MINING INSTITUTE DD TUZLA
Street Rudarska 72, 75000 Tuzla

REVISED
ENVIRONMENTAL IMPACT ASSESSMENT STUDY

FOR THE CONSTRUCTION OF THE REGIONAL SANITARY LANDFILL FOR TUZLA REGION AT THE LOCATION OF “SEPARACIJA 1”–MUNICIPALITY OF ŽIVINICE

“Eko-Sep” d.o.o.
ŽIVINICE

Tuzla, July 2015
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Executive Director of the Scientific Research Center
Zlatko Džambić

Director of the Tuzla Institute
Eldar Pirić

Tuzla, July 2015
List of contributors:

Team leader: Jasmina Isabegović

Contributors: Senaid Bajrić

Jasminka Spahić

Eldin Halilčević

Ranko Karišik
TABLE OF CONTENTS

1. INTRODUCTION ................................................................................................................................. 7
  1.1. ROLE AND IMPORTANCE OF THE RSL "SEPARACIJA 1" ................................................................. 9
  1.2. LEGAL FRAMEWORK FOR THE EIA .............................................................................................. 12
  1.3. SPATIAL PLANNING DOCUMENTS ............................................................................................... 14
2. DESCRIPTION OF THE PROPOSED PROJECT ..................................................................................... 21
  2.1. CURRENT SOLID WASTE MANAGEMENT IN THE PROJECT REGION ............................................ 21
    2.1.1. Current waste collection system ............................................................................................. 21
    2.1.2. Waste Quantities in 2013 ......................................................................................................... 24
  2.2. FORECAST OF QUANTITIES OF MUNICIPAL HOUSEHOLD WASTE .............................................. 26
    2.2.1. Waste that may not be disposed of at the landfill ................................................................. 29
  2.3. CALCULATION OF NECESSARY LANDFILL SPACE ........................................................................ 29
  2.4. DESCRIPTION OF PHYSICAL CHARACTERISTICS OF THE ENTIRE PROJECT AND MAP OF THE LOCATION... 31
    2.4.1. Description of the site ............................................................................................................. 31
    2.4.2. Purpose of the facility .............................................................................................................. 35
  2.5. DESCRIPTION OF PLANNED FACILITIES WITHIN THE RSL ...................................................... 37
    2.5.1. Construction of facilities adapted to the regional concept of waste disposal ......................... 37
    2.5.2. Waste disposal area - landfill body ......................................................................................... 41
    2.5.3. Landfill surrounding zone ...................................................................................................... 43
    2.5.4. Other facilities at the landfill ................................................................................................. 45
  2.6. AREA WITHIN WHICH OTHER PLANNED RSL FACILITIES WILL BE BUILT .................................. 47
    2.6.1. Administrative building .......................................................................................................... 47
    2.6.2. Service center ......................................................................................................................... 48
    2.6.3. Recycling yard ....................................................................................................................... 50
    2.6.4. Composting plant .................................................................................................................... 51
    2.6.5. Plateau for receiving and processing construction waste ..................................................... 53
  2.7. TRANSPORT OF WASTE TO THE LANDFILL ................................................................................. 54
  2.8. WORKFORCE .................................................................................................................................... 55
  2.9. BASIC CHARACTERISTICS OF THE PRODUCTION PROCESS, THE TYPE AND QUANTITIES OF MATERIALS TO
       BE USED ........................................................................................................................................ 56
    2.9.1. Selected waste disposal technology ....................................................................................... 56
    2.9.2. Site preparation for waste disposal ....................................................................................... 57
    2.9.3. Waste deposition, spreading and compacting ....................................................................... 58
    2.9.4. Waste spreading and compacting ....................................................................................... 59
    2.9.5. Waste covering and compacting of cover material ................................................................ 59
    2.9.6. Final capping layer .............................................................................................................. 60
  2.10. CONSTRUCTION EQUIPMENT NEEDED FOR REGULAR RSL OPERATIONS ............................... 63
    2.10.1. Selection of construction mechanization needed for regular RSL operations .................... 64
  2.11. WATER SUPPLY, ELECTRICITY SUPPLY AND PLANNED CONSUMPTION .................................. 65
    2.11.1. Water supply and foreseen quantities of water to be consumed .......................................... 65
    2.11.2. Sewage and quantity of sanitary and faecal water .............................................................. 66
2.11.3. Connection to power lines and estimated consumption.................................................................66
2.11.4. Planned amounts of fuel..................................................................................................................66
2.12. WASTEWATER TREATMENT PLANT ...............................................................................................66
2.13. SYSTEM FOR USE OF LANDFILL GAS ...........................................................................................67
2.14 ASSESSMENT BY TYPE AND AMOUNT OF EXPECTED WASTE AND EMISSIONS ................................70
   2.14.1 Expected leachate quantities........................................................................................................70
   2.14.2. Estimate of landfill gases .............................................................................................................72
2.15. EXPECTED INTENSITY OF NOISE IN THE ENVIRONMENT ............................................................76
2.16. TYPE AND QUANTITIES OF MATERIALS TO BE USED DURING RSL OPERATION .....................77
   2.16.1. Estimates per type and quantity of expected waste .................................................................77
3. DESCRIPTION OF THE ENVIRONMENT THAT MAY BE AFFECTED BY THE PROJECT ................78
   3.1. INFORMATION ON POPULATION .....................................................................................................78
   3.2. SOIL DATA ..................................................................................................................................81
   3.3. FLORA AND FAUNA .........................................................................................................................84
   3.4. CLIMATE FEATURES OF THE REGION .........................................................................................88
   3.5. EXISTING MATERIAL ASSETS INCLUDING CULTURAL AND HISTORICAL HERITAGE ...............94
   3.6. SPECIFIC IMPACTS IDENTIFIED IN THE PRIOR ENVIRONMENTAL IMPACT ASSESSMENT ..........94
4. DESCRIPTION OF POSSIBLE SIGNIFICANT IMPACTS ON THE ENVIRONMENT ...............................94
   4.1. IMPACTS ON POPULATION .............................................................................................................94
   4.2. IMPACTS ON FLORA AND FAUNA ...............................................................................................95
   4.3. IMPACTS ON GROUND AND SURFACE WATERS .........................................................................96
   4.4. IMPACTS ON AIR ............................................................................................................................97
   4.5. IMPACTS ON SOIL ...........................................................................................................................98
   4.6. IMPACTS ON CLIMATE CHANGE ...............................................................................................99
   4.7. IMPACTS ON MATERIAL ASSETS INCLUDING CULTURAL, HISTORICAL AND ARCHAEOLOGICAL HERITAGE .................................................................99
   4.8. IMPACTS ON LANDSCAPE .............................................................................................................99
   4.9. CORRELATION AMONG THE ABOVE FACTORS ............................................................................99
   4.10. DESCRIPTION OF METHODS USED FOR ENVIRONMENTAL IMPACT ASSESSMENT ...........100
5. DESCRIPTION OF MEASURES FOR MITIGATING NEGATIVE IMPACTS ...........................................101
   5.1. MITIGATION MEASURES DURING THE RSL CONSTRUCTION PHASE .....................................102
6. DESCRIPTION OF MONITORING MEASURES ..................................................................................110
   6.1. DESCRIPTION OF MEASURES FOR MONITORING WASTE GENERATION AND MANAGEMENT ....110
7. OUTLINE OF BASIC ALTERNATIVES .................................................................................................126
8. NON-TECHNICAL SUMMARY ............................................................................................................126
   8.1. DESCRIPTION OF THE PROPOSED PROJECT – SUMMARY ..........................................................126
   8.2. DESCRIPTION OF THE ENVIRONMENT THAT MAY BE AFFECTED BY THE PROJECT ............4
   8.3. DESCRIPTION OF POTENTIAL SIGNIFICANT PROJECT IMPACTS ON THE ENVIRONMENT AND MITIGATION AND PREVENTION MEASURES – SUMMARY ....6
9. INDICATION OF DIFFICULTIES ..........................................................................................................19
10. LEGISLATION AND DOCUMENTS USED .........................................................................................19
11. WASTE MANAGEMENT PLAN .........................................................................................................20
1. INTRODUCTION

The issue of building a regional sanitary landfill (RSL) in Tuzla Canton, one of the most populous cantons in FBiH, is of great importance. Construction of the RSL would lead to the closure of illegal landfills, which would significantly reduce the danger to the environment. The construction of RSLs is foreseen by the Federal Environmental Protection Strategy.

In the Tuzla region, each municipality has its own utility registered enterprise responsible for the collection and transport of waste to the existing landfill. An insufficient number of bins and containers is currently used to collect waste. Therefore, part of the waste is still disposed of in plastic bags around bins and containers. Waste collection service coverage is approx. 63% in the Municipality of Banovići, 38% in the municipality of Kladanj and 80% in the Municipality of Živinice. In general, about 72% of the population in the entire project region of Tuzla is covered by the existing system of waste collection. Organized and planned waste sorting and recycling of useful components of municipal waste in Tuzla region is practically non-existent, and is only carried out on an individual basis by some municipal public enterprises with more or less success. Vehicles for the transport of waste which are currently used are inadequate. In addition, currently used waste are practically "dumping areas" where waste is disposed of without any plan and order, and where no environmental and health protection measures are implemented. Accordingly, the current waste management practices indicate the urgent need for the construction of an RSL.

The RSL should be built in accordance with the relevant laws and regulations at the state/entity/municipal and EU level.

Tuzla Canton initiated certain activities in accordance with EU directives regarding the development of investment and technical documentation for the construction of an RSL at the location of "Separacija 1 - Živinice", as proposed in the "Regional Sanitary Landfill - Location Selection Study for the project region Tuzla Canton", which was prepared in 2012, which includes a waste generation forecast, characteristics of the site, optimization of leachate and waste gas management, optimization of transport to the landfill through transfer stations, cost of labour, financial and economic analysis, procurement plan, etc.

The "Regional Sanitary Landfill - Location Selection Study for the project region Tuzla Canton and the ensuing "Feasibility Study for Regional Sanitary Landfill - Tuzla Canton" developed by Fichtner/IPZ (under Contract CCI No. 2010/259-103 signed between the EU delegation to BiH and Fichtner) confirmed that the location of "Separacija 1" is the preferred location of the future RSL for the Tuzla region.

The target beneficiaries of this project are the 3 municipalities listed in Table 1.1.

Table 1.1. Target beneficiaries of the RSL for the Tuzla region

<table>
<thead>
<tr>
<th>Target municipalities within the region</th>
<th>Banovići</th>
<th>Kladanj</th>
<th>Živinice</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population 2012</td>
<td>30,053</td>
<td>15,199</td>
<td>101,125</td>
<td>146,377</td>
</tr>
<tr>
<td>Average Waste collection coverage rate</td>
<td></td>
<td></td>
<td>72% for the whole Tuzla region</td>
<td></td>
</tr>
<tr>
<td>Waste quantity 2010 t/d or t/a</td>
<td>22.5 t/d</td>
<td>11.1 t/d</td>
<td>44.2 t/d</td>
<td>77.8 t/d</td>
</tr>
<tr>
<td></td>
<td>8,212 t/a</td>
<td>4,067 t/a</td>
<td>16,124 t/a</td>
<td>28,403 t/a</td>
</tr>
</tbody>
</table>
The objective of construction of the RSL “Separation 1” in Tuzla region is to assist all municipalities to improve the current standard of waste management and to move the waste management system in the region closer to EU standards. The project will also help reduce investment and operating costs compared to the alternative of constructing sanitary landfills for each municipality separately.

In order to ensure the development of the necessary investment and technical documentation and the commencement of the project, the company Eko-Sep d.o.o. Živinice, which will be the implementing agency, signed a contract with certified companies for developing the necessary documentation. Eko-Sep also signed a contract on developing the “Environmental Impact Assessment” (EIA) for the project with the “Mining Institute d.d. Tuzla” which is licensed by the Federal Ministry of Environment and Tourism.

The development of the EIA is based on the provisions of the Law on Environmental Protection (O.G. of FBiH, number 33/03, 38/09), the Law on Waste Management (O.G. of FBiH, number 33/03, 72/09), the Law on Spatial Planning and Land Use at the Level of the Federation of BiH (O.G. of FBiH, number 52/02, 02/06 and 72/07), the Regulation on plants and facilities for which an EIA is mandatory, and plants and facilities which may be constructed and commissioned only if they have an environmental permit (O.G. of FBiH, no. 19/04).

The Environmental Protection Strategy of the Federation of BiH for the period 2008-2018 contains a Waste Management chapter. This Strategy defines the policy and strategic guidelines based on the general principles of the European Union transposed through the Law on Waste Management of FBiH, primarily the priorities and the basic principles of waste management.

In order to accomplish the objective and whilst taking into account the prevention of pollution and the minimization of the consequences for human health and the environment, the following measures shall be taken:

- it shall be ensured that the generation of wastes and especially the hazardous characteristics of such waste is reduced to a minimum,
- the reduction in the quantities of wastes shall be properly managed, taking into consideration special waste streams,
- wastes shall be treated in a way to ensure recovery; those wastes which are not subject to recovery shall be disposed of - incinerated or disposed of in landfills - in an environmentally sound manner.

The integrated waste management system is based on the principle of prevention, principle of recycling and the “polluter pays” principle.

In the context of all of the above mentioned, the “project of construction of an RSL in the Tuzla region and the construction of supporting facilities tailored to the regional concept of landfilling” which aims to improve
environmental protection through the rehabilitation of existing "wild" landfills and improve sanitary and health conditions in BiH fully fits the basic priorities of waste management in FBiH and the integrated waste management system defined in the mentioned Strategy.

**Correction per remark no. 1:**

Remark: Table 1.1. - target users of the sanitary landfill for the Tuzla region provides incorrect data on the number of inhabitants. It is assumed that the data from the Feasibility Study were used, but given that the population census was carried out in the meantime and that preliminary data are available, the following population numbers should be given: Živinice: 61,201, Banovići: 23,431 and Kladanj: 13,041. This should be corrected throughout the Study, except where the Feasibility Study is quoted.

Answer to remark:

The "Feasibility Study for Regional Sanitary Landfill - Tuzla Canton" was developed by Fichtner/IPZ (under Contract CCI No. 2010/259-103 signed between the EU delegation to BiH and Fichtner. The start date of the project was March 28, 2011.

The objective of the FS was to provide a comprehensive analysis of all aspects of the development of the RSL at the location "Separation 1 - Municipality of Živinice", which was proposed in the Location Study developed in 2012.

Data on the number of inhabitants (Banovići, Kladanj and Živinice) used for the preparation of the FS are the only data that were available at the moment of developing the FS to the consultant Fichtner/IPZ. A comprehensive analysis of RSL construction, forecast of waste generation, analysis of site location, optimization of wastewater and waste gas management, optimization of transport to landfill, labour costs, financial and economic analysis, procurement plan, etc. were all based on these data. Given the fact that preliminary census data became available only in 2013, new data were not taken into account when drafting this EIA Study, since this document is based on the FS. Changing the number of inhabitants according to unofficial preliminary results of the population census would mean that the FS and other project documentation would need to be revised.

### 1.1. ROLE AND IMPORTANCE OF THE RSL "SEPARACIJA 1"

As noted previously, the objective of the already developed "Feasibility Study for Regional Sanitary Landfill - Tuzla Canton" is to provide a comprehensive analysis of all aspects of the development of an RSL at the proposed location "Separacija 1 – Živinice”.

Following a review of the existing waste management systems in the region, assessment of the current quantities of waste, waste composition etc. and development of forecasts of population and waste quantities, the following three scenarios were given for the period 2012-2040:

- "Scenario 1" (so called "do nothing" – waste management concept without recycling and biowaste treatment (current situation).
- "Scenario 2"- waste management concept with recycling activities
- "Scenario 3"- waste management concept as in scenario 2 with additional biodegradable waste treatment to achieve the quantitative goals of EU Directive on waste for the year 2020.

Project implementation is based on scenario 2 until BiH becomes an EU member. After BiH becomes an EU, scenario 3 will be the basic scenario of the FS report. With this concept, the life span of the landfill would be much higher than in case of scenario 1. Only the design of the sanitary landfill is based on Scenario 1, as a worst-case Scenario, which means the landfill should be prepared for such scenario and the life span of the landfill should also be sufficient till 2040 even in case of scenario 1.

Table 1.2. below presents the forecast of the generated waste quantities in Tuzla region for the period 2012-2040.

**Table 1.2. - Forecast of generated waste quantities 2012-2040**

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Forecast</th>
<th>Non-Biodegradable</th>
<th>Bulky</th>
<th>Inert</th>
<th>Forecast</th>
</tr>
</thead>
</table>


The landfill is planned to be developed in 3 phases as shown in table 1-3 below.

Furthermore, the table below presents the estimated landfill volume needed in each of the three scenarios (start of operation in 2015).
Table 1.3. - Estimated landfill volume needed in each scenario

<table>
<thead>
<tr>
<th></th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landfill volume available per phase</td>
<td>394,683 m³</td>
<td>435,790 m³</td>
<td>438,867 m³</td>
</tr>
<tr>
<td>Total landfill volume (total of all 3 phases)</td>
<td></td>
<td>1,269,340 m³</td>
<td></td>
</tr>
<tr>
<td>Landfill volume required (in m³) until Scenario 1</td>
<td>2020</td>
<td>259,338 m³</td>
<td>199,831 m³</td>
</tr>
<tr>
<td></td>
<td>2025</td>
<td>487,136 m³</td>
<td>365,157 m³</td>
</tr>
<tr>
<td></td>
<td>2030</td>
<td>728,894 m³</td>
<td>532,216 m³</td>
</tr>
<tr>
<td></td>
<td>2035</td>
<td>988,667 m³</td>
<td>700,224 m³</td>
</tr>
<tr>
<td>Total in 2040</td>
<td>1,269,340 m³</td>
<td>865,867 m³</td>
<td>487,035 m³</td>
</tr>
<tr>
<td>% of Landfill volume used in 2040</td>
<td>100%</td>
<td>68%</td>
<td>38%</td>
</tr>
<tr>
<td>Estimated life span of the landfill</td>
<td>25 years</td>
<td>33 years</td>
<td>40 years</td>
</tr>
</tbody>
</table>

The RSL will be constructed in compliance with the legal regulations of the Federation of BiH, EU Directives, and World Bank standards. The life span of this RSL should be a minimum of 20 years.

According to the landfill design, the RSL is divided into the following main areas:
- entry-exit zone
- waste deposit zone – operational zone
- landfill surrounding zone
- other facilities (wastewater treatment, leachate treatment, etc.)
- reserved area for future facilities (recycling yard, facility for treatment, separation of raw materials and recycling, separate storage for acceptance of hazardous waste from communal sources, facility for mechanical -biological treatment of waste).

Remark: Table 1.4. - parameters for RSL design states that the design capacity is 1,269,340 m3. It needs to be amended to 1,269,340 m3. In addition, the table states that the nearest settlement is a “village of returnees”, and it needs to be amended to “village of internally displaced persons”.

Answer to the Committee’s remark: In Table 1.4. an update was made to the Commission’s remark.

Table 1.4 presents the main design parameters for the RSL “Separacija 1”.

Table 1.4: Main design parameters for the RSL “Separacija 1”

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area of landfill within the fence</td>
<td>13.0 ha with possibility of extension</td>
</tr>
<tr>
<td>Design capacity</td>
<td>1,269,340 m³</td>
</tr>
<tr>
<td>Start of operation</td>
<td>2015</td>
</tr>
<tr>
<td>Estimated lifetime of the landfill</td>
<td>at least 25 years (2015- 2040)</td>
</tr>
<tr>
<td>Type of landfill</td>
<td>Sanitary Landfill (no hazardous waste)</td>
</tr>
<tr>
<td>Compaction rate after settlement</td>
<td>0.9-1 t/m³</td>
</tr>
<tr>
<td>Number of operating staff required</td>
<td>13</td>
</tr>
<tr>
<td>Nearest residential area</td>
<td>The nearest village to the location is a village of Internally Displaced Persons. The closest residential building is located at a distance of approx. 500 m (linear distance).</td>
</tr>
<tr>
<td>Input material</td>
<td>Remaining waste streams according to scenarios 1 to 3</td>
</tr>
</tbody>
</table>
1.2. LEGAL FRAMEWORK FOR THE EIA

This chapter analyses the EU legislation that is not yet binding as well as FBiH legislation on the basis of which only the 1st phase of the project will be implemented (construction of an RSL with supporting basic facilities), whereas the Waste Management Centre is planned during the 2nd phase.

Remark: Referring to the Official Gazette is done in three different ways. It is necessary to harmonize it in the following manner: (Official Gazette of FBiH, number: 33/03).

Existing FBiH and EU legislation on waste management:

FBiH:
- Law on Environmental Protection (O.G. of FBiH, No. 33/03, 39/09)
- Law on Waste Management (O.G. of FBiH", No. 33/03, 72/09)

EU:

FBiH regulations

Law on Environmental Protection
EIAs involve the systematic identification and assessment of potential impacts of proposed projects, plans, programs or legal ventures on the biological, physical, chemical, cultural and socio-economic components of the environment.

The development of EIAs is based on the Law on Environmental Protection (O.G. of FBiH, No. 33/03).

The secondary legislation based on the Law on Environmental Protection (i.e., Regulation on plants and facilities for which an EIA is mandatory, and plants and facilities which may be constructed and commissioned only if they have an environmental permit (O.G. of FBiH, no. 19/04)) defines the procedure for obtaining environmental permits and the content of the EIA study. This Regulation also provides that an EIA is mandatory for:
- waste management facilities for:
  - incineration
  - chemical processing or
doisposal of hazardous waste
- plants for incineration of municipal waste
- plants for biological and physical/chemical treatment of non-hazardous waste for purposes of landfilling, with a capacity of less than 150 t / day
- landfills receiving more than 10 tonnes per day or a total capacity of more than 25,000 t, with the exception of inert waste landfills
- inert waste landfills with a capacity of 250,000 m3 of overall volume or area of 4 ha or more.

Law on Waste Management (O.G. of FBiH, No. 33/03)

Law on Amendments to the Law on Waste Management (O.G. of FBiH, No. 72/09)

The Law on Waste Management regulates all categories and types of waste (except certain categories as defined in the Law) as well as all types of waste management activities, operations and facilities. One of the most important and most relevant principles of this Law is defined in Article 33: "Permits for new sanitary landfills can only be issued for disposal at regional level".

Article 13 sets out the requirements for obtaining a permit for waste management. The Law further defines the general transport of waste, incineration, general requirements for handling hazardous waste,
transboundary movement of hazardous waste, inspection and penalty clauses, and determines that the existing facilities and activities are required to develop Adjustment Plans.

**Remark:** Only nine bylaws enacted on the basis of the Law on Management waste are listed. It should be amended to list all 16 bylaws.

**Answer to the Committee’s remark:** The list of bylaws has been amended to include all 16 bylaws.

**Secondary legislation that has been adopted based on the requirements of the Law on Waste Management:**

1. Regulation on waste categories with lists (O.G. of FBiH, No. 9/05)
2. Regulation on issuing permit for small-scale waste management activities (O.G. of FBiH, No. 9/05)
3. Regulation on necessary conditions for transfer of obligations from producers and sellers on operators of systems for collection of waste (O.G. of FBiH, No. 9/05)
4. Regulation determining the treatment of hazardous waste that is not on the waste list or whose content is unknown (O.G. of FBiH, No. 9/05)
5. Regulation on the content of a waste management adaptation plan for existing treatment or disposal facilities and activities undertaken by the competent authority (O.G. of FBiH, No. 9/05)
6. Decree on the types of financial guarantees to ensure transboundary movement of hazardous waste (O.G. of FBiH, No. 41/05)
7. Decree on financial and other guarantees to cover the cost of the risk of possible damage, cleaning and procedures after the closure of landfills (O.G. of FBiH, No. 39/06)
8. Decree on separate collection, packaging and labelling of waste (O.G. of FBiH, No. 38/06)
9. Decree on reporting obligations for operators and manufacturers of waste on conveying supervision, and monitoring and evidence in reference to conditions from waste management permit (O.G. of FBiH, No. 31/06)
10. Regulation on form, contents and methodology for provision of information on important characteristics of products and packaging (O.G. of FBiH, No. 6/08)
11. Regulation on animal waste and other non-hazardous substances of natural origin that can be used for agricultural purposes (O.G. of FBiH, No. 8/08)
12. Rulebook on the management of medical waste (O.G. of FBiH, No. 77/08)
13. Regulation on the management of packaging and packaging waste (O.G. of FBiH, No. 88/11)
14. Regulation on management of waste from electric and electronic equipment (O.G. of FBiH, No. 87/12)
15. Regulation on Amendments to the Regulation on the management of packaging and packaging waste (O.G. of FBiH, No. 28/13)
16. Decree on Fees for Plastic Bags dated 14/01/2014

**EU regulations**

- Directive 91/689/EEC on hazardous waste
- Directive (94/64/EC) on packaging and packaging waste
- Directive (75/439/EEC) on waste oils
- Directive (91/57/EEC) batteries and accumulators containing certain dangerous substances
- Directive (89/429/EEC) on the reduction of air pollution from existing municipal waste-incineration plants
1.3. SPATIAL PLANNING DOCUMENTS

This chapter elaborates the spatial planning documentation that defines the locations of specific facilities. This chapter also addresses the Environmental Protection Strategy which provides the basic guidelines for solid waste management in FBiH.

1) Spatial Plan of FBiH (draft)

A public hearing has been organised for the Spatial Plan of FBiH but it has not been adopted to date.

The European commitments contained in the guidelines of (a) the European Spatial Development Perspective (ESDP) and Guiding Principles; (b) for the sustainable development of the European continent as well as the strategic commitments of the regional, state and entity development documents, fully correspond to the general spatial planning objectives in FBiH.

In item 3 of the Spatial Plan (“specific objectives and guidelines for spatial development”), under the “Waste Management” section, it is stated that the following activities must be carried out:

- establish regional centres for waste management in all regions with all the necessary facilities, i.e.
  - build regional sanitary landfills
- prepare a waste management concept (prevention, separation, collection, transportation, final treatment) for all categories of waste
- create conditions for sanitary disposal of capacities for at least 5 years of landfilling in all regions
- establish and operationalize an integrated waste management system at state level, i.e.
  - establish a joint geographic information system (GIS) with data models which will enable monitoring of activities related to waste management
- improve cross-border system of waste transport according to the Basel Convention
- reduce the total generation of waste.

In item 3.2 of the Spatial Plan (“guidelines for spatial development of FBiH related to waste management”), it is stated that the following activities must be carried out:

- identify promotion of waste management as a high priority
- provide continuous insight into waste generation and the mechanisms to minimize and then recover and recycle as much waste as possible in an economically viable manner; treat remaining waste and then disposed of it in a manner that minimizes impacts on the environment
- prioritize raising awareness about the technical requirements for waste management during professional training for all employees working in this field
- raise public awareness about the reasons for adequate disposal of waste through better media coverage
- expand coverage of population by waste transport services
- improve disposal of solid waste at all levels, in order to shift the focus from daily operations at local landfills to building inter-municipal regional infrastructure which would be designed, built and operated in line with the highest standards
- close local landfills and replace them with regional inter-municipal landfills
- develop models by using the Geographic Information System (GIS) that optimizes the development scenario according to what is environmentally and technically feasible and/or necessary, and by calculation of expenses for each of the activities, which is the basis for determining prices that enable cost recovery
- implement the strategic and operational objectives, as well as the action plan for waste management defined in the Federal Environmental Protection Strategy 2008-2018.

The Spatial Plan states that the basic concept of waste management is based on one of the fundamental principles of the Law on Waste Management: the principle of regionality. The principle of regionality means the development of waste treatment and construction of facilities for its disposal in a manner that addresses the needs of the region and ensures the sustainability of facilities. The construction of RSLs is a prerequisite for the systematic solution of waste treatment in BiH. The Solid Waste Management Strategy of BiH defines that waste should be managed at regional level by constructing RSLs.
The “Solid Waste Management” Project foresees the rehabilitation of existing landfills and the construction of new RSLs for disposal of municipal waste. The project is implemented by FBiH and Republika Srpska, through two Project Management Units (PMUs), one for FBiH based in Sarajevo and the other for Republika Srpska based in Banja Luka. The regional concept involves joining of municipalities in the region served by a central regional landfill, whereby each municipality has a developed system of selective waste collection and recycling, treatment and transfer to the sanitary landfill. Waste sorting and recycling create a new economic value, whereas pre-treatment such as waste pressing reduces the need for frequent transportation, thereby reducing costs. Options for joining of municipalities from one canton into a common region may be different. Joining of municipalities in the region is voluntary and does not require the joining of municipalities in the same canton and/or entity. The number and arrangement of regional centres is primarily conditioned by economic factors.

The final Strategy foresees 16 RSLs:
- 10 in FBiH and 6 in RS which would result in an ultimate long-term solution of five major regional landfills throughout BiH.
- The construction of RSLs in BiH is already behind and so far only two sanitary landfills in Sarajevo and Zenica are currently in operation on the territory of the Federation. The problem is the selection and decision of location for the regional sanitary landfill due to the resistance of local communities.
- Development plans (physical and urban development plans) set out the long-term policy of using landfills for 30-40 years and the location should be of such dimensions to be used for a period of at least 20 years. The location must be equipped with public utilities, i.e. water supply, electricity, and sewerage system and road infrastructure. Without this infrastructure the hygienic-sanitary conditions cannot be met or environmental protection and fire protection provided for.
- The establishment of RSLs and the development of an integrated waste management system will enable the implementation of Regional Waste Management Centres (RWMC) around the very landfills.
- During the next phase of the Plan efforts will be made to precisely locate the landfill because it has shown that this process could not achieve the objectives at cantonal level.

An excerpt from the Spatial Plan of the Federation of Bosnia and Herzegovina is provided below.
Figure 1.3: Excerpt from the Spatial Plan of FBiH, 1. Map of land use with construction, agricultural, forest and unused land (original scale 1: 200000)

Figure 1.4. - Excerpt from the Spatial Plan of FBiH, 7. Map of all existing waste dumps (legal and illegal) with categorization (original scale 1: 200000)
2) Spatial Plan for Tuzla Canton 2005-2025

In section I ("Objectives of Cantonal Spatial Development"), under item 2.9. “Other base infrastructure” it is stated that it is important to perform:

- Controlled locating, construction and monitoring of landfill of solid waste from the settlements, or materials from extraction of mineral resources and industrial liquid and solid wastes.

In section II ("Projection of development"), under item 13.2. “Regional landfill and disposal site for hazardous wastes and specific waste”, it is stated that the consequences of improper handling of waste in Tuzla Canton are evident and adversely affect the condition and quality of the surrounding area, most of all by compromising standards of living of citizens and public health.

By the construction of regional landfills for disposal of municipal waste from the area of Canton and by the rehabilitation of existing illegal but official municipal landfills, pressure on the quality of the surrounding area and therefore a danger to life and health of people in the area of Tuzla Canton will be reduced.

This Spatial Plan determines the location of the regional landfill “Lukavačka Rijeka”, which is situated in Lukavac Municipality in the central part of Tuzla Canton, at a distance of about 2.5 km north of the village Huskići. This project was abandoned due to the opposition of the local community (Lukavac Municipality).

The 35.60 ha site is located within the open pit of coal mine “Lukavačka Rijeka” where excavation is not performed, but the purpose of terrain is not altered into a different purpose in the manner prescribed by the Mining Law of Bosnia and Herzegovina. “Regional EKO landfill” Tuzla is designed to accept in the future all municipal and equivalent solid waste in Tuzla Canton in a way that corresponds to European and national regulations.

However, the mentioned landfill for municipal waste will receive waste from 11 municipalities in the beginning: Tuzla, Lukavac, Srebrenik, Gradačac, Gračanica, Doboj Istok, Živinice, Banovići, Kalesija, Kladanj i Sapna. Disposal of municipal waste for the other two municipalities of Tuzla Canton (Teočak, Čelić) due to transportation costs will be dealt with within the regional landfill Bijeljina.

The municipalities Banovići, Živinice and Kladanj signed an agreement in 2012 on establishing an inter-municipal committee for implementation of the RSL project.

Section 15.2.3 (“Protection measures in waste management”) states the following:

Given the current state of waste management in the Canton, the basic goal in terms of reducing the pressure of waste on the environment would be to establish a system for an integral waste management and infrastructure for the whole system of waste management.

Based on this goal, the defined strategic objectives are:

- gradual reduction in the amount of all wastes types at source
- prevention of waste at the site of production (cleaner production program)
- recycling of large quantities of waste and the use of extracted secondary raw materials
- the maximum possible extended coverage of population for the collection and final disposal of waste
- equipping of municipal public utilities with modern equipment and machinery, and strengthening human resource capacities
- remediation and elimination of many illegal landfills
- construction of a Cantonal landfill in accordance with applicable international standards
- phasing out of municipal landfills, their rehabilitation and re-cultivation
- solving the issue of disposal of hazardous and specific waste.
1.3.1. Excerpt from Tuzla Canton Spatial Plan for 2005-2025, with marked location of the planned RSL

After the establishment of inter-municipal cooperation of the Municipalities of Banovići, Kladanj and Živinice who joined together with the aim of solving the issues related to waste management, it was necessary to amend the Spatial Plan for Tuzla Canton in order to include the new RSL for these three municipalities.

The Public Enterprise "Eko-Sep" doo Živinice submitted an application to the Ministry of Physical Planning and Environmental Protection of Tuzla Canton and received the amended extract from the Spatial Plan in which the RSL site is now marked on land plots 643/1 and 637 (cadastral municipality Odorovići), for the purpose of determining land use for the construction of the RSL, identified based on the coordinates of the borders of the future landfill.

In the Spatial Plan (Official Gazette of Tuzla Canton, No. 06/09), the 21 ha site is located in the western part of the Municipality of Živinice, in the populated area Odorovići near the border with the Municipality of Banovići. The river Oskova flows on the western side of the site. According to the Spatial Plan, the site is mainly forest land (eastern part), whereas the western part of the site is agricultural land (third agricultural zone, seventh land capability class). In addition, the site is located within the tailings landfill "Ježevac", as shown in the graph attached to the Spatial Development Projection - mineral resources.

Figure 1.5 shows an excerpt from the graph attached to the Spatial Development Projection, Synthesis of Land Use, with marked boundaries of the RSL site as well as with all other purposes in this and the wider area as determined in the Spatial Plan of Tuzla Canton.

![Figure 1.5. – Spatial plan of Tuzla Canton with marked location of the inter-municipal landfill for the municipalities of Živinice, Banovići and Kladanj - "Separacija 1"](image-url)
The Land Registry Excerpt and Title Deed are provided in the annex to this EIA Study. Figure 1.6. shows a copy of the cadastral plan.

Figure 1.6. – Copy of the cadastral plan for the RSL site

1.4. INVESTMENT OBJECTIVES, AND ECONOMIC AND FINANCIAL ASSESSMENT OF RSL CONSTRUCTION

1.4.1. Investment costs

The estimate of the necessary investments in the construction of the RSL and landfill costs in this point are provided below. The assumption is that the RSL will start operating in 2015. Investment costs are divided into 3 phases. In case of Scenario 1, each phase is 9 years. Therefore, the investment costs are divided into 3 phases categorized by the following time periods:

- Phase I 2015 – 2023
- Phase II 2024 – 2032
- Phase III 2033 – 2040.

Each phase indicates the construction of a certain landfill area at the beginning of the phase which then is filled up during the phase, filling up different cells within the constructed landfill area. Scenarios 2 and 3 will cause less waste on the RSL, and thus the landfill area constructed under the specific phase will last longer.

Necessary investment costs are estimated on the basis of the current market prices for works, equipment and services. Investment costs are categorized according to types of investments and are specified exclusive of Value Added Tax (VAT), in real values. It should be pointed out that the final year includes investments for closure of the landfill and monitoring for 30 years after closing. These investments should already be incorporated in the landfill tariff for waste disposal at the related phase so that the financial resources are available at the end of the phase and before closing the specific landfill area. Total investment costs are shown per phase, but it should be noted that phase 1 requires greater investments in associated facilities, whereas investment costs in subsequent phases are lower.
Table 1.5 shows the estimated investment costs for the construction of the landfill including replacement of vehicles and equipment necessary for operations in case of Scenario 1. A larger amount of replacements investments would become necessary in case of Scenarios 2 and 3, as these include longer phases (source of data: Feasibility Study for Regional Sanitary Landfill - Tuzla Canton, November 2012).

Table 1.6. Estimated investment costs for construction of the RSL “Separacija 1”

<table>
<thead>
<tr>
<th>Investment</th>
<th>Phase I 2015-2023</th>
<th>Phase II 2024-2032</th>
<th>Phase III 2033-2040</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Construction works</td>
<td>5,695,827</td>
<td>1,504,492</td>
<td>2,499,028</td>
</tr>
<tr>
<td>Building construction</td>
<td>176,000</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Roads, manipulative and working surfaces</td>
<td>2,569,089</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Water supply and sewage</td>
<td>718,516</td>
<td>167,376</td>
<td>167,376</td>
</tr>
<tr>
<td>Connection to electricity</td>
<td>30,000</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Fence with entrance door</td>
<td>148,847</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Groundwork</td>
<td>2,384,888</td>
<td>1,337,116</td>
<td>2,331,652</td>
</tr>
<tr>
<td>Equipment</td>
<td>1,244,067</td>
<td>25,733</td>
<td>12,867</td>
</tr>
<tr>
<td>Portable and equipment for measurement, devices, tools</td>
<td>777,400</td>
<td>25,733</td>
<td>12,867</td>
</tr>
<tr>
<td>Construction machinery</td>
<td>466,667</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Other investments</td>
<td>2,525,863</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total by phase, EUR:</td>
<td>8,850,266</td>
<td>1,530,225</td>
<td>2,511,894</td>
</tr>
</tbody>
</table>

Operating costs

For operating cost estimation, all major expenses at the landfill were taken into account.

Material costs include:
- temporary roads
- fuel and lubricants
- power
- water
- maintenance
- other.

Service costs include:
- monitoring during landfill operation
- other services (regular examination of workers, filling of fire fighting devices etc.).

Non-material costs include:
- insurance
- special purpose costs (costs of closing during the last year and post monitoring during 30 years)
- other (transportation, marketing and similar).
2. DESCRIPTION OF THE PROPOSED PROJECT

2.1. CURRENT SOLID WASTE MANAGEMENT IN THE PROJECT REGION

Construction of the RSL is the first step in developing the entire necessary infrastructure related to the waste management system that will one day become a Regional Waste Management Centre (RWMC). For this reason, a reserved area for future expansion is foreseen, on which it will be able to develop all the necessary facilities that form part of the RWMC (sorting plant, composting plant, mechanical biological treatment facility).

During the dimensioning of waste management facilities, as well as labour cost calculations, it is of key importance to correctly define the basic input data, which is the amount of waste that will be accepted at the site. The first part of this chapter provides an overview of the current state of waste management as well as a forecast of waste generation for three types of scenarios:

- **“Scenario 1”** (so called "do nothing" – forecast of the total amount of waste without recycling (separate collection of waste fractions); the predominant method of waste management today).
- **“Scenario 2”**- forecast of the total amount of waste according to the strategic objectives of the Federation (Environmental Protection Strategy)
- **“Scenario 3”**- forecast of the total amount of waste with additional separation of biodegradable waste from total mixed municipal waste flows in order to achieve the quantitative goals of EU Directive on waste for the year 2020.

The target municipalities within Tuzla Canton are the Municipalities of Banovići, Kladanj and Živinice which have joined together to resolve the existing issues related to waste management (Figure 2.1).

![Figure 2.1 – Target municipalities](image)

2.1.1. Current waste collection system

In Tuzla Canton (to which the Municipalities of Banovići, Kladanj and Živinice belong), municipal household waste and non-hazardous commercial/industrial waste is collected in an organized manner and transported to existing landfills.

Organized collection and disposal of waste at landfills are conducted in these municipalities by the following companies:

- Municipality Banovići JP Komunalno“ d.o.o.
- Municipality Kladanj JP “Komunalac” d.d.
Information on waste collection in each municipality, as presented below, has been collected from the utility companies which collect waste. The utility companies have provided this information in the form of responses to the questionnaires on waste management sent by the Consultant during data collection.

**Municipality of Banovići**
Transportation of municipal household waste is performed once a week, and more often in central parts of the municipality. Transportation of industrial waste is performed once a week to 1-2 times monthly, in the course of seven working days.

