8. MITIGATION OF ENVIRONMENTAL IMPACTS

The identification and analysis of potential negative impacts indicated that there is a need to propose the implementation of certain mitigation measures for the construction and operational phase of the landfill.

8.1 CONSTRUCTION PHASE

During the construction phase, it is more than necessary to adopt strategies to prevent or minimize dust emissions, noise generation, health and safety hazards, and negative impacts related to the construction wastes generated. The main control measures should be considered as requirements from contractors.

8.1.1 Soil

Measures should be adopted to reduce adverse effects such as soil improvement techniques as well as improving the green belt, obtaining construction materials from other sources, use of alternative construction materials like fly ash, where possible, and preparation of a storm water management plan.

The construction works may lead to soil erosion, slope instability and changes in the local morphology, however with proper resurfacing of exposed areas and the induction of vegetation, significant reduction of erosion can be achieved. In addition, impacts may also occur from accidental leakage of used chemicals, fuel, or oil products used in maintenance equipment. Utmost precautions and good working practices should be adopted for the proper disposal of hazardous waste. Education of workers on environmental protection will improve those practices, while the responsibility for the adoption of such practices lies with the supervision engineers and the operators of the facility components.

Furthermore, measures could focus on:

- ✓ All excavations, shafts, pits or openings more than two metres deep should be covered or protected by suitable means when access is not needed.
- ✓ All excavation wall over 1.2 metres deep should be reinforced with timber to prevent collapse to persons working inside.
- ✓ Sprinkling of water during construction
- ✓ Careful placement and management of soils in storage
- ✓ Good maintenance - check up on vehicles and equipment. Periodic engine control should take place.
- ✓ Allow for cleaning and rinsing of equipment only at certain places with the right protection to prevent soil pollution
- ✓ Regular site inspections to carry out visual checks on oil, fuel and chemicals spillage.
- ✓ Supervision of such works should include collaboration with safety supervisors.

8.1.2 Air

Mitigation measures proposed during the construction stage should include prevention of dust nuisance, namely dust emissions from piles of soil or from any other material during earthworks and excavation. Dust emissions should be controlled by wetting the relevant surfaces, using temporary windbreaks and covering trucks with canvas. Piles and heaps of soil should not be left over by contractors after the construction phase is over. In addition, excavated sites should be covered with suitable solid material and vegetation growth, while no soil surface should be kept bare and susceptible to erosion.

Dust and smoke generated by the movement of vehicles and machinery should be mitigated by regular air testing, by vehicle noise and smoke tests as well as establishing a speed limit (slow and sensible driving) and water-spraying. Excavation works should be avoided in extremely dry weather periods, while workers should be provided with dust masks in extreme dust producing operations. Daily sprinkling of water on the unpaved roads would reduce the dust pollution drastically. Sprinkling water twice a day could reduce the dust by 40 to 50%, while it can be applied using water trucks (bowsers), handheld sprays and automatic sprinkler systems. In order to mitigate the effects of dust as SPM, a dust control plan could be implemented.

Construction equipment is frequently left idling while the operators are on a break or waiting for the completion of another task. Emissions from idling equipment tend to be high, since catalytic converters cool down, thus reducing the efficiency of hydrocarbon and carbon monoxide oxidation. Modern idling control technologies automatically shut the engine off after a preset time.

The dust emission control is a simple management method, while the level of annoyance depends significantly on the control measures at source. Regarding the production of dust due to movement of work-site vehicles, a management system to reduce dust during construction includes:

• Spraying the traffic lanes with water

• Establishing maximum speed limits on all non-paved surfaces

• Ensuring that movement corridors are clean and non-dusty

The following mitigation measures shall be implemented by the contractors to minimize impacts to air quality:

- Covering all trucks carrying loose materials.
- Sprinkling loads with water during the movement and deposition of sand and gravel and washing the wheels of all vehicles leaving the work area
- maintaining all machinery and equipment used in construction in a good condition by meeting the manufacturer's specifications, to minimize dust emissions

8.1.3 Water

Mitigation measures should focus on reducing adverse effects i.e. constructing storage areas with impervious paving, impervious roads, lined drains, routing surface drainage to settlement tanks/pits etc. Measures should be taken to protect surface water resources and prevent reduction in their quality due to construction activities.

The following measures are suggested to protect the water quality during the construction phase:

- ✓ Solid waste generated during this phase from workers activities and consumable parts should be collected in closed bins to be disposed of at a safe place.
- ✓ Domestic wastewater generated from workers at the site during the construction and operation phases should be handled and disposed in an environmentally safe manner. It can be collected in enclosed tanks and transported to the nearest appropriate place,
- ✓ The waste oil produced from vehicles and machines should not be allowed to spill over the sites
- ✓ The site drainage control measures would help to reduce the impacts of polluted site run-off and the changed run-off characteristics of the site.

- ✓ Adequate containment is necessary to collect the vehicle washing effluents and others, i.e. routing of off-site drainage.
- ✓ No discharge of wastewater to soil and ground water
- ✓ Pit latrines and community toilets with temporary soak pits and septic tanks will be constructed on the site during the construction phase to prevent wastewater from entering the ground water or surrounding water bodies.
- ✓ To prevent surface and ground water contamination by oil/grease, leak proof containers will be used for storage and transportation of oil/grease. The floors of oil/grease handling area will be kept effectively impervious.
- ✓ All stacking and loading areas should be made impervious and provided with proper garland drains equipped with baffles to prevent run-off from the site from contaminating surface or ground water resources
- ✓ Ensure that all transport and construction equipment is in good serviceable condition and no service is carried out on site
- ✓ Employ silt traps and barriers to prevent the transfer of soil and sediment into the surface water management system for the site

A detailed “Storm Water Management Plan” will be developed after considering the above aspects. The plan incorporates best management practices such as the following:

- Regular inspection and cleaning of storm drains.
- Secondary containment and dykes in fuel/oil storage facilities.
- Conducting routine inspections to ensure cleanliness.
- Preparation of spill response plans, particularly for fuel and oil storage areas.
- Good housekeeping in the above areas.

In order to mitigate the effects of liquid waste to the soil, water, flora, etc. during the construction phase, managers of sites should prevent any discharge of oil to the soil and should create a system of its collection. The residual oil from construction machinery should be collected at a designated location on the site and disposed of in oil recovery units. In the case of fuel leakage, absorbents should be used such as sand, wood shavings or special geotextiles immediately after the spill

1.1.4 Noise Pollution

Temporary noise pollution due to construction works should be controlled by proper maintenance of equipment and vehicles (periodic engine control) as well as tuning of engines and mufflers, when they are not being used. Enclosures and screens could be used, where necessary and practicable, around the noisy fixed plant or equipment. Construction works should also be confined to daytime hours. It is the responsibility of the Supervision Engineer to monitor the mitigation measures for noise. Finally, ear protection should be provided if limits exceed safety standards for employees.

The measures proposed to reduce the noise to the statutory thresholds during the construction phase can be summarized as follows:

a) Machinery noise control by using models for noise emissions
b) The use of temporary noise barriers around the area of the site and use of mobile noise screens at receptors where high noise levels are experienced.

The contractor should select the layout of sites and planning of the work so as to cause the minimum inconvenience to the human environment, houses and the wider project area.

8.1.5 Construction and Solid waste

Options for minimization of solid waste and for environmentally appropriate disposal/recycling of waste to conserve natural resources should be planned. Plans should be made for management and disposal of temporary structures made during the construction phase. Construction waste can be reused and recycled unless hazardous waste is produced, while for solid waste, the contractor shall ensure proper collection and disposal**.**

Uncontrolled littering in the facility and surrounding areas should be prevented. Furthermore, some of the waste such as rocks or excavated soil can be used in the construction processes. For example, the rocks can be used to prepare the base for the fence around the facility and soil can be used for landscaping as well as in the processes of cut and fill for the purpose of adjustments in levels in the landfill area.

During the construction phase, solid waste (debris, etc.) should be collected daily in bins appropriately positioned at the site and along the area of operations and removed (under the responsibility of the contractor) from the construction site.

8.1.6 Biodiversity

The adverse ecological impacts are not necessarily irrecoverable. Recommended mitigation measures to minimize or eliminate the impacts on the biodiversity at the proposed location, include:

i. Avoid deforestation activities: plan the building sites and roads on areas void of trees.

ii. All waste resulting from construction works, land reclamation, or any other activity should be collected and disposed of properly in an allocated disposal site. Littering in the project area and surrounding areas should be prevented

iii. Gradual rehabilitation and re-vegetation of the area

A green belt is provided to mitigate various emissions. Green belts comprise a wide strip of trees and shrubs planted in rows to reduce air velocity in order to facilitate the settling of particles on the leaf surfaces and to allow absorption of the pollutant gases. It also serves to cool the atmosphere by transpiration from the leaf surface and also provides a habitat for birds, reptiles and insects. Finally, greenbelts help to restore the ecological balance, to prevent soil erosion, to improve the aesthetics in the area and to diminish noise pollution by absorbing some of the noise.

Selection criteria of Plant species for Green belt development

The selection of plant species for the Greenbelt development depends on various factors such as climate, elevation and soil. The plants species should be fast growing and be indigenous and locally available, be tolerant to air pollutants like SPM, SOx and NO_2 and be permeable to help create air turbulence and mixing within the belt.

