrastructure in the so called 'grey area', or how assets would be separated present some of the practical challenges in such a scenario. More critical is how vitally important communication, accountability, and transparency is to be achieved. In the current political climate, a split of the company would seem like a backwards step instead of recognizing that it is the very unity of the company that is the key factor for the quality of continued service provision.

6.3 CASCADING EFFECTS, CUMULATIVE IMPACT AND VICIOUS CYCLES

"The consequences of explosive weapons can feed into the vicious cycles and other dynamics (e.g. trade sanctions, brain drain) of the indirect and cumulative impact of protracted armed conflict upon urban services, whether these be on the whole system of the same service, or on other services." (Zeitoun and Talhami, 2017)

As discussed in previous chapters, the direct impact on water supply from military activity is largely limited to infrastructure damages in the area close to the line of contact. The consequences of such events, however, can have a much wider impact through indirect or cumulative effects.

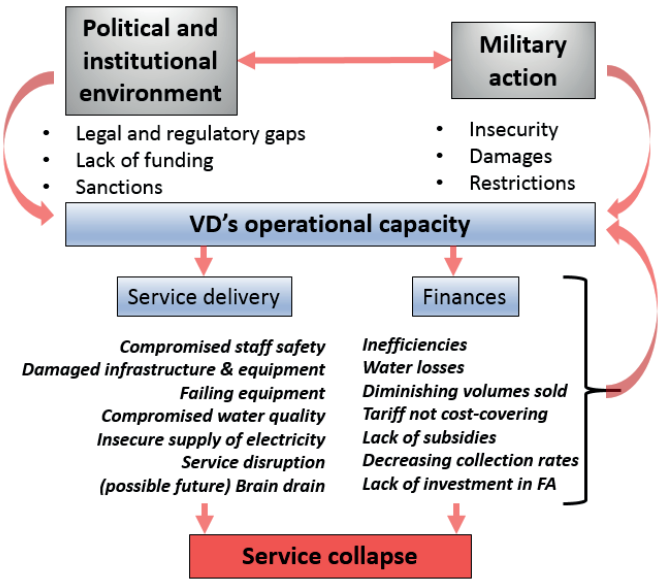

Figure 18: Cascading and cumulative effects

Figure 19: Cascading and cumulative effects

Knock-on or cascading consequences of water supply disruption affect the conflict-affected population in various ways. For example, in addition to the supply of drinking water to the civilian population, water provided through the VD system is also required for the functioning of centralized heating systems and industry. When the supply of water from Donetska WTP was stopped due to damages to the power supply during an escalation of hostilities in January/February 2017, centralized heating in Avdiyivka (population about 50,000) was out of operation for several days, leading to the closure of schools (OHCHR, 2017).

Water is also vital for the operation of coal mines, one of the main industries in the area. Water supply issues have led to closures over numerous days in the past, impacting on salaries and wages of miners. Electricity generation also depends on water; to date, however, no incident was reported where power supply was compromised following water supply cuts.

Whilst risks related to military activity might be the most apparent, as direct effects are rather immediate and visually often quite dramatic (see Annex 6), indirect effects as described above are less obvious, and cumulative effects by nature develop dynamically over time – and both may be of even greater importance.

Essentially, repetitive adverse consequences of hazardous events in protracted armed conflict undermine the service provider's ability to operate and respond (Figure 18: Cascading and cumulative effects

Figure 19). VD's baseline resilience is experiencing additional strain with every incident happening, whether caused by shelling, restrictions, or limited access to resources. The effects of spatially and temporally unrelated incidences sum up over time, accelerating a generally downward trend.

The financial analysis in chapter 4.1 highlights the impact the conflict has had on the service provider in terms of economic drawbacks, whereas chapter 4.4 details the risks related to the condition of the infrastructure due to insufficient investment. These two are clearly linked; with further financial losses inevitable if the operating context remains unchanged, technical failures will continue to increase and vital redundancies diminish. This, in fact, presents one main vicious cycle.

7 CONCLUSIONS AND RECOMMENDATIONS

7.1 CONCLUSIONS

The water supply service provided by VD is under serious and severe threat. The complex situation of protracted armed conflict imposes devastating operational conditions. VD is in urgent need of substantive and reliable support to its operational capacity and the affording of a 'special' legal status. Humanitarian assistance alone cannot provide adequate solutions at scale, nor substitute the various system governance aspects.

The conflict has crippled the company's finances, as it struggles to cope with additional costs from damages to and failures of equipment and infrastructure, and severely diminished subsidies. Tariffs, unequal on the two sides of the line of contact, do not cover costs, and leave no room for even the most critical investments into assets. Under these conditions, an impact of the dire financial and volatile security situation on staff is foreseeable.

Humanitarian assistance has contributed to a more or less continuous provision of services where and as possible. However, simple and isolated measures can bring about temporary relief only rather than halt, let alone reverse, the overall downward trend of gradually diminishing capacity to operate and respond.

Recommendation listed aim to prevent or control situations leading to 'vicious cycles' of cumulative impacts (See 5.3), with the overall objectives:

- Reduce the probability and frequency of hazardous events;
- Strengthen the baseline resilience where it is already critically reduced; and
- Lessen the severity of consequences, where possible.

The risks identified in this report show that the affording of a 'special' legal status to enable the company to address systemic economic and governance risks is perhaps the most viable mechanism to ensuring a safe and reliable supply of water to the conflict affected population.

Note that larger questions, including the future structure of Voda Donbasu, and whether specific geographic areas would be better served by separate systems, while not covered by this study, would require targeted consultations by all sides bearing in mind updated water demands that reflect or predict future water usage levels. This study has focused solely on how to preserve the existing networks, linking humanitarian action with development and transitional thinking in order to guarantee access to safe water during a difficult period.

Apart from the recommendations listed below that are designed to strengthen VD's operational capacity, it is a matter of urgency to create an enabling operational context in the political and security sphere, so that VD can fulfil its functions safely and reliably. There is an imperative need to establish a platform for dialogue between all sides sharing a common service. In this instance UNICEF invites all stakeholders to consider recommendations below within the context of a wider process, which requires commitment from all parties to guarantee the access to safe water to civilians caught up in tragic circumstances. Cooperation between UN member states, including within the Trilateral Contact Group is strongly encouraged and will be actively sought by UNICEF as follow up to the publication of this study, which represents only the first step in the process.

7.2 RECOMMENDATIONS AND MITIGATING ACTIONS

7.2.1 Economic and Financial Risks

Economic indicators for Voda Donbasu have been declining since the start of the conflict. For example:

- There have been increasing negative equity ratios since 2014 as a result of accumulated losses, and there has been a massive and rapidly increasing payables; trade payable have risen from 68% of total assets in 2013 up to 115% in 2016. The company is effectively dependent on its creditors.
- Gross profit of VD was negative every year from 2012 to 2016. In other words, the income (net sales) of the company is not enough to cover operating costs.
- Tariffs collected are inadequate: in 2016 tariffs for drinking water increased by 2.4 times for domestic consumers and by 2.8 times for VKs in the GCA, however in CADLR tariffs remain the same as in 2015. Overall collection rate decreased in average from around 100% in 2012 to 66% in 2016.
- Energy costs, which made up 53% of total operating costs in 2012–2014, rose to 62% in 2015-16.
- Government compensation has reduced: due to the different conditions for providing water in different regions of Ukraine, legislation is in place to ensure that power costs for "water pumping into water scarce regions" are compensated from the state budget[48]. Voda Donbasu should legally benefit from that compensation, however in reality this was only provided for 2 months in 2012.
- Official overall water losses increased from 36% at the end of 2013 to 46% in 2016.

Revenue from Vodakanals has dropped due to the reasons shown in table 21 below

Table 21: General factors resulting in accounts receivable of VD growth

VKs located in GCA	From the side of VKs located in CADLR
Water losses are above the loss rate accepted by the tariff regulator.	Water losses above the loss rate accepted by the tariff regulator *
Largely increased tariff for bulk water purchased from VD	Low tariff for water sold to consumers, not covering increased costs for water treatment and other consumables, and electricity costs.
Decreased collection rates from domestic consumers (for VD domestic consumers it was a decrease from 90% to 73% in 2015)	Decreased collection rates from domestic consumers
Over-projected water sales volume. As a consequence, actual costs per 1.0 m3 become higher than projected, hence tariff becomes too low	There is no scheme of benefits and subsidies (from the CADLR budget toward population), or scheme of reimbursement of difference in tariff since 2015

To ensure the economic stabilisation of the company including a restructuring of its debt, VD should be afforded 'special' legal status, for an interim period of 1 year, in order to ensure recognition of its humanitarian role in providing access to water for persons residing on both sides of the line of contact. Such status could potentially provide protection from creditors, thus preventing the freezing or seizure of assets, including bank accounts.

'Special' status would be premised on a consensus between all sides on effective to achieve coverage of actual costs of operation (tariffs, subsidies such as for 'pumping to water scarce regions'), inclusive of cost

[48] Directive of the CMU on the List of Water Utilities that are Pumping Water to the Water Scarce Regions No. 524, dated May 30, 1997.
[48] Directive of the CMU on Use of Funds Provided for Partial Compensation of Energy Consumption Costs Involved in Pumping Water to Water Scarce Regions No. 280, dated March 19, 2012

increases, costs for critical maintenance of the current asset value, costs for the repair of conflict related damages. Within the period of one year, all sides would determine the humanitarian, economic and security feasibility of restructuring VD, its assets and liabilities.

The scope of the status could draw on analogous models, including that of the Ingur/i hydroelectric station and under assets under a special management arrangements negotiated through a peace process.

7.2.2 Security Risks

VD staff work close to the line of contact where there is frequent shelling and exchange of fire of varying intensity. The danger to get injured by armed hostilities, a resulting chemical incident, or explosive remnants of war is extremely high. Staff at water treatment plants (WTPs), lift stations (LSs) and pumping stations (PSs) near the line of contact (Chapter 5.1) work in a very insecure environment and are frequently exposed to the possibility of nearby fighting. During pauses in the exchange of hostilities, unexploded ordnance in the area continues to threaten staff. Tragically, 9 of VD's staff were killed and 12 injured on duty from June 2014 to December 2016. The threat is very real to those working at facilities in proximity to the line of contact, as well as those crossing the line regularly for work purposes.

Active fighting near water infrastructure continues to necessitate staff to seek cover in bomb shelters, or evacuate the facility completely. This typically requires a stop of operations.

There are only 4 crossing points in operation between GCA and CADLR. Long queues at the check points and restrictions in the movement of staff across the line of contact pose a serious problem to VD's daily operation. Despite the existence of special passes for some VD staff, travel across the line of contact is time-consuming and dangerous[49]. The transfer of certain supplies, material and equipment, including VD's own assets such as valves and machinery, is prohibited. Restrictions in freedom of movement also impact on water quality testing. VD's central laboratory is located in Donetsk city. The transport of temperature-sensitive samples across the line of contact is highly problematic.

In order to facilitate the full implementation of the Minsk agreements, particularly in regards to the withdrawal of prohibited weapons, and disengagement of forces and hardware and to ensure protection of infrastructure indispensable for the survival of the civilian population, all sides must distinguish between civilian and military infrastructure and between fighters and civilians. Such a distinction should be clearly drawn for staff of VD, particularly workers operating VD assets along the line of contact who should, stemming from the 'special' legal status afforded to VD, be recognized as emergency (first) responders and provided adequate administrative, social and security protection.

As emergency responders, the staff of VD should be provided unimpeded access to both sides of the line of contact and to civilian infrastructure under VD management. The vehicles, uniforms, identification cards used by VD should be recognized by all sides as attesting to their status. The feasibility of procuring protective clothing, armoured vehicles and other measures should be explored in order to enhance the physical security of all VD staff.

All areas, particularly around civilian infrastructure need to be free of mines, unexploded ordnance and explosive remnants of war so that repair and maintenance activities can be carried out in safety. Information at the disposal of all sides, either through the JCCC or other instruments, should be communicated to VD on a systematic basis to ensure the safety and security of VD staff.

All sides must undertake to extend social benefits to the families of VD staff killed or injured in the period between 2014-2017 in line with the legislation of Ukraine.

[49] According to UN OCHA, 9 serious security incidents occurred at crossing points (2 at Mayorsk, 1 at Novotroyitske, 6 at Maryinka) between November 2016 and March 2017. 4 of the 5 resulting casualties were civilian.

7.2.3 Governance Risks

The emphasis placed by VD on compliance with current Ukrainian legislative and regulatory provisions and maintaining communication with all sides in order to ensure access to water on both sides of the line of contact, within the current system of corporate governance, has placed the company in a precarious situation with regard to the powers exercised over the company by 'duty bearers'.

Internally, VD's staff cooperate across the line of contact, constantly facing the threat of a potential split of the company into two entities along the line of contact. Such threats have exacerbated the corporate governance risks to which VD is exposed when delivering services in two different operational contexts.

Vitally important communication, accountability, and transparency, while maintained, is constrained by conflicting legal gaps. The company is registered in Ukraine and as such operates under Ukrainian law. However, its headquarters is located in Donetsk50 city and in order to remain operational, VD has to carry out business with entities in CADLR and cooperate with duty bearers on both sides of the line of contact.

The lack of clarity around primary duty bearers in this context prevents much needed coordination over the use of a shared resource. Legislation in support of the provision of essential services to the affected population is deficient. VD which operate in a largely unregulated and uncertain setting, are exposed to potential legal or reprimanding action.

To enhance the effectiveness of the management of VD, a 'special' legal status should be afforded in line with the legislation of Ukraine, for a period of one year. Within this period, the management of VD, would continue to report to the Civil-Military Administration however in close coordination with a Supervisory Board or Liaison Mechanism formed within the Trilateral Contact Group to ensure that key strategic, economic, security decisions are taken in consultation with all sides. Ensuring that the management of the company is protected from political instrumentalisation and to the extent possible authorized to operate on both sides of the line of contact unimpeded, would enhance the effectiveness of its corporate governance.

The scope of such 'special' legal status could be negotiated within the Trilateral Contact Group to ensure that the company is not exposed to risks associated with operating on both sides of the line of contact, including prohibitions and other measures imposed on the transfer of staff and supplies across the line of contact.

7.2.4 Environmental Risks that affect Water Supply

Environmental risks and recommendations below focus on Centralized wastewater disposal systems operated by VD structure cover 33 cities, 34 urban-type settlements, and 12 rural-type settlements, serving over 1.5 million people[51]. In total, the various utilities operate 54 WWTPs with total design capacity of 699,500 m^3/d (actual inflow: 197,250 m^3/d), and 165 Wastewater Pumping Stations (WWPSs)

Most WWTPs were commissioned in the 1960 and 1970s. Wastewater treatment technologies are outdated and plants are in urgent need of rehabilitation and upgrading. Currently, only minor repairs are undertaken, and important emergencies responded to with the aim to prevent pollution of the natural environment.

Key environmental risks which affect the production of clean water include:

- Of 3,358 km of sewer networks more than 2,000 km, or almost 60% are in a severely dilapidated state and 20 out of 54 facilities no longer perform biological treatment (aeration), resulting in discharge not conforming to the comparably strict standards by the environmental inspection.
- Treated wastewater is discharged into the river basins of the Dnieper, the Siverskyi Donets, and the basin of the Azov Sea. During power cuts, however, the effluent remains untreated. Sludge treatment and disposal poses a significant problem. Most WWTPs have accumulated huge volumes of partially dewatered and insufficiently stabilized sludge.

[50] An office with headquarter functions has been established at Krasnoarmiysk Regional Operational Office located in Pokrovsk (previously Krasnoarmiysk) to facilitate access to the Donetsk Oblast Administration.
[51] This number does not include people provided with wastewater collection services by VKs.

- Most of the 165 WWPSs lack back-up pumping equipment, ventilation, and experience structural collapse. Often, screens are missing, resulting in failures of pumping equipment. 227 of 448, or 51%, pumping units have exceeded their service life.
- Financial constraints do not allow for the procurement of much needed specialized machinery: for example flushing trucks, suction trucks, vacuum barrels, excavators for works at depths of 5m to 7m.

Risks of environmental pollution caused by potential and actual release of wastewater clearly affect water supply, representing a risk of cross contamination from sewage pipes into the water network, and of the pollution of raw water sources for private users and wells.

As well as the risks from wastewater entering the environment, unused coal mines are liable to flooding causing subsidence and therefore destruction of clean water pipelines above, and groundwater pollution that will demand additional treatment should sources be use for drinking water.

Liquidized chlorine gas used for water and wastewater treatment is a hazardous material. It is typically stored in bottles of 900 kg, in multiple locations owned by Voda Donbasu. Any spill incident caused by shelling damage would affect the general public as well as staff of the facility, with risk to life. Therefore Personalprotective Equipment, PPE is essential at all VD locations where chlorine is stored. PPE for a potential hazardous material situation at particularly risky locations has been procured in Ukraine with the support of a humanitarian organization, but the approval for transporting it across the line of contact has not been given so far. This permission for specific movements of PPE should be assured by all parties.

Although emergency procedures and protective measures are generally in place, many sites lack chlorine gas detectors; also, meteorological stations required to determine the potential level of exposure of the population residing in proximity are not functional. The safety installations in place (sprinklers, scrubbers for neutralization, and air extraction systems) are partly defective and need revision.

7.2.5 Technical Risks and mitigating measures

Technical risks would cause the supply of water to cease to the 3.65 million people served in total by Voda Donbasu. These can be grouped into prioritised civils, pipeline, mechanical and electrical repairs; urgently needed maintenance equipment; and emergency preparedness activities and have been prioritised from 1 to 3 according to:

- 1st Priority: humanitarian-focused repairs and initiatives which are urgently required, within one year, to prevent water stoppages, and increased risk of water-related diseases to the population;
- 2nd Priority: Urgent, but not yet critical, repairs which require additional planning, but still need to be completed within a 2-year timeline; and
- 3rd priority: transitional system strengthening work that is needed within the next 5 years, to ensure the water network can survive long enough, so that within the context of an end to the conflict system remodelling and design, feasibility studies and cost benefit analysis of options can be planned and implemented. This represents a robustification of the existing system to permit recovery programming.

Table 22 and 23 list the costs of priority technical measures focussing mainly on improvements to power supply equipment, pipeline repairs, essential urgently needed equipment and other activities that are critical to continue water supply.

Table 22: Priority measures focussing on water supply equipment in areas of military activity

Priority	Cost of main actions (USD)
Priority 1 (critical 1 year timeline)	4,676,924
Priority 2 (urgent, 2 years timeline)	5,787,630
Priority 3 (key actions within 5 years)	58,192,346
Total	68,656,900

Table 23: Priority measures focussing on water supply equipment in areas outside of military activity

Priority	Cost of main actions (USD)
Priority 1 (critical 1 year timeline)	27,359,175
Priority 2 (urgent, 2 years timeline)	50,017,427
Priority 3 (key actions within 5 years)	24,284,873
Total	101,661,475

Tables 22 and 23 are represented in full in Annex 7, a comprehensive list of physical mitigating actions, essential to the continued provision of safe water to 4 million people served by Voda Donbasu, not including strategic investments.

Annex 8 shows a breakdown of necessary distribution pipeline repairs, in all areas, prioritised using the same criteria (cost figures already included in Tables 22 and 23).

First priority, physical mitigating measures needed **within one year** include for the SDD channel:

- Electrical repairs to overhaul transformers at the 3rd Lift pumping station of the SDD channel, also to repair backup power lines to the same location.
  Estimated cost: 205,000 USD
- Overhaul of three, 8000 kW pump motors in two locations on the SDD channel: pump units No.8 and No.9 at the Lift Pumping Station No.1A and pump unit no. 8 at Lift Pumping Station no. 2A).
  Estimated cost: 225,000 USD

For the South Donbass Waterway:

- Replacement of outdoor sectional oil Circuit Breaker and two load breakers of main transformer at the 2nd Lift Station.
  Estimated cost: 170,000 USD
- Repair and reestablishment of cathodic protection for iron/steel pipelines, especially targeting areas near Pantelaimonivka and Mariinka.
  Estimated cost 1 million USD.
- Work to improve reliability and efficiency of main pumps
  Estimated cost: 476,920 USD

For the 2nd Donbass Waterway:

- Repair the first 3km of 1400 mm pipe of a vital 20km stretch, which feeds Sloviansk city. Estimated cost 3,520,000 USD.
- Replacement of 3 DC battery systems for emergency DC power supply of river intake control systems (220 VDC / 288 Ah) and WTP1 and WTP2 (220 VDC / 80 Ah each)
  Estimated cost: 30,000 USD

In multiple locations:

- Installing Frequency regulators at Verkhnikalmiuske Filter Station
  Estimated cost: 85,385 USD
- Rehabilitate or replace vacuum regulators and dosing units for chlorine gas at WTPs identified. Sufficient spare parts should be kept on stock; and staff trained in equipment servicing.
  Estimated cost: 50,000 USD.
- Most urgent pipeline repairs for all six divisions of Voda Donbasu.
  Estimated cost: 11,247,059 USD
- Supply of equipment (excavators, cranes, trucks, etc as detailed in Annex 9).
  Estimated cost: 3.4 million USD

Recommended emergency preparedness measures also required within one year due to include:

- The provision of three mobile generators of 180 KVA capacity which will be useful to provide emergency power supply as needed at Water Supply and Wastewater facilities. Note that some pumps are too big to run off these generators. These mobile generators need to be purchased, stored, maintained, and transported as needed, and a stock of fuel available on site. Estimated cost: 100,000 USD.
- Keep material frequently needed to repair power lines on stock, including: conductor wires, joints to connect new wires to existing ones, insulators for different voltage levels e.g. 110/35/6kV and of the types used at the existing pylons and masts, and steel profiles of various types to replace damaged brackets on masts, or repair damaged sections of pylons. A more detailed analysis of type, quality and quantity material required is required before any cost estimate can be provided. Relevant material should be stored at strategic locations to allow speedy repairs. Estimated cost: 250,000 USD.
- Sheets of steel of various dimensions for the repair of damaged pipes should be on stock at strategic locations, as well as replacement welding equipment. The same goes for pipes and accessories of relevant material and type.
  Estimated cost: 200,000 USD.
- Ensure that sufficient PPE for hazardous material incidents is available to staff where needed. Water facilities near the line of contact are particularly exposed; fully functioning protective measures should be put in place and tested regularly. Staff must be trained and have to be aware of emergency measures and procedures, including roles and responsibilities, and lines of communication.
  Estimated cost: 50,000 USD.
- Ensure that senior management, dispatchers and operators at particularly 'risky' infrastructure are equipped with two independent, reliable means of communication. Radio transmission might be a comparably affordable solution, if a specific frequency can be assigned.
  Estimated cost: 50,000 USD.
- Digitalize important data and information, and develop a back-up and storage strategy so that crucial information does not get destroyed and is at hand any time. In later programming this activity would need to be expanded, with management consent, to become a more solid asset management system.
  Initial cost estimate: 50,000 USD.

