

TE-TO AD SKOPJE

**Combined Cycle Co-Generation
Power Plant Project
Skopje**

Environmental Assessment Report

**SECTION G
ENVIRONMENTAL MANAGEMENT PLAN**

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Thermal Energy Plants Department

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1 Introduction

The Skopje CCPP project with a capacity of 220 MW will be implemented in a heavy industrial area of Skopje. Since the project is designated a "Category A" project, the EIA report shall include an Environmental Management Plan (EMP). The EMP shall describe mitigation, monitoring and institutional measures to be taken during implementation and operation of the project to eliminate adverse environmental and social impacts, or reduce them to acceptable levels.

The quality of ambient air in Skopje and other urban areas has been monitored for more than 25 years in a more or less frequent way and quality. This monitoring is carried out by the Republic Hydrometeorological Institute on the basis of separate program which is adopted and financed by the Government.

In recent times Macedonia is slowly moving towards the EU concerning regulations and guidelines which are taken over and implemented by the local authorities. Since until now no environmental monitoring agencies for emissions were required by the Macedonian law the government is currently founding these agencies with a broad support of the EU in order to monitor and control the occurring emissions and to implement counteractive measures where required.

For the Skopje CCPP project it is required that this newly founded environmental agencies will collaborate closely with the power plant's environmental management in order to monitor, evaluate and control the emissions occurring during plant construction and operation.

As mentioned in Section D, four automatic ambient air quality monitoring stations are operated by the Ministry of Environment and Physical Planning of the Republic of Macedonia. Monitoring data of the last years have been provided to Colenco. In addition to these data information from some manual measurements of SO₂ in ambient air in Skopje are available. Manual measurements have been done by State Hydro-Meteorological Institute (HMI) and State Health Protection Institute (HPI).

It is expected that the 4 automatic ambient air quality measuring stations remain in operation and will be used to monitor the ground level concentrations in Skopje also in future, i. e. during the operation phase of the new CCPP Skopje.

2 Mitigation Measures

2.1 Design Phase

There are no cultural or archaeological monuments, natural forests, or wildlife sanctuaries in the project area that could be encroached upon by the construction or operation of the Skopje CCPP. Therefore, measures for encroachment limitation of populated, cultural and protected sites are not necessary.

The required resettlement of squatters settlers will be performed according to the resettlement action plan of WB OD 4.30.

The Design of the combined cycle power plant Skopje is characterized by high efficiency and exclusively using natural gas as fuel. The gas turbine will be equipped with a dry low NO_x system to minimize the NO_x emissions. Concerning noise protection as well as waste and wastewater disposal, all required measures have been considered in the plant design to meet the relevant standards.

These design measures inherently ensure that:

- the specific CO₂ emission values are low
- the emissions of CO and NO_x are minimized and will meet the local and EU standards
- dust and SO₂ emissions are negligible
- the local and the requirements of the World Bank Noise regulations will be respected.
- the wastewater treatment systems and cooling water system will be completed according to the local and the EU requirements.
- all required safety measures (fire prevention with adequate control measures, workers health and safety) will be in accordance with the local Standards and the guidelines of the NFPA.

2.2 Construction Phase

The following measures will be considered during the construction phase of the Skopje CCPP:

Protection of water quality and aquatic ecosystems:

- Disposal of solid waste (construction waste, sand, stone etc.) and waste grease and oil from construction equipment to the local water source will be prevented. All the waste will be collected and disposed of to the approved disposal sites.
- The project will install adequate sanitation systems (for example mobile toilet facilities) for workers to prevent untreated or inappropriate domestic waste discharge.
- Discharge and disposal of domestic waste from the construction camps into water sources will be avoided. Domestic solid wastes will be collected and disposed of in approved disposal sites by the respective approved local companies.

