



Municipality of Yerevan

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European Bank
for Reconstruction and Development

ARMENIA: YEREVAN SOLID WASTE PROJECT – ENVIRONMENTAL AND SOCIAL DUE DILIGENCE

“ESDD4”

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

19th May 2015

CONTRACT No. C29500/AMIF-2014-07-07



Client:

Municipality of Yerevan

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Register of Submissions

DOCUMENT NAME:	7332_Solid_Waste_Yerevan_ESDD_04_20150519.docx
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REV NO.	DATE	DESCRIPTION
00	19.12.2014	Draft submission
01	27.02.2015	Revised version I
02	01.04.2015	Revised version II
03	29.04.2015	Revised version III
04	19.05.2015	Final submission for disclosure

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1. PROJECT DESCRIPTION

1.1 Project Rationale

The capital city Yerevan has a population of 1.1 million and is currently disposing most of its municipal solid waste at a dumpsite in Nubarashen, 11 km south-east of the city, as well as at several smaller dumpsites. On request of the Yerevan Municipality, the European Bank for Reconstruction and Development (EBRD) commissioned a Technical Feasibility Study in 2012.

To ensure a solid waste management system that fulfils international standards (e.g. in terms of safety and hygiene), the Yerevan Municipality decided to build a new sanitary landfill next to the existing one (on the basis of the recommendations of the Technical Feasibility Study).

The Republic of Armenia has set up a new national solid waste strategy to ensure a proper solid waste management system for the whole country. This national framework confirmed that project at hand is aligned with this strategy. After this confirmation, the Yerevan Municipality and the EBRD decided to continue with the project to build a new sanitary landfill in Nubarashen, which will be the first sanitary landfill in the country.

The closing of the existing dump site (not part of the project) was a condition of the EBRD's involvement in the project.

1.2 Description of Project Area

Nubarashen landfill is located about 12 km south of Yerevan center next to the district communities of Erebuni and Nubarashen.

Waste disposal at the site started in early 1960s and about 6-8 million tons of solid waste are estimated to have accumulated in landfill.

The project area of the new solid waste site is located in the south-east of Yerevan.

The project is situated in the district of Erebuni. The district of Nubarashen is in the south of the solid waste site and is currently affected by the operation of the existing landfill site and their emissions of air pollutants. The new sanitary landfill will be situated right next to the existing landfill site.

The area of the new landfill is located to the west of the extant landfill, with an expansion of about 1,000 m in maximum length and about 400 m in maximum width. The overall area size, which blows out towards the west, amounts to about 30 hectares.

1.3 Alternatives

1.3.1 Description of “Zero Option”

In case the current situation of the waste management system of Yerevan were not changed and improved (= “Zero Option”) and the existing landfill of Nubarashen continued to operate under the current undesirable conditions, the following impacts would occur: The people of the neighbourhood would continue suffering from the negative health impacts emitted from the landfill. The environmental pollution would increase and in the future, when the current landfills have reached their capacity, a serious question would arise ‘What to do with the waste?’ The financial investment to remediate such a situation (environmental and health

effects) would be very high. For detailed description of impacts refer to chapter 5 “Environmental Baseline Study”.

1.3.2 System Alternatives

Different system alternatives were assessed during the preparation of the preparation for the National Waste Strategy Armenia, and the system of **sanitary landfill** was selected due to the fact that it is the most cost-efficient waste treatment technology considering the current framework conditions in Armenia.

The alternative solution of a **waste incineration linked with energy production for heating** was not selected, due to the absence of suitable district heating networks. The operation and maintenance cost of this alternative would be several times higher compared to the operation of 5 regional landfills. Even for a waste incineration, a special landfill would be necessary to deposit the combustion residues.

In the course of preparing the National Waste Strategy Armenia, it is favoured to implement a decentralized system in Armenia based on standardized local provinces (Armenian: “marz”) level collection capability, transfer stations and a series of regional sanitary landfills meeting EU design and environmental standards established to serve a logical geographical area. In this system Yerevan's landfill in Nubarashen shall effectively serve as a regional disposal facility, with the understanding that Yerevan will independently develop and finance its collection and disposal capacity as well as its collection and transport process.

Although a waste sorting facility was considered as an option, due to affordability constraints resulting from limited financial resources it could not be included in the design.

The figure below shows the geographic dimension of the above described “Yerevan region” beside the other four remaining regional disposal facilities.



1.3.3 Site Alternatives

- The two alternative sites were identified and assessed during the Technical Feasibility Study 2012 *Technical situation of the existing landfill Spandarjan: The visit to the landfill Spandarjan showed that it is in a poor condition. It obviously lacks all sorts of technical facilities like basic sealing, a leachate collection system or a leachate pond with basic seal. There seems no potential for extension.; and*
- *Technical situation of the existing landfill Jrvezh: The visit to the landfill Jrvezh showed that it is in a poor condition. It obviously lacks all sorts of technical facilities like basic sealing, a leachate collection system or a leachate pond with basic seal. There could be potential for extension.*

The Nubarashen site was chosen as the best solution as it fulfils the following characteristics:

- Enough space to deposit waste for the next 20 years
- Spatial proximity of Yerevan
- Protected areas are not affected
- The demand for new infrastructure to make this area accessible to the existing road network is limited

1.3.4 Design Alternatives

Current design

The current design refers to the “Yerevan Solid Waste Project – Technical Feasibility Study, prepared by Consortium RCE Ringhofer Consulting, Kommunalkredit Public Consulting and Hydro Ingenieure Umwelttechnik, September 2012 [hereinafter called: “Technical Feasibility Study”]. Note: For the construction of the new landfill a detailed design is a prerequisite before tendering the project.

The new landfill will border at the western part of the extant landfill. According to the design of the Technical Feasibility Study it is foreseen to equip the western slope of the extant landfill with a slope sealing on which the new landfill will join (see below Figure 2). By this measure the negative effects of the instable slope of the extant landfill will be minimised. Additionally, the escaping leachate from the extant landfill will be captured together with the leachate of the new landfill via drainage into a leachate reservoir of the new landfill. The existing leachate stream of the extant landfill would thus be transferred into the controlled system of the new landfill, eliminating the currently observed pollution.

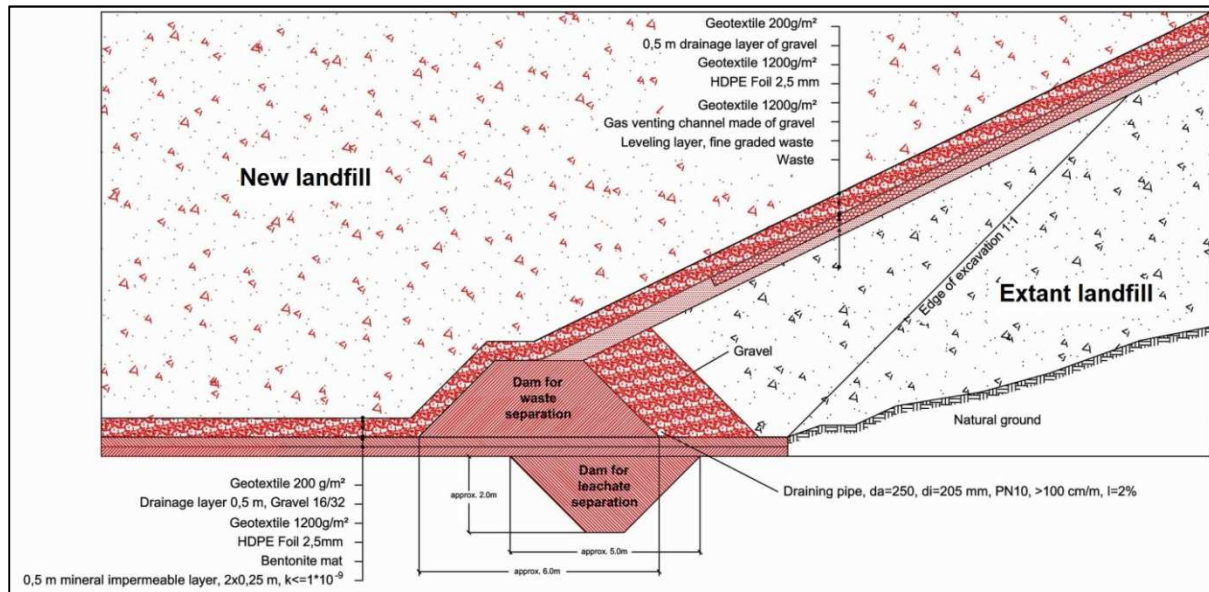


Figure 2: Schematic section of slope sealing between new and extant landfill (source: Technical Feasibility Study, 2012)

The construction of this slope sealing (approx. 4.5 ha) shall be implemented step by step parallel to the filling phase of the new landfill of zone 1 and zone 2 (see below fig Figure 3). The construction phase is to be supervised during the first operational years by a company with experience in landfill technology. This method of stabilizing and sealing for extant landfill slopes was designed according to Austrian technical landfill standards. (OENORM S2083 - waste disposal sites - Compartment requirements).



Figure 3: Affected area of slope sealing for extant landfill of new landfill zone 1 and new landfill zone 2 (source: Technical Feasibility Study, 2012)

The slope sealing has to be applied as follows (layers described from bottom to top):

- Levelling layer made of fine-grained waste (permeable to gas), thickness 0.5 m
- Gliding layer made of geotextile 1,200g/m²
- HDPE foil with rough surface, thickness 2.5 mm
- Gliding- and protection layer made of geotextile 1,200 g/m²
- Drainage layer made of gravel, thickness 0.5 m
- Geotextile 200 g/m² as separation layer (protection layer for the drainage layer) for the retention of fine-grained waste fractions

These above mentioned requirements are in compliance with the EU landfill directive 1999/31/EC of 26 April 1999.

The slope of the extant landfill will be stabilized by the following measures:

- Reducing the slope inclination to 1:2,5 This corresponds to 22 degree slope inclination.
- Compacting the planum

- Construction of a slope seal to prevent the infiltration of surface water and leachate. These measures improve the stability of the extant landfill slope.
- Covering (ballasting) the extant landfill slope with drainage material (gravel) and waste from the new landfill

Details of these measures are described in the technical feasibility study 2012.