Specific training and capacity-building measures should be developed in full partnership with Voda Donbasu staff:

- Determine alternative ways for staff to access relevant professional development opportunities. Staff need to be able to keep abreast of advances in their field of specialisation. Where restrictions of movement of staff are a hindrance, online training, webinars etc. might be an option.
- Make access to medical first aid kits, knowledge, and skills available to staff at facilities close to the line of contact and repair crews working in the grey area. These are locations that ambulances cannot access, and it is important to ensure that casualties can be stabilized on site for transport.
- Train human resource managers in psychological first aid. Staff should have access to psychological support and assistance following extremely stressful or traumatic experiences.
- Development of larger scale scenarios – such as a complete failure of the SDD, the SDWW, Donetska and Verkhniokalmiuska WTPs, and considering seasonal specifics – which should lead to the planning of preparedness measures. SES has only limited capacity to respond at local level.
- Double check and establish where they are not already present standard operating procedures for emergency situations at every VD facility.

The above list of priority actions is by no means exhaustive and represents meaningful investments that were identified within the constraints of a limited study. Note that the full, prioritised lists are available as Annexes 7 and 8. In planning further ahead, there is a need to fit in with eventual aspirations to remodel and redesign Voda Donbasu's water networks. A few priorities for the second year of implementation would include:

- Continued provision of installation and repair equipment: excavators, emergency team vehicles, truck-mounted cranes, sludge suction dredgers and vacuum trucks - 33 on GCA side and 75 on CADLR side (total). Range of cost: 3.4 million USD (see also Annex 9).
- In order to create a stock of crucial spare equipment of high voltage, some oil circuit breakers of the 110kV and 35kV outdoor substations should be replaced, and the old equipment stored as spare parts for other 'risky' WTPs and LSs. The same approach can be applied to the 6kV air insulated indoor switchgears, but here the replacement of the entire switchgear is recommended. Range of costs: 1 million USD.
- Ensure that preventive maintenance of the protective relays is carried out, and an adequate stock of spare parts and replacement protective relays kept. The reliable functioning of protective systems and relays is critical to avoid serious damage of large E&M components. Range of costs: 100,000 USD.
- Continued repairs to pipelines including the SDWW and 2DWW, as set out as priorities 2 and 3 in Annexes 7 and 8.

7.2.6 Request

While recognising the lead role of the government of Ukraine and all those involved in the conflict, in preventing risks and providing the population with water, UNICEF would welcome the involvement of international actors to renew their commitment to ensuring actions can be implemented. In that respect we request such actors to consider:

- To attempt to make available and coordinate appropriate supportive financing of the water supply services in conflict affected areas;
- Consider financial support to the State Emergency Services in the conflict-affected areas to ensure an appropriate and timely support to longer term / larger scale supply disruptions.
- Liaise as appropriate with all respective parties to comply with the provisions of the Minsk agreement, and to fulfil obligations under IHL;
- Impress the urgency to reach agreement over roles and responsibilities concerning essential service provision to the civilian population on relevant decision-makers, and to remind these to refrain from using essential services to apply political pressure on their opponents;
- Ensure that humanitarian actors are provided with timely and adequate means to support access to essential services to those living near the line of contact in the medium term; strategic support initiatives and assistance should foster communication and transparency to build trust on both sides of the line of contact.

8 ANNEXES

Annex 1: Event data

Annex 2: VD staff and facility (CADLR / GCA)

Annex 3: Table back-up reservoirs

Annex 4: Financial analysis of Voda Donbasu

Annex 5: Pictures power supply and electro-mechanical equipment

Annex 6: Pictures of damages

Annex 7: Prioritized physical mitigating actions

Annex 8: Detailed list of distribution pipeline repairs

Annex 9: List of urgently required specialized equipment

ANNEX 1 - Events and Consequences from Military Activity on VD Infrastructure and Operations

Note: representative data used was collected in a semi-systematic manner as follows, and re-organized for analysis:

2014: 03.June - 07.December
2015: 01.January - 16. August
2016: 07.January - December 31

Data sources: UNICEF, WASH Cluster, INSO, Krasnoarmisk Subdivision VDB

Total of 188 incidents

SDD = Severskiy Donets Donbass Channel
2nd DWW = Second Donetsk Water Way
SDWW = South Donbas Water Way
WTP = Water Treatment Plant
WWTP = Wastewater Treatment Plant
PS = Pumping Station
WWPS = Wastewater Pumping Station

No	Event Date	Relaunch Date	Event (directly related to military activity)	Consequence
1	6/3/14	7/15/14	Slovianska WTP 1 and 2 without electricity	Water supply of 2nd DWW stopped, including to Sloviansk, Kramatorsk, Druzhkivka, Kostiantynivka
2	6/10/14		**Two employees killed at 1st lift station**	
3	6/11/14	6/23/14	Transformer no 4 of 1st lift of SDD damaged	*no info*
4	6/11/14	6/27/14	Lift 1, 2, 3 of SDWW stopped due to shelling	Water supply to Velikoanadoskaya and Starokrymskaya WTP stopped
5	6/16/14	6/18/14	3rd lift of 2nd DWW without electricity	Water supply of 2nd DWW stopped, including to Sloviansk, Kramatorsk, Druzhkivka, Kostiantynivka
6	7/3/14	7/15/14	Pipes and 3 transformers damaged, 1st and 2nd lift of SDD without electricity	Water supply to Krasnoarmiyskaya WTP stopped 08.-09.07., and to Velykoanadolskaya and Starokrymskaya WTP 03.-19.07.
7	7/2/14		**One employee killed and one injured at 2nd lift of SDD**	
8	7/3/14	7/19/14	Lifts 1, 2, 3 of SDWW stopped	*no info*
9	7/3/14	7/12/14	Rupture in pipes between 3rd and 4th lift of 2nd DWW	3rd lift stopped
10	7/10/14	7/18/14	Siversk without electricity	Stoppage of Kirovskyi water intake
11	7/13/14	7/14/14	2nd lift of SDD without electricity	Water supply to Krasnoarmiyskaya WTP stopped 14.-16.07.
12	7/15/14		SDWW pipes damaged	Water supply to Krasnoarmiyskaya WTP stopped 15.-16.07.
13	7/17/14	8/4/14	Krasnoarmiyska WTP evacuated	Water supply from Krasnoarmiyskaya WTP stopped 17.07-04.08.
14	7/21/14	7/24/14	3rd lift station of SDD without electricity	Water supply to Horlivska, Yenakiyivska, Volyntsevska, Makiyivska, Verkhniokalmiuska, Donetska, Velykoanadolska and Starokrymska WTPs stopped
15	7/21/14		3 threads of pressure pipes near Horlivka severely damaged	*no info*
16	7/23/14		Pumping station in Horlivka without electricity	Horlivka without water supply
17	7/23/14		Bridge in Horlivka blown up; pressure pipes DN2400 passing under the bridge	*no info*
18	7/25/14	8/2/14	SDD stop caused stoppage of lifts 1, 2, 3 of SDWW	Water supply to Horlivska, Yenakiyivska, Volyntsevska, Makiyivska, Verkhniokalmiuska, Donetska, Velykoanadolska and Starokrymska WTPs stopped
19	7/25/14		SDWW pipe DN1400 near Krasnohorivka damaged - no access to investigate	*no info*
20	7/28/14	8/4/14	SDWW pipes near Maryinka damaged	Water transmission to Velykoanadolska WTP (supplying Volnovakha, Dokuchayevsk, Vuhledar) cut off
21	7/28/14		**One employee killed at Debaltseve**	
22	7/29/14		Novo-Stozhkovska PS without electricity	Water supply to Snizhne, Torez, Shakhtarsk stopped
23	7/30/14		Damages to Donetska WTP, and evacuation of staff	No water in Avdiyivka and neighboring villages
24	8/2/14	8/4/14	Dzerzhynsk PSs without electricty	PSs №1, "Kvartal 168", "Krasnie kolodtsi" stopped
25	8/2/14		PSs in Shakhtarsk without electricity	PSs "Yuzhna", "XVII Partzyizdu", "Zorka" stopped
26	8/4/14	8/5/14	3rd and 4th lift of SDD without electricity	*no info*
27	8/5/14	8/8/14	Lifts 1, 2, 3 of SDWW stopped	Water supply to Horlivska, Yenakiyivska, Volyntsevska, Makiyivska, Verkhniokalmiuska, Donetska, Velykoanadolska and Starokrymska WTPs stopped
28	8/7/14		**One employee killed at Horlivka water supply unit 2**	
29	8/7/14		**One employee injured in Horlivka at 3rd lift SDD**	
30	8/12/14	8/21/14	Pipes DN2100 and 2200 of SDD damaged	*no info*
31	8/13/14		**One employee injured in Makiyivka**	
32	8/17/14		1st lift of SDWW without electricity	Stoppage of lifts 2 and 3 of SDWW
33	8/17/14	10/21/14	1st lift of SDWW without electricity	Water supply to Krasnoarmiyska WTP 17.08.-11.10. and Velykoanadolska and Starokrymska WTPs 17.08-19.10.
34	8/17/14	8/20/14	Verkhniokalmiuska WTP without electricity	Water supply to Donetsk stopped
35	8/17/14		Volyntsevska and Yenakiyivska WTP without electricity	No water supply in Yenakiyeve, Vuhlehirsk, Debaltseve, Kirovske, Zhdanivka and adjacent villages
36	8/17/14		PS "Prykanalna" without electricity, affecting Horlivska WTPs 1 and 2	Horlivka and Dzerzhynsk without water supply
37	8/18/14		PS in Khartsyzk without electricity	*no info*
38	8/19/14		Olkhovska WTP without electricity	No water supply to Zuhres, Khartsyzk, partially Zhdanivka
39	8/19/14		Siphon (RC) of DN 2500 mm at 4th lift of SDD damaged	*no info*
40	8/20/14		Verkhniokalmiuska WTP shelled	Damage to roofs (warehouse, filter hall), fence and power lines
41	8/23/14		Olkhovska WTP without electricity	*no info*
42	8/24/14		PS at Kirovske hit	The water supply to Kirovske and Zhdanivka was reduced
43	8/24/14		"Olkhove-Khartsyzk" pipeline DN600 damaged	No water supplied to Khartsyzk from Olkhovska WTP
44	8/25/14		Hrabovska WTP without electricity	Water supply to Torez and Snizhne was stopped
45	8/25/14		Verkhniokalmiuska WTP shelled	PS, water-separators and other engineering structures damaged
46	8/26/14		Horlivska WTPs 1 and 2 without electricity	No water supply to Horlivka and Dzerzhynsk
47	8/27/14		**One employee injured (Donbasvodoremont)**	

No	Event Date	Relaunch Date	Event (directly related to military activity)	Consequence
48	8/27/14		6 missiles hit the territory of Makiyivska WTP	Staff hiding in bombshelter
49	8/28/14		WWPS in Sedove without electricity	*no info*
50	8/30/14		**One employee injured in Khartsyzk**	
51	9/1/14		Horlivska WTPs 1 and 2 without electricity	*no info*
52	9/2/14		Yenakiyivska and Volyntsevska WTP, and Vatutynska PS without electricity	Water supply to Yenakiyeve, Debaltseve and Vuhlehirsk stopped
53	9/3/14		**One employee at PS in Telmanove killed**	
54	9/3/14		Verkhniokalmiuska WTP without electricity	Water supply to Donetsk stopped
55	9/5/14		Missile hit to the roof and filters of Starokrymska WTP1	*no info*
56	9/7/14		Bridge near Pavlopilske reservoir blown up	
57	9/9/14		Pipe DN1000 "Novostozhkove — 3rd water lift" damaged	Damaged section is 12 meters in length
58	9/14/14		4th lift of SDD without electricity	Two oil-break switches of 35 kW and transformers as well as power networks out of service
59	9/14/14		Makiyivska WTP without electricity	No water supply to Makiyivka, Khartsyzk and adjacent villages
60	9/20/14		Pipe DN1000 transmitting water to Kuibyshevskyi PS in Donetsk damaged	*no info*
61	9/22/14		Pipeline "Kirovskyi water supply unit - Shakhtarsk" damaged by shrapnel	*no info*
62	9/24/14		Power networks supplying power to PS in Snizhne damaged	*no info*
63	9/29/14		Novo-Stozhkovska PS stopped, and staff evacuated	Torez receives only 20% of the required water volume
64	10/12/14		Kirovska PS and WWPS without electricity	Water supply to Kirovske and Shakhtarsk at 30%
65	10/13/14	10/15/14	3rd lift of SDD without electricity	Water supply to Krasnoarmiyska WTP stopped 14.-19.10.
66	10/13/14	10/15/14	Horlivska WTPs 1 and 2 without electricity	*no info*
67	10/28/14		PS in Dokuchayevsk without electricity; 4 power lines damaged supplying Olenivska PS	No water supply in Dokuchayevsk and Pivdenne
68	10/30/14	10/31/14	Mayorska substation and PS 3a at 3rd lift without electricity	*no info*
69	10/30/14		**Two employees injured at Horlivske reservoir**	
70	11/9/14		Novo-Troyitska PS without electricity	*no info*
71	11/13/14	11/13/14	Verkhniokalmiuska PS damaged	*no info*
72	11/13/14	11/13/14	Verkhniokalmiuska WTP without electricity	*no info*
73	11/17/14		Kirovska PS without electricity	*no info*
74	11/18/14		Volyntsevska WTP without electricity	No water supply to Kirovske, Snizhne, Shakhtarsk, Torez, Zhdanivka, Yunokomunarivsk, Olkhovatka and Maloorlivka
75	11/18/14		Verkhniokalmiuska WTP without electricity	Water supply to Donetsk stopped
76	11/29/14		Donetska WTP without electricity	*no info*
77	11/29/14		1st lift of SDWW stopped	*no info*
78	12/4/14		Volyntsevska WTP damaged	Power line out of service, 2 fence boards were broken, power transmission tower, communication lines and windows damaged
79	12/5/14		Pipe DN2300 of SDD damaged	Only one out of three lines operating
80	12/7/14		Donetska WTP shelled; more than 6 missiles hit the territory of the filter station	Windows broken, fragments hit boiler room and garage; staff hiding in bomb shelter
81	12/7/14	12/7/14	Horlivska WTPs 1 and 2 without electricity	*no info*
82	12/7/14		Yenakiyivska WTP damaged and without electricity	Sludge chamber and windows in the pumping station were broken
Sporadic data only for remainder of 2014 from December 7				
1	1/1/15		**One employee killed in Horlivka**	
2	1/10/15		Olenivska PS without electricity	No water supply to Olenivka
3	1/10/15		Only working supply pipe to Torez damaged	Water supply to Torez at 20%
4	1/12/15		Donetska WTP without electricity	*no info*
5	1/13/15		PS at Dokuchayevsk without electricity	*no info*
6	1/13/15		Shells exploded near Donetska WTP	*no info*
7	1/14/15	2/16/15	Donetska WTP damaged as a result of shelling; staff evacuated	Power lines, administration building, pumping station damaged, 2 chlorine pipes cut off. Avdiyivka, Krasnohorivka, Yasynuvata district settlements, partially Donetsk and Yasynuvata without water supply
8	1/14/15		2 shells landed on territory of chlorine storage at Verkhniokalmiuska WTP	*no info*
9	1/15/15		Dokuchayevsk WWTP without electricity	*no info*
10	1/15/15		**One employee injured in Dokuchayevsk**	
11	1/16/15		Horlivska PS without electricity	Consumers of Horlivka receive water by gravity, Bessarabka district and “Mine 6-7” settlement have limitations
12	1/17/15		Pipe DN1000 in Donetsk damaged	*no info*
13	1/17/15		Pipe DN1200 of SDWW damaged	*no info*
14	1/18/15		Several shells hit the territory of Donetska WTP	*no info*
15	1/18/15		5 shells exploded near the chlorine storage at Verkhniokalmiuska WTP	*no info*
16	1/18/15		SDD pipe at Horlivka damaged	*no info*
17	1/18/15		Horlivska WTP 2 and PS "Prykanalna" without electricity	*no info*
18	1/18/15		Yenakiyivska WTP partially and Volyntsevska WTP without electricity	*no info*
19	1/18/15		Pipe DN800 Yenakiyeve-Vuhlehirsk damaged	*no info*
20	1/18/15		Dokuchayevsk WWTP stopped	*no info*
21	1/21/15		Pipes 9 and 9a (transporting water from Verkhniokalmiuska WTP to Donetsk) near Yakovlivka village damaged	Kirovskyi, Petrovskyi and Kuibyshevskyi districts of Donetsk without water supply

No	Event Date	Relaunch Date	Event (directly related to military activity)	Consequence
22	1/22/15		3rd lift of SDD without electricity	Capacity of SDD channel reduced
23	1/23/15		PS "Prykanalna" and Horlivska WTPs 1 and 2 without electricity	*no info*
24	1/23/15		Leakage in pipe DN2300 of SDD	
25	1/24/15		Pavlopilska PS without electricity	Water supply to Azovstal and Ilyicha metallurgical plants stopped
26	1/24/15		Donetska WTP damaged	Administration building and canopy damaged, and windows blown out
27	1/24/15		Olenivka and Dokuchayevsk WWTP, Sovhozna PS in Dokuchayevsk, PS of Yasne village, WWPS and PS in Telmanove, WWPS 3 in Shevchenko, and WWPS of Olkhovatka without electricity	*no info*
28	1/26/15		Pump units 1 and 3 turned off at 3rd lift station of SDD because of shelling / explosions	*no info*
29	1/27/15	2/19/15	Pipes of SDD in Horlivka section damaged	Water supply to Krasnoarmiyska WTP 26.01.-12.02, to Velykoanadolska and Starokrymska WTP from 26.01.-21.02., and to Horlivska, Yenakiyivska, Volyntsevska, Makiyivska, Verkhniokalmiuska, Donetska WTPs stopped
30	1/27/15		1st lift of SDWW without electricity	All south-west cities cut off from water (Krasnoarmiysk, Ukrayinsk, Hirnyk, Kurakhove, Selydove, Dymytrov, Bilozerske, Novodonetske, Oleksandrivka, Volnovakha, Dokuchayevsk, Vuhledar as well as adjacent villages)
31	1/27/15	2/11/15	Verkhniokalmiuska WTP damaged	Communication cables and electric transformers at the PS damaged
32	1/27/15		Volyntsevska WTP damaged	Filter building damaged
33	1/29/15		Volyntsevska WTP hit	Filter building damaged, holes up to 1.5 meters, also damaged water mains
34	1/31/15		Pipe no 6 in Donetsk damaged	Technical water
35	1/31/15		"Bila Hora" PS near Kurdiumivka without electricity	*no info*
36	1/31/15		Olkhovska WTP without electricity	*no info*
37	1/31/15		Inputs no 1 and 2 at 3rd lift of SDD channel out of operation	*no info*
38	2/2/15		3rd lift of SDWW damaged	*no info*
39	2/2/15		WWPS "Nyzhnia Krynka" in Makiyivka shelled	*no info*
40	2/4/15		Chervonohvardiyskyi district section of Makiyivka facility hit	2 excavators, 3 emergency cars, 1 tractor, 2 welding machines and garage boxes severely damaged
41	2/5/15		"Pivdennyi" pipe DN800 in Horlivka damaged	*no info*
42	2/5/15		Horlivska WTP 2 shelled	Window glasses in primary chlorination unit, reaction camera gallery, secondary and reserve chlorination units and filter facility broken
43	2/5/15		Damages detected in DN900 pipeline supplying Dzerzhynsk	*no info*
44	2/5/15		**One employee injured in Debaltseve**	
45	2/7/15		**One employee injured in Debaltseve**	
46	2/9/15	2/11/15	"Prykanalna" PS and WTP 1 in Horlivka without electricity	*no info*
47	2/9/15		Sewage facilities in Telmanove without electricity	*no info*
48	2/9/15		City reservoirs and WWPS no 2 in Dokuchayevsk without electricity	*no info*
49	2/9/15		Pipe no 9 in Donetsk damaged	*no info*
50	2/9/15		**One employee killed at Debaltseve**	
51	2/10/15		3rd lift of SDD without electricity	*no info*
52	2/11/15		**One employee injured in Donetsk**	
53	2/12/15	2/16/15	All PSs of 3rd lift of SDD without electricity	Water supply to Krasnoarmiyska WTP 13-16.02, and to Horlivska, Yenakiyivska, Volyntsevska, Makiyivska, Donetska WTPs stopped
Lack of data between 12.02 and 13.05.2015				
54	5/13/15		Territory of Horlivska WTP 2 hit by 6 shells	Heating main, wells, fence damaged, doors and windows broken; all staff hiding in shelter
55	5/18/15	5/19/15	Avdiyivka WWPS without electricity	Pump hall flooded with sewage
56	5/30/15		Mayorsk section of SDD damaged	Locksmith's shop completely destroyed, slab near trash containment unit damaged, broken windows at trash containment unit, also damaged roof of outbuilding
57	5/30/15		Input no 2 at Horlivska WTP 1 without electricity	*no info*
58	6/2/15	6/3/15	Horlivska WTP 1 and 2 without electricity	*no info*
59	6/3/15	6/4/15	Krasnoarmiyska WTP without electricity	Krasnoarmiysk, Ukrayinsk, Selydove, Hirnyk, Dobropillia, Bilozerske and adjacent villages without water supply
60	6/3/15		SDWW pipe near Krasnohorivka damaged	Stoppage of Velykoanadolska WTP supplying Volnovakha, Dokuchayevsk, Vuhledar, Novotroyitske, Blahodatne, Volodymyrivka, Mykilske, Pavlivka
61	6/4/15	6/5/15		Water supply at Velykoanadolska WTP stopped
62	6/6/15		Only working pipeline of SDD in Horlivka section damaged	*no info*
63	6/6/15		Technical water pipe no 6 near Spartak damaged	Donetsk industrial enterprises left without water
64	6/6/15		Pipe no 14 in Donetsk damaged	*no info*
65	6/11/15		Horlivska WTP 2 without electricity supply, power lines and switchboard damaged	Horlivka and Dzerzhynsk without water supply
66	6/11/15	6/12/15		Water supply at Velykoanadolska WTP stopped
67	6/22/15	6/22/15	9 shells hit territory of 1st lift of SDWW, electricity supply cut	Power equipment, telemetry cables, facades damaged, window glasses and frames blown out
68	6/28/15		20 shells hit territory Donetska WTP	Power cables, roofs, floor slabs, facades at different buildings damaged
69	6/29/15		1st lift of the pumping station of the SDWW was shelled.	1st lift of the pumping station of the SDW was shelled.
Sporadic data only for remainder of 2015 (from June 29)				
70	8/11/15	8/11/15		Water supply at Velykoanadolska WTP stopped
71	8/16/15	8/18/16	3rd lift of SDD without electricity	Water supply to Krasnoarmiyska WTP 16-18.08., to Velykoanadolska and Starokrymska WTP 16.-19.08., and to Horlivska, Yenakiyivska, Volyntsevska, Makiyivska, Donetska WTPs stopped
Lack of data between 12.02 and 13.05.2015				

