**D. CONCLUSIONS OF THE ENVIRONMENTAL IMPACT STUDY (SUMMARY)**

**ŠUMETLICA RESERVOIR**

**1. Justification of the most suitable project option**

The purpose of the planned project that includes a dam and a reservoir on the Šumetlica stream is to provide sufficient quantities of water for supply to the settlements of Lipik and Pakrac. The location and dimensions of the designed reservoir were selected on the basis of the existing intake structure, the location of a water treatment plant and interdisciplinary field investigations and studies. The entire system respects the observed condition and no violent and non-environmentally friendly interventions are foreseen.

The selected location of the dam on the Šumetlica stream at station rkm 5+300 from the Pakra River is conditioned by the width of the stream valley suitable for damming; geological and hydrogeological characteristics of the location; available building materials for the dam; and the need to encompass the maximum possible extent of the stream basin. The natural characteristics of the terrain which rises along the stream banks create a favourable reservoir area and a large water volume retention capacity. The size of the planned reservoir at the maximum impounding height is 17.67 ha.

An earth-fill dam type has been selected, consisting of a clay core, retaining zones and filter zones made of rock. The dam crest lies at 382.00 m above sea level (asl), and the maximum reservoir water level at 379.00 m asl. Due to the existing terrain and excavation required, the total dam height at the highest point is 43.0 m.

Under the Šumetlica Reservoir Project, the following structures are foreseen: an earth-fill dam including foundation work and an auxiliary dam to enable safe performance of works; a bottom outlet; an intake structure to use the water from the reservoir; an access bridge to the intake structure; an access road to the dam running from the existing road in the village of G. Šumetlica with a guard lodge; a structure for the evacuation of high water (overflow); regulation of the stream channel downstream of the dam.

In order to reduce the volume of sediment which will enter the reservoir, the construction of in-channel flood barriers is foreseen on the main watercourse, Šumetlica, and its tributaries.

**2. Overview of environmental impacts of the selected option**

**2.1. Potential environmental impacts during preparation and construction**

**2.1.1 Potential impacts of construction works**

The potential impacts during preparatory and construction works depend on the construction technology, site management and construction site protection measures.

Adverse impacts may occur during excavation and transport. These shall be prevented in advance with by foreseeing remediation works.

**2.1.2 Potential impact on the watercourse (Šumetlica stream)**

The watercourse may become polluted due to accidental spill or infiltration of fuel and uncontrolled disposal of waste. Undesirable impacts on the watercourse may also occur as the result of the watercourse becoming filled up in some places caused by banks caving-in or by uncontrolled and accidental dumping-out of earth material.

There are no impacts on the quality and flow of water in the Šumetlica watercourse during construction, since both pipes of the bottom outlet are used as a bypass pipeline for the flow of the Šumetlica water.

**2.1.3 Impact on noise levels**

Minor impacts caused by noise may occur only during construction, since the works have to be carried out using heavy machinery (excavators, bulldozers) since earthworks account for the major share of the works.

**2.4 Impact on air pollution**

Earthworks are accompanied by dust which rises into the atmosphere and falls onto surrounding areas, roads and trees. In addition to dust, the atmosphere is also polluted by the operation of machines which run on diesel fuel and emit carbon monoxide into the atmosphere. In order to minimize the emission of such gases, the engines shall be turned off during traffic interruptions and loading of trucks.

**2.1.5 Impact on roads**

The access road to the project site, some 400 m long, forks from the settlement of Gornja Šumetlica and leads to the dam. The local road is in a very poor state (macadam surfacing) and is likely to deteriorate even more because of heavy traffic.

**2.1.6 Impact on soil and agriculture**

During construction, soil pollution is possible due to construction material falling off vehicles, in case of disposal of excess earth, construction waste or other waste onto the soil which is not foreseen and not prepared as a disposal site. Soil pollution is also possible due to accidental spill or leaking of fuel into the surrounding ground.

Such pollution can be controlled in a proper and integrated manner with good construction management and supervision during construction by a supervising engineer.

**2.1.7 Impact on cultural heritage**

There is no impact on ethnological heritage (a water mill) as it doesn’t lie in the project area.