Service beneficiaries of JP „Komunalno“ d.o.o. collect their waste and bring it to certain locations in 80l and 240l bins or 1,100 litre and 7 m³ containers.

About 60% of households deposit their waste in bins and about 40% in containers. According to the data received from the municipality as well as the utility company, about 63% of population was covered by organized collection of waste in 2011.

There is no separate collection of individual recyclables in the wider area. The following equipment is used for waste collection and transportation:

- special waste collection vehicle - “garbage truck” 2 pcs.
- truck crane for container transportation 1 pcs.

Collected waste is disposed of on the existing landfill “Čubrić”.

**Municipality of Kladanj**
Transportation of municipal household waste is performed 2 or 4 times a week. Transportation of industrial waste is performed once in a month, in the course of 5 working days. Service beneficiaries of JP „Komunalac“ d.d. collect their waste and bring it to certain locations in plastic bags, 50 l-240 l bins or containers with a volume of 1,100 litres as well as 4 and 6 m³.

About 5% of households deposit their waste in plastic bags, 70% in bins and about 25% in containers. According to the data received from the municipality as well as the utility company, about 38% of population was covered by organized collection of waste in 2011.

There is no separate collection of individual recyclables in the wider area. The following equipment is used for waste collection and transportation:

- special waste collection vehicle - “garbage truck” 1 pcs.
- truck crane for container transportation 1 pcs.
- garbage truck 1 pcs.

Collected waste is disposed of on the existing landfill “Stanovi”.

**Municipality of Živinice**
Collection of municipal waste is organized by three companies.

JKP “Komunalno” d.d. collects municipal household waste from the town of Živinice. Transportation of municipal household waste is performed once a week. Transportation of industrial waste is performed at demand in the course of 6 days a week.

Service beneficiaries of JKP „Komunalno“ d.d. collect their waste and bring it to certain locations in plastic bags, 50 l-120 l bins or in containers with a volume of 1,100 litres as well as 5 m³. About 20% of the households deposit their waste in plastic bags, 25% in bins and about 55% in containers.

The following equipment is used for waste collection and transportation:
• special waste collection vehicle - “garbage truck” 3 pcs.
• truck crane for container transportation 1 pcs.

“Rifpost” d.o.o. collects municipal household waste from local communities Stari Đurđevik, Kovači and Podgajevi. Transportation of municipal household waste is performed once a week. Transportation of industrial waste is performed once a week or on demand. The utility company works only on Saturdays.

Service beneficiaries of „Rifpost“ d.o.o. collect their waste and bring it to certain locations in plastic bags, 50l-80l bins or in 1,100 litre containers. About 98% of the households deposit their waste in plastic bags, 1% in bins and 1% in containers.

The following equipment is used for waste collection and transportation:
• dumper truck 1 pcs.
• pick-up truck 1 pcs.

“Akva Invest” d.o.o. collects municipal household waste from other local communities in the Živinice Municipality. Transportation of municipal household waste is performed once a week, in the course of 6 working days a week.

Service beneficiaries of “Akva Invest” d.o.o. collect their waste and bring it to certain locations in 120 l bins or in containers with a volume of 1,100 litres and 7 m3. About 95% of the households deposit their waste in bins and 5% in containers.

50 t of waste paper, 50 t of waste plastic and 30 t of waste nylon was separately collected in 2011.

The following equipment is used for waste collection and transportation:
• special waste collection vehicle - “garbage truck” 1 pcs.
• truck crane for container transportation 1 pcs.

Collected waste from the entire Municipality of Živinice is disposed of on the open pit mine “Višda”. According to the data received from the municipality as well as the utility company, about 80% of the population was covered by organized collection of waste in 2011. According to the Spatial Plan of Živinice Municipality, the existing landfill will continue to be used for a maximum one year.

Conclusion
It may be concluded that all the municipalities in the project region have a registered utility company responsible for waste collection and transportation to landfills. An insufficient number of bins and containers are used for waste collection; therefore part of the waste is still disposed of in plastic bags. From the data received from utility companies, coverage rate of the population is about 72% at regional level. Vehicles used for waste collection and transport are also inadequate. In addition, the landfills currently in operation are in general “dumping areas” on which the waste is disposed of without any plan and order and even without the application of basic environmental protection measures.

The above indicates the need for construction of an RSL that would be constructed in accordance with applicable laws and regulations and where waste would be disposed of in a sanitary manner.
Table 2.1. Analysis of available data

<table>
<thead>
<tr>
<th>Items</th>
<th>Municipalities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Banovići</td>
</tr>
<tr>
<td>Household Waste collection</td>
<td>1x/ week</td>
</tr>
<tr>
<td>Type of collection</td>
<td>Bins 60%</td>
</tr>
<tr>
<td></td>
<td>Containers 40% of households</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Collection of recyclable</td>
<td>No exist</td>
</tr>
<tr>
<td>components</td>
<td></td>
</tr>
<tr>
<td>Equipment</td>
<td>Garbage trucks 2 pc</td>
</tr>
<tr>
<td></td>
<td>Auto-lifter for container transportation 1 pc</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-hazardous commercial/</td>
<td>Non-hazardous commercial / industrial waste that generates in the analyzed region, is disposed at landfills together with household waste. It is estimated that in 2011 on the analyzed area there approximately 1,331 t of commercial / industrial waste has been generated.</td>
</tr>
<tr>
<td>industrial waste</td>
<td></td>
</tr>
<tr>
<td>Biodegradable waste</td>
<td>It is estimated that approximately 4 t of biodegradable waste from public areas was generated in 2011.</td>
</tr>
<tr>
<td>Inert waste</td>
<td>According to information available to authorized services in the region, and according to the received questionnaires on waste management in the region, about 3,297 t of inert waste in 2011 have been generated.</td>
</tr>
<tr>
<td>Bulky waste</td>
<td>According to information received from authorized services companies in the region, and according to the received questionnaires on waste management in the region, about 368 t of bulky waste have been generated in 2011.</td>
</tr>
</tbody>
</table>

(Source of data: Feasibility Study for Regional Sanitary Landfill - Tuzla Canton, 2012).

2.1.2. Waste Quantities in 2013

According to the Law on Waste Management (Official gazette of the FBiH**, No.: 33/03, 72/09), municipal waste is household waste as well as other waste which is similar to household waste because of its nature or composition.

Municipal waste is generated daily throughout the year and is collected through the regular activities of waste transport by utility companies to be disposed of at landfills of non-hazardous waste.

Household municipal waste is generated primarily through food preparation, whereby various types of biodegradable waste and packaging waste are generated, as well as through the cleaning of spaces where people live and work.

In production and/or service related commercial activities, municipal waste is generated primarily depending on the core business of the organisation. It is mostly packaging waste, paper, and waste generated through food preparation and consumption of beverages. Such waste is generated in areas used by employed staff and/or service users.

In 2013, approximately 84,007 residents in approximately 25,909 households were covered by organized waste collection and disposal services.

Table 2.2. – Household coverage by waste collection and disposal services

<table>
<thead>
<tr>
<th>Municipality</th>
<th>Population</th>
<th>Households</th>
<th>Households covered</th>
<th>Coverage in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banovići</td>
<td>23,431</td>
<td>7,665</td>
<td>7,548</td>
<td>98.5</td>
</tr>
</tbody>
</table>
The average coverage rate is 86%.

The quantities of municipal waste disposed of at municipal landfills in the Tuzla region in 2013 is estimated on the basis of data obtained from utility companies in the region and the data provided in the Feasibility Study (Fichtner/IPZ), and are estimated at approximately 21,800 tons. The quantities of municipal waste include all sources of municipal waste (household waste approx. 98.4%, bulky waste approx. 1.5% and others 0.1%).

Table 2.3. – Quantities of disposed municipal waste in 2013

<table>
<thead>
<tr>
<th>Municipality</th>
<th>Total quantities of disposed waste, t/y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banovići</td>
<td>5,868</td>
</tr>
<tr>
<td>Kladanj</td>
<td>2,524</td>
</tr>
<tr>
<td>Živinice</td>
<td>13,409</td>
</tr>
<tr>
<td>TOTAL:</td>
<td>21,801</td>
</tr>
</tbody>
</table>

Based on these data, the specific quantities of municipal waste generated in the analysed area per inhabitant covered by organized waste collection services were calculated for 2013, as follows:

Specific quantity = 21,801 tons x 1000/84,007 inhabitants x 365 days = 0.71 kg / inhabitant / day

Separate waste collection for recycling purposes is carried out to some extent (in the Municipality of Živinice), or not practised at all. According to the Public Utility Company in Živinice, it is estimated that about 130 t/year is collected, mainly plastics (nylon, mixed plastics) and paper.

The estimated composition of disposed municipal waste is shown in Table 2.4.

Table 2.4. – Waste composition in the Živinice region

<table>
<thead>
<tr>
<th>No.</th>
<th>Component</th>
<th>mass%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Paper and cardboard</td>
<td>19.3</td>
</tr>
<tr>
<td>2.</td>
<td>Glass</td>
<td>2.4</td>
</tr>
<tr>
<td>3.</td>
<td>Plastics</td>
<td>18.4</td>
</tr>
<tr>
<td>4.</td>
<td>Metal</td>
<td>1.3</td>
</tr>
<tr>
<td>5.</td>
<td>Wood</td>
<td>2.7</td>
</tr>
<tr>
<td>6.</td>
<td>Kitchen biowaste</td>
<td>10.5</td>
</tr>
<tr>
<td>7.</td>
<td>Garden biowaste</td>
<td>6.0</td>
</tr>
<tr>
<td>8.</td>
<td>Textile</td>
<td>8.0</td>
</tr>
<tr>
<td>9.</td>
<td>Diapers</td>
<td>2.7</td>
</tr>
<tr>
<td>10.</td>
<td>Inert</td>
<td>2.5</td>
</tr>
<tr>
<td>11.</td>
<td>Rubber</td>
<td>0.3</td>
</tr>
<tr>
<td>12.</td>
<td>Special waste</td>
<td>26.0</td>
</tr>
<tr>
<td>13.</td>
<td>Scraps (&lt; 30 mm)</td>
<td>19.3</td>
</tr>
<tr>
<td></td>
<td>Total:</td>
<td>100.0</td>
</tr>
</tbody>
</table>

(Source of data: Feasibility Study for Regional Sanitary Landfill - Tuzla Canton, 2012)

Non-hazardous commercial/industrial waste

Commercial waste materials are generated as part of a special kind of working practices (e.g. in shops, offices, etc.).

Industrial hazardous waste applies to all waste produced in industry, except for those defined by the law (in the defined lists) as hazardous waste.
According to the Law on Waste Management (Official Gazette of FBiH, No. 33/03, 72/09), non-hazardous waste is waste that is not defined as hazardous waste.

This type of waste is typically similar to municipal waste. The production volume affects the amount of non-hazardous waste disposed of in landfills.

According to available data from the Federal waste management plan 2012 – 2017 and the Feasibility study by the Regional waste management centre – Tuzla canton (Fichtner/IPZ Uniprojekt TERRA), it is estimated that companies and legal entities from the viewed area in the Bihać region annually transport approximately 1,400 tons of non-hazardous commercial and industrial waste to landfills.

**Inert waste**

According to the Law on waste management („Official Gazette of FBiH”, No. 33/03, 72/09), inert waste is waste that is not liable to significant physical, chemical or biological changes.

Inert waste will not be dissolved, burnt, biodegraded or otherwise physically or chemically processed, nor will it adversely affect other materials with which it comes in contact in a way that causes environmental pollution or causes harm to human health.

According to available data from the Federal waste management plan 2012 – 2017 and the Feasibility study of the Regional waste management centre – Tuzla canton (Fichtner/IPZ Uniprojekt TERRA), it is estimated that in the area of Živinice in 2013 approximately 2,600 tons of inert waste (soil, rubble) was generated.

### 2.2. FORECAST OF QUANTITIES OF MUNICIPAL HOUSEHOLD WASTE

The estimate of quantities of household waste for the upcoming period until 2040 has been made on the basis of available information on:

- rate of coverage by organized collection and transport of waste from households in the municipalities, according to data from 2011
- data received from municipalities, data from questionnaires on waste management, statistical documents, other relevant institutions and other relevant sources of the estimated population
- estimated increase of living standards
- estimate of trends in the amount of biodegradable, inert and bulky waste for the reviewed period.

Therefore, when assessing the amount of waste to be disposed of properly, and the determination of the required landfill space, the calculations were led by the following assumptions:

- in 2011, about 72% of the population was covered by waste collection services
- there is a positive trend in population growth - increase at an average annual rate of about 0.41%
- the increase of specific quantities of municipal waste generated per capita is estimated at 1.62% in 2012 - decreasing to 1.11% in 2040; thus, the average annual rate is around 1.4% (in line with statistical data)

The amount of **municipal waste** to be landfilled depends mostly on:

- total population and demographic changes
- population covered by organized waste collection and disposal
- the level of personal and social standards
- characteristics of the observed area
- specific daily amount of municipal waste generated per capita
- the level of development of organization of collection of all types of waste, within the households or the wider community
- other factors

The amount of **commercial and industrial** waste depends mostly on:

- the types of economic activities in the area
- total economic activities (economic growth, opening and closing of business entities and production)
- application of the principle of avoiding the generation of waste in production (rational production)
The input data for the projection of the amount of waste for the Živinice region are:

- estimated population covered by waste disposal services: 84,007
- total amount of landfilled municipal waste: 21,801 t mixed + 49 t biodegradable waste; total 21,850 t
- specific amount of communal waste: 0.71 kg/inh./day; 260 kg/inh./year
- the amount of separately collected waste for recycling: 130 t
- average annual rate of change of the total population of the Živinice region: 0.002 % (increase) till 2040,
- increase of the coverage of households with collection and disposal services: in 2014: 88 %, in 2018: 95 % (according to the Waste Management Plan of FBiH)
- average annual growth rate of a specific amount of communal household waste: 2.1 %
- increase of the amount of bulky waste and other types of communal waste: depending on the increase of the specific amount of communal domestic waste
- increase of the amount of biodegradable waste from gardens and parks: depending on the increase of coverage with the waste disposal service
- assumed increase of the waste management service with coverage of 100% to 2040
- increase of the share of separately collected components (paper/cardboard, plastic, glass, metal) waste for recycling: in 2014 2%, in 2019 10% (according to the Waste Management Plan from 2014 to 2019) - Scenario 2
- share of separately collected components (paper/cardboard, plastic, glass, metal) waste for recycling: in 2020 50% (according to the EU Waste Framework Directive) - Scenario 3
- average annual growth rate of commercial and industrial waste: 2.4 %
- separate collection of recyclable waste from the economy: in line with the work policy of each economy subject related to the prevention of waste production (the trend to minimize the production of waste in the incoming period will be applied increasingly)
- the assumed average annual growth rate of inert waste: 1.0 %

Tables 2.5 and 2.6 provide an estimate of the total amount of waste to be disposed of in the analysed area of the Živinice region in the period up to 2040 depending on the scenarios. For scenario 1, according to which the regional sanitary landfill is dimensioned, an overview of municipal and commercial/industrial waste is given.

Although the start of depositing is predicted for 2015, projections of waste amounts are given for the period from 2014 to 2040.

Table 2.5 estimates the total amount of waste for disposal in the Živinice region by 2040 – scenario 1.

<table>
<thead>
<tr>
<th>Year</th>
<th>Municipal waste disposal, t/year</th>
<th>Commercial/non-hazardous production waste disposal, t/year</th>
<th>Biodegradable waste disposal, t/year</th>
<th>Total amount of disposable waste (scenario 1), t/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>22,507</td>
<td>1,447</td>
<td>857</td>
<td>24,812</td>
</tr>
<tr>
<td>2015</td>
<td>23,485</td>
<td>1,486</td>
<td>951</td>
<td>25,922</td>
</tr>
<tr>
<td>2016</td>
<td>24,499</td>
<td>1,525</td>
<td>1,055</td>
<td>27,080</td>
</tr>
<tr>
<td>2017</td>
<td>25,552</td>
<td>1,564</td>
<td>1,171</td>
<td>28,287</td>
</tr>
<tr>
<td>2018</td>
<td>26,644</td>
<td>1,603</td>
<td>1,300</td>
<td>29,547</td>
</tr>
<tr>
<td>2019</td>
<td>27,293</td>
<td>1,643</td>
<td>1,318</td>
<td>30,254</td>
</tr>
<tr>
<td>2020</td>
<td>27,952</td>
<td>1,684</td>
<td>1,336</td>
<td>30,972</td>
</tr>
<tr>
<td>2021</td>
<td>28,622</td>
<td>1,725</td>
<td>1,355</td>
<td>31,702</td>
</tr>
<tr>
<td>2022</td>
<td>29,301</td>
<td>1,767</td>
<td>1,374</td>
<td>32,442</td>
</tr>
<tr>
<td>2023</td>
<td>29,992</td>
<td>1,810</td>
<td>1,393</td>
<td>33,195</td>
</tr>
<tr>
<td>2024</td>
<td>30,692</td>
<td>1,853</td>
<td>1,413</td>
<td>33,958</td>
</tr>
<tr>
<td>2025</td>
<td>31,404</td>
<td>1,897</td>
<td>1,432</td>
<td>34,734</td>
</tr>
<tr>
<td>Year</td>
<td>Municipal waste disposal, t/year</td>
<td>Commercial/non-hazardous production waste disposal, t/year</td>
<td>Biodegradable waste disposal, t/year</td>
<td>Total amount of disposable waste (scenario 1), t/year</td>
</tr>
<tr>
<td>-------</td>
<td>-------------------------------</td>
<td>-------------------------------------------------</td>
<td>---------------------------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>2026</td>
<td>32,126</td>
<td>1,942</td>
<td>1,452</td>
<td>35,521</td>
</tr>
<tr>
<td>2027</td>
<td>32,860</td>
<td>1,988</td>
<td>1,473</td>
<td>36,321</td>
</tr>
<tr>
<td>2028</td>
<td>33,604</td>
<td>2,034</td>
<td>1,493</td>
<td>37,132</td>
</tr>
<tr>
<td>2029</td>
<td>34,360</td>
<td>2,081</td>
<td>1,514</td>
<td>37,956</td>
</tr>
<tr>
<td>2030</td>
<td>35,128</td>
<td>2,129</td>
<td>1,536</td>
<td>38,792</td>
</tr>
<tr>
<td>2031</td>
<td>35,907</td>
<td>2,178</td>
<td>1,557</td>
<td>39,641</td>
</tr>
<tr>
<td>2032</td>
<td>36,697</td>
<td>2,227</td>
<td>1,579</td>
<td>40,503</td>
</tr>
<tr>
<td>2033</td>
<td>37,500</td>
<td>2,277</td>
<td>1,601</td>
<td>41,378</td>
</tr>
<tr>
<td>2034</td>
<td>38,315</td>
<td>2,328</td>
<td>1,623</td>
<td>42,266</td>
</tr>
<tr>
<td>2035</td>
<td>39,141</td>
<td>2,380</td>
<td>1,646</td>
<td>43,167</td>
</tr>
<tr>
<td>2036</td>
<td>39,981</td>
<td>2,432</td>
<td>1,669</td>
<td>44,082</td>
</tr>
<tr>
<td>2037</td>
<td>40,833</td>
<td>2,485</td>
<td>1,693</td>
<td>45,010</td>
</tr>
<tr>
<td>2038</td>
<td>41,697</td>
<td>2,539</td>
<td>1,716</td>
<td>45,953</td>
</tr>
<tr>
<td>2039</td>
<td>42,575</td>
<td>2,594</td>
<td>1,740</td>
<td>46,909</td>
</tr>
<tr>
<td>2040</td>
<td>43,465</td>
<td>2,649</td>
<td>1,765</td>
<td>47,879</td>
</tr>
</tbody>
</table>

Table 2.6 provides the estimated total amount of waste for disposal in the Bihać region by 2040 – scenarios 2 and 3.

<table>
<thead>
<tr>
<th>Year</th>
<th>Total amount of disposable waste (scenario 2), t/year</th>
<th>Total amounts of disposable waste (scenario 3), t/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>24,029</td>
<td>24,029</td>
</tr>
<tr>
<td>2015</td>
<td>25,025</td>
<td>25,025</td>
</tr>
<tr>
<td>2016</td>
<td>26,052</td>
<td>26,052</td>
</tr>
<tr>
<td>2017</td>
<td>27,108</td>
<td>27,108</td>
</tr>
<tr>
<td>2018</td>
<td>28,195</td>
<td>28,195</td>
</tr>
<tr>
<td>2019</td>
<td>28,738</td>
<td>27,160</td>
</tr>
<tr>
<td>2020</td>
<td>29,272</td>
<td>23,895</td>
</tr>
<tr>
<td>2021</td>
<td>29,796</td>
<td>24,313</td>
</tr>
<tr>
<td>2022</td>
<td>30,306</td>
<td>24,730</td>
</tr>
<tr>
<td>2023</td>
<td>30,800</td>
<td>25,146</td>
</tr>
<tr>
<td>2024</td>
<td>31,275</td>
<td>25,560</td>
</tr>
<tr>
<td>2025</td>
<td>31,727</td>
<td>25,972</td>
</tr>
<tr>
<td>2026</td>
<td>32,153</td>
<td>26,381</td>
</tr>
<tr>
<td>2027</td>
<td>32,548</td>
<td>26,788</td>
</tr>
<tr>
<td>2028</td>
<td>32,908</td>
<td>27,191</td>
</tr>
<tr>
<td>2029</td>
<td>33,226</td>
<td>27,591</td>
</tr>
<tr>
<td>2030</td>
<td>33,497</td>
<td>27,987</td>
</tr>
</tbody>
</table>
A table presenting the estimated movements of annual quantities of total municipal waste (household waste) for the period from 2012 to 2040 is given in the Waste Management Plan (an Annex to this EIA Study). It should be noted that the amount of biodegradable, bulky and tourist waste that will be generated in the project area is also included in the total quantity.

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Municipal Waste</th>
<th>Landfill Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2031</td>
<td>33,713</td>
<td>28,378</td>
</tr>
<tr>
<td>2032</td>
<td>33,868</td>
<td>28,764</td>
</tr>
<tr>
<td>2033</td>
<td>33,952</td>
<td>29,144</td>
</tr>
<tr>
<td>2034</td>
<td>33,956</td>
<td>29,519</td>
</tr>
<tr>
<td>2035</td>
<td>33,870</td>
<td>29,887</td>
</tr>
<tr>
<td>2036</td>
<td>33,681</td>
<td>30,247</td>
</tr>
<tr>
<td>2037</td>
<td>33,375</td>
<td>30,600</td>
</tr>
<tr>
<td>2038</td>
<td>32,939</td>
<td>30,944</td>
</tr>
<tr>
<td>2039</td>
<td>32,355</td>
<td>31,280</td>
</tr>
<tr>
<td>2040</td>
<td>31,605</td>
<td>31,605</td>
</tr>
</tbody>
</table>

2.2.1. Waste that may not be disposed of at the landfill

Hazardous waste may not be disposed of at the RSL. According to the Law on Waste Management (Official Gazette of FBiH, No. 33/03, 72/09), hazardous waste means any waste which is covered by separate regulations and which has one or more of the properties causing a risk to human health and the environment due to its origin, composition or concentration, and which is listed in the list of wastes adopted by a separate regulation as hazardous waste.

Landfilling of such waste can lead to:

- groundwater pollution
- outbreak of infectious diseases by surface scattering
- fires and explosions
- air pollution
- site contamination to such an extent that the site cannot be used for a longer period of time.

Hazardous waste includes: acids and alkalis, aggressive slags, galvanizing precipitates, metal hydroxides, filter dust, residues from tempering furnaces, other inorganic toxic wastes, oil and oil derivatives, organic acids and acid tars, phenols, used organic solvents and precipitates, precipitates of paint and varnish and residues in paint production, crop protection agents (pesticides, insecticides, herbicides, fungicides), various chemical wastes, sludge from treatment facilities, radioactive waste, hospital waste, etc.

In addition, sludge and pasty wastes with less than 35% dry matter cannot be disposed of at the landfill, irrespective of the composition of the eluate. Sludge from the wastewater treatment plants in the project in region is not considered in this study.

2.3. CALCULATION OF NECESSARY LANDFILL SPACE

The forecast of waste quantities as well as determination of required landfill area for the period from 2015 to 2040 was elaborated on the basis of data provided in the previous sections. It is assumed that the RSL will be ready for operation by 2015. The applied landfill operation technology and waste composition, which is then subject to microbiological decomposition resulting in landfill settling and accompanying secondary compaction and slides mostly affect the length of the time period in which the stated landfill site can be used for the set quantities of total waste.

Since municipal solid waste has a heterogeneous structured settlement, several models have been developed in order to calculate this effect. The Power Creep Law model (simplified model) indicating time dependent deformity under continuous pressure is applied here.
The following assumptions have been taken into consideration for the estimation of waste quantities and calculation of required landfill space:

- the waste will be compacted with initial average installation value of 0.75 t/m³
- the landfill settlement will progress according to the Power Creep Law due to microbiological composition
- on the basis of the waste settlement model, the landfill body density is estimated at about 1 t/m³
- the presumed quantity of daily cover material amounts to 10 vol%.

Considering that the RSL will in the future become a Regional Waste Management Center, the site will include a reserved space for the facilities planned in the future (waste sorting facility, composting facility, MBT facility, etc.). It is also planned to treat construction waste which can be implemented at the site during the earlier stages.

Table 2.7 presents the estimated landfill volume for each year for the selected Scenario 1, based on the presumption that the regional landfill which will start for operation in 2015.

**Table 2.7: Estimate of required landfill space per year for the period from 2015 to 2040 - “scenario 1”**

<table>
<thead>
<tr>
<th>Year</th>
<th>Waste quantity for the regional landfill t</th>
<th>Waste quantity for the regional landfill, cumulative t</th>
<th>Volume of waste for RSL m³</th>
<th>Cumulative Volume without settlement of covering material m³</th>
<th>Cumulative Volume with settlement of covering material m³</th>
<th>Cumulative Volume with settlement and covering material m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>28,755</td>
<td>28,755</td>
<td>38,340</td>
<td>38,340</td>
<td>38,262</td>
<td>42,088</td>
</tr>
<tr>
<td>2016</td>
<td>30,369</td>
<td>59,124</td>
<td>40,491</td>
<td>78,831</td>
<td>76,220</td>
<td>83,054</td>
</tr>
<tr>
<td>2017</td>
<td>32,074</td>
<td>91,197</td>
<td>42,765</td>
<td>121,596</td>
<td>115,116</td>
<td>126,627</td>
</tr>
<tr>
<td>2018</td>
<td>33,786</td>
<td>125,023</td>
<td>45,168</td>
<td>166,764</td>
<td>155,209</td>
<td>170,730</td>
</tr>
<tr>
<td>2019</td>
<td>34,783</td>
<td>159,806</td>
<td>46,377</td>
<td>213,141</td>
<td>195,381</td>
<td>214,519</td>
</tr>
<tr>
<td>2021</td>
<td>36,649</td>
<td>232,241</td>
<td>48,865</td>
<td>309,615</td>
<td>276,424</td>
<td>304,067</td>
</tr>
<tr>
<td>2022</td>
<td>37,609</td>
<td>268,820</td>
<td>50,146</td>
<td>359,760</td>
<td>317,423</td>
<td>334,165</td>
</tr>
<tr>
<td>2023</td>
<td>38,568</td>
<td>304,408</td>
<td>51,451</td>
<td>409,211</td>
<td>358,802</td>
<td>354,683</td>
</tr>
<tr>
<td>2024</td>
<td>39,526</td>
<td>340,924</td>
<td>52,781</td>
<td>463,992</td>
<td>400,601</td>
<td>440,661</td>
</tr>
<tr>
<td>2025</td>
<td>40,483</td>
<td>376,448</td>
<td>54,137</td>
<td>518,129</td>
<td>442,851</td>
<td>487,136</td>
</tr>
<tr>
<td>2026</td>
<td>41,440</td>
<td>412,900</td>
<td>55,713</td>
<td>573,702</td>
<td>486,385</td>
<td>534,199</td>
</tr>
<tr>
<td>2027</td>
<td>42,406</td>
<td>449,400</td>
<td>57,308</td>
<td>630,140</td>
<td>526,801</td>
<td>581,879</td>
</tr>
<tr>
<td>2028</td>
<td>43,372</td>
<td>486,772</td>
<td>58,955</td>
<td>689,723</td>
<td>572,912</td>
<td>630,203</td>
</tr>
<tr>
<td>2029</td>
<td>44,340</td>
<td>524,112</td>
<td>60,650</td>
<td>749,373</td>
<td>617,455</td>
<td>679,200</td>
</tr>
<tr>
<td>2030</td>
<td>45,310</td>
<td>560,422</td>
<td>62,361</td>
<td>810,445</td>
<td>662,631</td>
<td>726,884</td>
</tr>
<tr>
<td>2031</td>
<td>46,280</td>
<td>596,702</td>
<td>64,112</td>
<td>874,157</td>
<td>708,846</td>
<td>775,311</td>
</tr>
<tr>
<td>2032</td>
<td>48,250</td>
<td>704,952</td>
<td>65,920</td>
<td>939,077</td>
<td>754,976</td>
<td>830,473</td>
</tr>
<tr>
<td>2033</td>
<td>49,220</td>
<td>754,172</td>
<td>67,780</td>
<td>1,005,438</td>
<td>802,186</td>
<td>882,405</td>
</tr>
<tr>
<td>2034</td>
<td>51,190</td>
<td>805,962</td>
<td>69,650</td>
<td>1,073,595</td>
<td>850,117</td>
<td>935,126</td>
</tr>
<tr>
<td>2035</td>
<td>52,160</td>
<td>857,122</td>
<td>71,565</td>
<td>1,143,470</td>
<td>898,788</td>
<td>998,667</td>
</tr>
<tr>
<td>2036</td>
<td>53,130</td>
<td>911,282</td>
<td>73,525</td>
<td>1,215,097</td>
<td>948,419</td>
<td>1,043,641</td>
</tr>
<tr>
<td>2037</td>
<td>55,090</td>
<td>966,372</td>
<td>75,540</td>
<td>1,288,641</td>
<td>998,431</td>
<td>1,096,274</td>
</tr>
<tr>
<td>2038</td>
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<td>1,022,422</td>
<td>77,605</td>
<td>1,363,749</td>
<td>1,049,443</td>
<td>1,154,387</td>
</tr>
<tr>
<td>2039</td>
<td>57,010</td>
<td>1,068,432</td>
<td>79,710</td>
<td>1,440,454</td>
<td>1,101,275</td>
<td>1,211,402</td>
</tr>
<tr>
<td>2040</td>
<td>59,244</td>
<td>1,135,676</td>
<td>81,992</td>
<td>1,519,337</td>
<td>1,153,945</td>
<td>1,269,340</td>
</tr>
</tbody>
</table>

Cumulative amounts of waste in the year 2040 without settlement and covering material (column 5) will lower the intensity of settlement of the landfill under the influence of the weight of the upper layers to lower layers in which the processes of microbial degradation (column 6) occurs. In this volume, however, approximately 10% of overlay material should be added, which in turn indicates that the values from column 7 can be used to estimate the space required by these inputs.
It is foreseen that the RSL will be built in accordance with "scenario 1" in case the recycling targets defined by the Environmental Protection Strategy are not achieved.

If recycling is truly implemented, substantially less waste will be disposed of at the RSL according to "Scenario 2" and "Scenario 3", and the landfill lifespan will be extended.

It should be noted that the RSL will be built in phases so in case of achieving recycling targets, residual waste could be disposed of at the location for many years.

2.4. DESCRIPTION OF PHYSICAL CHARACTERISTICS OF THE ENTIRE PROJECT AND MAP OF THE LOCATION

2.4.1. Description of the site
The RSL site is located on the outskirts of the municipalities Banovići and Živinice, approximately 4 km from the Banovići centre, and approximately 12 km from the centre of Živinice. The location can be reached by regional road R-469 Ribnica-Banovići-Živinice, from which a turn is made into the local asphalted road with a length of 1 km. A 1.2 km gravel road separates from the local road, leading to the entrance to the landfill.

The site is located within the municipality of Živinice, on land marked as parts of land plots number 643/1 and 637, cadastral municipality Odorovidi, on cadastral plots number: 637/2, 637/3, 643/11 and 643/12, all belonging to cadastral municipality Odorovidi.

**Answer to the Committee’s remark:**

The site of the future RSL is located in the far western part of the municipality of Živinice, in the inhabited settlement of Ježevac, which is at a distance of 1.2 km. **On the west side of the future landfill, the Oskova River flows at a distance of approx. 300 m.**

The location that was previously used to dispose of tailings (formerly called the "Ježevac" landfill) from the brown coal mine Banovići covers an area of approximately 13 ha. The total area of the future RSL will occupy a space of 21 ha (Excerpt from the Ownership List). **The location is currently in the possession of the Banovići mine and Cantonal Forests.**

The site is mostly forest land (eastern part), while its western part is agricultural land belonging to the third agricultural zone of seventh land capability category. The surroundings are mainly low forests and overgrowth. Due to the configuration of the site, the location has the possibility of spreading vertically.

The nearest village to the site is the IDP settlement Ježevac. The closest residential building is located at a distance of approximately 500 m (air distance). There are no residential or commercial buildings at the site. The site has no connection to gas, water and drainage system. At the distance of approximately 250 m, there is a transformer station. Surface formations of the cover at the site under consideration, in the greater area of the existing waste-rock/tailings landfill from the wet-separation area, are typical Quaternary eluvial-deluvial genetic types (Q).

The said formations are mostly characteristic of „natural” autochthonous covers, namely the location of parent rock creep which are not in contact with deposited material from the „tailing” residue generated by coal exploitation.

Lithological surface cover units of humus and marly clay, thickness 0.30-1.00m have been recorded at the site. Presence of ground water has not been recorded. However, at the tailing dump site on which tailing residue is being deposited there are recorded sections with wet mud from the separation process.

Considering that the clastic materials from tailing are water impervious, the surface water in the landfill body are being directed towards the Oskova River. Instability processes of deposited tailing have also been recorded, namely at the section towards the Oskova River alluvium (data source: Study on Geomechanical Soil Testing).
Figure 2.2. shows the geographical position of the RSL, and Figure 2.3. shows a satellite image of the orthophoto location of the future RSL, as well as micro and macro locations.

Figure 2.2. – Geographical location of the RSL site (original scale M 1: 25000)

Figure 2.3. – Current appearance of the RSL site (Ježevac tailings pond)
Figure 2.4.- Ortho-photo location of the RSL site (source: Google)

Figure 2.4a.- Macrolocation of the RSL site on a satellite image
Figure 2.5. shows the location plan of the future RSL with marked construction phases.
2.4.2. Purpose of the facility

The purpose of the facility is landfilling of solid waste and industrial waste similar to household waste collected from the analysed area under controlled conditions, i.e. sanitary disposal of waste. Other types of waste cannot be disposed of at this landfill category. Waste would be disposed of at the landfill until the end of 2039, with the possibility of expansion of cells in the reserved area (phase II – Stage 3), which would significantly increase the useful lifespan of the site.

The total area of the planned RSL is approx. 21.0 ha. On this area, the landfill body will occupy 5.85 ha with a maximum height of about 52 m, while the rest of the landfill will consist of an entrance-exit zone, a service centre, a recycling yard, a construction waste treatment zone, an administrative building, green areas and reserved space for the construction of other RSL facilities.

The RSL will be enclosed with a 2.0 m high fence. The fence will be approximately 3,160 m long with a main entrance door with a width of 3.0 + 3.0 + 1.1 = 7.1 m. This phase (phase 1) involves the construction of a part of the fence with a total length of about 1,840 m. The entrance will have a double-wing door, and single-wing door for pedestrians. In the course of construction, temporary container-type facilities will be used for the needs of the contractors.

For the weighing of waste that will be transported to the landfill, a permanent electromechanical weighbridge with a capacity of 60 tons and 18 m in length will be placed with a canopy above the weighbridge, and a guard house (container type) will be placed.

After closing, the landfill body itself will be a green surface with a maximum height of about 52 m with a side slope of max. 1:2.5. On the closed landfill body, and along the fence, grass will be is sown, i.e. planting of shrubs and autochthonous plants, which will represent both a visual and a protective buffer zone towards the surrounding terrain. Along the fence, it is recommended to plant a thorny hedge to achieve greater safety and to prevent a view of the landfill.

PHASE 1 (figure 2.5.)

Stage 1:
- building an entry-exit zone (front door, weighbridge with a weighbridge house, and oil and grease separator and sedimentation tank)
- building a fence around part of the landfill
- building an administrative building and associated parking lot for passenger vehicles
- building a service centre with associated plateau
- construction of internal roads
- building the first part of the landfill surface for disposal of waste with a system for collection and recirculation of leachate and passive degassing system
- building a discharge canal around a part of disposal cells
- building a discharge canal around the landfill
- building a collector/tank to collect rain water
- building a platform for cleaning of vehicles
- building a water supply network
- building a sewage and electrical power supply network
- purchase of work machines
- building a construction waste disposal cell

Stage 2:
- building a recycling yard with associated canopy

Stage 3:
- building a construction waste disposal cell

Stage 4:
- building/installing a flare for burning of landfill gas (in 2021, or five years after the commissioning of the RSL)
Stage 5:
- building the remaining part of landfill disposal cells

Stage 6:
- Partial closure of the landfill final cover layer

**PHASE 2:**
- Building a mechanical biological treatment (MBT) facility in the reserved part of the site, and construction of the remaining part of fence around the landfill site
- Building a composting plant for processing organic waste in the reserved part of the site
- Building cells for disposal of waste with a system to collect leachate in the reserved part of the site and a channel for collecting rain water
- building a sorting facility in the reserved part of the site
- building a transfer station in the Municipality of Kladanj with all the necessary equipment (truck trailers) and equipment necessary for the operation of the station. Kladanj is required to provide a suitable location to accommodate the loading bay area of about 5,000 m²
- building a transformer station

The area of the reserved surface for this phase is approx. 8.7 ha.

**PHASE 3:**
- building/installing a facility for processing of leachate and sanitary wastewater in the reserved part of the site

The area of the reserved surface for this phase is approx. 0.02 ha.

**PHASE 4:**
- building/installing the system for the production of electricity from landfill gas in the reserved part of the site

The area of the reserved surface for this phase is approx. 0.03 ha.
2.5. DESCRIPTION OF PLANNED FACILITIES WITHIN THE RSL

2.5.1. Construction of facilities adapted to the regional concept of waste disposal

All facilities serving for proper and safe operation are to be located at the regional sanitary landfill site. All facilities are to be constructed with consideration of EU Directives. All the facilities that will have to be built in order to comply with the EU Directives are foreseen in the reserved space.

As stated above, the RSL is divided into the following areas:
- entry-exit zone
- waste disposal zone – operational zone
- landfill surrounding zone
- others
- reserved area.

The total area of the regional sanitary landfill within the fence is approximately 21.0 ha.

Figure 2.6. provides a location plan of the RSL with the disposition of the facilities.

Figure 2.6. – Location plan of the future RSL with the disposition of the facilities
2.5.1.1. Entry-exit zone with accompanying facilities

The entry-exit zone includes all facilities foreseen for operational staff and equipment. These are: the entrance gate, the staff building, septic tank for sanitary wastewater, the garage, two weighing bridges with a canopy and port, the washing platform for vehicles and equipment, parking place and recycling yard.

- The entrance gate has a total width of 6 m and consists of a double door for the driveway and a gate for pedestrians (1 m). The gate must be lockable.
- The staff building is a masonry facility.
- Parking place – it is necessary to provide about 10 parking spaces within the entry-exit zone.
- Sanitary wastewater from sanitary facilities has to be collected in a closed watertight septic tank with a capacity of 90 m³. The wastewater from the septic tank must be emptied by suction tankers for discharge to the city sewers.
- The RSL will be equipped with a weighbridge with a length of 18 m. A canopy and a prefabricated control container which will also serve as a guardhouse are planned to be placed beside the weighbridge.
- The platform for washing vehicles and equipment should be reinforced concrete. An integral part of this facility is an oil separator with sedimentation and storage chamber.
- Recycling yard is a specially designed facility for sorting and temporary disposal of certain wastes, such as: paper, cardboard, glass (straight and packaging), metal products, metal and PET recycling, bulky waste, tires, electrical and electronic waste, Styrofoam and others at the recycling yard will set the appropriate containers for separate collection of certain isolated components, automatic press-baler and temporary storage of hazardous waste.
- service centre
- administrative building

The entry-exit zone will have the following facilities and areas:

- guardhouse
- weighbridge
- canopy above the weighbridge
- oil and grease separator and sedimentation tank

The guardhouse and weighbridge house is foreseen as a prefabricated facility, container type, measuring 3.0 x 2.5 x 2.6 m, with an area of 7.5 m². The facility is located on reinforced concrete plateau, about 0.96 m high. The plateau is rectangular, with a layout of 2.5 x 1.5 m, with a 1.55 x 1.20 m access staircase.