No	Event Date	Relaunch Date	Event (directly related to military activity)	Consequence
1	1/7/16		**One employee killed at Pavlopilske reservoir**	
2	3/13/16	3/16/16	Donetska WTP evacuated and without electricity	Avdiyivka city and coke plant, as well as 50% of Yasynuvata, Krasnyi Partyzan, Verkhniotoretske, Spartak and surrounding area without water supply
3	5/19/16	7/1/16	PS near Berezove without electricity	Residents of Berezove and the surrounding settlements without water for the past six weeks. Few alternative local sources
4	7/19/16	7/20/16	Donetska WTP without electricity	Avdiyivka city and coke plant, as well as 50% of Yasynuvata, Krasnyi Partyzan, Verkhniotoretske, Spartak and surrounding area without water supply
5	7/21/16		Donetska WTP without electricity	*no info*
6	7/25/16	7/29/16	1 lift station of SDWW without electricity. 2nd lift switched pumps and pipe broke at valve in a manhole, flooding the PS	Flooding damaged electricity supply at 2nd lift
7	7/27/16		1st lift SDWW without electricity	Water supply stopped to Donetska, Krasnoarmiyska, Velykoanadolska, Mariupolska WTPs
8	8/3/16		Damages to Donetska WTP	Avdiyivka city and coke plant, as well as 50% of Yasynuvata, Krasnyi Partyzan, Verkhniotoretske, Spartak and surrounding area without water supply
9	8/4/16		Donetska WTP without electricity	*no info*
10	8/6/16	8/7/16	Water pipes at Dzerzhynsk damaged	*no info*
11	8/9/16		Dokuchayevsk WTP without electricity	*no info*
12	8/11/16		WWTP Dokuchayevsk sustained damages	*no info*
13	8/17/16		Damages to Novoluhanska WTP	Water supply to area at 50%
14	8/18/16		Input no 2 at PS "Prykanalna" in Horlivka without electricity	*no info*
15	8/18/16		Building of water laboratory Dokuchayevsk damaged	*no info*
16	8/18/16		Fire near Donetska WTP due to shelling	Fire extinguished
17	8/25/16		Fire near Verkhniokalmiuska WTP due to shelling	Fire extinguished
18	8/25/16	8/25/16	Shelling near Donetska WTP caused some damages	*no info*
19	8/30/16	8/31/16	Pipe DN1400 of 2nd DWW damaged (indirect damage, broken welding seam)	Sloviansk, Kramatorsk and Toretsk water supply reduced by 50%.
20	9/14/16	9/14/16	Shelling at Donetska WTP	Parts of power supply infrastructure and tanks damaged, windows broken
21	9/14/16		WWPS no 2 and 5 in Horlivka without electricity	*no info*
22	9/14/16		**One employee injured in Makiyivka**	
23	10/5/16		One electricity line to Verkhniokalmiuska WTP damaged, plant working off back-up line	*no info*
24	10/18/16	10/18/16	Shelling near 1st lift SDWW	no damages
25	11/11/16	11/11/16	Shell fell on territory of 1st lift of SDWW	no damages
26	11/18/16		WWTP at Dokuchayevsk damaged, staff evacuated	*no info*
27	11/19/16	11/20/16	Donetska WTP without electricity due to nearby shelling	*no info*
28	11/22/16	11/30/16	Pipe DN900 from Horlivka WTP 2 to Toretsk damaged	Toretsk without water, and access to pipe challenging; schools, kindergardens and boiler facilities stopped
29	11/24/16	11/25/16	1st lift of SDWW without electricity due to nearby shelling	Water supply to Velykoanadolska and Starokrymska WTPs stopped
30	11/25/16	11/25/16	Shelling close to Donetska WTP	*no info*
31	12/1/16		Donetska WTP without electricity	Avdiyivka city and coke plant, as well as 50% of Yasynuvata, Krasnyi Partyzan, Verkhniotoretske, Spartak and surrounding area without water supply
32	12/6/16		Donetska WTP without electricity	Avdiyivka city and coke plant, as well as 50% of Yasynuvata, Krasnyi Partyzan, Verkhniotoretske, Spartak and surrounding area without water supply
33	12/14/16	12/14/16	Donetska, Verkhniokalmiuska, Makiyivska WTPs and Central PS in Donetsk without electricity	*no info*
34	12/20/16		Shelling very close to Donetska WTP	no damage
35	12/23/16	12/28/16	Power lines to 3rd lift station of SDD damaged	Compromised electricity supply: water supply stopped to Makiyivska, Starokrymska, Donetska WTPs; 50% supply to Verkhniokalmiuska, Yenakiyivska, Krasnoarmiyska and Velykoanadolska WTPs

ANNEX 2 - Organizational Chart of Public Utility Voda Donbasu Company

as of 01.12.2016

Executive Office of PU Voda Donbasu Company	Engineering staff	147
	Operational staff	28
Information Computing Centre	Engineering staff	13
	Operational staff	
Central Machinery Repair Shop	Engineering staff	35
	Operational staff	109
Donbasvodoremont Department	Engineering staff	70
	Operational staff	325
Central Water Control and Research Laboratory	Engineering staff	130
	Operational staff	38
Avdiyivka Operational Office for Water and Wastewater Utilities	Engineering staff	31
	Operational staff	81
Amvrosiyivka Operational Office for Water and Wastewater Utilities	Engineering staff	36
	Operational staff	118
Volnovakha Operational Office for Water and Wastewater Utilities	Engineering staff	47
	Operational staff	250
Horlivka Operational Office for Water and Wastewater Utilities	Engineering staff	151
	Operational staff	537
Dzerzhynsk Operational Office for Water and Wastewater Utilities	Engineering staff	47
	Operational staff	184
Dymytrov Operational Office for Water and Wastewater Utilities	Engineering staff	43
	Operational staff	191
Dobropillia Operational Office for Water and Wastewater Utilities	Engineering staff	64
	Operational staff	255
Dokuchayevsk Operational Office for Water and Wastewater Utilities	Engineering staff	63
	Operational staff	237
Yenakiyeve Operational Office for Water and Wastewater Utilities	Engineering staff	143
	Operational staff	798
Kirovske Operational Office for Water and Wastewater Utilities	Engineering staff	38
	Operational staff	128
Krasnyi Lyman Operational Office for Water and Wastewater Utilities	Engineering staff	32
	Operational staff	136
Kostiantynivka Operational Office for Water and Wastewater Utilities	Engineering staff	53
	Operational staff	238
Makiyivka Operational Office for Water and Wastewater Utilities	Engineering staff	198
	Operational staff	1249
Selydove Operational Office for Water and Wastewater Utilities	Engineering staff	62
	Operational staff	277
Snizhne Operational Office for Water and Wastewater Utilities	Engineering staff	54
	Operational staff	188
Telmanove Operational Office for Water and Wastewater Utilities	Engineering staff	48
	Operational staff	201
Torez Operational Office for Water and Wastewater Utilities	Engineering staff	48
	Operational staff	197
Toretsk Operational Office for Water and Wastewater Utilities	Engineering staff	49
	Operational staff	204
Khartsyzk Operational Office for Water and Wastewater Utilities	Engineering staff	55
	Operational staff	214
Shakhtarsk Operational Office for Water and Wastewater Utilities	Engineering staff	49
	Operational staff	193
Regional Office of the SDD Channel Operation	Engineering staff	97
	Operational staff	638
Sloviansk Regional Operational Office	Engineering staff	66
	Operational staff	325
Chasiv Yar Regional Operational Office	Engineering staff	85
	Operational staff	502
Donetsk Regional Operational Office	Engineering staff	79
	Operational staff	361
Krasnoarmiysk Regional Operational Office	Engineering staff	70
	Operational staff	326
Mariupol Regional Operational Office	Engineering staff	71
	Operational staff	306

TOTAL:	11008	
Engineering staff	**2174**	
Operational staff	**8834**	

ANNEX 3 - Drinking water supply reservoirs in VD system

Info from: Voda Donbasu, December 7, 2016

Treatment Plant					Back-up				
Location / Name	Built in	Source	Location	No of consumers	Reservoir	Replenishment from river	Capacity in m^3 (seasonal)	Days capacity can last for (given normal consumption)	Consequence in case of SDD failure
Artemivska WTP	1958	SDD	GCA	109,139	Artemivske	Bakhmut, may be refilled from SDD	2,510,000	139	use of reservoir for Artemivsk & Soledar
Chasivyarska WTP	1958	SDD	GCA	16,767	none		n/a	0	no water
Horlivska WTP 1	1958	SDD	NGCA	358,171	none		n/a	0	no water
Horlivska WTP 2	1964	SDD	NGCA		Horlivske	SDD	2,390,000	52	use of reservoir for part of Horlivka & Toretsk
Yenakiyivska WTP	1961	SDD	NGCA	217,093	Volyntsevske	Bulavyn, may be refilled from SDD	12,200,000	106	use of reservoir
Volyntsevska WTP	1991	SDD	NGCA	166,625					
Makiyivska WTP	1972	SDD	NGCA	388,717	Makiyivske	SDD (& Shyroka creek)	9,470,000	67	use of reservoir
Donetska WTP	1981	SDD	NGCA	345,309			above		use of Makiyivka reservoir
Olkhovska WTP	1951	SDD	NGCA	114,469	Olkhovske	Olkhova	21,390,000	151	use of reservoir
Hrabovska WTP	1991	SDD	NGCA	59,578	Hrabovske	Mius	11,990,000		
Verkhniokalmiuska WTP	1959	SDD	NGCA	516,739	Verkhniokalmiuske	SDD	14,700,000	129	use of reservoir
Krasnoarmiyska WTP	1962	SDWW	GCA	60,000	none		n/a	0	no water
Velykoanadolska WTP	1972	SDWW	GCA	25,000	none		n/a	0	mainly out of water (few underground sources)
Mariupolska WTP 1	1936	SDWW	GCA	160,000	Starokrymske	Kalchyk, may be refilled from SDD	38,350,000	240	use of reservoir
Mariupolska WTP 2	1976	SDWW	GCA						

Annex 4 – Financial Analysis

Financial analysis of Voda Donbasa (VD)

VD Key financials and sales dynamic during 2012-2016

Public Utility "Voda Donbasu Company" (VD) is large unique company, specializing on central water supply services (78% of total sales) and waste water collection and treatment services (14% of total sales). Also the company provides hydro power supply services (6% of total sales) and others (2% of sales), such as: pipeline construction, machinery and equipment producing, research engineering, other.

Main financial data, which describes the business of the Public Utility "Voda Donbasu Company" is presented in table 1.

Table 1. Key financials of PU VD for 2012-2016 (based on official accounting data)

UAH tsd	2012	%	2013	%	2014	%	2015	%	2016	%
Balance sheet total	1 256 111	100%	1 359 333	100%	1 589 411	100%	1 892 412	100%	2 577 417	100%
Non-current assets	869 209	69%	997 871	73%	998 305	63%	992 499	52%	1 007 697	80%
Current assets	386 902	31%	361 462	27%	591 106	37%	899 913	48%	1 569 720	125%
Equity	503 405	40%	294 982	22%	-114 743	-7%	-433 289	-23%	-1 202 407	-47%
incl. Statutory fund	751 023	60%	626 498	46%	626 498	39%	626 498	33%	626 498	24%
Longterm liabilities	0	0%	0	0%	0	0%	0	0%	0	0%
Financial debt	0	0%	0	0%	0	0%	0	0%	0	0%
Current liabilities	751 759	60%	1 060 967	78%	1 700 760	107%	2 320 708	123%	3 774 832	147%
incl. trade payables	636 015	51%	918 375	68%	1 411 209	89%	1 774 547	94%	2 954 627	115%
Assets turnover	0,2		0,2		0,1		0,1		0,1	
Inventory period, days	31		27		26		25		33	
Receivables period, days	125		101		163		266		266	
Operating cycle, days	156		128		189		291		299	
Payables period, days	259		228		346		368		476	
Financial GAP, days	-102		-100		-157		-77		-178	
Working capital > 0	**-364 857**		**-699 505**		**-1 109 654**		**-1 420 795**		**-2 205 112**	
Equity Ratio (ER) >=25%	**40,1%**		**21,7%**		**-7,2%**		**-22,9%**		**-46,7%**	
Current Ratio (CR) >=1	**0,5**		**0,3**		**0,3**		**0,4**		**0,4**	
Net sales	894 257	100%	899 798	100%	803 374	100%	756 643	100%	1 133 884	100%
Gross profit	-286 466	-32%	-378 555	-42%	-450 754	-56%	-845 505	-112%	-702 394	-62%
EBITDA	211 272	24%	-311 031	-35%	-413 318	-51%	-313 154	-41%	-762 277	-67%
EBIT	157 240	18%	-370 010	-41%	-480 331	-60%	-384 184	-51%	-826 316	-73%
Net profit/loss	173 165	19%	-354 102	-39%	-456 692	-57%	-358 732	-47%	-800 888	-71%
Net sales growth ratio	**n/a**		**1%**		**-11%**		**-6%**		**50%**	

From the table we can see such a negative characteristics of the company's business, like:

- Negative equity since 2014 as a result of accumulated losses;
- Growth of current assets due to receivables growth, what impacts incoming operating cash flow of VD;
- Very huge and fast increasing trade payables, from 68% of total assets in 2013 up to 115% in 2016! That makes the company dependent on suppliers. Trade payables by 3 times in average have outweighed trade receivables since 2013;
- Very low assets turnover (0.2x – 0.1x), which mean during a year every UAH 1.0 spent on assets (invested in the business) brings UAH 0.2 – 0.1 of income;
- Negative financial GAP, which means VD invests in business actually at the expense of Suppliers.

As a result, VD has negative working capital during the whole observed period, negative equity ratio since 2014 and very low current ratio during 2012-2016. **It means VD has been insolvent company and financially dependent on its main Supplier since 2013.**

Main supplier and trade creditor of VD is DTEK group companies (PES Energougol, Donetskoblenergo, Vysokovoltnye seti) with 96% of total trade payables (table 2).

The above situation is caused by losses, VD suffered since 2013, and water volume decrease enhanced by the war conflict. Let us analyse the situation in detail step by step, starting with VD sales.

Table 2. Breakdowns of VD trade payables in dynamic

Contragent	for goods, services	Amount, tsd UAH as of the date:				
		31.12.2012	31.12.2013	31.12.2014	31.12.2015	30.09.2016
DTEK Donetskoblenergo	electricity	254 157	328 911	353 197	334 089	383 101
DTEK PES Energougol	electricity	323 394	537 611	966 749	1 313 782	2 036 568
DTEK Vysokovoltnye seti	electricity	871	3 188	27 176	32 452	68 406
Regionalnye elektricheskie seti	electricity	391	1 057	10 823	19 719	20 872
NAK Naftogaz Ukraina	natural gas	59	59	1 270	13 294	13 294
other		57 143	47 514	44 777	61 211	77 496
Total trade payables		**636 015**	**918 340**	**1 403 992**	**1 774 547**	**2 599 736**

Contragent	for goods, services	Amount, tsd UAH as of the date:				
		31.12.2012	31.12.2013	31.12.2014	31.12.2015	30.09.2016
DTEK Donetskoblenergo DTEK PES Energougol DTEK Vysokovoltnye seti	electricity	90,9%	94,7%	95,9%	94,7%	95,7%
Regionalnye elektricheskie seti	electricity	0,1%	0,1%	0,8%	1,1%	0,8%
NAK Naftogaz Ukraina	natural gas	0,0%	0,0%	0,1%	0,7%	0,5%
other		9,0%	5,2%	3,2%	3,4%	3,0%
Total trade payables		**100,0%**	**100,0%**	**100,0%**	**100,0%**	**100,0%**

As we can see from the table 1, VD sales decreased by 11% in 2014 (versus 2013), by 6% in 2015 (versus 2014) and grew up by 50% in 2016 (versus 2015). The sales growth is driven mainly by growth of income from water supply services by UAH 283 mln (table 3) and waste water collection by UAH 61 mln.

Table 3. VD Sales by economic activity in dynamic

		2012	2013	2014	2015	2016	sales increase
Total net sales	tsd UAH	894 257	899 798	803 374	756 643	1 133 884	377 241
Water supply services	tsd UAH	741 763	706 379	635 599	597 559	880 577	283 018
Waste water collection services	tsd UAH	116 487	141 518	122 079	102 680	163 878	61 198
Hydro power supply services	tsd UAH	15 384	21 594	29 237	42 973	71 146	28 174
other sales	tsd UAH	20 624	30 307	16 459	13 431	18 283	4 852

Sales from water supply (WS) and waste water collection (WWC) services increased in 2016 vs 2015 thanks to the respective tariffs growth (table 4).

Table 4. Tariffs for WS and WWC services approved for VD by National regulator, UAH /m^3

	GCA					NGCA	
	2012	2013	2014	2015	2016	2015	2016
is in force since	01.03.2012		01.03.2014		01.01.2016	01.09.2015	
Drinking water supply							
for population	3,47	3,47	3,47	3,47	**8,18**	4,165	4,165
for vodokanals	1	1	1,47	1,47	**4,09**	1,765	1,765
for others (in range)	2,37 - 5,3	2,37 - 5,4	2,37 - 5,5	2,37 - 5,6	**8,18**	2,845 - 6,36	2,845 - 6,37
Raw water (technical water)							
for further treatment	0,66	0,66	0,66	0,66	0,66	0,79	0,79
for agriculture	0,8	0,8	0,8	0,8	0,8	0,96	0,96
for others	1,89	1,89	1,89	1,89	1,89	2,27	2,27
Raw dischaged water							
for agriculture	0,07111	0,07111	0,07111	0,07111	0,07111	0,085	0,085
for industries	0,13128	0,13128	0,13128	0,13128	0,13128	0,16	0,16
Raw recycle water	0,07111	0,07111	0,07111	0,07111	0,07111	0,085	0,085
Waste water collection services							
for population	2,34	2,34	2,34	2,34	**7,19**	2,81	2,81
for budget organization	3,64	3,64	3,64	3,64	**7,19**	4,37	4,37
for heating, agriculture, social services, charity	3,45	3,45	3,45	3,45	**7,19**	4,14	4,14
other	4,49	4,49	4,49	4,49	**7,19**	5,39	5,39
Waste water treatment	1,03	1,03	1,03	1,03	**3,71**	1,235	1,235

VD target business is water abstraction, transferring and bulk water supply. So, the company's main buyers are vodokanals, which can buy treated or raw water for further distribution. Also VD has in its structure several vodokanals and actually distributes some water to final consumers too.

Since January 2016 tariff for drinking water increased by 2.4 times, from 3.47 UAH/m^3 up to 8.18 UAH/m^3, for domestic concumers and by 2.8 times, from 1.47 UAH/m^3 up to 4.09 UAH/m^3, for vodokanals (VK) in GCA. During years 2012-2015 the tariffs had not changed significantly. In spite of VD is Ukrainian company the increased tariffs are applicable in GCA only, consumers, located in NGCA pay for services under tariffs fixed as of 01.09.2015. Current tariffs for drinking water applied in NGCA are approx by 2 times lower the current ones in GCA. Tariffs for raw water are somewhat higher in NGCA. Although current tariffs for WWC services are by 2.6 times higher for domestic consumers and approx by 1.5 times for companies in GCA.

Water sales in physical terms has been decreasing from year to year, please see table 5.

Table 5. Dynamic of water volume sold

		2012	2013	2014	2015	2016
Water sold	tsd m3	468 108	428 382	350 454	325 997	324 755
dynamic to 2012	%	100%	92%	75%	70%	69%
dynamic year to year	%	-	92%	82%	93%	100%

Sales decrease was enforced by war conflict, when population and companies had left without water due to the water supply facilities damages – in 2014 volume of water sold declined by 25% vs 2012, in 2015 – by 30%! It is a huge decrease, which takes a toll on business result.

VD sales structure and bills pay level

VD sales structure is like this: 70% of water sold is drinking water for population, companies and 30% is raw water, some for further treatment, some for using by entities in operation.

More, than 90% of drinking water of VD is supplied to domestic consumers, among which 15-20% is supplied directly and 77- 74% - through independent VKs, please see chart 1.

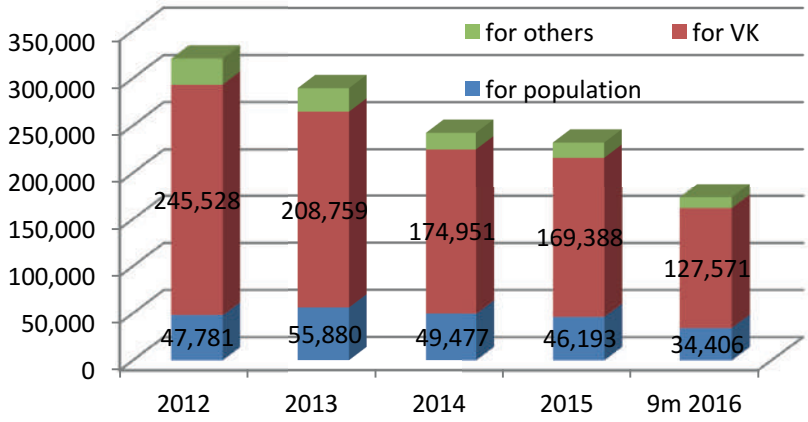

Chart 1. VD drinking water sold by structure and dynamic, tsd m^3

We can also see from the chart, volume of drinking water sold has decreased by 28% in 2015 full year vs 2012 full year.
VD client's base is rather stable during the observed period (table 6). Regardless people stay in the area or not, they continue to be a customer as long as they are registered at their original homes.

Table 6. VD customer's number in dynamic

		2012	2013	2014	2015	9m 2016
Number of Customers	items	774 959	772 707	806 202	800 815	801 999
incl. domestic consumers number		762 946	761 261	795 002	789 997	791 205
vodokanals		35	35	35	33	36
budgetary agencies		1 284	1 275	1 238	1 472	1 633
other		10 694	10 136	9 927	9 313	9 125

Assuming one domestic consumer connection is on the average 2.2 persons, we obtain: a more than 1.6 mln people is supplied by drinking water of VD directly and significantly more through VKs.

In money terms main buyers of WS and WWC services in 2012 were businesses (39% of sales) and VKs (30% of sales); in 2016 – VKs with 44% of sales and population with 30% of sales (chart 2).