The project has a potential impact on the prehistoric archaeological site of Selište, which is recorded in the wider region of the planned reservoir.

**2.1.8 Impact on micro-locations of borrow pits**

The construction of the dam for the Šumetlica reservoir requires the use of a certain volume of clay material which is not available in sufficient volume at the project site. For that reason, clay borrow pits have been defined at a new site lying some 500 m NW of the dam profile. This area includes meadows and pastures and there will be no landscape modifications, since the area will be restored once the exploitation is finished.

Once the dam is built, the borrow pits (clay pits) will be closed. The borrow pits will be remediated in parallel with exploitation. The purpose of the remediation is to mitigate adverse effects of exploitation and reintegrate the degraded site into the surrounding landscape, and to define its purpose once the technical and biological restoration is implemented in accordance with spatial planning documents in effect.

**2.1.9 Impact on forest ecosystem**

For the purpose of constructing the Šumetlica dam and reservoir, some 12 ha of forest in the area of the planned reservoir will have to be cut. The reservoir retention area lies at a height between 377.5 and 379 m asl. During low water levels in the summer month, it can be assumed that the retention area will be bare.

**2.1.10 Impact on hunting**

As the area within which the Šumetlica reservoir lies is part of open hunting ground number XI/124 – “PSUNJ”, this hunting ground will shrink in size as the result of constructing the planned dam and reservoir.

**2.1.11 Impact of construction on the future quality of water in the reservoir**

During preparatory works, it is necessary to remove all the residues left in the area, as well as mowing residues, cut-down scrub, brushwood and trees in order for the area foreseen for inundation to contain the minimum possible quantity of organic matter. The foreseen removal of the standing stock will not include the removal of tree stumps as protection of the surfaces of the reservoir from erosion.

**2.1.12 Occurrence of accidents during construction**

During construction, all potential accidents shall be minimized with proper construction management. The execution of works shall be managed in such a way to minimize any possibility of overflowing or caving-in, as well as the possibility of the formation of a torrential stream in the downstream section of the watercourse by commencing with construction during a low water level and by, once the auxiliary dam is built, commencing with the construction of the dam in order to additionally protect the area from overflowing or caving-in when high waters reach the area.

In order to protect the people and property, if an accident occurs during construction, it is necessary to have established active flood defence measures and organize alert and evacuation systems.

**2.1.13 Impacts on socio-economic conditions**

The construction of the project requires no resettlement, and no uncontrolled migration is expected. Likewise, the construction of the project doesn’t represent a risk to the health of the local population, since its purpose is to improve water supply.

**2.2 Potential environmental impacts during use**

**2.2.1 Impact on the landscape**

The planned project will alter the visual characteristics of the area. As a periphery, a forest community is at risk, and as an area, the characteristic valley between hills is at risk. The construction of the reservoir will result in a new spatial characteristic.

With the formation of the reservoir, the land use purpose is altered, i.e. the areas covered with vegetation will be transformed into a large water surface.

Due to oscillations of the water level in the reservoir during the year, it is possible that bare rocks will show at the very edge of the reservoir, resulting in a negative visual impact. This zone isn’t exposed to view from the landscape and will, because of the dam height of app. 38 m, be visible only from the upstream side of the reservoir where there are no settlements. The potential negative impact will be noticeable to hunters, hikers, rangers and other people who exceptionally carry out their activities upstream of the dam.

**2.2.2 Impact on climate conditions**

Minimum changes of micro-climate conditions are to be expected in the immediate project area next to the reservoir and parallel with that the succession from humid towards drier plant communities. However, in the wider project area, this change will have no impact on the ecosystem stability.

**2.2.3 Impacts on vegetation characteristics**

According to the Red Book of Vascular Flora of Croatia, rare plant species (*Cycopodium clavatum*) and endangered plant species (*Ilex aguifolium, Vinca minor*) are recorded in the area of the planned project for the construction of the Šumetlica reservoir.

In terms of the identified actual status of diversity of plant taxa (flora) and plant communities (vegetation) and their general distribution in Croatia, no undesirable consequences are expected on the presence of plant species and the composition of plant communities.

