Environmental Monitoring Report for Ada Tepe Prospect of Khan Krum Deposit 2016

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INTRODUCTION

The purpose of the 2016 Report is to present the analyzed results of the environmental and biological monitoring work completed at the local network, which supports the monitoring of surface and ground water, air, noise and vibration, soils and biological status in the area of Ada Tepe, Khan Krum deposit.

This document covers the completed monitoring activities related to the implementation of DPMK's project for Mining and Processing of Auriferous Ores from Ada Tepe prospect, Khan Krum Deposit, Krumovgrad. The main objectives of the Monitoring Plan are to:

- Gather information to complement the already existing database available at the Company prior to commencing construction works of the future minesite;
- Compare current results on local environmental status with future ones, i.e. once construction works begin and throughout the next stages of project implementation;

The monitoring efforts involve sampling from designated points and subsequent testing. Test results were used to identify any changes to the monitored environmental components in the in the Ada Tepe area, Khan Krum deposit. Lab tests were conducted by a certified lab, and by using Company equipment.

1. GENERAL

The Environmental Monitoring Report (the Report) of Dundee Precious Metals Krumovgrad ("DPMK" or "the Company") has been drafted in connection with environmental monitoring conducted in the area of the future minesite under the project for Mining and Processing of Auriferous Ores from Ada Tepe Prospect, Khan Krum Deposit, Krumovgrad Municipality, and in execution of the Company's obligations provisioned in the 2014 Environmental Monitoring Plan, endorsed by the respective environmental authorities.

Appendix 1 provides a map of minesite facilities and their respective distance from nearby populated areas.

According to the provisions of the Design Phase, item 3 of the EIA Resolution (Appendix 2), the Company has drafted an environmental monitoring plan. The plan is coordinated with REWI-Haskovo, the EEA and Krumovgrad Municipality, and the "Waters" Component is also agreed with the Basin Directorate for Water Management - East Aegean Region - Plovdiv.

2. POLLUTION SOURCES AND MONITORING THE IMPACT ON BIOLOGICAL COMPONENTS IN THE ADA TEPE AREA

3.1 Surface and Ground Water:

The East Aegean Catchment Directorate based in the city of Plovdiv is in charge of the area, where the Krumovgrad Gold Project will be implemented.

Water management is performed according to effective regulations in Bulgaria and specific short and long-term activities are consistent with the drafted Water Management Plan for the Arda River Basin, which includes Krumovitsa and its tributaries.

The monitoring area is subject to an effective ***River Basin Management Plan (RBMP) for the East-Aegean Region ,*** which is the key water management instrument and provides guidance on the current and future control over the water status in the the Arda River basin area.

The sources of pollution of surface and ground waters in the area depend on the nature of the agricultural business (typical of the region) which involves fertilizers, along with the local topography, precipitation intensity, mineral composition of the rock, degree of weathering, etc. Another important source of pollution is the fact that most local settlements, with very few exception, have no waste water treatment facilities on their territory.

DPMK had no mining operations in 2016. The Company is in a process of obtaining permits and detailed zoning approvals for the construction of peripheral infrastructure to support the minesite (roads, water and power lines, etc.), under the Spacial Planning Act. Minesite construction works started in 2016 with vegetation clearance and earthworks.

3.2 Air

According to Bulgaria's climatic division, the project area belongs to the Continental-Mediterranean climatic type, Southern Bulgarian climate sub-area, Eastern Rhodopean river valleys climatic zone. The low-mountainous topography of the Eastern Rhodope Mountains cut by the Krumovitsa River flowing south to the north allows free flow of both Mediterranean and cold continental air during winters.

The area is located east of the polluted air basins of Dimitrovgrad, controlled by the Ministry of Environment and Water (MOEW) (controlled air pollutants: dust, sulphur dioxide, nitrogen oxides, hydrogen sulphide, fluoric compounds, lead aerosols) and south of Kardzhali (controlled air pollutants: dust, sulphur dioxide, nitrogen oxides, lead aerosols). Due to its remoteness from the quoted basins, its rugged mountain terrain and the prevalent wind direction (NNW to SSE), the project area is not accessible for pollutants from these two monitored basins. No local industrial pollutants have been documented on Krumovgrad's territory.

This Report presents measurements of dust and gas emissions in ambient air, conducted by a certified lab (Measurement Records are provided in Appendix 3), as well as results from three PM2.5 and PM10 continuous monitoring stations, and eight deposited dust measurement stations. Appendix 3 features the 2016 Meteorological Data Report. There is free online access to continuous monitoring data at:

http://krumovgrad.webnoise.eu/index.php

3.3 Soils

According to Bulgaria's soil division, this region belongs to the Mediterranean soil district, Balkan-Mediterranean soil sub-area, East-Rhodopean-Sakar province. This province is dominated by shallow soils (Leptosols, LP) – umbric leptosols with lithosols, umbric liptosols with cinnamon luvisols (chromicq LVx) soils and development of erosion. The soils in the province belong mainly to Class IV of soil capability – poor.

The leached forest cinnamon soil is the prevalent soil type in the project area. The intrazonal soils – rendzinas are rare and the alluvial soils are even much rarer.

No acidification, salinisation, or other negative anthropogenic impacts on the Ada Tepe soils have been identified. Some sections of the forest soils in the Ada Tepe area demonstrate higher concentrations of arsenic, chrome and nickel due to the soil's natural chemistry. No soil monitoring was conducted in 2016, since soils have low pollutant dispersion dynamics.

3.4 Biological monitoring

The future minesite area falls within the footprint of the Natura 2000 protected site known as BG 0001032 Rhodopes East under Council Directive 92/43 on the Conservation of Natural Habitats of Wild Fauna and Flora.