Project for greening the overall landfill area is the Investor's obligation during the production of the Regional Landfill Master Project and i must be done in compliance with the Nature Protection Requirements for the need of production of a detailed regulation plan of the Regional Landfill in Subotica issued by the PE Institute for Urban Planning of the City of Subotica No. 03-860/2 of 8th November 2010.

Aiming to reduce or prevent noise distribution and emission of pollutants into the area, apart from using the adequate organization-technical solutions, the greening plan needs to be a constituent part of the plan documentation, and the greening process should be achieved

during the construction of facilities. The project must be determined in compliance with Article 18 of the Nature Protection Law ("The Official Gazette of the Republic of Serbia" No. 36/09) on the preservation of biological and landscape habitat diversity within the ecosystem, Article 5, paragraph 7, of the same Law on the survival of endangered wild species and related Rules on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi ("The Official Gazette of the Republic of Serbia" No. 5/2010), Convention on Biodiversity ("The Official Register of FRY" No. 11/2001 – International Agreements and Law on verification of the Convention on preservation of European flora and fauna and natural habitats ("The Official Gazette of the Republic of Serbia" No. 102/2007 – International agreements).

The greening process includes the development of protective greenery 15-20 meters wide within the scope of the borders part of the plan basis. The belt also needs to have a seam of grass vegetation 5-7 meters wide that will be maintained by cutting.

When developing the agri-protective greenery with a role of a multifunctional buffer belt, participation of at least 50% indigenous woody and bush species is recommended for the purpose of preservation of the biodiversity of rural and urban areas, with adequate diversity of species and physiognomy, or height of the woody vegetation of the protection belt.

During the selection of species for the development of the protective greenbelt, avoid species that belong to the category of invasive species. Their spontaneous spreading not only affects the natural vegetation, but significantly increases the cost of maintenance of the green areas.

Recommended woody and bush species that create favourable habitats of ingenious animal species are plants that belong to the natural unity of oak in a forest - Aceri tatarico-Quercetum, in a bushy unity - Pruno spinosae-Crataegetum: Quercus pubescens, Q. Cerris, Q. Robur, Acer tataricum, A. campestre, Prunus spinosa, Crataegus monogyna, Pyrus pyraster, Cornus sanguinea, Rosa canina, Rosa gallica, Viburnum lantana and Ligustrum vulgare.

In our areas, the invasive species include: Asclepias syriaca, Acer negundo, Ailanthus glandulosa, Amorpna fruticosa, Celtis occidentalis, Eleagnus angustifolia, Fraxinus pennsylvanica, Gledichia triachantos, Lycium halimifolium, Parthenocissus inserta, Prunus serotina, Reynouria syn. Fallopia japonica, Robinia pseudoacacia and Ulmus pumila.

8.1.7 Aesthetic Impacts

Mitigation measures could be:

- Since agricultural land surrounds the project area, special attention should be given and screening bunds should be provided to avoid direct contact with these land uses
- The use of good soil handling techniques to minimize the deterioration of soil quality, i.e. minimizing soil storage, careful placement.
- Installation of adequate drainage would also minimize the damage to the surrounding land uses
- Retention of landscape features as far as possible on site.

To address the impact on the landscape the following measures are proposed:

- Minimize the area of construction work at any stage
- Direct collection and removal of excess material
- Where topsoil is excavated, it should be collected and stored in stockpiles up to 2.5 m in height for re-use in the rehabilitation of embankments and borrow pits.

8.1.8 Public and Occupational Health Hazards

The likelihood of impacts on public and occupational safety can be significantly reduced by the following mitigation measures:

- Restricting un-authorised public access to the landfill area by proper fencing and guarding.
- Surrounding excavated locations with proper safety barriers and signs.
- Controlling movement of equipment and vehicles to and from the site
- Emphasizing safety education and training for staff and enforcing adherence to safety procedures.
- Providing appropriate safety equipment, fire protection measures, and monitoring instruments.
- Providing sufficient lighting
- Ensure that all lifting equipment has undergone statutory inspections and is well maintained.
- Provide side netting and barriers, where appropriate, to protect workers, pedestrians and motorists.
- Ensure that all scaffolds are made using materials and workmanship of the highest quality and under the supervision of safety supervisors.
- Employ only experienced workers and at appropriate numbers to avoid unnecessary overcrowding
- Road signs should be displayed to warn motorists of heavy vehicles and equipment.
- All electrical equipment should be handled by qualified persons and serviced regularly

Health and Safety Executive (HSE) management plan should be prepared for the construction phase including all relevant aspects for protection of employees, such as provision of Personal Protection Equipment (PPE) specific to certain tasks, i.e. ear protection, gloves, protective clothing, regular checks in the field to ensure that regulations and standards are respected.

Health and safety regulations should be imposed on all the workers. Safety regulations include life and health insurance, first aid kits, protective clothing such as uniforms, gloves and helmets, in addition to regulations concerning the storage and use of hazardous material such as gas. Furthermore, the facility should be kept clean to prevent pest infestation and workers should not be allowed to exceed working hours.

Health and safety of workers at contractor's camp should be ensured through proper training of contractor's crew about First Aid and Health & Safety procedures. Accidental hazards for people and livestock around the site should be mitigated by fencing the perimeter of the site by a 6 ft. high boundary wall, which should act as an animal-proof fence.

To prevent accidents, members of the public should not be allowed to access the construction site at any time, especially after working hours. This is ensured by proper site closure, fencing and securing the site using a night guard. In case of local monitoring team visits, the team should respect the safety codes set by the site management and should be accompanied by responsible personnel. There should be also control of dust during construction activities and transportation of materials.

As a conclusion, proper supervision, the application of good working practices, and provision of adequate safety measures will alleviate public and occupational risks.

8.2 Operation Phase

8.2.1 Soil

Landfill

Measures could focus on:

- ✓ Good maintenance and periodic checks on vehicles and equipment. .
- ✓ Allow for cleaning and rinsing of equipment and disinfection of wheels of vehicles leaving the landfill only at certain places with the right protection to prevent soil pollution.
- ✓ Regular site inspections to carry out visual checks on oil and chemical spillage.
- ✓ Protective fence and green belt. Cleaning of fence and internal area of wind-blown light waste.
- ✓ Regular disinfection. Chemical management of disinfection agents-proper use and storage to prevent adverse effect of chemicals.
- ✓ Regular compacting and daily covering layers of waste with inert material
- ✓ Prevent the release of leachate on soil. Strict inspection procedures on the protective layer in order to identify problems as soon as possible. Proper leachate transfer should be applied to minimize contamination, while waste should be removed from the borders of cells to reduce the risk of uncontrolled leachate generation. The head of leachate in the cell should be monitored not to exceed 1 metre above the HDPE liner in accordance with international specifications, while a groundwater monitoring program should be implemented. The lining and collection system should be correctly installed in the cells to avoid potential leachate infiltration in the soil and sub-soil layers, while a storm water management system is required to collect and treat the water run-off

Composting plant

Compost quality and application may significantly impact the receiving soil quality and therefore should be regularly monitored. In order to achieve compost of good quality, the sorting of MSW should be performed carefully to ensure the removal of impurities. In addition, regular maintenance of the aeration bays and the computerized monitoring system should be performed. Compost maturity is another parameter of quality and therefore, it is recommended to allow for full maturation of compost before soil application. It is the responsibility of the regional landfill operator to ensure compost quality and process maintenance.

Where the compost produced is of inferior quality, its application to food production systems should be strictly prohibited. It is also recommended that farmers should be educated on methods of compost application for each compost quality grade. Last but not least, if compost is to be packaged, clear labelling and application advice should be set out.

8.2.2 Air

Gases and Odours

Gases and Odours should be mitigated by implementing various practices, which include:

- Appropriate compaction;
- Speedy disposal and burial of malodorous wastes;
- Effective application of daily cover;
- Progressive capping and restoration of cells in order to minimize the penetration of water into the waste mass (water penetration favours biogas production);
- Effective leachate management;
- Efficient capture, transport and biogas treatment (burning);
- Regular inspection of a waste transportation truck for exhaust gasses emission control;;
- Protective greenery zones within the landfill complex

Where odour emissions could lead to complaints, the provision of covers to the odour sources should be considered, especially for compost storage and leachate collection tanks. Proper landscaping around the facility may serve as a natural windbreaker and minimize potential odour problems. When odour becomes an evident public nuisance, synthetic windbreakers (e.g. walls) should be employed to maintain odour nuisance within the site.

Dust

Measures to manage dust include:

- Wind abatement systems including vegetation or embankments
- Covering of vehicles containing dusty loads
- Control of traffic movements on designated roadways
- Placement of compacted quarry granular materials and possible sealing of regularly used roads
- Limiting the extent of disturbed areas and soil stockpiles, control of their orientation (with respect to prevailing wind directions), covering with vegetation and use of water or other dust suppressants
- The disposal routes to be paved to reduce the dust nuisance drastically
- Unloading and processing activities to be carried out under covered areas with proper ventilation
- Spraying of the landfill body and preventing the spread of dust
- Planting of trees as a protection zone (20 – 40 m wide), construction of a soil bank/berm as a buffer zone
- Use of masks by the workers for protection against dust where necessary.