**2.2.4 Impact on fauna**

The construction of the Šumetlica reservoir will not cause the dying off of any animal species in Croatia, since none of the endangered and protected species of the Croatian fauna live only and exclusively in the zone of impact and construction of the planned project.

**2.2.5 Impact on hunting**

With the construction of the reservoir, the areas that used to be the habitats of game and their source of food will be replaced by a water surface. This will definitely have an impact on the decrease in size of hunting productive areas, including the associated decrease of the basic stock of this kindof game. Still, this decrease will not be significant, as the hunting ground has sufficient areas to which the game will adapt and in which they will find new shelters and movement routes.

**2.2.6 Impact on hydrological regime and water quality downstream of the reservoir**

The water from the reservoir will be released into the channel of the Šumetlica stream, which will have an impact on the increased volume of water when compared to the status at present, when the flows are minimum due to the intake of water for water supply. During construction period the flow regime will not change, except at high water level, and during impoundment, the biological minimum will be at least 10-20% of the mean annual flow. When the reservoir is in use, it is proposed that the biological minimum of 25 l/s be used, which will increase the flow in the downstream section of the Šumetlica watercourse, thus improving the water quality, since the present flows are minimum because of the upstream intake structure.

**2.2.7 Impacts on groundwater quality**

Based on the results of laboratory analyses and the composition of cover layers, it can be concluded that the impact of the reservoir on groundwater will be very weak because of deposits of low permeability.

**2.2.8 Erosion and sediments**

The area of the planned reservoir is covered with forest cover which makes the substratum stable. Erosion occurs at places where the forest is cut down as well as in gorges and channels of streams. The basin is characterized with category III erosion. In order to protect the reservoir area from erosion, the tree stumps will not be pulled out after the cutting of trees.

**2.2.9 Social impacts**

In terms of social impacts, in the wider area which is covered with a water supply network the project can have positive impacts on the quality of life of the people living in the surrounding villages, since sufficient quantities of water for public water supply will be ensured.

Adverse impacts on the local population in the settlement of Gornja Šumetlica are possible. The population might develop a sense of fear and discomfort knowing that they live downstream of the dam and reservoir.

**2.3 Potential impacts in case of accidents**

Potential accidents are foreseen and defined by the Final Design of Public Alert and Information System – Šumetlica Dam, which was verified by the National Protection and Rescue Directorate, Service for System 112, Department for Public Alert System and Operational Technique in July 2007. The Design was prepared in accordance with the relevant regulations in the field of public alert and information, and fully fits into the concept of development of an integrated alert system in Croatia.

**2.4 Potential environmental impacts after termination of use**

Reservoirs are hydraulic structures intended for long-time use, and the primary function of the Šumetlica reservoir is water supply. It is not expected that its use will terminate.

**3. Environmental protection measures**

**3.1 Environmental protection measures during project preparation**

*Protection measures during project preparation*

1. Prepare a Site Management Report which shall define: internal transport, storage of materials, power and drinking water supply, method of disposal of wastewater, construction waste and other waste, measures for safety at work, fire protection system.

*Protection measures for water and watercourses*

1. Design documents shall define the materials and works performance method, in order to prevent adverse consequences due to poor execution of works or the use of inadequate materials.

**3.2 Environmental protection measures during construction**

*Protection measures for water and watercourses*

1. The mechanical repair of machines or storage of fuels and lubricants at the site shall be forbidden.
2. The supply with fuel and lubricants shall be done exclusively from tanker trucks under expert control and in protected and waterproof areas designated for that particular purpose, equipped with agents to neutralize potential spills of fuels and lubricants.
3. Temporary discharges from sewer systems into watercourses are forbidden.
4. Define measures for the regulation of the water regime in the event of high waters in accordance with the National Flood Defence Plan.
5. Inspect, through the existing water watchmen service, the status of watercourses in order to identify potential damage done during construction, disposal of material into watercourses and channel and bank erosion.
6. Plant mass residues, residues left from the mowing of grass and cutting down of shrubs and trees shall be removed. However, the tree stumps shall be left in the area foreseen for inundation in order to minimize the presence of organic matter in the reservoir and minimize the potential for erosion.