BG 0002012 Krumovitsa, a protected site under Council Directive 79/409/EEC on the Conservation of Wild Birds and endorsed by the Bulgarian Council of Ministers (Resolution № 122/02.03.2007), is in close proximity to the project area. Pursuant to the provisions of the Regulation on the Terms and Procedures for Compatibility Assessment of Plans, Programs, Projects and Investment Proposals with the Conservation Scope and Objectives of Protected Sites (promulgated in SG Issue 73/ 11.09.2007, amended in SG Issue 81/ 15.10.2010), a Compatibility Assessment has been drafted to determine the project's alignment with the scope and objectives of the East Rhodopes protected area. The assessment aims to define, describe and assess the direct and indirect impacts on the human health and the environmental media including biodiversity and its elements, soil, water, air, climate, landscape, subsurface environment, natural sites, diversity of minerals, and their interactions. The relatively small territory (approx 85 ha), i.e. some 0.04% to be affected, as well as the proximity of anthropogenic landscapes (many villages, fields, actively used meadows, forest plants), presuppose the averagely small number of habitats and species, which will be disturbed by DPMK's project. Monitored species in sample areas in 2016 are as follows:

- population of the Jersey Tiger moth (Euplagia quadripunctaria);
- population of the yellow-bellied toad (Bombina variegata);
- the populations of the two tortoise species - Hermann's Tortoise (Testudo hermanni) and Spur Thigh Tortoise (Testudo graeca)

3.5 Noise

The minesite is situated in a hilly area. There are no industrial sources of noise in close proximity. The noise is generated by the routine daily activities of local residents and the

Company's earthworks plus construction works on the access road to the minesite. A total of 6 points are planned for noise monitoring (at local settlements) as the 7th point, i.e. the minesite is not built yet. Measurements were conducted by an accredited laboratory and covered a period where blasting was performed for construction purposes.

3.6 Blast vibration impact (vibrations)

The purpose of this type of monitoring is to identify current vibration levels generated by various activities, including contracted vegetation clearance and construction works. One vibration monitoring device had been planned for installation at Pobeda hamlet, Ovchari village with the assumption that traffic from/to the minesite would have the most substantial impact on residential buildings and farm facilities that are closest to the nearby road, but local residents objected to that installation and the Company had to look for another location to install the seismograph.

The same applies to the installation point of the measurement devices for PM10 and deposited dust. After reviewing nearby settlements that would be affected by future minesite traffic, the village of Zvanarka was chosen as part of the access road recommended by the Kardzhali District Road Management, considered as the road of first choice during the EIA procedure. Measurement devices are located close to the road (at approx. 1.5 m) and will collect road traffic impact data, as traffic is one of the most likely sources of vibrations. Continuous monitoring data is freely available online at:
http://krumovgrad.webnoise.eu/seismo.php?sn=3003048

A map of all monitoring points is provided in Appendix 5.

3. LOCATION OF MONITORING POINTS, SAMPLING AREAS AND TERRITORIES

4.1 Water

Water quality assessment in the area of the future minesite will be done by sampling of 22 water points - 8 for surface and 14 for ground water. Only existing points are being monitored, since some points do not exist yet or have not been set up as monitoring points (e.g. old exploration boreholes). A map of surface and groundwater monitoring points in 2016 is presented in Appendix 4. Static water levels are observed at 24 points, with weekly and monthly frequency. A map of all piesometer drillholes, including inclined ones, is presented in Appendix 4. Details of the selected locations are provided in Table 4-1.1. The table below provides description of each individual point.

Table 4-1.1: Water monitoring points							
№	**Title**	**Suspended Solids (m)**	**coordinates: (WGS84)**	**Type**	**of monitored indicators**	**Sampling frequency**	**Location, Description and Objectives**
1	ESW 01	236	E 387727 N 45 86 770	Surface water	as described in Table 2-2-2	Once per month	Krumovitsa River – the source point (at confluence of Egrechka River and Kessebirdere) Identifies surface water quality south from the minesite
2	ESW 03	233	E 38 69 38 N 45 86 342	Surface water	as described in Table 2-2-2	Once per month	Kessebirdere - upstream of confluence with the Egrechka River. Identifies the water quality upstream of confluence point. Egrechka River
3	ESW 04	235	E 38 76 08 N 45 86 646	Surface water	as described in Table 2-2-2	Once per month	Egrechka River – upstream the confluence with Kessebirdere Identifies the water quality upstream of confluence point.
4	ESW 05	222	E 39 03 67 N 45 88 680	Surface water	as described in Table 2-2-2	Once per month	Buyukdere - upstream of confluence with the Krumovitsa River Identifies the water quality of Buyukdere upstream of confluence with Krumovitsa River
5	ESW 06	240	E 386225 N 4588202	Surface water	as described in Table 2-2-2	Once per month	Kaldzhikdere - upstream of the bridge at Pobeda hamlet of Ovchari village. Identifies water quality in the gully upstream of the intersection with the access road to the minesite and the section of the gully passing by the minesite.

Table 4-1.1: Water monitoring points							
№	**Title**	**Suspended Solids (m)**	**coordinates: (WGS84)**	**Type**	**of monitored indicators**	**Sampling frequency**	**Location, Description and Objectives**
6	ESW 07	220	E 38 77 91 N 45 89 777	Surface water	as described in Table 2-2-2	Once per month	Kaldzhikdere - upstream of confluence with the Krumovitsa River Identifies the quality of the stream flowing west of the minesite
7	ESW 08	231	E 388364 N 4587708	Surface water	as described in Table 2-2-2	Once per month	. Krumovitsa river, about 200 m downstream of the north sump of the IMWF.
8	ESW 09	215	E 386952 N 4592512	Surface water	as described in Table 2-2-2	Once per month	. Krumovitsa River, approximately 100m upstream of the discharge point Reference to point ESW 10. Indicates water quality before discharge
9	ESW 10	215	E 386822 N 4592681	Surface water	as described in Table 2-2-2	Once per month	. Krumovitsa River, approximately 100m upstream of the discharge point Its purpose is to assess the impact on the surface water quality after the discharge of water.
10	EGW 01	N/A	Design E 388187,46 N 4589517,6	Ground water	Water level	Once per month	The monitoring point is located NE from the site, and covers groundwater running towards the Krumovitsa River from the entire SW sector of Ada Tepe. It is situated in Eocene sandstones and conglomerates. The point monitors the water quality in SWB, code BG3G00PtPg2023 - Fissure-flow groundwaters, Krumovgrad-Kirkovo zone.
					as described in Table 2-2-2	4 times per year	