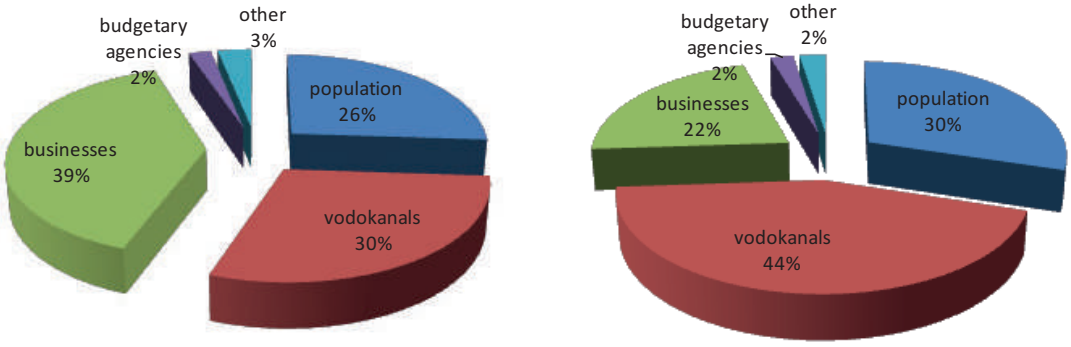

Chart 2. WS and WWC services of VD by consumer's structure in 2012 (left side) and for 9m 2016 (right side)

The situation is explained by the facts: raw water sale volumes decreased by 36% (in 2015 full year vs 2012 full year) and tariffs for raw water have stayed on low level since 2012 (see table 4). Thus, now VD is more dependent on VKs and population payments. Exactly these groups of customers appeared less solvent during 2014-2015, please see table 7.

Table 7. VD collection rate by customers during 2012 - 9m 2016

Collection rate	2012	2013	2014	2015	9m 2016
incl. domestic consumers	90%	94%	74%	73%	80%
vodokanals	120%	100%	49%	75%	37%
businesses	100%	100%	99%	93%	97%
budgetary agencies	99%	99%	75%	76%	96%
other	86%	93%	86%	83%	106%
Total collection rate	**103%**	**98%**	**74%**	**80%**	**66%**

Domestic consumers has paid 74-73% of WS and WWC services value during 2014-2015, vodokanals – just 49% in 2014 and 37% for 9m of 2016! Collection rate of 120% in 2012 and 75% in 2015 are the results of reimbursement of "difference in tariff" (difference between actual outlay without extra target costs and tariff) from the state budget in favor of VD subdivisions located in GCA.

The causes of so low level of VKs payment are the following: a) main customers of VKs are domestic consumers, who are more vulnerable and cannot be cut off easily; b) VKs' water losses (please see section "Reasons of VD account receivables growth").

Commercial companies have paid not less, than 93% of the services rendered. Actually entities are much more exposed to cut-offs for non-payment than the population.

The overall collection rate decreased from 103% and 98% before war conflict down to 74% in 2014 and 66% for 9m of 2016. It significantly affects incoming operating cash flow of VD.

Analyzing VD sales situation we shall consider differences between two areas of the company operation. GCA and NGCA differ between each other not only by tariffs for WS and WWC services (see table 4), but also by volume and structure of sales. 53% of VD water is sold in NGCA and 47% - in GCA; 60% of drinking water is sold in NGCA and the respective 40% - in GCA (please see table 8). Thus, more water is sold in NGCA with lower tariffs and less in GCA with currently higher tariff.

About 60% of VD income had been obtained in NGCA and the rest 40% - in GCA during 2014-2015. Since tariff growth in GCA, in 2016, the situation is reversed. Structure of sales by customers and collection rate differ among the areas as well (see table 8).

Table 8. Some VD characters separately for NGCA and GCA

		Non-government controlled are			Government controlled area			VD in total		
	units	2014	2015	9m 2016	2014	2015	9m 2016	2014	2015	9m 2016
Volume of water sold	tsd m3	188 496	170 520	128 052	161 959	155 478	114 465	350 454	325 997	242 516
incl. drinking water	tsd m3	145 032	136 150	103 669	97 089	95 590	69 707	242 121	231 741	173 377
incl. raw water	tsd m3	22 104	15 854	12 918	62 103	57 200	42 730	84 207	73 054	55 648
incl. recycle and other raw water	tsd m3	21 360	18 515	11 464	2 767	2 688	2 027	24 127	21 203	13 492
Share of drinking water in water sold	%	77%	80%	81%	60%	61%	61%	69%	71%	71%
Share of water sold in VDB total	%	54%	52%	53%	46%	48%	47%	100%	100%	100%
Share of drinking water in VDB total	%	60%	59%	60%	40%	41%	40%	100%	100%	100%
Sales WS + WWC (excl. VAT)	**tsd UAH**	**445 536**	**396 866**	**314 767**	**312 558**	**303 444**	**460 517**	**758 094**	**700 310**	**775 284**
incl. domestic consumers	tsd UAH	174 969	157 145	118 662	58 451	60 649	112 340	233 419	217 794	231 002
vodokanals	tsd UAH	131 081	135 146	103 207	118 542	121 860	238 897	249 622	257 005	342 104
businesses	tsd UAH	107 881	78 529	71 977	124 146	110 566	94 606	232 027	189 095	166 583
budgetary agencies	tsd UAH	11 595	9 111	9 719	4 364	4 549	6 832	15 958	13 660	16 551
other	tsd UAH	20 011	16 936	11 202	7 056	5 820	7 843	27 067	22 756	19 045
Share of the customers in sales	%	100%	100%	100%	100%	100%	100%	100%	100%	100%
incl. domestic consumers	%	39%	40%	38%	19%	20%	24%	31%	31%	30%
vodokanals	%	29%	34%	33%	38%	40%	52%	33%	37%	44%
businesses	%	24%	20%	23%	40%	36%	21%	31%	27%	21%
budgetary agencies	%	3%	2%	3%	1%	1%	1%	2%	2%	2%
other	%	4%	4%	4%	2%	2%	2%	4%	3%	2%
Share of sales in VDB total	%	59%	57%	41%	41%	43%	59%	100%	100%	100%
Bills paid	**tsd UAH**	**313 606**	**201 288**	**212 259**	**248 604**	**355 518**	**296 011**	**562 210**	**556 806**	**508 270**
incl. domestic consumers	tsd UAH	117 867	95 951	91 668	56 025	62 072	92 442	173 892	158 023	184 110
vodokanals	tsd UAH	64 350	19 702	31 690	59 097	174 314	94 238	123 447	194 016	125 928
businesses	tsd UAH	106 687	68 058	69 620	122 795	107 385	92 563	229 482	175 443	162 183
budgetary agencies	tsd UAH	7 601	5 761	9 410	4 441	4 625	6 467	12 042	10 386	15 876
other	tsd UAH	17 102	11 816	9 871	6 245	7 123	10 301	23 347	18 939	20 172
Share of bills paid in VDB total	%	56%	36%	42%	44%	64%	58%	100%	100%	100%
Collection rate by customers	**%**	**70%**	**51%**	**67%**	**80%**	**117%**	**64%**	**74%**	**80%**	**66%**
incl. domestic consumers	%	67%	61%	77%	96%	102%	82%	74%	73%	80%
vodokanals	%	49%	15%	31%	50%	143%	39%	49%	75%	37%
businesses	%	99%	87%	97%	99%	97%	98%	99%	93%	97%
budgetary agencies	%	66%	63%	97%	102%	102%	95%	75%	76%	96%
other	%	85%	70%	88%	89%	122%	131%	86%	83%	106%
Average staff number	persons	7 194	7 139	7 002	4 063	3 936	3 977	11 257	11 075	10 979
share in total	%	64%	64%	64%	36%	36%	36%	100%	100%	100%
Average salary per person	UAH	2 969	3 237	3 634	2 775	3 134	3 443	2 899	3 200	3 565
Energy consumption	tsd kWh	n/a	213 605	165 006		514 870	374 379	655 241	728 475	539 384
share in total	%		29%	31%		71%	69%	100%	100%	100%
Energy tariff (average, with VAT)	UAH/kWh		1,429	1,888		1,521	1,600		1,494	1,688
Energy costs	tsd UAH	n/a	305 251	311 507		782 983	599 027	720	1 088 234	910 534

Please, note critical collection rate of vodokanals (49%, 15% and 31%), also low collection rate of domestic consumers and budgetary agencies in NGCA. The difference between the areas is explained by possibility to apply two schemes:

1) benefits and subsidies (for domestic consumers), which was applied in GCA up to May 2016;
2) reimbursement of "difference in tariff" (for VKs), which was applied in GCA in 2015.

The reimbursement of "difference in tariff" scheme was not foreseen by state budget also for GCA in Donetsk region for 2016. As a result the average collection rate has been higher in GCA. So, less income in NGCA we shall multiply by lower collection rate at the area, while considering cash flow issue.

We considered all aspects of VD sales issue. It is the time to analyze VD profitability/losses issue.

VD business results and their reasons

Turning to table 1, we can see that VD gross profit is negative during the whole observed period. It means the income (net sales) of the company is not enough to cover operating costs (not considering administrative and distribution & sales costs). Gross profit margin declined from -32% of sales in 2012 down to -112% in 2015 (it means operating costs by more than 2 times higher the income!) and then improved up to -62% in 2016 (thanks to tariff growth in GCA).

To understand the reason of losses, we shall consider income from WS and WWC services and their costs, please see table 9.

Table 9. VD P&L from centralized WS and WWC services for 2012-2013

	unit	2012			2013		
		WS	WWC	Total	WS	WWC	Total
Water sold	tsd m3	468 108	42 382		428 382	50 192	
Sales (net income)	**tsd UAH**	**741 763**	**116 487**	**858 250**	**706 379**	**141 518**	**847 897**
Direct operating costs	tsd UAH	692 907	102 953	791 160	738 520	119 587	851 442
incl. primary materials		12 912	1 100	14 012	12 679	2 252	14 931
energy		530 166	30 695	560 861	567 209	36 097	603 306
wages (main+additional)		48 075	34 037	82 112	60 979	42 582	103 561
taxes on wages (ESV)		17 807	12 569	30 376	22 583	15 855	38 438
depreciation		30 669	8 097	38 766	32 003	8 933	40 936
rehabilitation and maintenance		45 594	11 756	57 350	32 968	7 203	40 171
wastewater treatment			4 699			6 665	
water pumping		7 309		7 309	9 721		9 721
bulk water transport		375		375	377		377
General operating costs		312 672	44 784	357 456	330 002	53 255	383 257
Operating costs		**1 005 579**	**147 737**	**1 148 617**	**1 068 522**	**172 842**	**1 234 699**
Gross profit	tsd UAH	-263 816	-31 250	-290 367	-362 143	-31 325	-386 802
gross profit margin	*%*	*-36%*	*-27%*	*-34%*	*-51%*	*-22%*	*-46%*
Administrative costs	**tsd UAH**	**67 158**	**11 235**	**78 393**	**69 747**	**11 544**	**81 291**
D&S costs	**tsd UAH**	**30 397**	**10 261**	**40 657**	**34 005**	**12 156**	**46 161**
Operating profit (EBIT)	tsd UAH	-361 371	-52 746	-409 417	-465 895	-55 024	-514 253
Total costs		**1 103 134**	**169 233**	**1 267 667**	**1 172 274**	**196 542**	**1 362 150**
Average tariff	UAH/m3	1,585	2,748		1,649	2,820	
Total cost per unit	UAH/m3	2,357	3,993		2,737	3,916	

Having income, cost and volume of the services sold we obtained average tariff and total cost per 1.0m^3 for water supply and waste water collection, difference between which is negative during 2012-2016, please see table 10.

Table 10. Difference between average tariffs and total cost per unit for WS and WWC services of VD

		2012		2013		2014		2015		2016	
		WS	**WWC**	**WS**	**WWC**	**WS**	**WWC**	**WS**	**WWC**	**WS**	**WWC**
Average tariff	UAH/m3	1,585	2,748	1,649	2,820	1,814	2,821	1,833	2,683	2,712	4,120
Total cost per unit	UAH/m3	2,357	3,993	2,737	3,916	3,247	4,938	4,504	6,192	5,229	6,430
Difference / losess	UAH/m3	-0,772	-1,245	-1,088	-1,096	-1,433	-2,116	-2,671	-3,509	-2,518	-2,311

It means income per 1.0 m^3 does not cover the respective costs. This difference is main reason of the company losses (we do not consider incomes/costs from other services provided by VD). There could be two next steps of the further analysis: operating costs structure and sufficiency of tariff analyses.

Power consumption of WS services

Too high operating cost for WS services is due to electricity costs, which share had been 53% of total operating costs since 2012 and reached 62% in 2015-2016 (table 11).

Table 11. VD WS operating cost structure during 2012-2016

	2012		2013		2014		2015		2016	
	UAH tsd	share , %	UAH tsd	share , %	UAH tsd	share , %	UAH tsd	share , %	UAH tsd	share , %
Primary operating cost:										
primary material	12 912	1%	12 679	1%	12 562	1%	20 408	1%	45 397	3%
electricity	530 166	53%	567 209	53%	554 240	53%	842 876	62%	983 248	62%
wages with taxes	65 881	7%	83 562	8%	87 639	8%	98 974	7%	97 464	6%
other	83 947	8%	75 070	7%	66 891	6%	72 734	5%	86 513	5%
General operating costs	312 672	31%	330 002	31%	316 690	31%	327 994	24%	368 631	23%
Operating costs	**1 005 579**	**100%**	**1 068 522**	**100%**	**1 038 022**	**100%**	**1 362 985**	**100%**	**1 581 251**	**100%**

It could be explained by high power consumption and high or increasing price for power.

Specific power consumption of WS services of VD is more, than 1000 kWh / 1000 m^3 (table 12).

Table 12. Specific power consumption of WS services provided by VD (by ROOs)

	uint	2012	2013	2014	2015	9m 2016
Krasnoarmeysk/ Pokrovsk ROO						
Water obtained	tsd m3	86 483	84 842	54 672	58 351	60 021
Energy consumption	tsd kWh	37 735	35 227	23 205	24 303	25 737
Specific energy consumption	kWh/tsd m3	482	457	482	482	480
Slavyansk ROO						
Water obtained	tsd m3	33 610	33 858	33 813	33 587	26 541
Energy consumption	tsd kWh	36 618	37 160	36 547	38 687	29 169
Specific energy consumption	kWh/tsd m3	1 070	1 080	1 060	1 130	1 100
Chasov Yar						
Water obtained	tsd m3	26 176	25 867	22 866	21 742	16 546
Energy consumption	tsd kWh	11 754	11 049	10 800	11 057	8 231
Specific energy consumption	kWh/tsd m3	744	707	779	780	842
RDCO*		**2012**	**2013**	**2014**	**2015**	**2016**
Water obtained	tsd m3	538 360	528 121	441 540	513 212	496 012
Energy consumption	tsd kWh	463 411	445 970	363 898	430 909	417 311
Specific energy consumption	kWh/tsd m3	866	849	829	844	846
Donetsk ROO						
Water obtained	tsd m3	257 582	240 751	194 754	186 536	218 658
Energy consumption	tsd kWh	65 484	58 310	51 791	54 527	54 586
Specific energy consumption	kWh/tsd m3	260	248	273	299	255
Mariupol ROO						
Water obtained	tsd m3	104 389	98 080	88 751	81 199	72 814
Energy consumption	tsd kWh	39 901	36 476	35 541	31 280	27 303
Specific energy consumption	kWh/tsd m3	383	373	402	386	376
VDB in total						
Water obtained	tsd m3	700 183	680 480	617 744	677 830	626 325
Energy consumption, WS**	tsd kWh	751 310	724 363	612 283	687 524	685 093
Specific energy consumption**	kWh/tsd m3	1 117	1 114	1 031	1 047	1 127

RDCO* - Regional Department of the SDD Channel Operation; ** the data for 2016 could be clarified

As it follows from the table, high specific power consumption is at Slavyansk ROO, Regional Department of the SDD Channel Operation (RDCO), Chasiv Yar ROO and Krasnoarmiysk ROO. As for the Krasnoarmiysk ROO ratio - water pumping is fulfilled by the 1st lift station of SDW of Donetsk ROO through water mains up to the 2nd lift station of SDW.

More, than half of VD water abstraction and power consumption has RDCO, special VD subdivision, which serves and keeps in its book the SDD channel. Main features of RDCO operation please see in table 13. Its main business is water abstraction from the river and transferring it into the channel, reservoirs. About 70% of the obtained raw water is transferred to Chasiv Jar and Donetsk ROOs, also to Makiivka and Yenakiyeve VKs. Approx 7% of the obtained water RDCO treats and delivers (by VD internal turnover) to Horlivka VK. Just approx 5% of the obtained water is sold to Kramatorsk VK and some companies.

It should be noted that all of the mentioned above ROOs have suffered financial losses during 2012-2016. Exception is for Krasnoarmiysk ROO in 2016. RDCO justifiably suffers the largest losses, please see table 14.

Table 13. Main characters of VD Regional Department of the SDD Channel Operation during 2012- 2016

Characters	unit	2012	2013	2014	2015	2016
Water obtained	**tsd m3**	**538 360**	**528 121**	**441 540**	**513 212**	**496 012**
Raw water transferred inside		**388 506**	**381 526**	**293 740**	**293 437**	**339 446**
incl. to						
Chasiv Yar ROO	tsd m3	20 171	19 409	16 679	17 331	17 531
Yenakiyeve VK	tsd m3	50 918	54 564	40 990	44 412	50 295
Makiyivka VK	tsd m3	69 048	72 426	57 930	58 350	65 485
Donetsk ROO	tsd m3	248 369	235 127	178 141	173 345	206 134
Water discharged to reservoires	**tsd m3**	**2 936**	**6 431**	**14 265**	**13 397**	**11 585**
dynamic	*%*	*100%*	*219%*	*486%*	*456%*	*395%*
WS services	tsd m3	**72 504**	**66 212**	**56 396**	**59 250**	**62 071**
dynamic	*%*	*100%*	*91%*	*78%*	*82%*	*86%*
incl. drink.water VD internal	tsd m3	**39 347**	**38 199**	**33 317**	**34 850**	**36 382**
Water sold, incl.	**tsd m3**	**33 158**	**28 014**	**23 079**	**24 400**	**25 689**
raw pumped water:	tsd m3	***29 976***	***25 275***	***20 609***	***21 977***	***23 105***
for treatment on WTP	tsd m3	12 592	11 897	11 149	11 144	10 682
for industrial companies	tsd m3	9 131	6 753	2 454	1 270	1 422
for agriculture	tsd m3	1 253	1 240	386	563	831
for Vuglegirska TPS	tsd m3	6 999	5 385	6 620	9 000	10 170
raw discharged water	tsd m3	***3 182***	***2 738***	***2 470***	***2 423***	***2 584***
Water losess	**tsd m3**	**74 414**	**73 951**	**77 139**	**147 128**	**82 911**
share of losess	*%*	*13,8*	*14,0*	*17,5*	*28,7*	*16,7*
Drink.water VD internal turnover	tsd UAH	48 396	46 985	40 980	42 866	102 562
Sales (w/o VAT)	**tsd UAH**	**29 144**	**23 707**	**14 770**	**13 434**	**14 030**
raw pumped water:	tsd UAH	***28 727***	***23 348***	***14 446***	***13 116***	***13 691***
for treatment on WTP	tsd UAH	8 204	7 852	7 358	7 355	7 050
for industrial companies	tsd UAH	17 258	12 763	4 638	2 401	2 688
for agriculture	tsd UAH	1 003	992	309	450	665
for Vuglegirska TPS	tsd UAH	2 263	1 741	2 140	2 910	3 288
raw discharged water	tsd UAH	***418***	***360***	***324***	***318***	***339***
Bills paid	**tsd UAH**	**30 617**	**23 743**	**7 279**	**19 092**	**9 317**
raw pumped water	tsd UAH	30 199	23 384	6 955	18 774	8 978
raw discharged water	tsd UAH	418	360	324	318	339
Level of payment	%	105%	100%	49%	142%	66%
incl.:						
Kramatorsk VK	%	114	100	21	162	46
heating company	%	100	100	100	100	92
others	%	100	100	100	100	99
Average tariff						
- VD internal for drinking water	UAH/m3	1,23	1,23	1,23	1,23	2,82
- raw pumped water	UAH/m3	0,96	0,92	0,70	0,60	0,59
- raw discharged water	UAH/m3	0,13	0,13	0,13	0,13	0,13
Unit cost of WS						
- VD internal for drinking water	UAH/m3	7,65	8,60	8,54	11,97	14,16
- raw pumped water	UAH/m3	2,24	2,61	4,68	7,10	5,19
- raw discharged water	UAH/m3	0,39	0,46	0,55	0,47	0,46
Energy						
Energy consumption	tsd kWh	463 411	445 970	363 898	430 909	417 311
Energy costs	tsd UAH	350 481	382 982	365 245	597 527	662 739
Specific energy consumption	kWh/tsd m	866	849	829	844	846
		end of 2012	end of 2013	end of 2014	end of 2015	end of 2016
Trade receivables (with doubtful)	tsd UAH	1 528	1 485	10 474	3 685	9 341
incl. from Kramators.VK, all doubtful	tsd UAH	1 506	1 468	10 454	3 655	9 271
Trade payables	**tsd UAH**	**326 680**	**519 598**	**716 982**	**815 317**	**1 433 731**
incl. for power	tsd UAH	324 983	517 589	712 954	809 354	1 426 276
share	*%*	*99,5%*	*99,6%*	*99,4%*	*99,3%*	*99,5%*
Fixed assets, initial value	tsd UAH	586 103	684 342	687 256	691 946	703 648
residual value	tsd UAH	190 877	276 258	265 681	256 622	254 937
residual value ratio	%	33%	40%	39%	37%	36%

Table 14. Main financial data of RDCO

	unit	2012				2016			
		Drink.internal	RP water	RD water	Total	Drink.internal	RP water	RD water	Total
Water (internal, sold)	tsd m3	39 347	29 976	3 182	72 504	36 382	23 105	2 584	62 071
Sales (net income)	tsd UAH		28 727	418	29 144		13 691	339	14 030
Internal turnover	tsd UAH	48 396			48 396	102 562			102 562
Direct operating costs	tsd UAH	250 636	55 774	368	306 778	464 757	108 415	333	573 504
incl. primary materials		1 106	0	0	1 106	3 750	0	0	3 750
energy		243 143	52 758	0	295 901	453 850	105 985	0	559 835
wages (main+additional)		2 162	411	0	2 574	3 095	569	0	3 664
taxes on wages (ESV)		805	153	0	958	680	119	0	799
depreciation		1 291	925	118	2 334	1 276	929	202	2 408
rehabilitation and maintenance		2 127	1 527	251	3 905	2 106	812	131	3 048
General operating costs		47 281	10 660	847	58 788	46 690	10 589	858	58 136
Opetating costs	tsd UAH	297 917	66 434	1 215	365 566	511 446	119 003	1 191	631 640
Gross profit	tsd UAH	-249 521	-37 707	-797	-336 422	-408 884	-105 312	-852	-617 610
gross profit margin	%	*-516%*	*-131%*	*-191%*	*-1154%*	*-399%*	*-769%*	*-251%*	*-4402%*
Administrative costs	tsd UAH	3 238	721	13	3 972	3 596	820	8	4 423
D&S costs	tsd UAH	0	0	0	0	0	0	0	0
Operating profit (EBIT)	tsd UAH	-252 758	-38 429	-810	-340 393	-412 480	-106 132	-859	-622 033
Total costs	tsd UAH	301 155	67 155	1 228	369 538	515 042	119 823	1 199	636 063
Tariff average	UAH/m3	1,23	0,96	0,13		2,82	0,59	0,13	
Total costs per unit	UAH/m3	7,65	2,24	0,39	5,10	14,16	5,19	0,46	10,25
Internal turnover	tsd UAH	-48 396	0	0	-48 396	-102 562	0	0	-102 562
Total costs w/o internal turnover	tsd UAH				321 141				533 501
Water sold w/o internal turnover	tsd m3		29 976	3 182	33 158		23 105	2 584	25 689

RP- raw pumped water RD - raw discharged water

Donetsk ROO and Mariupol ROO traditionally make profit for the company because of lower specific power consumption and larger volumes of the water sold (table 15).