Landfill gas

Management strategies for landfill gas will need to be developed to manage potential hazards and adverse impacts on the amenity and the environment during the landfill operational phase. Systems for active landfill gas collection and combustion are required to reduce greenhouse gas emissions,, for odour control or as part of the risk management strategy.

Options may include direct utilization by industry or as an energy source for heat production or electricity generation. Design and operation of utilization systems must be carried out in conjunction with the overall management strategy. It must not reduce the obligations for management in relation to the potential hazards and adverse impacts on human health, the environment or the amenity on the site or off site.

The designed landfill gas extraction (until the blower/flare units) system consists of:

- Landfill gas vertical extraction wells (extendable build-up wells);
- Landfill gas collection headers;
- Landfill gas collection and horizontal piping system for transport of gas.

In the landfill cells, vertical extraction wells (bio-thorns) will be installed. This makes it possible to start landfill gas extraction from the earliest moment of production (approximately 3 years after land filling of the first waste).

Within concrete pipes, perforated HDPE pipes with diameter of 90 mm are inserted as the corridor for vertical transportation of the biogas. Vertical HDPE pipe is connected, using elbow joint, to the network of horizontal non-perforated HDPE pipes. This network transports biogas to the flare. The horizontal network is installed above the last, top, layer of waste, in the biogas drainage layer of the landfill. Pipes out of the landfill are laid in trenches and covered.

The designed landfill gas combustion system is in line with safety standards prescribed by EN 60079-ff concerning fire protection. It consists of:

- Landfill gas filtration on pre-filter and ceramic filter;
- Condensate water siphons with simple leachate treatment installation with re-injection;
- Flare;
- The blower unit with engine resistant to EEx;
- Combustion chamber;
- Central unit for electrical control and system safety parameters;
- Mobile analyzer of the concentration of CH_4, O_2, and CO_2 (and monitoring wells).

A flare is needed to burn the landfill gas. The flare is a means of reducing the impact of biogas but it also introduces additional hazards or nuisances that that need to be considered holistically as part of a proper assessment before designing and setting a flare. The areas that should be covered in any assessment include:

- Local and global air quality and the effect of undesirable reaction products;
- Visual impact;
- Noise impact;
- Odour nuisance;
- Explosion, fire and asphyxiation.

The design and operation of the collection and combustion system will need to consider the following:

- ✓ Optimization of the quality and quantity of gas collected
- ✓ Operating hours and a backup/contingency plan for periods of maintenance or other down time
- ✓ Extraction wells including the layout, orientation (vertical and/or horizontal), design, area of influence, flow control mechanisms and monitoring points. Wells must not penetrate or impact on the integrity of base or side liner systems. The integrity of the landfill capping system must also be maintained
- ✓ Monitoring wells and points may need to be installed at different levels, depending on site-specific conditions to ensure that high-level concentration areas are detected
- ✓ The collection system between the extraction wells and combustion system, including pipe work, vacuum source, flow control facilities, monitoring and condensate management
- ✓ Protection and maintenance of the integrity, operation and durability of system components. Considerations include corrosive gas, landfill leachate, condensate, vandalism, stresses from surcharge loads and settlement of the waste
- ✓ The risk of air intrusion, potential explosion and fire hazards
- ✓ Control of air emissions from the combustion system
- ✓ Operation and maintenance during landfill operation and post-closure

Composting plant

Odour and dust are main issues during the composting process; therefore the waste will be dropped into a designated receiving platform and will be sprayed with a herbal insecticide through fogging nozzles. This confinement of waste will produce much less smell.

Proper process design and operation are essential for minimizing potential odour production, while special attention must be given to pre-processing, aeration requirements, temperature control and mixing requirements. The facility should be able to mix completely and effectively any required additives, such as nutrients, inoculums or enzymes (if used), and moisture with the waste material to be composted. The aeration equipment must be sized to meet peak oxygen demand requirements, while temperatures should be adequately controlled. The bio-filters if used should be regularly checked and maintained to prevent the emission of any noxious odours from the plant.

In addition, it should be ensured that that the compost operation follows the specific design consideration to prevent anaerobic fermentation: sufficient velocity, moisture content 50 to 60 % and controlled airflow rate.

Finally, the received wastes should not be kept in the facility for more than 1 day before processing. Wastes separated for recycling should be kept in designated closed containers or rooms.

Related to the composting method used, (i.e. aerated piles in open area), odour can be minimized by turning the pile on a regular basis.

MRF

The intake air from the premises should be extracted to the odour treatment system (preferably in bio filters). Liquid waste from washing floors and equipment should be transported to wastewater treatment plant(s). The good management and operation is a key measure to prevent the production of odours and dust during the MRF operation. An enclosed area for waste acceptance is also recommended.

A ventilation system which will create a slight vacuum in the entrance area will prevent the release of odours in the surrounding area. In the mechanical sorting building air from the points which maximize the surface of the waste to be treated (screens, shredders etc.), will be aspirated to be processed by an on-site bio-filter a network to prevent the diffusion of odours and dust. The air will be collected through a fan, particles will be kept in bag filters and the rest will be discharged into a bio filter in an adjacent building. For the removal of dust, cyclones, bag filters or electrical filters could be used.

Road

During the operational phase of the road, the atmospheric burden is mainly caused by gases emitted from vehicles using the road. There will be a significant increase in the traffic on the road because of the induced traffic due to the improved standard of the road, the improved connectivity between the respective areas and in particular the use of the road by collection trucks and trucks carrying the waste from the transfer stations to the landfill.

8.2.3 Noise Pollution

Noise pollution during the operation phase would be generated by mechanical equipment and therefore noise problems could be reduced to normally acceptable levels (85 dBA at 1 m distance from the equipment) by incorporating low-noise equipment in the design and/or locating such mechanical equipment in properly acoustically lined buildings or enclosures. Where there are adequate buffer zones between the facility and residential areas, the need for noise control measures is minimized. In this case, the facility site is located at distance of 1.6 km from the closest settlement and a distance of 150 meters from the nearest household in the area. Furthermore, dispersion of noise can be reduced by implementing a landscaping plan of trees that will act as a sound break.

Equipment will be statically and dynamically balanced to eliminate any vibration that can lead to noise generation. Blow off valves, discharge pipes, relief valves and other static equipment that produces noise will be equipped with silencers. Pipelines will be suitably sized to avoid excess velocities that can lead to noise generation. Wherever necessary, insulation will be provided for reducing noise pollution. The above measures will ensure that noise levels are kept below standards for the rotating equipment and in order to reduce the occupational impact on the employees working in the vicinity of the equipment, earplugs/muffs, or other protective wear will be provided to those working very close to the noise generating machinery.

Increased noise levels will also be observed due to the increased traffic levels by waste delivery trucks to and from the regional landfill. Therefore, all traffic activities should be limited to daytime working hours, while the working hours of the workers employed in high noise areas will be rotated.

The various incoming trucks to the location should be equipped with proper mufflers to reduce noise. Use of specialized electrical generators along with muffler silencers and electro-mechanical components of the plant should be maintained regularly to prevent malfunctions and subsequent unpleasant noise generation.

MRF

Noise from sorting equipment, mechanical grabs, forklift trucks, bulldozers and other plant can be reduced by installing white noise filters or silencers. MRFs should also implement policies – communicated with signage - preventing vehicle movements and plant operation in unsocial hours. As indicated in the previous chapter, the noise levels are not enough to provoke a major impact in the vicinity of the project area.

8.2.4 Solid waste

Good operational practices should be adhered to in terms of waste discharge, placement, compaction and covering to minimize the occurrence of scattered light waste. Scattered light

waste is the result of high winds and poor waste compaction processes performed by the compactor. If it is not under control, this situation might cause surface water pollution, as well as the pollution of the neighbouring terrain. The control measures in order to prevent scattering (i.e. wind blow) of light waste are:

- Proper waste management on the landfill body;
- Mobile fence installation around the active cell receiving waste;
- Installing fence around the landfill complex.
- Careful handling of lightweight waste in order to reduce the possibility of scattering.
- Not exposing light waste to the wind;
- Covering previously deposited light waste by heavy waste materials;
- Partial compaction of light waste prior to pushing;
- Careful waste pushing and quick compaction;
- Work zone to be limited to the smallest possible area
- Solid waste produced at the landfill to be disposed of to the landfill body or composting plant
- Disposal of sludge from the bottom of the WWTP facility - to the composting plant (depending on the quality)
- Oily waste to be properly stored and submitted to the authorised company for disposal.

To address the problem of the escape of small objects from the vehicles, the placement of portable fencing panels in front of each work active land filling area is recommended. The panels shall be removed and placed in the direction of the prevailing wind. In addition the active area should be fenced with chainlink wire fencing of a reasonable height to prevent entrainment of these items outside of the landfill. The fence is designed 15 m long and 3 m tall. The mesh fencing is made of extruded polymer of high strength. The supporting structure is made of aluminium profiles.

To prevent littering along roadways, all incoming vehicles shall be covered (e.g., with netting) to avoid litter problems en route and near the landfill site. Site staff shall be assigned as necessary to regularly retrieve windblown litter both on and off sites along the access road and from the periphery of the landfill site.

Littering of the surrounding area is prevented by ensuring appropriate unloading of wastes only in the locations designed for that purpose and the landfilled material should be well protected in order to avoid any undesired dispersion all over the landfill.