Table 4-1.1: Water monitoring points							
№	**Title**	**Suspended Solids (m)**	**coordinates: (WGS84)**	**Type**	**of monitored indicators**	**Sampling frequency**	**Location, Description and Objectives**
11	EGW 02	312	E 388103 N 4588506	Ground water	Water level	Once per month	The point is a well set up E-NE of the open pit at the foot of the slope (in Chobanka hamlet), and represents ground water in Palaeocene breccio-conglomerates and sandstones (Krumovgrad Group), with draining direction E-NE to the Krumovitsa River The point monitors the water quality in SWB, code BG3G00PtPg2023 - Fissure-flow groundwaters, Krumovgrad-Kirkovo zone.
					as described in Table 2-2-2	4 times per year	
12	EGW 03	312	E 386986 N 4588201	Ground water	Water level	Once per month	The monitoring point is situated in the metamorphic complex (metagranites and granite-gneiss) on the west slope of Ada Tepe and its purpose is to monitor groundwater flowing towards Kardzhikdere from the drainage on the west slope of the deposit. The point monitors the water quality in SWB, code BG3G00PtPg2023 - Fissure-flow groundwaters, Krumovgrad-Kirkovo zone.
					as described in Table 2-2-2	4 times per year	
13	EGW 04	229	E 387596 N 4586825	Ground water	Water level	Once per month	The monitoring point is set up in the metamorphic rocks on the slope descending to the Krumovitsa River terrace and covers groundwater flowing south downstream of the mining waste facility. The point monitors the water quality in SWB, code BG3G00PtPg2023 - Fissure-flow groundwaters, Krumovgrad-Kirkovo zone.
					as described in Table 2-2-2	4 times per year	
14	EGW 05	220	E 387957 N 4591016	Ground water	as described in Table 2-2-2	4 times per year	Krumovgrad drinking water abstraction, located in the in the alluvials of the Krumovitsa River. Identifies any negative changes in the quality of the groundwater abstracted for drinking. The purpose of the point is to monitor water quality in the quaternary aquifer of the water body named BG3G000000Q010 - Interstitial groundwaters in the Quaternary deposits.
15	EGW 06	218	E 387590 N 4590649	Ground water	as described in Table 2-2-2	4 times per year	Ovchari-Krumovgrad – II drinking water abstraction, located in the alluvial sediments of the Krumovitsa River. Identifies any negative changes in the quality of the groundwater abstracted for drinking. The point monitors the water quality in the quaternary aquifer of the water body named BG3G000000Q010 Interstitial groundwaters in the Quaternary deposits.

Table 4-1.1: Water monitoring points							
№	**Title**	**Suspended Solids (m)**	**coordinates: (WGS84)**	**Type**	**of monitored indicators**	**Sampling frequency**	**Location, Description and Objectives**
16	EGW 07	230	E 387521 N 4586750	Ground water	as described in Table 2-2-2	under discharge permit (but minimum four times a year)	Proprietary abstraction well, located in the alluvials of the Krumovitsa River. Identifies any negative changes in the quality of the groundwater abstracted for drinking. The point monitors the water quality in the quaternary aquifer of the water body named BG3G000000Q010 Interstitial groundwaters in the Quaternary deposits. When the construction of the Tube Well is completed, a conceptual design of the facility will be attached to the Monitoring plan in order to provide clarity on the contact point of the infiltration lateral in the tube well and the lithology structure.
17	EGW 08	N/A	Design E 387367 N 4587549	Ground water	Water level as described in Table 2-2-2	Once per month 4 times per year	At high elevation of Ada Tepe, a reference point over the IMWF. Set in a metamorphic complex - metagranites and gneisses, with some schists layers. The groundwater source is porous, with draining direction to the Krumovitsa River. The point provides the background characteristics of groundwater running towards IMWF.
18	EGW 09	N/A	Design E 388302 N 4587478	Ground water	Water level as described in Table 2-2-2	Once per month 4 times per year	At the toe of the north part of IMWF, between the North Collection Sump and the Krumovitsa River. Set in a metamorphic complex - metagranites and gneisses, with some schists layers. The groundwater source is porous, with draining direction to the Krumovitsa River. The point monitors the groundwater quality running to IMWF.
19	EGW 10	N/A	Design E 388392 N 4587262	Ground water	Water level as described in Table 2-2-2	Once per month 4 times per year	At the toe of the south part of IMWF, between the South Collection Sump and the Krumovitsa River. Set in a metamorphic complex - metagranites and gneisses, with some schists layers. The groundwater source is porous, with draining direction to the Krumovitsa River. The point monitors the groundwater quality running to IMWF.
20	EGW 11	325	E 385053 N 4589103	Ground water	as described in Table 2-2-2	4 times per year	Pump station of Zvanarka village. The captured springs are water bodies not pertaining to to the Krumovitsa River terrace. Krumovitsa River They drain waters in the Paleogene sediments. The point monitors household and potable water supply quality.

Table 4-1.1: Water monitoring points							
№	**Title**	**Suspended Solids (m)**	**coordinates: (WGS84)**	**Type**	**of monitored indicators**	**Sampling frequency**	**Location, Description and Objectives**
21	EGW 12	220	E 389417 N 4589599	Ground water	as described in Table 2-2-2	4 times per year	Tube well of pump station at Guliika village. Located in the alluvial deposits of the Krumovitsa river. The point monitors household and potable water supply quality.
22	EWW 01	N/A	Design	Waste water	Qty	Continuous	Household wastewater treatment plant - inlet. Water quality and quantity will be monitored, as this is important for the subsequent biological treatment process.
					as described in Table 2-2-2	Monthly	
23	EWW 02	N/A	Design	Waste water	Qty	Continuous	Household wastewater treatment plant - discharge. Water quantity and quality data will be collected prior to discharge.
					as described in Table 2-2-2	Monthly	
24	EWW 03	N/A	Design	Waste water	Qty	Continuous	Runoff Storage Pond - water quality and quantity will be monitored in view of the fact that the process is water-quality sensitive.
					as described in Table 2-2-2	Weekly	
25	EWW 04	N/A	Design	Waste water	Qty	Continuous	North collecting sump of the IMWF - the water quality and quantity will be monitored for reuse in the process.
					as described in Table 2-2-2	Weekly	
26	EWW 05	N/A	Design	Waste water	Qty	Continuous	South collecting sump of the IMWF - the quality and quantity of water will be monitored for reuse in the process.
					as described in Table 2-2-2	Weekly	

