PROJECT BENEICIARY 2:

MUNICIPALITY OF DIMITROVGRAD

PROJECT:

APPLICATION OF INNOVATIVE TECHNIQUES FOR IMPROVING THE QUALITY OF DRINKING WATER IN URBAN AREAS - AQUA-LITY

DELIVERABLE 3.2.2:

STUDY ON THE DEVELOPMENT OF AN EARLY WARNING SYSTEM WITH THE USE OF TELEMETRIC STATIONS FOR REAL-TIME MONITORING

CONTRACTOR:

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Contents

1 OPERATIONAL PROBLEMS WITH THE QUALITY OF THE DRINKING WATER USED FOR THE WATER SUPPLY OF DIMITROVGRAD

The quality of all water sources operated on the territory of the municipality of Dimitrovgrad is problematic and the levels of pollution of the raw water constantly or periodically exceed the normative permissible. Very high levels of manganese are observed at the water sources supply town of Dimitrovgrad. The measured maximum concentrations are in the range of 0.2 ÷ 0.3 mg/l at limit 0.05 mg/l or an average 400% excess. To solve the problem in 1994 was put into operation Water treatment plant for drinking water-DWTP Krum. The main function of the co-ordination is the de-regulation of the raw water achieving health-safe levels of water quality indicators.

In the result of the multi-annual supply of contaminated water, significant manganese hydroxides are deposited in the pipes. In case of sudden changes of water speed in the distribution grid, they are a threat to the quality of the already purified water, and in addition to creating hydraulic difficulties on the network because of the reduced water sections.

1.1 MAIN CONTAMINANTS OF WATER SOURCES

The water supply of the town of Dimitrovgrad is carries out by underground water sources (deep drilling) with alluvial groundwaters from the Maritsa river terrace. These are three main abstraction zones "Krumska Terasa" with 20 tubular wells and "Chernogorovo" with 9 tubular wells and "Lyav Bryag" with 6 tubular wells and 2 shafts wells. After connecting the pressure tank (PT) over the Maryino neighborhood with the "Goren Gaber" reservoir, the water section "Lyav Bryag" was stopped from operation and subsequently the equipment and facilities of the tubular wells and pumping station were removed.

After the introduction of Ordinance No 9/2001, new limits are adoptes for the limit concentrationa of certain contaminants in drinking water supply. One of these indicators is arsenic, as the norm

is modifies by max. 0.05 mg / l at 0.01 mg / l. This leads to the suspension of the "Merichleri-Velikan" abstraction group due to the content of arsenic in groundwater above the limit concentration as required.

In this Ordinance No. 9 of 16.03.2001 is defines the requirements for water quality, intended for drinking and household purposes. According to it, the indicators to be followed are divided into microbiological, chemical, indicators of indicative importance and radiological indicators.

The operating company has established a system for monitoring the quality of the water in the separate territory complying with the normative requirements. In addition, state control over water quality of water carried out by the regional directorates of RIEW (Regional Inspectorate for the Environment and Waters) and RHI (Regional Health Inspection).

The monitoring of drinking water quality consists of sampling and laboratory analysis at different points in the water supply systems. This includes, as well as samples of the raw water from water sources for drinking and domestic water supply and samples in the "final" water consumer, samples from different stages of purification, water samples from self-supplying sites and water from "public Local water sources "(public water fountains with open access, etc.).

The monitoring of drinking water carried out by the operator is fixed monitoring/in pre-specified points and stations on an approved schedule (and variable monitoring) at random points and time/.

Analyzes of the samples taken were also episodically recorded and inconsistencies with other indicators such as:

- some microbiological indicators - coliforms - mostly during / after emergency situations;
- Physico-chemical indicators – abnormal values of nitrates - are often due to unregulated fertilization of agricultural land and have a seasonal nature;
- residual chlorine – in case of chlorine overdose under decontamination process;

- increased indications of metals - arsenic.

The percentage of samples with deviations from the requirements of Ordinance № 9 ranged within ≤ 5.0% of all samples.

Based on the laboratory tests of the water used for drinking and domestic water supply was made a qualitative. Summary information on the observed deviation indicators with observed deviations is presented in the following table:

Problematic indicator	Watersection	Deviation from Permissible Exposure Limit (PEL)	Reasons
Manganese at PEL 0,05 mg / l	1. "Krumska terasa" all shallow tubular wells (TK № 1 ÷ 17) 2. "Lyav Bryag" all wells (not operated)	0,9 mg / l 1,0 mg / l	The manganese appears at the end of the 70 years due to pollution of the protective source-Maritsa river and hydrogeochemical processes in the river terraces
Nitrates in the MAC 50 mg / l	1. "Krumska terasa" tubulr well №3 - deep 2. "Chernogorovo" - all wells	60 mg / l To 90 mg / l	From 2010 for unexplained reasons; Karst region with non-observance of the norms for fertilization in the territory of unincorporated Sanitary Security Zones (SSZ);
Arsenic at PEL 0,01 mg/l	PS"Merichleri" (Merichleri-Vulkan not operated)	0,03 mg/l	It is naturally contained in layers. After the introduction of Ordinance № 9/2001, this indicator is above PEL.