The waste shall be compacted in lifts not exceeding 0.6 m thickness, and utilizing a steel-wheeled landfill compactor or crawler tractor, completing 2-5 passes over the total area of each lift in order to achieve waste compaction to appropriate landfill densities. This measure will increase the life of the landfill, as well as facilitating the application of cover material and enhancing its efficiency in preventing the escape of odorous gases. Compaction also assists in reducing the escape of windblown litter and the attraction of pests such as feral dogs and insect vectors of disease.

During the operation of the project, waste and litter collection could be organized in the terms of road maintenance operations.

8.2.5 Water

The mitigation measures taken into consideration for the operational phase for protecting water resources should aim at controlling the contaminated water that may be generated on the site.

- ✓ Reduction of contact of precipitation run-off water with waste by proper compacting of the landfill body - shaping landform, by sanitary disposal practice and compacting of layers with waterproof clay, and also by drainage of rainwater/precipitation by surrounding channels
- ✓ Site monitoring both for groundwater and surface waters on a regular basis to detect leakage
- ✓ A detailed "Storm Water Management Plan" to be developed while considering the following sources
  - Leachate generated from the waste
  - Management of atmospheric water from working and communication areas
  - Management of atmospheric water from covered parts of landfill
- ✓ Damage to protective layer: Strict inspection procedures as to the protective layer in order to identify problems as soon as possible. .
- ✓ Drainage and collection of leachate – located in the body of the landfill and in the piles of compost – collection and distribution to the leachate treatment plant.

Pollution due to wastewater and solid waste from the contractor's camp should be dealt with by providing enough arrangements for their safe disposal at a reasonable distance from the construction site.

Landfill & Composting plant

More specifically, there are several types of waste waters on the landfill:

- Conditionally clean atmospheric water from the roofs;
- Atmospheric water from the covered parts of the landfill;
- Atmospheric water from the "Clean Zone" of Manipulative- Service Zone;
- Atmospheric water from the "Dirty Zone" of the Plateau
- Technical wastewater;
- Sanitary wastewater;
- Wastewater from the composting plant;
- Wastewater after vehicle washing and disinfection;
- Leachate wastewater.

Surface Water/atmospheric waters from dirty surfaces-plateaus

Atmospheric (precipitation) waters from the conditionally clean roof surfaces can be discharged without cleaning onto green surfaces or ditches. The design envisages collecting this water into a tank from where a sufficient amount of water can be used for fire protection,

while excess water can be used for technical purposes or drained into the surrounding clean water channel and further to the final recipient.

Conditionally clean surface water/atmospheric water from the roofs

Atmospheric (rainfall) waters from the conditionally clean roof surfaces can be discharged without cleaning onto green surfaces or ditch. This water can be collected into a tank from where a sufficient amount of water can be used for fire protection, while the excess water can be used for technical purposes.

Surface Waters/atmospheric waters from covered area of landfill body

Once the total volume of a cell is filled, the cell will be closed and covered. Top covering is made of impermeable clay and a drainage layer for collecting surface water/atmospheric water will be installed. The surface is then grassed.

Surface water/atmospheric Water from the "Clean Zone" of Manipulative – Service Zone

Atmospheric water (precipitation) from the "clean zone" i.e. zone without waste, could be contaminated by gasoline and oil from the vehicles. Before being let out to the recipient these waters have to be treated in a separator for light liquids with a sedimentation zone and with proper capacity. Capacity should be sufficient for 15 minutes rain, the time estimated to be sufficient for washing and cleaning of the plateau, so that afterwards water can be drained directly to the recipient. An "API" Separator ('American Petroleum Institute (API) standards') with coalescing filter unit is proposed for purification of surface water from the ''clean part'' of the manipulative - service area potentially contaminated with oil or fuel from vehicles, before it is discharged to the internal channel.

Surface water/atmospheric Water from the "Dirty Zone" of the Plateau

Zones for waste transportation and plateaus for selected waste handling and waste storage create "dirty zone" surfaces. Atmospheric water (precipitation) from these surfaces will be treated for the first 15 minutes of rain; the time estimated to be sufficient for washing and cleaning of the plateau. After 15 minutes the atmospheric water will be directed via a sewerage pipeline through a collection manhole and discharge pipe to the internal surrounding channel. The first 15 minutes of these atmospheric waters will be treated in a light liquids separator with coalescing and sorption filter for eliminating fuel, oil and parts of the organic matter, with a sedimentation zone large enough for collecting and sedimentation of easily settleable matters.

Technical Waste Water

Technical waste water is water generated by the washing of collection vehicles, manipulative service plateaus, access road, waste separation line and building, waste handling equipment, water from laboratory and workshop, etc. This water will be transported by a sewage system to the selected waste water treatment plant. The quality of the waters corresponds to sanitary waste waters. For their treatment, a WWTP-plant of SBR type with proper capacity has been selected (see following paragraph). This SBR unit will also be used for sanitary-waste water treatment.

Sanitary Waste Waters

Sanitary and blackwater (wastewater, toilets) from the administrative building, workshop, guardroom, employees' building, and weight house, is drained by a 110mm PVC pipeline to the waste water treatment plant. The project envisages a single sewer system that receives and transfers sanitary and technical water (used for washing plant and equipment), to the SBR waste water treatment plant. After the necessary treatment, water is transferred into the reservoir for clean water where it will be used for technical water supply and fire fighting.

Waste water from the Composting plant

Waste water from the composting plant is rich in nutrient components and microorganisms, which makes it suitable for reuse (e.g. moistening of the compost). Therefore this quantity of water will be collected in a storage tank of 40 m^3 volume at the composting area and will be recirculated. Nearly all waste water from the composting plant will be re-used for compost moistening. The quantity and composition of the waste water will be variable over time because of variations in the composition of the waste.

Waste water from vehicle disinfection

The waste water from the disinfection area will be collected and drained into the landfill body.

Leachate collection and treatment

Leachate is collected in perforated HDPE pipes placed in the drainage layer of gravel at the bottom of the landfill. Leachate collected in the collection manhole is treated in the treatment plant, consisting of an aerated lagoon and a sedimentation lagoon and a system for treatment with reverse osmosis for excess water. Sludge is drained in the sedimentation lagoon that is not functioning, and it is transported to the landfill body.

The degree of contamination of landfill leachate water may vary and depends on many factors. General characteristics of landfill leachate are strong odour and specific dark colour, high concentrations of organic and inorganic pollutants, as well as very high values of BOD_5 and COD. Inorganic pollutants in the landfill leachate are mostly heavy metals, usually in lower concentrations, with the exception of iron and manganese. Leachate composition, typical, given in the Preliminary Project design is based on experience, literature data and the results of measurements at similar landfills.

Landfill leachate treatment depends on, changeable, inflow and high organic load, and the presence of other polluting matters such as heavy metals. Since organic pollution is the most dominant type of pollution, leachate treatment is most often carried out by biological methods. They are based on microbiological decomposition of biodegradable organic materials in leachate. Organic material is partly transformed into biomass, and partly into non-hazardous oxidation products which provide energy for bacteria metabolism. The biomass formed is extracted from the leachate by sedimentation.

This method of leachate treatment meets the requirements for 100% recirculation only because it cannot be drained into the recipient due to high content of hazardous and dangerous components that cannot be removed biologically.

Environmentally most acceptable method of excess water treatment is the reverse osmosis and this system is anticipated at the regional landfill in Subotica for final treatment of excess leachate that will be drained into the recipient.

Detailed description of treatment variants is provided in Chapter 6.

Landfill protection from leachate through layers

The natural mineral buffer layer should not be less than 0.5 metres. The surface of the landfill site consists of loess type soils, with different particle size distribution (clay content 3-11%). The permeability of the clay ranges from $k = 7.6 \times 10^{-6}$ - 2.9×10^{-5} cm/s, and is even greater for the dusty and sandy clay, as described above in the text. This means that the quality of the 'natural' geological barrier was not proven. For this reason, an additional artificial mineral liner has been designed for bottom sealing.

The designed bottom sealing consists of the following:

- A layer of 0.5 m compacted mixture of natural clay and bentonite powder, permeability coefficient k ≤ 1.0 x10^{-9} m/s, placed over levelled and compacted natural soil;
- A protective geotextile of 300 g/m^2, thickness 2.7 mm, which is placed above the layer of compacted natural clay mixture and bentonite powder, in order to prevent any damage to the geomembrane by the clay;
- An impermeable HDPE membrane, 2 mm thick, placed above the layer of geotextile;
- A protective geotextile of 800 g/m^2, thickness 5.2 mm, which is placed above the HDPE geomembrane to prevent any damage to the geomembrane caused by the movement of coarse particles in the drainage layer;
- A leachate drainage layer of 0.5 m of gravel, placed over the geotextile, with a built-in drainage system to collect and transport the leachate to the facility for leachate treatment.

The covering layer of inert soil, the support layer/gas drainage layer, the impermeable mineral layer, the storm water drainage layer and the top soil layer are described in detail in the project description chapter (chapter 5).

8.2.6 Aesthetic Impacts

Landfill

To avoid possible visual impacts resulting from the project, the following steps are to be implemented:

- Maintaining cleanliness within the treatment facility,
- Appropriate landscaping of the landfill grounds with planting of suitable trees
- Fencing and screening of the site with appropriate trees to obstruct the facility components from onlookers and residents in the general area.