Directly next to the guardhouse is the weighbridge space. Receiver of cargo measures 3.1x18.0 m, and is covered with a metal canopy with a ground plan area of 10.0 x 20.5 m and a height of about 6.14 m.

One weighbridge (for input and output) will be placed, with a capacity of up to 60 t. Thus, the overall mass of waste transported to the RSL will be regularly monitored and recorded.

Storm water that occur on asphalted and concrete handling areas (storm water from internal roads and work surfaces) can be contaminated with oil and grease as well as other soluble inorganic substances, and they must be collected and treated in an oil and grease separator and sedimentation tank, and then discharged into the surrounding terrain. The planned oil and grease separator and sedimentation tank has a volume of 35,000 l and a flow of 150 l/s for treatment of storm water from asphalted and concrete surfaces of the recycling yard plateau, entry-exit zone, service centre and administrative building.

Figure 2.7. shows the location plan with the marked entry-exit zone and disposition of the accompanying facilities.
Figure 2.7. - Location plan of the entry-exit zone with the disposition of accompanying facilities

Figure 2.8. shows the container-type guardhouse/weighbridge house.

Figure 2.8. – Guardhouse/ weighbridge house

Figure 2.9. shows the weighbridge with a canopy.
Figure 2.9. – Weighbridge with a canopy

Figure 2.10. shows a standard oil and grease separator and sedimentation tank.

Figure 2.10. – Standard oil and grease separator and sedimentation tank
**Plateau for washing vehicles**

The plateau for washing vehicles (Figure 2.11.) will be built as a concrete pavement with a thickness of 20 cm in two layers, with 400 kg of cement per 1 m³ of built-in concrete, and water will be drained through the primary settlement tank into the oil and grease separator and tank. Dimensions of the plateau are 10.0 mx 6.0 m = 60.0 m². The plateau will be levelled with the traffic area with a drop towards the water catchment area.

![Plateau for washing vehicles](image)

*Figure 2.11. – Plateau for washing vehicles*

**2.5.2. Waste disposal area - landfill body**

The waste disposal area (working zone) is the disposal area – cell where waste is disposed of in line with the planned technology. The RSL will have two disposal areas for waste disposal, to be constructed in two stages.

Figures 2.12. and 2.13. show the location plan of the prepared landfill in stages (stage I and stage II).

![Location plan of the landfill in stage I](image)

*Figure 2.12. – Location plan of the landfill in stage I*
The landfill bottom must be constructed as impermeable with a leachate collection and degassing system. The area for waste disposal covers approximately 6.7 ha.

At this stage, the cells are dimensioned to meet disposal needs during 25 years (2015-2040).

Table 2.8. - Capacity of controlled landfill of non-hazardous waste

<table>
<thead>
<tr>
<th>LANDFILL BODY</th>
<th>CAPACITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAGE 1</td>
<td>380,000</td>
</tr>
<tr>
<td>STAGE 2</td>
<td>720,000</td>
</tr>
<tr>
<td>TOTAL:</td>
<td>1,100,000</td>
</tr>
</tbody>
</table>

The basic parts of the landfill of non-hazardous waste are:
- first level capping layer,
- perimeter and separation dike,
- leachate collection system,
- biogas extraction/collection system,
- temporary capping layer,
- final capping layer,
- surface water drainage system.

The final capping layers described in the following chapters within the description of the stage in which it will be built. It is necessary to build the landfill base and sides in a manner that ensures the stability of the landfill and placement of the sealing liners and drainage layers. A sealing liner must be placed on the landfill base and sides. At the landfill of non-hazardous waste, leachate drainage must be ensured through the drainage layer and leachate collected outside the landfill body. The drainage layer must be at least 50 cm thick. Collected leachate must be treated before discharge into the receiver, according to the regulations on water protection. The entering of waste into the drainage layer must be prevented by acceptable technical solutions.

The sealing liner at the landfill of non-hazardous waste consists of a mineral layer - a bentonite liner (GCL) that is placed on a layer of earthen material with characteristics similar to clay, with a thickness of 50 cm. The mentioned bentonite liner must minimally have 1 m clay characteristics with a permeability coefficient of $k = 10^{-9} \text{ m/s}$. HDPE foil is placed on the bentonite liner. Protective 1,200 g/m² geotextile and drainage pipes are placed on HDPE foil, followed by a drainage layer for leachate with a thickness of $> 50$ cm. Waste is deposited on the drainage layer. The following composition and thickness of the bottom sealing system (from the most bottom layer upward) have been selected:
- layer of earthen material with characteristics similar to clay, with a thickness of approx. 50 cm
- bentonite liner (GCL), k 10-9m/s
- HDPE foil with a thickness of 2.5 mm
- protective geotextile 1,200 g/m²
- drainage layer for leachate >50 cm (stone layer 8/32)

The leachate collection and discharge system will be constructed in a form of a network consisting of set of lateral HDPE pipes connected vertically to the main collection HDPE pipes.

The scheme of pipeline placement will also be applied to the drainage layer for leachate water.

The pipelines will be placed inside a sand layer and covered for the purpose of protection against small gravel. The end/exit point of discharge pipes will be HDPE prefabricated manholes located at the lowest elevation point (of the landfill). From this point the leachate will be piped to a leachate basin and later on (in the phase III) to a treatment plant.

After the first level capping layer is placed, the landfill will be equipped with a drainage and leachate collection system for each sector, consisting of a network of slotted pipes placed on the first level capping layer, enabling leachate to flow towards the intercepting sewer due to gravitation.

Surface water will be generated on the landfill perimeter. **Surface water will be collected** by a canal around the edges of the landfill, which would collect conditionally clean storm water.

It is also planned to build temporary canals around individual modules in order to prevent the run-off of storm water from the surrounding terrain, which will be defined by the Main Design. Triangular side ditches are also planned on the surface of the closed parts of the landfill in order to reduce the amount of leachate produced at the landfill. Furthermore, the capping layer is designed as a drop so that the majority of storm water can be discharged from the surface of the landfill by the shortest route. Since all waste will be covered by an impermeable mineral layer, there is no possibility of direct contact between contaminated water from the landfill with the water in the perimeter canal. Nevertheless, quality of water in the canal will be controlled. All of the thus collected storm water will be discharged into a natural recipient.

The following chapters provide a detailed description of the selected technological procedure for waste disposal, as well as the preparation of the landfill site.

### 2.5.3. Landfill surrounding zone

The zone represents a buffer zone surrounding the landfill, limiting the entry of unauthorized persons, preventing the uncontrolled waste disposal and spreading of dust. This zone includes a fence, perimeter canals, fire road (service road), green area, collection tanks for leachate collection and leachate collection lagoon.

- The fence prevents entry of unauthorized persons as well as domestic and wild animals. The height of the fence wire is 200 cm. With the fence is advisable to plant a thorny hedge.
The perimeter canal collects the surface water flowing off from the closed parts of the landfill and will be designed according to the gravitation of the surrounding terrain. It is foreseen to be built in a concrete trapezoidal channel shape.

The fire road (service road) will be built with a width of 5.5 m around the area of the landfill body, allowing fire-fighting access around the entire landfill body.

In the green area indigenous plants shall be planted.

Leachate from the landfill drainage system will be led into concrete waterproof tanks (250 m³). Water in these tanks can also be used for fire-fighting purposes. The ground plan area dimensions of the collection tank are 7.6 x 15.6 m, and the total depth is about 3.4 m. The tank will be made of waterproof reinforced concrete of C30/37 class and will have two openings. From the tank, leachate will be recirculated on the landfill body by using submersible pumps during the first 5 years. In phase 3 of landfill operation, it is planned to build a leachate treatment plant.
Collection/sedimentation tank for storm water collection: storm water will be collected through a perimeter canal into a waterproof tank for storm water collection, with a useful volume of about 700 m³. The ground floor area dimensions of the tank are 25.8 x 10.6 m, and the total depth is 4.3 m. The tank will be made of waterproof reinforced concrete of C 30/37 class. The tank will have three partition walls that will serve to calm water flow and as a sedimentation tank for any resulting suspended particles in the perimeter canal. Water from the tank will also be used as industrial water for needs of landfill operation. After settling, the water be discharged into the surrounding terrain.

2.5.4. Other facilities at the landfill

- Permanent roads. Along the landfill body there will be a gravel road which is also the firefighting access to the landfill body. The width of the firefighting access is 5.5 m, with a 0.5 m shoulder on both sides.
- Temporary roads. In order to ensure the transport of waste to the working field it is necessary to build internal (temporary) roads. These will be gravel roads, but construction waste, debris etc. can be used, in combination with artificial materials. Since these roads will be located on poor loadbearing soil, it is recommended to use a sandwich layer, i.e. geosynthetics (geotextiles and net), and crushed stone. They will
be built-in parallel with expansion of the landfill. In order to ensure the movement of the trucks, the maximum permitted inclination will be 10%. Width of the roads is 3 to 6m. It is necessary to build perimeter canals as well. These roads are not permanent and will be covered by waste or recycled.

- The transport of vehicles bringing waste must be limited to the landfill site in accordance with the type of vehicle and its speed. For this reason, traffic signs will be placed at places where it is necessary.
- Water supply will be provided from an underground tank through a hydroblock.
- Electricity will be provided by connection to an electric generator.
- A wastewater treatment plant will be built at the location of the RSL; it is planned to be built in the third phase.
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- Water supply will be provided from an underground tank through a hydroblock.
- Electricity will be provided by connection to an electric generator.
- A wastewater treatment plant will be built at the location of the RSL; it is planned to be built in the third phase.

The flare for burning of landfill gas will ensure the protection of the environment as well as human health from uncontrolled emissions of landfill gas. During the burning of landfill gas, there will be no harmful products of combustion, since these will be standard flares as prescribed by the EU Directive and which are dimensioned with all the necessary environmental protection measures. The flare will be built on the site after 5 years of landfill operation.

The space for construction waste treatment is foreseen on part of the site and would be used for accepting and treating construction waste. The following types of waste materials will be accepted at the RSL: concrete, reinforced concrete, stone, asphalt, brick, tile and plaster. The following types of waste materials would not be accepted: mixed construction waste, construction carpentry, ceramic tiles, earth material etc. It is possible to use a mobile crusher at the site. The type and capacity will depend on the type of material treated.

- Green area will be used to separate the landfill from the surrounding space. Along the perimeter of the landfill, young trees and bushes will be planted, and the ground will be grassy. Trees and grass should be planted in closed parts of the landfill as well.
- System for the production of electricity from landfill gas (phase 4)

Figure 2.18. shows the location plan with other facilities planned within the RSL.
2.6. AREA WITHIN WHICH OTHER PLANNED RSL FACILITIES WILL BE BUILT

The RSL and the planned functional facilities will occupy an area of about 21 ha. The RSL will consist of the following functional units (structures, buildings, areas):

1. Administrative building (about 206 m2) with a parking lot for passenger vehicles (about 360 m2) and a buried tank for liquefied petroleum gas (about 7 m2)
2. An open-type recyclable yard (about 0.11 ha), with a canopy (about 130 m2) and a concrete surface (about 190 m2)
3. Service centre with garage, workshop, rooms for workers (about 334 m2) and associated asphalt plateau and parking lot for freight and passenger cars (about 1.670 m2)
4. Tank for industrial water with a hydroblock shaft (about 45 m2)
5. Landfill for non-hazardous waste with a system for collection of storm water and leachate (about 5.85 ha)
6. Area for recycling and treatment of construction waste (about 0.30 ha)
7. Reserved space for the plant for treatment of sanitary wastewater and leachate (0.025 ha)
8. Reserved space for facilities for processing and exploitation of landfill gas (about 0.03 ha)
9. Reserved space for MBT plant, compost plant for biodegradable waste treatment, waste disposal cell, waste sorting line and transformer station (about 8.7 ha)

2.6.1. Administrative building

The ground plan dimensions of the administration building are 16.20 x 12.70 m with an overhang at the entrance of 1.50 x 4.20 m, and a height of 7.38 m. The gross area of the administrative building is about 205.74 m2, while the net usable area is about 170.10 m2. The gross volume of the building is about V = 953 m3.

The administrative building is intended for the work of managerial and administrative staff, which will operate the RSL on a daily basis. Within the administrative building, there are sanitary facilities and bathrooms for the staff. The central RSL control system will also be located in the administrative area. Within the administrative space, a parking lot is planned with 10 parking spaces for personal vehicles, one of which is intended for persons with reduced mobility. The parking lot for personal vehicles is located on a surface of about 360 m2.

Storm water will be evacuated from the parking lot using vertical and horizontal slopes inclined towards the manholes, from there to the oil and grease separator and after treatment to the a natural recipient. The facility will be connected to the industrial water tank. Wastewater will be collected in a collection tank for collection of sanitary wastewater with a capacity of about 90 m3, made of waterproof concrete, located outside the facility as shown on the location map below.

Electric energy will be supplied by a connection to the electric generator. The electrical installations will be carried out in accordance with technical regulations and standards, and will be protected by lightning rods.

*Biomass/pellets should be planned for heating, as a domestic and environmentally friendly product.* - correction in line with the Committee’s remark.
2.6.2. Service centre

The ground plan dimensions of the garage for servicing of vehicles with a workshop are 16.90 x 19.75 m, and the height is about 7.0 m. The gross area of the building is about 333.78 m², while the net useful surface is about 298.0 m². In terms of construction, the service centre is a solid, prefabricated facility intended for servicing of work machines and vehicles.

Heating will be provided by gas appliances using liquid petroleum gas (LPG), while cooling will be provided via electrical air conditioners (split system). The LPG storage tank is located near the administrative building. The tank is underground.

An industrial water tank will be used at the facility. Wastewater will be collected in a sanitary wastewater collection tank with a capacity of about 90 m³, made of waterproof concrete, located outside the facility as shown on the location plan.

The facility will be supplied with electricity by connection to an electric generator. The electrical installations will be carried out in accordance with technical regulations and standards, and will be protected by lightning rods.

In the garage for servicing of vehicles and machines, it is planned to service vehicles (trucks) for transport of waste from a greater distance (transport of waste from transfer stations) and machines used within the RSL (bulldozer, compactor, etc.). The garage for trucks and machines is located right next to the road that is connected with the landfill area and the entry-exit zone. In this manner, the used machines will need to go as short as possible a route at the end of the work day, thereby minimising the chance of possible damage to the roads.
There will be no division of individual services in the workshop. In case of major machine defects, it will be possible to outsource special services for the necessary repairs. The workshop will have a service pit. With its technical equipment and the planned number of employees, the workshop will be able to provide services of simultaneous repair of a working machine or truck, which are necessary for the operation of the RSL. When servicing these machines, waste oils will be collected in a separate container, specially designed for this purpose.

Other waste material generated by repairs or servicing of machinery (e.g. packaging, cloths, filters, etc.) will be collected in special containers and sent for treatment (disposal).

It is necessary to provide space for storage of spare parts and consumable technical goods. Within the workshop, it is necessary to provide office space, lunch space, dressing room, sanitary facilities, dressing rooms and showers for the workshop staff.

The service centre also has a traffic and handling area which is an asphalted plateau covering approximately 1,670 m2 while the gross area of the building is about 333,78 m2. As part of the asphalt plateau within the service centre, 4 parking spaces for freight vehicles and 4 parking spaces for personal vehicles are planned.

Figure 2.20. – Service centre (ground plan)
2.6.3. Recycling yard

Recycling of waste is an important sub-system of a comprehensive waste management system with multiple benefits, from preserving natural resources by protecting them from excessive exhaustion and pollution, to raising environmental awareness among the population.

The primary function of the recycling yard is the temporary collection and storage of useful waste and part of harmful waste that is generated in the gravitational area, i.e. waste from households, small craft shops and the tourism industry. It should be taken into account that only those waste materials for which shipment for treatment purposes is provided are collected separately. An integral part of this facility is an oil separator with a sedimentation tank.

Right next to the transport centre and the entry-exit zone, there is a planned area of about 1,100 m² for an open-type recycling yard (citizens can bring their own recyclable material). The plateau of the recyclable yard will have standard metal canopy. The ground plan dimensions of the canopy are 10.0 x 13.0 m, the total gross area is about 130.0 m², and the total height is about 7.6 m. The roof of the canopy is a trapezoidal sheet.

On the plateau of the recycling yard, it is planned to build a reinforced-concrete pavement for accommodation of roller containers of approximately 190 m². Storm water will be evacuated from the recycling yard using vertical and horizontal slopes inclined towards the manholes, from there to the oil and grease separator and after treatment to a natural recipient. The following illustrations show examples of containers and bins used for the mentioned purposes (Tehnix, Catalog of products and plants, 2012).

The fractions to be collected are:
- Paper and cardboard of all types, including waste paper packaging,
Glass of all sizes and shapes, including waste glass packaging,
- Plastics, including waste plastic packaging or similar material,
- Metal waste,
- Wood, including waste wood packaging,
- Textile,
- Bulky waste,
- Clothes,
- Green waste,
- Construction waste.

For the purpose of easier disposal of the transported waste, the recycling yard will be built at two levels. The waste is delivered to the upper level, and the containers are in the lower level. The entire area around the recycling yard should be asphalted and designed for movement of trucks and other machinery.

![Recycling yard diagram](image)

**Figure 2.22. – Recycling yard**

### 2.6.4. Composting plant

A composting plant in which green waste from public areas will be processed can be installed at the site (in the part of the reserved space) within the future Waste Management Center.

A brief description of the composting plan is provided below.

**General description of biological treatment of waste**

The purpose of waste treatment with aerobic biodegradation (the term composting is also often used) is most frequently the conversion of unstable organic matter into a stable end product. Composting can generally be described as an exothermic aerobic process of organic matter decomposition (substrate).

The substrate (solid waste) is decomposed in a longer or shorter period of time, depending on the selection of the technological process and the characteristics of the input waste, whereby a dark brown grainy product...
resembling humus is produced. The compost thus obtained can then be used to improve the quality of soil that is distinctly clay or sandy.

It can also be used to fill different holes, to decorate the landscape, and depending on the quality of compost it can be used for both horticulture and agriculture, or as a soil for everyday covering of waste at sanitary landfills.

Microorganisms participating in the microbiological degradation process are bacteria, fungi, yeasts and actinomycetes. Although each of these groups is capable of degrading all raw materials in biodegradable waste, each group has an affinity for certain waste components.

In order to properly conduct the process of biological treatment of waste, certain parameters must be satisfied: particle size, temperature, humidity, air (oxygen supply), pH value, reversal, C/N ratio, structural material.

Composting of waste can be carried out through various technologies including:

<table>
<thead>
<tr>
<th>Composting type</th>
<th>Quantity of composted material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static pile composting</td>
<td>50 to 1,500 tons/year</td>
</tr>
<tr>
<td>Aerated windrows</td>
<td>Up to 25,000 tons/year</td>
</tr>
<tr>
<td>Simple channel tunnel system</td>
<td>Up to 100,000 tons/year</td>
</tr>
<tr>
<td>Complex channels and vessel systems</td>
<td>Up to 250,000 tons/year</td>
</tr>
</tbody>
</table>

Various composting technologies have been widely researched, and information is available through many sources. Some of the most common technologies are passive static pile composting and windrow composting. Each of these techniques has its advantages and disadvantages, and there are many variations that work well.

Raw material preparation is an important step in which the raw material is prepared before leaving the warehouse. During the preparation of the raw material, the properties of the raw material can be changed both physically and chemically. The changes made at this stage will optimize microbial performance during the composting phase. Depending on the type of collection system used, it is important to have the surface of the facility available for the raw material.

During this phase of your work, it is necessary to:
- Remove of pollution or other non-recoverable materials,
- Reduce particle size to increase the total area of the raw material and allow for better ventilation,
- Adding carbon or nitrogen to obtain the desired C:N measures,
- Add moisture to the moisture material to an acceptable level for microbial life,
- Add filler to increase air flow through the material (wood or straw).

Smaller particles allow for enhanced microbiological activity and decompose in a larger proportion. Microbiological activities occur on the surface of the particles, and the surface of the large particle is only a fraction of its total volume.

The size of the particles should be from 25 mm to 50 mm. Particles of this size will be subjected to strong microbial activity as well as expose them to the optimum amount of oxygen and moisture. A suitable particle size can be achieved by mechanical devices to reduce material to an acceptable size. A shredder can be used to reduce particle size. Shredders or grinders usually consist of a rotating drum with several teeth welded to it, and the teeth pass through the drum to rotate. The windrow can be formed using a variety of technologies and practices. Most are usually formed by means of a skid steer loader to accumulate material.

Ventilation of the windrows is a natural or passive way of moving the air (convection). Porosity in the windrows will determine the air change. Figure 2.23 shows an example of windrow composting using a vertical rotating machine, and Figure 2.24 shows a compost rotator.
2.6.5. Plateau for receiving and processing construction waste

In the first phase of RSL operation, it is possible to build a construction waste plateau where certain construction waste would be received and treated. Construction waste refers to waste generated during construction, reconstruction, repair or demolition of residential, commercial and other facilities, and waste generated during the construction of roads.

The following types of waste materials will be accepted at the RSL: concrete, reinforced concrete, stone, asphalt, brick, tile and plaster. The following types of waste materials would not be accepted: mixed construction waste, construction carpentry, ceramic tiles, earth material etc.

The basic operations in the treatment of construction waste are:
- weighing and entry control (at the entrance)
- referring to the place of unloading
- control during waste unloading
- crushing of building materials
- separation of metals
- screening of construction waste
- disposal of materials depending on the type and granulation in the dedicated space
The operation technology in construction waste treatment plants is separation and/or pre-treatment of basic usable components for further procedure or disposal. The basic operations in dealing with construction waste are:

- Collection and disposal of previously roughly separated and sorted construction waste
- Previous processing or recycling of construction waste
- Further production of materials and products of higher use value from raw materials obtained by recycling construction waste.

A mobile crusher can be used at the location. The type and capacity will depend on the type of material being processed. Since it is a mobile facility, it can be used on other locations within or outside the project area where construction, reconstruction and demolition of obsolete facilities - buildings or at wild dump sites which are planned for remediation. Processing is carried out by pouring the construction material through a grate into the crusher with the help of a loader, after which it is crushed, and then transported to a sieve by a conveyor belt, where different fractions/ granulations are obtained.

Recycling (recovery) of construction waste results in a series of "new materials". These are sorted materials (wood, plastics, cardboard, metals, etc.), granulated materials, asphalt, fine mineral waste etc. Granulated materials can have various applications in construction. They are used for the construction of noise protection embankments on highways, construction of lower layers of roads, improvement of substrate characteristics, soil bonding in non-bonding layers, roadway fixing, arrangement of parking areas and sports grounds, winter and similar road laying, soil improvement, concrete production and others.

Figure 2.25 shows a scheme of the area for the acceptance and treatment of construction waste.
During the further development of these two concepts, taking into account the fact that the RSL site is located in the area between Banovići and Živinice, only the concept of direct transportation of waste was applied, without a TS. It should be noted that the overall transport analysis was based on the estimated amounts of waste (excluding inert waste), as well as other data. (Data source: “Feasibility Study for RSL”).

Road connection:
The site can be reached by the regional road R-469 Živinice-Medaš from which it turns to a local asphalted road, about 1 km long. From the local road, a 1.2 km gravel road leads to the entrance to the landfill. The gravel road width is approx. 5-7 meters and needs to be improved in terms of width and road surface. The planned reconstruction of the road is not the subject of this Study, and was also not the subject of the Preliminary Design. It is also necessary to build a new road bridge over the Oskova River.

2.8. WORKFORCE

For normal operation of the RSL in the first phase, first shift operations are planned, whereas only security guards will work in the second and third shift. A total of 14 workers are planned.

The landfill will operate in the first shift.

The following workforce is necessary for the landfill operation:

- manager of the landfill, zone for construction waste treatment, service centre and recycling yard: 1 university or post-secondary education graduate (1st shift)
- machinist (work machine driver): 2 qualified workers (1st shift)
- scale worker (entrance control): 1 qualified worker (1st shift)
- assistant worker (also the guard in the 1st shift): 1 qualified worker (1st shift)
- guards: 2 semi-qualified workers (2nd and 3rd shift)

It should be noted that the employee responsible for the landfill must have at least VII/1 degree of qualifications (university degree) in technical or chemical/technical studies. He/she does not need to be present at the landfill at all times. Manager of the landfill controls the implementation of defined protection measures and manages the work in accordance with the technological design.

The machinist needs to ensure that the transported waste is unloaded at the designated place and is managed accordingly. The scale worker records the vehicles and controls entry, and the assistant worker is in charge of washing the truck wheels with a high pressure cleaner before leaving the landfill. He/she is also responsible for cleaning the plateau of mud and garbage, and also controls the levels in the oil separator and collection pools. He/she is also responsible for guarding the landfill during the 1st shift. The guards in the second and third shift are responsible for safeguarding of the landfill. The following workforce is planned to work in the business premises of the administrative building (this can be modified):

- director: 1 university or post-secondary education graduate (1st shift)
- economist: 1 university or post-secondary education graduate (1st shift)
- ecology engineer: 1 university or post-secondary education graduate (1st shift)
- secretary: 1 secondary education graduate (1st shift)

The planned workforce for the operation of the recycling yard is the following:

- assistant worker: 1 qualified worker (1st shift)

The planned workforce for the operation of the service centre is the following:

- mechanic worker, electrician: 1 qualified worker (1st shift)
- assistant worker: 1 qualified worker (1st shift)
The planned workforce for the operation of the construction waste treatment zone is the following:

- assistant worker (recycling yard worker): 1 qualified worker (1st shift)

Accordingly, 7 employees are necessary for landfill operation, 4 employees in the administration building, 1 employee at the recycling yard and 2 employees at the service centre. The number of employees (14 in total) refers to the first phase of the landfill.

In case of illnesses and during holidays, replacement employees should be organized if the existing number of employed staff cannot meet the needs of proper operation. All employed workers must complete a course of safety at work, and workers dealing with waste must also be trained in the field of protection against fires and explosions. All workers must be able to identify the basic types of hazardous waste that cannot be disposed of at the landfill.

Mobile phones will be used to communicate with the utility company.

2.9. BASIC CHARACTERISTICS OF THE PRODUCTION PROCESS, THE TYPE AND QUANTITIES OF MATERIALS TO BE USED

2.9.1. Selected waste disposal technology

The waste disposal technology will be implemented taking into consideration the specific conditions that characterize the selected location of the RSL.

All necessary facilities, equipment and labour required for the operation of the landfill comply with the standards prescribed for such type of facilities.

Below are the basic characteristics of operation technologies of sanitary landfills, i.e. the waste disposal system in which the waste is disposed of in a controlled manner on previously prepared terrain, thus avoiding all the harmful effects that occur during uncontrolled waste disposal. Landfills are closed after reaching the designed height, and long-term (20-year) monitoring is carried out after closure.

The operation technology at the RSL consists of the following:

- installation of a wire fence around a part of the regional landfill site (landfill, accompanying facilities)
- construction of the lower sealing liner by installing a mineral layer (bentonite liner + HDPE foil)
- construction of perimeter canals for collection of storm waters
- construction of a degassing system
- waste disposal with stratified compaction and filling up to designed height
- daily waste covering with a layer of inert material
- construction of the final capping layer on the filled parts (landfill closure)
- greening of the closed area and planting of high and low vegetation
- monitoring (control).

Waste disposal technology consists of the following basic operations:

- preparation of terrain and environmental protection measures (waterproof substrate, protection against drainage water and surface water, leachate collection, gas collection)
- preparation of the waste disposal area
- deposition of waste on the working surface, spreading it into layers and compacting
- daily waste covering
- final landfill closure and greening of the area
- monitoring during the operation and after the closure of the landfill.
2.9.2. Site preparation for waste disposal

When designing and constructing the lower sealing liner of the landfill, the general conditions set forth by the EU Directive (Council Directive 1999/31/EC of 26 April 1999) should be followed. After preparing the surface of the future landfill body (removal of trees and shrubs) it is necessary to lay a layer of levelling material on the already prepared existing terrain.

After the surface of the site has been prepared, a waterproof layer needs to be installed (compacted clay liner - CCL or geosynthetic clay liner - GCL). In case compacted clay liner (CCL) is used for the construction of a waterproof layer, the thickness of the liner must be at least 1.0 m.

If a geosynthetic clay liner (GCL) is used, it has to be placed on a layer of earthen material which is similar to clay, with a thickness of 0.50 m. HDPE foil and a protective layer of geotextile are placed on the waterproof layer.

A drainage layer of gravel with layer thickness greater than 50 cm is installed for leachate drainage. Waste is deposited on this layer.

Figure 2.26. shows the lower sealing liner with geosynthetic clay liner (GCL).

The total area of the RSL inside the fence is approximately 21.0 ha. The surface of landfill cells in stage 1 is approximately 3.55 ha while the surface of landfill cells in stage 2 is approx. 2.3 ha.

The existing site is located in an uneven terrain, and the application of a combined method of waste disposal in levels is foreseen. The construction of the lower sealing liner begins by cleaning and levelling the surface, in parallel to construction of service roads around the landfill body. After preparation of the ground it is necessary to place the sealing layer - consisting of: a sealing layer of low permeability material with a thickness of 50 cm, \(k = 10^{-7} \text{ m/s}\), geosynthetic clay liner, HDPE foil, protective geotextile layer and drainage layer for drainage of leachate / storm water with a thickness min. 50 cm. Waste has to be deposited on the drainage layer.

Before the start of waste disposal, it is necessary to prepare a 2.5 m high embankment on the lowest part of the landfill. The embankment also has to be built on the edge of each new level. The internal road is used for all works. The embankment width (on top) is 1 m. The embankment is built with an inner slope of 1: 1 and an outer slope of 1: 3 (width: height).

A system of perimeter canals for the reception of storm water from the landfill will be constructed. Storm water from perimeter canals will be drained into a collection tank for collection of stormwater, and then
discharged into the surrounding terrain. Leachate is drained into leachate collection tanks, each with a volume of 250 m$^3$.

Figure 2.27 shows the lower sealing liner with clay. In both cases, it is necessary to achieve a water permeability coefficient of $k = 1 \times 10^{-9}$ m/s.

![Figure 2.27. – Lower sealing liner (alternative)](image)

**Waste disposal**

Waste is transported by waste transport vehicles to the landfill cell using a temporary road. The vehicle enters the temporary internal road, arrives at the cell and unloads the waste at the reserved place. Waste is deposited in levels. Prior to the start of waste disposal around each level, a 2.5 m high embankment has to be built, which corresponds to the height of each level. The embankment width (on top) is 1 m. The embankment is built with an inner slope of 1:1 and an outer slope of 1:3 (width: height).

**2.9.3. Waste deposition, spreading and compacting**

The first level is formed by constructing the cell. The cells are filled to the height of 2.5 m, and the thickness of waste layer in the first level is approximately 2.5 m. The following levels also have to be constructed with a thickness of 2.5 m. The bottom of the cells in the cross-section is built at a slope of 3% and 1% towards the drainage in the middle of the field, while in the longitudinal section the slope is of 1% towards the end of the field. At the exit from the field, a full drainage pipe - collector has to be installed.

At the end of the working day, waste should be covered with a daily covering layer (inert material or LDPE fireproof and waterproof membrane for daily and temporary waste covering).

The upper cell of the level is covered with clay material which is well compacted and is carried out with a drop of at least 2% towards the ends.

This prevents access to rodents, insects and birds, and the scattering of light waste, while facilitating the movement of vehicles. In the event of unfavourable weather (heavy rain, snow), waste is disposed of directly
along the internal road. In this place, waste is covered by a construction shaft which will be prepared for this purpose, and when the weather improves, such deposited waste is transported to the waste disposal field.

Inert material is obtained by the excavation of the surrounding terrain. The material is deposited in the reserved place.

The covering material should be protected before winter with a warm-insulating material (foil, straw, leaves, etc.). When working in summer the working face should be moistened (spraying with leachate or water brought by a tanker to prevent dust raising). In case of stronger winds, it is necessary to install mounting fences around the working face to collect light waste. Each day the working face is marked by the landfill manager.

The order of filling up the landfill is very important for proper operation. Waste is disposed of in levels designed to shape the landfill as a natural hill or a cascading trench. The waste and the covering material should be well-levelled to avoid erosion due to precipitation.

2.9.4. Waste spreading and compacting
After being unloaded from the garbage truck or lift truck, waste is spread in layers on the working field by using a compactor. The working field has a slope of 1: 3 or milder. The working machine compacts waste, and it is necessary to pass through each waste field 4-7 times. Good waste compacting reduces later inadequate settling, and more waste fits on the prepared field. Handling and compacting waste is easier when the waste is wet and it should be moistened in the summer. Leachate is used for this purpose. Large waste may not be disposed of at the landfill, but it must be collected separately and only pre-treated waste may be permanently disposed of at the landfill or temporarily in the recycling yard.

2.9.5. Waste covering and compacting of cover material
Daily covering of waste layers is a mandatory operation of sanitary waste disposal. It is performed daily with inert material (soil, inert material from construction works) with a thickness 10-20 cm or with a special LDPE foil.

Covering during the day may be more frequent, especially in the summer, while in the winter it is done less often, i.e. every two to three days. Daily covering covers only the horizontal (upper) part of the level, while the working face is not covered with inert material, but a mobile LDPE fireproofing foil. After filling the first level, its upper surface is covered with a 15 cm thick layer of clay or inert material, and the geomembrane (LDPE foil) is moved onto a new (neighbouring) cell – and so on. The intermediate and final covering layer has a slope of minimum 2%, whereas the proposed slope is 3%. The cover material should be well-levelled and compacted to avoid erosion caused by precipitation. A well-constructed and greened cover layer reduces the amount of leachate, prevents the presence of insects and birds, reduces the probability of these phenomena to a minimum and prevents the scattering of lighter waste fractions due to the wind.

Waste of large dimensions should not be disposed of on the landfill, but must be collected separately. Figure 2.28. shows the landfill operation technology.
2.9.6. Final capping layer

The final capping layer is compliant with Council Directive 1999/31/EC of 26 April 1999. The closure shall be carried out by aligning the upper landfill cell, and then the final capping layer has to be made, followed by recultivation.

The final capping layer represents the underlying layer for vegetation and protects the lower layers from frost, roots, drought, erosion and damage caused by animal or human factors. According to TAS standards the thickness of the recultivation layer should not be less than 100 cm, and its construction should be performed with as little compression as possible, in order to maintain the maximum pore volume in the layer. At the top of the recultivation layer, it is proposed to place humus necessary for grass growth, which is planted as a surface layer for several reasons, among which the most important are aesthetic appearance, prevention of erosion, reduction in the amount of leachate due to evapotranspiration, etc. During planting of the grass it is important to select drought-resistant species that do not require care during the growth. It is also proposed to plan afforestation after final landfill closure.

A “sandwich layer” is proposed as the final capping layer, and is composed of:
- levelling layer of cover material
- drainage layer for gases (min 30 cm)
- protective geotextile layer
- Clay / dusty terrain material (min 50 cm)
- bentonite liner with clay characteristics \(k=10^{-9}\text{ m/s}\)
- drainage layer for storm water (min 50 cm) or alternatively artificial drainage layer (geodren)
- protective geotextile layer (if necessary)
- Recultivation final capping layer (min. 100 cm)
- Greening (grass and trees).

When selecting the thickness of individual layers, the possibility of slipping, the amount of moisture that can be retained for the purpose of greening and the prevention of formation of cracks which occurs during drying were taken into consideration. Sufficient moisture, nutritability and thickness of the final capping layer allow proper growth of vegetation, so the consequences of degradation and erosion are reduced, and the penetration of animals and roots through the cover layer is prevented. Greening is one of the most important factors during closure of each landfill. It is quite expensive, but it is a good investment in relation to the public. It is done for aesthetic reasons, but also to prevent erosion due to surface runoff of precipitation and in order to reduce the quantities of leachate.

Figure 2.29. shows a detail of landfill closure.
Figure 2.30.- Example of the method for landfill closure
2.10. CONSTRUCTION EQUIPMENT NEEDED FOR REGULAR RSL OPERATIONS

During the selection of equipment for the RSL, the following functions need to be considered:

- waste treatment (spreading, crushing, compaction)
- excavation and transportation of cover material and its compaction
- maintenance of landfill body and temporary roads.

Waste operations refer to the collection, transport and spreading of waste at the reserved place and its compaction. Table 2.10 below shows the daily quantities of waste to be disposed of according to the foreseen operation technology, and on which basis the necessary construction machinery is selected.

**Table 2.10. Daily quantities of waste**

<table>
<thead>
<tr>
<th>Year</th>
<th>Total waste t/work day</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>110.6</td>
</tr>
<tr>
<td>2016</td>
<td>116.8</td>
</tr>
<tr>
<td>2017</td>
<td>123.4</td>
</tr>
<tr>
<td>2018</td>
<td>130.3</td>
</tr>
<tr>
<td>2019</td>
<td>133.8</td>
</tr>
<tr>
<td>2020</td>
<td>137.3</td>
</tr>
<tr>
<td>2021</td>
<td>141.0</td>
</tr>
<tr>
<td>2022</td>
<td>144.7</td>
</tr>
<tr>
<td>2023</td>
<td>148.4</td>
</tr>
<tr>
<td>2024</td>
<td>152.3</td>
</tr>
<tr>
<td>2025</td>
<td>156.2</td>
</tr>
<tr>
<td>2026</td>
<td>160.3</td>
</tr>
</tbody>
</table>
Operation of a compactor and bulldozer are foreseen to operate on the site of the RSL.

2.10.1. Selection of construction mechanization needed for regular RSL operations

The choice of type, size and number of waste equipment depends on the possibility of waste spreading, compacting and covering with inert material, which depends on the following factors:
- amount and type of waste per day
- amount and type of covering material per day
- the distance of transport
- waste disposal method
- degree of compactness
- additional requirements such as road maintenance and similar requirements
- available financial resources.

Equipment capacities and selection
When choosing the number of machines, a wide range of factors should be considered, since working with waste involves a wide range of issues, such as bulky waste, dust, erosion, poor weather, production waste and control of pests and fires.

The number and type of equipment primarily depends on the amount of waste, the transport distances and the degree of compactness.

The daily amount of waste, as well as the type of waste, is the most important factor in choosing the number of machines that will work with waste. On the RSL, it is planned to unload about from 90 to 160 t/work day of waste (6 work days per week).

On the basis of calculations, the need for 2 work machines at the beginning of the project is estimated, and the purchase of an additional work machine by the end of the project period.

One compactor and bulldozer will be used for transport and compacting of waste and covering material, building the embankments and the final capping layer, construction of temporary roads, etc. The compactor has a diesel engine of about 314 kW, weighing 32.1 tons, and a knife capacity of 17 m³. The bulldozer engine power is 230 kW and weighs 39 tons. The permanent presence and operation of these machines is planned. Before the end of the project period, an additional work machine with similar characteristics will be purchased.

Other necessary equipment
It is planned to purchase a high-pressure washer, hydroblock, generator, sludge pumps and pumps for leachate, mobile oil pumps, fire-fighting appliances and other manual materials. A mobile phone is also planned to be purchased.
In the part reserved for temporary storage and sorting of waste (recycling yard) that will be located in the area of the entrance-exit zone, containers with a volume of 5, 7, 10 and 30 m³ are planned.

In Phase 3, a mobile membrane device for wastewater treatment will be procured and installed. In Phase 4, the construction/installation of a system for the production of electricity from landfill gas is foreseen.

2.11. WATER SUPPLY, ELECTRICITY SUPPLY AND PLANNED CONSUMPTION

2.11.1. Water supply and foreseen quantities of water to be consumed

The RSL will not be connected to a water supply system. An industrial water tank will be used with a 100 m³ volume hydroblock shaft to ensure industrial water supply.

Figure 2.32 shows the layout of the industrial water tank (Data source: Preliminary Design for the Construction of the Regional Sanitary Landfill "Separacija 1").