1.2 FACILITIES FOR PURIFICATION

DWTP Krum was built to ensure the water supply of the town of Dimitrovgrad. It is located about 3-4 km away from the town, near to the village of Krum and purifies the water from the "Krumska

Terasa" water catchment area. The station is designed to solve the main problem with the quality of the raw water – the manganese. Before its construction, all urban districts received water with an elevated manganese content (0.7 to 2.0 L/s).

DWTP Krum is designed for a gross water quantity in the final stage Q op. = 605 L/s, but in 1994 it was built and introduced into exploitation only the first stage for Q op. = 375 L/S. Taking into the needs of the city at present the station is purified Qw. = 150 ÷ 200 L/S.

The technological scheme is a two- step without the use of reagents except for the chlorination for decontamination of purified water. The manganese is removed from the principle of oxidation and filtration by means of sand filters with pearlite and quartz sand filling. There is currently no need for further oganization, by adding potassium permanganate or any other reagent, because of the output station the manganese indicator is in norms. It follows that the filters purify the water sufficiently and currently fulfil their purpose.

Informative data about the scope of work of DWTP Krum are given in the following table:

№	Indicator	Unit measure	Value input	Value of Output	Ordinance №9 / 2001
1	pH	-	7.0	7.3	6,5 - 9,5
2	turbidity	mg / l	acceptable	acceptable	acceptable
3	oxidisability	mgO_2 / l	2.1	1.8	5
4	Ammonium ions	mg / l	0,039	0.0	0.5
5	nitrite	mg / l	0,041	0.0	0.5
6	nitrate	mg / l	43	44	50
7	chloride	mg / l	30	31	250
8	manganese	µg / l	279	0	50
9	Hardness of water	mg eqv / l	7.2	7.3	12
10	Water conductivity	µs / cm3	818	809	2000
11	free chlorine level	mg / l	0	0.4	0.3-0.4

1.3 INTERNAL WATER SUPPLY

Serious problem for the internal water supply of the city of Dimitrovgrad, Merichleri and Velikan village are the manganese deposits in the pipes. As a result of the long lasting supply of depleted water, deposits of manganese hydroxides have accumulated in the pipes, which in the case of abrupt shifts of water velocity leads to dissolving them, and in addition they significantly reduce the section of the pipes, which is a potential problem for the hydraulics ot the network. In Mariyno, Vulkan and Chernokonevo districts , water supply system is with highest manganese content (up to 2.0 ÷ 2.5 mg/l) of decommissioned catchment area "Lyav Bryag" is supplied sespectivly.

In order to solve the problem with manganese water, a project for water supply for Mirichleri and Velika forom the Dimitrovgrad network was further developed and implemented. Water is supplied to the Septic Tank / ST / Pump Station / PS / Merichleri and then to the consumers.

2 OPERATIONAL MEASURES TO CONTROL THE QUALITY OF DRINKING WATER - STUDY FOR THE DEVELOPMENT OF A EARLY WARNING SYSTEM USING TELEMETRIC STATIONS IN REAL TIME MONITORING

In 1994 Drinking Water Treatment Plant was put into operation, whose main purpose is the removal of manganese in the water harvested from the pipe wells, still under certain hydraulic conditions are reported problems with its increased content. This is due to the fact that as a result of the long-term supply of water in the pipes, deposits of manganese hydroxides have accumulated. Under sensitive speed changes, so-called hydraulic impacts, particles of deposits are dissolved in water and there is a risk of an increase in manganese concentration above the normative value of 50 μg / l.

In order to ensure adequate monitoring of the quality of drinking water in the city's distribution network, it is envisaget to build a real time monitoring system of basic chemical indicators at key points of the water supply network. The system will consist of 5 control points/CT/, installed in pre-selected control points. Their location is consistent with the characterization of the entire water supply system, so as to ensure maximum coverage of the city and the urban water-supplying network of Dimitrovgrad.

2.1 MONITORING ZONES

The main feature of Dimitrovgrad's internal / distribution / water supply network is its dispersion, which justifies its classification as branched. This is due to the peculiarities of urban development - it consists of five relatively remote parts, each with its own water supply network, usually with one entrance and exit, the only control zone 1 - the central city part has two entrances .