Table 4-1.1: Water monitoring points							
№	**Title**	**Suspended Solids (m)**	**coordinates: (WGS84)**	**Type**	**of monitored indicators**	**Sampling frequency**	**Location, Description and Objectives**
27	EWW 06	N/A	Design	Waste water	Qty	continuous	Collection sump at the open pit (mine water) -the quality the water will be monitored for reuse in the process.
					as described in Table 2-2-2	Weekly	
28	EWW 07	207	E 386952,99 N 4592540,62	Waste water	Qty	Continuous	Discharge Point (preliminarily agreed with the East Aegean Basin Directorate) - discharge water quality.
					as described in Table 2-2-2	Weekly	

* "Seasonal" means:

- Spring – May through June;
- Summer – July through September;
- Fall – October through November;
- Winter – February through March

Surface and groundwater samples for testing were taken in March, June, October and December 2016. Samples were taken from current monitoring points, provided the presence of water therein.

Appendix 4 provides a specialized report on the water monitoring performed in 2016 .

4.2 Air

Ambient Air Quality (AAQ) was analyzed by a certified lab at 6 points outlined in Table 4-2.1. The following indicators are planned for monitoring: NO, NO_2, SO_2, H_2S, O_3, NH_3, CO, CH_4, non-methane hydrocarbons, PM_{10} , $PM_{2,5}$ – fine particulate matter and meteorological parameters: temperature, relative humidity, air pressure, wind velocity, wind direction.

Table 4-2.1: Monitoring of ambient air

Place of measurement	Points №	Number of Points	Parameters	Frequency
Krumovgrad, Izgrev quarter	AA 01	1	As listed above	Once per annum
Pobeda hamlet, Ovchari village	AA 02	1		
Varhushka hamlet, Ovchari village	AA 03	1		
Dazhdovnik village	AA 04	1		
Zvanarka village	AA 05	1		
Chobanka hamlet, Ovchari village	AA 06	1		

A map of all monitoring points is provided in Appendix 3

Air quality assessment was conducted in October, 2016 by the Stara Zagora regional Lab of the Executive Environmental Agency in order to establish whether there are any changes to pollution levels, which may be generated by DPMK's construction works or seaosanal activities of local residents.

In 2015 the Company installed and commissioned the following devices for continuous monitoring of fine particulate matter in ambient air and deposited dust measurements:

- 3 dust meters of the E Sampler type, produced by Enviro Technology, UK, for PM10 , PM2,5 measurements;
- 8 deposited dust meters (Frisbee type dust deposit gauge).

PM10, PM2,5 and deposited dust (per unit area) measurements at the monitoring points are presented in the Table below:

Table 4-2.2 Internal monitoring of ambient air

ID No	Receptor	Parameters Measured	Duration
AA 01	Krumovgrad, Izgrev quarter	PM10 and PM2.5 (µg/m3), and deposited dust (mg/m2/daily)	Continuous
AA 02	Pobeda hamlet, Ovchari village		
AA 03	Soyka hamlet, Ovchari village		
AA 04	Sinap hamlet, Ovchari village	Deposited Dust (mg/m2/day)	Continuous
AA 05	Kupel hamlet, Dazhdovnik village		
AA 06	Zvanarka village**		
AA 07	Varhushka hamlet, Ovchari village.		
AA 08	Chobanka hamlet, Ovchari village		
AA 09	Process Plant area***	PM10 and PM2.5 (µg/m3), and deposited dust (mg/m2/daily)	Continuous

The map of all monitoring points is provided in Appendix 3

**No monitoring devices have been installed at point AA02, as local residents objected the installation.*

*** PM measurement equipment is installed in point AA 06 instead of AA02.*

****Measurements in AA 09 will begin when the point is available.*

Internal monitoring data is presented in Appendix 3 to this report.

4.2.1. Weather Monitoring

According to the international conventions and the Bulgarian legislation all industrial operations must have in place a system for control of environmental impact. The weather monitoring is an integral component of that system, as the ambient air is the media where gas and dust emissions disperse. In this connection, a professional Automated Weather Station (AWS) was set up and commissioned in early November, 2013. The station is located north-east of the minesite, on the outskirts of the town of Krumovgrad. It is at about 3,000 m distance from the future minesite. The Weather Station will send real time data on key weather components:

Air temperature and humidity;
Atmospheric pressure;
Wind direction and speed;
Amount and intensity of precipitation;

The continuous 24h gathering of weather data is part of the national weather monitoring system. Dundee Precious Metals Krumovgrad EAD (the Company) provides access to these data to the National Institute of Meteorology and Hydrology at the Bulgarian Academy of Sciences (NIM-BAS) on the basis of a bi-lateral agreement. The weather station is located in Krumovgrad on NIM-BAS property. The AWS was commissioned in November 2013. All weather data collected at the project implementation stage are used in the environmental monitoring reports, as well as for preparation of blast work plans, taking into account wind speed and direction, IMWF and open pit water balance.

4.3 Soils

No soil sampling was done in 2016 as it is considered that soil dynamics are low.

4.4 Biological monitoring

Biological monitoring components cover:

- Analysis and assessment of the Jersey Tiger moth (Euplagia quadripunctaria) population and assessment of the project's anthropogenic impact on it;
- Analysis and assessment of the population status and dynamics of the yellow-bellied toad (Bombina variegata), in particular the project's anthropogenic impact on this species.
- Analysis and assessment of the population status and dynamics of the two tortoise species Hermann's Tortoise (Testudo hermanni) and Spur Thigh Tortoise (Testudo graeca), including the project's anthropogenic impact on them. Furthermore, the success of the Tortoise Relocation Project should be examined, as well as the measures undertaken within the framework of the Biodiversity Action Plan, which covers the present state of nearby habitats, i.e. those in close proximity to the open pit;

4.5 Noise

Noise monitoring is planned at 7 points and actual measurements were taken at 6 points (local settlements) due to the lack of the 7th point, i.e. the minesite itself.