Table 15. Main financial data of Mariupol ROO

	unit	2012	2013	2014	2015	2016
Water obtained	tsd m3	104 389	98 080	88 751	81 199	72 814
losess	tsd m3	4 186	3 521	3 424	2 977	3 577
	%	*4%*	*4%*	*4%*	*4%*	*5%*
Water sold	tsd m3	100 203	94 559	85 326	75 187	69 237
Sales (net income)	tsd UAH	168 808	145 207	140 730	128 342	237 071
Direct operating costs	tsd UAH	40 751	40 300	41 054	50 106	53 386
incl. primary materials		1 608	1 625	1 603	2 528	4 467
energy		30 567	29 508	32 142	38 926	39 465
internal water (VDB)						
wages (main+additional)		2 717	2 977	3 195	3 591	3 883
taxes on wages (ESV)		1 027	1 133	1 221	1 353	858
depreciation		1 759	1 950	2 078	2 004	2 048
water pumping outside						
waste water treatment outside						
rehabilitation and maintenance		3 073	3 108	815	1 704	2 666
General operating costs		19 461	19 632	18 357	18 993	20 495
Operating costs		60 212	59 933	59 411	69 098	73 881
Gross profit	tsd UAH	108 596	85 274	81 319	59 244	163 191
gross profit margin	%	*64%*	*59%*	*58%*	*46%*	*69%*
Administrative costs	tsd UAH	2 503	2 921	3 168	4 342	4 614
D&S costs	tsd UAH	305	146	166	132	41
Operating profit (EBIT)	tsd UAH	105 787	82 207	77 985	54 770	158 536
EBIT	%	*63%*	*57%*	*55%*	*43%*	*67%*
Average tariff	UAH/m3	1,685	1,536	1,649	1,707	3,424
Total costs per unit	UAH/m3	0,629	0,666	0,735	0,979	1,134
Difference	UAH/m3	*1,056*	*0,869*	*0,914*	*0,728*	*2,290*

Please, note, the higher specific energy consumption is in GCA, where water is abstracted and transferred to other VD subdivisions.

Thus, WS service of VD is a power-consuming industry, because water is supplied throughout the Donetsk region by means of 4 lift stations and because of energy-intensive equipment used. All facilities were

constructed during Soviet Union time, assuming large volume of water consumption and using energy-intensive equipment available at that time.

Additionally, tariff for power has been increasing from year to year, please see table 16. Tariffs on power supply, WS and WWC services are to be approved by National regulator (NKREKP). But they have full force and effect in GCA only. VD has higher power tariff and lower tariffs for WS and WWC services in NGCA.

Table 16. Power and VD water tariffs growth ratios during 2012-2016 (tariffs are without VAT)

	2012	2013	2014	2015	2016
Power tariff average, UAH/kWh	0,776	0,833	0,955	1,266	1,455
Growth ratio, %		*7%*	*15%*	*33%*	*15%*
Water tariff for VK, UAH/m3	1	1	1,47	1,47	4,09
Growth ratio, %		*0%*	*47%*	*0%*	*178%*
Water tariff for population, UAH/m3	3,47	3,47	3,47	3,47	8,18
Growth ratio, %		*0%*	*0%*	*0%*	*136%*

As can be seen from the table, in spite of the power tariff growth in 2013 and 2015 (more than by 5%) water tariffs were not increased during these years. Although, water tariff increased more, than the power one in 2014 and 2016. Power price grew up by 15% in 2016 vs 2015, but water price grew up by 2.8 times for VKs and by 2.4 times for domestic consumers, both in GCA. Centralize water tariff growth is one of the reasons why accounts receivable of VD from VKs and population increased by approx 2 times in 2016 versus 2015.

According to Ukrainian legislation, power cost spent on water transferring shall be financed from state budget. VD utilizes in average 73% of the power, consumed for water transferring (table 17).

Table 17. Share of energy consumption for water transferring during 2012- 2016

		2012	2013	2014	2015	2016
Energy consumption, WS	tsd kWh	751 310	724 363	612 283	687 524	685 093
Energy consumption for water transferring	tsd kWh	552 414	530 221	434 272	513 689	505 395
share	*%*	*74%*	*73%*	*71%*	*75%*	*74%*

Assuming state compensation of the power costs for water transferring we will obtain the following difference between average water tariff and cost per unit (table 18).

Table 18. Difference between average tariff and cost per unit presuming power costs for water transferring is compensated

		2012		2013		2014		2015		2016	
		WS	WWC	WS	WWC	WS	WWC	WS	WWC	WS	WWC
Average tariff	UAH/m3	1,585	2,748	1,649	2,820	1,814	2,821	1,833	2,683	2,712	4,120
Total cost per unit	UAH/m3	1,524	3,993	1,767	3,916	2,125	4,938	2,573	6,192	2,996	6,430
Difference / losess	UAH/m3	0,061	-1,245	-0,118	-1,096	-0,312	-2,116	-0,740	-3,509	-0,284	-2,311

Thus, even after covering power costs for water transferring, VD WS and WWC services would make losses with the respective tariffs during 2012-2015. Tariffs applied in GCA since January 2016 are enough to cover WS and WWC costs under the condition that power costs for water transferring are repaid (table 19).

Table 19. Difference between average tariff and cost per unit presuming power costs for water transferring is compensated and considering difference between GCA and NGCA

	unit	2016 VDB total			2016 NGCA			2016 GCA		
		WS	WC	Total	WS	WC	Total	WS	WC	Total
Water sold	tsd m3	324 755	39 779		138 310	26 730		186 445	13 049	
Sales (net income)	tsd UAH	880 577	163 878	1 044 455	289 808	65 083	354 892	590 769	98 794	689 563
Direct operating costs	tsd UAH	487 276	167 405	647 863	258 817	114 569	367 056	228 460	52 835	280 808
incl. primary materials		45 397	3 097	48 494	26 583	1 999	28 581	18 814	1 098	19 912
energy		257 903	59 928	317 831	131 212	40 379	171 591	126 691	19 549	146 240
wages (main+additional)		80 154	63 677	143 831	45 208	43 667	88 875	34 946	20 011	54 957
taxes on wages (ESV)		17 310	13 774	31 084	9 766	9 393	19 159	7 544	4 382	11 926
depreciation		35 445	10 772	46 217	18 234	6 953	25 187	17 212	3 819	21 031
rehabilitation and maintenance		37 813	9 339	47 152	20 053	5 849	25 902	17 760	3 490	21 249
wastewater treatment			6 818			6 330			488	
water pumping		12 542		12 542	7 344		7 344	5 198		5 198
bulk water transport		712		712	417		417	295		295
General operating costs		368 631	63 964	432 595	200 654	37 368	238 022	167 977	26 596	194 573
Operating costs		855 907	231 369	1 080 458	459 471	151 937	605 078	396 436	79 431	475 380
Gross profit	tsd UAH	24 670	-67 491	-36 003	-169 662	-86 854	-250 186	194 332	19 363	214 183
gross profit margin	%	*3%*	*-41%*	*-3%*	*-59%*	*-133%*	*-70%*	*33%*	*20%*	*31%*
Administrative costs	tsd UAH	79 466	13 375	92 841	43 311	8 265	51 576	36 155	5 110	41 265
D&S costs	tsd UAH	37 533	11 049	48 582	21 943	5 941	27 884	15 591	5 108	20 698
Operating profit (EBIT)	tsd UAH	-92 329	-91 915	-177 426	-234 916	-101 060	-329 645	142 587	9 145	152 219
Total costs		972 906	255 792	1 221 880	524 724	166 143	684 537	448 182	89 649	537 343
Average tariff	UAH/m3	2,712	4,120		2,095	2,435		3,169	7,571	
Total cost per unit	UAH/m3	2,996	6,430		3,794	6,216		2,404	6,870	
Difference	**UAH/m3**	**-0,284**	**-2,311**		**-1,698**	**-3,781**		**0,765**	**0,701**	

It follows from the table, that under the conditions: a) energy costs for water transferring is financed by duty-bearer ; b) tariffs for WS and WWC introduced in 2016 and applied in GCA, are the same in NGCA, VD would make profit from WS and WWC services in 2016.

Actually VD obtained some part (for 2 months) of compensation for water transferring costs just in 2012 during the observed period, please see table 20.

Table 20. VD state budget financing during 2012 – 2016, UAH tsd

	2012	2013	2014	2015	2016
Budget financing, incl.:	**706 992**	**188 917**	**127 056**	**564 380**	**83**
difference in tariff	653 979	164 129	105 510	563 563	0
water transferring costs	42 523	0	0	0	0
other	10 490	24 788	21 546	817	83

Thanks to the above budget financing VD made profit in 2012.

We can see from the table also reimbursement of difference in tariff during 2012-2015. This kind of the budget financing was not foreseen for VD for 2016 because tariffs for WS and WWC services introduced since 2016 are economically justified if water transferring costs are repaid and the introduced tariffs are the same in the both areas. But we know from the above analysis, there are actually two areas with different water supply volumes, supply structure, power consumption, tariffs and budgetary support (please return to table 8).

Cash flow of VD Company

Cash flow of the company based on the accounting data is presented in table 21.

Table 21. VD cash flow for 2012-2016

Cash flow, UAH tsd	2012	2013	2014	2015	2016
Cash flow from operating activity:					
EBITDA	211 272	-311 031	-413 318	-313 154	-762 277
Changes in working capital	-195 137	333 954	406 873	314 776	790 036
changes in ST and LT provisions	-335	2 437	10	1 599	-1
changes in inventory	5 618	5 202	1 335	-46 962	-51 376
changes in trade receivables	108 689	6 056	-224 576	-157 810	-393 729
changes in other receivables	31 176	11 051	-9 689	-101 999	-218 982
changes in trade payables	-365 048	282 360	492 834	363 338	1 179 819
changes in other payables	13 253	12 818	133 299	248 475	264 824
chang. in other current liabil.	11 510	14 030	13 660	8 135	9 481
Operating cash flow	16 135	22 923	-6 445	1 622	27 759
financial expenses	-2	0	0	0	0
other revenue/expenses	15 927	15 908	23 639	25 452	25 428
Net operating cash flow	**32 060**	**38 831**	**17 194**	**27 074**	**53 187**
Cash flow from investing activity	-146 548	-187 641	-67 447	-65 224	-79 237
total changes in FA	-146 548	-187 641	-67 447	-65 224	-79 237
Cash flow from Equity & subdebt activ.	99 047	145 679	46 967	40 186	31 770
Net cash flow from investing act.	**-47 501**	**-41 962**	**-20 480**	**-25 038**	**-47 467**
Cash flow from financing activities	0	0	0	0	0
changes in ST&LT interest bearing debt	0	0	0	0	0
Net cash flow from financing act.	**0**	**0**	**0**	**0**	**0**
Net changes in cash position	-15 441	-3 131	-3 286	2 036	5 720
Cash at the beginning	27 000	11 559	8 428	5 142	7 178
Cash at the end	11 559	8 428	5 142	7 178	12 898

As it follows from the table, main business of VD resulted in negative cash flow for 2013-2016 (see EBITDA). Positive EBITDA in 2012 has been explained by the budget financing. Net cash flow from operating activity became positive thanks to: a) changes in working capital, namely due to huge increase of trade and other accounts payable; b) thanks to other non-operating revenues. Negative net cash flow from investing activity means VD has kept increasing fixed assets (FA). These investments in FA (non-current assets) comprise of: 1) new FA introduced into operation, 2) rehabilitation and modernization of the available assets, also 3) increase in the value of the available FA. The latter is not actually investing in FA, it is just revaluation of 100% depreciated FA, which cannot be written off due to the lack of a replacement.

Given the fact VD has no separate accounting reports for GCA and NGCA; let us consider cash flow issue with the help of a simple table (example) to understand the situation with cash in NGCA (table 22). This area has lower WS and WWC tariffs, higher power tariff and lower collection rate. For calculation was used earlier considered data on sales, collection rate and some groups of costs, which we ranged by priority.

Table 22. Incoming and outcoming cash flow from operating activity in NGCA (example)

	unit	2014	2015	2016
Sales (net income)	tsd UAH	456 171	407 354	354 892
Collection rate	*%*	*70%*	*51%*	*67%*
Bills paid (incoming cash)	**tsd UAH**	**319 320**	**207 750**	**237 777**
salary and wages		163 536	199 403	221 726
taxes on salary and wages		59 938	73 084	81 265
rehabilitation and maintenance		19 427		
services obtained		17 873		
primary materials		10 879		
fuel		17 095		
Rest of the incoming cash		**30 573**	**-64 736**	**-65 214**

As it follows from the table, thanks to higher sales and collection rate in 2014, operating incoming cash in NGCA amounted to UAH 319.3 mln. This cash was enough to pay salary and wages, taxes on the salary and wages; to fulfill rehabilitations and maintenances during the year; to pay for services obtained, primary materials and fuel. The rest amount after supposed expenditures is positive for 2014. But incoming cash was definitely not enough to cover all costs (UAH 780 mln). In 2015 incoming cash amounted to UAH 207.8

mln and could be spent on salary and wages and partly on taxes on salary and wages. The same situation was in 2016. Also, considering the example we should remember that we take into account yearly amounts only and do not consider cash flow by months. It means we cannot take into account delays in cash incoming during a year. Money could be obtained not by equal parts within a year, but in the end of a year only. It is true for 2014, when the SDD channel was damaged in July and there was no WS during several days; shortage and delay with payment obtained.

The cash flow between the NGCA and the GCA is very restricted due to a very few possibility to reroute cash between these areas (due to contact line) inside one company. Moreover, NGCA circulating currency is RUR.

Due to cash flow shortage, VD subdivisions and other VKs have been supported by humanitarian organizations, such as: Switzerland embassy in Ukraine, International Committee of the Red Cross, UNICEF, PIN also by Russian Federation.

Humanitarian support by water treating materials, fuel, machinery and equipment also other inventory (construction materials, spare parts, pipes, fittings, electrodes, bearing parts, metalware and so on) amounted to UAH 53.8 mln in 2015 and UAH 96.5 mln in 2016, please see table 23.

Table 23. Humanitarian aid toward VD in comparison with its own procurement, UAH tsd

	2015				**2016**			
	GCA		NGCA		GCA		NGCA	
	at own expense	**humanitarian aid**	at own expense	**humanitarian aid**	at own expense	**humanitarian aid**	at own expense	**humanitarian aid**
fuel	37 775		11 127	7 134	28 446		28 841	1 822
treating materials	4 225	8 460		22 292	3 309	15 151		40 103
inventory	21 638	590	4 358	13 306	40 197	91	19 291	26 682
machinery and equipment	3 301		350	1 972	9 093	194	2 004	12 155
work protective clothes	135		35		1 315		361	342
total	**67 074**	**9 050**	**15 870**	**44 704**	**82 360**	**15 436**	**50 497**	**81 104**

Please, pay attention all treating materials for NGCA are supplied as humanitarian aid. In 2016 57% of the humanitarian support was spent for treating materials, 28% for inventory and 13% for machinery & equipment.

Humanitarian support makes up about 40% of all costs for treating materials, fuel, machinery and equipment, other inventory of VD in 2015-2016. The other 60% cost was at own expense. About 84% of the support has been provided into NGCA and the rest of 16% into GCA.

VD fixed assets analysis

Initial value of VD FA is UAH 2.99 bln as of the end of 2016, its residual value is UAH 0.96 bln or 32% of the initial value. It is just average ratio for the whole company. For example, FA residual value ratio by ROOs as of the end of 2016 is like this: at Krasnoarmiysk ROO - 32%, Slavyansk ROO – 35%, Mariupol ROO – 18%, Chasiv Jar ROO – 8%! Artemivsk WTP, Chasiv Yar WTP, built in 195,8 are depreciated by 93%! WPS in vil. Nikolaevka was put into operation in 1885!

Considering the increase in the value exercising by the company during previous years, actual residual value ratio of all assets is less, than 32%. Deterioration of the assets differs between economic groups of FA. For example, WS assets are more deteriorated, than WWC assets. Residual value of WS FA was 30% as of the end of 2015, please see table 24.

Table 24. VD Fixed assets for water abstraction, treatment and water supply, UAH tsd

UAH tsd	2012	2013	2014	2015
FA at initial value, beg. of the year	1 918 690	2 053 811	2 197 368	2 237 557
New FA	12 826	6 678	1 639	2 336
Liquidated FA	15 695	8 409	3 883	2 390
FA Rehabilitation, modernization	13 156	6 968	1 323	1 998
Increase in the value of FA	12 310	32 778	16 323	14 092
Residual value, end of the year	623 077	724 019	698 018	682 842
FA residual value ratio, end of year, %	32%	35%	32%	30%
100% depreciated FA	33 362	48 721	94 004	86 213
100% depreciated FA to resid.value ratio	5%	7%	13%	13%
Net FA value increase for the year, incl.:	**22 597**	**38 015**	**15 402**	**16 036**
due to new FA, considering liquidat.	-2 869	-1 731	-2 244	-54
due to rehabalitation, modernization	13 156	6 968	1 323	1 998
due to increase in the value	12 310	32 778	16 323	14 092

Completely depreciated WS FA at the end of 2015 reached 13% relative to residual value. Thus, if there is no investment in FA, the available WS FA will be depreciated up to 100% in 8 years. Please, note, WS FA grow mainly due to increase in the value and partly due to rehabilitation and modernization. New assets are not enough to replace the liquidated ones. It means VD needs significantly more investment into FA, than done until 2015.

Residual value of WWC assets was 40% as of the end of 2015, please see table 25.

Table 25. VD Fixed assets for sewerage, waste water collection and treatment, UAH tsd

UAH tsd	2012	2013	2014	2015
FA at initial value, beg. of the year	221 432	302 838	352 529	395 571
New FA	1 938	10 233	359	563
Liquidated FA	5 136	453	162	788
Rehabilit., moderniz.	610	9 276	442	569
Increase in the value	833	2 096	4 091	2 175
Residual value, end of the year	119 212	151 516	160 926	159 928
FA residual value ratio, %	54%	47%	45%	40%
100% depreciated FA	5 653	25 805	21 376	29 678
100% depreciated FA to resid.value ratio	5%	17%	13%	19%
Net FA value increase for the year, incl.:	**-1 755**	**21 152**	**4 730**	**2 519**
due to new FA, considering liquidat.	-3 198	9 780	197	-225
due to rehabalitation, modernization	610	9 276	442	569
due to increase in the value	833	2 096	4 091	2 175

Completely depreciated WW FA at the end of 2015 reached 19% relative to residual value. Thus, if there is no investment in FA, the available WW FA will be completely depreciated in about 5 years! WWC fixed assets grow mainly due to increase in the value, partly due to rehabilitation and modernization and due to introduction into operation new assets (UAH 9.78 mln in 2013). These new assets make up 6.5% only relative to the respective residual value.

Reasons of VD account receivables growth

Increased water tariff (by 2.8 times in 2016 vs 2015), over-projected water sales and large water losses are the main reasons of VKs indebtedness toward VD. Plan for water sales per year is set up by National regulator as well as tariff. Higher tariff (actually water price) for VD means higher expenditure (water cost) for vodokanals, which buy bulk water (drinking or raw) and distribute it among retail consumers. Buying bulk water and distributing it among population and entities, VKs are affected not only by VD water tariff, but also by water losses. Every VK (and VD as well) has approved process losses, which are considered in the tariff calculation. These process losses are verified by respective institutions and approved every 5 years according to VK apply. In general, the more water losses, the more cost per 1.0 m^3. Finally it can results in VK financial losses.

Some data on VKs operation is presented in tables 26-28.

Table 26. Some data on Mariupol VK operation

		2012	2013	2014	2015	9m 2016
Water obtained	*tsd m3*	50 691	52 521	51 643	48 696	35 134
Water losses	*tsd m3*	17 281	17 501	17 544	18 310	16 899
losses	*%*	*34%*	*33%*	*34%*	*38%*	*48%*
Water sales	*tsd m3*	33 410	35 020	34 099	30 385	18 235
Sales w/o VAT	*UAH tsd*	144 839	156 109	164 076	182 462	196 048
collection rate	*%*	*103%*	*102%*	*97%*	*94%*	*92%*
Average tariff	*UAH/m3*	4,34	4,46	4,81	6,00	10,75
Total cost per unit	*UAH/m3*	3,07	3,29	4,22	5,03	11,42

Water bough amounted to 48% of total Mariupol VK costs in 2012 and 67% in 2016.

Table 27. Some data on Krasnoarmiysk VK operation

		2012	2013	2014	2015	9m 2016
Water obtained	tsd m3	8 496	8 355	5 645	6 922	5 737
Water losses	tsd m3	4 822	4 714	3 110	3 940	3 458
water losses	%	57%	56%	55%	57%	60%
Water sold	tsd m3	3 674	3 641	2 535	2 982	2 279
Sales w/o VAT	UAH tsd	19 035	18 841	12 815	16 315	19 536
collection rate	%	99%	100%	95%	100%	90%
Average tariff	UAH/m3	5,2	5,2	5,1	5,5	8,6
Total cost per unit	UAH/m3	5,2	5,5	7,1	7,3	14,6

Water cost share increased from 44% in 2012 up to 71% in 2016.