The internal water supply network in Dimitrovgrad is divided into:

- Central part and "Iztok" neighborhood / I and II / - powered by pressure plumbing /PP/ "Desen Bryag" and pumping station / PS / "Chernogorovo" the water from the pumping station is mixed with water from DWTP Krum in PP "Denen Bryag ";
- Neighborhood of Mariyno, Vulcan and Chernokonevo - powered by conection from the "Desen Bryag".

The water supply between the two zones can be adjusted by means of a shut-off valve in Mariynovo after crossing the bridge over the Maritsa River (2 x Φ225 HDPE – over the bridge). There is also a hydrophore installation that sends water to PT Mariyno.

In addition, the water supply network in Dimitrovgrad is supplies by the town of Merichleri and Velikan - after reconstruction are connected PT Mariyno and hydroform station with a 50 m3 tank, from where water is supplied to the two settlements.

№	setpoint	Place of assembly	covered area
1	№1 - entrance PR 8000 m3	Existing shaft with pressure regulators - is envisaged that measuring equipment be mounted on the water pipe steel 475 mm after the union of the volume of water passing through two regulators	About 80% of the water supply network of the city
2	№2 - direct entrance in the town between DWTP and PT 8000 m3	Existing pit with water meter and air vent - provides measurement equipment is to be installed plumbing Eternit 200 mm	The rest of the volume of water for water supply of the city

3	№3 - out of downtown neighborhoods	Existing shaft with a tee after the bridge over the river. Maritsa	The northern districts of the city, city. Merichleri with. Velikan
4	№4 - entrance from PT4000 m3	Existing shaft with pressure regulators - envisaged measuring equipment be mounted on pipeline steel 400 mm after the unification of the volume of water passing through two regulators	Neighborhoods of Mariyno. Chernokonevo, Vulcan city, Merichleri and Velikan
5	№5 - hydrophore pump station	Existing hydrophone station in the Chernokonovo neighnorhood - envisaged measuring equipment be installed plumbing PE 140 mm, then the pump	Merichleri , Velikan

2.2 CONTROL POINTS

The locations for the installation of the measuring stations are chosen to meet the main objective of the project - effective control of the quality of the water intended for drinking household purposes. In addition, for each Control Point, the possibility of quickly and easily differentiating the installation of the necessary equipment, easy access for service and the possibility of providing power supply was assessed.