Protection of air quality:

Air pollution during the construction phase (i. e. mainly during civil work activities) may occur mainly due to dust emission. The following mitigation measures will be performed:

- During dry weather, periodic watering of the construction sites access
- EPC Contractor shall be required to implement and apply the following measures to mitigate dust and prevent traffic accidents:

- Limit the speed within the construction site, and the access road leading to the site.
- Regularly water down the site and access roads
- Wash down the vehicles, which are leaving site.
- Vehicles transporting open loads of construction materials such as sand, clay shall be covered where necessary

Noise:

To reduce noise during the construction phase appropriate measures shall be taken to comply with local regulations:

- Prohibition of noisy activities during the night.
- Speed restrictions to be applied to heavy/articulated vehicles, which pass through residential areas.

Impact by Traffic:

To maintain the traffic safety it is considered to keep the traffic slow which pass through residential areas by appropriate measures such as giving a safety education to the drivers.

A **summary** of all important impacts during the construction phase and the applied mitigation measures are given in the following Table G- 1:

No.	Impact	Possible Effects	Assessment / Mitigation Measures
1	Land clearing of local people	Resettlement and compensation of people	Resettlement of squatters who are located on an area of about 3900 m ² . Resettlement to be performed according to WB OD 4.30.
2	Land used	Space requirement	A total of approx. 2 ha of land is required (no requirement of green field; Site located in an industrial area
3	Traffic / transportation	Increase in traffic volume	Temporarily affects. Transport of main plants and equipment by road/railway. Keep the traffic slow for safety and noise reasons.
4	Construction labour and activities	Increase in air pollution, noise and waste quantity	Temporarily affects. Avoiding of dust pollution by periodic watering of site during civil works. Avoiding of noisy activities during the night. Wastewater and solid waste disposal according to the local regulations.
5	Socio-economic	Employment aspects	Positive effects on temporary employment for local workers.

Table G- 1: The main Project Impacts and Mitigation Measures during Construction Phase

2.3 Operation Phase

The operational impacts can be considered as follows:

- Flue gas emissions into the atmosphere (e. g. NO_x, CO)
- Ambient air quality
- Cooling water supply and discharge
- Noise within and outside the plant boundary
- Waste water discharge
- Solid waste disposal

2.3.1 Air Pollution

As investigated in Section E, the NO_x and CO emissions of Skopje CCPP will be below the Macedonian and EU Emission Standards with natural gas as the only fuel (see Table G- 2).

No special secondary mitigation measures to control air emissions are required during the operation of Skopje CCPP. The mitigation measures to minimise air pollution are found in the technology and design of the power plant, such as:

- Combined cycle concept with high efficiency
- Natural gas as exclusive fuel
- Dry low NOX system (gas as fuel)

The plant will be operated in combined cycle mode, i. e. the flue gas of the gas turbine will pass a heat recovery steam generator (HRSG) before it will be discharged to the atmosphere via a stack of 60 m height to ensure sufficient dispersion of the pollutants.

	CCPP Skopje expected emission mg/Nm ³	Local standard mg/Nm ³	EU standard mg/Nm ³
NO _x natural gas as fuel	40	350	75
CO natural gas as fuel	20	100	

Table G- 2: Comparison between Skopje CCPP Emissions and Standards

The dispersion calculations (Section E 3.2.4) show that the contribution of the new CCPP to the ground level concentrations is very low. Even for NO_x as the most important component of the new CCPP, compared to existing situation (DHP), barely any deterioration of ambient air quality will occur. For the pollutants SO₂ and dust the situation will improve as these pollutants do not occur with the new plant.

2.3.2 Cooling Water

The cooling water discharge point to the river Vardar has been selected to ensure adequate/thorough mixing in the initial contact and dissemination zone. Since the amount of cooling water discharged is very low no excess of the allowed temperature increase is likely.

2.3.3 Noise

The Skopje CCPP is located at around 250 m from the nearest residential areas. To reduce noise levels in the neighbourhood and to protect workers in the plant, the plant will be designed in a way that the equipment will meet the requirements of the WB Guidelines (e. g. by installing silencers) and will not create a noise pressure level of more than 60 dB(A) at the south and west fence and 70 dB(A) at the north and the east fence.