![Figure 2.32 – Industrial water tank](image)

Drinking water will be supplied in bottles. It is estimated that the RSL employees will consume approximately 351 m³ of sanitary water per year (in the sanitary facilities and showers). Approximately 150 m³/year will be needed for technological needs, i.e. for the washing of machines that operate on the landfill and the tires of trucks before leaving the landfill, as well as for cleaning of garbage trucks, cleaning of the RSL complex, etc. Therefore, the total need for water is about 500 m³ per year.
2.11.2. Sewage and quantity of sanitary and faecal water

The RSL will not be connected to the public sewage system. The construction of a closed waterproof collection tank for the collection of sanitary and faecal wastewater with a volume of 90 m³ is planned. The content of the collection tank, in which sanitary and faecal wastewater is collected, should be discharged by engaging a company registered for the disposal of wastewater.

Wastewater is calculated considering the estimated consumption of sanitary water, and industrial water losses of about 20% (evaporation). A total of 351 m³/year of sanitary wastewater will be generated at the site.

Taking into account the possible need for water in future work processes (Phase II), it is necessary to consider the possibility of connecting the RSL to the public water supply system.

2.11.3. Connection to power lines and estimated consumption

An electricity generator will be used as the source of electricity at the RSL. Based on the installed power of the equipment and required hours of operation, the estimated electricity consumption will be 53,150 kWh. The installed power of the generator will be 31.0 kW. Phase 2 foresees the connection of RSL to a power substation.

2.11.4. Planned amounts of fuel

A bulldozer and a compactor will be purchased for RSL operations. For the operation of construction machinery and equipment at the landfill, it is necessary to consume approximately 4.4 litres of diesel and approx. 0.05 litres of petrol per tonne of disposed waste. Lubricants consumption corresponds to ten percent of the fuel value.

2.12. WASTEWATER TREATMENT PLANT

For the purpose of wastewater treatment at the RSL site, Phase 1 foresees the construction of a standard container-type plant for treatment of wastewater in membrane bioreactors (MBR) or any other methods and facilities that can treat the wastewater to the allowed level for discharge into the environment.

The treatment of wastewater in the MBR is carried out by aerobic suspended growth of microorganisms at the expense of nutrients from the incoming water with the simultaneous filtration of the membrane of certain characteristics.

The advantage of membrane processes in relation to other processes is that chemicals are not used, and they can process large quantities of wastewater to a high quality in small spaces. In the membrane plant, the incoming water passes through a porous membrane by the action of increased pressure, whereby two currents are created. Permeate or filtrate is the current in which the concentration of soluble matter decreases by passing through the membrane. The second current is the retentate that did not pass through the membrane and in which the concentration of soluble matter increases.

MBRs have their advantages and disadvantages. The advantages include:

- High output quality, enabling the exploitation of treated water, in terms of sustainable technologies, cooling, irrigation or industrial water.
- The absence of a secondary precipitator which reduces space requirements.
- In the MBR process, a very long mean sludge retention time can be maintained, which results in complete retention of slow-growing micro-organisms.
- Biomass concentration may be higher than in conventional systems. Therefore, the system can tolerate high flows with a smaller reactor volume.
- High rates of degradation of organic waste materials and retention of soluble substances by great molecular masses are achieved.
- The production of sludge in the treatment of municipal wastewater is significantly reduced.
Removal of bacteria and viruses is achieved without the addition of chemicals. There are no unpleasant odours as the process equipment can be kept closed.

The disadvantages include: high investments and plant costs, frequent monitoring and maintenance of membranes, limitations limited to pressure in the membrane, membrane sensitivity to some chemicals, less effective oxygen transmission caused by high concentrations of suspended solids.

2.13. SYSTEM FOR USE OF LANDFILL GAS

During the first 5 years of operation, passive degassing of the landfill body is foreseen at the RSL site, which will be carried out by the installation of gas wells and a horizontal gas-bearing layer. Vents will be placed along the landfill body – vertical gravel canals with a diameter of up to 100 cm, located at intervals of approximately 20-40 m.

Each vent should be covered with a biofilter (lightweight compost that must not be covered with a geotextile), min. 2 m thick with the function of landfill gas treatment.

Considering the Kyoto protocol and that the amount of greenhouse gases to be reduced, after 5 years of landfill operation, it is possible to install a system for active degassing of the landfill, i.e. a flare for burning of landfill gas. Through the system of collection pipelines, which will be placed horizontally, the vents on the landfill body will be collected. In this manner, landfill gas will be collected and led to the flare where it will be burnt (at a temperature of 1,000-1,200°C). At the lowest points of the pipeline, condensing pots will be installed to separate the gas condensate, which will be returned to the landfill body through the leachate collection tank.

Flares are used for the burning of landfill gas to protect the environment as well as the health of people from uncontrolled landfill gas emissions. Combustion products (carbon monoxide (CO), sulphur dioxide (SO2), nitrogen oxides (NOx), hydrochloric acid (HCl), suspended particles and other combustion products) are emitted into the atmosphere by burning of landfill gases, and such combustion products may include toxic substances if the burning process is not adequately managed. For this reason, the process of burning of landfill gas needs to be well-managed.

The basic chemical reaction in the flare is the combustion of methane, whereby carbon dioxide and water are produced by the release of heat:

\[
\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O} + \text{heat}
\]

Combustion of methane in the flare will be complete if an appropriate amount of oxygen, i.e. air, is provided.

To burn harmful ingredients that occur in traces in landfill gas, it is important to achieve a certain high temperature and retention time at that temperature to allow the complete degradation of such ingredients. If the planned operation technology is applied and the prescribed environmental protection measures are implemented, toxic products will not occur (only in case of an accident if the combustion process is not carried out in the prescribed manner) and the existing wind rose will have no effect on the surrounding population, workers at the landfill dr.

Flaring of landfill gas will not result in harmful combustion products since the flare types prescribed by the EU Directive will be used and which are designed to incorporate all the environmental measures.

According to Germany’s experience in the treatment of landfill gas ("Evaluation of aerated biofilter systems for microbial methane oxidation of poor landfill gas ", R. Haubrichs, R. Widmann), if the total production of landfill gas is 30-50 m³ / h, gas treatment is technically and economically unprofitable. The flare will function when there is a minimum of approximately 50 m³ /h of gas and over 30% of methane in the gas. During one of the phases, it is possible to plan the use of landfill gas on the site to produce electrical energy.
Biogas is led by blowers to gas engines, whereby electricity is produced. In case of need (accidental situations, failures) and if the amount of gas that is generated is not sufficient or the quality of the gas is unsatisfactory, the gas that is led to the gas engines can be routed to the high temperature flare.

Figure 2.33. shows a high temperature flare.

The degassing system in the first stage is planned as a passive degassing system, i.e. through wells placed through the entire landfill and through the final layer of the landfill. In subsequent stages, it will be easy to implement an active degassing system by connecting the wells through the collector to the flare or generator for electricity production.

As the technology foresees the disposal of waste in 2.5 m high layers, it is envisaged to degass the landfill space by installing vertical gravel canals (ventilators) with a diameter 100 cm, at an interval of 20 to 40 m. Stone with a fraction of 32 to 64 mm is placed in the gas drainage. The openings through the final cover layer are rectangular, with side lengths of 2 m (2 m x 2 m). During the closing the landfill, a biofilter (lightweight compost which should not be covered with geotextile, min. 2 m thick) is placed on the upper surface of the gravel canal, to purify landfill gas.

The Figure below shows the degassing details. The exact places of the ventilation canals will be defined by the Main Design.
Figure 2.34. - Degassing details

As a temporary capping layer, after filling of the module, a levelling layer is placed on the surface of the waste before placing of the temporary LDPE foil, which will be placed to seal the module on the side on which new waste will lean on the next module (level).

At the end of the working day, waste should be covered with a daily covering layer (inert material or LDPE with fireproof and waterproof membrane for daily and temporary covering of waste). The upper surface of the level is covered with clay material with a drop of a minimum of 2% to the edges. This prevents access to rodents, insects and birds, and the scattering of light waste, as well as easier vehicle movements. In case of adverse weather conditions (heavy rains, snow), waste is deposited directly alongside the internal road. Here the waste is covered with a construction shaft which will be prepared for this purpose, and when the weather becomes more favourable, such waste should be transferred to the waste disposal area.

The order of filling up the landfill is very important for proper operation. Waste is disposed of in levels designed to shape the landfill as a natural hill or a cascading trench. The waste and the covering material should be well-levelled to avoid erosion due to precipitation. After being unloaded from the garbage truck or lift truck, waste is spread in layers on the working area by using a compactor. Waste is spread over the working field from the shredding site of the "smearer" truck or the lift truck/compactor. The working field has a slope of 1: 3 or milder. The working machine compacts waste, and it is necessary to pass through each waste field 4-7 times. Good waste compacting reduces later inadequate settling, and more waste fits on the prepared field. Handling and compacting waste is easier when the waste is wet and it should be moistened in the summer. Leachate is used for this purpose. Large waste may not be disposed of at the landfill, but it must be collected separately and only pre-treated waste may be permanently disposed of at the landfill or temporarily in the recycling yard.

Waste is spread in layers of thickness ranging 0.3 to 0.5 m. It is important to ensure that the layers are not more than 0.5 m thick, which results in better compaction. The levels are waste layers and covering material with a height of 2.5 m. When filling each level, it is necessary to fill it approx. 0.5 m higher than the final desired height - due to settling.
The internal roads within the RSL are classified as permanent and temporary roads. Permanent roads are gravel and asphalted roads with a width of 5.5-6 m, with a radius that meet the conditions for the use of trucks with trailers and thus fire trucks. Temporary roads are located within the landfill space, and their position can be changed depending on the filling of the landfill space. They are 4 m wide and are used to transport waste to the landfill, and are made of materials such as construction waste. Temporary roads are also built around individual landfill modules (perimeter roads) in order to allow access for fire-fighters to the landfill body.

In addition to asphalt roads, permanent roads include firefighting access that is planned to be built around the entire landfill and along the landfill cells. The firefighting access is partially asphalted, and partly a gravel road (over closed landfill cells) with a width of 5.5 meters.

2.14 ASSESSMENT BY TYPE AND AMOUNT OF EXPECTED WASTE AND EMISSIONS

2.14.1 Expected leachate quantities

By disposing of waste according to the foreseen technology, the possibility of leachate generation is minimized.

Leachate is contaminated water generated by leaching through waste. It is collected by a drainage system placed on a waterproof substrate of a part of the landfill to which the waste is daily transported and disposed of. Leachate is taken out of the landfill and collected in collection tanks of a volume of 250 m$^3$.

At the beginning of landfill operation, the leachate will be processed by recirculation, since it is the cheapest method. The leachate is first taken from the tank to the spray system.

During recirculation, sprayers are placed on the surface above the waste, and leachate is sprayed through the landfill. Droplets or aerosols spread about 25 m around the sprayer. Due to elevated temperature within the landfill body (approx. 60-70°C, a part of the water will evaporate and the other part will return to the process). The spray system must be placed on the landfill body in a manner preventing spillage. Spraying begins after the end of operations of the working day. It is also possible to foresee recirculation by draining the leachate into drainage ditches without any airborne spraying or (perforated pipes) placed on the landfill body. All of the aforementioned methods can be applied and, if the process is carried out according to the prescribed technology, there is no negative impact on the surrounding population.
The empirical calculation of the amount of leachate (Bogomolov, 1975) during the operation of the landfill, in relation to the amount of precipitation, is

\[ Q = k \times (A \times P) / 365 \]

where:
- \( k \) - coefficient that characterizes the ability to absorb moisture and evaporate waste (amounts to 0.2)
- \( A \) - total surface under waste (approx. 5.8 ha)
- \( P \) - average annual amount of precipitation (909 mm).

The average quantity of leachate in relation to the amount of precipitation that can occur during the operation period of the landfill on the open surface under waste of 5.8 ha is approximately \( Q = 29.1 \text{ m}^3/\text{day}, 874 \text{ m}^3/\text{month} \), i.e. 10.485 m\(^3\) of leachate annually.

Infiltration of water through the porous cover material into the landfill body is calculated on the basis of Darcy’s law:

\[ Q = K \times A \times \frac{dh}{dL} \]

where:
- \( dh/dL \) - hydraulic gradient
- \( A \) - surface under waste (approx. 2 closed cells \times 2.9 ha)
- \( k \) - coefficient of permeability of the cover material (1×10\(^{-9}\) m/s).

The theoretical amount of leachate is 5.0 \( \text{m}^3/\text{day} \), provided that the covering material of the mentioned permeability coefficient is placed.

Taking into consideration the performed calculations, an average quantity of leachate in the amount of 13.5 + (4.7) = 18.2 \( \text{m}^3/\text{day} \) can be expected during the operation of the landfill, while after its closure, the quantities will be reduced to minimum values, which will depend on the consistency of the cover material, i.e. upper capping layer. It is listed in one of the items in the 20-year monitoring after closing.
2.14.2. Estimate of landfill gases

Biodegradable waste of organic origin disposed of on landfills is subject to various microbiological digestion processes, by producing various types of gases which can pose a danger to the environment and to the surrounding population if not properly collected.

An example of aerobic and anaerobic digestion is shown in the following formulas.

**Aerobic digestion**

organic matter + nutrients + O$_2$ → CO$_2$ + H$_2$O + NO$_3^-$ + PO$_4^{3-}$ + SO$_4^{2-}$ + new cells + (-ΔH/kJ)

e.g. C$_6$H$_{12}$O$_6$ + 6O$_2$ → 6CO$_2$ + 6H$_2$O + (-ΔH/kJ)

**Anaerobic digestion**

CH$_3$COOH → CH$_4$ + CO$_2$
Gases produced during aerobic and anaerobic digestion of organic matter at landfills may directly or indirectly affect the environment. CH₄ and CO₂ are dominant, followed by H₂S, NH₃, N₂, various aldehydes, mercaptans and others.

The average composition of landfill gas is as follows
- CH₄ - 45%
- CO₂ - 45%
- other gases - 10%

Basic gas properties:
CO₂ is heavier than air and drops to the bottom of the landfill where it melts in water, increases the acidity and corrosivity of leachate. CH₄ is a colourless and odourless gas; it dissolves poorly in water, and produces an explosive mixture at a concentration of 5-15% with oxygen. It is necessary to repeat that anaerobic conditions prevail in the landfill body where methanogenic bacteria release methane.

Methane gas is lighter than air and therefore easily migrates. Its movement within the landfill body depends on the pressure and diffusion into the environment. In this way, methane is accumulated in certain places, which can result in explosions.

Since even a small amount of methane (5-15%) forms an explosive mixture with oxygen, it is important to undertake all measures to prevent the possibility of explosion and fire at landfills.

For this reason, controlled landfill degassing is necessary. In addition, it is necessary to measure gas quantities regularly in order to avoid the mentioned accidental situations.
Gas development on landfills

Gas production

Legend:
Blue-Predicted first order reaction
Red-Increase of methane production during first 5 years, after which production drops

**Figure 2.37. - Landfill gases**

The quantities of gas produced are shown in the table, taking into account the amount of waste that has so far been disposed of and the calculated amount of waste that will be further disposed of. Due to the microbiological degradation of waste, the formation of gases can be defined by the following mathematical model

\[ \frac{dV}{dt} = V_0 \cdot e^{-kt} \]
where
\( V \) - gas volume
\( t \) - time
\( k \) - constant
\( V_0 \) - gas volume resulting from decomposition of 1 t of waste

Degassing is carried out via built-in vertical gravel canals 100 cm in diameter, at a distance of 30 m. Ventilators are vertical canals filled with gravel into which a perforated HDPE pipe is inserted. When the space around the existing canals is filled with waste; new canals have to be placed on the existing ones. In this manner, a ventilation canals grow alongside the height of the landfill.

Below is a table showing the annual and hourly amounts of methane and carbon dioxide as well as the total landfill gas that will be generated at the RSL. The estimation is given for the period from 2016 to 2040 (taking also into account 30 years after the end of waste disposal).

Table 2.11. - Estimated average hourly quantities of methane and carbon dioxide, as well as total landfill gas for the period from 2016 to 2070 (estimated on the basis of waste composition and proposed technology, and taking into account landfill closure in 2040)

<table>
<thead>
<tr>
<th>Year</th>
<th>Landfill gas, m³/h</th>
<th>CH₄, m³/h</th>
<th>CO₂, m³/h</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>38.7</td>
<td>21.3</td>
<td>17.4</td>
</tr>
<tr>
<td>2017</td>
<td>75.7</td>
<td>41.7</td>
<td>34.1</td>
</tr>
<tr>
<td>2018</td>
<td>111.3</td>
<td>61.2</td>
<td>50.1</td>
</tr>
<tr>
<td>2019</td>
<td>145.7</td>
<td>80.1</td>
<td>65.5</td>
</tr>
<tr>
<td>2020</td>
<td>178.0</td>
<td>97.9</td>
<td>80.1</td>
</tr>
<tr>
<td>2025</td>
<td>316.5</td>
<td>174.1</td>
<td>142.4</td>
</tr>
<tr>
<td>2030</td>
<td>428.2</td>
<td>235.5</td>
<td>192.7</td>
</tr>
<tr>
<td>2035</td>
<td>524.9</td>
<td>288.7</td>
<td>236.2</td>
</tr>
<tr>
<td>2040</td>
<td>614.3</td>
<td>337.9</td>
<td>276.4</td>
</tr>
<tr>
<td>2045</td>
<td>437.1</td>
<td>240.4</td>
<td>196.7</td>
</tr>
<tr>
<td>2050</td>
<td>275.8</td>
<td>151.7</td>
<td>124.1</td>
</tr>
<tr>
<td>2055</td>
<td>174.0</td>
<td>95.7</td>
<td>78.3</td>
</tr>
<tr>
<td>2060</td>
<td>109.8</td>
<td>60.4</td>
<td>49.4</td>
</tr>
<tr>
<td>2065</td>
<td>69.3</td>
<td>38.1</td>
<td>31.2</td>
</tr>
<tr>
<td>2070</td>
<td>43.7</td>
<td>24.0</td>
<td>19.7</td>
</tr>
</tbody>
</table>
The figure shows the production of landfill gas during the stable anaerobic phase with the following ratio \( \text{CH}_4 : \text{CO}_2 = 55\% : 45\% \). This gas ratio is taken as an average for this phase, and is the result of many years of testing at landfills. As methanogenic bacteria develop, the amount of methane increases gradually. Stable anaerobic conditions are achieved in 1 to 2 years.

According to the calculation, the largest amount of landfill gas will be created one year after the end of waste disposing, in 2041 (348 m\(^3\)/h). This is a stable anaerobic phase. Subsequently, the production of methane will be in a slight decline, as the amounts of substrates affected by methanogenic bacteria will also decrease.

Since these are estimates of the quantities made on the basis of the assessment of the characteristics of waste to be disposed of, the theoretical values presented in practice may deviate from the estimated ones. Deviations may also occur depending on compliance with disposal instructions and the disposed types of waste. Factors affecting the amount of gases produced are: waste characteristics, temperature, pH value and moisture content at the landfill. Salt concentrations, such as sulphates and nitrates, may also be important.

### 2.15. EXPECTED INTENSITY OF NOISE IN THE ENVIRONMENT

During the operation of the landfill, certain processes and equipment on the site will generate noise. These include construction machines, recycling plant, sorting line, transportation vehicles, etc. The generated noise will be dominant at the landfill site itself, and according to the characteristics of the equipment provided by the manufacturer, the level of this noise is below the limit values for these activities and the location. The Law on Protection against Noise of FBiH ("Official Gazette of FBiH", No. 110/12) is applicable to this issue.

Noise on the landfill comes from two sources:
- noise produced by equipment at the landfill
- noise produced by transport vehicles (waste carriers, truck lifting devices, trucks, and similar) when moving or unloading of waste.

At the working area, noise during mechanical equipment operation is envisaged to reach approx. 85 dB(A). This intensity of noise is estimated at the distance of 3 m from the source. Noise is also generated by the transport vehicles, on the landfill, as well as on the access roads. As estimated, individual noise shall not exceed 85 dB(A), while at the distance of 600 m from the landfill it will decreased to approx. 39 dB(A). In general, the level of noise at the access roads shall depend on the selected transport vehicles, frequency of
traffic and quality of roads. Since works are carried out during the first working shift, noise impact over environment shall be avoided during the second and third working shifts.

The adverse impact of noise generated by these interventions is reduced or completely disappears at smaller distances from the location of the works, so we can conclude that their negative impact on the environment is negligible.

Bearing in mind that the RSL is about 1200 meters from the nearest populated settlement, it may be concluded with certainty that there will be no harmful effects of noise on the inhabitants of this settlement, and that the noise cannot represent a disturbance at any time (during the day or night).

2.16. TYPE AND QUANTITIES OF MATERIALS TO BE USED DURING RSL OPERATION

In the operation phase of the landfill, a certain amount of different materials will be used, which are necessary for the proper functioning of the system of sanitary disposal of municipal waste. Quantities and types of materials to be used in the operation phase are very difficult to predict. During the operation phase, it will be necessary to keep records of the consumption of all materials.

The estimates of waste generation and emissions during the operation phase of the landfill are presented below.

2.16.1. Estimates per type and quantity of expected waste

This issue will be presented in more detail in the Waste Management Plan for the RSL operation phase. The measures that need to be taken in order to reduce the production of all types of waste are described in the mentioned document.

Collection and storage of waste must be in accordance with the basic principles of waste management:
- principle of separate collection,
- principle of prevention, and
- principle of recycling

During the RSL operation phase, certain quantities of different types of waste will be generated (municipal waste, packaging waste, wood, plastics, metals, smaller quantities of hazardous waste, etc.).

Waste generation sources are the work processes of the plants and facilities at the site, workers present at the site, mechanization, etc.

The estimated types and quantities of waste that will be generated in the operation phase within one year, with guidelines for the management of certain types of waste, are provided in the aforementioned Waste Management Plan.

The presented types and quantities of waste are estimated based on the operation method of the landfill, its content in terms of the number of workers, types of plants, mechanization, waste disposal methods, etc.
3. DESCRIPTION OF THE ENVIRONMENT THAT MAY BE AFFECTED BY THE PROJECT

3.1. INFORMATION ON POPULATION

Response to the Committee’s remarks:

Waste management in Živinice region is based on a regional concept which includes the construction of a regional sanitary landfill site “Separacija 1” (RSL) located on the western brinks of Municipality Živinice, on the border with Municipality Banovići.

The nearest settlement to the landfill site is Ježevac, a settlement inhabited by internally displaced persons. The centre of the settlement is c. 650m (air distance) away from the landfill site while the closest residential building is c. 500 m (air distance) away.

An estimate of the number of population within the Tuzla Canton project region (Municipalities Banovići, Kladanj and Živinice) was conducted on the basis of data received from the municipalities (data dating back to 2011), data from spatial planning documentation (Spatial plan for the region of Tuzla Canton) and statistical data (data from the Federal Bureau of Statistics of the Federation of Bosnia and Herzegovina).

The data on the number of inhabitants in the municipalities in 2011 was obtained from the responsible persons from the above listed municipalities as official data used in the “Feasibility Study for Regional Sanitary Landfill – Tuzla Canton (2012).” It is important to underline that the number of population indicated by Municipalities Živinice and Banovići differs from the data given by the Federal Bureau of Statistics of the Federation of Bosnia and Herzegovina and the spatial planning documentation. Municipality Živinice submitted on June 21, 2012 an official document specifying that the total population of Municipality Živinice amounts to 100,702 inhabitants explaining that this data was obtained from the CIPS database (Citizen Identification Protection System – a single system on the state level) and the health insurance database.

According to the data from the Federal Bureau for Statistics, the total number of inhabitants in Municipality Banovići in 2011 amounted to 25,816. On June 20, 2012, Municipality Banovići submitted a document on the number of inhabitants in its municipality. According to the estimates of the local community administration, based on the number of registered residences in the area of Municipality Banovići, the number of issued health insurance premiums along with the estimated number of persons without a health insurance, it arises that 30,000 inhabitants is a realistic number of people who generate waste in Municipality Banovići. Municipality Kladanj concurred with the number of population presented by the Federal Bureau for Statistics for 2011. Acting upon the municipalities’ requests, the Study used the data on the number of population that was officially verified by the municipalities themselves. According to this data, Table 3-2 provides an estimate of the number of population by municipalities for the 2006-2011 period.
Table 3.1 – Estimated population for the 2006 - 2011 period

<table>
<thead>
<tr>
<th>Year</th>
<th>Banovići</th>
<th>Kladanj</th>
<th>Živinice</th>
<th>Total for the region</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total population</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>29.242</td>
<td>15.253</td>
<td>76.971</td>
<td>121.465</td>
</tr>
<tr>
<td>2007</td>
<td>29.392</td>
<td>15.243</td>
<td>81.221</td>
<td>125.856</td>
</tr>
<tr>
<td>2008</td>
<td>29.543</td>
<td>15.162</td>
<td>85.706</td>
<td>130.411</td>
</tr>
<tr>
<td>2009</td>
<td>29.694</td>
<td>15.086</td>
<td>90.438</td>
<td>135.219</td>
</tr>
<tr>
<td>2010</td>
<td>29.847</td>
<td>14.981</td>
<td>95.432</td>
<td>140.260</td>
</tr>
<tr>
<td>2011</td>
<td>30.000</td>
<td>14.900</td>
<td>100.702</td>
<td>145.602</td>
</tr>
</tbody>
</table>

Projected population numbers

The projection of population numbers in the analysed region was conducted for the 2012-2040 period (for every 5 years) and presented in Table 3.2. The projected population numbers were calculated on the basis of the data from the 1991 Census, data obtained from the Federal Bureau for Statistics, data gathered from municipalities (for 2011), data from spatial planning documentation for 2025 and 2040 (Spatial Plan for Tuzla Canton region), data collected from public enterprises, other relevant institutions and other significant sources. Due to the particularity of each municipality, the estimates were made for each municipality separately.

Table 3.2 – Estimated population for the 2012-2040 period

<table>
<thead>
<tr>
<th>Year</th>
<th>Banovići</th>
<th>Kladanj</th>
<th>Živinice</th>
<th>Total for the region</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total population</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>30,053</td>
<td>16,199</td>
<td>101,125</td>
<td>146,377</td>
</tr>
<tr>
<td>2015</td>
<td>30,201</td>
<td>16,131</td>
<td>102,406</td>
<td>148,750</td>
</tr>
<tr>
<td>2020</td>
<td>30,480</td>
<td>16,258</td>
<td>104,577</td>
<td>151,315</td>
</tr>
<tr>
<td>2025</td>
<td>30,750</td>
<td>16,385</td>
<td>106,795</td>
<td>153,930</td>
</tr>
<tr>
<td>2030</td>
<td>31,433</td>
<td>16,704</td>
<td>109,059</td>
<td>157,195</td>
</tr>
<tr>
<td>2035</td>
<td>32,130</td>
<td>17,028</td>
<td>111,371</td>
<td>160,529</td>
</tr>
<tr>
<td>2040</td>
<td>32,843</td>
<td>17,359</td>
<td>113,732</td>
<td>163,935</td>
</tr>
</tbody>
</table>

The above estimates indicate that the analysed region has a positive demographic trend with an annual rate in the increase of number of inhabitants of c. 0.41%.

Table 3.3 indicates household waste collection and treatment service coverage in 2013.

Table 3.3- Household waste collection and treatment service coverage

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Banovići</td>
<td>23,431</td>
<td>7,665</td>
<td>7,548</td>
<td>98.5</td>
</tr>
<tr>
<td>Kladanj</td>
<td>13,041</td>
<td>3,877</td>
<td>2,882</td>
<td>74.3</td>
</tr>
<tr>
<td>Živinice</td>
<td>61,201</td>
<td>18,582</td>
<td>15,479</td>
<td>83.3</td>
</tr>
<tr>
<td>Total:</td>
<td>97,673</td>
<td>30,124</td>
<td>25,909</td>
<td>86.0</td>
</tr>
</tbody>
</table>

However, the area where the RSL is to be constructed belongs to Municipality Banovići and the subsequent data on population will be based on this municipality.
Banovići is a small mining town in the north-east part of Bosnia. The town is situated on the north-west slopes of Mt. Konjuh at an altitude varying between 330 and 380 meters, on the main road that links two industrial cities Tuzla and Zenica, i.e. Tuzla Canton and Zenica-Doboj Canton.

The surface area of the municipality is 176 km² which makes up 0.34% of the total territory of BiH.

Analysing the current system of residential areas and gravitational coupling, the central areas – focal points – were established for each region and a development centre system was proposed forming a backbone of a polycentric development model whereby the central settlements are differentiated as follows:

City-region formation

I – Primary centre – central parts of the canton – city of Tuzla

II – Secondary centres – sub-cantonal centres
a. II.A – within the city - region (municipal centres Živinice and Lukavac)
b. II.B – other secondary centres (municipal centres Gračanica and Gradačac)

III – Tertiary centres
a. III.A – close to the city-region (municipal centres Banovići, Kalesija and Srebrenik)
b. III.B – other tertiary centres (municipal centre Kladanj)

IV – other centres – (municipal centres Doboj Istok, Čelić, Teočak and Sapna)

The key role in the formation of development axes and transfer of development impulse is played by the transportation infrastructure notably the motorway Tuzla-Orašje, the express road Tuzla-Kladanj-Sarajevo and a possible express road Tuzla-Banovići-Zavidovići-Sarajevo.

The railway infrastructure stretching from Banja Luka – Doboj – Tuzla – Serbia and the stretch Banovići-Tuzla-Brčko are also important development axes in Tuzla Canton. The following significant settlements make up municipality Banovići: Banovići, Banović selo, Borovac, Čatići, Gornji Bučik, Grivice, Lozna, Milići, Mrgan, Omazići, Oskova, Podgorje, Pribitkovići, Repnik, Seona, Stražbenica, Treštenica Donja, Treštenica Gornja, Tulovići and Željova.

The population density in Municipality Banovići is 151 inhabitants per km².

The industry in Banovići is mostly oriented towards the functioning of a coal mine “Banovići” - the largest coal mine in BiH. Apart from the coal mine, Banovići also have a pretty developed metal industry (Furnace factory HELIOS, FGO – construction equipment factory, "Elektoremont", TMB – Factory for micromotors and gadgets), clothing factory “Borac” and transportation companies (“Litvatrans”, "Autosobračaj" and "Autoremont").

With the investment of Austrian capital, a “Plantrans-Dijabaz” diabase mine was also opened

There are 5,806 employees currently employed within the municipality while the number of unemployed totals to 4,280
3.2. SOIL DATA

(heading amended per Committee’s recommendation)

Considering that a part of the terrain is covered by tailings that formed an embankment / cover of the basic terrain with unfavourable mechanical features, it is important to find out the thickness of this layer, its spread, mechanical features and the presence of water within the layer.

The geotechnical investigations or the Preliminary Geotechnical Study (Mission G1) has not been completed during the development of this Study and it will be submitted subsequently together with the other required documents for the issuing of an urban planning consent. The stabilization of the Foundation Soil project is an integral part of the Main design and it will be developed as such together with the Main design.

The following parts include a programme of investigation works including the geotechnical investigation works as presented in the Preliminary design for the construction of the RSL.

The location of exploratory holes is presented on Figure 3.1.

Figure 3.1 Location of exploratory holes
Ongoing terrain investigation works:
- investigations conducted according to the methods recognized by Eurocode 7
- 4 drill holes, drilling depth minimum 1m into the basic rock, assumed tailing thickness 10-30m, CPT or Marchetti dilatometer
- the core should be piled into a box, 1.0 m long, photograph from SPT position, disturbed sample and non-disturbed sample position
- perform a Standard penetration test every 4m, take a sample from the cylinder
- Disturbed samples – when the change of materials occurs;
- Non-disturbed samples at 5.0 m, 10.0 m and 15.0 m (only in B2) - use thin-walled cylinder, fixed-piston sampler, measure piston impress and displacement, double paraffin protection, careful transportation without vibrations

Considering that the aforementioned investigation works are ongoing, the results were not available at the time of the Study design.

3.2.1. Engineering and geological characteristics of the terrain base

The data provided in the following chapter is based on earlier investigations of the location:

*Engineer and geological characteristics of the terrain base,* the geological substrate, made of peridotite is mostly silicate-based with 45-55% SiO2 composition. The mentioned sediments have a massive or partially layered texture, with grained to partially porphyry structure. From the engineering and geological aspect, these usually make stable terrains for building constructions.

It should be underlined that the substrate sediment is covered by tailings from the wet-phase separation and the thickness of the tailing fill reaches up to 30 m over the peridotite. The substrate sediments have favourable physical and mechanical characteristics and homogeneous conditions for excavation and founding. The geomechanical characteristics of the peridotite are the following: Φ=45-55º; c=200 kPa; Y = 25 kN/m³; Ms = 60 MPa.

The excavation category according to GN 200 = VI-VII category. The physical and mechanical characteristics of the material from the tailings are heterogeneous and unfavourable from the aspect of building construction. Such materials include 30% moisture and a “zero” consistency index. Once filled with moisture, these materials are very difficult in contact. During dry periods, the tailings collected from the exploitation and separation of coal are also very unstable as they partially transform into coal dust.

Clay and marl clastic series in contact with the atmospheric influences are unstable and often change their stability with the change of humidity. They trigger and cause exodynamic phenomena and processes, most often landslides and creeps on the slopes of the tailing embankment. Such materials require high level of care and the most favourable weather conditions during excavation and construction. It is very difficult to operate the machinery at the tailings because it acts as an extreme building material.

Differential settlement of material is inevitable.
3.2.2. Hydro-geological characteristics of the terrain

The hydro-geological characteristics of the terrain, made of the geological substrate and cover products, are simple. According to the hydro-geological categorization, the rocky masses are grouped in impermeable rocks. These rocks are made of lithological parts of periodite. They make up the foundations of the RSL site. The terrain is anhydrous and mostly impermeable and without registered sources at the surface in the site’s inner zone.

Just next to the tailings, at the hypsometric level of Oskova alluvial, we can expect to find groundwater at the level of the river itself.

Linear erosions occur at the tailings embankment after incidental precipitation. The volcanic sediments of Mt. Konjukh are typical representatives of foothill barriers with strong impermeable features. The filtration coefficient for these materials is: \( K_f = 2 \times 10^{-8} \) - \( 10^{-10} \) m/s.

There is a constant surface water flow from River Oskova registered at the RSL site in the vicinity of the tailings. The alluvial formations of River Oskova are near to the tailings and special attention must be paid to avoid possible contamination of groundwater next to the tailings.

3.2.3. Seismological characteristics of the terrain

Regarding the seismicity of the terrain, the maximum expected earthquake is 6º on the MCS scale and 63% probability in the return period of 100 years.

3.2.4. Terrain stability, surface and ground water

The surface formation of the cover at the location in matter, in the wider area of the current tailings landfill generated from wet separation, is typically alluvial-deluvial soil type of quaternary age. Such formations are characteristic for “natural” autochthonic covers. These are locations of original degradation of rocks that have not been in contact with the deposited material from the “tailings” generated from coal exploitation.

The lithological parts of the surface covers comprised of humus and granulated clay 0.30-1.00 meter thick have been registered at the site. No ground water was registered. However, stretches of wet mud generated from the separation process have been noted at the location where the remains of the tailings are deposited.

In view of the fact that the clastic material from the tailings is impermeable, the ground water in the body of the tailings is directed towards River Oskova. Some instability of the deposited tailings has been registered at the stretch towards the alluvium of River Oskova.

Figure 3.2 presents an extract from a geological map of the wider area of the potential RSL.

![Figure 3.2](image)

Figure 3.2- A geological map of the wider area of the potential RSL (original scale 1:25000), according to the data of the General Geological Map of SFRY, 1:100000, sheet Tuzla
3.2.5 Pedological characteristics

The productive soil i.e. the surface, loose layer of earth is a physical and geographical element which is generated as a result of interaction between the geological structure, relief, climate, hydrological characteristics, vegetation but also human influence. Various types of soil are present in the wider region due to these factors with the dystric cambisol, terra rosa, calcocambisol, pseudogley and alluvial soils being most widely represented.

A large presence of pseudogley can be found at the upper stream of river Oskova, from the spring catchment area to Gostilja river mouth. The alluvial soils are found along the course of river Litva and Oskova. These are less developed soils that are generated as a result of sedimentation of materials along these rivers.

They can be shallow or very deep. Since such soils require levelled valley bottom, they are suitable for cultivation and they give high yields if irrigated.

Humus and loam represent a very thin layer of up to one meter in thickness which covers the serpentine as well as the marl and gravel. From the aforementioned, we can conclude that the location “Separacija1” is suitable for the planned construction of the regional sanitary landfill.

3.3. FLORA AND FAUNA

Ecological - vegetation map of the wider area

According to the ecological and vegetation area distribution, the Mt. Konjuh region belongs to the Inner Dinarides. This area is under the influence of a temperate continental climate with strong penetration of the Mediterranean climate in the period between June and August. An average of 56% of the annual precipitation occurs during the vegetation period creating a favourable ratio between rainfall and potential evapotranspiration. The vegetation period lasts between 180 and 190 days, as registered in Kladanj. The most widely spread type of soil in this area is eutric cambisol on peridotite and serpentinite as well as the dystric cambisol on acid silicate rocks while the eutric cambisol is less present on the remaining silicate rocks, pseudogley, calcomelanosol and calcocambisol. The specificity of the region lies in the peridotite and serpentinite geological base that continuously stretches from Mt. Kozara in the north-west of BiH to Mt. Konjuh, Kladanj and Banovići, enabling the development of specific and unique serpentinite eco - systems in the region of tertiary-relic nature.
Floristic composition of forest ecosystems in the wider area is very rich and conditioned by different types of forests that exist in this region. Depending on the pedological and ecological characteristics of certain locations, 30 different types of forest plant communities have developed and are grouped into the same number of forest management classes. In addition to the typical serpentine – peridotite flora representatives, this region is characterized by other ecosystems, mostly related to different geological and pedological combinations and orographic conditions. These include: the beech and fir with spruce (Abieti fagetum serpentinicum) forest ecosystems, the beech and fir forest (Abieti - Fagetum) and the black hornbeam forest Querco - Ostryetum carpinifoliae).

Furthermore, this region is covered by large ecosystems of mountainous spruce. There is a smaller presence of the pure mountainous beech forest and pine wood ecosystems within the black hornbeam forest zone.

Response to the Committee’s remark:

The flora and fauna description was done for the wider area of the location. The location where the regional sanitary landfill is to be constructed has previously been degraded by mining and disposal of tailings from the coal mine Banović.

Flora in the wider region:

The vegetation in the observed region belongs to the climatic community of pine, beech, fir and spruce forests. In addition, there are areas of sessile oak and hornbeam forests as well as:

- Rare plants: Bosnian lily (*Lilium bosniacum*), Bosnian iris (*Iris bosniaca*), spring snowflake (*Leucojum vernum*), willow, yellow gentian, chrysanthemum
- Rare and relic plant communities: The Scots and black pine forests on peridotite and serpentinite *Pinetum silvestris – nigrae serpentinicum*, *Erico - Pinetum nigrae serpentinicum*
- Relic and endemic plants: *Asplenium cuneifolium*, *Minuartia bosniaca*, *Notholaena marantae*, *Halacsya sendtneri*, *Potentilla visionii*, *Fumana bonapartei*, *Haplophyllum bossierianum*, *Gypsophila pergulaefolia*

![Figure 3.4 – Bosnian lily](image1.png)  
![Figure 3.5 – Yellow gentian](image2.png)
Characteristics of Fauna:

The dominant presence of diverse forests and the primordial, pristine nature have created conditions for a great number of animals in the area. An exclusive value is the presence of the wood grouse (*Tetrao urogalos*), rare and endangered type of forest bird that lives solely at the pristine habitats, which is another verification of the quality of environment of the analyzed region. In addition to the wood grouse, this area is inhabited by the following animal types of interest for hunting: Bear (*Ursus arctos*), wild boar (*Sus scrofa*), wolf (*Canis lupus*), roe deer (*Capreolus capreolus*), fox (*Vulpes vulpes*), wildcat (*Felis silvestris*), rabbit (*Lepus europaeus*), as well as the mink, squirrel, polecat, weasel, mole, dormouse, mice, vole...etc.