Table 4-5.1: Noise Monitoring

Point #	Place of Measurement	Number of Points	Parameters	Frequency
1	Krumovgrad, Izgrev quarter	1	Equivalent noise level (dBA)	Once every year, by a certified lab
2	Soyka hamlet, Ovchari village.	1		Once every year, by a certified lab
3	Varhushka hamlet, Ovchari village.	1		Once every year, by a certified lab
4	Pobeda hamlet, Ovchari village	1		Once every year, by a certified lab
5	Dazhdovnik village	1		Once every year, by a certified lab
6	minesite*	1		Once every year, by a certified lab
7	Chobanka 2 hamlet, Ovchari village.	1		Once every year, by a certified lab

According to the 'Methodology for determination of the total sound power emitted into the environment from industrial sites and determination of the noise levels at the points of impact'

A map of all monitoring points is provided in Appendix 7

Measurements are conducted by a certified lab.

4.6 Blast vibration impact (vibrations)

Blast vibration impact monitoring prior to the start of minesite construction works is ongoing. The monitoring point is situated in Zvanarka village. The monitoring points listed in Table 3-6.1 are included in the Monitoring Plan. No seismograph is yet installed in Soyka hamlet of Ovchari village.

Table 3-6.1: Internal and external monitoring of blast vibration impact

Point #	Place of measurement	Number of Points	Parameters*	Frequency
1	Soyka hamlet, Ovchari village	1	PPV, f	24-hour monitoring
2	Pobeda hamlet, Ovchari village	1	PPV, f	
3	Process Plant (admin. building)	1	PPV, f	

*This point was replaced by a point in Zvanarka village for the reasons described in 3.6. above.

The Company uses its own continuous monitoring device - a Minimate Pro 4 seismograph by Instantel, which measures:

- Peak particle velocity - PPV mm/s;
- Acceleration – a, m/s2;
- Displacement – U, µm;
- Frequency – f, Hz.

4. MONITORING TYPE AND FREQUENCY

5.1 Water

The water monitoring data are not included in this section as detailed Water Monitoring Report is provided in Appendix 4.

5.2 Ambient Air

A one-off air quality test campaign was carried out in October 2016. The tests were carried out by an EEA certified lab - the Stara Zagora Regional Laboratory. Test results were compared against the regulated values set in Regulation 12/15.07.2010 on the Air Emission Limits for Sulphur Dioxide, Nitrogen Dioxide, Fine Particulate Matter, Lead, Benzene, Carbon Monoxide and Ozone and against the values set in Regulation 14/23.09.1997 on the Regulated Limits for Harmful Substances in the Ambient Air of Populated Areas. All test results are provided in Appendix 3.

Since 2015, the Company has started its own continuous monitoring at three PM2.5 and PM10 points, together with deposited dust measurements. Results are presented in an independent report (Appendix 3).

5.3 Soils

No soil monitoring was performed in 2016.

5.4 Biological monitoring

Within the reported period, animal species were monitored in the area of Ada Tepe prospect, Khan Krum deposit, Krumovgrad municipality, in the period April through September, 2016. The monitored territories were those listed in the approved Monitoring Plan, "Biodiversity" section. Appendix 8 presents includes individual reports on all animal species monitored in 2016. together with comparative data from previous years.

5.5 Noise

Noise measurements were conducted once at 6 points (settlements) by a certified lab. Results are presented in Appendix 7. Measurements were conducted on 22.12.2016, for daytime, evening and nighttime noise levels, in compliance with Regulation 6/ 26.06.2006 on the Environmental Noise Indicators of Time-Dependent Levels of Discomfort, Environmental Noise Limits, Methods for Assessment of Noise Levels and Negative Effects of Noise on Human Health. Noise levels were also measured during construction-related blasts on the site. The data were analyzed against the reference values listed in Regulation 6 above.

5.6 Blast vibration impact

Continuous measurements of vibrations were conducted at one monitoring point (Zvanarka village) in 2016. Data collected since 17.09.2015 (measurements' starting date) is presented in Appendix 5. Files can be opened by using a software which is freely accessible and available for downloading from the webpage of the measurement equipment manufacturer at:

http://www.instantel.com/downloads/default.aspx

5. RESULTS FROM THE IMPLEMENTATION OF THE MONITORING PLAN

The results are provided by monitoring point for various environmental components:

6.1 Water

Sampling and chemical testing of water samples was conducted four times - in March, June, October and December 2016 - by a certified lab (Eurotest-control EAD, Sofia). Samples

were taken from surface waters of tributaries and the Krumovitsa River, as well as from groundwaters, including drinking water abstractions.

Chemical test results from all monitoring points are included in the Water Monitoring Report in Appendix 4.

6.2 Air.

Air quality tests was performed from 12 to 24 October, 2016 at various points by an accredited laboratory - the Stara Zagora Regional Laboratory of the Executive Environmental Agency. Baseline data gathered over the years will enable accurate future assessment of the impact of mining and processing operations at the Ada Tepe prospect, Khan Krum deposit.

Test results from all monitoring points are provided in Appendix 3.

The certified lab measured the following parameters: nitrogen oxide (NO), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), hydrogen sulphide (H_2S), ozone (O_3), ammonia (NH_3), carbon oxide (CO), methane (CH_4), fine dust particles with a diameter up to 10 micrometers (PM 10), suspended particles, lead (aerosol) (Pb), benzene, polycyclic aromatic hydrocarbons (PAH), heavy metals – cadmium (Cd), nickel (Ni) and mercury (Hg), arsenic (As).

Overall, the conclusion is that ambient air quality is good.