8.2.7 Health and Safety Hazards

8.2.7.1 Occupational Hazards

Landfill

A Health & Safety management plan should be implemented, imposed on all the workers, including life and health insurance. Injuries to workers by sharp objects including glass, metal and wood, and injury to farmers by sharp objects should be mitigated by use of Personal Protective Clothing (PPC) and Personal Protective Equipment (PPE) such as first aid kit, air-filtering headgear, safety shoes, eye and noise protection gears and puncture proof impermeable gloves and health check-up of workers/staff engaged in various/activities of solid waste management. Each worker who descends into a pit or sump or tank must wear a gas mask. In this case there should be a second person for safety reasons, to assist generally and to pull out the other person if there is a need.

The plan should also incorporate:

✓ Education of all workers on their risks and what to do (also hygiene and illnesses).

✓ Contingency plan for accidents (fire, explosion)

- ✓ Permit to work system, regular checks in the field to ensure that regulations and standards are respected.

Other measures could be:

- ✓ Proper handling of dispersed solid waste during transportation and storage
- ✓ Proper handling of the solid waste to prevent the generation of odours
- ✓ Applying daily cover over the cell during operation to prevent odour impact
- ✓ Noise levels should be measured by a monitoring program
- ✓ The domestic wastewater resulting during the operation phase should be collected and managed in safe manner
- ✓ The facility should be cleaned frequently to prevent the risk of diseases
- ✓ Training and awareness of workers on proper handling of biodegradable waste
- ✓ Smoking should be banned in places where work is related to drilling wells, excavations, installation of machinery or generally wherever biogas is emitted
- ✓ Regular deratization and disinsection;

A major problem encountered during the operational phase of a landfill is the presence of rodents and insects (mainly flies) and the increased numbers of birds. In order to tackle this problem, there should be compaction and the covering of the waste in a daily basis as well as proper fencing. The problem is more pronounced during the summer months, when the climatic conditions favour their multiplication. Given that the incubation of the larvae of a fly is 2-3 days, it is clear that the daily covering of waste minimizes the problem.

Composting plant

Account should be taken of the dangers posed by the presence of glass in the compost which can cut the workers as well as the users of the compost and the release of hazardous gasses such as ammonia, H_2S and methane during the turning of windrows, due to anaerobic conditions inside the windrows. The first problem can be minimised by carefully sorting of the waste before placing it in the windrows. The second problem can be tackled by frequently turning th piles or by putting perforated pipes inside the windrows in order to ensure aerobic conditions.

Where monitoring results show high pathogenic contamination of the final compost product, thorough investigation should be conducted in order to detect the source of the contaminated waste source or the fault in the composting process. Ultimately, the plant should be equipped according to international and local safety codes of industrial plants such as fire extinguishers, emergency doors, first aid kits, alarms and others.

8.2.7.2 Public Hazards

The public should be excluded from access except under careful control as during conducted tours. Proper fencing at a height of 3 meters around the whole site should be ensured, as previously proposed, and the facility should also have a night guard. Where a local monitoring team visits, the team should respect the safety codes set by the site management and should be accompanied by responsible site personnel.

Regular daily covering of deposited waste and periodic disinfection of the complex are provided in order to prevent possible disease and/or occurrence of pests. This will prevent spreading of infection from the landfill and adverse effect on the health of the local population.

Risks to public health and other risks related to the work of the regional landfill should be under permanent supervision and control. There is a difference between the responsibilities

of the regional landfill operator and the responsibilities of the competent authorities in the regulation of the operation of the regional landfill operation and in the implementation of the prescribed measures.

The regional company has to provide for the functioning of the regional landfill as well as treatment and disposal of waste in accordance with local laws. Reports and information, submitted to the authority responsible for issuing licenses, related to monitoring and enforcement of measures should be regular, transparent and based on an objective view of the data collected. The availability of information on the effectiveness of waste treatment and disposal, and the risks that arise with these activities will enhance public confidence in the efficiency of waste disposal.

8.2.8 Economic and social component

To ensure the acceptability of the project the impacts should be properly mitigated as set out above. This will to a large extent depend on the developer's awareness of his responsibilities and willingness to work with the local community. Management commitment to recruit locally as far as possible should help to ensure beneficial local economic impact, while good management practice in terms of sensitive design, control and monitoring of the landfill site will be the primary means of ensuring that stress and concern about problems are mitigated. The establishment of a formal complaints system which responds quickly and directly to the complainants about odour, noise, or other nuisance will assist in building confidence in the site management. As evidence of effective management, site monitoring and publication of data and reports on environmental performance can also be important and guidance to that will be given in the following chapter.

8.2.9 Biodiversity

Related to biodiversity, as set out in the first part of this chapter, a landscape plan that enhances the landscape aesthetic value using local and native population flora should be established. Vegetation cover across the landfill restoration areas to encourage ecological diversity could be proposed.

Bird control techniques should be carefully planned taking into consideration the species likely to be affected. Measures, which should be used to mitigate bird nuisance include the employment of good landfill practice, working in small active areas and progressive prompt covering of waste, together with the use of bird scaring techniques.

The most successful bird deterrent strategies rely upon a variety of techniques. While the immediate spreading of cover material over the wastes may not entirely deter birds, it can be supplemented with other options such as nets or monofilament wires over glide-paths or water dams, and active measures such as acoustic bird scaring devices, predator decoys or even using dogs. Since birds become accustomed to one particular measure, some variation in the active measures used is necessary.

Flies, mosquitoes, rats and cats (typical disease vectors) are attracted by food wastes and still waters at landfills. If uncontrolled, these pests can affect public health and surrounding ecosystems. The main mechanisms for the control of disease vectors are the use of daily cover material and the elimination any water bodies that are not required for fire, sediment and leachate control; however, other measures, such as scare devices and traps, may be used to reduce or control infestations. Professional pest exterminators should be employed to reduce problem infestations of vermin.

8.3 CLOSURE PHASE

At the end of the landfill's active life, the landfill site shall be capped with suitable material and re-contoured with design grades and features established to provide adequate drainage while limiting runoff velocities to minimize erosion of the cap. Such re-contouring will be done

in a manner that is harmonious with the surrounding landscape. In designing the post-closure plan, sufficient allowance shall be given to the degree of settlement of the landfill.

The land shall be re-vegetated appropriately, with natural vegetation according to the determined land use. The type of land use for post-closure shall be determined in consultation with appropriate government agencies and public groups.

The aim of establishing a landscaping project is to protect the natural values of the region. By preserving natural habitats, regional biodiversity will also be preserved, and that is the main condition for creating and maintaining a healthy environment.

A cultivated green zone is planned around the manipulative – service plateau as a protection measure for rodents and airborne waste, noise, unpleasant smells, view, etc. It is designed for about 400 pcs of coniferous trees or high, medium and low growing deciduous and evergreen trees, bushes and low vegetation types to be planted between the clean and dirty zone of the manipulative – service area, and between the manipulative – service area and the landfill body area, as a kind of dividing green belt. All this vegetation shall remain there after the landfill closure.

Planting of saplings shall be at a separation distance of 5 to 8 m depending on the plant material. It is proposed to plant 250 saplings of coniferous trees Pinus Nigra (optional Taxus baccata "Repanndens") and 150 saplings of deciduous trees Elaeagnus Carvacrol (optional Hippophaerhamnoides). Saplings are planted in holes measuring 60 cm x 60 cm x 60 cm, with a mixture of excavated soil and added manure. After the planting, the soil around the plants will be compacted manually and watered.

According to the Decree on waste disposal in landfills (Official Gazette RS, No. 92/2010), the impermeable mineral layer should be ≥ 0.5 m thick, while the layer of soil for re-cultivation should also be ≥ 0.5 m thick.

8.4 Contingency plan

For the effective and safe implementation of the project, it is important to identify associated safety hazards and carry out an effective risk assessment / disaster management / contingency plan that could include critical aspects such as safety culture, training and awareness, relationships and training of contractor staff and many others as well as safety measures, possibility of accidents either due to human errors and/ or due to equipment/ system failure and/or force majeure.

The prevention of emergencies through good design, operation, maintenance and inspection are essential to reduce the probability of occurrence and consequential effect of such eventualities. However, it is not possible to totally eliminate such eventualities and random failures of equipment or human errors, while unsafe acts, cannot be ruled out. An essential part of major hazard control has therefore, to be concerned with mitigating the effects of such emergencies and restoration of normal operations at the earliest opportunity.

The overall objective of a disaster management plan is to make use of the combined resources at the site and outside services to achieve the following:

- To localize the emergency and if possible eliminate it;
- To minimize the effects of the accident on people and property;
- Effect the rescue and medical treatment of casualties;
- Safeguard other people;
- Evacuate people to safe areas;

- To inform and collaborate with statutory authorities;
- Provide authoritative information to news media;
- Initially contain and ultimately bring the incident under control;
- Preserve relevant records and equipment for the subsequent enquiry into the cause and circumstances of the emergency;
- Investigate and take steps to prevent reoccurrence

The Regional Company, as the operator, should prepare a plan in case of emergencies, incorporating the above issues as the main cornerstones which will be in accordance with the Law on Safety and Health at Work (Official Gazette of RS, no. 101/05) and Regulation of preventive measures for safe and healthy work at workplace (Official Gazette of RS, no. 21/2009). Implementation of the contingency plan will reduce the risk of fire, water and soil pollution, and dispersal of waste.