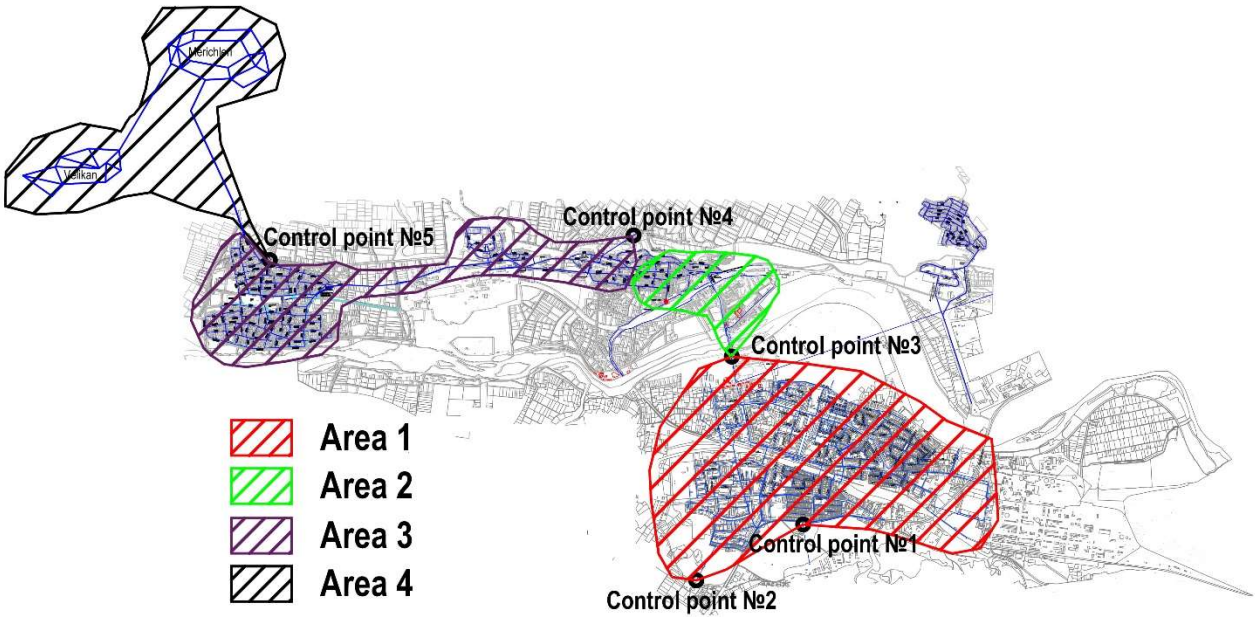
Control point №1

Control point №2

Control point №3

Control point №4

Control point №5



scheme 1 - diagram of the surveillance zones

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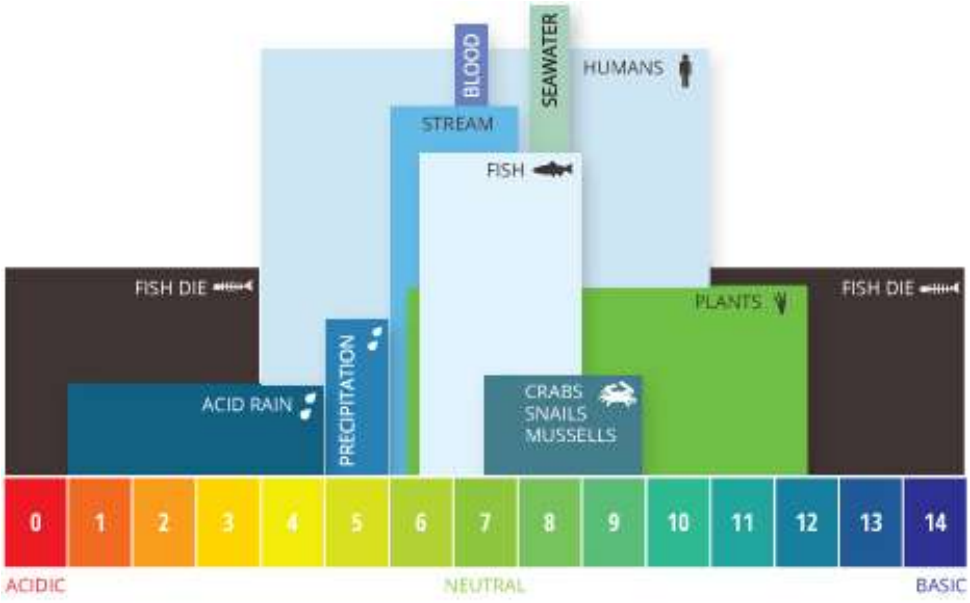
2.3 OBSERVED PARAMETERS

In order to ensure the quality of water pollution risk management at selected points in the water supply network, a set of sensors is planned to be interchanged by telemetry stations and transmitted remotely to the central dispatch point. The newly built system will enable the water and sewerage operator to monitor the real time on the main chemical indicators of the water. In addition, it is foreseen in the quality control point to measure and use the main indicator - current consumption and pressure. This will make it easier to operate the network by providing information about its hydraulic performance in real time.

2.3.1 *pH*

This is a measure of the amount of hydrogen in the liquid. It does not reflect the alkalizing or acidifying chemicals in the liquid, and the amount of hydrogen atoms.Water with a pH lower than 6.5 is corrosive, it may contain metal ions such as - iron, copper, zinc or manganese and is dangerous for the human health and for the plumbing infrastructure.