Test results were compared against the regulated values set in Regulation 12/15.07.2010 on the Air Emission Limits for Sulphur Dioxide, Nitrogen Dioxide, Fine Particulate Matter, Lead, Benzene, Carbon Monoxide and Ozone and against the limits set in Regulation 14/23.09.1997 on the Regulated Limits for Harmful Substances in the Ambient Air of Populated Areas.

The certified Regional Lab in Stara Zagora established that there are no elevated pollutant levels. Test results were also a good indicator of the air impact of solid fuel local residents use for heating purposes. The same pollutants appear in almost all residential areas of the region, although in various ratios (see Table below). No presence of the same pollutants is identified in the summer, based on the tests of the same accredited laboratories, which entails that they are generated by solid fuel cobmustion.

Table:

Pobeda hamlet, Ovchari village	Zvanarka village	Izgrev area in Krumovgrad	Varhushka hamlet, Ovchari village	Chobanka hamlet of Ovchari village.	Dazhdovnik village
Fluoranten		Fluoranten	Fluoranten	Fluoranten	Fluoranten
Pyrene	Pyrene	Pyrene	Pyrene	Pyrene	Pyrene
Benzo(a)athracene			Benzo(a)athracene	Benzo(a)athracene	Benzo(a)athracene
Chrysene			Chrysene	Chrysene	Chrysene
Benzo[k]fluoranthene		Benzo[k]fluoranthene	Benzo[k]fluoranthene	Benzo[k]fluoranthene	Benzo[k]fluoranthene
Benzo[a]pyrene		Indeno[1,2,3-cd]pyrene			
Indeno[1,2,3-cd]pyrene		Benzo(ghi)perylene			
Benzo(ghi)perylene					

Results from the Company's internal measurements of PM 10 and PM 2.5 also show no elevated concentrations against the limits of Regulation 12. Deposited dust concentrations calculated per unit of surface area also meet the statutory requirements of 350 mg/m^2/24 hours, provisioned in Regulation 2/ 19.02.1998 on Air Emission Limits (Concentrations in Waste Gases) of Harmful Substances Emitted from Static Sources.

It should be noted that there were some exceptions of deposited dust levels above the regulated limits, whose sources are detailed in a designated report attached in Appendix 3, together with test results.

It should be noted that in winter months, the average hourly rates of fine dust particles very often exceed statutory thresholds but do not exceed the limit of 50µg/m^3 for PM_{10} for more than 24 hours. Hence, elevated hourly rates cannot be combined and reported as air pollution. In terms of $PM_{2,5}$, elevated concentrations are observed in the average data per hour in winter months. However, they cannot be calculated per annum, since the 25 µg/m^3limit under Regulation 12 is an average annual value. The specialized report in Appendix 3 explains the reasons of the elevated dust values. One important finding of the Report is that those elevated levels cannot be attributed to the earth works, which started in November.

Results from the Company's continuous internal monitoring of fine particulate matter and deposited dust are presented in Appendix 3.

6.3 Soils

No soil tests were performed in 2016. The last sampling and testing was carrid out in 2015.

6.4 Biological monitoring

Monitoring of Reptiles: The two protected tortoise species, the Herman's Tortoise (Testudo hermanni) and the Spur-Thighed Tortoise (Testudo graeca) were monitored over 45 man-days in 2016. Monitoring was conducted in April through September, which provided a much broader picture of the development of these populations at two very important moments of their life cycle, i.e. before and after winter hibernation. Tortoise monitoring began in 2012 and the data gathered throughout the years is presented in a comprehensive monitoring report on both species. The biological monitoring reports of tortoises, insects and amphibians is provided in Appendix 8.

6.5 Noise

The 2016 noise monitoring included noise measurement on 22.12.2016 at 6 points around the minesite. Each monitoring point was visited three times to measure day-time, evening and night-time noise levels, as required under Regulation 6/ 26.06.2006 on the Environmental Noise Indicators of Time-Dependent Levels of Discomfort, Environmental Noise Limits, Methods for Assessment of Noise Levels and Negative Effects of Noise on Human Health (Regulation 6). Day-time noise levels were measured during the first construction-related blasts.

Results obtained from those 6 monitoring points were compared against the noise level limits of Regulation 6. Comparative levels are presented in the Table below:

Sites and Development Areas within or outside Urbanized Areas		Equivalent noise level dB(A)		
		Day	Evening	Night
1	Urban areas and sites	55	50	45

Data has been analyzed both in terms of individual time zones and equivalent values per 24 hours.

Location	Type	**L day**	**L evening**	**L night**	**L 24**
	Residential areas	55	50	45	-
	Industrial areas	70	70	70	-
	Measurement unit	dB (A)	dB (A)	dB (A)	dB (A)
1 Krumovgrad (Izgrev quarter)	Residential area noise	37.1	35	37.2	43.5
2 Soyka hamlet*	Residential area noise	33	33.7	27.2	36.9
3 Barhushka hamlet *	Residential area noise	34.9	27.5	38.3	43,8
4 Pobeda hamlet *	Residential area noise	51.7	29	28.1	47.2
5 Dazhdovnik hamlet	Residential area noise	49.3	21	25.3	44.7
6 Minesite**	Industrial area noise	-	-	-	-
7 Chobanka hamlet *	Residential area noise	39.5	25	21.5	35.8

* hamlets of Ovchari village

** Measurements shall commence when the minesite is commissioned.

Data analysis shows that all measured values are below the regulated limits. It should be noted that equivalent night-time noise measurements in Pobeda hamlet (44.9 dB (A)) and Dazhdovnik village (44.12 dB (A)), are very close to the regulated night-time noise limit of 45 dB (A).

Quite lower night-time noise levels were measured in Pobeda hamlet (38.3 dB (A)) and Dazhdovnik village (25,3 dB (A)), which can be attributed to the winter season, which is free of noise generated by insects (such as crickets).