The waste on the extant landfill slope consists of older consolidated waste. Therefore the settlements will be low after the compaction of the planum. If settlements take place in the older waste base, the slope drainage (and slope seal) will still function after settlements due to the inclination of 22 degrees. After settlements the inclinations is possibly reduced and inhomogeneous, but there will remain enough inclination for water transport down to the bottom drainage body

Design alternatives:

Alternatives to physical separation between new and extant landfill

A proposal to design a complete physical separation between extant and new landfill ("stand alone solution") was considered. However, such alternative would have the following effects:

- The instable extant landfill slope would not be improved (= not be stabilized): Risk of landslide from the old landfill towards the new landfill
- In consequence the construction of the slope seal would not be possible, surface waters could infiltrate into the landfill. The leachate amount would increase and the stability of the extant landfill would decrease more and more. This would result in a permanent danger to the working people in the area of the new landfill.
- Leachate would still drain out from the extant slope which would be accumulated in the valley between extant and new landfill resulting in generating a river/lake of leachate with the same negative environmental effects as it can be observed at the current leachate river on site now. Such situation would have to be solved by additional cost intensive measures, like pumping (maintenance and energy consuming) and transport of leachate.
- Due to volume reduction the total lifespan of the landfill would be reduced approximately by 15% from 28 years to 24 years.

Due to the above mentioned negative effects the application of this alternative is not recommended.

1.4 Project Description and Associated Facilities as defined under EBRD Performance Requirement 1

1.4.1 Construction Phase

1.4.1.1. New sanitary landfill

The area of the new landfill is situated to the west of the extant Nubarashen landfill, with an expansion of about 1,000 m in maximum length and about 400 m in maximum width. The dumping height is approx. 40 m after compaction. The dumping height is lower at the edges of the landfill. It is foreseen to deposit municipal and similar non-hazardous solid waste. The lifespan is calculated with 28 years. The overall area size has about 29 hectares and is located west of the extant landfill. This new landfill shall meet the state-of-art according EU directive for landfills and comprises the following infrastructure:

-
- Access and departure, operating road
 - Weighbridge
 - Tyre wash
 - Office and administration building
 - Garage hall
 - Respective machinery (e.g. trucks, etc)
 - Facility petrol station
 - Fencing and electric lighting

Base sealing and surface sealing:

The new landfill consists of a base sealing to avoid infiltration of leachate into the subsoil. The results of the geotechnical survey and the analysis of existing data have shown, that a base sealing is necessary. A collection and discharge system, which is located at the top of the base sealing, conducts the leachate to a leachate reservoir. Via gas wells the gas of the landfill will be collected and flared. As soon as each landfill zone reaches its final filling height, a surface sealing has to be applied on the respective filling zone.

Construction phases of the new landfill:

Based on the assumed annual waste volume of 300,000 t, the new landfill is divided into 5 landfill zones with different volumes and lifespans (total life span: 28 years).

The figure below shows the chronological operation of the 5 different landfill zones, starting with zone 1 in the east until zone 5 in the northwest:

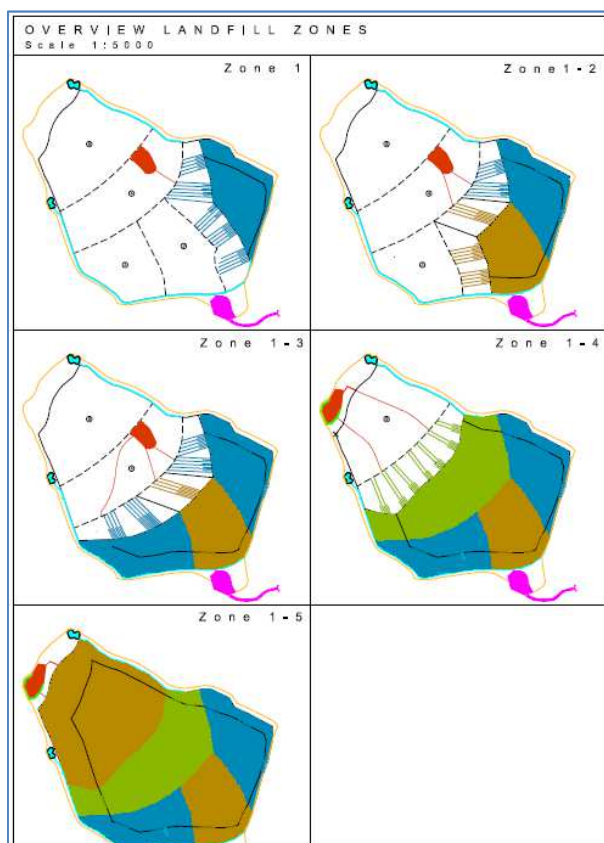


Figure 4: Filling zones of the new landfill (source “Technical Feasibility Study”; 2012)

The construction phases between each landfill zone shall be coordinated in such a way that the operation phase (= filling of the landfill with waste) is continuously working from landfill zone 1 until landfill zone 5. This means that in the last year of the operation of e.g. landfill zone 1, the construction of landfill zone 2 has to be completed. The table below shows the simplified time schedule for construction and operation of new landfill Nubarashen (not including aftercare measures).

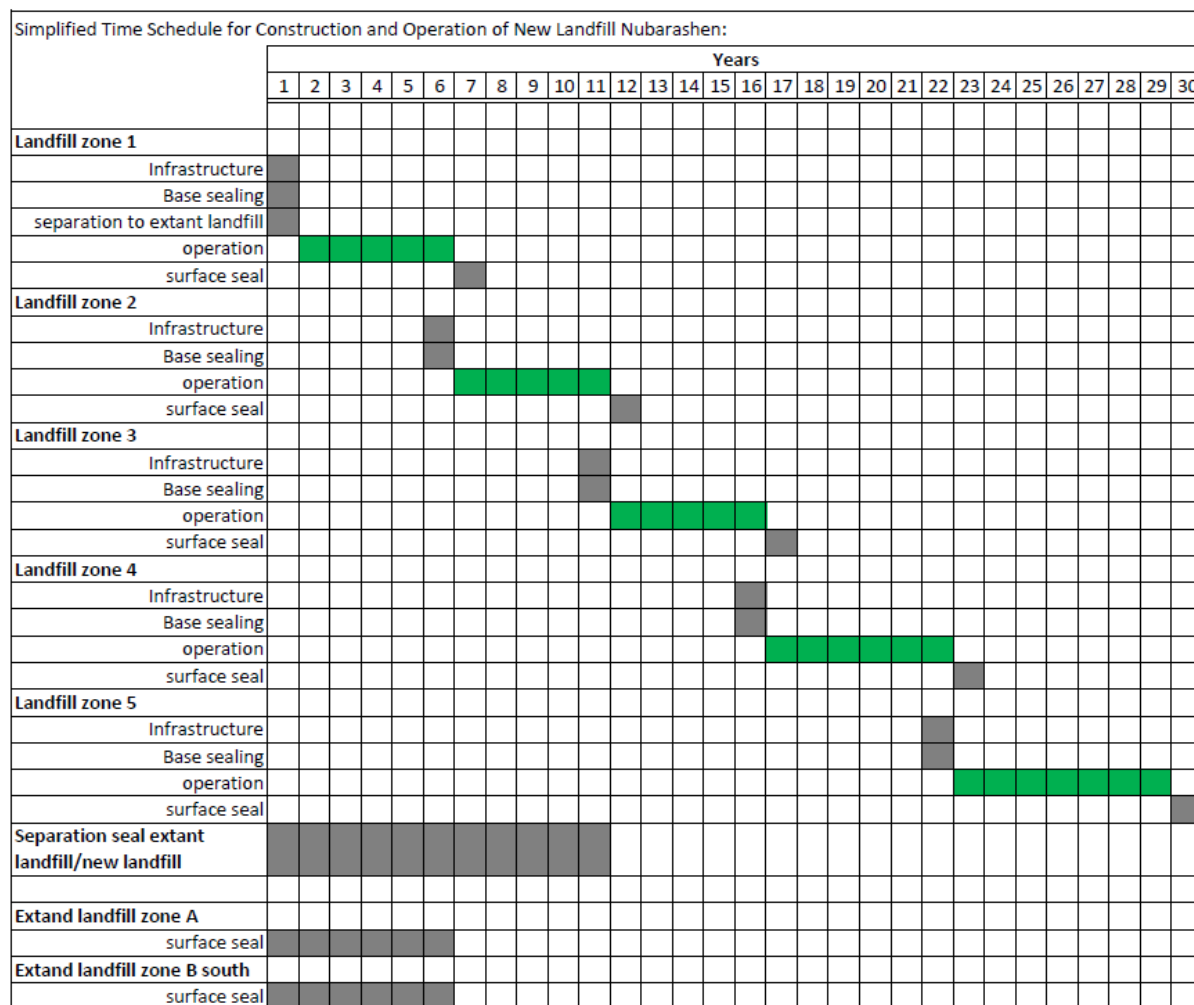


Figure 5: Simplified Time Schedule for construction and operation of new landfill Nubarashen based on data of "Technical Feasibility Study"; 2012

1.4.1.2. Construction of slope sealing between new landfill and extant landfill of Nubarashen

At the area of the proposed project there is an existing extant landfill, which is currently used for Yerevan City waste disposal.

The aim of the rehabilitation is to equip the western slope of the extant landfill with a slope sealing on which the new landfill will join. By this measure the negative effects of the instable slope of the extant landfill will be minimised and additionally the escaping leachate from the extant landfill will be captured via drainage into a leachate reservoir of the new landfill. The construction of this separation seal shall be implemented step by step parallel with the filling phases of the new landfill.

1.4.2 Operation Phase

The operation will start with depositing the waste in landfill zone 1. After reaching the respective filling height of landfill zone 1, the operation will continue with landfill zone 2 and so on, until finally the filling height of landfill zone 5 is reached. This marks the end of the operation period of this landfill which is calculated with a life span of 28 years. During

operation the leachate will be collected in a leachate reservoir [for dimensions and design of the leachate reservoir refer to the FS] from where it will be irrigated on the surface of the landfill zones. This means that under normal conditions no leachate has to be treated outside the landfill. Gas wells will collect the gas generated by the deposited waste.