Table 28. Some data on Slavyansk VK operation

		2012	2013	2014	2015	9m 2016
Water obtained	tsd m3	9 919	9 858	8 419	8 851	6 247
Water losses	tsd m3	6 206	6 144	5 137	5 101	3 245
losses		*63%*	*62%*	*61%*	*58%*	*52%*
Water sold	tsd m3	3 713	3 715	3 282	3 751	3 002
Sales w/o VAT	UAH tsd	13 730	13 805	11 149	18 936	31 763
collection rate		*89%*	*72%*	*95%*	*85%*	*66%*
Average tariff	UAH/m3	3,70	3,72	3,40	5,05	10,58
Cost per unit	UAH/m3	5,39	5,43	7,26	7,65	12,47

We can sum up from the tables 26-28 the following:

- All of the examined VKs have high water losses, more, than 30%. Krasnoarmiysk VK water losses reached 60% in 2016.
- Mariupol VK and Krasnoarmiysk VK have acceptable collection rate, more than 90%. Slavyansk VK has low collection rate of 72-66%. It is caused by structure of sales: share of domestic consumers in sales of Krasnoarmiysk VK reaches 46-65%; of Mariupol VK – 36-54%; of Slavyansk VK – 78-87%. The more share of domestic consumers in sales, the less collection rate. However, they are located in GCA and can apply scheme of benefits and subsidy.
- All of the examined VKs have costs per unit, which are higher than the average tariff (except for Krasnoarmiysk VK in 2012), thus negative differences and possible financial losses.
- Please, note while decreasing water losses, VK cost has become less influenced by a growth of tariff for water bought. Mariupol VK and Krasnoarmiysk VK water losses grew up in 2016 vs 2015

and their cost per unit increased by approx 2 times. Slavyansk VK decreased water losses in 2016 vs 2015 and its cost per unit grew up by 60% only. It means water losses affect VKs cost per unit more, than the tariff for bought water.

General causes of VKs' indebtedness toward VD are resumed in table 29.

Table 29. General factors resulting in accounts receivable of VD growth

From the side of VKs located in GCA	From the side of VK located in NGCA
Water losses above approved process losses	Water losses above approved process losses*
Largely increased tariff for water bought	Low tariff for water sold to consumers, not covering increased costs for water treatment and other consumables, and electricity costs.
Decreased collection rates from domestic consumers	Decreased collection rates from domestic consumers
Over-projected water volume sales. While planning cost per 1.0m^3 is less than actual cost relative to lower volume sold	Neither scheme of benefit and subsidy (from the state budget toward population), nor scheme of reimbursement of difference in tariff since 2015.

*High water losses are common situation for vodokanals in the whole, given the fact we had no possibility to obtain data on independent VKs located in NGCA, we presume big losses. Exception is Donetsk VK, which declined water losses from approx 50% in 2012 down to 33% in 2016 thanks to respective investigations made prior to conflict and correspondent measures fulfilled.

One more factor, which we do not consider like a general one for VKs in NGCA, is the following. Considering Donetsk VK is registered in GCA, it credits taxes according to Ukrainian fiscal legislation, locating in NGCA it has to pay taxes in accordance to local legislation as well. For example, to get money from Donetsk republic bank account to pay salary, VK shall pay 31% from the amount. The same factor affects VD subdivisions located in NGCA.

VD water losses

Water losses is a pressing challenge for VD Company as well (table 30).

Table 30. VD water losses during 2012-2016

	units	**2012**	**2013**	**2014**	**2015**	**2016**
Water obtained	tsd m3	700 183	680 480	617 744	677 830	626 325
Water discharged to reserv.		8 754	6 880	33 266	28 919	26 740
water losses	tsd m3	223 321	245 219	234 024	322 914	274 830
water losses	*%*	*32%*	*36%*	*40%*	*50%*	*46%*
Water sold	tsd m3	468 108	428 382	350 454	325 997	324 755

VD water losses growth up to 50% in 2015 is a result of SDD channel DN 2100 – 2800 damages, also water main and water network damages. Water losses among VD ROOs (table 31).

It follows from the table, that the average share of the losses within the VD ROOs is not more, than 23%. VD water losses of 36-46% are caused by substantial losses of some VKs, which are included into VD structure.

Table 31. VD ROOs water losses

	uint	2012	2013	2014	2015	9m 2016
Krasnoarmeysk/ Pokrovsk ROO						
Water obtained	tsd m3	86 483	84 842	54 672	58 351	60 021
water losses	*%*	*3,0%*	*3,1%*	*5,5%*	*5,5%*	*5,4%*
Slavyansk ROO						
Water obtained	tsd m3	33 610	33 858	33 813	33 587	26 541
water losses	%	*20,0%*	*22,6%*	*35,2%*	*34,0%*	*35,2%*
Chasov Yar						
Water obtained	tsd m3	26 176	25 867	22 866	21 742	16 546
water losses	%	*8,7%*	*9,5%*	*10,7%*	*10,5%*	*10,0%*
RDCO*		**2012**	**2013**	**2014**	**2015**	**2016**
Water obtained	tsd m3	538 360	528 121	441 540	513 212	496 012
water losses	%	*13,8*	*14,0*	*17,5*	*28,7*	*16,7*
Donetsk ROO						
Water obtained	tsd m3	257 582	240 751	194 754	186 536	218 658
water losses	%	*2,3%*	*2,3%*	*2,0%*	*2,2%*	*2,2%*
Mariupol ROO						
Water obtained	tsd m3	104 389	98 080	88 751	81 199	72 814
water losses	%	*4,0%*	*3,6%*	*3,9%*	*3,7%*	*4,9%*
RDCO* - Regional Department of the SDD Channel Operation						

One through the big VKs included into VD Company is Horlivka VK, which water losses reached 77% in 2016, please see table 32 with details of the VK operation in table 33.

Table 32. Some data on Horlivka VK (VD subdivision) operation

		2012	2013	2014	2015	2016
Water obtained	tsd m3	39 329	38 184	33 302	34 844	36 371
Water losses	tsd m3	26 784	25 542	22 701	26 473	27 931
losses	*%*	*68%*	*67%*	*68%*	*76%*	*77%*
Water sold	tsd m3	12 545	12 642	10 602	8 370	8 440
Sales w/o VAT	UAH tsd	46 527	47 423	39 434	31 222	32 354
collection rate	*%*	*94%*	*95%*	*69%*	*61%*	*77%*
Average tariff	UAH/m3	3,71	3,75	3,72	3,73	3,83
Cost per unit	UAH/m3	6,56	6,53	6,96	9,35	17,27

From the table we can see not only huge share of the water losses, also low collection rate for WS services since 2014. It is because domestic consumers make up about 73% of total sales, share of businesses decreased from 17% in 2012-2013 down to 15%. The biggest consumer in the area, "Artemugol", wound up its business in 2014. Please, note the lower average tariff for 2015 – 2016 (in comparing to tables 26-28) due to location in NGCA. Also, please, take into account, that Horlivka VK, as a part of VD, pays for water under internal VD tariff (1.23 UAH/m^3 during 2012-2015 and 2.82 UAH/m^3 since 2016). Comparing cost per unit of Horlivka VK for 2016 (17.27 UAH/m^3) with the same criteria of independent VKs considered in tables 22-24 (11.42 UAH/m^3; 12.47 UAH/m^3; 14.60 UAH/m^3), we can make conclusion that in spite of cheaper water bought (2.82 UAH/m^3 for insiders vs 4.09UAH/m^3 for outsiders), Horlivka VK has larger total cost per 1.0m^3 because of significant water losses. It means water losses affect VKs' cost per unit more than the tariff for water bought.

Horlivka VK was the first VK included into VD structure in 2004. Technical condition of Horlivka VK water network is very bad, it requires of 50 km of network replacement per year.

Table 33. Horlivka VK WS and WWC profit and losses

	unit	2012			2013			2014			2015			2016		
		WS	WWC	**Total**	WS	WWC	**Total**	WS	WWC	**Total**	WS	WWC	**Total**	WS	WWC	**Total**
Water obtained	tsd m3	39 329			38 184			33 302			34 844			36 371		
losses	tsd m3	26 784			25 542			22 701			26 473			27 931		
losses	*%*	*68%*			*67%*			*68%*			*76%*			*77%*		
Water sold	tsd m3	12 545	9 349		12 642	9 458		10 602	7 782		8 370	5 675		8 440	5 558	
Sales (net income)	**tsd UAH**	**46 527**	**25 870**	**72 397**	**47 423**	**26 285**	**73 708**	**39 434**	**21 152**	**60 587**	**31 222**	**15 212**	**46 434**	**32 354**	**15 358**	**47 712**
Direct operating costs	**tsd UAH**	**58 495**	**15 112**	**73 607**	**57 773**	**16 330**	**74 103**	**50 730**	**14 580**	**65 309**	**53 384**	**14 264**	**67 648**	**114 681**	**18 198**	**132 878**
incl. primary materials		11	105	116	10	129	139	7	66	73	24	0	24	30	48	78
energy		1 644	5 858	7 502	1 772	6 234	8 006	1 541	5 598	7 139	1 748	6 095	7 842	2 567	8 790	11 357
internal water (VDB)		48 374		48 374	46 966		46 966	40 962		40 962	42 858		42 858	102 543		102 543
inside VDB water tariff		*1,230*			*1,230*			*1,230*			*1,230*			*2,819*		
wages (main+additional)		2 163	2 857	5 020	3 488	4 542	8 031	3 401	4 376	7 777	3 676	4 177	7 853	3 691	4 813	8 504
taxes on wages (ESV)		822	1 094	1 917	1 336	1 747	3 083	1 298	1 675	2 973	1 362	1 561	2 923	808	1 067	1 875
depreciation		1 572	1 348	2 921	1 624	1 424	3 048	1 602	1 384	2 986	1 596	1 113	2 708	1 528	1 306	2 833
water pumping		872		872	846		846	841		841	1 115		1 115	1 318		1 318
waste water treatment			1 389	1 389		1 608	1 608		1 336	1 336		1 045	1 045		1 301	1 301
rehabilitation and maintenance		3 036	2 460	5 496	1 731	645	2 376	1 079	144	1 222	1 007	274	1 280	2 197	873	3 070
General operating costs		**15 671**	**5 905**	**21 576**	**16 484**	**6 423**	**22 907**	**15 883**	**5 317**	**21 200**	**17 684**	**4 932**	**22 616**	**22 225**	**4 999**	**27 224**
Gross profit	tsd UAH	-27 638	4 853	-22 786	-26 834	3 532	-23 302	-27 178	1 255	-25 923	-39 846	-3 984	-43 830	-104 552	-7 838	-112 390
gross profit margin	*%*	*-59%*	*19%*	*-31%*	*-57%*	*13%*	*-32%*	*-69%*	*6%*	*-43%*	*-128%*	*-26%*	*-94%*	*-323%*	*-51%*	*-236%*
Administrative costs	**tsd UAH**	**2 827**	**804**	**3 631**	**2 854**	**877**	**3 731**	**2 606**	**780**	**3 385**	**2 676**	**713**	**3 389**	**3 400**	**577**	**3 977**
D&S costs	**tsd UAH**	**5 274**	**1 499**	**6 773**	**5 462**	**1 678**	**7 141**	**4 588**	**1 375**	**5 963**	**4 538**	**1 241**	**5 778**	**5 433**	**926**	**6 359**
Operating profit (EBIT)	tsd UAH	-35 739	2 550	-33 190	-35 150	977	-34 174	-34 372	-900	-35 271	-47 060	-5 937	-52 997	-113 385	-9 341	-122 726
EBIT	*%*			*-46%*			*-46%*			*-58%*			*-114%*			*-257%*
Average tariff	UAH/m3	3,709	2,767		3,751	2,779		3,720	2,718		3,730	2,681		3,833	2,764	
Total costs per unit	UAH/m3	6,558	2,494		6,532	2,676		6,962	2,834		9,352	3,727		17,267	4,444	
difference	UAH/m3	-2,849	0,273		-2,781	0,103		-3,242	-0,116		-5,622	-1,046		-13,434	-1,681	

Annex 5 – Images of electromechanical equipment

SDD 3rd Lift Station

The pumps of Pumping Station 3, No. 1, dismantled

The main transformers at the substation of SDD 3rd Lift Station

SDD channel with ice cover at the intake for the Pumping Station 3

Pumps no. 3+4 at Pumping Station 3

Main pipes after Pumping Station 3A

SDD 4th Lift Station

Machine hall of 4th Lift Station, unit no. 2, dismantled motor

Main pipes after Pumping Station 4

6kV indoor switchgear at Sloviansk WTP 1

Protection relay board at Sloviansk WTP 2

Krasnoarmiyska WTP machine hall

Krasnoarmiyska WTP indoor 6kV switch gear

Verkhniokalmiuska WTP

Outdoor 35kV Oil Circiut Breaker, affected by shelling

Verkhniokalmiuska WTP filter hall

Horlivska WTP 2

35/6kV main transformer of the outdoor substation of Horlivska WTP 2

Indoor 6kV Circuit Breaker cell, damaged by shelling

Makiyivska WTP

Pumping hall Makiyivska WTP

New motor installed in 2013

New Frequency Converter, installed in 2013

ANNEX 6 – Illustrative pictures of select damages

Damages to transformers at 1st lift pumping station of the SDD channel caused by shelling

Damaged pressure pipeline of the SDD channel

Destroyed motor-way bridge across the SDD channel in Sloviansk District

Damaged SDD channel pipeline in winter near Horlivka

Damaged façade of the administrative office and laboratory building at Donetska WTP

Damaged building of the chemicals section at Donetska WTP

Damages to the Karlivske weir structures of Krasnoarmiyska WTP caused by shelling

Damaged storage building for emergency repair machinery and damaged machinery at Donetska WTP

Damages of SDD channel bed following unusual operational stoppages due to conflict

Damages to specialized equipment / vehicles

Flooding of 2nd lift station of the South Donetsk Water Way following unusual operational conditions

Annex 7 - Prioritised physical mitigating actions - Draft CONFIDENTIAL

New Number	Old Number	Facility	Description	Estimated cost (USD)	PRIORITIES 1 - implementation in 1st year 2 - implementation in 2nd year 3 - implementation within 5 years	RISK OF MILITARY OPERATIONS	Comments	Relation to Projects on the Oblast Water Plan
1	35 and 36	Lift Pumping Station 1A of Siversky Donets Donbass (SDD) Channel	Overhaul of two motors 8000 kW capacity for pump units No.8 and no.9 (75,000 USD each).	150,000	1	No	Urgent pump repairs to restore the Fist Lift Pumpng Station of the SDD channel to full capacity. PS 1 and PS 1A are next to each other.	
2	37 and 39	Lift Pumping Station 2A of SDD	Overhaul of motor 8000 kW pump unit No.8 (75,000 USD) and overhaul of transformer, ТДН-40000/110 (45,000 USD).	120,000	1	No	Urgent pump repairs to restore the second Lift PS to full capacity. Some motor stators also need rewinding but VD can do this onsite, themselves. Also, replacing oil and spare parts for one transformer.	
3	40	Lift Pumping Station 2A of SDD	Overhaul of transformer (ТДГ-20000/110)	260,000	2	No	As a second priority, replacing oil and spare parts for the other transformer, which also including replacement wire for rewinding coils of the transformer.	
4	1	Lift Pumping Station 3 of SDD	Overhaul of several transformers at Pumping Stations 3 and 3a, 110/10.5/10.5 kV, 63 MVA each (insulation levels currently at 1/3 of the specified value).	185,000	1	Yes	If not completed the whole PS may not function soon as a consequence.	
5	2	Lift Pumping Station 3 of SDD	Repair of second 110 kV power line to PS 3	20,000	1	Yes	The line runs through the area exposed to shelling / security issues. This project would be competed by DTEK.	
6	3	Lift Pumping Station 3 of SDD	Repair or replacement of one motor shaft at PS 3	230,000	3	Yes	There are 7 pumps in that location: after 5 years all are at risk of failure and this project is to repair or replace just one shaft, 5m in length and 400mm diameter. Motors will be rewound by VD themselves onsite.	
7	11	Lift Pumping Station 4 of SDD	Finishing repair of pump No 2 (Impeller) 1.25 MW pump	250,000	2	No	One of three pumps at that location supplying the SDD channel	
8	47	Lift Pumping Station 1 of South Sonbass Water Way (SDWW)	Installation of frequency regulator. The capacity is 800 kW	85,385	1	Yes	PS1 has been shelled several times in 2017. The FR will permit more efficient pumping as the speed can be varied, also decreasing pressure in downstream pipelines.	
9	new	Lift Pumping Station 1 of SDWW	Replace 800 KW pump motor at the 1st Lift Pumping Station of the South Donbass Water Pipeline.	50,000	1	Yes	Pump motor was damaged by shelling in June 2017. There are eleven pumps in total at the 1st Lift Pumping Station of the South Donbass Water Pipeline: one is broken and needs to be replaced	
10	43	Lift Pumping Station 2 of SDWW	Replacement of pump #7.(the type of pump is Д2000/100, capacity - 2000 cubic meters/hour. The pressure 100 m. The capacity of electric motor is 800 kW)	100,000	1	No	Mariupol and Vulnavakha rely on this Pumping Station as well as Dokuchaievsk in NGCA. To cope with current and future damage to the SDWP which results in lower flows, VD needs one pump with less capacity than the others for saving energy and water.	
11	12	Lift Pumping Station 2 of SDWW	Replacement of outdoor sectional oil Circuit Breaker (CB) and two load breakers of main transformer with, instead, three vaccuum switches 110 KV.	170,000	1	No	This is the main power supply for the Pump Station No.2. (Transition from an oil circuit breaker to a vacuum switch)	
12	44	Lift Pumping Station 3 of SDWW	Installation of pumps. (The type of pump is 1Д1250-63a, capacity is 700 cubic meters/hour, the pressire is 24 m. The capacity of electric motor is 75 kW)	6,150	1	No	Mariupol relies on this pumping station. There is only a need to replace the pumping unit, not the motor at this location. This is a small flushing pump for filters, which is very worn out and will soon be out of order.	
13	45	Lift Pumping Station 3 of SDWW	Installation of pumps. (The type of pump is 1Д1250-63a, capacity is 900 cubic meters/hour, the pressure is 45 m, the capacity of electric motor is 200 kW)\	15,385	1	No	Only need to replace the pump unit, not the motor. After damage to the SDWP and predicting future damages VD needs this smaller size pump to have possibility supply water to Dokuchaivsk, Novotroitske and Volnovakha.	
14	42	Lift Pumping Station 3 of SDWW	Replacement of pump #9.(the type of pump is Д6300-27-3-1. The capacity - 5000 cubic meter per hour, the pressure - 32 m.) The capacity of electric motor is 630 kW	220,000	1	No	Pump and motor both need replacing. After damage to the SDWP and predicting future damages VD needs this pump (630 kW), which is lower pressure than the one installed now (1600 kW) to give flexibility in operating the system.	
15	9	South Donbass Water Way (SDWW) pipelines	Urgent pipeline repairs due to shelling damage near Avdiivka, and re-establish cathodic corrosion protection.	1,000,000	1	Yes	Between Panteleymonivka and Maryinka the pipeline line runs through an area permanently exposed to shelling. Initially Voda Donbasa will assess the condition of pipes and check diameters. Overall length of 30 km in the "grey zone". Replacing 1km of 1400mm pipe costs around 750,000 USD and VD estimate that around 1km will need replacing, as well as reestablishement of cathodic protection of the pipe. Demining and Windows of Silence would also be required.	
16	14	2DWW intake and Slovianska FSs no.1 and no.2	Replacement of 3 DC battery systems for emergency DC power supply of river intake control systems (220 VDC / 288 Ah) and FS1 and FS2 (220 VDC / 80 Ah each)	30,000	1	No	Battery systems need replacement. They are used for startup DC power to turn on pumps in three locations.	5
17	52	PS pumping to Kramatorsk water reservoirs	Replacement of pump #1.(the type of pump is Д200-90, the capacity is 720 cubic meters / hour, the pressure 90 m, the capacity of electric motor is 110 kW	2,250	1	No	This connects the 2DWW with the reservoir. Only the pump needs replacing, not the motor unit.	
18	53	PS1 of 2DWW	Replacement of pump #26.(the type of pump is Д320-50, the capacity is 320 cubic meters / hour, the pressure is 50 m, the capacity of electric motor is 75 kW	1,500	1	No	Only need to replace the pump unit, not the engine Old pump, which is should be replaced. This pump is installed on a borehole #26	
19	49	PS 3 of 2DWW	Replacement of pump #2.(the type of pump is 1Д1250-125, the capacity is 1250 куб.м/ч, the pressire 125м, the capacity of electric motor is 630 kW)	5,000	1	No	Only need to replace the pump unit, not the engine. There is a need to install more powerfull pump unit, as the one currently installed is insufficient. It does not create the necessary pressure.	10
20	54	PS4 of 2DWW	Replacement of the pump type K65-50-160, the capacity is 25 cubic meter per hour, the pressure is 32 m, the capacity of electric motor is 22 kW)	2,000	1	No	Currently one of the large pumps is being used as a drainage pump. This needs replacing with a more suitable option, and to free up the larger pump for other uses.	11
21	15	2DWW	Replacement of 3 km of water pipeline	3,520,000	1	No	Project is already prepared waiting for a government expertise/feedback. This confirms the veracity and real need of this project.	7
22	16	2DWW	Replacement of 5 km of water pipeline	5,600,000	2	No	This is the second priority 5km sections of large diameter (1400mm) pipeline that will need to be replaced before the end of 2019. Project is already prepared waiting for a government expertise/feedback. This confirms the veracity and real need of this project.	8
23	17	2DWW	Replacement of 12 km of water pipeline	13,500,000	3	No	12 km of pipeline will need replacing before the end of 2022 Project is already prepared waiting for a government expertise/feedback. This confirms the veracity and real need of this project.	8
24	18	Makiyivska FS	Replacement of the 35 kV switches to vacuum switches in the outdoor substation supplying the FS and 6 kV indoor switchgear also to use vacuum switches.	120,000	2	No	This is the main power supply for the FS. This would be done by VD as they own the substation.	
25	5	Horlivska FS	Spare parts for switchgear	4,000	2	Yes	Not the highest priority but still needed fairly urgently.	