The following types of reptiles are present: green lizard, viviparous lizard, slow-worm, adder as well as the following types of amphibians: fire salamander, bullfrog, agile frog, toad frog.
Figure 3.8- Wood grouse

- Ornithological values
  - Relic types of birds: wood grouse (*Tetrao urogallus*) and hazel grouse (*Bonasa bonasia*)
  - Endangered types of birds: wood grouse (*Tetrao urogallus*), Ural owl (*Strix uralensis*) and hazel grouse (*Bonasa bonasia*)

- Water fauna:
  - Rare and endangered water fauna: otter (*Lutra lutra*), noble crayfish (*Astacus astacus*), brown trout (*Salmo trutta*) as well as the Danube barbel (*Barbucus balcanicus*), carrying an LC4 status.

Figure 3.9- Noble crayfish (*Astacus astacus*)

- Specific fauna
  - Endangered types of animals: brown bear (*Ursus arctos*)
3.4. CLIMATE FEATURES OF THE REGION

Analyzing and explaining the climate features of a certain region is very important from the aspect of utilizing specific thermal energy facilities and their effects on the surrounding area due to the varying degree of effects in different meteorological conditions. This is notably significant from the aspect of evaluating atypical situations where the negative effects of the thermal energy facilities are distinctive.

Tuzla and its wider region are under the effect of moderate-continental climate with particularities manifested through the features of humid and microthermal climate.

The seasons are characterized by changing weather conditions with autumns being warmer than springs while in summers, due to the atmospheric high-pressure centre that develops over the subtropical region towards the north, the region is under the effect of the Azores High which is characterized by pretty stable weather conditions and occasional, brief, local precipitation. The weather conditions in winter are under the influence of the cyclonic activities from the Atlantic Ocean and notably from the Mediterranean and the winter Siberian High.

In order to define the climatic conditions in a certain region, the normal mean values (according to the agreement with the World Meteorological Organization) are established on the basis of long-term (thirty years) meteorological data sets. The current, average long-term data set is for the period 1991-2020. All measurements and analysis of meteorological elements are directed towards commenting on the derogations from the normal long-term data sets. Considering the fact that we do not have long-term averages of meteorological elements for Banovići, but only short-term data for certain elements, we have used data from the nearby meteorological stations to describe climate features.

3.4.1. Air temperatures

Air temperature is one of the basic climate elements as it gives insight into the heat condition of the atmosphere that is being heated in the ground level from the earth’s surface.

The absorption of a part of the solar radiation by the earth’s surface and the heating of the air depend on the latitude, altitude, exposition, cloudiness and air turbidity.

Based on temperature data from long-term measurements, we can note that the highest temperatures in the annual temperature flow are registered in July (19.3 °C) while the coldest month is January with an average temperature of -0.8 °C with the average annual temperature for Tuzla being 10.0 °C. Thus, the annual temperature amplitude is 20.1 °C.

Table 3.4 – Monthly and annual air temperature averages (°C)

<table>
<thead>
<tr>
<th>Period: 1961-1990</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
<th>VIII</th>
<th>IX</th>
<th>X</th>
<th>XI</th>
<th>XII</th>
<th>AVERAGE ANNUAL TEMP.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS Tuzla</td>
<td>-0.8</td>
<td>1.7</td>
<td>5.7</td>
<td>10.4</td>
<td>14.8</td>
<td>17.7</td>
<td>19.3</td>
<td>18.9</td>
<td>15.4</td>
<td>10.6</td>
<td>5.6</td>
<td>0.9</td>
<td>10.0</td>
</tr>
</tbody>
</table>
Figure 3.11 – Average monthly temperature variation

Table 3.5 – Absolute minimum air temperature (°C)

<table>
<thead>
<tr>
<th>Period: 1961-1990</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
<th>VIII</th>
<th>IX</th>
<th>X</th>
<th>XI</th>
<th>XII</th>
<th>MIN.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuzla</td>
<td>-25.8</td>
<td>-20.0</td>
<td>-15.8</td>
<td>-4.0</td>
<td>-0.9</td>
<td>1.4</td>
<td>5.7</td>
<td>4.0</td>
<td>-1.4</td>
<td>-5.2</td>
<td>-16.0</td>
<td>-17.6</td>
<td>-25.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Period: 1961-1990</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
<th>VIII</th>
<th>IX</th>
<th>X</th>
<th>XI</th>
<th>XII</th>
<th>MAX.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuzla</td>
<td>18.8</td>
<td>22.8</td>
<td>27.8</td>
<td>30.0</td>
<td>35.6</td>
<td>35.0</td>
<td>39.5</td>
<td>39.0</td>
<td>34.7</td>
<td>29.0</td>
<td>25.6</td>
<td>23.5</td>
<td>39.5</td>
</tr>
</tbody>
</table>
Table 4.4 - Absolute maximum air temperature (°C)

![Absolute maximum and minimum air temperature graph](image)

Figure 3.12 – Maximum / minimum temperature flows

According to the frost snow map for Banovići, the first days of frost in the region appear on average in the period between November 1st and November 16th while the last frost occurs on average in the period between April 16th and May 1st. In higher altitude areas, the frost may appear before November 1st while the last days of frost snow are between May 1st and May 16th.

3.4.2. Humidity

Humidity represents the degree of saturation of air with water vapour. The absolute humidity implies to the amount of water vapour in the air and is expressed in grams per cubic meter of air.

The information on relative air humidity is the most important in practical terms as it represents the degree of saturation of air with water vapour, i.e. it represents the ratio between the actual quantity of water vapour and the maximum quantity that the air could accept at the same temperature.

The relative air humidity depends as much from the temperature as from the content of water vapour in the air. The daily and annual relative humidity trend in a certain region is usually in an inverse ratio with the temperature flow. Thus, the relative air humidity is higher at night and in winter and lower during the day or in summers.

The drop in relative air humidity in the first half of the year is characteristic for our region and it is connected with the increased cyclone activities in spring and early summer.

The mean annual values of relative air humidity for the three meteorological stations near Banovići range from 77% (Kladanj) to 80% (Živinice).

We can assume that the mean values for this meteorological element vary in the same range and that the annual trend of mean monthly values are similar for Banovići as well.

![Annual trends of mean relative air humidity](image)

Figure 3.13 – Annual trends of mean relative air humidity values
Table 4.5 – Relative air humidity mean values

<table>
<thead>
<tr>
<th>Period: 1961-1990</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
<th>VIII</th>
<th>IX</th>
<th>X</th>
<th>XI</th>
<th>XII</th>
<th>ANNUAL MEAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuzla</td>
<td>83</td>
<td>79</td>
<td>73</td>
<td>70</td>
<td>74</td>
<td>76</td>
<td>74</td>
<td>76</td>
<td>79</td>
<td>81</td>
<td>82</td>
<td>85</td>
<td>78</td>
</tr>
<tr>
<td>Kladani</td>
<td>82</td>
<td>78</td>
<td>73</td>
<td>71</td>
<td>74</td>
<td>75</td>
<td>73</td>
<td>75</td>
<td>79</td>
<td>80</td>
<td>81</td>
<td>83</td>
<td>77</td>
</tr>
<tr>
<td>Živinice</td>
<td>85</td>
<td>81</td>
<td>75</td>
<td>76</td>
<td>76</td>
<td>79</td>
<td>75</td>
<td>77</td>
<td>81</td>
<td>82</td>
<td>84</td>
<td>86</td>
<td>80</td>
</tr>
</tbody>
</table>

3.4.3. Precipitation

Precipitation is one of the most significant climate elements and the level of water that precipitates in different forms onto 1m² of surface is measured in mm during a single day. One millimetre corresponds to one litre of water.

Various cyclonic activities with penetration of wet and cold air masses from the Atlantic Ocean from the west and north-west, warm air masses from the south and south-west from the Mediterranean and cold, winter air masses from the north and north-east have a prevailing effect on precipitation in Tuzla region.

Table 4.6 – Annual trends of average precipitation measured for the 1964 – 1986 period for Banovidi

<table>
<thead>
<tr>
<th>Months</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
<th>VIII</th>
<th>IX</th>
<th>X</th>
<th>XI</th>
<th>XII</th>
<th>Annual mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>KS</td>
<td>51.0</td>
<td>62.4</td>
<td>59.4</td>
<td>86.5</td>
<td>87.5</td>
<td>115.9</td>
<td>99.3</td>
<td>98.2</td>
<td>70.4</td>
<td>75.4</td>
<td>83.1</td>
<td>67.4</td>
<td>956.5</td>
</tr>
<tr>
<td>Banovidi</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.4.4. Wind

Wind is usually expressed in terms of its direction, incidence and wind speed.

Table 4.7- Average wind speed and incidence for Banovidi region
<table>
<thead>
<tr>
<th>Wind direction</th>
<th>N</th>
<th>NE</th>
<th>E</th>
<th>SE</th>
<th>S</th>
<th>SW</th>
<th>W</th>
<th>NW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind speed m/s</td>
<td>2.62</td>
<td>2.1</td>
<td>2.4</td>
<td>2.59</td>
<td>3.5</td>
<td>4.6</td>
<td>3.1</td>
<td>3.8</td>
</tr>
<tr>
<td>Incidence (total)</td>
<td>337</td>
<td>704</td>
<td>15</td>
<td>37</td>
<td>7</td>
<td>301</td>
<td>235</td>
<td>1305</td>
</tr>
<tr>
<td>Incidence %</td>
<td>11.5</td>
<td>23.9</td>
<td>0.5</td>
<td>1.3</td>
<td>0.2</td>
<td>10.2</td>
<td>8</td>
<td>44.4</td>
</tr>
</tbody>
</table>

As we can see from the previous table and the wind rose diagram, the most frequent wind direction is north-west followed by north-east and least from the direction of south and east.

The incidence of wind coming from the west which could carry the smoke from the power plant chimney directly towards the town is very low and this is a relatively favourable fact for Banovići as it is located east of the cement plant. The highest average wind speed is usually for the winds coming from the south-west. The indicated data refers only to wind conditions. The wind: calm ratio is 50:50, i.e. half the time it is windy and the other half it is calm.

### 3.4.5. Cloudiness

Cloudiness or the coverage of the sky with clouds is one of the important climate elements. High cloud coverage prevents sun penetration, decreases the intensity of the solar irradiance and hinders earth’s radiation thus moderating the daily temperature variations.

Cloudiness is an element that is not measured with instruments but rather by observing and evaluating the coverage of the sky with clouds.

*Table 4.8 – Average monthly cloud coverage expressed in the tenths of sky coverage*

<table>
<thead>
<tr>
<th>Months</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
<th>VIII</th>
<th>IX</th>
<th>X</th>
<th>XI</th>
<th>XII</th>
<th>Annual Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuzla</td>
<td>7.1</td>
<td>6.6</td>
<td>6.2</td>
<td>5.8</td>
<td>5.8</td>
<td>5.4</td>
<td>4.2</td>
<td>3.7</td>
<td>4.4</td>
<td>5.4</td>
<td>7.2</td>
<td>7.6</td>
<td>5.8</td>
</tr>
</tbody>
</table>
Analysing the annual trend of cloud coverage, we can say that the lowest coverage is in August (3.7 tenths or 37%) while the highest is in December (76%). The average cloud coverage is highest during winter (71%) followed by spring (59%), autumn (56%) while the lowest is during summer with only 44%.

Furthermore, we can conclude that the annual cloud coverage trend is highly concurrent with the relative humidity trend and almost inverse to the annual temperature trend.

In addition to the average cloud coverage, a very important indicator is the average number of cloudy days per month and per year.

Table 4.9 – Average number of cloudy days in a year

<table>
<thead>
<tr>
<th>Period: 1961-1990</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
<th>VIII</th>
<th>IX</th>
<th>X</th>
<th>XI</th>
<th>XII</th>
<th>Annually</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuzla</td>
<td>15</td>
<td>14</td>
<td>13</td>
<td>11</td>
<td>9</td>
<td>8</td>
<td>5</td>
<td>7</td>
<td>9</td>
<td>14</td>
<td>16</td>
<td>126</td>
<td></td>
</tr>
</tbody>
</table>

3.4.6. Fog

The annual fog incidence variations are very high with years with only 18 registered foggy days to years registering more than 80 days of fog occurrence.

Fog is a very important meteorological phenomenon considering that the low-lying cloud prevents sun penetration during the day and radiation during the night. Furthermore, fog is an important source of moisture in the atmosphere.

Mixed with exhaust gases, pollutants and other impurities such as soot and smoke, fog can cause life-threatening health conditions to humans. This is notably present in large cities, city clusters and industrial zones located in valleys.

Serious air pollution usually occurs during anticyclone activities (large-scale circulation of winds around a central region of high atmospheric pressure) in winter.

Table 4.10 – Average number of foggy days per year

<table>
<thead>
<tr>
<th>Months</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
<th>VIII</th>
<th>IX</th>
<th>X</th>
<th>XI</th>
<th>XII</th>
<th>Annually</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuzla</td>
<td>8</td>
<td>6</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>9</td>
<td>8</td>
<td>9</td>
<td>64</td>
</tr>
</tbody>
</table>
Figure 3.17 – Average number of foggy days

The appearance of fog is more common in the colder period of the year (autumn – fall) and much rarer in the warmer period.

3.5. EXISTING MATERIAL ASSETS INCLUDING CULTURAL AND HISTORICAL HERITAGE

Response to the Committee’s remarks:

There are no material assets or cultural and historical heritage at the location of the future regional sanitary landfill. The border of the protected landscape “Konjuh” and its values is 5.7 km away from the location.

3.6. SPECIFIC IMPACTS IDENTIFIED IN THE PRIOR ENVIRONMENTAL IMPACT ASSESSMENT

No prior environmental impact assessment was conducted and thus there are no specific elements that have not already been established in this Study.

4. DESCRIPTION OF POSSIBLE SIGNIFICANT IMPACTS ON THE ENVIRONMENT

4.1. IMPACTS ON POPULATION

The construction of the Regional Sanitary Landfill “Separacija 1” will have very positive impacts on the neighbouring population. The reason is that the current environmental conditions regarding the tailings is very bad and that the construction of a sanitary landfill will prevent further wild dumping of household waste and its harmful impacts on the population in the wider Tuzla region.

4.1.1. Impacts on population during the RSL construction phase

The following cases may cause possible negative impacts, of a psychological nature, on the population during the construction phase:

- Increased level of noise during the construction,
- Increased emission of flue gases and solid particles resulting from the construction machine and transportation vehicle operation,
- Scattering of solid material,
• Increased traffic on the local roads and damage to the local roads,
• Occurrence of accidents (fires, explosions...etc) during the construction.

4.1.2. Impacts on the population during the RSL exploitation phase

Possible negative impacts on the population during the exploitation phase may occur in the following cases:

• Increased level of noise from resulting from operations at the landfill site,
• Occurrence of accidents (fires, explosions, failures at the degasification system...etc.)

The positive impacts on the population of the RSL construction project are reflected through the following:

• Applying sanitary means of waste disposal prevents the possibility of generation of odours in the vicinity and the wider area of the landfill site,
• Building a system of controlled degasification of the landfill body will significantly reduce the possibility of fires and explosions within the landfill body,
• Constructing ancillary buildings and facilities will generate a certain number of new jobs (c.30) whereby the local population will be given precedence in employment.

4.2. IMPACTS ON FLORA AND FAUNA

The biotope of the future landfill site is neither an endangered nor a rare type of biotope that would require protective measures. There are no environmentally significant areas in the project zone (the protected landscape Konjuh is 5.7 km away). The construction, exploitation and capping of the landfill will not interfere with the wildlife habitats and thus there is no need for the implementation of measures, methods and technical means that would contribute to the well-preservation of the species and that would least disturb the wild life and their habitats.

There are no projections that the construction of RSL will have immediate adverse impacts on the autochthonous flora and fauna on the site. Namely, the project will develop the RS site thus improving conditions for the growth and development of flora and fauna. Despite the fact that the probability of adverse impacts of the project on flora and fauna is low, it is important to single out the possible negative impacts during the construction and exploitation phase of the RSL.

4.2.1. Possible impacts on flora and fauna during the RSL construction phase

Possible negative impacts on flora and fauna during the construction phase may occur in the following cases:

• Increased level of noise during the construction,
• Increased emission of flue gases and solid particles resulting from the construction machine and transportation vehicle operation,
• Scattering of solid material,
• Occurrence of accidents (fires, explosions...etc.) during the construction

4.2.2. Possible impacts on flora and fauna during the RSL exploitation phase

Possible negative impacts on flora and fauna during the exploitation phase may occur in the following cases:

• Increased level of noise from resulting from operations at the landfill site,
• Occurrence of accidents (fires, explosions, failures at the degasification system...etc.).

The positive impacts on flora and fauna of the RSL construction project are reflected through the following:
• The plan is to build a fence around the landfill which will prevent rodents and other animals from entering the landfill body and thus hinder uncontrolled scattering of waste and spreading of diseases,
• The project foresees for the whole landfill site to undergo horticultural development after the capping of the landfill. This will open the door to new flora and fauna development at the site.

4.3. IMPACTS ON GROUND AND SURFACE WATERS

The RSL construction project plans for the construction of a system for collection and drainage of leachate as described in the previous sections of this document. The system will collect and recirculate the leachate from the landfill body.

After the construction of the upper liner, the rainfall from the landfill body and the surrounding surfaces will be collected through a rainfall collection and drainage system. This way, the rainwater will not come into contact with the waste and no contamination will occur.

Furthermore, the project provides for the construction of separate systems for collection of clean rainfall from roofs of buildings and non-work surfaces, system for collection and treatment of rainwater from work surfaces and the system for collection and treatment of sewage waste water. The possible negative impacts on ground and surface waters are presented below.

4.3.1. Impacts on ground and surface waters in the landfill construction phase

Possible negative impacts on ground and surface waters in the RSL construction phase may occur in the following cases:
• In case of uncontrolled leakage of fuel, oil and lubricants from construction machines and transportation vehicles,
• In case of accidents that occur while handling hazardous liquid materials,
• In case of irregular waste disposal on green and other areas during construction works,
• In case of improper treatment and drainage of waste waters generated during the construction phase of the landfill and the accompanying buildings.

The treatment and disposal of waste waters during the construction phase needs to be in accordance with the Construction Waste Management Plan and the Construction Site Organization Plan that the investor must draw up.

4.3.2. Impacts on ground and surface waters in the landfill exploitation phase

The RSL construction project provides for the construction of all necessary systems in order to minimize the negative impacts of waste disposal on ground and surface waters. The possible negative impacts on ground and surface waters in the exploitation phase may occur in the following accidental situations:
• In case of penetration of contaminated leachate into the soil,
• In case of failures in the system for collection, drainage and recirculation of contaminated leachate,
• In case of failures and damages to the system for treatment of rainwater from work surfaces and sewage waste waters,
• In case of spillage of contaminated leachate due to the improper size of the leachate collection pool
• During accidental leakage of hazardous liquid materials onto surfaces that have not been into the system for collection of manipulative rainwater.
The positive impacts of the RSL construction project on the ground and surface waters are reflected on the following:

- Building the leachate collection system will reduce penetration of contaminated water into the soil and the ground water at the site,
- Non-contaminated rainfall will be collected and drained through separate systems thus preventing their contamination,
- Rainfall from work surfaces and sewage waste waters will be collected, treated and drained separately into the public sewage system,
- As part of landfill operation monitoring, the quality of waste waters and the quality of water from the nearest surface flows and sources will be monitored. This will result in prompt identification of potential water contamination.

4.4. IMPACTS ON AIR

The impacts of the project on the quality of air will be briefly reflected during the landfill construction phase as the operation of machinery will result in the emission of smoke and particulate matter. This is an imminent occurrence and as such is only temporary, leaving a short-term impact at the construction site itself without long-term and permanent impacts on the environment.

After the construction of the landfill, the possible occurrence of negative impacts will be brought to a minimum since the disposed waste is covered by inert material on daily basis and a landfill gas collection system is installed, as described in the previous sections of this document.

4.4.1. Impacts on air during the RSL construction phase

Possible negative impacts on air may occur in the following cases:

- Increased emission of flue gases (CO2, SO2, NOx... etc.) and solid particles due to the operation of construction machines and transportation vehicles,
- Increased emission of dust and solid particles during construction works,
- Accidents (fires, explosions...etc) that may lead to large emission of hazardous substances into the air.

4.4.2. Impacts on air during the RSL exploitation phase

The project provides for the implementation of all necessary measures and the development of required systems (daily covering of disposed waste, construction of a gas collection system, construction of an upper liner after the capping of the landfill) in order to bring the negative impacts of waste disposal onto the air to a minimum.

Possible negative impacts on air during the RSL exploitation phase may occur in the following accidental cases:

- Increased emission of flue gases and solid particles in cases of failures and improper operation of the machines and combustion engines,
- Increased emission of dust and solid particles in case of irregular handling and disposal of household and other waste,
- Emission of harmful gases from the landfill body in case of failure of the landfill gas collection and drainage system.

The positive impacts of RSL construction on the air is reflected on the following:

- The construction of the gas collection system will bring about controlled collection and drainage of gas generated in the landfill body. This will prevent uncontrolled emission of
landfill gas in the air and uncontrolled collection of gas in the landfill body which might lead to fires and explosions.

- Waste disposal will be sanitary meaning that the layers of disposed waste will be covered by inert material. This is aimed at preventing odours arising from the disposed waste,
- After the regional sanitary landfill is put in operation and the landfill is capped, the landfill body will be closed by constructing an upper liner which will be subjected to reclamation and landscaping.

4.5. IMPACTS ON SOIL

The negative impacts of solid waste on the soil may vary and may lead to serious and occasionally permanent consequences on the soil. These consequences may include:

- Soil infection which implies that harmful microorganisms (bacteria, viruses...etc.) have entered the soil and may later cause infections both to people and animals. This is present in urban and suburban areas where infected animals move about or where their carcasses are buried.
- Soil contamination is the entering of various pollutants into the soil such as heavy metals, pesticides, biocides, cancerous hydrocarbons that reach the soil through the disposal of solid waste and medicine and whose presence leads to the changes in the soil’s chemical and biological features.
- Furthermore, physical impacts of waste on the soil is witnessed through the pressure that the waste exerts on the soil leading up to the collapse of the upper levels of the disposed waste. The impacts on the surrounding soil may be demonstrated through depositing of dust, vapour and aerosols due to wind gusts. This impact depends on the wind rose and wind speed as well as the size of the waste disposal site.

4.5.1. Impacts on soil during the RSL construction phase

In view of the fact that this is already a degraded area, the construction of the landfill and the accompanying buildings will not bring about the degradation of the soil surrounding the landfill.

Possible negative impacts on soil during the RSL construction phase may occur in the following accidental cases:

- In case of uncontrolled leakage of fuel, oil and lubricants from construction machines and transportation vehicles, which leads to soil contamination,
- Degradation of the surrounding land during landscaping of the landfill site,
- In case of accidents that occur while handling hazardous liquid materials and leakage of liquids into the soil,
- In case of irregular disposal of waste and other hazardous materials on green and unprotected areas and their contamination,
- Improper treatment and drainage of waste waters that are generated during the RSL construction phase may also lead to soil contamination.

4.5.2. Impacts on soil during the RSL exploitation phase

There is a very small probability of occurrence of negative impacts on the soil in the RSL exploitation phase. The negative impacts may occur primarily in the following accidental situations. Possible negative impacts on soil during the RSL exploitation phase may occur in the following accidental cases:

- In case of penetration of contaminated leachate into the soil and its contamination,
- In case of penetration of contaminated leachate into the soil due to failures and damages to the system for collection, drainage and recirculation of contaminated leachate and the
system for collection and treatment of rainwater from work surfaces and sewage waste waters,

- In case of spillage of contaminated leachate into the soil due to the improper size of the leachate collection pool,
- During accidental leakage of hazardous liquid materials onto surfaces that have not been into the system for collection of manipulative rainwater.

The positive impacts of RSL construction project on the soil is reflected on the following:

- The project provides for the construction of a system for collection and treatment of all types of waste waters (leachate from the landfill body, rainfall from work surfaces and sewage waste waters). This will prevent contamination of land and soil at the landfill site.
- The plan is to build a fence around the whole landfill site which will prevent unauthorized access of people and different animals to the landfill site and thus hinder uncontrolled scattering of waste onto the surrounding land,
- During the construction of the landfill and the accompanying facilities, necessary measures will be undertaken regarding terrain stability which will result in complete terrain stabilization and prevent further land degradation at the site.

### 4.6. IMPACTS ON CLIMATE CHANGE

In view of the operational processes that will take part at the landfill after its construction, the process of the construction itself and the illustrated technology to be used for RSL exploitation as well as the location of the project implementation, we can conclude that they will not have negative impacts on the climatic features of the region.

This conclusion is based on the fact that the planned activities within the scope of the project do not represent sources of emission that might have a negative impact on climate factors.

During the landfill exploitation phase, there will be processes (construction machine and transportation vehicle operation) which will emit a certain amount of exhaust flue gas (CO2, SO2, NOx etc.). However, the assessed amount and composition of the exhaust gases is insufficient to cause any negative impacts on climate factors in the vicinity or in the wider region.

### 4.7. IMPACTS ON MATERIAL ASSETS INCLUDING CULTURAL, HISTORICAL AND ARCHAEOLOGICAL HERITAGE

There are no significant natural landscapes nor remains of cultural monuments at the RSL site. The project will not have apparent impacts on the natural resources considering the location of the landfill. Namely, significant natural resources are located at a distance and the impacts of the project brought down to a minimum. Protected landscape Konjuh is located 5.7 km away.

### 4.8. IMPACTS ON LANDSCAPE

Considering the fact that RSL construction project will take place at a location that was the site of the tailings pond from Banovići coal mine, we can only talk about the positive impacts of the project on the landscape. The rehabilitation includes reclamation and landscaping of the whole landfill area in order to fully embed it into the existing landscape.

### 4.9. CORRELATION AMONG THE ABOVE FACTORS

Analysing the above factors of possible impacts (impact on population, impact on flora, fauna, air and soil, impact on climate factors, material assets together with cultural, historical and archaeological heritage as
well as the impact on landscape and protected parts of nature) and comparing them with each other, we can conclude that their interrelation will not cause significant negative impacts on the environment.

4.10. DESCRIPTION OF METHODS USED FOR ENVIRONMENTAL IMPACT ASSESSMENT

In view of the general methodological principles, this Study initially defined the following elements:

- Basis of research,
- General program elements
- Provisions of the current laws and by-laws (the content of the Study was defined by Chapter III, Articles 12-19 of the Regulation on facilities subject to obligatory environmental impact assessment and facilities which may be constructed and operated only with a valid Environmental Permit “Official Gazette of FBIH, no. 19/04),
- Spatial planning and project documentation,
- Regional characteristics

The largest bulk of the research was focused on quantifying and assessing the current situation and the technology to be used during the construction and exploitation of the landfill where it was noted that certain risks in the context of environmental impact are present. Therefore, the second part of the research includes specific indicators of possible impacts.

Those basic impacts that have proven to have established correlation between the project and the environment in concrete conditions are analyzed in details. On the ground of verified indicators, a research was conducted on the possibilities of protecting and improving the environment and adequate measures were proposed in order to rationally reduce the negative effects.

The Study used the methods of comparison, calculation and measurement of certain Study elements. The description of methods which includes the following, is given below:

- Immediate and indirect impacts,
- Permanent and temporary,
- Current and long-term
- Positive and negative.

Immediate impacts are project’s impacts on: arrogation of land, destruction of vegetation, contamination of soil, ground and surface waters and air pollution. Indirect impacts may cause more profound consequences than the direct ones.

Current impacts are the ones that have a short-term impact on the environment such as dust and noise during construction. Long-term impacts have irrevocable effects if no measures for rehabilitation are undertaken.

Thus, negative impacts are primary in the elaboration process while the positive impacts mostly relate to the population (social and economic effect), the quality of ground and surface water and the quality of air in the vicinity of the location.
5. DESCRIPTION OF MEASURES FOR MITIGATING NEGATIVE IMPACTS

In general, the measures for mitigating or preventing, reducing and alleviating negative effects on the environment are defined as:

- General mitigation measures,
- Specific mitigation measures and
- Technical mitigation measures

**General mitigation measures:**

In implementing the mitigation measures, the project investor / beneficiary shall:

- Abide by all relevant legislation relating to protection of water, air and soil in BiH both during the RSL construction and exploitation phase;
- Monitor and control all activities relating to the protection of water, air and soil during the preparation, construction and exploitation phase,
- Undertake necessary measures in case permissible emission limits are exceeded during the preparation, construction and exploitation phase,
- Inform relevant authorities and the public in case of serious accidents and impairment of water, air and soil quality during all of the phases,
- Build an access road for machines before initiating construction works and provide disposal sites at locations that would least damage the vegetation. After the conclusion of works, perform rehabilitation of the access road and remove excess construction and waste material from the area surrounding the newly built landfill,
- Perform frequent and controlled treatment of household and hazardous waste in a proper manner and ban any temporary or permanent disposal of such waste at the surrounding land. Also, provide leak-proof waste containers,
- Take an active part in public discussion within the local community to be organized by the Federal Ministry of Environment and Tourism in the process of obtaining an environmental permit for the RSL construction project.

**Specific mitigation measures:**

In implementing the mitigation measures, the project investor / beneficiary shall:

- Provide detailed information about the project to the local population to allow them to perceive all the aspects of potential impacts and take part in the decision-making process,
- Form emergency intervention teams. Before this is done, draw up adequate operational plans for emergency intervention in case of accidents,
- Pay special attention to watercourses due to the risk of contamination which would lead to the changes in the eco system’s life conditions. Changes to the physical and chemical characteristics of the water eco-system would directly reflect on the life of macrophytes and algae as well as to the overall trophic relationship.
Technical mitigation measures:

In implementing the mitigation measures, the project investor / beneficiary shall:

- Undertake rigorous measures and conditions for treatment of waste waters and implement projects that include a closed drainage system. That implies treating waste waters to the degree that its quality will correspond to the highest water quality level.
- Develop a project on leachate and rainfall waste water drainage for the whole location.
- The leachate needs to be collected through an adequate system into a leachate collection pool and the water should be returned into the landfill body.
- In case of leakage of the leachate, waste waters need to be treated to the quality level of urban waste waters. The leachate collection pool should be placed at a location that allows access to the tank vehicle to discharge the pool. Abidance of threshold emission levels for waste waters that are discharged into surface watercourses or the existing sewage needs to be harmonized with the relevant regulations. Our recommendation is to use the Decree on Conditions for Discharge of Wastewater into Natural Recipients and Public Sewer Systems (“Official Gazette of FBiH,” 04/12) as a guideline.
- Build an adequate system for controlled collection and drainage of landfill gases.
- Draw up a Report on Waste Treatment and a Report on Environmental Protection within the Main Design which would review and adopt the need for disposal of waste and earth material, oil spills...etc. The measures for mitigating negative impacts or the measures for preventing, reducing or alleviating adverse impacts on the environment may be perceived from the following two aspects:
  - Mitigation measures during the RSL construction phase and
  - Mitigation measures during the RSL exploitation phase.

5.1. MITIGATION MEASURES DURING THE RSL CONSTRUCTION PHASE

In order to mitigate the negative impacts during the RSL construction phase, it is important to undertake necessary measures. Such measures imply that the investor needs to implement a large number of activities.

The investor needs to carefully consider that the equipment and machinery used during construction works has minimum impact on the environment and the local population. This phase requires constant control over the work of construction machines, storage methods and handling hazardous and harmful materials as well as the control over construction waste management in accordance with the Construction Waste Management Plan and the Construction Site Organization Plan that the investor needs to draw up.

These plans need to include:

- Monitoring during the transportation of material (anticipated measures: transportation of sodden or covered load is aimed at reducing the emission of dust during transportation. This monitoring will be done on daily basis by the contractor and the supervising staff).
- Monitoring for unobstructed and safe traffic (monitoring traffic flow to the construction site and at the site itself in order to ensure unobstructed and safe vehicle and pedestrian movement).

Monitoring the emissions from the construction site and the state of environment within the construction zone (permanent control and monitoring of construction works will be conducted in order to prevent water and soil pollution. Furthermore, there will be monitoring of the machinery involved in construction works in order to prevent uncontrolled/accidental discharge of pollutants into the water, air and soil.
One of the relevant impacts during the construction phase is the noise made by the construction machines during construction works. However, it is important to underline that the construction site is located in an industrial zone and thus the noise will not have any impact on the population considering the distance of residential buildings from the construction site.

The investor will undertake the following measures to mitigate negative impacts during construction works:

- Wet or cover the dry, loose material that is being dispersed into the environment during transportation,
- Perform constant monitoring over the construction machines in order to maintain it in proper order (special attention must be paid to the proper work of the noise suppressor, oil installations, oil, lubricants...etc.)
- Prevent mud from being taken out onto the main road on the wheels of construction machines and cargo vehicles,
- Perform continuous monitoring of the Construction Waste Management Plan implementation that the investor must provide which will completely eliminate the possibility of soil contamination with oils, fuels and lubricants,
- Perform all works according to the technical documentation and devote special attention to the segments relating to environment protection,
- Prior to the launch of construction works, establish storage sites for easily flammable liquids and technical gases should they be required,
- The material used must be attested by the manufacturer and must be in accordance with the current regulations and standards,
- Works must be performed within the projected site area,
- Equipment installation and assembly must be performed in accordance with the manufacturer’s instructions on use, the technical drawings and the project descriptions,
- During construction works, it is important to undertake all measures stipulated by the current regulations on construction including occupational safety measures (liquid fuels and lubricants need to be kept in closed containers placed in appropriate locations). In case of oil and lubricant spillage, have the sawdust or other absorbent ready and undertake emergency construction measures,
- Collect the whole waste generated during this phase separately into a separate and appropriate packaging,
- The investor needs to authorize a person for implementing and monitoring environmental protection measures.

In order to eliminate and mitigate the negative impacts, the following activities are planned:

- Keep small amounts of construction waste for a short time at the locations designated for its storage,
- The construction waste will be used following the phase construction of infrastructural facilities. The unused waste will be finally disposed at a “determined” location in accordance with Construction Waste Management Plan that the investor will draw up prior to the launch of construction works,
- The construction site will have to be insured with necessary equipment and construction work resources. In view of the methods for the construction of landfill and the accompanying facilities, the constructors selected by the investor, will have to have sophisticated resources, equipment, use permit, skilled staff and required certificates.

The construction company (individually or as a consortium) engaged to perform construction works, needs to introduce a system or work in accordance with the environment management system as part of the general system of management, that ensures a systematic relation of the organization towards the
environment. The construction site needs to be organized in a manner where the accommodation and movement of vehicles and machines will strictly serve the function of the construction itself.

Liquid fuels and other liquid materials used in the construction need to be stored in closed containers placed in a secure location and if possible in an impermeable, covered tub. In case of fuel spillage, it is important to have sawdust or other absorbent at hand and to undertake emergency rehabilitation measures.

Furthermore, it is important to comply with the following:

- In case of accidental leakage of hazardous materials, the contaminated soil needs to be treated or removed to an adequate landfill,
- Ban spillage of liquid waste into the soil and the sewage system together with the uncontrolled disposal of chemicals intended for use during construction works,
- Reduce the degree of noise of the machines during construction to an admissible level and avoid the use of machines during the night. This also includes constant control of proper operation of machines.
- All construction waste needs to be immediately collected and disposed at a determined and developed location before it is driven off from the site.
- Design long enough entry and exit lanes so as not to hinder traffic on the main road.
- Roads, working areas and plateaus have to be adapted to relevant loads and protected by adequate road surface according to the traffic loads and technical and technological requirements and conditions stipulated by the relevant authorities.

Considering the reversible, short-term, spatial and time limited nature of the aforementioned impacts during the site preparation and construction phase, we can conclude that impacts will not cause adverse effects on the environment and health of the population.

5.1.1. Measures for mitigating impacts on flora and fauna during RSL construction phase

Certain types of flora and fauna will not be specifically affected by the erection of a construction site for the construction of the landfill.

During disposal of the excavated waste and materials attention needs to be focused on subsequent landscaping in accordance with the current regulations.

5.1.2 Measures for protection of soil, surface and ground waters during the RSL construction phase

The constructor should be required to use biodegradable lubricants for its machines and biodegradable oils for its gearboxes in order to reduce the potential for soil contamination and accidental spillage during construction works to a minimum.

Special attention should be devoted to activities that might act as potential pollutants:

- Transportation and refuelling
- Storage of hazardous material and mineral oils,
- Parking area for machines and vehicles
- Temporary disposal site for hazardous materials.

If waste water contaminated beyond the threshold parameters for drainage of waste waters directly into water-sources or sewage system appears during construction works, the water treated to a required level before it is released into the water-source.

Appropriate storage and handling of petrol, diesel, lubricants and paints needs to be defined during the landfill construction phase. Avoid leakage of substances hazardous for the water such as oils or lubricants. In case of uncontrolled spillage, undertake emergency cleaning measures. The same applies to the local borrow pits that could be selected during the Main design development phase.
Before leaving the construction site, all transportation vehicles and machines need to have their wheels and the underfloor washed.

This is done to prevent scattering of waste and hazardous materials outside the construction site. The easiest way to do the washing is to use a mobile wheel washing device.

The device is placed at the landfill site exit and the wheels are washed after the vehicle passes over the washing platform.

An advantage to this form of device is that the dirty waters from the washing do not end up in the environment but are rather drained into a collection tank through a closed system and then transported for further treatment with a storage tank.

In addition, the following measures should also be indicated:

- In case of irreversible soil contamination with hazardous materials, the contaminated terrain needs to be excavated, temporarily stored into barrels and treated as hazardous waste.
- Uncontrolled changing of motor oil, refrigerants and car batteries on all vehicles is prohibited.
- Washing of vehicles and vehicle parts is prohibited at the site (with the exception of the aforementioned wheel washing device).
- All outlets into surface waters or the sewage system need to be closed/sealed.
- Control storage of waste and secondary raw materials.
- In case of uncontrolled leakage of processed media, ensure containers and materials to prevent higher degree of contamination such as sand, sawdust, polystyrene and degreasers. Such collected waste and soil needs to be treated as hazardous waste.

5.1.3. Measures to mitigate impacts of noise during RSL construction phase

During the construction of the landfill, there is undoubtedly an increased level of noise exceeding 90 dB (A) due to the use of construction machines (digger, excavators, bulldozers, air compressors...etc.) and transportation vehicles (lorries). However, this noise is solely connected with the construction site which is far away from a residential area and thus the following measures should be undertaken:

- Keep strict records on technical soundness of the construction machines and transportation vehicles (notably their exhaust systems and mechanical compositions) and eliminate defective machines/vehicles from construction works.
- Monitor the use of protective equipment by the workers on the construction site.
- Conduct construction works until 18h latest in one extended shift.

The Law on Noise Protection (“Official Gazette of FBiH,” no. 110/12) establishes permissible levels of noise, noise protection measures and noise measuring methods.

5.2. MITIGATION MEASURES DURING RSL EXPLOITATION PHASE ACCORDING TO BAT GUIDANCE NOTES

This item will give an overview of the measures to be undertaken in order to prevent negative impacts of the RSL during its exploitation phase.

The relevant local regulations regarding environmental protection, the EU Landfill Directive 1991/31/EC and the Final draft BAT Guidance Note on Best Available Techniques for the Waste sector: Landfill Activities, hereinafter BAT, were taken into consideration in defining these measures.

5.2.1. General measures

According to BAT, the handling and disposal of waste at a landfill includes the following primary measures:

- Financial provision for environmental liabilities (known and unknown), including restoration and aftercare.
- Landfill design for each type of landfill and operation as per the Landfill Directive including:
  - Water control;
leachate management;
an appropriate landfill lining system;
an appropriate landfill capping system;
appropriate measures for the prevention & management of landfill gas.
- Construction Quality Assurance (CQA) for construction of landfill lining systems.
- An Environmental Management System (EMS) that incorporates the following features:
  ✓ Management and Reporting Structure;
  ✓ Schedule of Environmental Objectives and Targets;
  ✓ Annual Environmental Report (AER);
  ✓ Landfill Environmental Management Programme (LEMP);
  ✓ Documentation System;
  ✓ Corrective Action Procedures;
  ✓ Awareness and Training Programme;
  ✓ Communications Programme;
- Appropriate storage and handling of construction materials, consumables and wastes.
- Emissions management.