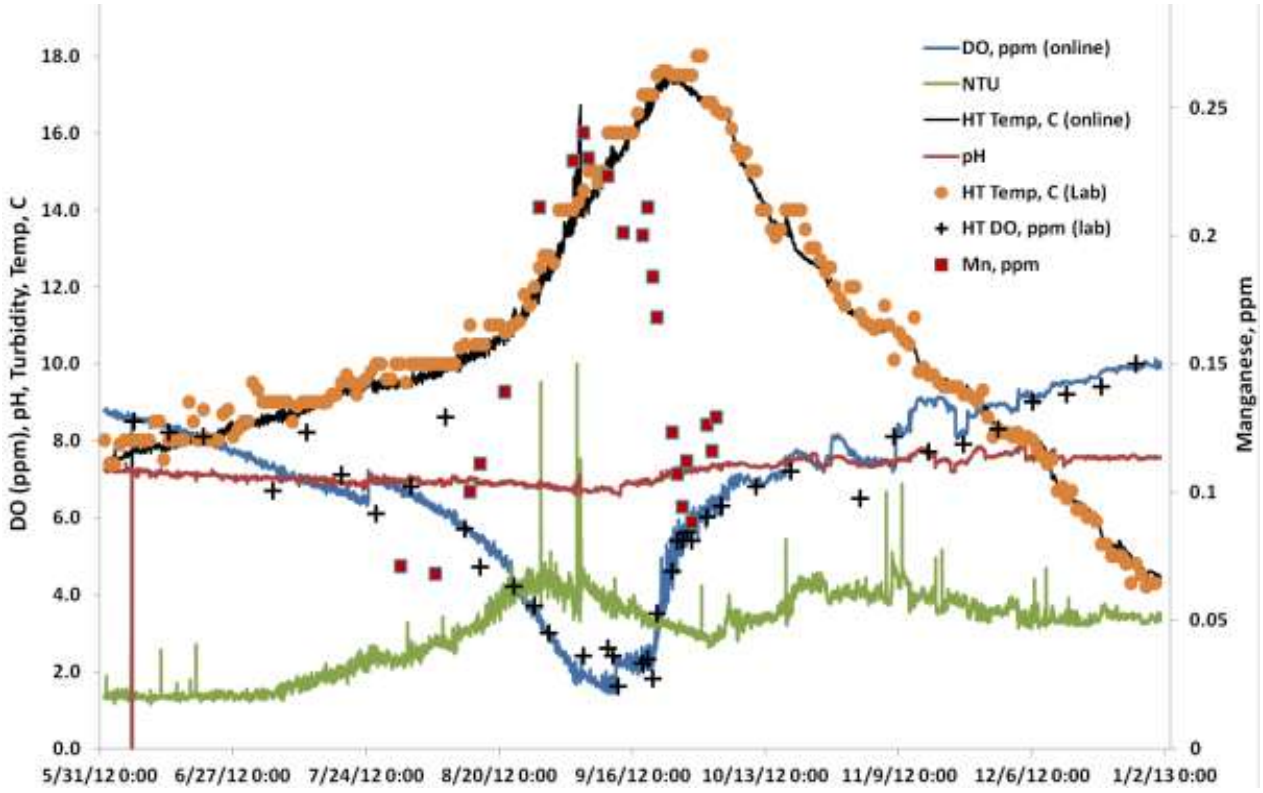
2.3.2 *Reduction potential ORP*

Redox potential indicates potential contamination, especially in industrial wastewater. Due to the fact that in the presence of a high concentration of metal salts value of ORP is significantly very often monitoring of this parameter is performed to control the pollution of ground and surface waters by heavy metals.

2.3.3 *Manganese*

The potential threat of high concentrations of manganese in drinking and household use of water due to the dissolution of deposits of manganese hydroxides of pipes is one of the biggest challenges in terms of providing quality service to consumers. The deviation of this indicator is of no direct health significance, even in excess of the norm to a certain extent, but it is very important to consumers as higher concentration of manganese changed greatly organoleptic characteristics of the water, in some cases deviations make it even problematic to use some household use in households.

Measuring the concentration of manganese in the water can be difficult mainly in the laboratory with specialized equipment or property with pre-calibrated portable equipment. Therefore such equipment is installed mainly to sewage treatment plants for drinking water, where it is used and maintained by qualified personnel or in special laboratories. Given that the team plans monitoring the concentration of manganese in the water it indirectly through constant monitoring of climate values of the other two parameters to be monitored - pH and ORP. With the decrease in the redox potential of the water is reduced and dissolved oxygen therein, which in turn is inversely proportional to the concentration of manganese.



2.3.4 *Residual chlorine*

Chlorine (or chlorine-containing substances) are used to disinfect drinking water due to the fact that it degrades the molecules of organic compounds of plant and animal nature and thus destroys all disease-causing micro-organisms. Taking this into account, another top priority of a water quality monitoring system will be to provide reliable data on residual chlorine in the water supply network. For this purpose, it is planned to install a specialized automatic system of sensors and instruments, which every 2.5 minutes will extract water directly from the water pipeline through a sampler. The system will use an indicator reagent that will be stained by the free chlorine in the sample taken from the pipeline. The end result of the measurement will be available in the on-screen display or remotely in the dedicated monitoring software.

The five residual chlorine monitoring points to be built will enable the WSS operator to maintain its concentration in the required water quality requirements of Ordinance No 9 / 16.03.2001 for drinking and household purposes of 0.3 - 0.4 mg / l.

2.3.5 *Water quantity*

The division of the water supply network into areas with constant monitoring of water quantity and inlet pressure is the most popular method for controlling water losses. In the presence of already separated zones from the operational point of view it is logically parallel with the water quality monitoring equipment at the selected points to install measuring devices for water quantity.