1.4.3 Closure Phase

At each landfill zone a temporary surface seal shall be applied after the filling height of approx. 40 m of the respective zone has been reached. For more details regarding construction of different surface sealings, refer to Chapter "Definition of minimum requirements for appropriate closure of existing landfill".

After completion of disposal activities of the landfill, the aftercare measures shall start.

The **aftercare measures** ensure the landfill's operational capability as a technical construct in terms of its properties in order to avoid emissions and pollution after the operational phase. The aftercare measures are foreseen for a period of 30 years. These activities are divided into 2 phases, which will take place in the years 1 to 5 respectively 6 to 30 after completion of disposal activities and entail the following measures according to the Feasibility Study:

Phase 1: Aftercare period year 1 to 5 after completion of disposal activities

For this phase, directly after finalizing all disposal activities, the following activities are considered:

- Repair or retrofitting of the temporary surface sealing;
- General maintenance: Monitoring the impermeability of leachate transmission lines, shafts and impounding reservoir, flushing of the leachate lines, maintenance of fences, gates, earth dams, maintenance of groundwater probes;
- Leachate disposal;
- Capture and treatment of landfill gas;
- Environmental monitoring:
 - Collection of groundwater evidence and evidence of surrounding surface water;
 - Leachate sampling.

Phase 2: Aftercare period year 6 to 30 after completion of disposal activities

Here, the same factors are considered, however, with a lower intensity. Repair of surface sealing is no longer considered, since only low settlements are to be expected that will not impact the functioning of the surface sealing.

The reason for the lower intensity aftercare approach is based on the assumption that from the 6th year onwards after closure of operations, the processes in the landfill body decline substantially, thereby causing a much lower need for aftercare measures.

- General maintenance: Monitoring the impermeability of leachate transmission lines, shafts and impounding reservoir, flushing of the leachate lines, maintenance of fences, gates, earth dams, maintenance of groundwater probes;
- Leachate disposal;
- Capture and treatment of landfill gas;
- Environmental monitoring:

- Collection of groundwater evidence and evidence of surrounding surface water;
- Leachate sampling.

1.4.4 Facilities to be affected by the Project

Regarding construction and operation of the new landfill the following associated facilities could be identified:

- 1.) **Extant landfill:** The territory of the extant landfill belongs to Yerevan Municipality and is currently under permanent lease to the private company “Erebuni Maqrutyun” (Էրեբունի Մաքրություն ՍՊԸ) who are operating the extant landfill. The proposed project of the new landfill will directly affect the extant landfill as a prerequisite of the Bank’s support in this project is closure of the operation of the extant landfill as soon as the new landfill starts to operate. Currently the area of the extant landfill is partly enclosed by fences. In the course of the closure of the operation of the extant landfill, the area of the extant landfill should be protected by fences to avoid unauthorized access.
- 2.) **Gas capture installation of the extant landfill:** At the extant landfill there is an existing installation which captures gas from the body of the extant landfill. It is operated by the Japanese Company Shimizu. Since 2009, parts of the extant landfill, a landfill gas (“LFG”) flaring facility is operated by the Company Shimizu under CDM¹ CO₂ emissions arrangement. This gas capture installation collects gas from the body of the extant landfill. It was foreseen to convert the gas into energy, but currently the gas is just flared.
- 3.) **Access Road:** From “Nubarashen road” (i.e. main road leading from Yerevan to Nubarashen) there is an existing access road leading to the extant landfill with an approximate length of 1km. The access road of the extant landfill belongs to Yerevan Municipality and is currently under permanent lease to the private company “Erebuni Maqrutyun” (Էրեբունի Մաքրություն ՍՊԸ) who are operating the extant landfill.
- 4.) **Junction area at Nubarashen road:** The junction area where the access road leads into “Nubarashen road”, including the part of approx. 100m north and approx.100m south on Nubarashen road, is also an affected facility. While the access road is private property, the Nubarashen road is under the responsibility of the respective authority of the Municipality of Yerevan.

The location of above described associated facilities is shown in Figure 6 below.

¹ Clean Development Mechanism (CDM) by United Nations Framework Convention on Climate Change (UNFCCC)

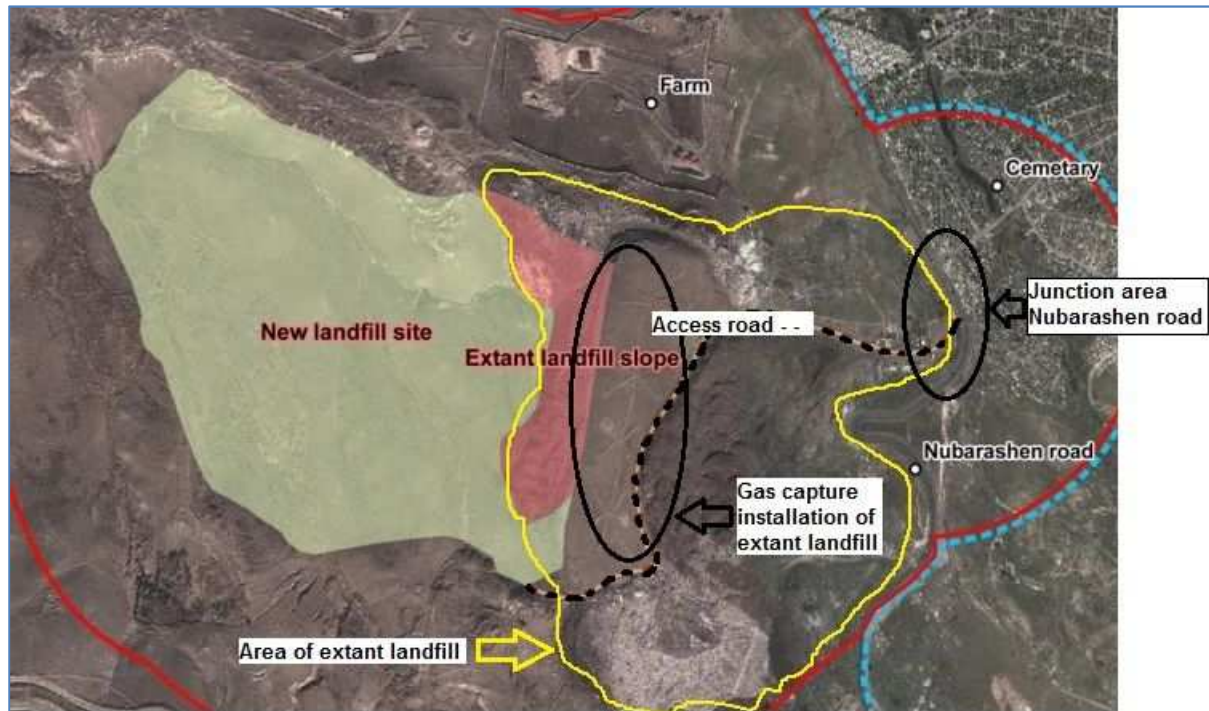


Figure 6: Location of associated facilities

1.5 Definition of minimum Requirements for Appropriate Closure of existing Landfill

According to information from Yerevan Municipality, the closure of the existing landfill is within the responsibility of Yerevan Municipality.

The closure of the existing landfill can be divided into two stages:

- Slope sealing between new landfill and extant landfill and
- Surface sealing of the remaining extant landfill.

The slope sealing is already described in detail in chapter “design alternatives / current design” of this report.

Closure of the extant landfill by surface sealing:

There are three zones at the extant landfill - Zone A, Zone B North and Zone B South (see figure below).

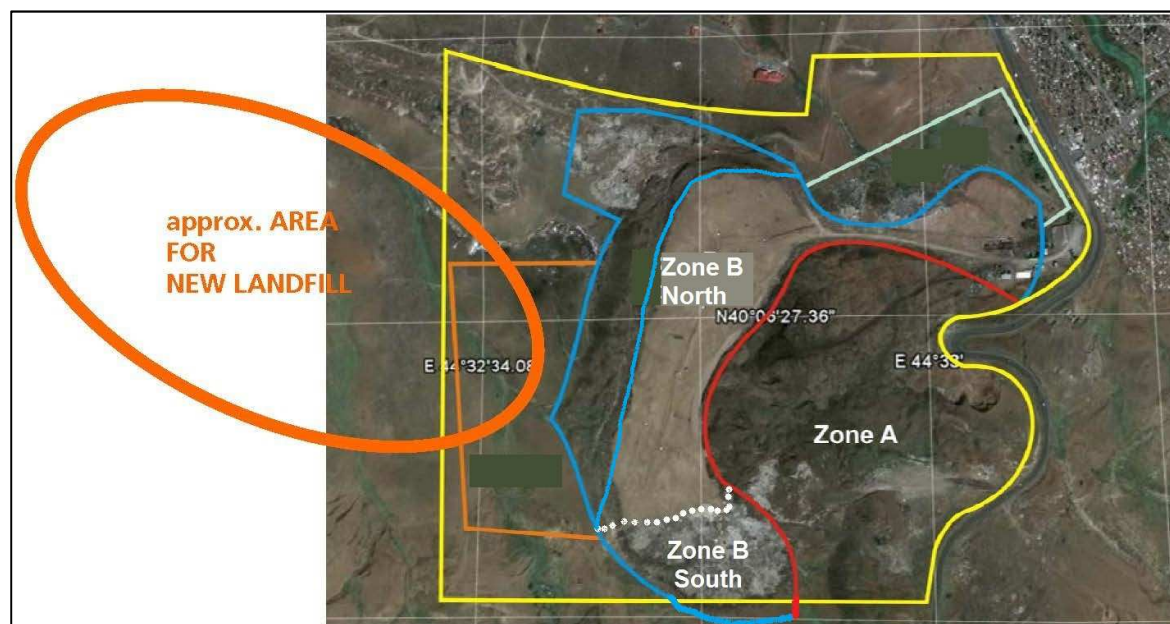


Figure 7: Schematic situation the Zone A, Zone B North and Zone B South of the extant landfill (adapted from source: Technical Feasibility Study"; 2012)

High priority should be given to **Zone B south** (approx. 5.5 ha), where the waste is currently being dumped; a temporary sealing is strongly recommended. A final surface sealing (e.g. according to the EU Directive) will only be reasonable after the decay of the settlements (duration approx. 20 years), because landfill settlements may damage the surface sealing in such a way that it loses its function. The temporary surface sealing entails a slightly lower degree of efficiency as compared to the final surface sealing. However, temporary surface sealing can absorb the settlements without any adverse effects.