6.6 Blast vibrations

Blast vibrations were measured at one monitoring point in Zvanarka village, next to third-class road 509, which was recommended to the Company as an access road to the future minesite. One seismograph was installed on 03.06.2015. The device detected 1,769 events in 2016. A list of all detected events is accessible on-line at:

http://krumovgrad.webnoise.eu/seismo.php?sn=3003048

One event stands out with its three-axial acceleration amplitude. The event is marked in yellow on the list. The event occurred on 26.05.2016. Appendix 5 includes two reports on that event. The source remained unidentified, and regardless the high values, the impact was below the the values, which may pose a risk to any residential buildings, cultural heritage or industrial sites, as indicated in the report (see values of L1, L2 and L3 on the chart). The values of L1, L2 and L3 are defined by the German DIN4150 Standard by structure type.

6. ASSESSMENT OF THE EFFICIENCY OF THE MONITORING NETWORK FOR 2016

7.1 Efficiency

Water Component

The applied on-site monitoring design provides an overview of the state and tendencies for changes in the hydrodynamic and hydro-chemical conditions of surface and groundwaters in the area of the future minesite. The analysis of monitoring data brings to the following conclusions about the efficiency of the monitoring network used in 2016:

- The location of the monitoring points enables the evaluation of the general water status picture by providing the option for comparison with an eventual future contamination of surface and groundwaters as a result of Dundee Precious Metals Krumovgrad EAD's operations on the basis of hydrogeological and hydrochemical conditions close to the footprint of the future mine that represent the various types of groundwaters, which by one way or another are geologically connected to the ore body of Ada Tepe and the layers beneath it;

Ambient Air Component

The current on-site monitoring design gives an overview of the status and trends of changes in ambient air quality in the area of the future project. Reviewed monitoring data leads to the conclusion that the chosen monitoring design is effective enough and gives an overview of:

- Ambient air quality as the only source of information for the Company;
- The location of the monitoring points makes it possible to evaluate the general picture of ambient air status by providing the option for comparison with an eventual future contamination as a result of DPMK's operations;
- Dust meters installed in three settlements operate 27/7 to enable construction impact assessment. At all three monitoring points, measuring devices collect data not only on PM10, as required by the Monitoring Plan, but also on the PM2,5 respiratory fraction which also poses risks to human health;
- Deposited dust measuring devices present the current status quo and results can be compared with subsequent data collected during the different stages of minesite operations.

Biological monitoring

Progress on the Krumovgrad Gold Project enhanced the Company's approach to the protection of endangered animal species in the Eastern Phodopes protected area which falls entirely within the footprint of the future minesite. That led to the drafting of a Biodiversity Action Plan, which has a strong focus on developing the habitats of the two protected tortoise species (Hermann's tortoise and Spur Thigh Tortoise). The Plan's main objectives are to improve habitats in the minesite's vicinity, facilitate the development of local populations of tortoises and combat poaching. The Company has drafted a project to implement the actions and activities envisaged in the Biodiversity Action Plan. Some of those activities were carried out in 2016 and it would be fair to say that they helped clarify and specify the objectives set out in the Plan, and their corresponding performance measures.

The 2016 environmental activities also involved construction of small anti-erosion structures comprising small water collection ponds, which can be used by live stock in the dry season, along with preparation work for land vegetation, which will improve parts of the tortoise habitats.

Also, we are accumulating more and more data on tortoises under the Species Monitoring Plan and the Biodiversity Action Plan, which improves the reliability of our database, and that will be the trend over the next years of our monitoring effort. Reported results on the development of tortoise populations cover the period from 2012 to 2016. Besides the agreed requirements, we have added new tortoise monitoring areas in the the Biodiversity Action Plan, as we believe they are indicative of the development of tortoise populations.

The Company will continue making analyses and assessments based on field surveys, so as to account for the interaction between abiotic, biotic and anthropogenic factors, and estimate environmental patterns and the impact of external stress factors.

Soils

No soil monitoring was performed in 2016.

Noise

Current noise tests are showing typical levels without industrial operations impact, but reflect the construction works. Data from the past and the most recent data of 2016 confirm the noise assessments included in the Environmental Impact Statement with regards to the minesite construction works, as we now have empirical data of the actual construction stage. Collected data will enable before-and-after comparison during the operation stage, and will hep us to identify key areas to introduce noise protection measures to, if required.

Blast vibrations (Vibrations)

Blast vibration measurements at 1 point in Zvanarka village, located 2m from the main access road, recommended by the Kardzhali District Road Management, i.e. road III-509 through the villages of Zvanarka and Tokachka, are an indication of current blast vibration impacts. Since there is not statutory framework for buildings-safe vibration levels in Bulgaria, results are compared with the German standard DIN 4150 for the protection of buildings and

cultural monuments. Current measurements show values that bear no industrial impact. Data collected to date do not indicate any values above the regulated levels.

Collected data will help compare data before/ after minesite operations, as well as identify key areas to introduce vibration and noise protection measures on access roads.

7.2 Proposals for improving efficiency

Water Component

- The locations for setting up new piesometer boreholes for environmental monitoring have been chosen following recommendations of the Environmental Agency. The future water monitoring points indicated as EGW 01, EGW 08, EGW 09, EGW 10 are included in the Company's Monitoring Plan. Those monitoring boreholes will be built at the end of the mine construction works, as they will be situated immediately next to the future mining facilities. The mine construction works may damage the boreholes, if built before the major constrution works are over.
- Potassium should be added as a tested element in all groundwater monitoring points except EGW 05, 06, 07, 11 and 12, since it is among the key ions and influences ion balance.
- In addition to the physical and chemical surface water indicators, the following biological elements for quality will also be monitored at ESW 08, ESW 09 and ESW 10: Biotic index for macrozoobenthos ("Methods for monitoring the biological element macrozoobenthos in rivers (biotic and trophic index"), and IPS index for phytobenthos - flint (diatom) algae ("Methods for monitoring the biological element phytobenthos in rivers (IPS index)").
- Continue collecting data on static water levels in piesometers until construction works commence, then reduce their number to those that are currently featured in the Monitoring Plan.

Air

- Data on the two types of PMs (sized 2,5 to 10), as well as deposited dust data should be collected throughout the entire period of minesite operations.

Soils

No recommendations.