Given the availability of a steady-state power supply, "transit time" with external mounting sensors is preferred as the most appropriate water consumption measurement technology, which determines the average fluid velocity based on the effective sound propagation velocity. With this technology, two sensors (hydro-acoustic transducers) are installed that continuously emit audible pulses, and the device takes into account the difference in time that the sound signal needs to cross the water section in and out of the water. The value thus obtained is proportional to the velocity of the fluid. By using the "transit time" technology, the need for installation of shut-off valves and pipework is eliminated, which significantly reduces the cost for the establishment of water quantity measurement points. In addition, the complete installation is realized without limiting the water supply. To ensure maximum accuracy of the measurement, the meters to be installed shall be of an approved type in relation to the requirements of the Ordinance on measuring instruments subject to metrological control.

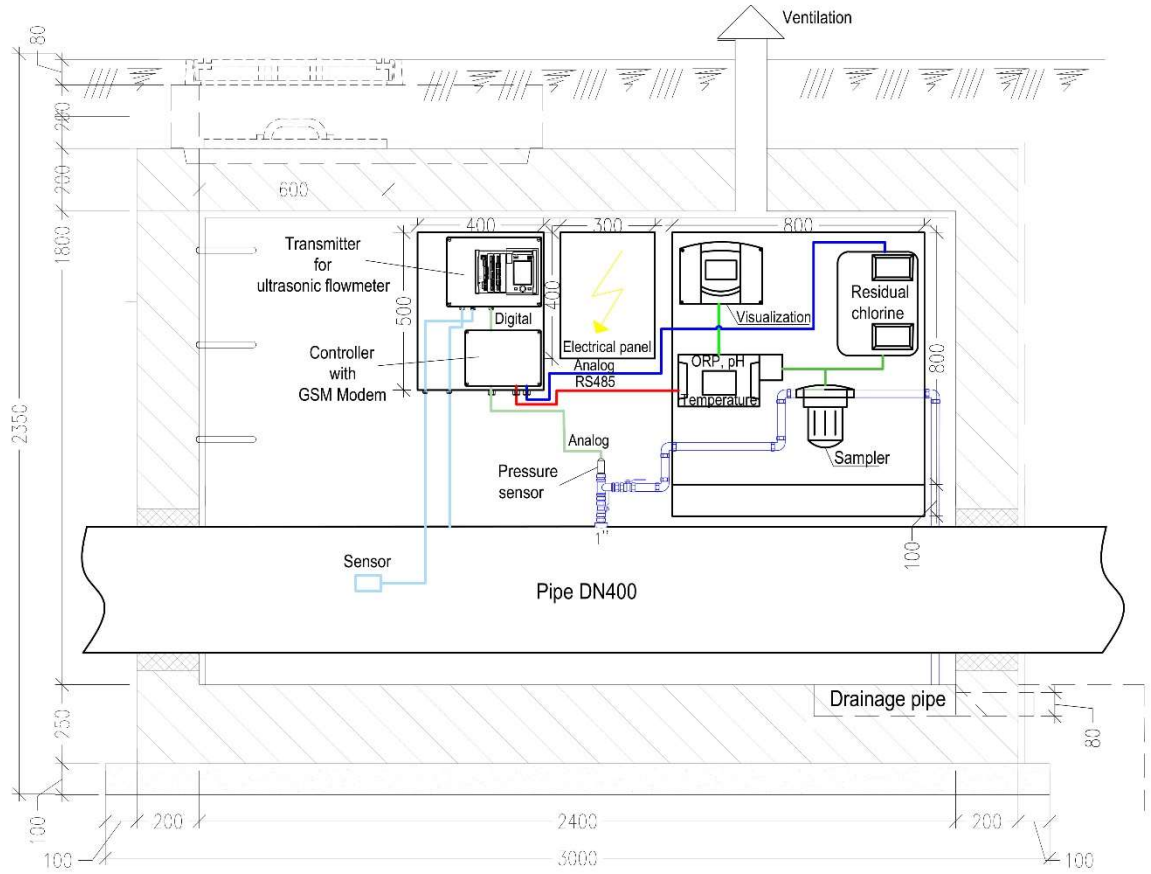
2.3.6 *Pressure*

It is envisaged to install a pressure transducer with an analogue output of 4-20mA, directly mounted on the water pipe connection, from which the water quantity required for the water quality monitoring sensors will be taken. The power supply of the sensors will be carried out by the main controller.

2.4 CHARACTERISTICS OF THE SYSTEM

The monitoring benchmarks will be reported through dedicated sensors, with a separate sensor generally required for each indicator. The sample required to measure the observed parameters will be taken directly from the water conduit via a nozzle and stored in special samplers where the sensors provided will be in contact with the fluid. The monitoring of the oxidation-reduction potential and pH will be carried out in a common sampling and the chlorine residual monitoring system is equipped with its own water recirculating device.