*Noise protection measures*

1. Works shall be performed only during the day in accordance with the Ordinance on maximum permitted levels of noise in an environment in which people work and stay (OG 145/04).

*Atmosphere pollution protection measures*

1. During the transport of highly dry dusty material, if the truck will take public roads, the material shall be covered with a protective cover in order to reduce atmosphere pollution.

*Soil protection measures*

1. Prepare a design on the exploitation of clay sites, which shall define the method and depth of excavation, operating and final slopes, surface drainage, excavation drainage, and final improvement of the exploited site.
2. Excess material from the excavation shall be disposed in such a way to fit nicely into the landscape and not disturb the environmental quality and the land use purpose.
3. During the exploitation of clay, technical and biological restoration shall be done in order to enable successful rehabilitation.
4. Plant material (plant cover of medium height) shall be removed in an environmentally acceptable way.
5. The area shall be improved using autochthonous plant species or, if appropriate, left to natural succession.
6. Define phased implementation of landscape improvement which shall be done in parallel with exploitation.
7. Plant species within the protective green belt shall be planted in such a way to visually isolate the excavation.
8. The excavated areas shall be rehabilitated successively during the exploitation of clay.
9. Landscaping shall be done using natural landscape structures to the maximum possible extent, except in the potential areas intended for the growing of agricultural crops.
10. Once the exploitation of clay is finished, all unnatural materials in the project area shall be removed in order to facilitate final biological restoration or change of use.

*Traffic and road protection measures*

1. The roads shall be maintained in the condition which ensures the safety of traffic and people.
2. A traffic regulation design shall be prepared for each road section which is in contact with project implementation.
3. The roads shall be restored into their original condition upon the completion of works.

*Landscape protection measures*

1. The Final Design shall include a landscaping design.
2. The area surrounding the reservoir shall be landscaped so as to preserve all the specifics of the natural landscape by planting autochthonous trees and scrub.
3. Biological restoration measures shall be taken in the erosion-affected peripheral parts of the banks.

*Cultural heritage protection measures*

1. Archaeological recognisance of the terrain shall be taken in order to update the registered archaeological sites.
2. Continuous or occasional archaeological supervision shall be conducted in the area where a potential archaeological site is expected.
3. The protection measures and the period during which they will be implemented shall be defined by the competent heritage authority by identifying special requirements in the process of issuing a building permit.

*Forest protection measures*

1. Adverse impacts on forests and forest land during construction shall be avoided with proper and thorough construction management, supervision and cooperation with the competent forest management authority.
2. Construction waste (top soil, excess earth, rocks) and different plant residues (brushwood, branches) shall be transported from the construction waste in an organized manner. Municipal waste shall be disposed of into containers.
3. It shall be forbidden to light fire in the open in the vicinity of a forest.
4. All the trees and plants which don’t have to be cut for project implementation purposes shall be protected in cooperation with the competent authority of the local self-government.

*Hunting protection measures*

1. Before the commencement of preparatory and construction works, the hunting lessee shall be timely informed about the works in order for him to chase the game away from the area concerned, in order to avoid the small game in the reservoir area from getting hurt.
2. If despite that the game gets hurt, the employer shall compensate the hunting lessee for the damage according to the relevant price list for damaged game.
3. During the period of reproduction and taking care of offspring, activities which might result in the game getting hurt shall be avoided.

*Fire protection measures*

1. The developer shall provide constant supervision over the part of the construction site where flammable materials are located (fuels and lubricants) in order to prevent fire at the construction site.

*Protection measures for the disposal of waste material*

1. Municipal waste shall be disposed of into closed containers or tanks.
2. A municipal waste container shall be picked up by the competent municipal service company.
3. Construction waste (rocks, earth, etc.) shall be removed from the project site by the authorized company with which a contract has been signed.
4. Branches and brushwood shall be removed together with the municipal waste.”