Biological monitoring

- The Company should continue its biological monitoring effort in order to accomplish its main objective, i.e. to provide an impartial monitoring of project impact in the Ada Tepe license, Krumovgrad municipality. Ensure the monitoring of all biological components at Ada Tepe, indicated in the Compatibility Assessment Report.

- Apply the measures stipulated in the Biodiversity Action Plan and the project designed for its implementation.

7. CONCLUSION

Waters

After summarizing the results of tests conducted in 2016 and comparing them with the quality standards provisioned in Regulation № H-4/ 14.09.2012 on Surface Water Characterization (issued by the Minister of Environment and Water, prom. in SG 22/ 5.03.2013, effective 5.03.2013), the following conclusions can be drawn:

1. Surface waters, as follows:

- Krumovitsa River - compliant with Regulation №H-4 stipulations for "good" water status, except results observed at monitoring point ESW 09, i.e. 100 m upstream of the wastewater discharge point, which monitoring point serves as reference for the ESW 10 one, where the values of samples taken on 03.10.2016 for NH_4, N_{total}, PO_4, P_{total}, Mn^+ and BOD_5, and then on 06.12.2016 for Fe^+ and again BOD_5 showed elevations above the permitted levels. However, elevated concentrations from previous samples were below the standard threshold. These findings very much confirm 2015 results, when these contaminants had elevated concentrations, too, except total phosphorus, which is present only in the 2016 reporting period. It should be noted that the concentration of copper ions remains within norms in 2016. Unlike in 2015, there are no elevated contaminant concentrations at monitoring point ESW 10, except one sample taken on 06.12.2016 regarding NO_2 and the 28.06.2016 sample as to zinc ions (Zn^+). Both times, these were one-off cases that had no re-occurrence, unlike in 2015 when Al and Fe ions demonstrated elevated levels compared to Regulation 4 permitted values for rivers of the Krumovitsa River
- Egrechka River - meets the requirements of Regulation № H-4;
- Kessebirdere - meets the requirements of Regulation № H-4, with only one exception during the March sampling, which showed a slightly elevated concentration of copper (Cu) ions;
- Buyukdere - meets the requirements of Regulation №H-4;
- Kaldzhikdere - meets the requirements of Regulation №H-4, with two exceptions in the sample taken on 06.12.2016 at EGW 06, where the concentration of sulphate ions (SO_4) was elevated, as well as measured conductivity (in the same sample), which is a clear sign of correlation between the two indicators.

2. Groundwaters – Groundwaters' quality in the monitoring points is related to the mineralogy of the specific earth layers through which the drillhole passes, as well as the layers through which waters run prior to reporting to the monitoring point. As evident from the information presented in the report, there are elevated concentrations of certain metals, which could be a combined consequence of the mineralogical structure of the layers, piesometers' corroded pipe casing or polluted drillholes from drills. Most common elevated concentrations of ions were those of iron (Fe), aluminum (Al), manganese (Mn) and rarely arsenic (As).

3. Different numbers and types of microorganisms that should not be present in potable water have been detected at monitoring points for groundwaters, used for domestic and drinking purposes. This was most probably due to the fact that sampled water was not chlorinated. It should be noted that total alpha activity measurements again exceed those stipulated in Regulation 9 for potable water.

Air

The following conclusions can be made on the basis of the 2016 test results.

Monitoring activities conducted at 6 points by a certified lab showed no ambient air pollution. The winter-time pollution profile is consistent in all residential areas in terms of fluoranthene, pyrene, benzo(a)athracene, chrysene, benzo[b]fluoranthene and like air pollutants, which is very likely to be generated by the solid fuels local residents use for heating, as those pollutants typical coal components. No long-term pollution with fine dust particles has been observed, regardless that some averaged hourly values may exceed the regulated limits. Excess values have been observed mostly during the winter and they originate from the same source - solid fuels.

Soils

No soil testing was carried out in 2016.

Biological monitoring

Tortoises:

- Throughout the entire period of the survey, only the winter of 2013-2014 can be defined as an unfavorable period in terms of climate conditions, with potentially high risk for the tortoises. And the summer of 2016 was unfavorable to T.hermanni.
- The nutritional status of the Spur Thigh Tortoise at the end of the 2016 season (identified on the basis of the weight index enables adequate winter hibernation.
- The nutritional status of the Hermann's Tortoise at the end of the 2016 season (identified on the basis of the weight index) is unsatisfactory.
- Sub-populations of both tortoise species are aging - a fact which was again confirmed this year.
- Collected data on the dynamics of tortoise numbers, their spatial distribution and private moves, reveals that migration process have a great impact on their populations.
- Reproduction rates of the two tortoise species are very low in all three surveyed areas.
- Tortoise-eating in is becoming lesser and lesser threat to terrestrial tortoises in the region.
- With the start of the mine construction works, it is becoming more and more important that DPMK's team returns tortoise individuals which manage to cross the fence.

- The execution of the Biodiversity Action Plan for the Hermann Tortoise (Testudo hermanni) and the Spur-thighed Tortoise (Testudo graeca) in the Ada Tepe Project area in all of its aspects will significantly improve living conditions for these two species and will help curb poaching.

Jersey Tiger Moth

- The species is local, also found beyond the project site;
- and decreasing in numbers.
- This year has been less favourable for the species at Ada Tepe, compared to results from the first year of the survey.
- More comprehensive information on the status of the Jersey Tiger moth population should be collected in the Krumovgrad region.

Yellow-bellied Toad:

- The population of this species in the area is very small;
- Its population is stable.
- The implementation of the "Biodiversity Action Plan for the Hermann Tortoise (Testudo hermanni) and the Spur-thighed Tortoise (Testudo graeca) in the Ada Tepe Project area" will significantly improve the living conditions of the yellow-bellied toad by creating new habitats (micro water reservoirs).
- Fountain troughs need to be cleaned again.

Noise

Noise measurements do not exceed permitted urban values.

Blast Vibration Impact

Conducted blast vibration measurements show a number of single events whose sources cannot be definitively determined. However, they display values in different directions relative to the ground surface, which do not exceed the limits set out in the German standard DIN4150 for residential buildings and cultural monuments.