In Zone B south, based on the Technical Feasibility Study, the following temporary surface sealing should be applied (bottom to top):

- Levelling layer made of fine-grained waste (permeable to gas), thickness: 0.5 m;
- Protection layer made of geotextile 1,200g/m²;
- Geo-synthetic sealing element, bentonite mat;
- Synthetic draining element;
- Surface soil made of material suited for vegetation cover, thickness > 1.0.

Zone B north (approx. 7.5 ha, not counting the "slope sealing" of 4-5 ha) covers the area where the Japanese Shimizu Corporation operates a gas capture system. This area has already a sealing. In the future, it is recommended to perform permeability tests at this surface field. Depending on these results, this surface sealing should be improved (if necessary) to reach the characteristic of a water tight surface sealing to mitigate the infiltration of rainwater.

For **Zone A** (approx. 16 ha) the Feasibility Study suggests the following setting for the temporary surface sealing:

- Simple temporary sealing made of natural soil, thickness > 1.0 m)

The waste deposited in Zone A is older than in Zone B. Zone A was operated approx. from 1960 till 1985. Due to the higher age of the waste, the emission potential is lower than in

Zone B. The surface sealing can therefore be made simpler than in Zone B.

After the settlements have stopped, a final surface sealing should be applied. The existing temporary surface sealing shall be integrated in the final surface sealing.

When installed, the composition of the final surface sealing should be in compliance with all statutory provisions at the time of installation. The following exemplary composition of a final surface sealing may be carried out (bottom to top):

- Removal of the surface soil of the temporary surface sealing, lateral storage; levelling;
- Protection layer made of geotextile 1,200 g/m²;
- Mineral impermeable layer, double-ply, thickness 0.5 m, and probably also in combination with a HDPE foil, 2.5 mm;
- Protection layer made of geotextile 1,200 g/m²;
- Drainage layer made of gravel, thickness 0.5 m²;
- Surface soil made of material suitable for vegetation cover, thickness > 1.0 m

1.6 Revision of Investment Plans with Respect to Environmental and Social Issues

The Municipality of Yerevan has planned no other investments in the vicinity of the project area.

1.7 Amendments to the Technical Project from 2012 (Technical Feasibility Study, 2012)

As a result of the carried out ESIA the following measures are to be incorporated in the detailed project design to be in compliance with EBRD's policy requirements (see chapter 7.1 tabular environmental management plan and ESAP for more information):

- Relocation of permanent storm water basin and leachate basin to warrant a distance of 10 m to the existing water supply pipeline "Garni-Yerevan" (has no influence on predicted landfill volume)
- Speed bumps and street lights for safety reasons
- Base sealing is necessary

1.8 Landfill Protection Zone

The Best Available Techniques for the Waste Sector (BAT) guidance note recommends a buffer zone of 750 m around the borders of a new landfill site. The Armenian legislation does not include an SPZ [Sanitary protection zone] requirement.

Considering the applied technology (e.g. rainwater irrigation of the waste) gas capture and flaring, small open tipping areas, leachate collection, base sealing) any impacts will be limited to the project area. The distance to the nearest houses is 300m and between the houses and the landfill the terrain is steep (noise will not reach the houses). Furthermore, the terrain and the distance to the project area prevents both the potential impacts such as odour and noise as well as any risks such as fire, explosion, gas migration, etc to impact the nearby community. Hence, lack of an SPZ does not currently cause any problems.

However, in order to avoid possible futuristic impacts, no further buildings (also industrial buildings) should be allowed to be constructed within an buffer area of 750 m around the outer borders of the landfill site as required by BAT guidance document. Therefore, the ESAP requires the Municipality to set up a SPZ based on a risk assessment and ensure no

buildings to be built within the SPZ.

2. APPLICABLE REQUIREMENTS

2.1 National Regulatory Requirements

2.1.1 National Waste Strategy Armenia

In the National Waste Strategy Armenia different 4 scenarios for SWM systems were developed by an external consultant (COWI, 2013)

Following a working meeting with all institutional stakeholders at the beginning of February, a deeper analysis of the four scenarios and further consultations with stakeholders, the Consultant concluded that the best option for Armenia is a decentralized system based on standardized local and marz level collection capability, transfer stations and a series of regional sanitary landfills meeting EU design and environmental standards established to serve a logical geographical area. In this system Yerevan's landfill in Nubarashen will effectively serve as regional disposal facility, with the understanding that Yerevan will independently develop and finance its collection and disposal capacity as well as its collection and transport as now being pursued.

Based on this decision, the area of a 30 ha is sufficient to serve Yerevan with a nominal capacity of 300.000 t/year of waste as a new landfill site.

2.1.2 Armenian Laws on Waste

The law (law on waste of RA from November 24, 2004) regulates legal and economic relations connected to the collection, transfer, maintenance, development, reduction of volumes, and prevention of negative impact on human health and environment.

The law defines objects of waste usage, the main principles and directions of state policy, the principles of state standardisation, inventory, and introduction of statistical data, the implementation of their requirements and mechanisms, the principles of waste processing, the requirements for presenting waste for the state monitoring, activities to reduce the amount of the waste, including nature utilisation payments, as well as the compensation for the damages caused to the human health and environment by the legal entities and individuals, using the waste, as well as requirements for state monitoring and legal violations.

In November 2014 the Republic of Armenia will adopt "The Law of the Republic of Armenia on Waste." This law describes the aims of waste collection and the responsibility of authorized bodies.

The Republic of Armenia has also launched the "Republic of Armenia Law on Waste Management and Sanitary Cleaning" (draft version).

This law gives an overview of the different definitions of waste, the requirements for waste collection and methods for payment of management fees. Until now, this law has not come into force.

These laws mainly just mirror sound waste management principles.

2.1.3 Technical Norms for Sanitary Landfills

Armenia doesn't have any regulatory standard for the construction of sanitary landfills. Therefore the European standard

Council Directive 1999/31 of 26 April 1999 on the landfill of waste (OJ L182, 16.7.1999, p.

1), last amended by Regulation (EC) No 1137/2008 of the European Parliament and of the Council of 22 October 2008 (OJ L 311, 21.11.2008, p. 1). (EU Directive)

should be applied as a technical framework to ensure “best-practice.” This directive defines in detail the requirements for a safe and cost-efficient operation of a sanitary landfill.

2.1.4 EIA – Regulation in Armenia

2.1.4.1. National Legislation for Environmental and Social Impact Assessment

The 10th Article of the Constitution of the Republic of Armenia (passed in 1995, amended on 2005) outlines the State responsibility for environmental protection, reproduction and sustainable use of natural resources.

Classification of landfill will be done according to RA Law on Environmental Impact Assessment and Expertise, adopted on 21.06.2014.

2.1.4.2. ESIA Law in Armenia

The Law on Environmental Impact Assessment contains the standard steps of the EIA process for various projects and activities in Armenia.

According to the following criteria an ESIA has to be undertaken.

2.1.4.3. Classification of Sanitary Landfills – Screening

The law regulates the legal, economic and institutional aspects of the environmental impact assessment of intended activities and concepts. According to Article 14, the following intended activities are subject to EIA in the solid waste management sector:

For Category A

(a). hazardous waste collection, storage, use, processing, recycling, disposal and waste neutralization,

For Category B

(a). landfill organization and/or waste processing in 20 thousand and more populated areas.

In Armenia all waste disposal facilities have to carry out an ESIA (without case by case decisions or thresholds).

2.1.4.4. Process

In accordance with Art 15, the examination is carried out in two stages:

1.) A preliminary examination / screening, during which the study is a preliminary evaluation of the document / activities.

2.) The main stage/ detailed examination, during which examine the main document/activities in accordance with Art 16.

The preliminary examination stage of the examination / screening conducted by the initiator after submission to the Authorized body the application within 30 working days.

The preliminary examination stage is considered as an initial assessment of the application sets, particularly considered contents and completion of the concept document and (or) the possible impact of the scope. ToR for main stage of EIA should be developed and provided to initiator.

Application for detailed examination should contain the following data:

- 1.) Initiator name and place of residence (location);
- 2.) Concept paper or activities name and purpose;
- 3.) Concept paper and (or) the subject area, including a brief description of the environmental situation in the scheme;
- 4.) Concept paper and (or) the characteristics (capacities, expected use of materials and natural resources, technical and technological solutions);
- 5.) Environmental and Social Impact Assessment and Environmental Management Plan with all negative impacts description and environmental impact mitigation measures;
- 6.) Preliminary arrangement with local authority concerning public awareness and hearings, if of otherwise provided by RA law.

As a result of preliminary examination the authorized body shall provide one from the following opinion/decisions:

- 1.) Concept document or activities is inadmissible – decision has been made taking into consideration requirements of RA legislation;
- 2.) Application could be returned to initiator with the purpose of completion, according to content of point 3 of Art 16;
- 3.) Application could be returned in case of trans-boundary context of concept document or activities;
- 4.) In case of classification A or B category, ToR should be developed and provided for further detailed examination;
- 5.) In case of C category classification final decision will be provided.

ToR should be developed in accordance to provision of this law

If the application is uncompleted or contents are not fulfilling point 3, Art. 16, the authorized body returns the documents to the initiator for completion within five days. From the moment of returning, the preliminary examination process will be stopped until the submission of an amended version for project application.

The Terms of Reference (Methodology) shall be developed in accordance with Article 7 (natural objects and characteristics of environmental impacts: Ambient air, soil, bio resources, etc.), as well as, with Article 18 (content and scope of ToR) of the Law.

The ToR forms have to be approved by the authorized body.

During the preliminary examination/ screening period (30 days) the initiator of an intended activity informs the competent state authorized body – RA MoNP – about upcoming activities. The first public hearing should be organized and provided by the initiator after the notification of affected public and stakeholders 7 days in advance.

Within 30 days the competent authority shall notify the initiator of the final decision whether the EIA is required. The next step is the submission of the detailed documents required by the competent authority (based on ToR developed as a result of screening), which the latter immediately sends "to the heads of the province or the community, to the relevant state body and the affected community".

The hearings, with the participation of the community leaders and the initiator, shall be finalized within 30 days. If more than one community is affected, the venue of public hearings shall be determined by the competent authority.