2.3.4 Wastewater pollution

2.3.4.1 Rainwater drainage:

Rain water shall be handled according to the grade of its spoilage:

- Roof water shall be collected as clean water.
- Water from green areas is deemed as clean as well and should seep away to the ground where possible. Special gravel seeping strips should be foreseen.
- Rain water from paved surfaces and roads and dirt areas shall be guided to the storm sewer pipe system via road or yard gullies and or directly towards the natural run off ditch system. Sand traps to be installed where reasonable.
- Rain water from oil contaminated areas shall be treated as waste water and shall be specially treated

2.3.4.2 Sanitary wastewater

The sanitary wastewater will be collected in by a separate duct and conducted directly to the municipal sewage treatment plant.

2.3.5 Industrial and Sanitary Solid Wastes

2.3.5.1 Sanitary Waste:

In the operation phase the quantity of sanitary waste from the workers is minimal and will be collected and disposed to approved disposal sites by the respective approved local companies in accordance with local requirements.

2.3.5.2 Industrial Waste:

Industrial solid waste such as packs, cloths saturated with oil and/or grease and sludge extracted from a treatment system will be gathered and disposed of to approved disposal sites by the respective approved local companies in accordance with local requirements.

2.3.6 Fire Prevention

Fire prevention and control at the Skopje CCPP will be designed in accordance with the NFPA. The design of the project's fire prevention and control systems shall be approved by the Macedonian Authority.

A **summary** of all important impacts during the operation phase and the applied mitigation measures are given in the Table G- 3:

No.	Impact	Possible Effects	Assessment / Mitigation Measures
1	Climate	Greenhouse effect	Minimising of specific CO ₂ emissions by high plant efficiency and natural gas as fuel (392 kg/MWh _{el})
2	Emissions	NO _x , CO and other pollutants	Limitation of NO _x emission by applying modern combustion technology (DLN). No SO ₂ and dust emissions (gas as exclusive fuel)
3	Ambient air quality	Increasing of pollutant ground level concentration	Despite higher annual NO _x and CO emission loads (due to longer operation time), the impact on ambient air will barely deteriorate
4	Noise	Plant surrounding	Applying noise protection measures in order to meet the required standard
5	Fresh water demand	Water availability	Fresh water demand will be supplied by wells drilled specially for the plant
6	Cooling water demand	Water availability	Limited demand because of combined cycle technology. About 70 % of power will be generated by gas turbines which do not need cooling water. Maximum demand for Skopje CCPP is about 90 m ³ /h which will be supplied by the drilled wells
7	Wastewater discharge	River pollution	Applying of wastewater treatment in order to meet the required standards
8	Cooling water discharge	Temperature increase of river water. Effects on fish species	Limitation of cooling water temperature increase. Using of suitable discharge system for appropriate temperature

No.	Impact	Possible Effects	Assessment / Mitigation Measures
			distribution in Vardar River. Temperature increase at the edge of the mixing zone max. 0.6 °C. This temperature increase in a closed area will not affect the fish species.
9	Solid waste disposal	Pollution of rivers and near area	The solid waste will be disposed by an authorised local disposal company according to local regulations.
10	Socio-economic	Country and future development	The impact of the project on the local and Macedonian socio-economic development can be assessed as high

Table G- 3: The Main Project Impacts and Mitigation Measures during Operation Phase

3 Monitoring

The Project Company (CCPP Plant Owner Company: TE-DO AD Company) is committed to implementing an environmental monitoring plan which will ensure, that the construction and the operation of the new plant will comply with the environmental standards and the requirements of Macedonian and international procedures and guidelines.

3.1 Organisation

3.1.1 Environmental Management Group

In order to properly assess environmental impacts of the CCPP Skopje as well as evaluate the effectiveness of mitigation measures applied for the abatement of environmental pollution, a program of monitoring and oversight of the project shall be implemented.

Figure G-1 indicates the proposed organization of the environmental management and monitoring of the CCPP Skopje project.