8.4.1 Floods

Prevention of floods is performed by the construction of a perimeter drainage system for collection and transfer of surface water from the landfill site to the receiving water. The key prevention measure for pipelines failures is their installation in accordance with the legislation and standards for design of pipe-lines (drainage).

8.4.2 Fire protection measures on the landfill body

Landfill fires may be very dangerous, so proper protection measures must be undertaken during all activities on the landfill. Fires may form holes in the waste, so great care is required while operating compactor over the burning waste. Inhaling the smoke produced by waste combustion presents another danger. Therefore, workers who are involved in putting out the fire must be equipped with appropriate protective clothing and equipment, and conditions not endangering their health and safety should be provided.

A network of hydrants in the installation corridor, positioned around the landfill body could present the fire extinguishing system. Over-ground hydrants for installation of fire extinguishing equipment are positioned at 80m centres around the landfill body. The network of hydrants is to be installed in phases, simultaneously with the cell construction on the landfill body.

Fire prevention is achieved by visual overview of waste prior to unloading into cell, and by noting and removing burning or hot waste. Waste should be covered daily as defined by the disposal technology. More specifically:

- ✓ Waste arriving at transfer/ recycling stations should be monitored to certify that explosive or flammable waste is taken away from the other waste. Site rules should include appropriate fire prevention measures, including restrictions on smoking and open flames on site. A fire contingency plan could be established, which will include instructions for isolating and spreading waste, and applying inert cover material or if appropriate, water, in such a way that any fire is smothered and contained, and that unnecessary loading of the landfill with water is avoided. Suitable fire fighting equipment (i.e. extinguishers of a sufficient size) shall be maintained on the landfill site, in proper working condition. This should consist of a self-contained tank c/w gas engine and pump mounted on a trailer. The tank should remain full at all times. Suitable areas to borrow soil material for covering the burning area should be identified, while the use of leachate as an arbitrary fire extinguishing measure should only be used in an emergency case.

8.4.3 Failure in the biogas management

A contingency plan should incorporate guidance for the landfill gas protection system to effectively prevent migration of landfill gases and their intrusion into structures. The type of contingency plan required depends on the type of gas control system, the building type, type of occupancy, and the site location.

The treatment of failures in the management of biogas projects consist of the following:

a) In case of failure in the collection system due to failure of the vertical shafts collection – if the damage cannot be repaired, then a new shaft should be drilled in the same area.

b) In case of failure related to the combustion of biogas and if the pumping system is operating, then the pumping of biogas should be continued in order to avoid a build-up of biogas in the waste mass. In this case, the biogas is released untreated in the atmosphere temporarily, until the failure is restored.

c) In case of failure of the biogas pumping system, regardless of whether or not the combustion system is working, the continuous removal of biogas from the landfill body must be ensured so that it cannot accumulate and create excessive pressure. For this purpose, the biogas heads are temporarily detached until the failure is restored.

8.4.4 Failure in the leachate management

Measures for the leachate management system consist of:

a) In case of failure of the leachate collection system, the drainage layer serves as the main drainage system. If the failure relates to blockage of the leachate collection system, it can be restored by cleaning the pipes. Therefore, devices for the pipe cleaning of the primary collection network should be available.

b) For any failure of the pumping stations, there should be spare pumps.

c) In case of failure of the leachate treatment plant, the leachate will be temporarily pumped back to the landfill body.

In case of a leakage of leachate, the following actions should be taken:

- Notify the site manager
- Refer to the Emergency Action Plan
- Dig temporary ditches to intercept the leachate
- Construct temporary sumps to collect the leachate
- Construct temporary berms to divert the leachate
- Monitor the performance of the temporary ditches and berms
- Sample surface waters at existing monitoring stations
- Obtain laboratory analysis of the surface water samples

8.4.5 Power-cut

Landfill

In case of an electrical power cut, there will be a standby generator that can handle loads for the safe operation of the project (pumping stations, pumping stations and combustion of biogas, lighting, etc.).

Composting plant & MRF

Both the composting and MRF should have its own energy supply in order to handle any shortage in electricity or fuel.

8.5 Transfer Stations

Measures to be applied at transfer stations:

- Clean-up of operating floors – elimination of crevices, etc.
- Sealing surfaces to minimize odour absorption
- Minimising on-site waste storage and holding
- Removing all waste from the tipping areas at the end of the day and cleaning the relevant areas
- Implementing a rapid clean-up procedure for any liquid spills which may occur from any mixture of liquid wastes with incoming solid wastes
- Treating drainage systems regularly with odour-neutralising and bacteria-inhibiting agents
- Refusing to accept identified highly odorous wastes
- Minimising idling of equipment not in immediate use by turning off engines
- Cleaning truck bodies and tyres to reduce tracking of dirt onto the streets
- Installing bird-deterrent measures such as hanging wires and eliminating horizontal surfaces where birds can congregate
- Minimising horizontal ledges where dust and litter can accumulate
- Using fencing and netting to keep wind-blown litter from escaping
- Screening to remove large solids and litter, followed by detention to remove solids by settling and oily water by skimming
- For run-off, implementation of storm water and containment measures for any contamination
- Implementation of an odour management system with spray control (automatic water spray would be triggered by sensors – deodorization may be needed), extractions fans (to ensure the air within the building is drawn to the fans and extracted) and carbon filtration.

8.6 General road mitigation measures

Component	Potential Beneficial and Adverse Impacts	Enhancement and Mitigation Measures
Air / Noise	• Degradation of air quality by dust and vehicle emissions. • Increase in ambient noise.	• Near residential areas, avoid noisy works after regular working hours. • Maintain vehicles and machinery in good condition in order to minimize gas emissions and noise. • Use appropriate means for minimizing dust dispersion during construction. • Near the houses, use appropriate measures, such as vegetation hedges along transport corridors, to minimize noise and the aerial transport of dust.
Soil	• Runoff erosion resulting in sedimentation problems. • Change in the local topography. • Contamination of soils from spilling of hazardous materials. • Soil compaction.	• Avoid areas sensitive to erosion. • Prevent sedimentation with appropriate measures such as silt fences, sediment traps and drainage dikes. • Limit the circulation of heavy machinery to designated areas. • Use existing borrow pits rather than creating new ones; after the works, restore borrow pits by stabilizing slopes and facilitating the regeneration of vegetation. • Stabilize the soils in order to reduce potential erosion. • At the end of the construction works, level off the soils and facilitate the regeneration of vegetation.
Flora	• Destruction of the vegetation cover.	• Minimize land clearing areas. • Protect trees from machinery along rights-of-way.
Landscape	• Degradation of the landscape by land clearing, embankments, cuttings, fillings and quarries. • Roadside litter	• Use an architectural design integrating the infrastructure into the landscape. • Provide for disposal facilities and rest areas.

Quality of life	• Improvement in quality of life due to new economic opportunities. • Better access to goods and services. • Degradation of the quality of life due to nuisances such as noise, dust, vibrations and traffic. • Deterioration of the visual quality of the landscape due to land clearing, construction works, new infrastructures, etc. • Increased waste along roadsides.	• Establish a formal consultation mechanism with local authorities to discuss issues disturbing inhabitants and to find solutions satisfying all parties. • Train workers (men and women) in the field of environmental protection. • Implement an adequate communication plan to inform the local population (men and women) in advance on the proposed work and opportunities for them. • Favour an architectural design integrating the new infrastructures into the landscape. • Try to facilitate the establishment of dedicated pedestrian, cycle and animal traction paths • Provide safe crossing points and use traffic calming devices. • Ensure appropriate support from social services to facilitate the transition and to prevent conflicts within families or among groups. • Plan waste management as part of the project.
Injuries	• Increased risk of injuries and death for the local population due to working sites and increased traffic. • Occupational injury during construction.	• Control access to working sites. • Install and maintain appropriate signs. • Develop, communicate and implement safety and preventive measures for the population (such as traffic calming devices). • Check the condition of vehicles used for transport of employees • Provide accident and emergency facilities.