Within 10 days of the preliminary examination period and an adopted one from listed in Art

16 decisions were taken.

Within 30 days of the receipt of the expert conclusion, the authorized body is finalizing the decision to arrange the second round of expertise consultation.

In accordance with Art 19, the time line to evaluate the detailed examination by the authorized body ranges from the:

- Concept Document (includes e.g. methodology) – 60 working days
- For A category – 60 working days
- For B category – 40 working days

For some cases the detailed examination period could be extended (limit is one extension and for half period for each category), based on written notification provided by the state authorized body. In case of a not completed package submission, 10 additional days for completion of ESIA package could be provided.

Two public hearings shall be organized in detailed examination period (minutes of meeting from community meeting shall be attached to the application) and stakeholders and affected communities opinions should be reflected in the final document.

After the decision concerning the final conclusion from the authorized body, three public hearings shall be organized by the initiator with the purpose of providing final information on EIA process to affected community.

MoNP developed and submitted to RA Government Draft of Decree “On Public Notification and Discussion” – it is not adopted yet. This document defines in detail the procedure for implementation of public hearings and responsibility of initiator, authorized body, expertise centre and local authorities.

The Law on Preservation and Utilisation of Immovable Monuments of History and Culture and of the Historic Environment (adopted on the 11 November 1998) addresses the following: (i) the concept of monuments of history and culture, (ii) the procedure of their preservation and use, (iii) the classification of monuments, (iv) the rights and responsibilities of the state and the local self-government bodies with regard to preservation and use of monuments and (v) the procedure for the state registration of monuments. It provides a framework for preservation of monuments and the historic environment and supports the study of monuments and archaeological digs.

2.1.4.5. Documents to be submitted

1.) The initiator submits the documents on the intended activities subject to environmental impact assessment to the authorized body by established procedure.

2.) The documents and the list of data and its scope are established by the proposal of the authorized body to the government of the Republic of Armenia.

2.1.4.6. Administrative framework

Key administrative authorities

There are several public and private institutions that are involved at different levels in environmental and social issues of the Nubarashen landfill management. The roles, authorities and responsibilities of those organizations are briefly presented below.

Ministry of Nature Protection of RoA

The Ministry of Nature Protection elaborates and implements the policies of the Republic of Armenia in the areas of environmental protection and sustainable use of natural resources

and is represented by the Minister and the staff of the Ministry.

Within the system of the Ministry there are also State Non-Commercial Organizations and Institutions. The main functions of the Ministry of Nature Protection of RoA are listed below:

- 1.) Develop and coordinate implementation of the state policy and strategy on environmental protection and efficient use and reproduction of the natural resources;
- 2.) Develop the environmental regulations;
- 3.) Develop the economic instruments for efficient use and reproduction of environment and national resources;
- 4.) Facilitate fulfilment of international environmental commitments;
- 5.) Development of the main directions of environmental education and awareness raising strategy;
- 6.) Execute the state environmental monitoring;
- 7.) Carry out the investigation on the negative impact on the environment;
- 8.) Regulate and ensure sustainable use of natural resources.

The above mentioned functions of the Ministry are implemented through the following units:

The key departments and organizations within the Ministry of Nature Protection (MNP) have administrative authority over the EIA.

2.1.4.7. Organisation of Ministries

State Environmental Expertise (SEE) SNCO conducts environmental assessments of design documentation for construction, reconstruction, extension and maintenance of industry related production units, auxiliary facilities and infrastructure, including waste utilization sector, according to the requirements of National legislation and ratified International agreements and issues experts' conclusions.

Information Analytical Center provides data concerning environmental issues and natural resources for stakeholders, such as state authorities, NGOs, mass media, community, etc.

Center for Waste Investigation SNCO contributes to the environmentally friendly waste treatment and management and prevention of the waste negative impacts on the environment.

Environmental Impact Monitoring Center monitors water and air quality in different areas of Armenia through its network of observation points.

Separate Units

Water Resources Management Agency with its five Basin Management Organizations is the key institution responsible for the water resources management including, but not limited to, the development and implementation of the National Water Policy, National Water Program and Basin Management Plans; regulation of water use by issuance of permits for use of surface and ground water resources; assessment and classification of water resources by their use; participation in development of water standards and control of application, etc.

Bio-Resource Management Agency participates in the environmental impact assessment of eco-system; ensures protection, reproduction and rational usage of bio resources; draws up inventory and carries out monitoring of flora and fauna, etc.

State Environmental Inspectorate (SEI) with its 11 regional offices oversees the implementation of legislative and regulatory standards on natural resources protection, use and renewal. SEI is responsible for inspecting projects to ensure compliance with conditions

imposed by the SEE and with the Project EMP.

All above-mentioned divisions and organizations of RA MoNP are responsible for reviewing and providing professional opinion within their responsibilities.

Chapter 2 of the Law defines the responsibilities of RA Government, State Authorized Body-MoNP, territorial and local authorities as well as EIA expertise center (independent center, provided experts for examination process and development of ToR during the screening for farther EIA).

Other participating authorities:

The Ministry of Culture has jurisdiction over archaeological, historical, and cultural sites. It is not, however, involved with the fate of modern monuments erected along the highway by private citizens in commemoration of accident victims. The relocation of those monuments will be coordinated by the respective provincial authority.

The Ministry of Economy of RoA is responsible for:

- 1.) Elaboration and implementation of the economic and industrial development policies of the Republic of Armenia;
- 2.) Elaboration and implementation of the scientific-technical and innovation policy as well as investment programs of development of industrial technologies;
- 3.) Develop the separate investment programs by means of Ministry infrastructure and if necessary provide assistance directed to the implementation;
- 4.) Carry out reviews concerning the efficient utilization of natural resources in the field of industry, issue the conclusions and proposals.

Ministry of Emergency Situations of RoA is responsible for development and implementation of RoA policy in the area of civil defence and protection of the population in emergency situations. The following separate divisions and state agencies, such as State Hydrometeorology and Monitoring Service of Armenia, National Technical Safety Center, Armenian Rescue Service, National Reserves Agency and National Seismic Protection Service Agency, are also included in the structure of the Ministry.

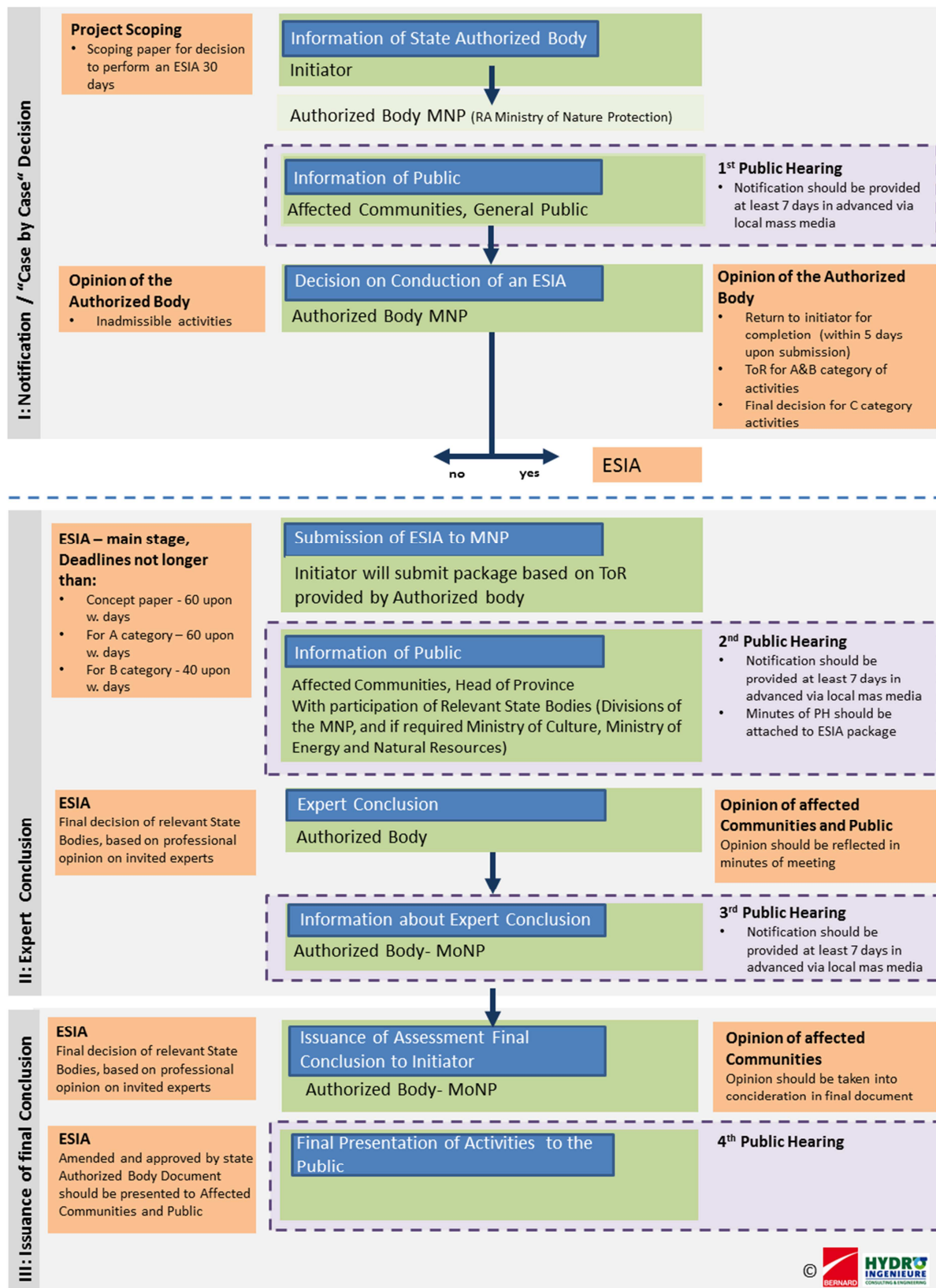
Armenian State Hydro-Meteorological Monitoring Service conducts regular monitoring of meteorological and hydrological conditions in different areas of Armenia through its network of metrological stations.

National Technical Safety Center organizes and carries out measures and actions for provision of technical safety in the industrial dangerous objects operated (constructed, modernized, decommissioned, demolished) in Armenia except for nuclear and power stations, radioactive substances treatment, aviation, auto and railway transport as well as military objects.