Given the specificity of each parameter, it is intended that the information from each sensor is collected and processed in an individual controller with a local display and then the data transmitted via one or more of the following communication channels - RS485, analogue output 4-20mA, digital output to the central telemetry stations that will be installed at each Control Point.



scheme 2 - conditional scheme of distribution equipment in the control point

The collected information will be transmitted remotely via GSM modem, and management and visualization of data will be done through specialized SCADA system.

2.5 DATA ACCESS

Data from all measurements will be integrated into specialized SCADA system where information about the readings will be available in graphical and tabular format. It is foreseen that the software be installed on specially assigned for this server, which will allow the application to be available remotely. The communication between telemetry stations and SCADA system will be bidirectional

via custom-built VPN network. This will allow for manual retrieval of data and remote adjustment of the controllers as necessary.

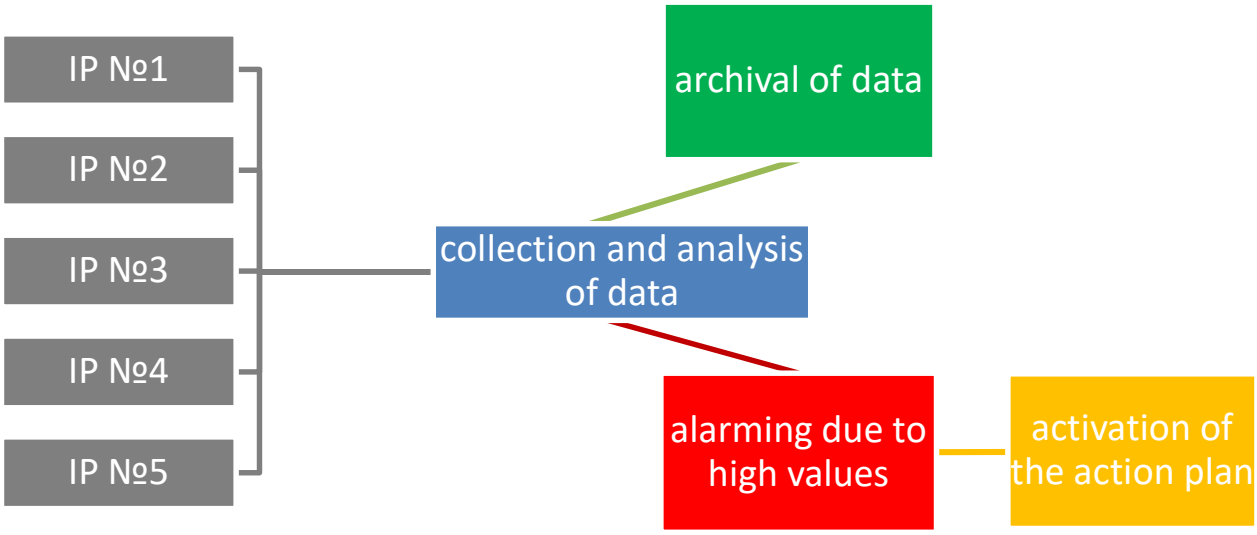
The functionality of the system will allow the creation of different levels of access. administrators save option for remote access to telemetry stations will be able to create alarms and different logics.

3 PROCEDURE (ACTION PLAN) ON RECEIPT OF AN ALARM FOR POTENTIAL CONTAMINATION OF THE WATER:

3.1 CONTROL SYSTEM DATA

Early warning system with telemetry monitoring stations in real time will carry out measurements around the clock, as data will be available in real time with update interval of five minutes. Management and visualization of information will rely on specialized software / local SCADA / with predefined range of readings, alarm levels and type of signaling. All reports from the system will be backed up automatically. In deviation of any of the monitored parameters SCADA system will perform the following actions - local signaling via a message on the screen and send e-mail to a predefined list of contacts.

After receiving the signal for exceeding the prescribed limit levels of some of the monitored parameters responsible officials of the Operator have the task to analyze the information received and to launch the action plan.



scheme 3 - conditional scheme with the sequence of processes when working with the system for early warning and real-time monitoring