5.2.2. Measures for mitigating impacts on water and soil during the RSL exploitation phase
The following is BAT for discharges to surface water:
- Only roof-water and water from undisturbed unpaved areas are appropriate for direct
discharge to surface waters and sewage systems.
- No untreated trade effluent shall be discharged direct to surface water and sewage system,
- Waste waters being discharged into the surface water after treatment need to meet limit
values for hazardous materials as stipulated by relevant regulations,
- The provision of infrastructure to allow for isolation and monitoring of surface water
discharges.

Measures relating to discharge into the sewage system:
- Before being discharged into the sewage system, the waste waters need to meet threshold
values as stipulated by relevant regulations,

As stated in previous chapters of this document, the system of collection and discharge of roof-water
from undisturbed surfaces and within the landfill body as well as the system for collection, discharge and
treatment of roof-water from working areas, will be constructed at the landfill site.

Furthermore, a system for collection, discharge and recirculation of leachate in the landfill body in order
to prevent penetration of leachate into the soil and ground water. These waters are collected, discharged
and returned into the landfill body through a common system.

Measures relating to discharge into the ground water:
- Prohibit direct emissions to groundwater of effluents containing certain hazardous
substances, and apply strict controls to prevent indirect emissions
- Prevent disposal of waste or other materials in a manner that might lead to a discharge of
harmful particles into ground waters,
- Remove risks of emissions to groundwater through appropriate controls such as
containment, bunding, construction of capping... etc.,
- Provide groundwater monitoring to enable early detection of any contamination of
groundwater that may arise from the facility.

As stated earlier, the RSL construction project provided for the construction of a system for collection,
discharge and recirculation of leachate as described in previous chapters of this document. The landfill
rim will include a system for collection and discharge of leachate that will then be collected and
discharged into a leachate collection tank. The water will be returned from the tank into the landfill body
through a leachate recirculation system.
In order to reduce the negative impacts on water and soil, the following measures should be undertaken:

- Construct the internal sewage system full from water-tight material,
- All catchment areas that are exposed to contamination must be impermeable,
- Roof-water from traffic areas and parking lots need undergo through treatment facility, oil and lubricant separator before they are discharged into the sewage system,
- All traffic areas need to be curbed and sloped towards impermeable catchment areas for collection of roof-water
- Act according to the Water Management permit,
- Regular discharge and at least annual control of the efficiency and functionality of the separator parts are mandatory.

Perform testing of technical integrity and water-tightness of the internal discharge system before the facility is put into operation.

- Perform adequate treatment of sludge from the separator and treatment facilities (signing of an service contract with an authorized company for hazardous waste treatment),
- Maintain roof-water and leachate sewers clean,
- Roof-water and leachate tailrace should have inspection panels that are used for unobstructed sampling and measuring of the flow,
- perform adequate storage of oils and lubricants used in the process,
- Perform adequate treatment of waste oils, lubricants and packaging (service contract with an authorized company for hazardous waste treatment),
- before exiting the landfill site, all trucks and transportation vehicles need to have their wheels and underfloor washed. This is done by means of a special device for wheel washing as described in the previous sections of this document.

All systems for discharge and storage of waste waters need to have water-tightness attest and need to be re-examined every five years by an authorized institution. All activities must be done in accordance with the Water Management Permit obtained from a relevant institution.

5.2.3. Measures to mitigate impacts on air during the RSL exploitation phase

This negative impact of the landfill is reflected in the emission of gases generated in the landfill body into the air and the emission of odours into the environment.

According to BAT, the measures to mitigate impacts to air include:

- Construction of adequate and good-quality system for collection and treatment of landfill gas,
- Maintain negative air pressure in the landfill gas extraction wells,
- Use of horizontal and vertical landfill gas extraction wells,
- Regular monitoring of landfill extraction well field, balancing of wells and elimination of non-design condensate traps,
- Use of horizontal landfill gas collection pipe-work at the top of the side wall riser,
- Provide landfill gas management systems,
- Control the combustion conditions of enclosed flares, in terms of the carbon monoxide concentration, temperature and retention time by ensuring that combustion occurs at 1,000°C with a product retention time of 0.3 seconds within the combustion zone.

As stated earlier, the RSL construction project provided for the construction of a system for collection and discharge of gas generated within the landfill body as described in previous chapters of this document

The aforementioned system fully meets the listed measures and requirements. It is assessed that the gas collection system with flares for gas combustion will be satisfactory for the landfill in matter. The Main Design will provide detailed estimates and will thus establish the capacity and the type of gas collection system.
Regarding the odours being generated at the landfill, it is important to ensure that the odours do not have significant impacts outside the landfill site.

According to BAT, the measures to mitigate impacts of odours include:

- Develop and operate of an Odour Management Plan,
- Minimise the open tipping face area,
- Promptly compact and cover wastes with appropriate daily/weekly/intermediate or final cover,
- Immediately bury odorous wastes,
- Restrict tipping activities during periods of adverse weather,
- Upgrade and seal of sump covers,
- Aerate leachate storage areas,
- Improve landfill gas collection, venting and combustion systems,
- Consider the use of auxiliary fuels during periods when the rate of landfill gas production alone is insufficient to allow the operation of landfill gas combustion equipment (case of active gas collection system).

The project provides for a complete seal-off of all open tipping face areas which will result in minimization of odour impact. Regardless of this fact, the above measures need to be complied with and implemented.

However, despite the fact that this a good quality solution regarding air emissions, a periodical evaluation of air quality will be conducted at the landfill location as part of the mitigation and prevention measures. This way, the qualitative and quantitative indicators of possible, unexpected air pollution will be perceived. In addition to the aforementioned, it is important to maintain the working and technical discipline of the staff during the capped landfill phase as well as establish and regularly implement environmental monitoring, continuously perform staff training on environmental protection and draw up special operational plans for protection from accidental situations.

In addition to the aforementioned, the following measures should also be observed:

- Use a cover over the loading part of the vehicle during transportation of crushed material in order to prevent generation of dust,
- Regularly control the proper working order of the vehicles and equipment used at site with regards to the combustion system,
- Wet the inert material used as daily waste cover during dry periods,
- Conduct regular control and monitoring of the animal waste incinerator.

5.2.4. Measures mitigating the impacts of noise during RSL exploitation phase

During the exploitation of the landfill, there is undoubtedly an increased level of noise exceeding 90 dB (A) due to the use of construction machines (digger, excavators, bulldozers, air compressors...etc.) and transportation vehicles (lorries). However, this noise is solely connected with the construction site which is far away from a residential area and thus the following measures should be undertaken:

- Keep strict records on technical soundness of the construction machines and transportation vehicles (notably their exhaust systems and mechanical compositions) and eliminate defective machines/vehicles from construction works.
- Monitor the use of protective equipment by the workers on the construction site.

In this case, there is no need to apply special mitigation measures although the employees are obliged to wear protective equipment (antiphones) when using tools and machines that produce noise above 90 dB (A) in accordance with the regulations on occupational safety.
5.2.5. Mitigation measures in case of accidents during the RSL exploitation phase

Appropriate actions and procedures should be established in case of accidents.

One of the greatest chances of accidents is fire eruption alongside the possibilities for floods, earthquakes, spills, effusion or explosion of hazardous materials. The following preventive measures need to be undertaken:

- Installing an effective fire-fighting system with a fire alarm and extinguisher system,
- Labelling and special handling of hazardous and easily inflammable material,
- Proper scaling and designing of the waste water discharge system,
- Designing and conducting construction works in accordance with geological, geomechanical, seismological and erosive characteristics of the site,
- Educating and training of staff.

One of the important measures to reduce the incidence of fires is the implementation of measures stipulated in the Fire Protection Report. Therefore, the following needs to be done:

- Perform training and conduct testing on fire protection among staff at least once a year in accordance with the regulations in the field,
- Ensure a sufficient number of fire extinguishers at the locations defined under the Report
- Regularly control accesses to internal and external hydrants,
- Ensure proper working order and maximum coverage of the fire-alarm system,
- Conduct all other measures stipulated in the Report.

In case of an accident (fire, flood, spillage of hazardous material into the working area...etc), the following needs to be undertaken, depending on the type and scope of impact on the environment:

- Conduct emergency intervention
- Evacuate the staff through the nearest evacuation routes and act in an organized manner,
- Provide necessary first aid and call the relevant services (ER, fire-fighters...etc),
- In case of spillage of hazardous substances into the working area, the substances need to be diluted, neutralized and absorbed.

The above mentioned activities and treatment needs to be performed by a professional using prescribed protective equipment and according to previously established procedures.
6. DESCRIPTION OF MONITORING MEASURES

As defined by the Law on Environmental Protection, monitoring is a term that implies observation and control of environmental conditions and systematic measuring of certain quality parameters of elements or integral components of the environment at selected locations and related procedures of supervision intended to detect changes in the environment in the context of such parameters.

6.1. DESCRIPTION OF MEASURES FOR MONITORING WASTE GENERATION AND MANAGEMENT

Monitoring of waste quantities during the RSL construction and exploitation phase as well as the pace of waste generation shall be conducted by using special forms whereby the types of materials, quantities, entrance and exit dates and remarks will be noted down. It is important to submit the forms containing incorporated data on waste quantity to the relevant ministry after the construction of the landfill in order to ensure insight, records and cross-check of waste disposal. Furthermore, these waste related forms drawn up during the exploitation phase shall be submitted regularly to the relevant ministry.

Treatment of certain types of waste should be conducted in the following manner:

- Treatment of construction waste (17 01... possibly hazardous waste) generated during construction of the landfill will be conducted in accordance with the technical documentation. This is the duty of the contractor in accordance with construction works contract while the workers or the supervising engineer are obliged to conduct control and supervision over construction works.
- Treatment of non-hazardous waste (metal, plastic or paper) that can be reused, will be collected separately and disposed in designated metal or plastic containers. The waste will then be handed over to an entity authorized to collect this type of waste. The Investor will sign a contract with an authorized company to collect this type of waste.
- Handling household waste (20 01... possibly hazardous waste) will include disposal of the waste into special containers within the landfill site which will then be systematically disposed into the landfill. Disposal of other, separately collected waste into the household waste containers will not be allowed (Report on waste generation and flow).
- Handling packaging waste (15 01...possibly hazardous waste) will include disposal of this waste into containers labelled “NON-HAZARDOUS PACKAGING” and “HAZARDOUS PACKAGING”(plastic and other types of boxes, oil and lubricant packaging, packaging containing chemicals...etc) and handed over to an authorized, contracted company.
- Waste car batteries and other types of batteries are classified as hazardous waste. They are declared as harmful for the fact that they contain elements such as mercury, cadmium, lead, copper, selenium, lithium, beryllium and boron. Due to these hazardous materials, relevant actions must be undertaken to prevent uncontrolled disposal and danger of environmental pollution. Considering its specific nature, this type of waste should be disposed into separate, designated containers. The hazardous waste storage should include a special container for disposal of old car batteries and other types of batteries. An authorized company for collection of this type of waste from the location should be contracted (Report on battery and car battery waste generation and flow).
- Electric and electronic (EE) waste is the discarded electric and electronic equipment that includes compositions and spare parts. Disposal of EE waste should be conducted in accordance with the regulations and maximum environmental protection measures. As with car batteries, the hazardous waste storage site should include a container for disposal of this type of waste which will later be adequately treated. An authorized company should be contracted to collect and treat this type of waste.
• Waste oils may be oils from workshops or cooking oil. Treatment of waste oils will be regulated between the investor and the authorized company for collection of this type of waste. Records on waste oils must be maintained.

• Waste tyres are tyres from operating machines and specialized devices that are not in use any more due to damage, wear out, expiry or any other reason and have to be discarded. In view of the fact that there is no organized treatment of waste tyres on the level of the state or the Federation BiH, the problem with old tyres at the site will be resolved by having temporary disposal at the site. An authorized company will be contracted to collect the waste from the site and the company will issue a certificate on final treatment of this type of waste.

• Liquid collection fillers will be used in case of minor leakage of oils and fuels. The admixture with collected (soaked) liquids will be temporarily stored in the hazardous waste storage into water-tight containers and further treated by the authorized companies. The filler containers will be placed at accessible locations for the staff tasked to undertake emergency actions in case of minor leakages.

According to the Regulation on Selective Collection, Packaging and Labelling of Waste (Official Gazette of the FBiH, no. 38/06), the waste producer needs to hold documents on transportation of waste which will be returned to him by the authorized operator contracted to collect and treat hazardous waste (Report on Waste Transportation)

6.1.1. Description of monitoring measures during the RSL construction phase

6.1.1.1. Monitoring air emissions during landfill construction phase

It is important to draw up an Air Monitoring Project – interference to the environment during construction works. The project on monitoring air pollution during the construction phase needs to includes, in addition to the general part, the following data and annexes:

• The selection of monitoring sites in relation to the assessment of potential threats to the environment as assessed by the project designer.
• Location, description, purpose and distance of the facility to be monitored.
• Operational plan for implementation of measures which will depend on the operation plan of construction works.
• Measures have to be implemented during the highest intensity of construction works.
• Means of conducting measuring and monitoring.
• Drafting of reports and including the names and the addresses of the institutions that the reports are to be submitted.

The monitoring project will be designed by a company qualified and authorized by the relevant ministry. The report needs to include all necessary data and results as follows:

• the name of the responsible person from the investor’s side (or the contractor, depending on the contract requirements) tasked to implement the provisions of the Monitoring Project as well as other data and provisions important for the regularity of the monitoring.

The monitoring project and the report on measuring must be submitted to the relevant ministry.

Dust monitoring will be conducted in a manner whereby 3 samplings and an analysis will be done at a single site during a 3-month period. Dust sampling will be done every 8 hours.

6.1.1.2 Monitoring water quality during the RSL construction phase

No actions or activities will be undertaken during the construction of the landfill that will result in the generation of waste waters. The construction works itself will not impact the surface and ground water at the landfill site.
In view of the above and considering that there will be no discharge of water into the water supply or sewage system, no water monitoring is necessary.

6.1.1.3 Monitoring the level of noise in the RSL construction phase

The construction and other machine operation at the construction site might be the source of noise in the environment. In addition to the general parts, the noise monitoring project during the landfill construction phase needs to include the following data and annexes:

- The sensitivity level/s of the region.
- Noise level limits for the region.
- Location, description, purpose and distance of the facility to be monitored.
- Operational plan for implementation of measures which will depend on the operation plan of construction works.
- Measures have to be implemented during the highest intensity of construction works.
- Means of conducting measuring and monitoring.
- Drafting of reports and including the names and the addresses of the institutions that the reports are to be submitted.

The report needs to include all necessary data and results as stated in the regulation:

- the name of the responsible person from the investor’s side (or the contractor, depending on the contract requirements) tasked to implement the provisions of the Monitoring Project
- Other data and provisions important for the regularity of the monitoring.
- The report on noise measuring during the landfill and accompanying facilities construction phase needs to include data on the following:
  - person conducting the measuring,
  - reporting entity and his business activity,
  - main technical characteristics of the source of noise,
  - the working condition of the noise source during measuring,
  - noise measurements used,
  - emission locations and monitoring period,
  - measuring methods and calculation of noise level equivalents,
  - measuring of day and night peak levels of noise alongside the background levels
  - comparing noise parameters with the stipulated noise level limits.

Using the conclusions of the monitoring report, the person responsible for monitoring during construction needs to intervene in order to reduce the noise emission levels at the construction site. The monitoring project and the monitoring results need to be submitted to the:

- Ministry of Environment and Tourism of the Federation of BiH.

The Law on Noise Protection (“Official Gazette of FBiH,” no. 110/12) establishes permissible levels of noise, noise protection measures and means of measuring noise levels. The noise level limits are harmonized with the area allocation and thus do not endanger the lives, the health and the work of people.

Considering that the location is in the industrial zone, it is important to comply with the stipulated admissible levels of noise.

The noise monitoring should include three locations during a three month period. The measuring of noise levels will be conducted on hourly basis. The day period should be considered from 6:00 a.m. to 22:00 p.m. and the night period from 22:00 p.m. to 6:00 a.m. The L1 ceiling levels are the exceeded noise levels for 1% of the total measuring time, during the day or night.

6.1.2 Monitoring Plan during the RSL construction phase
The Monitoring Plan includes monitoring and measuring of the key characteristics of the RSL construction that might have negative impact to the environment. The Plan is adopted on annual basis and a person tasked to implement the plan is appointed.

The aims of developing a Monitoring Plan for the operator are to monitor the impacts on the environment or:

- To monitor the changes in the environment and the impacts on living organisms in order to point out to the decrease in pollution;
- To locate and follow the samples in order to undertake corrective and preventive measures;
- To evaluate its harmonization with the relevant regulations.

The basis for the Monitoring Plan is the Law on Air Protection (“Official Gazette of FBiH,” no. 33/03 and 4/10), the Law on Environmental Protection (“Official Gazette of FBiH,” no. 33/03 and 72/09), the Law on Noise Protection (“Official Gazette of FBiH,” no. 110/12) and the Law on Waters (“Official Gazette of FBiH,” no. 12/05).

Furthermore, the Plan also took into consideration the by-laws of the Law on Environmental Protection:

- Regulation on Air Quality Monitoring and Definition of Pollutants Types, Limit Values and Other Air Quality Standards (The Official Gazette of FBiH, 1/12),
- Regulation on limit values for emissions into the air from combustion plants (“Official Gazette of FBiH” No. 3/13),
- Rulebook on Air Quality Monitoring (“Official gazette of FBiH,” 12/05),
- Decree on the Conditions for Discharge of the Wastewater into the Natural Recipients and Public Sewer Systems (The Official Gazette of FBiH, no. 4/12),

The following table present the Monitoring Plan for the RSL construction phase in accordance with the current regulations and deadline for implementation of activities.
<table>
<thead>
<tr>
<th>Activity type and location</th>
<th>Air quality</th>
<th>Noise</th>
<th>Waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitoring air quality:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measuring the quality of air at the landfill construction site</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monitoring noise levels:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At the site, on the brink of the construction site and in the nearest residential area</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monitoring waste generation and management:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complete construction site</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Types of measurements and parameters</th>
<th>Parameters being measured:</th>
<th>Parameters being measured:</th>
<th>Parameters being measured and monitored:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- NOₓ, SO₂, CO, O₃</td>
<td>Equivalent noise levels for day and night</td>
<td>Waste type and quantity being generated in the construction phase (hazardous and non-hazardous)</td>
</tr>
<tr>
<td></td>
<td>- Solid particles (dust)</td>
<td></td>
<td>- Means of transportation and temporary storage</td>
</tr>
<tr>
<td></td>
<td>Meteorological parameters: wind direction and speed, humidity, air pressure</td>
<td></td>
<td>Collection by an authorized company</td>
</tr>
</tbody>
</table>

| Activity frequency | Four times a year starting from the launch of construction works | Four times a year starting from the launch of construction works | Daily activities |
|                   |                                                               |                                                               |                 |

<table>
<thead>
<tr>
<th>Activity agent</th>
<th>Authorized institution</th>
<th>Authorized institution</th>
<th>Contractor</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Reporting deadlines</th>
<th>Within 30 days from the day of measure implementation</th>
<th>Within 30 days from the day of measure implementation</th>
<th>Latest until January 31 for the previous year and after the conclusion of</th>
</tr>
</thead>
</table>

**Table 6.1 – Monitoring plan for the RSL construction phase**

Note: The person responsible for the implementation of the Monitoring Plan in the construction phase is the environmental manager.
6.1.3. Reporting during the RSL construction phase

According to the current legislation, the measuring of emissions is conducted by an authorized organization. The authorized company will submit reports on conducted measurements to the operator and the responsible person will submit the reports to the relevant institutions as indicated in the table below.

*Table 6.2 – Means of reporting on monitoring during the landfill construction phase*

<table>
<thead>
<tr>
<th>Name of Report</th>
<th>Dynamics - deadlines for submission of reports</th>
<th>Report-receiving institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Report on conducted measurements of air quality</td>
<td>Upon implemented measurements</td>
<td>- Federal Ministry of Environment and Tourism</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Relevant environmental protection inspectorate</td>
</tr>
<tr>
<td>Report on generated waste quantities</td>
<td>Latest until January 31 for the previous year and after the conclusion of construction work</td>
<td>- Cantonal Ministry of Spatial Planning and Environmental Protection</td>
</tr>
<tr>
<td>Report on noise level measurements</td>
<td>Within 30 days from the day of measure implementation</td>
<td>- Federal Ministry of Environment and Tourism</td>
</tr>
<tr>
<td>Summary report on all monitoring measures regarding the production and generation of waste and emissions</td>
<td>Latest until January 31 for the previous year and after the conclusion of construction work</td>
<td>- Federal Ministry of Environment and Tourism</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Relevant environmental protection inspectorate</td>
</tr>
</tbody>
</table>

The constructor or the supervisory body shall inform the Federal Ministry of Environment and Tourism on the collected data as stipulated under Article 8 of the Rulebook on Registries of Plants and Pollution (“Official Gazette of FBiH,” no. 82/07). The reports need to be sent within the deadlines set out in the table above.

The constructor or the supervisory body shall report immediately on each extraordinary situation that might have a negative impact on the environment.

6.1.4. Description of monitoring measures during the RSL exploitation and after-care phase

In order to monitor the conditions at the landfill and to anticipate the impacts on the environment after the construction, the plan is to establish monitoring during the exploitation phase and the closing of the landfill. The monitoring needs to be conducted in accordance with the legislation.

There are two types of necessary monitoring:
- Monitoring during landfill’s active operation, and
- Monitoring after the closing of the landfill.
Almost the same types of measuring and monitoring are conducted during landfill’s active operation and after the closing of the landfill. Monitoring following the closing of the landfill needs to be carried out for the next 30 years.

Piezometers intended for monitoring quality of ground water need to be installed as part of the fixed monitoring equipment. Other types of monitoring will be conducted (air, surface water, leachate...etc.) through measuring, sampling and analysing the samples in the lab.

The following parameters need to be monitored during landfill’s active operation as well as after the closing of the landfill:

- Meteorological data,
- Air emissions,
- Emissions into ground and surface water (measuring the leachate parameters),
- Impacts on ground water and
- The topography of the region (data on landfill body).

Based on the above monitoring, the control over the landfill’s operation and cross-check of the following parameters will be made possible:

- Are landfill processes proceeding as planned,
- Is the environmental protection system effective, and
- Are the landfill processes under control.

In addition to the aforementioned, monitoring of landfill management includes the following activities:

- Control monitoring at the landfill entry – weighing the weight at the weighing scale and recording its quantity, origin, the vehicle bringing the waste and the specific waste characteristics.
- Exit monitoring – visual control of vehicles and whether all vehicles exiting the landfill site have had their wheels washed.
- Control of landfill access – access is allowed only to authorized persons.
- Monitoring the means of waste disposal – this will guarantee the most efficient waste disposal with a minimum risk to the health of people and the quality of the environment.
- All employees need to report immediately any suspicious events at the landfill site. These can be related to the waste characteristics, possible fire eruptions, lighting of fire unauthorized access and any other activities that are in contrast with the standard activities at the landfill site.
- Daily control of leachate quantity in the collection tank in order to ensure efficiency of the leachate treatment through recirculation and evaporation.
- Monthly control of leachate quality. It is important to perform sampling and analysis of the leachate to verify the content of organic components HPK, BPK, ammonium, nitrates, total nitrogen, total phosphorous, electrical conductivity, pH, in order to monitor the physical and chemical process of waste decomposition within the landfill body and the quality of leachate.

6.1.5. Control of meteorological data during the RSL exploitation and after-care phase

It is recommended that the monitoring of the landfill operation includes collection of meteorological data at the landfill site or at the nearest meteorological station. The following measurements need to be conducted: measuring the quantity of precipitation, the air temperature, wind speed and direction, humidity and evapotranspiration. The measurements need to be in accordance with the regulations relating to the monitoring of hydro-meteorological data. The following table includes the frequency of certain measures. According to the 1999/31 EC Directive annex III, the measuring of certain types of meteorological data needs to be conducted in order to evaluate the source of the leachate or whether the leachate has originated in the landfill body or whether it is the case of precipitation.

The following table presents the data that needs to be recorded at the nearest meteorological station.
Table 6.3 – Meteorological parameters that need to be monitored in the landfill exploitation and after-care phase

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Measuring frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precipitation volume and intensity</td>
<td>On daily basis</td>
</tr>
<tr>
<td>Temperature (min, max, 14:00 CET)</td>
<td>On daily basis, on the same day in a month</td>
</tr>
<tr>
<td>Predominant wind direction and intensity</td>
<td>Monthly average</td>
</tr>
<tr>
<td>Evapotranspiration (lysimeter)</td>
<td>On daily basis, on the same day in a month</td>
</tr>
<tr>
<td>Atmospheric humidity</td>
<td>Monthly average</td>
</tr>
</tbody>
</table>

6.1.6. Air emissions during RSL exploitation and after-care phase

As with the construction phase, these phases also require the development of an Air Monitoring Project - interference to the environment during the landfill exploitation and after-care phases. The Air Pollution Monitoring Project during the landfill exploitation and after-care phases needs to include all the necessary information.

Measuring the emission of air pollutants from the landfill includes:

- Regular measuring of methane (CH4), carbon-dioxide (CO2) and oxygen (O2) in the landfill gas, in order to assess the degradation of biological degradable materials in the landfill body,
- Occasional measuring of the landfill gas composition depending on the content of H2S, H2 and other gases if these substances are present in the landfill gas in relation to the composition of the waste disposed,
- Measuring the emission of substances into air from idle engines with internal combustion from landfill gas incineration plants (if incineration and generation of electrical energy is performed).

If the results of landfill gas composition measurements are repeated the period between measurements may be extended but not longer than 6 months.

After the closing of the landfill, the measurement frequency is 6 months. The frequency rate for measuring landfill gas quality is indicated in the following table.

Table 6.4 – Frequency of landfill gas quality measurements in the landfill exploitation and after-care phase

<table>
<thead>
<tr>
<th>Type of measurement</th>
<th>During exploitation</th>
<th>After closing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas emissions and air pressure:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Methane CH4</td>
<td>On monthly basis</td>
<td>Every six months</td>
</tr>
<tr>
<td>- Carbon-dioxide (CO2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Oxygen(O2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- H2S (hydrogen sulphide)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- H2 (hydrogen)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6.1.7. Monitoring water quality during landfill exploitation and after-care phases

Measuring the emission of substances during the separation of the leachate and contaminated roof-water includes:
• Occasional measuring of leachate parameters,
• Occasional measuring of contaminated roof-water parameters from covered areas of the uncapped parts of the landfill and from its working areas including waste waters generated from washing of vehicles and other equipment at the landfill site,
• Occasional measuring of roof-water parameters or water from the covered areas of the capped parts of the landfill if these waste waters are not discharged, without mixing with other waste waters into the public sewage system or directly into the water or indirectly in the soil leachate.

The site for sampling of leachate and surface water needs to be representative. Sampling and measuring of leachate (flow and composition) must be conducted at every location where the leachate is separated from the landfill. Sampling must be done in accordance with ISO 5667-2 and the current legislation. If there is evidence that the longer intervals between measurements are equally effective, the frequency of measurements may be adjusted.

The frequency of leachate measurements is presented in the table below.

Table 6.5– Frequency of leachate measurements in the landfill exploitation and after-care phase

<table>
<thead>
<tr>
<th>Type of measurement</th>
<th>During operation</th>
<th>After closing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leachate quantities</td>
<td>On monthly basis</td>
<td>Every 6 months</td>
</tr>
<tr>
<td>Leachate composition</td>
<td>Every 3 months</td>
<td>Every 6 months</td>
</tr>
<tr>
<td>Quantities and composition of surface water</td>
<td>Every 3 months</td>
<td>Every 6 months</td>
</tr>
</tbody>
</table>

According to the “Decree on the Conditions for Discharge of the Wastewater into the Natural Recipients and Public Sewer Systems (The Official Gazette of FBIH, no. 04/12), “technological waste waters are waters arising from industrial and other manufacturing processes together with contaminated industrial, economic and other areas including traffic surfaces.” In view of the above, the waste waters from the RSL may be considered as:

• leachate originating in the landfill body and being collected in the collection tank that is, in case of overflow, taken by a cistern for emptying and transporting sceptic tank content, except in exception overflows when the leachate is discharged into a nearby drainage canal,
• roof-water from working areas that are collected and treated within the oil and lubricants separator before being discharged into the sewer system, and
• leachate under the landfill body that is generated in case of malfunction on the protection system.

Furthermore, according to the Decree (04/12) “the analysis of industrial waste water will be performed at the monitoring site during the technological process directly before its discharge into the public sewer system.” In view of this, the monitoring of waste waters should be conducted in two places:

• Monitoring site 1. The first two types of waste waters relate to one monitoring site – the public sewer system. In view of this, it is important to provide a monitoring site with an adequate manhole, sampling pipe and possibly a flowmeter.
• Monitoring site 2. In order to monitor possible generation of leachate under the landfill body, it is important to install a piezometer at a suitable location at the landfill brink placing it at the depth reaching the water-tight layer.

The exact number of required annual waste water quality measurements will be established once the unit per-capita loading is set for the facility according to the Decree (04/12).
The minimum number of waste water samples discharged from the waste water treatment plant and waters discharged from industrial entities whose waste waters predominantly include organic loads, is given in the table below according to the aforementioned Decree.

**Table 6.6 - Minimum number of waste water samples discharged from the waste water treatment plant and waters discharged from industrial entities whose waste waters predominantly include organic loads**

<table>
<thead>
<tr>
<th>Unit per-capita loading / population equivalent (PE)</th>
<th>Minimum number of samples in a year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 2.000 PE</td>
<td>4 samples during the first year</td>
</tr>
<tr>
<td>2.000 - 9.999 PE</td>
<td>12 samples during the first year; 4 samples during subsequent years if there is evidence that the waste waters from the treatment plant have met the requirements from the Decree; 12 samples have to be taken in the following year if any of the samples do not produce satisfactory results</td>
</tr>
<tr>
<td>10.000 - 49.999 ES</td>
<td>12 samples</td>
</tr>
<tr>
<td>50.000 and more ES</td>
<td>24 samples</td>
</tr>
</tbody>
</table>

The basic parameters of the analysis stipulated in the aforementioned Decree are temperature, pH, alkalinity, electrical conductivity, volatile residue, annealing loss, total suspended matter, HPK, BPK5, ammonium, nitrates, total nitrogen, total phosphorous and toxicity. Apart from the basis waste water quality parameters, it is important to analyse the heavy metals (Pb, Ni, Zn, Cu, Cd, Cr, Hg, As), lubricants and oils, mineral oils, detergents, sulphates, phenols, cyanides, sulphides, ToC, total aromatic hydrocarbons.

Considering that the potential overflow of waste waters would occur at the time of heavy precipitation, the leachate in the drainage canal would be significantly diluted thus reducing its negative impact on the environment. However, apart from the regular monitoring (Decree 04/12), this Study provides for monitoring at the moment of leachate discharge.

Automatic sampling, proportional to the flow should be performed and if not possible, sampling should be done every 15 minutes by recording the flow thus forming a composite sample. Sampling needs to be performed in one day during the production process (every 8, 16 or 24 hours).

As for monitoring site 2, monitoring of possibly present leachate should be recorded every 15 days. An analysis of the selected parameters should be conducted as they could serve as indicators of possible, uncontrolled leaching. These include: HPK, BPK5, ammonium, nitrates, total nitrogen, total phosphorous.

The analysis and assessment of industrial waste water quality may only be performed by an authorized lab whose authorization stands in accordance with the Law on Water.

### 6.1.8. Monitoring noise during the landfill exploitation and after-care phases

The operation of construction and other machines at the landfill site, the work of transportation vehicles bringing and disposing waste or any other process taking place at the landfill site may act as sources of noise in the environment.

The Noise Monitoring Project during landfill’s operational phase needs to include, in addition to the general parts of the project, all other required data as indicated in item 4.3.2.3 of this document.

The report on measuring of the noise level during the landfill exploitation phase needs to include data on:

- person conducting the measuring,
• reporting entity and his business activity,
• main technical characteristics of the source of noise,
• the working condition of the noise source during measuring,
• noise measurements used,
• emission locations and monitoring period,
• measuring methods and calculation of noise level equivalents,
• measuring of day and night peak levels of noise alongside the background levels and
• comparing noise parameters with the stipulated noise level limits.

The person responsible for monitoring during the exploitation of the landfill needs to intervene on the basis of the conclusions of the measurement report, in order to reduce the noise emission levels at the site. The monitoring project and the measuring results need to be submitted to the:
• Ministry of Environment and Tourism of the Federation of BiH.

The Law on Noise Protection (“Official Gazette of FBiH,” no. 110/12) establishes permissible levels of noise, noise protection measures and means of measuring noise levels. The noise level limits are harmonized with the area allocation and thus do not endanger the lives, the health and the work of people. Considering that the location is in the industrial zone, it is important to comply with the stipulated admissible levels of noise.

6.1.9. Monitoring the topography of the region – data on landfill body during the RSL construction and after-care phases

The landfill body parameter measuring frequency is presented in the table below.

<table>
<thead>
<tr>
<th>Type of measurement</th>
<th>During operation</th>
<th>After closing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landfill structure and composition (*)</td>
<td>Annually</td>
<td>Annual readings</td>
</tr>
<tr>
<td>Landfill body settlement</td>
<td>Annually</td>
<td>Annual readings</td>
</tr>
</tbody>
</table>

(*) Data to indicate the conditions at the landfill: area covered by waste, volume and composition of waste, disposal methods, time and duration of disposal, calculation of remaining landfill capacities.

6.1.10. Monitoring Plan during the landfill exploitation and after-care phase

The Monitoring Plan includes monitoring and measuring of the key characteristics of the RSL exploitation and after-care phase that might have negative impacts to the environment. The Plan is adopted on annual basis and a person tasked to implement the plan is appointed.

The aims of developing a Monitoring Plan for the operator are to monitor the impacts on the environment or:
• To monitor the changes in the environment and the impacts on living organisms in order to point out to the decrease in pollution;
• To locate and follow the samples in order to undertake corrective and preventive measures;
• To evaluate its harmonization with the relevant regulations.

The basis for the Monitoring Plan is the Law on Air Protection (“Official Gazette of FBiH,” no. 33/03 and 4/10), the Law on Environmental Protection (“Official Gazette of FBiH,” no. 33/03 and 72/09), the Law on
Noise Protection ("Official Gazette of FBiH," no. 110/12) and the Law on Waters ("Official Gazette of FBiH," no. 12/05). Furthermore, the Plan also took into consideration the by-laws of the Law on Environmental Protection:

- Directive on the Landfill of Waste -1999/31/ EC (Annex III.), Control and monitoring procedures in operation and after-care phases,
- Regulation on Monitoring of Pollutants Emissions in the Air ("Official Gazette of FBiH", no. 12/05),
- Regulation on Limit Values of Pollutants Emissions in the Air ("Official Gazette of FBiH", no. 12/05),
- Regulation on the Conditions for the Operation of Waste Incineration Plants ("Official Gazette of FBiH", no. 12/05 i 102/12),
- Regulation on Limit Values for emissions into the air from combustion plants ("Official Gazette of FBiH" No. 3/13)
- Regulation on Air Quality Monitoring ("Official Gazette of FBiH," 12/05),
- Decree on the Conditions for Discharge of the Wastewater into the Natural Recipients and Public
- Sewer Systems (The Official Gazette of FBiH, no. 4/12)

The following tables present the Monitoring Plan for the RSL exploitation and after-care phases in accordance with the current regulations and deadline for implementation of activities.
<table>
<thead>
<tr>
<th>Type of activity and location</th>
<th>Meteorological data</th>
<th>Landfill gas emission</th>
<th>Water quality</th>
<th>Air quality</th>
<th>Noise</th>
<th>Waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitoring meteorological data:</td>
<td>Monitoring meteorological data:</td>
<td>Monitoring landfill gas air emissions: discharge locations of waste landfill gas</td>
<td>Monitoring water emissions and water quality: Discharge location of waste waters into recipients, Sampling location for surface and ground water</td>
<td>Monitoring air quality: Measuring the quality of air at the landfill construction site</td>
<td>Monitoring noise levels: Measuring after the landfill is put in operation after its construction, On the brinks of the construction site and outside in the nearest residential.</td>
<td>Monitoring waste generation and management: Complete construction site</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Types of measurements and parameters</th>
<th>Parameters being measured:</th>
<th>Parameters being measured:</th>
<th>Parameters being measured:</th>
<th>Parameters being measured:</th>
<th>Parameters being measured and monitored:</th>
<th>Parameters being measured and monitored:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitirng meteorological data:</td>
<td>- Precipitation volume and intensity, Temperature (min., max.), Wind direction and intensity, Evapotranspiration (lysimeter), Atmospheric humidity</td>
<td>- Methane CH₄, Carbon-dioxide (CO₂), Oxygen(O₂), H₂S (hydrogen sulphide), H₂ (hydrogen)</td>
<td>- Periodical monitoring of all legally stipulated parameters at the discharge locations into the recipients and measuring of general and specific parameters of discharged water quality (on monthly basis, 12 times a year),</td>
<td>-NOₓ, SO₂, CO, O₃, Solid particles (dust), Meteorological parameters: wind direction and speed, humidity, air pressure</td>
<td>- Waste type and quantity being generated in the construction phase (hazardous and non-hazardous), Means of transportation and temporary storage, Collection by an authorized company</td>
<td></td>
</tr>
<tr>
<td>Activity agent</td>
<td>Activity frequency</td>
<td>Measuring frequency – On daily basis</td>
<td>Measuring frequency – Once a month</td>
<td>Measuring frequency: - Continuously (Dust, TOC, HCl, HF, SO2, NO, NO2, internal temperature, O2, H2O). - Twice a year (all listed heavy metals, dioxins and furans, NOx, CO – once every 3 months in the first 12 months of the facility’s operation,)</td>
<td>Measuring frequency: -Monitoring at the outlet; on monthly basis, 12 times a year (all parameters according to the Decree), -Monitoring of leachate and surface waters; leachate quantity – on monthly basis, 12 times a year leachate composition – every 3 months, surface water composition – every 3 months - Once in two years for establishing PE</td>
<td>Measuring frequency - Four (4) times a year starting from the launch of construction works</td>
</tr>
<tr>
<td>---------------</td>
<td>--------------------</td>
<td>-------------------------------------</td>
<td>-----------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Reporting deadlines</td>
<td>Latest until January 31, for the previous year</td>
<td>Within 30 days from conducted measurements</td>
<td>Within 30 days from conducted measurements</td>
<td>Upon conducted measurements. The lab conducting measurements submits report to relevant agency</td>
<td>Latest until January 31, for the previous year</td>
<td>Upon conducted measurements</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------------------------------------------</td>
<td>------------------------------------------</td>
<td>------------------------------------------</td>
<td>-----------------------------------------------------------------</td>
<td>-----------------------------------------------</td>
<td>------------------------------------------</td>
</tr>
</tbody>
</table>

*Table 6.8- Monitoring Plan for the landfill exploitation phase*
Following the start of waste disposal at the regional sanitary landfill, the monitoring of the landfill needs to be performed for the next 30 years.

**NOTE:** Person responsible for the implementation of the Monitoring Plan is the Environmental Manager.

### 6.1.11. Reporting during the RSL operation and after-care phase

The authorized company shall submit a report to the operator on the implemented measures while the responsible person shall deliver them to the relevant institutions as indicated in the table below.

**Table 6.9 – Methods of reporting on monitoring during the RSL operation and after-care phase**

<table>
<thead>
<tr>
<th>Name of Report</th>
<th>Dynamics - deadlines for submission of reports</th>
<th>Report-receiving institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Report on conducted measurements of waste water contamination expressed through PE</td>
<td>Within 30 days from the day of measure implementation and once in two years</td>
<td>Sava River Watershed Agency, Sarajevo</td>
</tr>
<tr>
<td>Report on conducted measurements of air quality, landfill gas emissions and emissions from animal waste incineration plants</td>
<td>Upon implemented measurements</td>
<td>Federal Ministry of Environment and Tourism, Relevant environmental protection inspectorate</td>
</tr>
<tr>
<td>Report on generated waste quantities</td>
<td>Latest until January 31 for the previous year and after the conclusion of works on landfill rehabilitation</td>
<td>Cantonal Ministry of Spatial Planning and Environmental Protection</td>
</tr>
<tr>
<td>Report on noise level measurements</td>
<td>Within 30 days from the day of measure implementation</td>
<td>Federal Ministry of Environment and Tourism</td>
</tr>
<tr>
<td>Summary report on all monitoring measures regarding the production and generation of waste and emissions</td>
<td>Latest until January 31 for the previous year and after the conclusion of works on landfill rehabilitation</td>
<td>Federal Ministry of Environment and Tourism, Relevant environmental protection inspectorate</td>
</tr>
</tbody>
</table>

The landfill operator shall inform the Federal Ministry of Environment and Tourism on the collected data as stipulated under Article 8 of the Rulebook on Registries of Plants and Pollution (“Official Gazette of FBiH,” no. 82/07). The reports need to be sent within the deadlines set out in the table above.