9. ENVIRONMENTAL MANAGEMENT PLAN - MONITORING

The Environment Management Plan (EMP) has an important role in protecting the environment by maintaining any impacts within the allowable levels and by assisting in the realization of the expected project benefits. A good understanding of environmental priorities and policies and up-to-date operational information are required in order to achieve a good environmental performance. In order to maximize the efficiency of EMP, an Environmental Management System (EMS) could be established at the proposed project. The EMS will include the following:

- An Environmental Management Team
- Environmental Monitoring Program
- Personnel Training

Monthly environmental monitoring reports should be prepared in which the environmental performance of the Project is evaluated according to EMP requirements.

a)

b)

9.1 Environmental Management Team

It is necessary to have a permanent organizational set up assigned with the task of ensuring the effective implementation of mitigation measures and of conducting the environmental monitoring. The major duties and responsibilities of the Environmental Management Team should be as following:

- To implement the Environmental Management Plan,
- To ensure regulatory compliance with all relevant rules and regulations,
- To ensure regular operation and maintenance of pollution control devices,
- Review and interpretation of monitored results and corrective measures where the monitored results are above the specified limits.
- Maintain environmental related records.
- Maintain a database of public complaints and the actions taken

9.2 Environmental Monitoring Program

The Environmental Management Plan should include a monitoring plan for the construction and operational phase of the landfill. This monitoring plan should cover in general the technological process of landfilling, the maintenance of vehicles and machinery (disinfection and washing) health and safety regulations, which shall be visually regularly checked on daily basis as well as leachate, groundwater and surface waters and landfill gas control, which should be monitored at least twice a year, with quarterly monitoring for the first few years to establish an accurate baseline. It is necessary to define the parameters that will be analyzed at the monitoring (sampling) points as well as their sampling frequency. Quality levels, acceptable and unacceptable values must be clearly stated with appropriate corrective measures set out. The monitoring program should include the frequency, scope, quality assurance (QA) procedures, documentation and recommendations for corrective actions, as well as record keeping and regular reporting.

The regional company has to submit monitoring reports and any irregularities during the operational phase to the authorities that have issued the operational permit. On the other

hand, the authorities have the right to enforce the control of a site and require corrective measures. Adequate management of the landfill is ensured with the responsible attitude of the institutions, assigned for the monitoring of the regional landfill, and the pressure applied by such institutions on the operator to implement measures for environmental protection.

As far as the monitoring related to the settlement of the landfill body is concerned, 79 geodetic benchmarks will be set up after completion of landfill closure works. Each benchmark consists of steel plate that is d = 4 mm thick with welded steel pipe 2'' at its end. The plate is placed at a depth of 0.7 m from the final covering layer, on to a concrete foundation that is d = 20 cm thick. Monitoring of the landfill body involves measurements, (i.e. the relative position of the benchmarks in the area, is compared to a stable control point in the area), while the measurements need be made every three months during the first year after completion of the landfill closure works and every six months thereafter during the post-operational period.

9.2.1 Issues to be monitored

The inspection and maintenance procedures are directed at the landfill's most critical environmental components:

- ✓ Groundwater monitoring
- ✓ Surface water monitoring
- ✓ Leachate monitoring
- ✓ Landfill gas monitoring and control
- ✓ Bio monitoring
- ✓ Leachate collection and removal
- ✓ Surface water drainage
- ✓ Closure cap integrity
- ✓ Access control
- ✓ Access roads

Groundwater monitoring

The purpose of the groundwater monitoring system is to monitor the impact of the landfill on groundwater pollution and to assess the negative impact, level and cause of the pollution, on groundwater if it occurs. This system comprises a network of 6 piezometers, which are arranged on the landfill complex, installed for the geotechnical investigations. In addition, it is necessary to install three further piezometers.

Ground water monitoring comprises level measuring in the piezometers and testing the sample in the laboratory. The levels will be measured using a portable device, while laboratory testing will be done in the certified institutions. Samples will be taken according to ISO 5667-11 standard, while laboratory tests should be performed according to '*Standard Methods for the Examination of Water and Wastewater*' defined by American Public Health Association (APHA), the American Water Works Association (AWWA), and the Water Environment Federation (WEF). The scope of measurements from piezometers will be laid down in the permit document and reflects the leaching characteristics of the waters.

A portable device for the ground water level measuring has to be set up for conditions of dirty and aggressive water. The measuring tape has to be made of stainless steel and coated with polyethylene. The measuring tape has to be capable of measuring down to ½ mm. The polyethylene coating provides durability. The sensor has also to be made of stainless steel with EPDM protection in order to protect against false signals due to humidity in the piezometer. It should be possible to tune sensitivity, due to various electrical conductivities. Finally the device has to be made under EN 50081-1 AND EN 50082-1 standards according

to EU Directive 89/336 (CE signal). The sensor has to be operable up to 85 ^{o}C and produced in IP 54 protection.

Ground water levels in the piezometers will be measured twice per month during the operational phase and quarterly during the post-closure period. The data should be regularly updated and stored in the database. In case of pollution impact by the landfill, the management company has to inform the relevant authorities, who will decide on appropriate measures to be taken, if necessary.

Parameters determined in ground waters are as follows:

Table 9.1 Ground waters quality parameters

No.	**PARAMETER**	**Standard method**
1	pH	4500 – H B.
2	Conductivity	2520 B.
3	Odour	2150 B.
4	BOD5	5210 D.
5	COD	5220 B.
6	Total organic carbon	5310 C.
7	SO_4	4500 – SO4 – E.
8	Ammonium (NH_4-N)	4500 – NH3 C.
9	Organic nitrogen N	4500 – Norg. B.
10	Cl	4500 – Cl B.
11	Zn	3111 B.
12	As	3111 B.
13	Cd	3111 B.
14	Cu	3111 B.
15	Ni	3111 B.
16	Phenols	5530 D.
17	Phosphates	4500 – P D.
18	Total solid particles (TS)	2540 B.
19	Volatile solid particles (VS)	2540 E.
20	Suspended solid particles (SS)	2540 D.
21	Soluble solid particles (DS)	2540 C.

Surface water monitoring

During the construction, operation and restoration phase, water quality monitoring should focus on general visual inspection of water bodies to identify physical pollution or blockages to water flow, and measurement of total suspended solids and oil pollution. The nearest surface water flow is the channel-recipient Orom-Čik-Krivaja, 1.7 km away. The quality of the water in this channel will be monitored on a regular basis based on the monitoring of water quality in the pump station that discharges water into the channel. The quality of the water in the channel-recipient will also be monitored, in accordance with the EU and Serbian legislation, monthly during the first year of landfill operation, then every three months, and finally twice per year in the post-operational phase.

Leachate monitoring

Monitoring of leachate composition and amount is one of the key parameters that reflects the effects of WWTS operation at the landfill.

Leachate monitoring shall include assessment of the amount of leachate generated, and that, by multiplying the pump operation hours of leachate pumping stations with their capacity

Also, it is required to take leachate samples for analysis in the authorized laboratory. Samples shall be taken from the leachate tank, the treatment system, as well as from the pumping station for discharge into the recipient. Sampling spots are shown at the monitoring situation plan.

Samples are to be taken in compliance with ISO 5667-11 standard, while laboratory analysis Parameters required are given in the following table:

Table 9.2 Parameters to determine leachate quality

No.	Parameter	Standard method
1.	*pH*	*4500 HB*
2.	*Electrical conductivity*	*2520 B*
3.	*Odour*	*2150 B*
4.	*BOD_5*	*5210 D*
5.	*COD*	*5220 B*
6.	*Organic Carbon Total*	*5310 C*
7.	*SO_4*	*4500 – SO_4 – E*
8.	*Ammonium (NH_4-N)*	*4500 – NH_3 C*
9.	*Organic Nitrogen N*	*4500 – Norg. B*
10.	*Cl*	*4500 – Cl B*
11.	*Zn*	*3111 B*
12.	*As*	*3111 B*
13.	*Cd*	*3111 B*
14.	*Cu*	*3111 B*
15.	*Ni*	*3111 B*
16.	*Phenols*	*5530 D*
17.	*Phosphates*	*4500 PD*

18.	*Solid particles total*	*2540 B*
19.	*Evaporable solid particles (VS)*	*2540 E*
20.	*Suspended solid particles (SS)*	*2540 D*
21.	*Soluble solid particles (DS)*	*2540 C*

The following table shows the frequency of measuring the above parameters:

Table 9.3. Measuring frequency

Parameters	Frequency	
	Operational period	**Post-operational period**
Leachate quantity	Monthly	Every 6 months
Leachate composition	Every 3 months	Every 6 months
Treated leachate composition	Monthly	Monthly

Landfill Gas

Production and emission of gas from the landfill to the surrounding soil will be monitored through the installed boreholes. According to the design, 13 monitoring wells will be drilled at a spacing of 300m around the entire body of the landfill. The depth of each well is 6 m and definitely above the level of groundwater, while the prescribed periodic measurements include measurement of static, differential and barometric pressure and quantity-concentration (% volume) of methane, carbon dioxide, and oxygen, as well as the volume of gas, once a month in the operating period, and twice per year in the post-operative period. Temperature and concentration of other components, such as hydrogen, hydrogen sulphide and nitrites, can be measured by adding additional sensors. The amount generated and the affected gas is measured by the control unit flare.

The monitoring system, in addition to the above, should detect any migration of gas outside the landfill body and high, explosive concentration in the buildings of the complex of the landfill, its surroundings and in the soil. The maximum permissible concentration of methane in the air should not exceed a limit of 25% of the lower explosive limit (LEL Lower explosive level) in facilities and 100% of the LEL in the area. The LEL for methane is 5% (concentration of methane in the air).

The monitoring of possible gas migration out of the landfill into the atmosphere will be performed by measuring the concentration of methane in the facilities, while ensuring safe operation of the landfill. For this purpose, a central control unit will be installed, equipped with seven detector-transmitters, placed in the check-in-lodge, the administration building, the workshop, in the building for waste separation, the composting plant facility, the facility for leachate treatment and the hangar for machinery maintenance (placed at the landfill body).