26	41	Olkhovska FS	Installation of vacuum switch 35 kV (2 pieces)	30,000	1	No	Originally they used 25,000 m3/d from the reservoir. After building Makievska FS this reduced to 6,000 m3, now mixed with water from the SDD channel which is better quality raw water. If SDD is cut this represents an alternative supply.	
27	4	Verkhniokalmiuska FS	Replacement of a motor-driven pressure valve at the booster Pumping Station.	10,000	2	Yes	This is valve on a RPS (Reserve Pumping Station). It is in operation, but due to the its bad condition, it needs to be replaced.	
28	46	Verkhniokalmiuska FS	Installation of frequency regulator. The capacity is 800 kW	85,385	1	Yes	This is for the pumping station that sends clean water to the populatrion. Installing the regulator will allow them to save electricity and to reduce pressure in the pipes.	
29	7	Donetska FS	Supplying transport vehicles, machines, lab equipments, improvement of technological process	2,000,000	1	Yes	According to previous Kaschka report, immediate action is necessary to ensure the finter station continues to supply clean water to the target population (345,000 people according to Voda Donbasa in Dec 2016).	
30	6	Donetska FS	Repair and overhaul of basic process equipment (incl. chlorination safety provisions)	1,900,000	2	Yes	Check this is not already included in the previous Kaschka report. Give a bit more detail on this activity. The idea of this project is to replace all the system of chlorine pipes (it have many benches and taps). Second priority is because DFS is under the shellnig almost every week. This project was included to the Kashka's report. VD has agreed to remove it for now from the list.	
31	8	Donetska FS	Optimization of technological process acoring to the recommendations of the "Kashka report" of 2016.	34,000,000	3	Yes	According to the previous Kaschka report (2016) significant work is needed in the medium term to optimize the working of the filter station.	
32	19	Krasnoarmiyska FS	Rehabilitation of Karlovskoe water reservoir dam, supplying lab equipment, optimization of technological process and rehabillitation of damaged buidlings of Krasnoarmiiska FS	8,810,000	1	No	High priority work was listed in the previous Kaschka report from 2016.	36
33	20	Krasnoarmiyska FS	Optimization of technological process and further modernization of Krasnoarmiiska FS	18,900,000	2	No	Medium term, but still relatively urgent work is listed in the previous Kaschka report.	
34	21	Krasnoarmiyska FS	Overhaul of the 1st Lift Pumping Station of Krasnoarmiiske FS.	646,000	2	No	Implementation of the project "Major Overhaul of the 1st Lift PS of Krasnoarmiyska FS" required. This PS was abandoned, as the SDD channel was created, and the resrevoir became Technical water. This project is to reverse that process to provide a backup reservoir for Krasnoarmiiske FS.	
35	22	Velykoanadolska FS	Exchange of 35/6 kV outdoor substation and 6 kV indoor switchgear, installing vacuum switces throughout.	85,000	2	No	This is the main power supply for the FS. This would be done by VD as they own the substation.	
36	23	Yelenovka PS.	Construction of alternative power line to Yelenovka to facilitate water pumping from Velikoanadolske water treatment plant to the people of the town and 4 villages.	20,000	1	Yes	The old power line crosses the LoC and has bee destroyed in April 2016..	

37	38	Starokrymska reservoir	Repairs to the dam to avoid further deterioration of condition	1,000,000	3	No	Concrete condition is deteriorating every year, as the hollow concrete dam is showing signs of leakage. Elevators inside also need replacing.	
38	13	Starokrymska FS 1 and 2	Overhaul and servicing of 2 outdoor substations 35/6 kV (10 MVA) and of indoor switchgear 6 kV (42 cells)	25,000	3	No	Work would be completed by Voda Donbasa. This is a simple job of replacing the oil (manual) switches with vacuum (automatic)	
39	48	PS 2 of Slovianska FS#2 (groundwater)	Replacement of pump #6a.(the type of pump is 1250-125, the capacity is 1250 cubic meters/ hour, the pressire is 125 m, the capacity of electric motor is 630 kW)	5,000	1	No	Only need to replace the pump unit, not the engine There is a need to install more powerfull pump, as this does not create the necessary pressure	13
40	50	PS 1 of Sloviansk FS #2 (river water intake)	Replacement of pump #4.(the type of pump is Д3200-70, the capacity is 2700/3420 cubic meters / hour; the pressure is 71 m, the capacity of the electric motor is 1250 kW)	9,385	1	No	Only need to replace the pump unit, not the engine. There is a need to install more powerfull pump, as this does not create the necessary pressure	
41	51	PS 2 of Slovianska FS#2	Replacement of pump #4.(the type of pump is Д1600-90, the capacity is 1600 cubic meters / hour, the pressure is 90 m, the capacity of electric motor is 630 kW)	6,600	1	No	Only need to replace the pump unit, not the engine. There is a need to install more powerfull pump, as this does not create the necessary pressure	
42	new	Toretsk City	Connection of Toretsk city to the 2nd Donbass Water Way (2DWW) - project design	310,000	3	Yes	This is the design phase only of a larger $25 million project to connect Toretsk from the North. (11 km of pipes, d=600 mm, Price of the design is 310,000 $. The project includes building new PS, pipes, and connection to the 2DWW, instead going through 'Grey Zone' from Horlivka.	
43	55	Distribution pipeline repairs	Priority 1 repairs of treated water distribution pipelines in areas at risk of military operations.	1,131,154	1	Yes	See Annex 8 for the complete list of distribution pipes that need urgent replacement.	9; 16-23; 30; 32-35; 37
44	56	Distribution pipeline repairs	Priority 1 repairs of treated water distribution pipelines in areas not at risk of military operations.	10,115,905	1	No	See Annex 8 for the complete list of distribution pipes that need urgent replacement.	9; 16-23; 30; 32-35; 37
45	57	Distribution pipeline repairs	Priority 2 repairs of treated water distribution pipelines in areas at risk of military operations.	3,873,630	2	Yes	See Annex 8 for the complete list of distribution pipes that need urgent replacement.	9; 16-23; 30; 32-35; 37
46	58	Distribution pipeline repairs	Priority 2 repairs of treated water distribution pipelines in areas not at risk of military operations.	19,666,427	2	No	See Annex 8 for the complete list of distribution pipes that need urgent replacement.	9; 16-23; 30; 32-35; 37
47	59	Distribution pipeline repairs	Priority 3 repairs of treated water distribution pipelines in areas at risk of military operations.	23,652,346	3	Yes	See Annex 8 for the complete list of distribution pipes that need urgent replacement.	9; 16-23; 30; 32-35; 37
48	60	Distribution pipeline repairs	Priority 3 repairs of treated water distribution pipelines in areas not at risk of military operations.	9,759,873	3	No	See Annex 8 for the complete list of distribution pipes that need urgent replacement.	9; 16-23; 30; 32-35; 37
49	26	General	Exchange critical electrical parts of the main transformers and the oil circuit breakers of the 110 kV and 35 kV outdoor substations and the circuit breakers of the 6 kV air insulated indoor switchgears at 'risky' FSs and LSs.	1,000,000	2	No	These are second priority but still needed. The exchanged parts can be kept as emergency back-up.	
50	27	General	Ensure that preventive maintenance of the protective relays is carried out, and an adequate stock of spare parts and replacement protective relays kept. The reliable functioning of protective systems and relays is critical to avoid serious damage of large E&M components.	100,000	2	No	This is an emergemcy preparedness activity to ensure that larger equipment is protected in the next few years. With electricity supply getting more unreliable, more power surges and low-voltage conditions can be expected.	
51	28	General	Rehabilitate or replace vacuum regulators and dosing units for chlorine gas at FSs identified. Sufficient spare parts should be kept on stock; and staff trained in equipment servicing.	50,000	1	No	Ensuring operation of desinfection systems for drinking water to be supplied to consumers.	
52	24	General	Installation and repair equipment: excavators, emergency team vehicles, truck-mounted cranes, sludge suction dredgers and vacuum trucks - 33 on GCA side and 75 on NGCA side.	3,390,000	1	No	Specific equipment and vehicle needs are detailed in Annex 9	
53	25	General	Installation and repair equipment: excavators, emergency team vehicles, truck-mounted cranes, sludge suction dredgers and vacuum trucks - 33 on GCA side and 75 on NGCA side.	3,390,000	2	No	Specific equipment and vehicle needs are detailed in Annex 9	
54	29	General	Ensure that senior management, dispatchers and operators at particularly 'risky' infrastructure are equipped with two independent, reliable means of communication. Radio transmission might be a comparably affordable solution, if a specific frequency can be assigned.	50,000	1	No	This is an emergency preparedness action, require to ensure staff can communicate in the event of crises, whether from shelling or from chlorine gas leaks or other hazards.	
55	30	General	180 KVA generators for standby operation of vital infrastructure.	100,000	1	Yes	As an emergemcy preparedness activity 180 KVA generators x 3, two located in NGCA areas and one in GCA due to distribution of infrastructure. This will protect the SDD channel from overflows or under flow, that would damage it, by allowing motorised gates, penstocks and valves to be operated even during a power cut.	
56	31	General	Keep material frequently needed to repair power lines on stock, including: • conductor wires, • joints to connect new wires to existing ones, • insulators for different voltage levels e.g. 110/35/6 kV and of the types used at the existing pylons and masts, and • steel profiles of various types to replace damaged brackets on masts, or repair damaged sections of pylons.	250,000	1	No	This is an emergency preparedness action, to facilitate rapid repairs to power supplies that supply water treatment facilities.	
57	32	General	Sheets of steel of various dimensions for the repair of damaged pipes should be on stock at strategic locations, as well as replacement welding equipment. The same goes for pipes and accessories of relevant material and type.	200,000	1	No	This is an emergemcy preparedness activity, to ensure the reliability of centralized drinking and technical water supplies. Voda Donbasa can supply a more specific list of materials.	
58	33	General	Ensure that sufficient PPE for hazardous material incidents is available to staff where needed. Water facilities near the contact line are particularly exposed; fully functioning protective measures should be put in place and tested regularly. Staff have to be aware of emergency measures and procedures, including roles and responsibilities, and lines of communication.	50,000	1	No	Personal Protective Equipment has been procured previously but has been refused entry into NoN-Government Controlled Areas. However the equipment is urgently needed in case chlorine gas containers are hit by explosions or shelling and they would ensure staff not only survive themselves but that they are in a position to take action to prevent more widespread casualties within the local communities.	
59	34	General	Digitalize important data and information, and develop a back-up and storage strategy so that crucial information does not get destroyed and is at hand any time.	50,000	1	No	Equipment, and staff costs, for regular digitizing and storage of important information is needed urgently. This would also enable the organisation to consider more thorough future options for Asset Management, such as linking computer models of the system to GIS and financial models.	
				170,318,375				

Physical mitigating actions not inclu	Risk of Military ops	Not at risk of military ops	All areas
Priority 1	4,676,924	27,359,175	32,036,099
Priority 2	5,787,630	50,017,427	55,805,057
Priority 3	58,192,346	24,284,873	82,477,219
Total	**68,656,900**	**101,661,475**	**170,318,375**

Annex 8 - Prioritised Pipeline Repairs

#	Water mains	Diameter, mm	Total length, km	Section in need of replacement, km	Estimated cost, UAH (thousands)	Cost in USD	1 - implementation in 1st year 2 - implementation in 2nd year 3 - implementation within 5 years	Risk of military actions (Yes/No)	Areas supplied by the main	Name of the Project in Oblast Program
Non-Government Controlled Areas										
				Horlivka Operational Office for Water and Wastewater Utilities						
1	Hertsenskyi water pipeline	300-500	9.9	1.0	2,914	112,077	2	No	water supply to consumers in the city's central district of Horlivka	
2	Ostapenskyi water pipeline from WTP 2 along Ostapenko street - Besposhchadnoho street	500	1.3	0.2	840	32,308	2	No	water supply to consumers in the city's central district of Horlivka	
3	Water pipeline "Vnekvartalnyi" Quarter 88	700-1400	5.9	0.7	18,945	728,654	2	No	water supply to consumers in the city's central district of Horlivka	
4	Water pipeline of Lenin Mine	273-700	0.4	0.2	1,825	70,192	2	No	water supply to consumers in the city's central district of Horlivka	
5	Water pipeline along Lenina av.	200	2.2	0.4	261	10,038	2	No	water supply to consumers in the city's central district of Horlivka	
6	Water pipeline "Pivdenne Pivkiltse"	400-800	8.7	1.2	4,137	159,115	2	No	water supply to consumers in the city's central district of Horlivka, Korolenko settlement, Kocheharka Mine settlement	
7	Water pipeline "Pivnichne Pivkiltse"	600-800	9.8	1.6	5,474	210,538	2	No	drinking water supply to Water Supply Unit No 2 tanks, PS "Verkhnia" Quarter 88, water supply to consumers in Lenin Mine settlement	
8	Water pipeline "Ø 1000 mm"	1000	4.2	0.7	4,462	171,615	2	No	water supply to "Budivnykiv", "Komsomolets", "Komarova" residential areas, Gagarin Mine settlement	
9	Water pipeline "Druhyi Donetskyi" along Stozhka street from motor racing track in Gagarin Mine settlement up to Yasna street	315-500	2.1	0.5	812	31,231	2	Yes	water supply to Gagarin Mine settlement	
10	Water pipeline "Kleban-Bytska Peremychka" from 60-letiya SSSR street, 46 up to Water pipeline "Kleban Byk"	315-600	2.8	0.5	812	31,231	2	Yes	water supply to Mykytivskyi District of Horlivka, Bessarabka settlement, Rtutnyi settlement	
11	Water pipeline in Komarova settlement	300	2.0	0.5	1,533	58,962	2	Yes	water supply to "Komarova" residential area	
12	Water pipeline along Kolkhozna street from car cooperative "Impuls" up to Havovoho street	300-800	4.6	1.0	3,809	146,500	2	No	water supply to consumers in the city's central district, Pobeda village	
13	Water pipeline "Podzemgaz"	160-530	8.6	1.0	2,141	82,346	2	No	water supply to Oktiabrskyi settlement, Vorobyivka settlement	
14	Water pipeline "Novo-Rumiantsevskyi"	110-400	5.1	1.0	1,453	55,885	2	No	water supply to Mykytivka settlement, Rumiantsev Mine settlement	
15	Water pipeline "Komsomolskyi" from WTP 1 by-passing Mahistralna street, from WTP 1 up to Altayska street	200-500	3.6	0.6	1,457	56,038	2	No	water supply to "Soniachnyi" residential area	
16	Water pipeline of dolomite plant to Holmovskyi urban-type settlement	300-400	9.4	3.0	12,634	485,923	2	Yes	water supply to Holmovskyi urban-type settlement, Bayrak settlement	
17	Water pipeline from water main "Kleban Byk" up to Artemivske Shosse street	200-400	0.3	0.3	488	18,769	2	Yes	water supply to Mayorsk settlement	
18	Water pipeline "Kleban Byk"	200-600	14.3	3.0	5,563	213,962	2	Yes	water supply to "Soniachnyi" residential area, part of Mykytivskyi District	
19	Water pipeline "Pivdennyi"	400-700	3.9	1.0	7,241	278,500	2	No	water supply to Kuznetsovka settlement	
20	Water pipeline "Staromiskyi" from water main "Pivdennyi" (new) DN700 mm up to Internatsionalna street	250	4.5	1.0	1,020	39,231	2	No	water supply to Myrnyi settlement	
	Total:		**103.6**	**19.4**	**77,821**	**2,993,115**				
				Dokuchayevsk Operational Office for Water and Wastewater Utilities						
1	Water pipeline of Novotroyitske	630-530	8.4-6.5	3	20,505	788,654	2	Yes	drinking water supply from water treatment PS to Dokuchayevsk and Olenivka urban-type settlement	
2	Water pipeline of Olenivka	300	12.9	3	9,198	353,769	2	Yes	drinking water supply to Olenivka urban-type settlement	
3	Water pipeline of Shevchenko	426	9.4	9.4	50,353	1,936,654	2	No	drinking water supply to Dokuchayevsk; not operated - in need of rehabilitation	
	Total:		**37.2**	**15.4**	**80,056**	**3,079,077**				
				Starobesheve Section of Dokuchayevsk Operational Office for Water and Wastewater Utilities						
1	PS - water tower	219	2.9	1.0	3,975	152,885	1	No	water supply to population of Komsomolske	
		250	1.1				1	No		
		400	1.2				1	No		
		500	0.5				1	No		
2	PS - Naberezhna street	273	0.9	1.0	2,375	91,346	2	No	water supply to population of Komsomolske	
		250	0.7				2	No		
		250	0.8				2	No		
3	PS - hospital	150	1.1	0.2	198	7,615	2	No	water supply to population of Komsomolske	
4	PS - Rudnik settlement	100	1.4	0.5	300	11,538	2	No		
			10.5	**2.7**	**6,848**	**263,385**				
1	PS Starobesheve - Starobesheve settlement	150	0.2	1.0	1,171	45,038	2	No	water supply to population of Starobesheve settlement	
		150	2.3				2	No		
		200	0.1				2	No		
2	PS Kypucha Krynytsia - Starobesheve settlement	315	3.0	5.0	23,344	897,846	1	No	water supply to population of Starobesheve settlement	
		325	0.2				1	No		
		400	0.8				1	No		
		500	5.8				1	No		
			12.3	**6.0**	**24,515**	**942,885**				
	Total:		**22.9**	**8.7**	**31,363**	**1,206,269**				
				Donetsk Regional Operational Office						
1	Rehabilitation of raw water main to DMP from PK 04+32 up to PK 05+60 Donetsk	400		0.129	1,259	48,423	2	No	Raw water pipeline to PU Donetskmiskvodokanal, TEK LLC, Donfrost LLC, DMZr PrJSC; Donetsk Metallurgical Plant PrJSC. 630 mm pipeline from Krasnoarmisske FS will be replaced with 400 mm	
	Rehabilitation of raw water main to DMP from PK 111 up to PK 117 Donetsk	400		0.584	6,417	246,808	2	No		
	Rehabilitation of raw water main to DMP from PK 121+85 up to PK 123+05 Donetsk	400		0.124	1,356	52,154	2	No		
	Rehabilitation of raw water main to DMP from PK 123 up to PK 131 Donetsk	400		0.803	5,590	215,000	2	No		
	Rehabilitation of raw water main to DMP from PK 117 up to PK 119+50 Donetsk	400		0.287	3,244	124,769	2	No		
	Rehabilitation of raw water main to DMP from PK 107 up to PK 111 Donetsk	400		0.419	3,811	146,577	2	No		
2	Water pipeline No 7:	1000-1200	14.4	0.20	2,914	112,077	1	No	drinking water supply from Verkhniokalmiuska WTP to Central Water Supply Unit	
	PK108+50 up to PK 110+50	1020					1	No		
3	Water pipeline No 9a from Verkhniokalmiuska WTP up to Petrovskyi Water Supply Unit	1020-1420	30.418	0.9	13,115	504,423	1	Yes	drinking water supply to Kirovskyi and Petrovskyi Water Supply Units	
3a	Water pipeline No 9 from Verkhniokalmiuska WTP up to PS "Pidkachka" ("Booster Pumping") Donetsk	920-1220	15.822	0.9	13,115	504,423	1	Yes	drinking water supply to Kirovskyi and Kuibyshevskyi Water Supply Units	
4	Water pipeline from Donetska WTP up to water pipeline No 9 Donetsk	1220	42.604	15.1	292,722	11,258,538	3	Yes	drinking water supply to Donetsk. Currently replacement is impossible as the pipeline runs through Opytne village, Spartak, Donetsk airport, Pisky.	
5	Water pipeline от Donetska WTP up to water pipeline No 9A Donetsk.	1220	42.604	16.6	321,800	12,376,923	3	Yes	drinking water supply to Donetsk. Currently replacement is impossible as the pipeline runs through Opytne village, Spartak, Donetsk airport, Pisky.	
	Total:		**158.9**	**36.0**	**665,343**	**25,590,115**				
				Yenakiyeve Operational Office for Water and Wastewater Utilities						
1	Water pipeline from Yenakiyivska WTP up to Vuhlehirsk	800	7.933	1.2	12,487	480,269	2	No	water supply to Vuhlehirsk	
2	Water pipeline to Lisne settlement of Yunokomunarivsk	300	1.976	0.5	1,533	58,962	3	No	water supply to Lisne settlement of Yunokomunarivsk	
3	Water pipeline from Volyntsevska WTP up to tanks in Yunokomunarivsk	700	8.603	2.1	19,165	737,115	3	No	water supply to Yunokomunarivsk	
4	Water pipeline from water main DN 700 mm near pioneer camp up to Krasnyi Horodok settlement	500	8.6	1.6	6,727	258,731	3	No	water supply to Krasnyi Horodok settlement of Yenakiyeve	
5	"Kirovskyi Water Supply Unit - Shakhtarsk", PK-80 PK 124	820	15.7	3.8	39,544	1,520,923	1	No	water supply to Shakhtarsk	
6	"Volyntsevska WTP - Novo-Stizhkivskyi Water Supply Unit", PK-62 - PK-82	820- 1020	11.7	2.0	20,812	800,462	1	No	water supply to Shakhtarsk, Torez, Kirovske	
7	"Yenakiyivska WTP - Novo-Stizhkivskyi Water Supply Unit", PK-7 - PK-38	820	14.8	2.3	23,934	920,538	1	No	water supply to Shakhtarsk, Torez, Kirovske	
8	"Yenakiyivska WTP - Debaltseve" PK - 48 PK - 64	820	17.0	1.6	1,876	72,158	2	Yes	water supply to Debaltseve	
9	Major overhaul - placing water pipelines B5, B5I, B5II above the spillway of the Volyntsevske reservoir, Yenakiyeve	820;1020		0.4	3,680	141,538	2	No	water supply to Shakhtarsk, Kirovske, Torez	
	Total:		**86.3**	**15.5**	**129,758**	**4,990,696**				
				Kirovske Operational Office for Water and Wastewater Utilities						
1	Water pipeline "Olkhova-Zhdanivka", Zhdanivka	300	2.2	2.2	11,784	453,231	1	No	drinking water supply from Olkhova WTP to 2nd LS "Zhdanivka"	
		426	1.1				1	No		
		426	4.0				1	No		
	Total:		**7.3**	**2.2**	**11,784**	**453,231**				
				Makiyivka Operational Office for Water and Wastewater Utilities						