The Ministry of Energy and Natural Recourses of RoA is responsible for elaboration and implementation of the policies of the Republic of Armenia in the sector of energy and natural resources management. The structure of the Ministry includes main staff and several subordinate state non-commercial organizations and institutions, such as Concessions Agency, Geological Agency, Mineral Resources Agency, State Energy Inspectorate and State Inspectorate for Control of Mineral Resources.

The Ministry of Healthcare of RoA elaborates and implements the policy of the Republic of Armenia in the healthcare sector. The structure of the Ministry includes main staff and two subordinate bodies: National Healthcare Agency and National Hygiene and State Anti-Epidemiological Surveillance Inspectorate.

State Anti-Epidemiological Surveillance Inspectorate with its 19 regional offices is responsible for participation in development of sanitary norms and standards; coordination of all issues related to healthcare; supervision of sanitary norms, hygienic and anti-epidemiological measures implementation by organizations and citizens.


**ESIA Process according to RA Law on Environmental Impact Assessment and Expertise,
adopted on 21.06.2014**


Legend**Table 1: EIA Process in Armenia****2.1.5 Ratified Treaties**

The following international documents are also relevant for the SEP preparation:

- UNECE Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Aarhus Convention);

“The Aarhus Convention is a multilateral environmental agreement through which the opportunities for citizens to access environmental information are increased and transparent and reliable regulation procedure is secured. It is a way of enhancing the environmental governance network, introducing a reactive and trustworthy relationship between civil society and governments and adding the novelty of a mechanism created to empower the value of public participation in the decision making process and guarantee access to justice: a “governance-by-disclosure” that leads a shift toward an environmentally responsible society”.

Armenia is a party to a number of conventions and international treaties providing a framework for the public consultation process with regard to the Project, including the following relevant legislation:

NO.	CONVENTION OR PROTOCOL, NAME AND PLACE	IN FORCE	SIGNED	RATIFIED	COMMENT
1	Convention on Wetlands of International Significance especially as Waterfowl Habitat (Ramsar, 1971)	1975	1993	Ratified by USSR	
2	Convention on Biological Diversity (Rio-De- Janeiro, 1992)	1993	1992	1993	Reregistered in UN 1993
3	Cartagena Protocol on Biological Safety (Cartagena, 2000)		2000	2004	
4	UN Framework Convention on Climate Change	1994	1992	1993	Reregistered in UN 1993
5	Kyoto Protocol (Kyoto, 1997)			2002	Reregistered in UN 2003
6	Convention on Long-range Transboundary Air Pollution (Geneva, 1979)	1983		1996	Reregistered in UN 1997
7	Convention on Environmental Impact Assessment in a Transboundary Context (Espoo,	1997		1996	Reregistered in UN 1997
	Protocol on Strategic Environmental Assessment (Kiev, 2003)		2003		
	Convention on the Transboundary Effects of Industrial Accidents (Helsinki, 1992)	2000		1996	Reregistered in UN 1997

NO.	CONVENTION OR PROTOCOL, NAME AND PLACE	IN FORCE	SIGNED	RATIFIED	COMMENT
8	Protocol on Civil Liability and Compensation for Damage caused by the Transboundary Effects of		2003		
9	UN Convention to Combat Desertification (Paris,	1996	1994	1997	Reregistered in UN 1997
10	Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel, 1989)	1992		1999	Reregistered in UN 1999
11	Convention for the protection of Ozone Layer (Vienna, 1985)	1988		1999	Reregistered in UN 1999
	Montreal Protocol on Substances that Deplete the Ozone Layer (Montreal, 1987)	1989		1999	Reregistered in UN 1999
12	Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (Aarhus,	2001	1998	2001	
13	Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade		1998	2003	
14	Convention on Protection and Use of Transboundary Watercourses and International	1996	1999		
	Protocol on Water and Health (London, 1999)		1999		
15	Stockholm Convention on Persistent Organic Pollutants (Stockholm, 2001)		2001	2003	
16	Convention on the Prohibition of Military or any Other Hostile Use of Environmental	1978		2001	Reregistered in UN 2002
17	European Convention on Landscape			2004	
18	Convention on Protection of the World Cultural			1993	
19	Energy Charter Treaty (Lisbon, 1994)			1997	
	Energy Charter Protocol on Energy efficiency			1997	
20	European Convention on Protection of Wild Nature and Habitat (Bern, 1979)	1982	2006		

Table 2: List of environmental conventions and protocols signed and ratified by RoA

- Convention on Environmental Impact Assessment in a Transboundary Context (Espoo, 1991).
- Protocol of Strategic Environmental Impact Assessment of the Convention on Environmental Impact Assessment in a Transboundary Context (Kiev, 2003).
- Convention on Protection and Use of Trans-boundary Watercourses and International Lakes, 1992 (has not been signed by Armenia).
- Water and Health Protocol of the Convention on Protection and Use of Trans-boundary Watercourses and International Lakes (1999) Engagement of stakeholders and public consultation activities are also included in the Guideline for Landfill Construction and Operation adopted by the Ministry of Urban Development of Armenia in 2010.

2.1.6 Legal Framework and Common Practice for ESIA Processes in Armenia – Implications for the Project

The most important conclusion is that the approval process in the follow up process can take up to four years (ESIA process and other permits).

The consideration of the opinion of the most important stakeholders at an early project stage might therefore shorten this process.

2.1.7 Other required permissions for Construction and Operation of a Landfill Site in Armenia in the follow up process

In addition to a positive conclusion on the submitted ESIA by the authorized body, the initiator also needs a landownership certificate and a construction permit.

The consultant will carry out inquiries at the cadastral office about the current landownership status of the potentially affected landowner. These data can be provided for this additional requirement. The initiator should apply for the construction permit for after the positive conclusion of the ESIA by the authorized body.

2.1.7.1. Forest Law – allocation of forests

An important legal issue concerns the land use. Aside from 1 private property with a proven (cadastral office) landuse for establishing a landfill site, the remaining area are forest areas. Due to the Armenian forest code, where forests are defined as “forested lands and lands allocated or envisaged for flora or fauna protection, nature protection as well as non-forested land allocated or envisaged for the running of forest economy.” Even though the project area is not covered with forests (or is part of a nature protection network), the initiator has to pay a charge for forest use for affected state forests. The tariff will be determined by the Government of the Republic of Armenian.

Furthermore the initiator cannot buy the rest of the required project area for the new landfill site, if the area is considered as forests in the meaning of the Armenian forest code. But these areas can be allocated free of charge by the decision of the Republic of Armenia.

2.1.7.2. Landownership –Legislation of Armenia

Due to the long period of Armenia being a republic of the former Soviet Union, the landownership status is for vast areas an open question. In general, forested shall be subject to state registration. Also the areas that are unknown, the property is likely to be owned by the State of Armenia. For only 1/3 of the required area, the owner can be proven by cadastral information. (landuse: landfill, 1 private owner)

Therefore in the follow up process, it should be determined by the Government of Armenia, who holds property rights in the unknown areas.

2.2 EU-Legislation

2.2.1 EU Legislation for Environment and Social Assessment

The EIA-Directive – Directive 2014/52/EU of the European Parliament and the Council of April 16, 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment differs between projects of Annex I and Annex II referring to different requirements for assessments.

Annex I projects fall under the Articles 5 to 10 of the EU Directive. Annex II projects are under the purview of the member state and assess by national thresholds and criteria. Case

by case examinations is possible in accordance with the EU EIA directive.

Classification of Waste Disposal Sites

Annex II is the Article 4(2) is relevant for the determination of the project type. It describes the “Installations for the disposal of waste” (projects not included in Annex I);

Article 4(2)

In case non-hazardous waste and no chemical treatment or incineration with volume above 100 tons / day is foreseen to be deposited a:

- (a) A case-by-case examination; or*
- (b) Thresholds or criteria set by the Member State. (→ Armenian law) should be carried out.*

Member States may decide to apply both procedures referred to in points (a) and (b).

2.2.2 Directive 2010/75/EU - The Industrial Emissions Directive

The IED is the successor of the IPPC Directive and in essence, it is about minimising pollution from various industrial sources throughout the European Union. Operators of industrial installations operating activities covered by Annex I of the IED are required to obtain an integrated permit from the authorities in the EU countries.

The IED is based on several principles, namely (1) an integrated approach, (2) best available techniques, (3) flexibility, (4) inspections and (5) public participation.

The integrated approach means that the permits must take into account the whole environmental performance of the plant, covering e.g. emissions to air, water and land, generation of waste, use of raw materials, energy efficiency, noise, prevention of accidents, and restoration of the site upon closure. The purpose of the Directive is to ensure a high level of protection of the environment taken as a whole.

The permit conditions including emission limit values (ELVs) must be based on the

- Best Available Techniques (BAT)

2.2.3 Directive 1999/31/EC on the landfill of waste

Where waste needs to be landfilled, it must be sent to landfills which comply with the requirements of Directive 1999/31/EC on the landfill of waste. The objective of the Directive is to prevent or reduce as far as possible negative effects on the environment, in particular on surface water, groundwater, soil, air, and on human health from the landfilling of waste by introducing stringent technical requirements for waste and landfills.

The Landfill Directive defines the different categories of waste (municipal waste, hazardous waste, non-hazardous waste and inert waste) and applies to all landfills, defined as waste disposal sites for the deposit of waste onto or into land. Landfills are divided into three classes:

- landfills for hazardous waste;
- landfills for non-hazardous waste;
- landfills for inert waste.

2.3 EBRD's Performance Requirements

This Project has been categorized A under the EBRD's 2008 Environmental and Social Policy.. Accordingly, an Environmental and Social Impact Assessment (“ESIA”) is required for the Project, including an environmental and social review of the existing facilities and

activities.

Preparation of an Environmental and Social Impact Assessment (ESIAC compliance with its Performance Requirements (as applicable to category A projects) including:

- PR1 - Environmental and social appraisal;
- PR2 - Labour and working condition;
- PR3 - Pollution prevention and abatement;
- PR4 - Community health, safety and security;
- PR5 - Land acquisition, involuntary resettlement and economic displacement;
- PR6 - Biodiversity conservation and sustainable management of Living resources;
- PR7 - Indigenous peoples (not applicable to this project);
- PR8 - Cultural heritage;
- PR9 - Financial intermediaries (not applicable to this project);
- PR10 - Information disclosure and stakeholder engagement;

Compliance with good international environmental practice, such as:

- EU standards; and

ILO core labour standards on:

- Forced labour (C105)
- Discrimination (C111),
- Freedom of Association and the Right to Organize (C 87);
- Equal Remuneration (C100);
- Minimum Age (C138).