The landfill operator shall report immediately on each extraordinary situation that might have a negative impact on the environment.
7. OUTLINE OF BASIC ALTERNATIVES

In the context of the Law on Environmental Protection ("Official Gazette of FBiH," no. 33/03 and 38/09), the alternative solutions are those solutions that equally meet the social and economic requirements as do the general solutions.

The alternative solutions have not been elaborated during the development of the Main design considering that this is a new sanitary landfill for household waste which needs to be constructed so as not to stand as a threat to the environment.

8. NON-TECHNICAL SUMMARY

8.1. DESCRIPTION OF THE PROPOSED PROJECT – SUMMARY

Resolving the question of construction of a regional sanitary landfill site in the Tuzla Canton region, as one of the most populated cantons in FBiH, is of great importance. The construction of RSL would imply the closure of wild-dumps and would thus significantly reduce the threat to the environment. The FBiH Environmental Protection Strategy also provides for the construction of regional sanitary landfills.

Acting in accordance with the EU directives, Tuzla canton initiated the development of the investment and technical documentation for the construction of a regional sanitary landfill (RSL) at the “Separacija 1” location – Municipality Živinice, as proposed in the “Location Selection Study for Regional Sanitary Landfill – Tuzla Canton.” The Study, prepared in 2012, includes waste generation projections, location layout, optimization of the leachate and waste gas management, optimization of transport to the landfill by including transfer stations, labour costs, financial and economic analysis, procurement plan...etc.

“Location Selection Study for Regional Sanitary Landfill – Tuzla Canton,” and the “Feasibility Study for the Regional Sanitary Landfill – Tuzla Canton,” developed by Fichtner and IPZ (Engineering Project Institute) (in line with Contract no: 2010/259-103 CCI signed between the EU Delegation to BiH and Fitchner) confirmed that the “Separacija 1” location is the preferential location of the future RSL in Tuzla region.

The construction of the regional sanitary landfill represents the first step in developing the necessary infrastructure related to the waste management system and one day it will grow into a Regional Waste Management Centre.

The Figure below shows the area of the Tuzla Canton project region - municipalities Banovići, Kladanj and Živinice that have come together with the aim to jointly resolve the problem of waste management. (Figure 8.1.)
Location “Separacija 1” is on the peripheral area of Municipalities Banovići and Živinice, located ca. 4 km from the centre of Banovići and ca. 12 km from Živinice.

The location can be reached by turning from the main road Banovići-Višća and taking a macadam road for another 2 km.

The location is situated in municipality Živinice, at the parcel of land labelled plot no. 643/1 and 637 cadastre municipality Odorovići, at cadastre plots no: 637/2, 637/3, 643/11 and 643/12 all cadastre municipality Odorovići.

The location of the future regional sanitary landfill is situate at the far western part of municipality Živinice, 1.2 km away from the settlement inhabited by internally displaced persons. River Oskova runs around 300m away to the west of the future landfill site.

The location where the tailings from Coal Mine Banovići have been deposited (previously known as “Ježevac” disposal site) spreads to an area of 13 ha with the possibility of extension. The location is held by Coal Mine Banovići and the Cantonal Forest Management company. The site is mostly woodland (eastern part) while the western part includes agricultural land of third agricultural zone and seventh rating category value. Coppiced woodland and vegetation prevail in the surrounding area. The location has the potential to be expanded upwards due to the configuration of terrain.

The closest residential area is the Ježevac settlement inhabited by internally displaced persons. The closest residential building is located 500 m (air distance). There are no residential buildings or business facilities at the location itself. There are no connections to the gas, water supply or public sewage network. A transformer substation is located 250 m away.

Figure 8.2 gives a satellite image of the wider area of the location for the future regional sanitary landfill “Separacija 1”.

Figure 8.1.- Municipalities included in the Tuzla canton project region
The surface formation of the cover at the location in matter, in the wider area of the current tailings landfill generated from wet separation, is typically alluvial-deluvial soil type of quaternary age (Q). Such formations are characteristic for “natural” autochthonic covers. These are locations of original degradation of rocks that have not been in contact with the deposited material from the “tailings” generated from coal exploitation.

The lithological parts of the surface covers comprised of humus and granulated clay 0.30-1.00 meter thick have been registered at the site. No ground water was registered.

However, stretches of wet mud generated from the separation process have been noted at the location where the remains of the tailings are deposited.

In view of the fact that the clastic material from the tailings is impermeable, the ground water in the body of the tailings is directed towards River Oskova. Some instability of the deposited tailings has been registered at the stretch towards the alluvium of River Oskova.

The location provides for an area that can be reserved for future expansion of the site and where all necessary facilities that make up a regional Waste Management Centre can be implemented (sorting unit, composting unit, mechanical and biological treatment plant).

In order to properly scale all waste management facilities and to do an accurate labour cost calculations, it is of utmost importance to define accurately the input data and that is the amount of waste taken in at the
The first part provides an overview of the current situation regarding waste handling as well as three scenarios of projections regarding the quantities of waste generated:

**Scenario 1** (the so-called "do nothing" scenario – Projection of the total amount of waste generated without recycling (separated collection of certain waste components); the most frequent type of waste management today)

**Scenario 2** Projection of the total amount of waste generated according to the FBIH strategic aims (Strategy on Environmental Protection)

**Scenario 3** Projection of the total amount of waste generated with additional separation of biodegradable waste from the total, mixed, household waste in order to meet the quantitative aims of the EU Waste Directive for 2020.

8.1.1. Facility allocation - summary

The purpose of the facility is the disposal of household and industrial waste of similar characteristics to the household waste from the analysed region under controlled conditions - sanitary disposal of waste. Other types of waste cannot be disposed into this category of the landfill. The waste would be disposed at the landfill until the end of 2039 with the possibility of extending the disposal site to the reserved area (phase II - stage 3) which would significantly increase the lifetime of the location.

The total project area spreads to 21.0 ha. This area would be used for the construction of the landfill body with the area of 5.85 ha, with the maximum height of the body being 52 m while the rest of the landfill will be made up of the entrance-exit zone, the service centre, recycling yard, construction waste treatment zone, administration building, green areas, and a reserved area for the construction of other regional landfill facilities.

The RSL will be fenced off with a 2.0 m. high and 3.160 m long fence with the main entrance gate 3.0 + 3.0 + 1.1=7.1 m. wide. This way, (phase 1) provides for the construction of a part of the fence 1.840 m long. The entrance will be secured by a double-leaf door and a single door for the pedestrians. During the construction, the workers will be situated in container-type temporary buildings.

A permanent, electro-mechanical, platform scale with a 60 t load-bearing capacity will be placed to weigh the waste being brought to the site. The scale will be 18m long with a canopy above. There will also be a security building at the site (a container type building).

After the capping of the landfill, the landfill body will be a green area with a maximum height of 52 m and a side slope of max 1:2.5. The plan is to plant grass i.e. bushes and autochthonous plants at the capped part of the landfill as well as along the fence which represents both a visual and a protective buffer zone for the surrounding terrain. It is recommended to plant a thorny hedge alongside the fence in order to achieve higher level of security and block the view to the landfill.

PHASE I - construction (Figure 2.5)

- Construction of entrance- exit zone (entrance gate, platform scale, canopy above the scale)
- Construction of a part of the fence
- Construction of an administrative building
- Construction of waste disposal trays
- Construction of a recycling yard
- Construction of a service centre
- Construction of landfill gas incineration flare
- Construction of a surface for treatment of construction waste

The RSL location provides for an area reserved for future expansion (future Waste Management Centre) where certain facilities could be placed. The following facilities are projected:
PHASE 2
- Construction of a plant for mechanical and biological treatment of waste at the reserved part of the location and the construction of the remaining part of the fence around the landfill site
- Construction of a composting unit for treatment of biodegradable waste at the reserved part of the location
- Construction of waste disposal trays including a leachate collection system and roof-water collection canal at the reserved part of the location
- Construction of the waste sorting unit at the reserved part of the location
- Construction of a transfer station in Municipality Kladanj together with all the necessary machinery (tow truck) and the necessary equipment for its operation. Municipality Kladanj shall provide an appropriate location for the transfer station that would spread at an area of 5,000 m$^2$.
- Construction of a power transformation sub-station

The reserved area for this phase amounts to 8.7 ha.

PHASE 3
- Construction/erection of a leachate and sanitary waste water treatment plant

The reserved area for this phase amounts to ca. 0.02 ha.

PHASE 4:
- Construction/erection of a system for production of electrical energy from the landfill gas

The reserved area for this phase amounts to ca. 0.02 ha.

8.1.2. Construction of the facility - summary

The RSL area with the projected functional facilities takes up an area of ca. 21 ha. The plan is for the following functional units (buildings, structures, surfaces):

1. Administrative building (around 206 m$^2$) with a parking for private vehicles (around 360 m$^2$) and the whole storage for liquid petroleum gas (around 7 m$^2$)
2. Open recycling yard (around 0.11 ha) with a canopy (around 130 m$^2$) and a concrete surface (around 190 m$^2$)
3. Service centre with a garage, a workshop and a workers’ room (around 334 m$^2$) and the accompanying asphalt plateau together with a parking for freight and private vehicles (around 1,670 m$^2$)
4. A cistern for industrial waste water with a shaft for the hydroblock (around 45 m$^2$)
5. Landfill for non-hazardous waste with a system for collection of roof-water and leachate (around 5.85 ha)
6. Area for recycling and treatment of construction waste (around 0.30 ha)
7. Reserved area for sanitary and leachate treatment plants (0.025 ha)
8. Reserved area for the landfill gas treatment and exploitation plant (around 0.03 ha)
9. Reserved area for the mechanical and biological waste treatment plant, waste sorting unit and the power transformer sub-station (around 8.7 ha)

8.1.3. Selected methods of operation regarding waste disposal – summary

The waste disposal procedure will be performed by complying with the specific conditions characteristic for the selected location for the new sanitary landfill.

All required facilities, equipment and labour force for the operation of the landfill are in accordance with the standards stipulated for this type of facility.
The text below will present the general characteristics of the sanitary landfill technological operation which includes a system for waste disposal where the waste is disposed in a controlled manner onto a previously prepared terrain thus avoiding all harmful impacts that might be generated from uncontrolled waste disposal. After reaching the projected capacities, the landfill is capped and long-term (20 years) monitoring of the landfill is then performed.

The methods of operation at the regional landfill site include the following:

- setting up a wired fence around part of the regional landfill site (landfill, accompanying facilities)
- construction of a lower
- sealing layer by placing a mineral layer (geosynthetic clay lines + HDPE foil)
- construction of drainage canals for collection of roof-water
- construction of the landfill gas collection system
- layer-compact ed waste disposal and filling in until the projected capacity
- daily waste coverage with a layer of inert material
- placement of the final, ceiling layer at the waste-filled parts of the landfill (capping of the landfill)
- landscaping of the capped part of the landfill and planting high and low vegetation
- monitoring (control).

The waste disposal methodology includes the following basic operations:

- preparation of the terrain and development of ecological protection (water-tight undercoat, protection from roof-water and surface waters, collection of leachate, collection of gases)
- preparation of the waste disposal area
- disposal of waste on the operational surface, its layering and compaction
- daily waste coverage
- final capping of the landfill and landscaping of the area
- monitoring during the landfill’s operational and after-care phase

8.2. DESCRIPTION OF THE ENVIRONMENT THAT MAY BE AFFECTED BY THE PROJECT

Waste management in Živinice region is based on a regional concept which includes the construction of a regional sanitary landfill site “Separacija 1” (RSL) located on the western brinks of Municipality Živinice, on the border with Municipality Banovići.

The nearest settlement to the landfill site is Ježevac, a settlement inhabited by internally displaced persons. The centre of the settlement is c. 650m (air distance) away from the landfill site while the closest residential building is c. 500 m (air distance) away.

The project beneficiaries are the 3 municipalities listed in the table below.

| Table 8.1 –Target beneficiaries of the regional sanitary landfill for Tuzla region |
|--------------------------------------|---------------------------------|----------------|-------|
|                                | Banovići | Kladanj | Živinice | Total |
| Population in 2012             | 30,053 | 15,199 | 101,125 | 146,377 |
| Mean service coverage       | 72% of the total Tuzla region |
| Waste quantity in 2010 t/day or t/year | 22.5 t/day | 11.1 t/day | 44.2 t/day | 77.8 t/day |
|                                      | 8,212 t/year | 4,067 t/year | 16,124 t/year | 28,403 t/year |
The location “Separacija 1” includes a continuous surface flow in the form of River Oskova in the immediate vicinity of the tailings. The alluvial formations of River Oskova are near to the tailings and special attention must be paid to avoid possible contamination of groundwater next to the tailings.

Regarding the seismicity of the terrain, the maximum expected earthquake is 6º on the MCS scale and 63% probability in the return period of 100 years.

The surface formation of the cover at the location in matter, in the wider area of the current tailings landfill generated from wet separation, is typically alluvial-deluvial soil type of quaternary age. Such formations are characteristic for “natural” autochthonic covers. These are locations of original degradation of rocks that have not been in contact with the deposited material from the “tailings” generated from coal exploitation.

The lithological parts of the surface covers comprised of humus and granulated clay 0.30-1.00 meter thick have been registered at the site. No ground water was registered. However, stretches of wet mud generated from the separation process have been noted at the location where the remains of the tailings are deposited.

In view of the fact that the clastic material from the tailings is impermeable, the ground water in the body of the tailings is directed towards River Oskova. Some instability of the deposited tailings has been registered at the stretch towards the alluvium of River Oskova.

The productive soil i.e. the surface, loose layer of earth is a physical and geographical element which is generated as a result of interaction between the geological structure, relief, climate, hydrological characteristics, vegetation but also human influence. Various types of soil are present in the wider region due to these factors with the dystric cambisol, terra rosa, calcocambisol, pseudogley and alluvial soils being most widely represented.

A large presence of pseudogley can be found at the upper stream of river Oskova, from the spring catchment area to Gostilja river mouth. The alluvial soils are found along the course of river Litva and Oskova. These are less developed soils that are generated as a result of sedimentation of materials along these rivers.

They can be shallow or very deep. Since such soils require levelled valley bottom, they are suitable for cultivation and they give high yields if irrigated.

Humus and loam represent a very thin layer of up to one meter in thickness which covers the serpentine as well as the marl and gravel. From the aforementioned, we can conclude that the location “Separacija1” is suitable for the planned construction of the regional sanitary landfill.

The most widely spread type of soil in this area is eutric cambisol on peridotite and serpentinite as well as the dystric cambisol on acid silicate rocks while the eutric cambisol is less present on the remaining silicate rocks, pseudogley, calcomelanosol and calcocambisol. The specificity of the region lies in the peridotite and serpentinite geological base that continuously stretches from Mt. Kozara in the north-west of BiH to Mt. Konjuh, Kladanj and Banovići, enabling the development of specific and unique serpentinite eco-systems in the region of tertiary-relic nature.

Floristic composition of forest ecosystems in the wider area is very rich and conditioned by different types of forests that exist in this region. Depending on the pedological and ecological characteristics of certain locations, 30 different types of forest plant communities have developed and are grouped into the same number of forest management classes. In addition to the typical serpentine – peridotite flora representatives, this region is characterized by other ecosystems, mostly related to different geological and pedological combinations and orographic conditions. These include: the beech and fir with spruce (Abietifagetum serpentinicum) forest ecosystems, the beech and fir forest (Abieti-Fagetum) and the black hornbeam forest Querceto-Ostryetum carpinifoliae).

The dominant presence of diverse forests and the primordial, pristine nature have created conditions for a great number of animals in the area. An exclusive value is the presence of the wood grouse (Tetrao
urogalis), rare and endangered type of forest bird that lives solely at the pristine habitats, which is another verification of the quality of environment of the analyzed region. In addition to the wood grouse, this area is inhabited by the following animal types of interest for hunting: Bear (Urcus arctos), wild boar (Sus scrofa), wolf (Canis lupus), roe deer (Capreolus capreolus), fox (Vulpes vulpes), wildcat (Felis silvestris), rabbit (Lepus europeus), as well as the mink, squirrel, polecat, weasel, mole, dormouse, mice, vole...etc.

There are no material assets or cultural and historical heritage at the location of the future regional sanitary landfill. The border of the protected landscape “Konjuh” and its values is 5.7 km away from the location.

The previous environmental impact assessment was not done pursuant to the provisions of Article 18 (54a) of the Law on the Amendments to the Law on Environmental Protection (“Official Gazette of FBiH,” no. 38/09) and an Environmental Impact Assessment Study was developed immediately afterwards which is submitted in the process of issuing an environmental permit instead of the request for the issuing of the permit.

8.3. DESCRIPTION OF POTENTIAL SIGNIFICANT PROJECT IMPACTS ON THE ENVIRONMENT AND MITIGATION AND PREVENTION MEASURES – SUMMARY

The document presented the measures that need to be implemented during the landfill construction, exploitation and after-care phases.

The tables below provide a summary of the project impacts on the environment and the adequate measures that need to be undertaken in order to prevent, reduce and mitigate the mentioned impacts on the environment. The analysis of these elements is presented below:
Table 8.2 - Summary of the impacts on population and adequate prevention and mitigation measures

<table>
<thead>
<tr>
<th>IMPACTS ON POPULATION</th>
<th>CONSTRUCTION PHASE</th>
<th>EXPLOITATION PHASE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Impact</strong></td>
<td>Negative impacts:</td>
<td>Positive impacts:</td>
</tr>
<tr>
<td></td>
<td>• Increased level of noise during construction,</td>
<td>• Applying sanitary means of waste disposal prevents the possibility of generation of odours in the vicinity and the wider area of the landfill site,</td>
</tr>
<tr>
<td></td>
<td>• Increased emission of flue gases and solid particles resulting from the construction machines and transportation vehicle operation ,</td>
<td>• Building a system of controlled degasification of the landfill body will significantly reduce the possibility of fires and explosions within the landfill body,</td>
</tr>
<tr>
<td></td>
<td>• Dispersion of solid material,</td>
<td>• Constructing ancillary buildings and facilities will generate a certain number of new jobs (c.30) whereby the local population will be given precedence in employment.</td>
</tr>
<tr>
<td></td>
<td>• Increased traffic on local roads and damage to the local roads,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Occurrence of accidents (fires, explosions...etc) during the construction.</td>
<td></td>
</tr>
<tr>
<td><strong>Detailed description of the impact</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No special mitigation and protection measures are necessary. The following must be observed:</td>
<td>No special protection and mitigation measures are necessary: It is important to comply with the following:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Perform continuous control and supervision of transportation vehicles and construction machines (noise silencers, fuel and lubricant installations).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Use covers on transportation vehicles.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Often wet the roads in residential areas with water</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Supervision: Constructor</td>
</tr>
<tr>
<td><strong>Prevention and mitigation measures</strong></td>
<td></td>
<td>Supervision: Operator</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impact</td>
<td>Detailed description of the impact</td>
<td>Prevention and mitigation measures</td>
</tr>
<tr>
<td>--------</td>
<td>----------------------------------</td>
<td>-----------------------------------</td>
</tr>
<tr>
<td><strong>CONSTRUCTION PHASE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impact on biodiversity and ecological balance within the ecosystem (flora and fauna)</td>
<td>Negative impacts:</td>
<td>No special protection and mitigation measures are projected. It is important to comply with the following:</td>
</tr>
<tr>
<td></td>
<td>• Increased level of noise during construction,</td>
<td>• Prompt implementation of measures provided under the Construction Waste Management Plan and the Construction Site Organization Plan,</td>
</tr>
<tr>
<td></td>
<td>• Increased emission of flue gases and solid particles resulting from the construction machines and transportation vehicle operation,</td>
<td>• Comply with the provisions of the Report on Environmental Protection within the Main Design,</td>
</tr>
<tr>
<td></td>
<td>• Dispersion of solid material onto green areas outside the landfill site,</td>
<td>• Cultivate the damaged terrain, where possible, after the conclusion of construction works,</td>
</tr>
<tr>
<td></td>
<td>• Occurrence of accidents (fires, explosions...etc) during the construction.</td>
<td>• Establish that the constructor holds operation and handling manuals and instructions on use of construction machines.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Supervision: Constructor</td>
</tr>
<tr>
<td></td>
<td>Positive impacts:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• The plan is to build a fence around the landfill which will prevent rodents and other animals from entering the landfill body and thus hinder uncontrolled scattering of waste and spreading of diseases,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• The project foresees for the whole landfill site to undergo horticultural development after the capping of the landfill. This will open the door to new flora and fauna development at the site.</td>
<td></td>
</tr>
</tbody>
</table>

| **EXPLOITATION PHASE** | | |
| Impact on biodiversity and ecological balance within the ecosystem (flora and fauna) | Negative impacts: | No special protection and mitigation measures are projected. It is important to comply with the following in order to prevent accidents from occurring: |
| | • Increased level of noise during landfill operation, | • Installing an effective firefighting system, |
| | • Occurrence of accidents (fires, explosions, failures of the landfill gas collection system...etc) | • Drawing up instructions on handling of hazardous and easily inflammable material, |
| | Positive impacts: | • Proper designing of the waste water discharge system, |
| | • The plan is to build a fence around the landfill which will prevent rodents and other animals from entering the landfill body and thus hinder uncontrolled scattering of waste and spreading of diseases, | • Educating and training of staff, |
| | | • Drawing up a Fire protection report, |
| | • The project foresees for the whole landfill site to undergo horticultural development after the capping of the landfill. This will open the door to new flora and fauna development at the site. | • Prompt rehabilitation. |
| | | Supervision: Operator |
Table 8.4: Summary of the impacts on water and adequate prevention and mitigation measures

<table>
<thead>
<tr>
<th>Impact</th>
<th>Detailed description of the impact</th>
<th>Prevention and mitigation measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONSTRUCTION PHASE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative impacts:</td>
<td>Measures that need to be undertaken:</td>
<td></td>
</tr>
<tr>
<td>---------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>• In case of uncontrolled leakage of fuel, oil and lubricants from construction machines and transportation vehicles,</td>
<td>• Uncontrolled changing of motor oil, refrigerants and car batteries on all vehicles is prohibited.</td>
<td></td>
</tr>
<tr>
<td>• In case of accidents that occur while handling hazardous liquid materials,</td>
<td>• Washing of vehicles and vehicle parts is prohibited at the site (with the exception of the wheel washing device).</td>
<td></td>
</tr>
<tr>
<td>• In case of irregular waste disposal on green and other areas during construction works,</td>
<td>• All outlets into surface waters or the sewage system need to be closed/sealed.</td>
<td></td>
</tr>
<tr>
<td>• In case of improper treatment and drainage of waste waters generated during the construction phase of the landfill and the accompanying buildings.</td>
<td>• Control storage of waste and secondary raw materials.</td>
<td></td>
</tr>
<tr>
<td>• In case of irreversible soil contamination with hazardous materials, the contaminated terrain needs to be excavated, temporarily stored into barrels and treated as hazardous waste.</td>
<td>• In case of uncontrolled leakage of processed media, ensure containers and materials to prevent higher degree of contamination such as sand, sawdust, polystyrene and degreasers. Such collected waste and soil needs to be treated as hazardous waste.</td>
<td></td>
</tr>
</tbody>
</table>

Supervision: Constructor

**Impact on water**
Negative impacts:
- In case of damage to the lower sealing layer and penetration of contaminated leachate into the soil,
- In case of failures in the system for collection, drainage and recirculation of contaminated leachate,
- In case of failures and damages to the system for treatment of rainwater from work surfaces and sewage waste waters,
- In case of spillage of contaminated leachate due to the improper size of the leachate collection pool
- During accidental leakage of hazardous liquid materials onto surfaces that have not been into the system for collection of manipulative rainwater.

Positive impacts:
- Building the lower sealing layer and the leachate collection system will prevent penetration of contaminated water into the soil and the ground water at the site,
- Non-contaminated rainfall will be collected and drained through separate systems thus preventing their contamination,
- Rainfall from work surfaces and sewage waste waters will be collected, treated and drained separately into the public sewage system,
- As part of landfill operation monitoring, the quality of waste waters and the quality of water from the nearest surface flows and sources will be monitored. This will result in prompt identification of potential water contamination.

Measures that need to be undertaken:
- Only roof-water and water from undisturbed unpaved areas are appropriate for direct discharge to surface waters and sewage systems.
- No untreated trade effluent shall be discharged direct to surface water and sewage system,
- Waste waters being discharged into the surface water after treatment need to meet threshold values for hazardous materials as stipulated by relevant regulations,
- The provision of infrastructure to allow for isolation and monitoring of surface water discharges.
- Before being discharged into the sewage system, the waste waters need to meet limit values as stipulated by relevant regulations,
- Prohibit direct and indirect emissions to groundwater of effluents containing certain hazardous substances, and apply strict controls to prevent indirect emissions
- Prevent disposal of waste or other materials in a manner that might lead to a discharge of harmful particles into ground waters,
- Remove risks of emissions to groundwater through appropriate controls such as containment, bunding, construction of capping... etc.,
• Provide groundwater monitoring to enable early detection of any contamination of groundwater that may arise from the facility.

Supervision: Operator

<table>
<thead>
<tr>
<th>Impact on soil</th>
<th>Detailed description of the impact</th>
<th>Prevention and mitigation measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative impacts:</td>
<td></td>
<td>Measures that need to be undertaken:</td>
</tr>
<tr>
<td>• In case of uncontrolled leakage of fuel, oil and lubricants from construction machines and transportation vehicles, leading to soil contamination</td>
<td></td>
<td>• In case of irreversible soil contamination with hazardous materials, the contaminated terrain needs to be excavated, temporarily stored into barrels and treated as hazardous waste.</td>
</tr>
<tr>
<td>• Degradation of the surrounding area during the development of the landfill site</td>
<td></td>
<td>• Uncontrolled changing of motor oil, refrigerants and car batteries on all vehicles is prohibited.</td>
</tr>
<tr>
<td>• In case of accidents that occur while handling hazardous liquid materials,</td>
<td></td>
<td>• Washing of vehicles and vehicle parts is prohibited at the site (with the exception of the wheel washing device).</td>
</tr>
<tr>
<td>• In case of irregular waste disposal on green and other unprotected areas during construction works, leading to soil contamination</td>
<td></td>
<td>• All outlets into surface waters or the sewage system need to be closed/sealed.</td>
</tr>
<tr>
<td>• In case of improper treatment and drainage of waste waters generated during the construction phase of the landfill, leading to soil contamination</td>
<td></td>
<td>• Control storage of waste and secondary raw materials.</td>
</tr>
</tbody>
</table>

Table 8.5- Summary of the impacts on soil and adequate prevention and mitigation measures
In case of uncontrolled leakage of processed media, ensure containers and materials to prevent higher degree of contamination such as sand, sawdust, polystyrene and degreasers. Such collected waste and soil needs to be treated as hazardous waste.

- Perform continuous control and supervision of transportation vehicles and construction machines (noise silencers, fuel and lubricant installations).
- Use covers on transportation vehicles.

## EXPLOITATION PHASE

### Negative impacts:
- In case of damage to the lower sealing layer and penetration of contaminated leachate into the soil,
- In case of failures in the system for collection, drainage and recirculation of contaminated leachate and failures and damages to the system for treatment of rainwater from work surfaces and sewage waste waters
- In case of spillage of contaminated leachate due to the improper size of the leachate collection pool
- During accidental leakage of hazardous liquid materials onto surfaces that have not been into the system for collection of manipulative rainwater.

### Positive impacts:
- The rehabilitation of the landfill implies the development of the existing area where the waste is disposed. This means that uncontrolled dumping of waste to areas outside the landfill site will stop and the waste will be removed and further uncontrolled waste disposal to surrounding green areas will be prevented.

The measures to be undertaken are identical to the measures for reducing the impacts on water.

Supervision: Operator
• The project provides for the construction of a system for collection and treatment of all types of waste waters (leachate from the landfill body, rainfall from work surfaces and sewage waste waters). This will prevent contamination of land and soil at the landfill site.

• The plan is to build a fence around the whole landfill site which will prevent unauthorized access of people and different animals to the landfill site and thus hinder uncontrolled scattering of waste onto the surrounding land,

• During the construction of the landfill and the accompanying facilities, necessary measures will be undertaken regarding terrain stability which will result in complete terrain stabilization and prevent further land degradation at the site.
Table 8.6 - Summary of the impacts on air and adequate prevention and mitigation measures

<table>
<thead>
<tr>
<th>Impact</th>
<th>Detailed description of the impact</th>
<th>Prevention and mitigation measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact on air</td>
<td>Negative impacts:&lt;br&gt;• Increased emission of flue gases (CO2, SO2, NOx... etc.) and solid particles due to the operation of construction machines and transportation vehicles,&lt;br&gt;• Increased emission of dust and solid particles during construction works,&lt;br&gt;• Accidents (fires, explosions...etc) that may lead to</td>
<td>Measures to be undertaken:&lt;br&gt;• Construction waste, including small crushed material, should be covered by foil in order to reduce the possibility of dust generation due to wind.&lt;br&gt;• Temporarily abrupt works in case of intense winds blowing from critical directions.</td>
</tr>
</tbody>
</table>
- Control storage of waste and secondary raw materials.
- In case of strong winds, do not apply autogeneous cutting process using gas nor handle other materials that may cause large scale or uncontrolled dusting.
- Crush or dismantle the waste intended for transportation to the size appropriate for transportation.
- Use a cover over the loading part of the vehicle during transportation of crushed material in order to prevent generation of dust,
- Perform continuous control and supervision of transportation vehicles and construction machines (exhaust systems),
- Often wet the roads in residential areas with water

**Supervision:** Constructor

<table>
<thead>
<tr>
<th>EXPLOITATION PHASE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Negative impact:</strong></td>
</tr>
<tr>
<td>- Increased emission of flue gases and solid particles in cases of failures and improper operation of the machines and combustion engines,</td>
</tr>
<tr>
<td>- Increased emission of dust and solid particles in case of irregular handling and disposal of household and other waste,</td>
</tr>
<tr>
<td>- Emission of harmful gases from the landfill body in case of failure of the landfill gas collection and drainage system.</td>
</tr>
<tr>
<td><strong>Measures that need to be undertaken:</strong></td>
</tr>
<tr>
<td>- Construction of adequate and good-quality system for collection and treatment of landfill gas,</td>
</tr>
<tr>
<td>- Maintain negative air pressure in the landfill gas extraction wells,</td>
</tr>
<tr>
<td>- Use of horizontal and vertical landfill gas extraction wells,</td>
</tr>
<tr>
<td>- Regular monitoring of landfill extraction well field, balancing of wells and elimination of non-design condensate traps,</td>
</tr>
<tr>
<td>- Use of horizontal landfill gas collection pipe-work at the top of the side wall riser,</td>
</tr>
</tbody>
</table>
Positive impact:

- The construction of the gas collection system will bring about controlled collection and drainage of gas generated in the landfill body. This will prevent uncontrolled emission of landfill gas in the air and uncontrolled collection of gas in the landfill body which might lead to fires and explosions.
- Waste disposal will be sanitary meaning that the layers of disposed waste will be covered by inert material. This is aimed at preventing odours arising from the disposed waste.
- After the regional sanitary landfill is put in operation and the landfill is capped, the landfill body will be closed by constructing an upper liner which will be subjected to reclamation and landscaping.

• Provide landfill gas management systems,
• Control the combustion conditions of enclosed flares, in terms of the carbon monoxide concentration, temperature and retention time by ensuring that combustion occurs at 1,000°C with a product retention time of 0.3 seconds within the combustion zone.

Supervision: Operator

<table>
<thead>
<tr>
<th>Impact</th>
<th>Detailed description of the impact</th>
<th>Prevention measures and mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 8.7: Summary of the impacts of noise and adequate prevention and mitigation measures
### Impacts of Noise

**Negative impact:**
- Increased level of noise during construction due to the operation of construction machines and other devices.

**Measures that need to be undertaken:**
- Keep strict records on technical soundness of the construction machines and transportation vehicles (notably their exhaust systems and mechanical compositions) and eliminate defective machines/vehicles from construction works.
- Monitor the use of protective equipment by the workers on the construction site.
- Conduct construction works until 18h latest in one extended shift.

**Supervision:** Constructor

### EXPLOITATION PHASE

**Negative impact:**
- Increased level of noise during regular landfill operation (construction machines, engines...etc)

**Measures that need to be undertaken:**
- Keep strict records on technical soundness of the construction machines and transportation vehicles (notably their exhaust systems and mechanical compositions) and eliminate defective machines/vehicles from construction works.
- Monitor the use of protective equipment by the workers on the construction site.

**Supervision:** Operator

### 8.4. DESCRIPTION OF MEASURES OF MITIGATING NEGATIVE IMPACTS – SUMMARY

The description of measures for mitigating negative impacts is presented in a table in item 8.3 of this document, while a detailed description of the impacts was given in Chapter 4 and mitigation measures in Chapter 5.

In general, these measures were analysed through two phases: the landfill construction phase and the landfill exploitation phase. These two phases were also used to analyze the impacts on: population, flora and fauna, water, soil, climate, material assets, cultural, historical and archaeological heritage and landscape.

### 8.5. OUTLINE OF BASIC ALTERNATIVES - SUMMARY
The alternative solutions have not been elaborated during the development of the Main design considering that this is a new sanitary landfill for household waste which needs to be constructed so as not to stand as a threat to the environment.

9. INDICATION OF DIFFICULTIES

There weren’t any relevant difficulties and limitations during the development of the Environmental impact study for the construction project of the Regional sanitary municipal waste landfill in Živinice municipality at the „Separacija 1“ location and construction of the associated facilities adapted to the regional disposal concept. The main share of the necessary information for its development was provided by the Investor (documents on the construction method, machines and equipment to be used, Conceptual design of the landfill construction), and a part of the information was provided by the Project developer (data on the population, flora and fauna, climate, air, etc.).

10. LEGISLATION AND DOCUMENTS USED

- FBiH Strategy on Environmental protection for the 2008-2018 period,
- Federal Waste Management Plan 2011 – 2016,
- EU umbrella directive (75/442/EEC) in the field of waste management,
- Directive 2008/98/EC on waste,
- Directive 1999/31/EC on waste disposal sites,
- EU Directive (1999/31/EC) referring to the landfills of all types of waste,
- BAT Guidance Notes for the Waste Sector: Landfill Activities, December 2011,
- Law on Environmental Protection („Official Gazette of FBiH“, no. 33/03, 38/09),
- Law on Waste Management („Official Gazette of FBiH“, no. 33/03 and 72/09),
- Law on Air Protection („Official Gazette of FBiH“, no. 33/03),
- Law on Waters („Official Gazette of FBiH“, no. 70/06),
- Regulation on waste categories with lists („Official Gazette of FBiH“, no. 9/05),
- Decree on Conditions for Discharge of Wastewater into Natural Recipients and Public Sewer Systems („Official Gazette of FBiH“, no. 04/12),
- Decree on Buildings and Interventions of Importance for the Federation of Bosnia and Herzegovina and on Buildings and Interventions that Might Significantly Affect Environment, Life and Health of People in the Federation of Bosnia and Herzegovina and Wider, for which the town planning permits are issued by the Federal Ministry of Physical Planning (Official Gazette of FBiH“, no. 85/07),
- Conceptual design of the Regional sanitary municipal waste landfill „Separacija 1“, Živinice municipality, December 2014,
- Validation study of the location of the Regional sanitary landfill for the Tuzla Canton, 2008.

Director:

Eldar Pirić, MA mechanical
- Research associate -
11. WASTE MANAGEMENT PLAN

Pursuant to the provision of Article 19 of the Law on Waste Management ("The Official Gazette of FBiH", no. 33/03), Waste Management Plan is a legal obligation of every plant operator requiring Environmental permit. Waste Management Plan for the Regional sanitary landfill plant at the “Separation 1” location determines method, admission and handling of waste both during the construction phase and during the exploitation phase. The Plan defines activities for a long-term waste management method, possible adjustments in case of changes to the technological process taking into consideration, most commonly, financial limitations.

The purpose of Waste Management Plan at the location is to show waste flows from their production, current disposal and final disposal with minimal negative environmental impacts.

The Plan in particular regulates the following activities:

- waste management methods and procedures,
- environment protection from waste discharge or uncontrolled disposal.

Waste Management Plan pursuant to the above mentioned Law should contain:

- documentation on produced waste (origin, types of waste in accordance with the waste list, composition, amount);
- waste prevention measures, especially hazardous waste;
- waste separation, especially hazardous waste from other types of waste as well as re-usable waste;
- waste disposal at landfills;
- treatment and/or disposal methods.

Waste Management Plan has been developed pursuant to the following legal acts:

- Law on Waste Management (Official Gazette of FBiH no. 33/03)
- Rulebook on the Content of Waste Management Adjustment Plan in Existing Facilities for Waste Treatment or Disposal and Activities Undertaken by the Competent Authority (Official Gazette of FBiH no. 9/05)
- Regulation on Waste Categories with Lists (Official Gazette of FBiH no. 9/05)
- Rules on Handling of Hazardous Waste that is Not in the Waste Catalogue or Whose Content is Unknown (Official Gazette of the FBiH no. 9/05)
- Regulation on Necessary Conditions for Transfer of Obligations from Producers and Sellers on Operators of Systems for Collection of Waste (Official Gazette of FBiH no. 9/05)
- Decree on Separate Collection, Packaging and Labelling of Waste (Official Gazette of FBiH no. 38/06)
- Decree on the Mandatory Submission of the Annual Report on Meeting the Requirements Set Out in the Water Management Permit (Official Gazette of FBiH no. 31/06)
DEFINITIONS

The following definitions are used for the purpose of this Plan:

**Waste management** – means a system of activities and actions related to waste, including waste prevention, reduction of waste quantity and its dangerous features, waste treatment, planning and monitoring waste management activities and processes, as well as reducing its negative environmental impacts and waste treatment according to management principles;

**Waste** – means materials or items an owner disposes of, intents to dispose of or wants to have them disposed in accordance with one of the waste categories set in Regulation on Waste Categories with Lists (Official Gazette of FBiH, no. 9/05.);

**Plant** – for the purpose of this Plan it is Regional sanitary landfill at the “Separation 1” location;

**Plant site** – all facilities within the future Regional sanitary landfill at the „Separation 1“ location;

**Municipal waste** – is household waste as well as any other waste similar to household waste in its nature or composition;

**Industrial Wastewater** – is liquid mixture with any amount of oil and grease;

**Waste sludge** – is liquid and semi-liquid matter generated from different activities, which, during use, have become unsuitable for use compared to its original purpose (residue of oil and grease separators, pools, septic tanks);

**Waste recycling** – is an activity of re-using waste in a production process, including organic recycling, but not using it for energy;

**Waste disposal** – is an activity of controlled, permanent waste disposal at disposal facilities – disposal sites or any other activity of permanent waste disposal.

11.1 PERSON RESPONSIBLE FOR THE WASTE MANAGEMENT PLAN IMPLEMENTATION AND WASTE COORDINATOR

According to the Law on Waste Management “Official Gazette of FBiH”, no. 33/03, the Federal minister of physical planning and environment, Article 20, the operator of plants that need an environmental permit as a producer must appoint a person responsible for the waste management operations.

The competent body from Article 11 of this Law shall be notified on the appointment of the responsible person. The responsible person shall:

- draft and update Waste Management Plan;
- implement Waste Management Plan;
- suggest measures to improve waste prevention, re-use and recycling;
- monitoring the set waste management conditions and report it to the operator.
The responsibility of the person from paragraph 1 of this Article does not exempt the operator from the financial and legal responsibility to comply with the waste management requirements.

In this specific case, the responsible person shall be appointed afterwards.

11.2 LOCATION BACKGROUND

The location „Separation 1“ is at the peripheral area of Banovići and Živinice municipalities, about 4 km away from Banovići town center and about 12 km from Živinice town center. A local paved road 1 km long leads to the location taken from R-469 Ribnica-Banovići-Živinice regional road. At the local road there is a 1.2 km gravel road heading to the landfill entrance.