1	Water pipeline "Makiyivska WTP - Panteleymonivka" PK 6- PK 11	630	9.0	0.5	3491.0	134,269	2	No	drinking water supply to Panteleymonivka	
2	Water pipeline "Olkhova-Makiyivka" PK 45+06-PK 46+56	630	14.8	0.2	1396.0	53,692	2	No	drinking water supply to Makiyivka	
	Total:		**23.8**	**0.7**	**4,887**	**187,962**				
				Novoazovsk Section of Mariupol Regional Operational Office						
1	Water pipeline from PS No 2 up to PS No 3	300	4.5	2.0	6,132	235,846	2	No	water supply to PS No 3 and the city's eastern part	
2	Water pipeline from PS No 2 to Sedova settlement	300	7.0	4.0	21,427	824,115	2	No	water supply to Sedova settlement	
3	Water pipeline from PS No 3	250	4.0	1.2	2,575	99,038	2	No	water supply to to the city's central part	
	Total:		**15.5**	**7.2**	**30,134**	**1,159,000**				
				Telmanove Section of Mariupol Regional Operational Office						
1	Rehabilitation of emergency section of water pipeline Samsonove-Telmanove from PS-2 Samsonove up to VK-4 of Telmanove District	315	4.4	3.5	6,861.00	263,885	1	No	drinking water supply to Samsonove village	
			13.25				1	No	Kalynine village, Konkove village, Svobodne village	
			1.4				1	No	Telmanove urban-type settlement	
			26.6				1	No	Kalynine village, Konkove village, Svobodne village	
	Total:		**45.7**	**3.5**	**6,861**	**263,885**				
				Torez Operational Office for Water and Wastewater Utilities						
1	Water pipeline (old) from Novo-Stizhkivskyi Water Supply Unit of Yenakiyeve OO up to PS "Miski Rezervuary" ("City Tanks") Torez	700	19.7	5.0	91,264	3,510,154	1	No	water supply from Novo-Stizhkivskyi Water Supply Unit of Yenakiyeve OO up to PS "Miski Rezervuary" ("City Tanks") Torez	
2	Water pipeline (new) from Novo-Stizhkivskyi Water Supply Unit of Yenakiyeve OO up to PS "Miski Rezervuary" ("City Tanks") Torez	700	21.5	5.0			1	No		
3	Major overhaul of emergency section of water pipeline along Kozakhska street, Torez	300	0.8	0.731	2,384	91,692	2	No	drinking water supply to Torez	
4	Lutuhynskyi water pipeline, Torez	630	4.5	2.0	13,964	537,077	2	No		
	Total:		**42.0**	**10.7**	**107,612**	**4,138,923**				
				Shakhtarsk Operational Office for Water and Wastewater Utilities						
1	from PS "17 Partzyizd" up to PS "Druhyi Pidyom"("Second Lift")	150	3.0	1.0	993	38,192	2	No	water supply to Shakhtarsk	
2	from PS "Pivdenna" up to PS "Druhyi Pidyom"("Second Lift")	600	3.6	1.2	8,378	322,231	2	No	water supply to the city's northern part	
3	water pipeline microregion 8	500	2.1	0.8	3,363	129,346	2	No	water supply to microregion 8	
4	water pipeline microregion 7	250	3.0	0.8	1,717	66,038	2	No	water supply to microregion 7	
5	from water pipeline D500 mm up to PS "Stizhkove"	250	2.8	0.7	1,502	57,769	2	No	water supply to Stizhkove settlement	
6	from PS "Novo-Stizhkivska" up to Olkhovchyk settlement	400	16.0	3.0	16,070	618,077	2	No	water supply to Olkhovchyk settlement, Krasnyi Luch village	
	Total:		**30.5**	**7.5**	**32,023**	**1,231,654**				
Government Controlled Areas										
				Avdiyivka Operational Office for Water and Wastewater Utilities						
1	Construction of water supply in Avdiyivka (Levanevskoho street) (correction)	160.110	1.2	1.2	1,661	63,895	2	Yes	water supply to population in Levanevskoho street	
	Total:				**1,661**	**63,895**				
				Volnovakha Operational Office for Water and Wastewater Utilities						
1	Rehabilitation of water pipeline "Velykoanadolska WTP - Donetsk Chemical and Metallurgical Plant" PK0 — PK50, Volnovakha District of Donetsk Region	700	19.45	5215.0	15,033	578,192	3	No	water supply to Volnovakha and Oktiabrske settlement	#30 (1 sheet)
2	From water pipeline "Velykoanadolska WTP -Donetsk Chemical and Metallurgical Plant" up to Water Supply Unit in Volnovakha	500	4.00	1.0	6,688	257,231	2	No	water supply to Water Supply Unit-1 Volnovakha	
3	Water pipeline "Velykoanadolska WTP-Novotroyitske"	700	10.20	5.0	45,632	1,755,077	2	Yes	water supply to Novotroyitske urban-type settlement, Olhynka settlement	
4	From water pipeline "Velykoanadolska WTP-Vuhledar" up to Water Supply Unit in Volodymyrivka settlement	325	2.10	0.6	1,839	70,731	3	No	water supply to Water Supply Unit-3 Volodymyrivka settlement	
5	Water pipeline in Myrne settlement	100	4.00	1.0	302	11,615	3	Yes	water supply to Myrne village	
6	Repair of emergency section of street pipeline D=200 mm Water Supply Unit in Volnovakha — Tsentralna street, 350 LM long, from Tsentralna street, 127 up to Mahistralna street, 55 through Matrosova street (near Central District Hospital)	200		0.3	967	37,197	2	No	water supply to Volnovakha	
	Total:		**39.8**	**5222.6**	**70,461**	**2,710,043**				
				Dzerzhynsk Operational Office for Water and Wastewater Utilities						
1	Water pipeline Quarter 168	400	2.8	0.4	2,142	82,385	3	No	water supply to Kirove settlement	
2	Water pipeline "Artem"	400	2.6	0.6	3,214	123,615	2	No	water supply to Artemove	
3	Water pipeline "Furmanivskyi"	400	2.4	0.5	2,678	103,000	2	No	water supply to Dzerzhynsk	
4	Water pipeline "Mahdalynivskyi"	200	0.8	0.3	1,367	52,577	3	No	water supply to Kirove settlement	
5	Water pipeline "Enhelsa"	315	1.4	0.6	2,522	97,000	2	No	water supply to Dzerzhynsk	
		500	0.1				2	No	water supply to Dzerzhynsk	
	Rehabilitation of water pipeline D400mm of Dzerzhynsk OO from PS "Vodoprovidnyi Vuzol" ("Water Supply Unit") up to Tsentralna street in Toretsk	250		0.898	1,582	60,841	1	No	water supply to Dzerzhynsk	is in the implementation phase
	Major overhaul of water pipeline along Kuibysheva street in Dzerzhynsk	225		0.23	673	25,875	2	No	water supply to Dzerzhynsk	
6	Major overhaul of water supply networks from water pipeline "Zabalka" up to Pioneriv av. in Toretsk (correction)	160	4.0	1	1,193	45,885	2	No	water supply to Dzerzhynsk	is in the implementation phase
	Total:		**14.1**	**3.4**	**15,371**	**591,177**				
				Dymytrov Operational Office for Water and Wastewater Utilities						
1	Rehabilitation of 1st Dymytrov water pipeline - Myrnohrad, Donetsk Region	315	4.6	3.05	7,680	295,385	2	No	drinking water supply to the city	#32 (1 sheet)
2	Rehabilitation of 2nd Dymytrov water pipeline - Myrnohrad, Donetsk Region	355	15.8	6.256	15,063	579,346	2	No	drinking water supply to the city	#33 (1 sheet)
3	2nd Donetsk Water Way	500	1.6	0.6	2,522	97,000	2	No	drinking water supply to the city	
4	Water pipeline "Promin"	250	1.5	0.5	1,073	41,269	3	No	drinking water supply to the city	
5	Water pipeline "Svitlyi" microregion	500	0.5	0.5	2,102	80,846	3	No	drinking water supply to the city	
6	Water pipeline "Molodizhnyi" microregion	500	3.1	0.7	2,943	113,192	3	No	drinking water supply to the city	
7	Water pipeline Myra street	400	0.9	0.9	4,821	185,423	2	No	drinking water supply to the city	
8	Rehabilitation of water supply networks from Chernyshova street, Quarter 40 building 8 up to "Molodizhnyi" microregion, building 49 - Myrnohrad	225		1.8	1,773	68,208	1	No	drinking water supply to the city	
9	Construction of water pipeline from Novohrodivka water main D=400mm up to Water Supply Unit Myrnohrad	315	1.4	1.4	3,543	136,258	1	No	drinking water supply to the city	#31 (1 sheet)
	Total:		**28.0**	**12.5**	**41,520**	**1,596,928**				
				Dobropillia Operational Office for Water and Wastewater Utilities						
1	Water pipelines between underground intake wells "Zolotyi Kolodiaz": -2nd LS wells No 405-No 914-No 915-No 928	250	6.0	2.0	3,417	131,423	2	No	drinking water supply to 2nd LS of "Zolotyi Kolodiaz" water intake	
2	2nd LS wells No 712,406,715	300	4.0	1.3	3,986	153,308	2	No		
3	2nd LS wells No 711,902	200-300	6.3	3.0	9,198	353,769	2	No		
4	Water pipeline from "Zolotyi Kolodiaz" water intake up to 3rd LS Dobropillia	500	17.5	5.0	33,440	1,286,154	2	No	drinking water supply to 3rd LS Dobropillia	
5	From connection of Krasnoarmiysk ROO up to PS Bilozerske	500	2.7	0.6	4,012	154,308	2	No	drinking water supply to PS Bilozerske	
6	From connection of Krasnoarmiysk ROO up to PS Bilytske	500	3.6	0.8	5,350	205,769	2	No	drinking water supply to PS Bilytske	
7	Water pipeline from PS Zhdanivskyi settlement up to Dobropillia	500	3.7	1.0	6,688	257,231	3	No	drinking water supply to the city	
	Total:		**43.8**	**13.7**	**66,091**	**2,541,962**				
				Kostiantynivka Operational Office for Water and Wastewater Utilities						
1	Bilohirkyi water pipeline	400, 500, 600	23.5	5.0	41,894	1,611,308	2	No	water supply from Bilohirkyi VZ up to Kostiantynivka	
2	Water pipeline from 2DWW to clearwater tanks "Volhohradska"	400, 600	3.9	1.0	6,982	268,538	2	No	water supply from 2DWW to Kostiantynivka	
3	Water pipeline from clearwater tanks "Volhohradska" up to PS in Abramov street	600	13.0	2.0	13,964	537,077	2	No	water supply from clearwater tanks "Volhohradska" to PS No 2 (to left bank)	
4	Water pipeline from clearwater tanks "Volhohradska" up to PS No 2	400	9.4	3.2	17,141	659,269	3	No	water supply from clearwater tanks "Volhohradska" to Novoselivka settlement and up to Lomonosova av.	
5	Water pipeline from 2DWW to clearwater tanks "Volhohradska" with branch along Staleplavylna street	400, 315	3.8	0.6	3,214	123,615	3	No	water supply from clearwater tanks "Volhohradska" up to Santurynivka settlement	
6	Water pipeline along Trudova street	500 mm	1.2	0.6	2,522	97,000	3	No	water supply to Santurynivka settlement	
7	Water pipeline along Odeska street - Oktiabrska street- clearwater tanks "Volhohradska"	400 mm	6.3	2.2	11,784	453,231	3	No	water supply from clearwater tanks "Volhohradska" to Santurynivka settlement - lower part of Krasnyi Oktiabr settlement	
	Total:		**61.1**	**14.6**	**97,501**	**3,750,038**				
				Krasnoarmiysk Regional Operational Office						
1	Dobropillia water pipeline PK133-134	800	32.1	0.4	469	18,038	1	No	water supply to Rodynske, Dobropillia, Bilytske	
2	Dobropillia water pipeline PK56	800		0.3	3,121	120,038	1	No	water supply to Rodynske, Dobropillia, Bilytske	
3	Novohrodivka water pipeline PK58-PK62	400	10.0	0.1	535	20,577	1	No	water supply to Novohrodivka, Rubizhne	
4	Novohrodivka water pipeline PK62-PK65	400		0.012	8	290	1	No	water supply to Novohrodivka, Rubizhne	
5	Major overhaul of Selydove water main No 2 D=600 mm	630		3.500	11,063	425,486	2	No	drinking water supply to Selydove	#35 (1 sheet)
	Total:		**42.1**	**0.8**	**15,195**	**584,430**				
				Krasnyi Lyman Operational Office for Water and Wastewater Utilities						
1	Water pipeline No 3 "Zelenyi Klyn"	300	11.2	3.5	10,731	412,731	3	No	ensuring water supply of the city's northern part	
2	Water pipeline No 4 "Zelenyi Klyn"	200	8.8	2.6	4,442	170,846	3	No	ensuring water supply of the city's southern part	
3	Water pipeline Drobysheve settlement	250	5.0	1.00	2,146	82,538	3	No	ensuring water supply of Drobysheve settlement	
4	Water pipeline Stavky village	200-300	1.0	0.5	1,533	58,962	3	No	ensuring water supply of Stavky village	
5	Water pipeline Rubtsi village	150	3.5	1.2	1,191	45,808	3	No	ensuring water supply of Rubtsi village	
	Total:	**x**	**29.5**	**8.8**	**20,043**	**770,885**				
				Mariupol Regional Operational Office						

1	Major overhaul of section of water pipeline D=400 mm "Sartanka", Mariupol	400	1.7	1.0	3,180	122,308	1	Yes	water supply to Mariupol	
2	Water pipeline from 2nd LS up to 3rd LS "Myrnyi" PK0 up to PK20, PK37	1000	8.0	0.2	2,914	112,077	1	No	water supply to Mariupol	
	Total:		**9.7**	**1.2**	**6,094**	**234,385**				
				Selydove Operational Office for Water and Wastewater Utilities						
1	Kotliarivka water pipeline	500	4.4	1.2	8025	308,654	3	No	water supply to Selydove (old centre), Vyshnevyi settlement, Leninske village, Petrivka village	
2	Hoholivskyi water pipeline	200	2.8	0.8	1367	52,577	3	No	water supply to Selydove microregions	
3	Mykolayivka water pipeline	500	8.4	3.0	20064.0	771,692	3	No	подача на PS 1 Selydove, Mykolayivka village and Marynivka village	
4	Hirnyk water pipeline No 1	500	7.5	3.2	21401.0	823,115	3	No	water supply to PS Hirnyk, Zhelanne-2 village	
5	Hirnyk water pipeline No 2 ("Tsentralnyi")	325	2.5	1.0	3066.0	117,923	2	No	water supply to "Tsentralnyi" microregion, partially private sector area in Hirnyk	
6	Ukrayinsk water pipeline No 1 (from PK112 up to PS Ukrayinsk)	400	4.5	2.0	10713.0	412,038	2	No	water supply to PS, Ukrayinsk, Zukuryne settlement (Novoselydivska Poultry Farm)	
7	Kurakhivka water pipeline No 2	200	7.4	3.0	5126.0	197,154	3	No	water supply to Oleksandopillia village, Kurakhivka village	
	Total:		**37.5**	**14.2**	**69,762**	**2,683,154**				
				Sloviansk Regional Operational Office (not including main SDWW repairs)						
1	Branch of 2DWW to Kramatorsk tanks PK35+70-PK41+70	500	10.20	0.60	4,012	154,308	2	No	water supply to Sloviansk, Kramatorsk, Druzhkivka, Kostiantynivka, Toretsk	#18(1 sheet) (The program solves the issue more fully)
2	Branch of 2DWW to Kramatorsk tanks PK 12-PK13 (crossing under motor road Sloviansk-Kramatorsk)	500	10.20	0.10	668	25,692	2	No	water supply to Sloviansk, Kramatorsk, Druzhkivka, Kostiantynivka, Toretsk	#18(1 sheet) (The program solves the issue more fully)
3	Water pipeline of 2DWW from 3rd LS up to 4th LS PK263+50-PK266+50	1000	419.00	0.30	4,371	168,115	3	No	water supply to Sloviansk, Kramatorsk, Druzhkivka, Kostiantynivka, Toretsk	#19(1 sheet) (The program solves the issue more fully)
4	Water pipeline "Branch to Sloviansk Clearwater Tanks" PK0+00-PK39+00	500	4.00	3.90	26,083	1,003,192	2	No	water supply to Sloviansk, Kramatorsk, Druzhkivka, Kostiantynivka, Toretsk	#16(1 sheet) (The program solves the issue more fully)
5	Rehabilitation of 2DWW in Donetsk direction - Kostiantynivka District, Yasynuvata District (PK0 — PK 218+78) — (PK 55+79 — PK 218+78)	400, 325, 315 250,160	21.00	13.96	22,811	877,335	3	No	water supply to Sloviansk, Kramatorsk, Druzhkivka, Kostiantynivka, Toretsk	#22(1 sheet)
6	Rehabilitation of 2DWW in Pokrovsk direction (PK0-PK113+50) in Kostiantynivka District, Donetsk Region (correction)	225,140,110		11.90	14,879	572,278	1	No	water supply to settlements in Kostiantynivka District	#21(1 sheet)
	Total:		**686.40**	**8.43**	**72,824**	**2,800,921**				
				Toretsk Operational Office for Water and Wastewater Utilities						
1	Water pipeline from 2DWW up to Yakovlivka clearwater tanks	600	5.4	1.0	6,982	268,538	2	No	drinking water supply to Druzhkivka	
2	Water pipeline from 2DWW up to Yakovlivka clearwater tanks	400	5.7	1.0	5,356	206,000	2	No	drinking water supply to Druzhkivka	
3	Water pipeline from 2DWW up to Yakovlivka clearwater tanks	200	5.3	1.0	1,708	65,692	2	No	drinking water supply to Druzhkivka	
4	Water pipeline from 2DWW up to Oleksiyevo-Druzhkivka clearwater tanks	400	3.2	0.8	4,285	164,808	3	No	drinking water supply to Oleksiyevo-Druzhkivka settlement	
5	Water pipeline from Yakovlivka clearwater tanks up to PS No 4	600	5.3	2.0	13,964	537,077	3	No	drinking water supply to PS No 4	
6	Water pipeline from Yakovlivka clearwater tanks up to PS No 1	400	3.5	1.2	6,428	247,231	3	No	drinking water supply to Yakovlivka settlement	
7	Replacement of water supply network in Bohdana Khmelnytskoho street, Druzhkivka (correction)	355		1.3	5,710	219,615	1	No	drinking water supply to Druzhkivka	
8	Rehabilitation of water supply network in Dobroliubova street, Druzhkivka	400		1.0	4,016	154,453	1	No	drinking water supply to Druzhkivka	
	Total:		**28.4**	**7.0**	**48,449**	**1,863,414**				
				Chasiv Yar Regional Operational Office						
1	Water pipeline from underground water intake Vyimka village up to Berestove village	200-300	10.0	3.00	9,198	353,769	2	No	drinking water supply to Berestove village	
2	Pipeline route Hryhoryivka village	426	6.9	3.00	16,070	618,077	3	No	drinking water supply to Chasiv Yar	
3	Water pipeline PS Bohdanivka village-2nd LS	200	5.7	2.50	4,272	164,308	2	No	drinking water supply to Chasiv Yar	
4	Main pressure pipeline of Bakhmutske village	200	2.5	1.00	1,708	65,692	3	No	drinking water supply to Bakhmutske village, Pokrovske village	
5	Pressure pipeline of Bakhmutske village	100	4.7	1.60	483	18,577	3	No	drinking water supply to Bakhmutske village, Pokrovske village	
6	Water pipeline from wells of Kirovskyi water intake up to tanks (2 lines)	300	13.6	4.00	12,264	471,692	2	No	drinking water supply to Siversk	
7	Water pipeline from Sukhoyarskyi water intake's well (KKP)	300	8.0	3.50	10,731	412,731	3	No	drinking water supply to Siversk	
8	Water pipeline from SDD to Toretsk	200	11.15	0.10	137	5,269	3	Yes	water supply to Toretsk	
9	Drinking water pipeline from clearwater tanks at Artemivska WTP up to Soledar	200	14.9	0.12	165	6,346	2	No	water supply to Soledar	
10	Drinking water pipeline from PS to Kostiantynivka clearwater tanks	325	24.5	0.50	1,533	58,962	2	No	water supply to Kostiantynivka	
11	Major overhaul of water main from Hryhoryivskyi water intake up to 2nd LS Chasiv Yar	400	6.88	1.40	6,235	239,808	2	No	water supply to Chasiv Yar	#34(1 sheet)
12	Water pipeline from SDD to industries in Kostiantynivka	400	20.3	0.30	1,607	61,808	3	No	water supply to industries in Kostiantynivka	
13	Major overhaul of emergency section of raw water pipeline D=600mm SDD — Artemivska WTP, Artemivsk District of Donetsk Region	630	8.97	1.90	6,094	234,369	2	No	water supply to Bakhmut	#37(1 sheet)
14	Water pipeline from 2nd LS of Chasivyarska WTP up to Kanal settlement	89	1.8	0.05	20	769	2	No	water supply to Kanal settlement	
15		100		0.05	20	769	2	No		
16	Water pipeline from site of Horlivska WTP 2 up to Water Supply Unit-1 Toretsk	900	5.4	0.02	32	1,231	1	No	water supply to Toretsk	
	Total:		**145.3**	**23.0**	**70,569**	**2,714,177**				

	No risk of military	Risk of [illegible]	
Total pipe replacement costs in USD	**68,199,335**	**39,542,205**	**28,657,130**
Priority 1	**11,247,059**	**10,115,905**	**1,131,154**	needed within 1 year
Priority 2	**23,540,057**	**19,666,427**	**3,873,630**	needed within 2 years
Priority 3	**33,412,219**	**9,759,873**	**23,652,346**	needed within 5 years

NGCA	**45,293,927**
GCA	**22,905,408**
Total (check)	**68,199,335**

ANNEX 12 – Specialized equipment needs

The company VD uses specialized equipment in their daily operation, such as excavators, emergency team vehicles, truck-mounted cranes, dredging tools, sludge suction equipment, and vacuum trucks.

About 73% of VD's vehicle and machinery fleet is depreciated. Repairs and replacements of this equipment are urgently needed. **The company puts its current need of new equipment for emergency work at 108 pieces. The total costs for these are estimated at UAH 176.3 million (6.78 million USD).**

Below table is an **illustrative example** of high priority needs and presents only parts of the total requirements of VD.

#	Machinery item	Brief technical description	Pieces
1	JCB 3CX	Backhoe loader (for carrying out emergency rehabilitation and repair works, replacement of water supply and waste water disposal networks, works on laying new water pipelines)	13
2	Maintenance team vehicle	For transporting maintenance teams, equipment and materials	13
3	Power unit	1 phase, 7-9 kW, for feeding power to welding equipment, lighting, connecting up auxiliary handheld power tools	13
4	Welding equipment	Inverter type, 5-7 kW	13
5	Power-driven pump	60-100 m^3/h, for pumping out contaminated liquid from trenches, pits, manholes	13
6	Truck-mounted crane	Carrying capacity – 12 t, equipped with a telescoping boom, for loading and unloading works, mounting works, at operational facilities	1
7	Truck-mounted crane	Carrying capacity – 25 t, equipped with a telescoping boom, for loading and unloading works, large-scale mounting works, at operational facilities	1
8	Tower vehicle	Height of lift – 22 m, for repair and maintenance works at height (power transmission lines, lighting, communications, roofing and facades of buildings and structures)	2

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