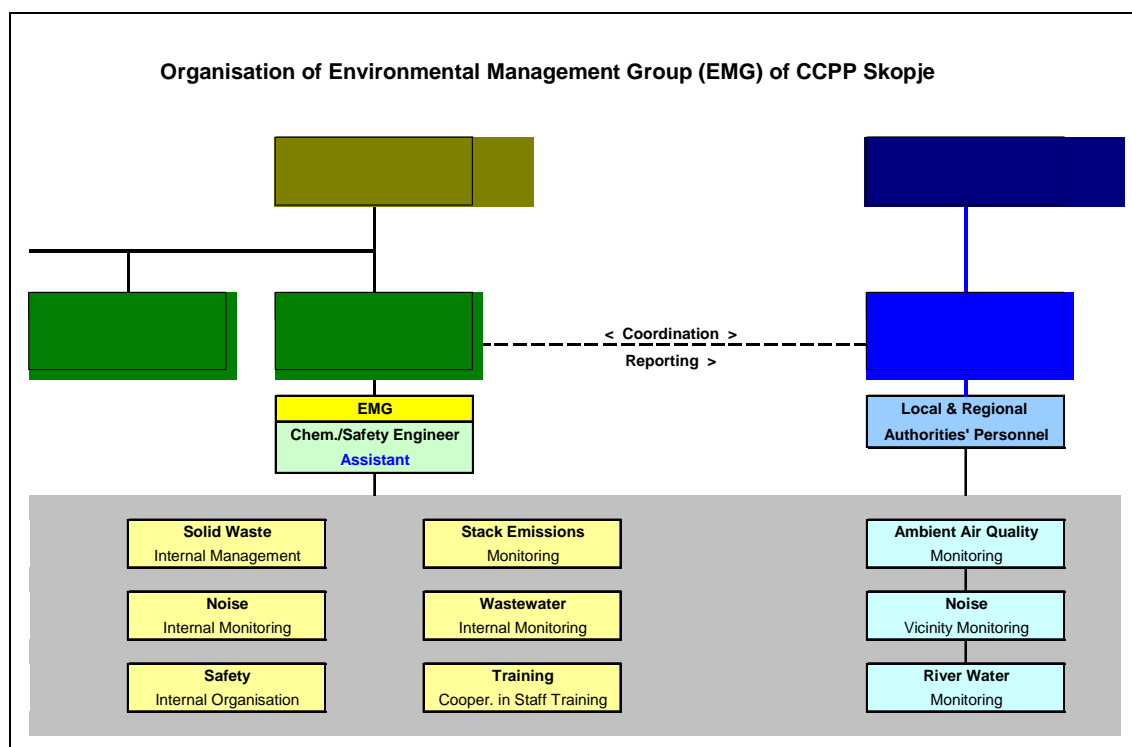


Figure G- 1: Organization of Environmental Management

The Management Board of the CCPP Skopje will be responsible for the internal environmental management and monitoring of the plant. For this purpose, the board shall nominate and appoint an Environmental Engineer as head of an **Environmental Management Group (EMG)**. He will report directly to the General Manager of the CCPP Plant Company. The environmental engineer as Head of the EMG shall be assisted by a chemical engineer of safety engineer as Assistant and Deputy Head of EMG.

The EMG shall be responsible for the execution of environmental related issues such as:

- Stack emission monitoring
- Internal waste management
- Wastewater monitoring
- Internal noise monitoring
- Labor safety
- Organization and cooperation in staff training activities.

Other activities like the monitoring of the ambient air quality (using the existing 4 automatic stations) will remain in the responsibility of the regional and local authorities.

The Head of the environmental management group is also responsible for:

- Coordination of environmental measurements and monitoring with local and regional authorities
- Informal reporting of environmental issues to the local and regional authorities
- Preparing and submission of the requested environmental reports (e. g. annual emission report).

The organisation of the environmental management group of CCPP Skopje shall be set in place early in order to commence work during the construction phase.

Monitoring will be carried out using standard techniques and equipment agreed with the Macedonian Ministry of Environmental and Human Surrounding Protection. The equipment will be calibrated, operated and maintained in accordance with the manufacturer's specifications. Monitoring data will be analyzed and reviewed at regular intervals by CCPP Plant Company, and compared with the relevant standards, so that any necessary corrective actions can be taken in a timely manner.