The location is in the area of Živinice municipality, at the property marked as parts of a lot cadaster plot no. 643/1 and 637 Odorovići cadaster municipality, at caster plots no.: 637/2, 637/3, 643/11 and 643/12 all in Odorovići cadaster municipality.

The location of the future regional sanitary landfill is at the further Western part of Živinice municipality, 1.2 km away from Ježevac refugee camp. Oskova river flows about 300 m away on the Western side of the future landfill.

The location where tailings from Banovići coal mine have been disposed of (formerly „Ježevac“ disposal site) covers the area of 13 hectares and may be expanded. The location is mainly forest land (Eastern part), while the western part consists of agricultural land of the third agro-zone and seventh prudential category. The surroundings consist mainly of low forest and plants. The location can be expanded upwards due to its terrain configuration.

The nearest residential buildings are about 500 m (air-way) away.

There are not any constructed residential or business buildings at the location itself. There are not any connections to the gas, water or sewage lines. There is a substation about 250 m away.

Figure 11.1 shows a satellite image of the micro location of the future Regional sanitary landfill at the “Separation 1“ location.
11.3 DESCRIPTION OF THE PLANT

The purpose of the facility is disposal of municipal waste and technological waste similar to municipal waste from the analyzed area under controlled conditions, i.e. sanitary waste disposal. Other types of waste must not be disposed at this landfill category.

Waste should be disposed at the landfill by the end of 2039 with a possibility of expanding the disposal cells at a reserved area (phase II – stage 3) which would extend the location lifespan.

The entire project area is about 21,0 ha. Waste disposal site of 5,85 ha with maximum height of 52 m shall be constructed, and the rest of the landfill shall consist of entry/exit zone, service center, recycling yard, construction waste treatment zone, main office, green area and area reserved for the construction of other regional landfill facilities.

Regional sanitary landfill “Separation 1” shall be enclosed with a 2.0 m high fence. The fence will be about 3,160 m long with the main gate 3,0 + 3,0 + 1,1=7,1 m wide. This phase (phase 1) is scheduled for the construction of a fence part of total length of 1,840 m.

The entrance shall be secured with a double door and a single door for pedestrians.
Temporary container-type facilities shall be used for the contractors during the construction.

A permanent electromechanical 18m long weighbridge with a canopy and capacity of 60 tones shall be installed to weigh the waste arriving to the disposal site, as well as a doorman/guard house (a container-type structure).

After final closure, the disposal site itself shall be a green area maximum 52m high with a side slope of max 1:2.5. Grass, i.e. bushes and native plants shall be planted at the closed part of the disposal site, as well as along the fence representing both visual and protective buffer zone towards the surrounding terrain. Preferably, thorny hedge should be planted along the fence to enhance security and prevent the visibility of the disposal site.

I PHASE: construction (Figure 2.5.)

Stage 1:
- construction of the entry/exit zone construction (gate, weighbridge with a weighbridge house, a separator and an oil and grease sedimentation tank)
- construction of the fence enclosing a part of the landfill
- construction of the main office with a related parking lot for personal vehicles
- construction of the service center with a related plateau
- construction of internal roads
- construction of the first part of landfill cells for waste disposal with a collection system and leachate recirculation and passive degassing system
- construction of perimeter canal around disposal cells
- construction of perimeter canal around the landfill
- construction of rainwater pools/tanks
- construction of a car wash facility
- construction of water supply network
- construction of sewage and electrical power supply network
- heavy machinery procurement
- construction of the construction waste disposal cell

Stage 2:
- construction of the recycling yard with a related canopy

Stage 3:
- construction of the construction waste disposal cell

Stage 4:
- construction/installment of the landfill gas flare system (in 2021 or 5 years upon putting the regional sanitary landfill into service)

Stage 5:
- construction of the rest of landfill waste disposal cells

Stage 6:
- partial landfill closure
A reserved area for future expanding (future Waste Management Center) where certain future facilities may be built is planned at the location of the regional sanitary landfill.

The following facilities have been planned:

PHASE 2

- construction of a mechanical biological waste treatment plant at the reserved part of the location, as well as construction of the rest of the fence around the landfill site
- construction of a composting plant for biodegradable waste treatment at the reserved part of the location
- construction of a waste disposal cell with a leachate system at the reserved part of the location as well as a rainwater harvesting canal
- construction of a sorting facility at the reserved part of the location
- construction of a transfer station in Kladanj municipality with all the necessary machinery (a container truck) and equipment necessary to operate it. Kladanj municipality is obliged to provide a suitable location for the construction of a transfer station requiring 5,000 m²
- construction of a substation

The size of the reserved area of this phase is about 8.7 hectares.

PHASE 3

- construction/installment of a leachate and sanitary wastewater treatment plant

The size of the reserved area of this phase is about 0.02 hectares.

PHASE 4:

- construction/installment of a landfill gas power plant

The size of the reserved area of this phase is about 0.03 hectares.

Figure 11.2. shows the setting of the regional sanitary landfill “Separation 1” with mapped construction phases.
Figure 11.2. – Situation map of the regional landfill – construction phase
### 11.4 WASTE PRODUCTION AND FINAL DISPOSAL

**Table 11.1. – Waste production during construction phase, location of origin and amount, disposal method**

<table>
<thead>
<tr>
<th>Type of waste</th>
<th>Code</th>
<th>Waste</th>
<th>Waste composition</th>
<th>Waste origin location</th>
<th>Amount/year</th>
<th>Collection location</th>
<th>Final disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>02 Wastes from agriculture, horticulture, aquaculture, forestry, hunting and</td>
<td>02 01</td>
<td>Wastes from agriculture,</td>
<td>Wood, vegetal waste, bushes</td>
<td>Forests, bushes at the planned location from</td>
<td>approx 30 l</td>
<td>Temporary storehouse</td>
<td>Firewood, incineration</td>
</tr>
<tr>
<td>fishing, food preparation and processing</td>
<td></td>
<td>horticulture, aquaculture,</td>
<td></td>
<td>landfill construction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>02 01</td>
<td>forestry, hunting and</td>
<td></td>
<td>Wood, vegetal waste and bushes from cleaning</td>
<td>approx 15 l</td>
<td>Authorized company</td>
<td></td>
</tr>
<tr>
<td></td>
<td>02 01</td>
<td>fishing</td>
<td></td>
<td>and preparation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>02 01</td>
<td>Waste from forestry</td>
<td>Wood, vegetal waste and bushes from cleaning</td>
<td>Temporary storehouse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>02 01</td>
<td>Waste paint and varnish</td>
<td>Paints and varnishes</td>
<td>Authorized company</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>08 Wastes from the manufacture, formulation, supply and use of coatings</td>
<td>08 01</td>
<td>Wastes from the manufacture,</td>
<td>Paints and varnishes</td>
<td>Entire location of planned works</td>
<td>approx 30 l</td>
<td>Temporary storehouse</td>
<td>Authorized company</td>
</tr>
<tr>
<td>(paints, varnishes and vitreous enamels), adhesives, sealants and printing</td>
<td></td>
<td>formulation, supply and use</td>
<td>When painting roads and coating metal structures</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>inks</td>
<td></td>
<td>and removal of paint and</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>varnish</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>08 01</td>
<td>Waste paint or varnish</td>
<td></td>
<td></td>
<td>approx 15 l</td>
<td>Temporary storehouse</td>
<td>Authorized company</td>
</tr>
<tr>
<td>remover</td>
<td>08 01</td>
<td>remover</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>08 01</td>
<td>Waste paint or varnish</td>
<td></td>
<td></td>
<td>approx 15 l</td>
<td>Temporary storehouse</td>
<td>Authorized company</td>
</tr>
<tr>
<td>thinner</td>
<td>08 01</td>
<td>thinner</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Waste hydraulic oils</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13 Oil and liquid fuel wastes (except edible oils and waste from 05, 12 and 19)</td>
<td>13 01</td>
<td>Waste hydraulic oils</td>
<td></td>
<td></td>
<td>approx 50 l</td>
<td>Hazardous waste storehouse</td>
<td>Authorized company</td>
</tr>
<tr>
<td></td>
<td>13 01</td>
<td>Mineral-based non-chlorinated</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>hydraulic oils</td>
<td>13 01</td>
<td>hydraulic oils</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>13 01</td>
<td>Synthetic hydraulic oils</td>
<td></td>
<td></td>
<td>approx 50 l</td>
<td>Hazardous waste storehouse</td>
<td>Landfill disposal</td>
</tr>
<tr>
<td></td>
<td>13 02</td>
<td>Synthetic engine, gear and</td>
<td></td>
<td></td>
<td>approx 60 l</td>
<td>Temporary hazardous waste</td>
<td>Authorized company</td>
</tr>
<tr>
<td>lubricating oils</td>
<td>13 02</td>
<td>lubricating oils</td>
<td></td>
<td></td>
<td></td>
<td>storehouse</td>
<td></td>
</tr>
<tr>
<td></td>
<td>13 02</td>
<td>Engine oils, lubricants,</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>lubricating materials</td>
<td>13 02</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Hazardous waste storehouse is a collection location for hazardous waste, which may require special handling and disposal procedures.
<table>
<thead>
<tr>
<th>Type of waste</th>
<th>Code</th>
<th>Waste</th>
<th>Waste composition</th>
<th>Waste origin location</th>
<th>Amount/year</th>
<th>Collection location</th>
<th>Final disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>13 02 07*</td>
<td>Waste packaging, absorbents, absorption materials, filter materials and protective suits not otherwise specified</td>
<td>Engine oils, lubricants, lubricating materials</td>
<td>Entire location of planned works</td>
<td>approx.60 l</td>
<td>Temporary hazardous waste storehouse</td>
<td>Authorized company</td>
</tr>
<tr>
<td></td>
<td>13 07 01*</td>
<td>Readily biodegradable engine, gear and lubricating oils</td>
<td>Engine oils, lubricants, lubricating materials</td>
<td>Entire location of planned works</td>
<td>approx.40 l</td>
<td>Temporary hazardous waste storehouse</td>
<td>Authorized company</td>
</tr>
<tr>
<td></td>
<td>13 07 02*</td>
<td>Fuel oil and diesel</td>
<td>Motor fuel</td>
<td>Heavy equipment, equipment installation, entire location of planned works</td>
<td>approx.20 l</td>
<td>Temporary hazardous waste storehouse</td>
<td>Authorized company</td>
</tr>
<tr>
<td></td>
<td>13 07</td>
<td>Waste of liquid fuels</td>
<td>Motor fuel</td>
<td>Heavy equipment, equipment installation, entire location of planned works</td>
<td>approx.20 l</td>
<td>Temporary hazardous waste storehouse</td>
<td>Authorized company</td>
</tr>
<tr>
<td></td>
<td>13 08 99*</td>
<td>Wastes not otherwise specified</td>
<td>Oily clothes, clothes, oily materials</td>
<td>Heavy equipment, equipment installation, entire location of planned works</td>
<td>approx.50 kg</td>
<td>Temporary hazardous waste storehouse</td>
<td>Authorized company</td>
</tr>
<tr>
<td></td>
<td>15 01</td>
<td>Packaging (including separately collected municipal packaging waste)</td>
<td>Paint and varnish packaging</td>
<td>Facilities, coating metal structures</td>
<td>approx.100 kg</td>
<td>Temporary hazardous waste storehouse</td>
<td>Authorized company</td>
</tr>
<tr>
<td></td>
<td>15 01 10*</td>
<td>Packaging containing residues of or contaminated by dangerous substances</td>
<td>Paint and varnish packaging</td>
<td>Facilities, coating metal structures</td>
<td>approx.100 kg</td>
<td>Temporary hazardous waste storehouse</td>
<td>Authorized company</td>
</tr>
<tr>
<td></td>
<td>15 02 02*</td>
<td>Absorbents, filter materials (including oil filters not otherwise specified), wiping cloths and protective clothing contaminated by dangerous substances</td>
<td>Filters, absorption fillers</td>
<td>Entire location of planned works</td>
<td>approx.100 kg</td>
<td>Temporary hazardous waste storehouse</td>
<td>Authorized company</td>
</tr>
<tr>
<td>Type of waste</td>
<td>Code</td>
<td>Waste</td>
<td>Waste composition</td>
<td>Waste origin location</td>
<td>Amount/year</td>
<td>Collection location</td>
<td>Final disposal</td>
</tr>
<tr>
<td>---------------</td>
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<td>-------------------</td>
<td>-----------------------</td>
<td>-------------</td>
<td>---------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>16 Wastes not otherwise specified in the list</td>
<td>16 01</td>
<td>End-of-life vehicles from different means of transport (including off-road machinery) and wastes from dismantling of end-of-life vehicles and vehicle maintenance (except 13, 14, 16 06 and 16 08)</td>
<td>End-of-life tyres</td>
<td>Waste from used-up tires</td>
<td>From using heavy machinery</td>
<td>approx.200 kg</td>
<td>Temporary waste storehouse</td>
</tr>
<tr>
<td></td>
<td>16 01 03</td>
<td>End-of-life tyres</td>
<td>Waste from used-up tires</td>
<td>From using heavy machinery</td>
<td>approx.200 kg</td>
<td>Temporary waste storehouse</td>
<td>Authorized company</td>
</tr>
<tr>
<td>16 06 Batteries and accumulators</td>
<td>16 06 05</td>
<td>Other batteries and accumulators</td>
<td>Batteries and accumulators</td>
<td>Heavy machinery and transportation vehicles</td>
<td>approx.50 kg</td>
<td>Temporary hazardous waste storehouse</td>
<td>Authorized company</td>
</tr>
<tr>
<td>17 Construction and demolition wastes (including excavations from polluted/contaminated locations)</td>
<td>17 01</td>
<td>Concrete, bricks, tiles and ceramics</td>
<td>Concrete</td>
<td>Cement suspension, concrete, concrete supports</td>
<td>Entire location of planned works</td>
<td>approx.200 m³</td>
<td>Temporary waste storehouse</td>
</tr>
<tr>
<td></td>
<td>17 01 01</td>
<td>Concrete</td>
<td>Cement suspension, concrete, concrete supports</td>
<td>Entire location of planned works</td>
<td>approx.200 m³</td>
<td>Temporary waste storehouse</td>
<td>Construction waste landfill</td>
</tr>
<tr>
<td>17 02</td>
<td>wood, glass and plastic</td>
<td>Wood</td>
<td>Wooden planks, poles, wooden scaffolding, wooden coasters, wood panels</td>
<td>Entire location of planned works</td>
<td>approx.30 m³</td>
<td>Temporary hazardous waste storehouse</td>
<td>Construction waste landfill</td>
</tr>
<tr>
<td></td>
<td>17 02 01</td>
<td>Wood</td>
<td>Wooden planks, poles, wooden scaffolding, wooden coasters, wood panels</td>
<td>Entire location of planned works</td>
<td>approx.30 m³</td>
<td>Temporary hazardous waste storehouse</td>
<td>Construction waste landfill</td>
</tr>
<tr>
<td></td>
<td>17 02 03</td>
<td>Plastic</td>
<td>Heat-shrinkable sleeves, geotextile, PVC sacks, warning tapes, foils, PVC pipes, cables, PHD pipes, HDPE foils</td>
<td>Entire location of planned works</td>
<td>approx.300 kg</td>
<td>Selective disposal containers</td>
<td>Authorized company</td>
</tr>
<tr>
<td>Code</td>
<td>Waste</td>
<td>Waste composition</td>
<td>Waste origin location</td>
<td>Amount/year</td>
<td>Collection location</td>
<td>Final disposal</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>-------</td>
<td>------------------</td>
<td>-----------------------</td>
<td>-------------</td>
<td>---------------------</td>
<td>---------------</td>
<td></td>
</tr>
<tr>
<td>17 02 04*</td>
<td>Glass, plastic and wood containing or contaminated with dangerous substances</td>
<td>Mixtures of the above mentioned materials</td>
<td>Entire location of planned works</td>
<td>approx. 100 kg</td>
<td>Temporary hazardous waste storehouse</td>
<td>Authorized company</td>
<td></td>
</tr>
<tr>
<td>17 03 01*</td>
<td>Bituminous mixtures containing coal tar</td>
<td>Plastic anticorrosion tapes, waste asphalt, bitumen</td>
<td>Landfill site and roads</td>
<td>approx. 30 m³</td>
<td>Temporary waste storehouse</td>
<td>Authorized company</td>
<td></td>
</tr>
<tr>
<td>17 04 05</td>
<td>Iron and steel</td>
<td>Assembly tools, damaged steel and iron parts, wires, tagging poles, road safety barriers, sheet metal, grounding belt, reinforcement</td>
<td>Construction of fence and all facilities within landfill</td>
<td>approx. 1.5 t</td>
<td>Selective disposal containers</td>
<td>Authorized company</td>
<td></td>
</tr>
<tr>
<td>17 04 07</td>
<td>Mixed metals</td>
<td>Electronic equipment, welding electrode remnants, cables</td>
<td>Construction of fence and all facilities within landfill</td>
<td>approx. 300 kg</td>
<td>Selective disposal containers</td>
<td>Authorized company</td>
<td></td>
</tr>
<tr>
<td>17 05 04</td>
<td>Soil and stones other than those mentioned in 17 05 03</td>
<td>Soil and small pebbles from dredging to be used for capping, big stones to be disposed</td>
<td>Excavation, landfill enabling works, road and drainage canal construction, sand embankments</td>
<td>approx. 30,000-40,000 m³</td>
<td>Temporary disposal sites</td>
<td>For soil and small pebbles – landfill site, for big stones – construction waste landfill</td>
<td></td>
</tr>
</tbody>
</table>

**1703** Bituminous mixtures, coal tar and tarred products

**1704** Metals (including their alloys)
<table>
<thead>
<tr>
<th>Type of waste</th>
<th>Code</th>
<th>Waste</th>
<th>Waste composition</th>
<th>Waste origin location</th>
<th>Amount/year</th>
<th>Collection location</th>
<th>Final disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 Municipal wastes (domestic waste and similar wastes from industrial and craftsmanship plants) including separately collected fractions</td>
<td>20 01 01</td>
<td>Paper and cardboard</td>
<td>Cardboard boxes, paper packaging,...</td>
<td>Construction material storehouse, assembly tools, workers, i.e. entire location of landfill</td>
<td>approx. 300 kg</td>
<td>Selective disposal containers</td>
<td>Authorized company</td>
</tr>
<tr>
<td>20 01 Separately collected fractions (except 15 01)</td>
<td>2003 Other municipal wastes</td>
<td>20 03 01</td>
<td>Mixed municipal waste</td>
<td>Food products, packaging,...</td>
<td>approx. 600 kg</td>
<td>Municipal waste containers</td>
<td>Sorting facility/disposal to the landfill</td>
</tr>
</tbody>
</table>
Table 11.2. – Waste production during exploitation phase, location of origin and amount

<table>
<thead>
<tr>
<th>Type of waste</th>
<th>Code</th>
<th>Waste</th>
<th>Waste composition</th>
<th>Waste origin location</th>
<th>Amount/year</th>
<th>Collection location</th>
<th>Final disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>08</strong> Wastes form the manufacture, formulation, supply and use of coatings (paints, varnishes and vitreous enamels,) Adhesives, sealants and printing inks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>08 01</td>
<td>Waste paint and varnish containing organic solvents or other dangerous substances</td>
<td>Paints and varnishes</td>
<td>Plant and facilities during overhaul and repair, service center</td>
<td>approx.10 l</td>
<td>Hazardous waste storehouse</td>
<td>Authorized company</td>
<td></td>
</tr>
<tr>
<td>08 01 11*</td>
<td>Waste paint and varnish remover</td>
<td>Paints and varnishes</td>
<td>Plant and facilities during overhaul and repair, service center</td>
<td>approx.10 l</td>
<td>Hazardous waste storehouse</td>
<td>Authorized company</td>
<td></td>
</tr>
<tr>
<td><strong>13</strong> Oil wastes and wastes of liquid fuels (except edible oils, and those in chapters 05, 12 and 19)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13 01</td>
<td>Waste hydraulic oils</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13 01*</td>
<td>Mineral-based non-chlorinated hydraulic oils</td>
<td>Hydraulic oils</td>
<td>Transportation vehicles, heavy machinery, service center</td>
<td>approx.50 l</td>
<td>Hazardous waste storehouse</td>
<td>Authorized company</td>
<td></td>
</tr>
<tr>
<td>13 01 11*</td>
<td>Synthetic hydraulic oils</td>
<td>Hydraulic oils</td>
<td>Transportation vehicles, heavy machinery, service center</td>
<td>approx.50 l</td>
<td>Hazardous waste storehouse</td>
<td>Authorized company</td>
<td></td>
</tr>
<tr>
<td>13 02</td>
<td>Waste engine, gear and lubricating oils</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13 02 06*</td>
<td>Synthetic engine, gear and lubricating oils</td>
<td>Engine oils, lubricants, lubricating materials</td>
<td>Transportation vehicles, heavy machinery, service center</td>
<td>approx.55 l</td>
<td>Hazardous waste storehouse</td>
<td>Authorized company</td>
<td></td>
</tr>
<tr>
<td>13 02 07*</td>
<td>Readily biodegradable engine, gear and lubricating oils</td>
<td>Engine oils, lubricants, lubricating materials</td>
<td>Transportation vehicles, heavy machinery, service center</td>
<td>approx.55 l</td>
<td>Hazardous waste storehouse</td>
<td>Authorized company</td>
<td></td>
</tr>
<tr>
<td>13 05</td>
<td>Oil/water separator contents</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13 05 02*</td>
<td>Sludge from oil/water separators</td>
<td>Sludge from oil/water separators</td>
<td>Oil and grease separator</td>
<td>approx.10 l</td>
<td>Hazardous waste storehouse</td>
<td>Authorized company</td>
<td></td>
</tr>
<tr>
<td>13 07</td>
<td>Wastes of liquid fuels</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of waste</td>
<td>Code</td>
<td>Waste</td>
<td>Waste composition</td>
<td>Waste origin location</td>
<td>Amount/year</td>
<td>Collection location</td>
<td>Final disposal</td>
</tr>
<tr>
<td>---------------</td>
<td>--------</td>
<td>-------------------------------</td>
<td>--------------------------------------------</td>
<td>---------------------------------------------</td>
<td>-------------</td>
<td>--------------------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>Fuel oil and diesel</td>
<td>13 07 01*</td>
<td>Motor fuel, waste from fuel oil tank cleaning</td>
<td>Transportation vehicles, heavy machinery, service center</td>
<td>approx. 20 l</td>
<td>Hazardous waste storehouse</td>
<td>Authorized company</td>
<td></td>
</tr>
<tr>
<td>Oil wastes not otherwise specified</td>
<td>13 07 02*</td>
<td>Petrol</td>
<td>Heavy machinery, equipment installment, entire road</td>
<td>approx. 20 l</td>
<td>Hazardous waste storehouse</td>
<td>Authorized company</td>
<td></td>
</tr>
<tr>
<td>13 08</td>
<td>Oil wastes not otherwise specified</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wastes not otherwise specified</td>
<td>13 08 99*</td>
<td>Oily cloths, clothes, oily materials</td>
<td>Entire landfill location, service center</td>
<td>approx. 80 l</td>
<td>Hazardous waste storehouse</td>
<td>Authorized company</td>
<td></td>
</tr>
<tr>
<td>Packaging (including separately collected municipal packaging waste)</td>
<td>15 01</td>
<td>Paper and cardboard packaging</td>
<td>Feedstock and office material packaging</td>
<td>Main office, service center</td>
<td>approx. 200 kg</td>
<td>Selective disposal containers</td>
<td>Authorized company</td>
</tr>
<tr>
<td>Mixed packaging</td>
<td>15 01 06</td>
<td>Materials packaging in use</td>
<td>Main office, service center</td>
<td>approx. 300 kg</td>
<td>Sorting facility</td>
<td>Landfill disposal</td>
<td></td>
</tr>
<tr>
<td>Packaging containing residues of or contaminated by dangerous substances</td>
<td>15 01 10*</td>
<td>Paint and varnish packaging, cleaners and chemicals packaging, etc.</td>
<td>Service center</td>
<td>approx. 100 kg</td>
<td>Hazardous waste storehouse</td>
<td>Authorized company</td>
<td></td>
</tr>
<tr>
<td>Absorbents, filter materials, wiping cloths and protective clothing</td>
<td>15 02</td>
<td>Absorbents, filter materials (including oil filters not otherwise specified), wiping cloths, protective clothing contaminated by dangerous substances</td>
<td>Filters, absorption fillers</td>
<td>Entire location, service center</td>
<td>approx. 100 kg</td>
<td>Hazardous waste storehouse</td>
<td>Authorized company</td>
</tr>
<tr>
<td>End-of-life vehicles from different means of transport (including off-road machinery) and wastes from dismantling of end-of-life vehicles and vehicle maintenance (except 13, 14, 16 06 and 16 08)</td>
<td>16 01</td>
<td>End-of-life vehicles from different means of transport (including off-road machinery) and wastes from dismantling of end-of-life vehicles and vehicle maintenance (except 13, 14, 16 06 and 16 08)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of waste</td>
<td>Code</td>
<td>Waste</td>
<td>Waste composition</td>
<td>Waste origin location</td>
<td>Amount/year</td>
<td>Collection location</td>
<td>Final disposal</td>
</tr>
<tr>
<td>---------------</td>
<td>---------</td>
<td>--------------------------------------------</td>
<td>------------------------------------------</td>
<td>-----------------------</td>
<td>-------------</td>
<td>---------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td></td>
<td>16 01 03</td>
<td>End-of-life tires</td>
<td>Waste from used-up tires</td>
<td>Service center, transportation vehicles, heavy machinery</td>
<td>approx.300 kg</td>
<td>Hazardous waste storehouse</td>
<td>Authorized company</td>
</tr>
<tr>
<td></td>
<td>07*</td>
<td>Oil filters</td>
<td>Oil filters from different vehicles</td>
<td>Service center</td>
<td>approx.20 kg</td>
<td>Hazardous waste storehouse</td>
<td>Authorized company</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>Brake pads other than those mentioned in 16 01 11</td>
<td>Pads</td>
<td>Service center</td>
<td>approx.10 kg</td>
<td>Hazardous waste storehouse</td>
<td>Authorized company</td>
</tr>
<tr>
<td></td>
<td>13*</td>
<td>Brake fluids</td>
<td>Brake fluids from vehicles</td>
<td>Service center</td>
<td>approx.10 l</td>
<td>Hazardous waste storehouse</td>
<td>Authorized company</td>
</tr>
<tr>
<td></td>
<td>14*</td>
<td>Antifreeze fluids containing dangerous substances</td>
<td>Batteries and accumulators</td>
<td>Service center</td>
<td>approx.40 l</td>
<td>Hazardous waste storehouse</td>
<td>Authorized company</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>16 06</td>
<td>Batteries and accumulators</td>
<td>Batteries and accumulators</td>
<td>Service center</td>
<td>approx.50 kg</td>
<td>Temporary storehouse</td>
<td>Authorized company</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>08</td>
<td>Wastes from waste water treatment plants not otherwise specified</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>05</td>
<td>Sludge from treatment of urban waste water</td>
<td>Sludge from septic tank cleaning at landfill location</td>
<td>Septic tank for sanitary waste water</td>
<td>approx.300 kg</td>
<td>Storage tank</td>
<td>Authorized company</td>
</tr>
<tr>
<td></td>
<td>13*</td>
<td>Sludge containing dangerous substances from other treatment of industrial waste water</td>
<td>Sludge from cleaning leachate tanks</td>
<td>Leachate tanks</td>
<td>approx.300 kg</td>
<td>Storage tank</td>
<td>Authorized company</td>
</tr>
<tr>
<td>19 12</td>
<td>Wastes from the mechanical treatment of waste (for example sorting, crushing, compacting, pelletizing)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>11*</td>
<td>Other wastes (including mixtures of materials) from mechanical treatment of waste containing dangerous substances</td>
<td>Hazardous materials found during sorting waste</td>
<td>Waste sorting facility</td>
<td>approx.1000 kg</td>
<td>Hazardous waste storehouse</td>
<td>Authorized company</td>
</tr>
<tr>
<td>20</td>
<td>01</td>
<td>Separately collected fractions (except 15 01)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Municipal wastes (household waste and similar commercial, industrial and institutional wastes) including separately collected fractions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>20 01 01</td>
<td>Paper and cardboard</td>
<td>Old paper and cardboard</td>
<td>Main office</td>
<td>approx. 300 kg</td>
<td>Selective disposal containers</td>
<td>Authorized company</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of waste</th>
<th>Code</th>
<th>Waste</th>
<th>Waste composition</th>
<th>Waste origin location</th>
<th>Amount/year</th>
<th>Collection location</th>
<th>Final disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 01 21*</td>
<td>Fluorescent tubes and other mercury-containing waste</td>
<td>Used compact fluorescent lamp</td>
<td>Entire landfill location</td>
<td>approx. 10 kg</td>
<td>Hazardous waste storehouse</td>
<td>Authorized company</td>
<td></td>
</tr>
</tbody>
</table>

**20 03 Other municipal wastes**

| 20 03 01 | Mixed municipal waste | Food products and other wastes | Entire landfill location | approx. 600 kg | Sorting facility | Landfill disposal |
11.5 MEASURES TO BE TAKEN IN ORDER TO PREVENT WASTE PRODUCTION, ESPECIALLY HAZARDOUS WASTE

The Operator is obliged to provide measures to prevent waste production, especially toxic and hazardous waste.

Hazardous waste must not be disposed of at the regional sanitary landfill. Pursuant to the Law on Waste Management (Official Gazette of FBiH, no. 33/03, 72/09), hazardous waste is waste identified by a specific regulation with one or more features harmful for human health, and environment in its origin, composition or concentration, as well as waste listed as hazardous in the list and directed by implementing rules;

Regional sanitary landfill “Separation 1” shall have Environmental Waste Management Program within its procedures, which shall precisely define waste collection method (collection) and waste treatment during construction and exploitation phase, as well as after closure.

Wastewater

A drainage system shall direct leachate from the landfill to concrete watertight tanks (250 m³). The water in these tanks can be used for fire protection.

- The tank shall be made of C30/37 category watertight reinforced concrete and it shall have two openings. Two submerged pumps shall recirculate from the tank through the landfill site during the first 5 years. In the Operational phase III of the landfill, a leachate treatment equipment shall be constructed.

![Figure 11.3. – Leachate collection tank](image)

- Tank / sedimentation tank for rainwater harvesting – rainwater shall be harvested by a run-off collection canal in a watertight tank for rainwater harvesting with useful volume of approx. 700 m³. The tank shall be made of C30/37 category watertight reinforced concrete. The tank shall have three dividing walls which shall settle the water flow, i.e. it shall be a sedimentation tank for any possible suspended particles in the run-off collection canal.
The water from the tank shall be used as industrial water for the landfill needs. After sedimentation, the water shall be discharged into the surroundings via a spillway.

Figure 11.4. – Tank / sedimentation tank for rainwater harvesting

In order to prevent or reduce waste production, the Operator/Investor is obliged to set up waste monitoring, and establish and duly keep waste records regarding its type and amount, which also must be duly kept by a person responsible for waste management (an officer for conducting work protection measures).

The person responsible for waste management is obliged to correctly record every dangerous situation or accident specifying all the activities taken to eliminate or reduce the intensity of those accidents.

In the end of each calendar year, this person shall fill in a special form, given in the annex, entitled “Dangerous situations and accidents record form with an overview of actions taken to mitigate their environmental impacts”.

Table 11.4. shows a form example to be filled in with additional explanations of each accidental situation. Each environmental accident must be reported to the nearest inspection.

The entire organized and recorded environmental documentation is stored in the Investor’s archive.
## Table 11.4. – Dangerous situations record form

<table>
<thead>
<tr>
<th>No.</th>
<th>Date and place</th>
<th>Description of the occurred accident/dangerous situation</th>
<th>Cause of the accident/dangerous situation</th>
<th>Consequences – environmental impact</th>
<th>Environmental impact area – water, air, soil or people</th>
<th>Description of the action taken to mitigate environmental impact</th>
<th>Control authority certificate on eliminating the cause of the accident/dangerous situation</th>
<th>Record no.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Suggestions, recommendations, remarks, improvement proposals:

Annual list completion date: List was made by: Checked and authorized by:

- Head of service
- Fire protection officer, date

Deliver:

- Fire protection officer (original)
- Work protection officer (copy)
11.6. WASTE SEPARATION, ESPECIALLY HAZARDOUS WASTE FROM OTHER TYPES OF WASTE TO BE RE-USED

The Operator is obliged to provide measures for selective collection (separation) of waste in order to recycle and further use usable waste and safely dispose of useless waste at the landfill in accordance with waste management regulations. Hazardous waste must be separately collected and stored in assigned containers in a closed storehouse and labeled “hazardous waste”.

Soil and stone excavation (humus layer) waste is used for other purposes. This excavated soil is then used as a buffer during road construction, construction lot filling, and terrain leveling.

Residue expected in the tank (to be built) for mechanical impurities separated from wastewater and collected from working surfaces shall be temporarily disposed of at a temporary landfill and as such can be used with soil as a buffer for internal roads, depression leveling, etc.

Oil and grease waste and other hazardous waste shall be selectively collected regarding its type in assigned closed metal barrels in hazardous waste storehouse in a closed facility, if possible, in accordance with the provisions of Decree on separate collection, packaging and labelling of waste.

Old oil filters, accumulators, and replaces antifreeze liquids are temporarily stores in assigned dispensers in a closed storehouse and occasionally delivered to the authorized operator for hazardous waste disposal.

Mixed municipal waste from the main office restaurant and other non-hazardous waste shall be disposed of at the landfill.

In order to ensure selective collection and waste disposal, the operator/investor is obliged to set up waste monitoring and record keeping regarding type and amount and it has to be duly kept by a responsible person, an officer for conducting work protection measures of this Company. Waste monitoring record should contain the name of hazardous material, amount, date of entry and exit and certain remarks.

The Operator, i.e. person responsible for hazardous waste marked with an asterisk in the table is obliged to:

- keep record on amount (e.g. used oil and grease, oil filters, accumulators, antifreeze liquids, etc.),
- provide a covered or closed space and appropriate containers for storing hazardous waste,
- separately collect regarding type, i.e. waste category,
- provide hazardous waste disposal in assigned containers labeled “hazardous waste” (e.g. used oil, oil filters, lead accumulators, antifreeze liquids, etc.),
- transfer the accompanying hazardous waste sheet with the information on type, amount, origin and hazardous waste packing method to the collector (e.g. used oil, oil filters, lead accumulators, antifreeze liquids, etc.),
- archive the record for minimum 5 years,
- if necessary make it available to the environment protection inspector.

Forms which the Operator is obliged to fill in both construction phase and exploitation phase of the landfill are given below:

- ✔ Record sheet
✓ Record on origin and flow of waste batteries and accumulators
✓ Record on waste origin and flow in a year
✓ Waste transportation documentation
<table>
<thead>
<tr>
<th>Date</th>
<th>Code</th>
<th>Amount</th>
<th>Storage</th>
<th>Authorized operator for waste transportation and treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:

Date: ____________________________________
Responsible person: ____________________________________
Signature: ____________________________________

*Figure 11.5. – Record Sheet*
## RECORD ON ORIGIN AND FLOW OF WASTE BATTERIES AND ACCUMULATORS

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>COMPANY</th>
<th>ADDRESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRODUCER – OWNER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COLLECTOR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TREATMENT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RECYCLING</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXPORTER</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WASTE CODE</th>
<th>WASTE TYPE</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>DATE</th>
<th>AMOUNT IN TONNES</th>
<th>AMOUNT OF HANDED OVER WASTE</th>
<th>COLLECTION</th>
<th>TREATMENT</th>
<th>RECYCLING</th>
<th>EXPORT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ENTRY</td>
<td>EXIT</td>
<td>STATUS</td>
<td>TRANSPORTATION</td>
<td>R</td>
<td>R</td>
</tr>
</tbody>
</table>

| TOTAL | |

*Figure 11.6. – Record on origin and flow of batteries and accumulators disposal*
# RECORD ON ORIGIN AND WASTE FLOW FOR YEAR ______

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>COMPANY</th>
<th>ADDRESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRODUCER – OWNER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COLLECTOR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CARRIER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRANSPORTATION AGENT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STORAGE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TREATMENT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RECOVERY</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DISPOSAL</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Activity generating waste:

Waste characteristics: Label H from Annex II of Decree on categories, types and classification of waste with the waste catalogue and the list of hazardous waste (NN 50/05)

<table>
<thead>
<tr>
<th>H1</th>
<th>H4</th>
<th>H8</th>
<th>H12</th>
</tr>
</thead>
<tbody>
<tr>
<td>H2</td>
<td>H5</td>
<td>H9</td>
<td>H13</td>
</tr>
<tr>
<td>H3A</td>
<td>H6</td>
<td>H10</td>
<td>H14</td>
</tr>
<tr>
<td>H3B</td>
<td>H7</td>
<td>H11</td>
<td></td>
</tr>
</tbody>
</table>

### Process generating waste:

Planned recovery or disposal procedures

<table>
<thead>
<tr>
<th>Recovery procedures</th>
<th>Disposal procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>R</td>
</tr>
<tr>
<td>D</td>
<td>D</td>
</tr>
</tbody>
</table>

### Physical state of waste

<table>
<thead>
<tr>
<th>Solid</th>
<th>Powder</th>
<th>Fluid</th>
<th>Liquid sludge</th>
<th>Other</th>
</tr>
</thead>
</table>

### Packing method of waste

<table>
<thead>
<tr>
<th>Dispenser (up to 1m³)</th>
<th>Containers</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plastic sacks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tanks</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Name, surname and signature of the responsible person

<table>
<thead>
<tr>
<th>WASTE CODE</th>
</tr>
</thead>
</table>

### WASTE TYPE

Figure 11.7. – Record on origin and waste flow for year

# WASTE TRANSPORTATION DOCUMENTATION

Transport documentation no. ______________________

## A. Information on the shipment

1. Below mentioned waste is being disposed from (name, address, municipality)
2. Waste will be transported to (address)
3. [ ] Single shipment [ ] Multiple shipments Please specify....................
4. Expected date/disposal time .................
5. Name ...................... On behalf of (company)
   Signature ........................
6. Phone
7. The waste manufacturer is (if different from the above mentioned)

## B. Description of the waste

1. Waste is .................
2. Classification .........................
3. Physical form [ ] Liquid [ ] Powder [ ] Sludge [ ] Solid [ ] Mixed
11.7 WASTE DISPOSAL AT THE LANDFILL

Waste disposal method at the landfill must be without risk for environment or its individual elements.

Other types of waste during construction and exploitation which shall not be disposed of at the landfill itself shall be collected in assigned dispensers and stored in a closed facility within Regional sanitary landfill in order to use it further or transport it to authorized institutions (oil and grease wastes, etc.).

Accumulators, old oil filters and antifreeze liquids are temporarily stored in assigned dispensers kept in an assigned storehouse until its delivery to an authorized operator for hazardous waste disposal. Transportation of this waste must not pollute the environment. The waste shall be transported by refuse collection vehicles.

In case of pollution during transportation, the transportation agent is responsible for cleaning and reinstating the polluted area.
11.8 CONCLUSION

The operator is obliged to update Waste Management Plan every three years or in case of a modification in activities.

Also, the operator is obliged to sign contracts and adjust them to this Plan regarding removal, treatment, deposit and disposal of the waste produced during construction phase, as well as removal of hazardous waste which shall not be disposed of at the landfill itself during exploitation. The contracts must include an authorized third party as a proof of environmentally acceptable waste disposal which is the executor’s responsibility.

The operator’s responsibility is to treat every type of waste, which is generated in the area of Regional sanitary landfill, and which must not and shall not be disposed of (only municipal waste is exclusively disposed of) in accordance with this Plan and waste management regulations.

The person responsible for the waste management activities, the officer for controlling the implementation of work protection measures, is obliged to implement this Waste Management Plan, suggest measures to improve waste prevention, re-use and recycling and monitor meeting waste management requirements.

Waste producers, i.e. plant operators are obliged to report to a relevant authority, i.e. environment protection inspection about detected negative environmental impacts immediately, 12 hours upon the occurrence of the negative impact the latest.

Mining Institute director:

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Eldar Pirić, MA mechanical
- Research associate-