On-site buildings and other enclosed structures must be monitored regularly to determine whether LFG is seeping into them and giving rise to the risk of explosion. This means that the monitoring should focus on observation of vegetation distress, odour, surface conditions and measurements of landfill gas in monitoring bores and areas where landfill gas may accumulate and pose a hazard. Monitoring points may need to be located near the site boundary.

The quantities and gas composition will be measured with a portable analyzer, equipped with sensors and measuring device which registers and transmits data to the computer, while the measurements are performed at the valves installed on horizontal pipes for gas extraction, before the blowers and flares.

Table 9.4. Measuring frequency

PARAMETERS	FREQUENCY	
	Operative period	**Operative period**
Amount of biogas produced	Monthly	Every 6 months
Pressure, methane, carbon dioxide and oxygen content	Monthly	Every 6 months

Monitoring the integrated final layer – subsidence control

Postoperative monitoring includes the inspection of the final layer due to excessive subsidence, erosion and physical damage. Any damage of the landfill covering layer shall be repaired as needed, and the following activities will also be done

- Erosion prevention / control
- Recovery of depressions, sealing and inspection of cracks in the covering layer that have resulted from subsidence
- Vegetation recovery / maintenance

Monitoring composition and quantity of the received waste

During the operational period of the landfill, company managing the landfill should keep daily evidence of composition and quantity of the delivered waste. This operation is performed in order to prevent the disposal of prohibited waste, but also to obtain statistical data on the waste quantity and composition, as well as its alternations over the years.

At vehicle's arrival, the person in charge of accepting the waste should write down the following information:

- Name and address of vehicle's owner, first name and last name, and phone number of person in charge,
- Waste source, Name and address of the owner (i.e. producer) of the waste
- Waste type,
- Waste weight
- Date and time of receipt

In addition to the above information, it may be necessary to take an occasional sample of delivered waste, in order to test its composition. The following should be recorded during any such testing:

- Date and time of testing,
- Waste origin,
- Necessary information on vehicle and driver,
- Remarks of the person conducting the testing.

Daily visual monitoring

Daily visual monitoring has to be provided in a/o the following areas:

- To ensure the use of prescribed and designed processes for the operation of landfill.

- To ensure proper maintenance of the landfill and internal roads – quality and quantity of internal materials, washing, daily removal of disseminated waste, inspection of daily activities performed and corrections made if necessary.
- To ensure the quality of washing and disinfection of the vehicles (entrance/exit control).
- To ensure the application of health and safety regulations to protect workers – rules for operation and inspection of the equipment, machinery and vehicles before operation, speed limit, checking the area for waste disposal, lighting and parking.
- To check for the presence of pests – insects and rats, waste covering with inert material, disinfection at least annually by contracted company for disinfection and rodent control.

Meteorological data

Meteorological data should be attached as supportive information. These measurements need to be done by the company managing the landfill during the operational and post-operational phase. The meteorological station in Palić could be used and the data needed will be:

- Quantity of precipitation: daily,
- Temperature (Min. – Max. at 14:00h): daily,
- Wind direction and strength: daily,
- Evaporation: daily,
- Air humidity (at 14:00 h): daily.

Bio monitoring

The Monitoring Plan should exceptionally include bio monitoring, which includes regular visual observation of the plant community condition in the protection belt around the landfill, and at the surrounding soil, if needed, because living organisms have the fastest reaction to the unfavourable effects and they provide excellent image about the condition of the surrounding biocenosis.

Monitoring includes a system of successive observations of the environmental elements in space and time. Goal is to collect quantitative and qualitative data about the presence and distribution of pollutants, monitor the emission and immision of pollution sources and their allocation, pollutant transport and to determine their concentration at certain measuring spots.

Advantage of biological indication in regard to physical-chemical methods of environmental pollution monitoring lies in the facts that living organisms may show the pollutant accumulation effect during a long period time. On the other hand, the physical-chemical methods provide more exact data, but they are available at certain exact moment only.

The term *bio indicator* was first used by Clements in 1920 to mark the organisms that clearly indicate with their presence to the environmental conditions of a habitat.

Bio indicator is an organism or biological change that reveals the presence of pollution with the occurrence of typical symptoms, and therefore it is more qualitative. Changes in such organisms (or communities) may be physiological, chemical or behavioural and they may be observed by monitoring as follows:

- amount of elements or compounds contained by the organisms;

- their morphological or cell structures;

- metabolic-biochemical processes;

- behaviours;

- population structure;

Community assessment (so-called bio-surveillance) i.e. biological monitors or bio monitors are defined as organisms that acquire quantitative information about the quality of the environment they are found in. The whole community is samples to determine which taxonomic type survives.

Use of bio monitors is called biological monitoring (bio monitoring) and includes the use of organisms to acquire information about certain aspects of the biosphere. In regard to the form of the environment in which the changes are being monitored, biological monitoring is divided for methodology reasons to:

- Biological monitoring of air pollution (bio indicators are most often lichen and moss);
- Biological monitoring of water pollution (bio indicators are most often fish, frogs, water fleas, freshwater zooplankton);
- Biological monitoring of soil pollution (bio indicators are high plants, or vegetation);

Pollution bio monitoring may be:

- Passive (observed are organisms naturally living in the environment);
- Active (test organisms of familiar genotype and reaction to a pollutant are places in the study area);

There are several types of bio indicators:

- Lichen – indicate changes in forests caused by climate changes, air quality changes (sulphur dioxide, nitrogen oxides…);
- Algae – indicate the amount of nutrients (nitrogen, phosphorus) in water systems;
- GMO, e.g. weed with different colour if poisons are present in soil;
- Animals – increase or decrease of their number, monitoring poison concentration in tissue, monitoring frequency of occurrence of deformities in a population;
- Microorganisms – in the presence of cadmium and benzene, some microorganisms produce new proteins, the so-called stress proteins;

It is required to define precisely which kind and what scope of monitoring will be applied at the Subotica landfill in the Monitoring Plan for which guidelines are provided here, and in compliance with the location specificities.

Other controls

The security facilities (fences, gates, locks, etc.) will be inspected periodically for any possible damage or needed maintenance.

Access roads, directional and identification signs will be inspected regularly for any required maintenance / repairs. Signage will be maintained in a readable condition and repairs will be made when needed.

Litter, health and safety monitoring is achieved continuously or weekly through visual inspections, and recording of accidents. Noise monitoring is achieved by measuring noise levels in the facility and the surrounding area only after complaints, since the facility is fairly distant from residential areas and is located in a valley that will prevent the dispersion of noise to the surroundings.

The contractor (i.e. the operation manager for at least the first year of operation depending on the contract) in collaboration with the union of municipalities should be responsible for the

monitoring of various impacts to ensure the proper functioning and implementation of mitigation measures along with the environmental management plan presented in the next section.

9.3 Monitoring of compost quality

Compliance monitoring requirements include testing of compost quality, while the following should be ensured:

- ✓ Trained staff (facility operator, laboratory staff, maintenance team, etc.) and defined responsibilities
- ✓ Authorized Standard Operating Protocols (SOPs) for representative sampling, laboratory analysis, and data analysis,
- ✓ Maintenance and calibration of monitoring equipment,
- ✓ Provision of safe storage and retention of records.

At the proposed Regional landfill, qualified plant operators and laboratory staff should carry out compost quality testing. The compost should be tested for metal contamination, the presence of pathogens and material composition. Lab tests on the final compost produced should be performed on a monthly basis to determine the safety of the material produced for land disposal. If the compost does not meet the proposed standards, it should be sent to a landfill or used as daily cover. The parameters to be monitored are:

- The absence of pathogens
- The level of heavy metals and in particular the levels of mercury, cadmium, and lead in relation to the allowable limits set by local standards
- Material identification analysis, to identify the product obtained as compost based on the organic matter and carbon content (C/N ratio)
- Determination of maturity grade / degree of decomposition or stabilisation

9.4 MRF monitoring

All vehicles delivering material to the site shall be screened to ensure that they are carrying acceptable materials. A waste transport vehicle shall be refused access to the site and facility if it is known to contain unacceptable material/ waste. A trained operator shall oversee the unloading of dry recyclables that are delivered to the receiving area and identify any unacceptable materials. Unacceptable materials shall be immediately segregated and removed from the site.

Ideally dry recyclables shall be incorporated into the recovery process on the day of delivery. A maximum of two days processing capacity of materials shall be stored in an enclosed area at any one time. Procedures for receiving and documenting sources, quantities and types of dry recyclables, and directing vehicles to the appropriate area of the site shall be outlined in the operations manual.

The material recovery facility shall only accept dry recyclable materials as outlined in the facility Operating Permit. Material preparation would include manually opening bags to remove material, movement of recyclables over conveyer belts to various areas for manual sorting.

Designated areas are needed for storage of materials that have been received and processed, waiting to be delivered to markets. Adequate storage, furthermore, protects the product from degradation and product contamination. Preferably all materials awaiting

transport to market should be stored in an enclosed building or at least under cover to avoid the absorption of moisture (especially fibrous materials). Outside storage of materials should be as brief as possible and done in a way that reduces contamination (e.g. separated from other materials that could cause contamination, protected from accumulation of dirt and mud). Materials in storage for extended periods of time (greater than one month) should be stored inside. The size and location of storage areas must not prevent the flow of traffic or operation of equipment. The storage areas shall be kept free of unprocessed materials and accumulated supplies and equipment.