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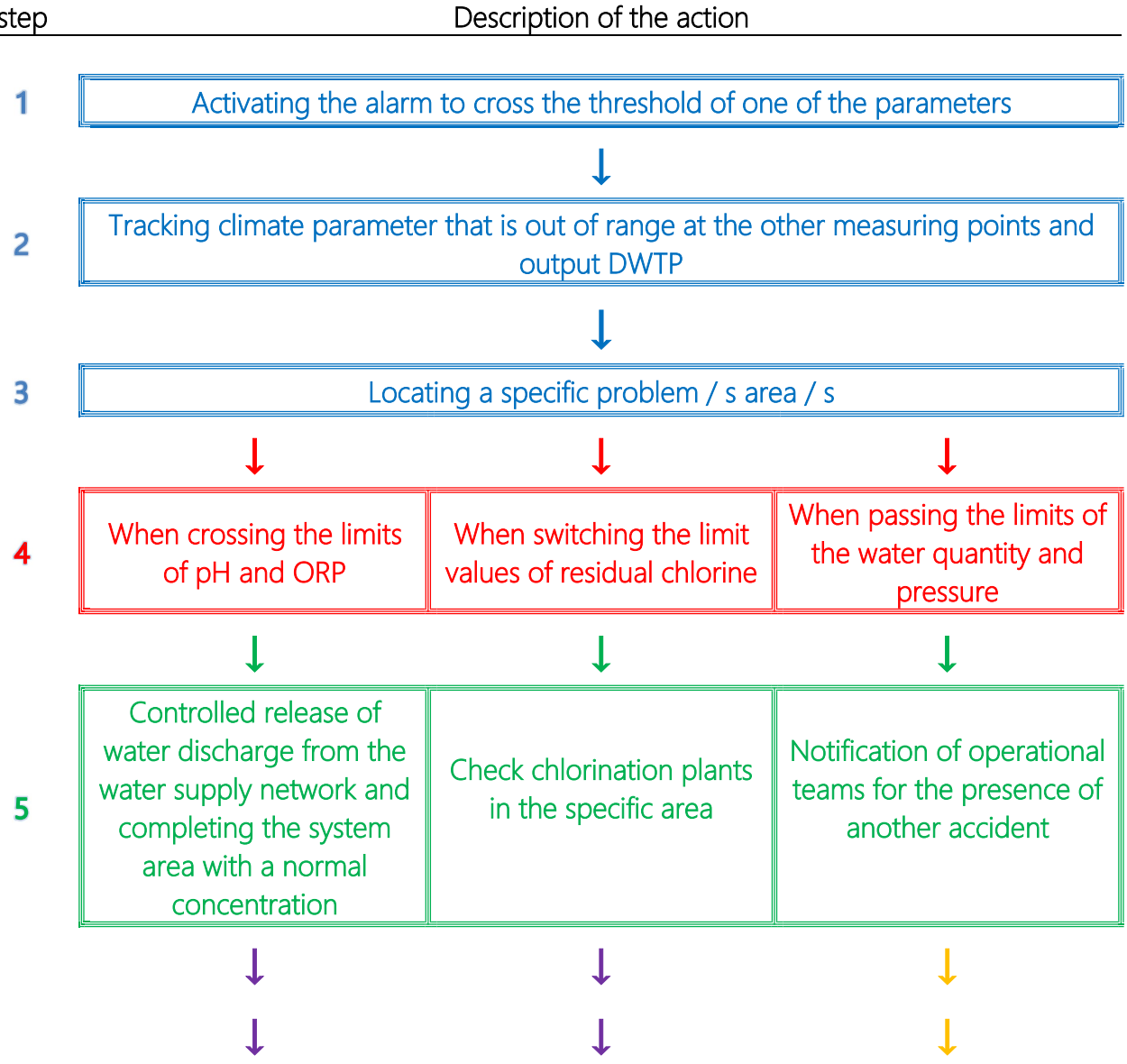
3.2 ACTION PLAN

After building the early warning system and real-time monitoring contractor plans to hand over operation of Water Operator, where it will become part of the existing dispatch system management and monitoring of key facilities. With the transmission system will be introduced following plan of action that will apply upon reaching the preset limit values for some of the observed parameters.



step	Description of the action	
5	Failing inserting alarm parameter within normal operating limits within an hour passes to notifying interested parties of a problem with the quality of drinking water	Monitoring the work of the operating teams detection and removal of accident ↓ If it is impossible to remove the accident within 12 hours and supply of the affected population from another zone passes to notifying interested parties

3.3 LIST OF STAKEHOLDERS

In addition to the Water operator, who will be directly involved in the operation and effective use of real-time early warning and monitoring data, the other stakeholders are as follows:

№	interested party	With its quality of	Way of notifying a problem
1	Dimitrovgrad municipality	A representative of the population contracting the activities of Water Operator and owner of Water Assets	Report by phone and e-mail to the Head of "Investment, environment and water"
2	Regional health inspection	Territorial Authority of the Ministry of Health of the municipality of Dimitrovgrad main role in implementing and carrying out state policy to protect public health	Report by phone and e-mail to the Directorate 'Public Health'
3	Population of territory	Users of WSS services - directly affected party	Signal on the website of Water Operator and announcement on the local radio