**3.3 Environmental protection measures during use**

*General environmental protection measures*

1. Upon the completion of construction of the reservoir, the structure itself and its surroundings shall be regularly maintained and an Ordinance on reservoir maintenance and use shall be prepared, defining the maintenance and use methods.
2. At the access to the structure, a notice shall be put up, specifying the code of conduct in the vicinity of the reservoir (disposal of waste forbidden, lighting of fire forbidden, etc.).

*Water protection measures*

1. All plant mass in the area foreseen for inundation shall be removed before impoundment, except of tree stumps remaining after the cutting of trees.
2. A Study on Water Protection Zones shall be prepared and water protection areas shall be defined in accordance with the Ordinance on identification of sanitary water source protection zones (OG 55/02).
3. Polluted water or waste material shall not be discharged of into the reservoir.
4. In case of cleaning the reservoir, the collected organic sludge shall be transported to the area outside of the reservoir zone.
5. Water shall be released from the reservoir to meet the biological minimum needs.
6. The employer shall use the excess sediment deposited at the upstream sediment retaining dams for the construction and reconstruction of local roads or shall offer it to the local population.
7. An Ordinance on the operation of the bottom outlet valve shall be prepared.

*Landscape protection measures*

1. The area surrounding the reservoir shall be developed in such a way to preserve all the specifics of the natural landscape by planting autochthonous trees and scrub.
2. The reservoir zone with the surrounding area (banks in particular) shall be formed and harmonized with the surroundings. A landscape architect shall be consulted in further preparation of design documents.

*Protection measures in case of accidents*

1. In case of accidents, actions shall be taken according to the Integrated Alert System in Croatia.

**3.4 Environmental protection measures after termination of use**

As the reservoir is foreseen as a permanent structure, there are no environmental protection measures after termination of use.

**3.5 Environmental protection measures to prevent and mitigate potential environmental accidents**

1. An Operating plan for the implementation of measures in the event of sudden water pollution shall be prepared in accordance with the National Water Protection Plan (OG 8/99) and shall be used even after system completion.
2. A Plan of environmental protection interventions shall be prepared in accordance with the National Flood Defence Plan and the Požega-Slavonija County Plan.
3. A Plan of emergency measures for environmental accidents shall be prepared, exactly defining the people, equipment and plan of activities in the event of accidents involving pollutant contamination at the construction site.
4. A Public Alert Plan and emergency measures in the event of dam collapse shall be established.

**4. Environmental monitoring programme**

**4.1 Water quality monitoring for the Šumetlica watercourse**

1. Monitor the quality of water in the Šumetlica stream downstream of the reservoir, according to the schedule defined by Hrvatske vode, at least 4 times per year, by analysing the mandatory parameters under the Regulation on water classification (OG 77/98).

**4.2 Reservoir and dam monitoring**

1. Monitor the quality of water in the reservoir according to the schedule defined by Hrvatske vode, at least 4 times per year, by analysing the mandatory parameters under the Regulation on water classification (OG 77/98).
2. Monitor the water levels in the reservoir and the water levels at the overflow and chute when in function (water level gauge or automatic meters).
3. Monitor dam deformations, dam settlement and slope stability (geodetic monitoring of geodetic markers established on the crest).
4. Monitor the water pressure in the dam and foundation soil (single and double piezometers established on the crest).
5. Monitor the quantity of sediment in the reservoir in order to define the frequency of required cleaning, even though the experience gained so far suggests that the need for cleaning arises after a period of approximately 50 years.
6. Inspect the dam and evacuation structures in order to identify the safety of structures and identify the need for repair. The inspection shall identify the occurrence of erosion processes at the dam itself and on reservoir banks, as well as any other unwanted developments and changes in the environment in the immediate reservoir area. The inspection dynamics shall be defined by the Ordinance on dam maintenance and use.
7. Establish a small meteorological observation station to monitor the water balance. The station should be equipped with rain and air temperature gauges and a class A evaporimeter.

**4.3 Monitoring of flood barriers**

1. Monitor the condition of flood barriers in order to identify the frequency of required cleaning, even though the experience gained so far suggests that the need for cleaning arises approximately once a year.