The Head of the EMG will ensure that the defined monitoring measures during construction and operation of the new plant will be implemented. He will be responsible also for maintaining any pollution control equipment and for maintaining a written Environmental Register with respect to environmental impacts as required under Macedonian and international (World Bank) guidelines.

Records of monitoring results will be reported to the responsible Government authorities and relevant parties, as required.

The new plant will be equipped with a Distributed Control System (DCS) that is intended as a fully integrated control, monitoring and supervising system.

3.1.2 Training

It is recommended to conduct a consulting and training program for lead personnel of CCPP Skopje. This will ensure that highly qualified staff will take over the responsibility and will work on environmental management and monitoring. The training program should be performed in coordination with the responsible local authorities.

The consulting and training program should commence towards the end of the construction period and be completed in the first few months of operation. The detailed scope and schedule may be established later, an initial brief outline of a possible scope is given in the following Table G- 4.

Activity	Subject	Specialist	Duration (weeks)
Consulting	Preparation of training program	Plant Management, Head of EMG	1
Consulting	Support in establishing the environmental management group and definition the environmental management program	Plant Management, Head of EMG	2
Training	Environmental monitoring of thermal power plants and potential mitigation measures (overview)	Head of EMG, Assistant	1
Training	Emission monitoring equipment: - Methods & techn. alternatives Specification	Head of EMG, Assistant, Staff of EMG	1

Activity	Subject	Specialist	Duration (weeks)
	- Operation - Maintenance - Evaluation of results (supported by equipment suppliers)		
Training	Wastewater analysis and waste management	Head of EMG, Assistant, Staff of EMG	1
Training	Worker safety and health aspects	Head of EMG, Assistant	1

Table G- 4: Brief Summary of Training Services

3.2 Atmospheric Pollution Monitoring

Impacts on air quality shall be monitored by measuring the emissions of the new plant as well as by monitoring the ambient air quality and meteorological parameters in the area around the site according to the corresponding regulations.

The Environmental Management Group (EMG) of CCPP Skopje shall be responsible for the execution and evaluation of the stack emission measurements. The authority will organize and perform the ambient air quality monitoring according to the national regulations. All monitoring activities shall be coordinated between the parties involved.

The emission monitoring system (EMS) of the new plant shall monitor all relevant atmospheric emissions during operation and shall collect the needed operational and reference values. The following requirements shall be fulfilled:

A continuous EMS shall be installed for the concentrations of

- nitrogen oxides NO_x
- carbon monoxide CO

The following process parameters shall be monitored continuously:

- O₂ in flue gas
- flue gas temperature
- flue gas pressure
- water content in the flue gas (not needed in case the flue gas sample is dried before entering the emission analyzers).

Being a gas turbine plant, the EMS must not include analyzers for SO₂ and dust. The emission monitoring system shall include a storage and calculation unit for the registration, storage, evaluation and presentation of the emission data in accordance with the requirements of 2001/80/EC.

Monitoring during Construction and Operation

The following Table G- 5 summarizes the recommended scope and plan of air pollution monitoring:

	Parameter to be monitored	Location / Method / Frequency	Responsibility Estimated Cost
Construction Phase:	Ambient Air: Dust	- Skopje CCPP site and surrounding - Approx. monthly during civil work activities (approx. 5 times)	EMG of Skopje CCPP Measurement cost: 8'000 €
Operational Phase	Emissions: NO _x , CO, Parameters: O ₂ , t, p, (H ₂ O)	- Stack - Analyzers with evaluation unit - Automatic, continuously	EMG of Skopje CCPP Cost of instruments: Approx. 120'000 €
Operational Phase	Ambient Air: NO _x , CO, PM, SO ₂	- Site surroundings - 4 automatic ambient air monitoring stations - continuously; data to be aggregated to hourly, daily and monthly averages	Authority. Automatic stations existing
Operational Phase	Meteorological Parameters: Wind velocity and direction, temperature, pressure, humidity	- Site surroundings - Ambient air / meteorological monitoring stations - automatic, continuously	Authority. Automatic stations existing

Table G- 5: Atmospheric Pollution Monitoring Plan

3.3 Noise Monitoring

Noise level monitoring is the competency of the Ministry of Urban Planning, Construction and Environment. Data on the actual noise situation in the vicinity of the plant are available (traffic noise) and from the noise measurements performed by Toplifikacija.