The project moreover is published on the EBRD's website for 120 days (PR 10 for Public Disclosure)

3. MATRIX OF RELEVANCE

The matrix of relevance presents the results of the preliminary investigation (screening, feasibility study). The axes of the table represent the entity of environmental and social issues of the project opposed to the impact factors resulting from the project. Thus the scope of investigation is defined by the relevant impacts and their potential interference with the asset. This model is commonly used for the identification of relevant impact factors within ESIA-procedures in Austria and Germany. (e.g. RVS 04.01.11²).

The following matrix represents the first step of the evaluation process. Here, the relevant impacts and indicators are defined. All relevant impact factors are addressed by an associated mitigation, compensation or monitoring measure.

Aside from threshold according to given decrees or laws to assess impact on assets, in some cases a qualitative assessment will complement these proposals for evaluation.

² RVS 04.01.11 - Environmental Examination, Austrian Research Association for Roads, Railroads and Transport, 2008).

				impact factors														
issues	assets	sub topic	indicator	Resettlement	Land consumption	Economic displacement	Landscape/geo-morphology	Emissions of odour	Emission of noise	Emission of air pollutants	Barriers (e.g for migration of animals)	Emissions of waste water (effluents - leachate)	Change of spatial structures	Vibrations	Erosion	Diseases /accidents		
environmental and social issues	human being	human health, well-being and safety	impacts of noise, vibrations, air pollutants						X	X								
			impacts spread of diseases															
			impacts on odour					X										
			impacts due to accidents															X
		economic impacts	business and economic activities (livelihoods)		X	X												
			landownership		X													
			loss (damage) of structures		X													
		social impacts	social conflicts		X	X												X
			gender issues			X												
			residential area (project and host area)							X	X							
			loss of social services and infrastructures															
	landscape	landscape and visual resources, recreation	impact on landscape and visual resources		X		X							X				
			impacts on recreation															
	Biodiversity	fauna / flora	impacts on plants / habitats		X						X	X	X					
			impacts on habitats of animals		X					X	X	X	X					
			impacts on protected areas															
			impacts on migration corridors for animals									X						
	soil	geology / geomorphology	impacts on mining resources															
			impacts on soil		X		X						X				X	
			impacts on brown fields		X													
	water	ground water	qualitative impact										X					
			quantitative impact		X								X					
		surface water	quantitative impact										X					
			qualitative impact		X								X				X	
	climatic conditions	micro climatic situation	impacts on the exchange of fresh and cold air		X							X						
		macro climatic situation	GHG emississions								X							
	cultural heritage	religious monuments	impacts on churches, cemeteries							X	X							
		other monuments	impacts on archeological sites															

Table 3: Matrix of Relevance

Considered Phases in Project Cycle

The construction (including pre-construction), the operation and closure phase (e.g. re-use as an area for recreation) are considered.

Irrelevant Assets – “No-Impact Statement”

Moreover, the Urban Development Yerevan stated, that the new landfill site is foreseen for

the construction and operation of a new landfill site and not potential mining activities. Therefore, this indicator (part of the asset soils) does not have to be evaluated. Evaluation is not necessary, neither in the baseline survey nor in the impact assessment.

Overall evaluation of impacts

The magnitude of a potential impact is considered in 2 steps.

In the first step – part of the matrix of relevance – the potential impacts were identified and evaluated in regards to the potential impacts on assets.

In the second step the potential impacts were recorded, described and evaluated. The evaluation system considers technical standards (e.g. guidelines for landfill sites), relevant decrees (e.g. on noise from Germany) and guidelines.

Environmental and social impacts were identified, described and evaluated. The evaluation is done in a separate chapter as a table for all assets. In order to highlight certain impacts as project risks, these are classified in addition to the evaluation significant or none-significant in ordinal scales from “very high”, over “high” and “medium” down to “low” and very “low.” The evaluation is conducted qualitatively.

4. DELINEATION OF PROJECT AREA

Based on the project design, the inherent project components and the coverage of certain environmental impact factors (see Chapter Matrix of Relevance); the investigation area for the new landfill site Nubarashen is divided into two zones, as shown below.

For the impact factors related to the construction site, an inner investigation area of 250 m around the designated landfill site was considered. This distance covers the factors noise, air quality, vibrations, land consumption, soil-geology-geomorphology, cultural heritage, flora and fauna. The buffer (mirroring the main area of influence) can be limited to this area because the new landfill site is in a valley and the main impacts are focused on the direct losses of land.

Every impact factor causing potential impacts within a broader coverage (e.g., social impact, water, human health and safety) is analysed selectively in the outer investigation area due to its broader coverage. This zone is described selectively for each relevant impact factor.

The boundaries of the project area include:

- The project area for the description of environmental impact (potential direct effects);
- The project area for potential social impacts (potential indirect effects).

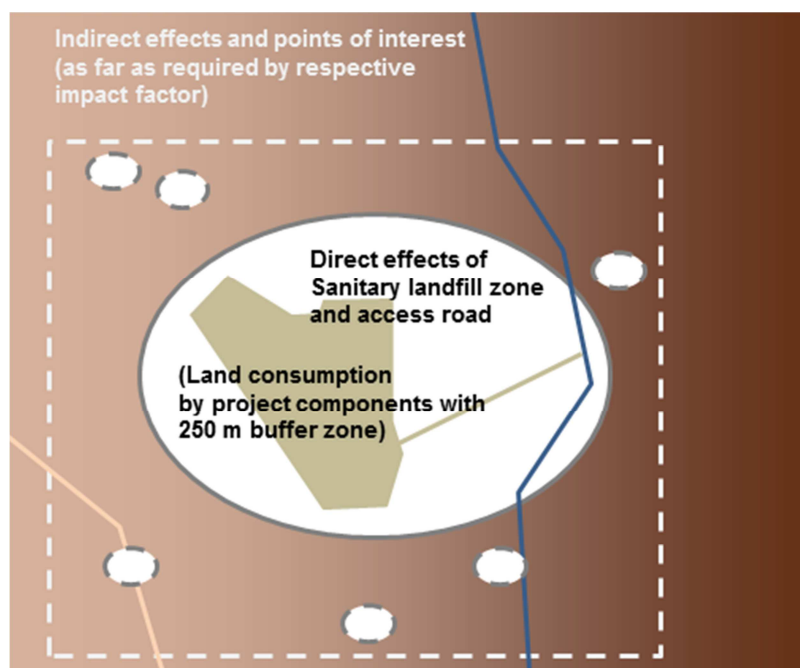


Figure 8: Outer and inner investigation area

Subject of the ESDD is the approved technical project from the feasibility study 2012 headed by Hydro Ingenieure Umwelttechnik. In the kick-off meeting in 2012 the client confirmed this presumption (see protocol annex I). Transport of waste from the City of Yerevan to Nubarashen is contracted to two other companies and is not part of this project. Hence, the potential impacts associated with the transport of waste from the City of Yerevan to Nubarashen are not included in the ESIA.

The new landfill site is situated at the same location as the existing one. Therefore the borders of the project area can be limited to the location of the landfill site and the access

road. Indirect effects mainly concern the positive effects of the new project (e.g. the attractiveness of Nubarashen as housing area will be improved, due to the likely decrease of odour and air pollutants).



Figure 9: Inner and outer project area

5. ENVIRONMENTAL BASELINE STUDY

The baseline study is divided in an environmental and a social baseline.

5.1 Health, Well-Being and Safety

The assets and indicators that are related to human health are described in the “environmental” chapter, because some emissions also concern other assets (e.g. noise and fauna).

5.1.1 Noise

5.1.1.1. Material References

- Noise measurement and assessment;
- Traffic counts;
- Site visit (September/ October 2014)

5.1.1.2. Methodology of Baseline and Assessment

Baseline data collected during the Environmental Screening phase is further analysed and supplemented by findings of the later site visits.

Noise measurement

A detailed baseline noise measurement was conducted at the Nubarashen road at the crossing with the road leading to the hotel (UTM coordinates: 4958811, 4883164).

The chosen place is situated within the outer investigation area and covers the total traffic volume of the road. The waste trucks of the current sanitary landfill are coming from and leaving towards the city of Yerevan.

The measurement was conducted as an observation of the current situation during a certain time frame. The purpose was to extrapolate the full traffic volume of the road and to estimate the noise exposure of the close-by houses. The measuring instrument was installed at the roadside, in a distance of 4 meters from the road axis (place of sound emission). The measured sound level is the record of noise at the roadside.

LOCATION	DATE	TIME	INTERVAL	PARAMETER	ENV. SETTINGS
Nubarashen Road	30.10.2014	8:45 - 9:45	30 sec	Noise level dB (A)	Absorbing

Table 4: Parameters of noise measurement event



Figure 10: Noise measurement, 4 m from the road axis



Figure 11: Noise measurement point at Nubarashen road

The evaluation of the noise follows existing guidelines (WHO guideline on noise³); Noise projection is based on approved dispersal models (Model of the Austrian Federal Ministry of Environment and Forestry and the University of Graz⁴). The measured value, respective mean value and the night values are inserted to the aforementioned dispersion models. Noise level estimations located further than 50 m from the roadside measurements values were extrapolated by using linear dispersion models based on the given model.

Traffic counts

Traffic was counted in order to forecast the value of the daily traffic of Nubarashen road. In the same manner as for noise the counting represents a snapshot. The counting was conducted on the 30.10.2014 between 10 AM and 11 AM. The passing traffic was classified in bicycle/pedestrian, motorbike/autocycle, car/minibus/light truck, truck, bus and special vehicles. Counting was projected on 24 h duration under consideration of a typical pattern of daily variations of traffic.

LOCATION	DATE	TIME	INTER VAL	PARAMETER	SETTINGS
Nubarashen Road	30.10.2014	10:00 - 12:00	1 hour	Traffic volume for vehicle category	2 lanes road

Table 5: Parameters traffic count

5.1.1.3. Description of Noise

The table below presents the minimum and maximum values measured at the location as well as the average value per day. This results in a L_{eq} of 64.0 dB(A) (calculated by the model).