Monitoring during Construction and Operation

During construction of the plant the noise level shall be recorded both at the construction site and near the fence. During operation phase, noise monitoring shall be performed within the boundary of the new plant, at the fence line and in the adjacent residential area. The responsibility for measuring/recording the noise levels shall be within the EMG for the plant internal measurements and with the a. m. authority for the measurements in the plant's vicinity. The measurements shall be performed according to the corresponding Macedonian regulations. Table G- 6 summarizes the noise monitoring plan.

Item	Parameter to be monitored	Location / Method / Frequency	Responsibility / Costs
Construction Phase: Noise at the site and in its surrounding	Noise levels (LEG)	At construction site and near the fence line / Portable acoustimeter / during peak hours of construction	EMG Cost: Approx. 2000 €
Operation Phase: Noise of main equipment of CCPP (e.g. gas and steam turbine)	Noise levels (LEG)	Near sources of high sound pressure and at the fence line / Sound pressure 1 m from equipment with portable acoustimeter / monthly	EMG Cost: Approx. 2500 €

Operation Phase: Noise in the surrounding of the site	Noise level	Outside the plant site, close to nearest residential area / portable acoustimeter / two times a year	Cost: Approx. 2500 €
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Table G- 6: Noise Monitoring Plan

3.4 Water Pollution Monitoring

On the basis of the existing legislation, supervision (monitoring) of the quality of surface waters is the competency of the Ministry of Agriculture, Water Economy and Forestry, the Ministry of Urban Planning, Construction and Environment and the Ministry of Health, acting through the National Water Economy Administration and inspectorates functioning as subsidiary bodies of the ministries listed.

In Skopje, all waters (ground, underground and drinking water) have been already monitored by two independent institutes – the Department for Health Protection of Skopje, and the Hydro-Meteorological Institute. Frequency of measuring and analyzing the data is once per month for both institutes, and if something is wrong with water quality, measurements are performed more frequently.

Monitoring during Construction and Operation

During the construction phase, periodic visual inspections of the site drainage quality and runoff are required to ensure the implementation of good management practices. Also, the receiving water body (Vardar River) shall be controlled. Site management practices and site drainage systems will be continuously monitored by the Environmental Management Group (EMG).

During the operation phase, the EMG will perform Internal monitoring to confirm the operational efficiency of waste water pre-treatment systems. The discharge of waste waters during operation shall be monitored regularly under supervision of the Head of EMG or his deputy. Waste water composition can be checked any time from a representative sample taken by a composite sampler which shall be installed at the waste water outfall to the river. For determination of the water quality of all discharged waters a regular water quality monitoring program shall be prepared including regular measurements of temperature, pH value and monitoring of process water regarding COD, TSS, oil/grease and residual chlorine, heavy metals and other pollutants. The measurements shall ensure that the waste water composition stays within the defined discharge limits.

In case the existing HPP "East" would have to be in operation, besides CCPP (during winter season for limited time during peak heat demand), also the wastewater discharge from this plant should be sampled and analyzed.

The implementation of the water monitoring program shall commence during the construction phase and will continue during plant operation. The measurement and monitoring shall be performed according to the corresponding Macedonian and international (World Bank) requirements. The survey area will include the area affected by the thermal plume (e.g. at least 200 m from the discharge point). The water monitoring plan is summarized in Table G- 7 below.

Item	Parameter to be monitored	Location / Method / Frequency	Responsibility / Costs
Construction Phase: Site drainage, runoff	Color, odor, clarity, floating and suspended solids, foam, oil sheen	Site drainage / visual inspection/ once per week Runoff / visual inspection / as appropriate, based on rainfall frequency	EMG Cost:
Construction Phase: Vardar River water quality	Temperature, pH, COD, TSS, BOD, TOC, oil, grease, heavy metals, coliforms	Upstream and downstream of construction site / grab sampling, analysis in a registered laboratory / every three months	Authority Cost: Approx. 2400 €/a
Operation Phase: Effluent discharge of CCPP	Temperature and pH COD, BOD, TSS, oil, grease and chlorine heavy metals, coliforms and other pollutants	Discharge structure, wastewater outfall / automatic monitoring / continuously Discharge structure, wastewater outfall / water sampling, analysis in a registered laboratory / monthly Discharge structure, wastewater outfall / water sampling, analysis in a registered laboratory / every three months	EMG Cost: Approx. 4000 €/a
Operation Phase: eventually: Effluent discharge of existing HPP "East"	Temperature and pH COD, BOD, TSS, oil, grease and chlorine heavy metals, coliforms and other pollutants	Discharge structure, wastewater outfall Discharge structure, wastewater outfall / water sampling, analysis in a registered laboratory / if required (exist. heating plant in operation for limited time)	EMG Cost:
Operation Phase: Vardar River water quality	Temperature, pH, COD, BOD, TOC, DO, TSS, oil, grease, chlorine, heavy metals, coliforms	Area predicted to be affected by the discharge plume / grab sampling, analysis in a registered laboratory / every three months	Cost: Approx. 4000 €/a

Table G- 7: Water Pollution Monitoring Plan

3.5 Aquatic Organisms Monitoring

The Ministry for Urban Planning, Construction and Environment is responsible for environmental protection and supervision.

There are no baseline data on the present composition of water organisms living in the River Vardar available. Therefore, this program should commence during pre-construction phase and last for the first 3 years of operation.

Aquatic organisms shall be collected, stored and examined (determination of species, size, number and health state) following proven/standard methods applied by ecological research institutes in Macedonia and abroad. The background situation shall be determined in the pre-construction phase. The ultimate monitoring program shall commence at the end of the construction phase and shall be performed for 3 years of operation as outlined in Table G- 8.

Item	Parameter to be monitored	Location / Method / Frequency	Costs
Pre-Construction Phase: Aquatic Organisms	Plankton, benthos, fishes (adults, eggs and juveniles)	Upstream and downstream of plant site / transect sampling, species determination and analysis by experts / 1 times	Authority Cost: Approx. 2500 €/
End of construction phase: Aquatic Organisms	Plankton, benthos, fishes (adults, eggs and juveniles)	Upstream and downstream of plant site / transect sampling, species determination and analysis by experts / 1 times	Authority Cost: Approx. 2500 €/a
Operation Phase: Aquatic Organisms	Plankton, benthos, fishes (adults, eggs and juveniles)	Within a 1 km radius of the discharge point / transect sampling, species determination and analysis by experts / two times per year in different seasons, first three years of operation	Authority Cost: Approx. 4000 €/a

Table G- 8: Aquatic Organisms Monitoring Plan

3.6 Solid Waste Monitoring

Continuous monitoring of solid waste is required to ensure the implementation of good management practices during construction and operation. Wastes generated on site and collected for disposal by skilled firms will be referenced, weighed and recorded. Environmental audits will be undertaken which will assess the quality and suitability of on-site and off-site waste management procedures. Visual inspections and audits shall be performed daily to make sure, that waste is segregated, stored and treated in an adequate way according to its type (non-hazardous wastes and hazardous wastes). The solid waste monitoring plan is summarized in Table G- 9.

Item	Parameter to be monitored	Location / Method / Frequency
Construction Phase: Solid Waste	Type of waste	Construction site / visual inspection, audit and documentation / daily
Operation Phase: Solid Waste	Type of waste	Inside the plant and at the plant site / visual inspection, audit and documentation / daily

Table G- 9: Solid Waste Monitoring Plan