³ Berglund, B. Lindvall, T. & D. H. Schwela (1995): Guidelines for Community Noise. World Health Organisation (WHO), Geneva.

⁴ Austrian Federal Ministry of Environment & University of Graz (2014): Noise estimations for roads. In: <http://www.laerminfo.at/situation/laermrechner.html>

LOCATION	L _{MAX}	L _{MIN}	L _{MEAN} (DAY)	L _{EQ}	ENV. SETTINGS
	DB(A)				
Nubarashen Road	84.4	34.8	63.3	64.0	Absorbing

Table 6: Results of Noise monitoring (decibel scale)

Noise is based on the following traffic volumes. Traffic counts from 2 h were projected on 24 h duration. The waste trucks (former Russian trucks) form the vast majority of trucks on Nubarashen road. The projected levels of waste trucks are described in the impact analysis **Fehler! Verweisquelle konnte nicht gefunden werden.** Impacts by Noise (refer to chapter 7.2.1)

CATEGORY VEHICLE	AVERAGE NUMBER / 24H
Bicycle, Pedestrian	20
Motorbike, Moped	13
Car, Car and trailer, Minibus, Light truck	5923
Trucks (waste trucks)	571
Bus, Long Buses	115
Truck trailer, special vehicles (e.g.) earthmovers	14
Total vehicles/day	6661
Percentage of heavy traffic	11,75%

Table 7: Results of traffic counting

At the measurement location, day pollution levels were found to be already at an elevated level due to trucks passing by during the day time (7h-18h). Night time noise levels are negligible in the project context, as the landfill operates only during daytime and waste is only then delivered. The project will not change night time noise levels. Day value of Nubarashen road is L_{eq} 64 dB (A).

The significant noise level (L_{max}) was observed mostly by the general vehicular movement of trucks on road. Almost every truck on Nubarashen road is a waste truck. Presently, a daily number of 571 trucks travel along Nubarashen road. The carried total waste amount during one year is approx. 200.000 tons. The average number of trucks is expected after commencing the operation of the new landfill site. (see chapter 7.1.1)

Noise thresholds

Specific environment	Critical health effect(s)	LAeq [dB]	Time base [hours]	LAmx, fast [dB]
Outdoor living area	Serious annoyance, daytime and evening Moderate annoyance, daytime and evening	55 50	16 16	- -
Dwelling, indoors	Speech intelligibility and moderate annoyance, daytime and evening	35	16	
Inside bedrooms	Sleep disturbance, night-time	30	8	45
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	8	60
School class rooms and pre-schools, indoors	Speech intelligibility, disturbance of information extraction, message communication	35	during class	-
Pre-school Bedrooms, indoors	Sleep disturbance	30	sleeping -time	45
School, playground outdoor	Annoyance (external source)	55	during play	-
Hospital, ward rooms, indoors	Sleep disturbance, night-time Sleep disturbance, daytime and evenings	30 30	8 16	40 -

Figure 12: Critical noise levels as defined by the World Health Organisation,
Source: <http://www.who.int/docstore/peh/noise/Comnoise-4.pdf>

THRESHOLDS	NOISE (L _{EQ} DAY DB (A))	HEALTH RISK
WHO guideline (outdoor living area, residential)	50 dB (A)	-
Armenian noise standard (outdoor living area, residential)	55 dB (A)	-

Table 8: Thresholds for Noise Day and Night L_{eq} dB (A). Source: Ministry of Health, Republic of Armenia, 2002, WHO, Critical noise levels.

Due to the partially poor technical standard of the equipment which will be still in use, the people who are working there are exposed to noise emission and resulting health risks caused by noise.

5.1.2 Air Pollution

5.1.2.1. Material References

Air quality assessment; secondary sources

Site visit (Site visit September/ October 2014).

5.1.2.2. Methodology of Baseline and Assessment

Baseline data were collected during the Environmental Screening phase and were further analysed and supplemented by findings of the later site visits. The situation is described qualitatively. The evaluation of the air quality follows existing guidelines (WHO guideline on

air quality). Air quality and pollution projections are based on approved dispersal models (MLuS, Guideline for Air Pollution along Roads, Germany, 2012).

5.1.2.3. Air Quality

Yerevan is surrounded by mountains on three sides which hamper the natural dispersion of pollutants in the atmosphere. This leads to high concentrations of pollutants in the “urban” air. The main source of air pollutants are emissions arising from automobiles, which is exacerbated by a congested road network. In the Yerevan Master Plan it is estimated that approximately 95% of the pollutants in the air are associated with the operation of urban transport.

Data collected at a sampling station of Erebuni Airport MNP are representative in order to determine the Yerevan region background levels. Although the Erebuni airport is 6 km distant, the sampling location serves as data source, due to the same geographical setting and closeness to neighbouring similar industrial areas (in the south-eastern part of the Yerevan basin).

The table below presents the concentrations of air pollutants (Dust PM₁₀, Sulfur dioxide, Nitrogen oxide and nitrogen dioxide) measured from 2007 to 2012 at this station.

POLLUTANT	ANNUAL AVERAGE VALUE (MG/M ³), EREBUNI AIRPORT						
	2007	2008	2009	2010	2011	2012	Total Average
Dust / PM ₁₀ (µg/m ³)	160	150	70	100	No data	400	180
Sulfur Dioxide (SO ₂) (µg/m ³)	70	50	40	40	20	No data	50
Nitrogen Dioxide NO ₂ (µg/ m ³)	85	52	61	96	53	68	70

Table 9: Sampling at Erebuni Airport

The measured PM₁₀ concentrations are far beyond the WHO Guidelines. The interim targets given for Asian cities are not reached.

The high deposition of particulate matter (PM₁₀) is attributed to pollution caused by vehicle emissions and lack of dust absorbing vegetation. The combination of transportation and deforestation combined explain the results shown in the table below. Moreover the topographical situation of Yerevan promotes heavy pollution by particulate matter.

THRESHOLDS	PM ₁₀ (ANNUAL AVERAGE)	HEALTH RISK
<u>Yerevan Erebuni Airport</u>	180 µg/m ³	+
Interim target (IT1) WHO	70 µg/m ³	+
Interim target (IT2) WHO	50 µg/m ³	+
WHO guideline	20 µg/m ³	-

Table 10: Thresholds PM_{2.5} and PM₁₀ in comparison with Erebuni samples.

The concentrations for NO₂ at the sampling location were also found to be higher than the

WHO Guidelines. An annual mean value for SO₂ can only be compared with a historical value for SO₂. The SO₂ is the only value not exceeding a given threshold. But it has to be taken into account, that a value for annual threshold is actual not published (24h-mean, 1-hour mean value). In order to be able to compare the received data, the only comparable annual threshold for SO₂ was published in the year 1996 (Historical US Standard).

THRESHOLDS	NO ₂ (ANNUAL AVERAGE)	SO ₂ (ANNUAL AVERAGE)	HEALTH RISK
Yerevan Erebuni Airport	70 µg/m³		+
Historical US Standard (1996)	-	53 µg/m ³	-
Erebuni sample	-	50 µg/m³	-
WHO guideline	40 µg/m ³	-	-

Table 11: Thresholds PM_{2.5} and PM₁₀ in comparison with Erebuni samples,
http://www.epa.gov/ttn/naaqs/standards/so2/s_so2_history.html

Due to the partially poor technical standard of the equipment currently in use, the people who are working there are exposed to dust, gas emissions, odour and other health risks caused by waste.

5.1.3 Macro-Climatic Conditions – GHG Emissions

5.1.3.1. Material References

- The waste composition as described for Yerevan city (Armenia Solid Waste Management Improvement project, Asian Development Bank, 2013).
- EBRD Greenhouse Gas (GHG) Assessment Methodology, 2010
- Shimizu Corporation: Nubarashen Landfill Gas Capture and Power Generation Project in Yerevan: Project Design Document, 2005.
- Guideline on landfill gas, Ministry for Environmental Protection, Baden-Wuerttemberg, Germany, 1992
- Guideline on landfill gas, Ministry for Environment, North-Rhine Westphalia, Germany, 2004

5.1.3.2. Methodology of Baseline and Assessment

- EBRD Greenhouse Gas Assessment Methodology 2010

5.1.3.3. Baseline of GHG Emissions

Methane generation potential

The significant global warming potential of Solid waste landfills constitutes in the direct emission of methane CH₄. CH₄ has a 21 times higher global warming potential than CO₂.

Based on the GHG guideline assessment methodology published by the EBRD released in the year 2010, the category Municipal solid waste landfill is categorized as *Medium-Low* category with an emission range of 20-100 kt CO_{2e} per year.

Methane emissions from a landfill are time-dependent over the active lifetime of the facility after closure. Emission rates are a complex function of waste characteristics, including composition, moisture, content and age, and the design of the landfill. Nevertheless, a

calculation method provided by the GHG guidelines allows an estimation of the methane yield by the landfill project. For the emission of CH₄ – as the climate relevant emission of Municipal landfills – the degradable organic fraction [hereinafter DOC], is the most relevant parameter in order to determine the methane yield.

Derived from the GHG assessment guideline of the EBRD and determination the CH₄ emission as tons/year the DOC is based on the waste composition and its organic compounds as well as on the total amount of waste per year. In addition to that, only a part of each waste share is degradable organic carbon. Moreover, it is assessed if the degradable organic fraction is ultimately degraded and released. Correction factors [DOC_f] adapt the calculated values from the waste-DOC. Data from the Armenian Solid waste management improvement from the Asian development Bank 2013 study could be acquired for Armenian cities >100.000 inhabitants as Yerevan.

The waste composition of cities >100.000 inhabitants is described in the following table:

ORGANIC WASTE	PLASTICS	PAPER/ CARDBOARD	METALS	GLASS
27 %	17 %	10 %	4 %	2%

Table 12: Waste composition regarding cities >100.000 inhabitants in Armenia. Source: (Armenia Solid Waste Management Improvement project, Asian Development Bank).

Yerevan's waste generation and the need for waste disposal during a year, summarizes at rate of 300.000 tons/year.

In case of gas capture and flaring the landfill gas, methane can be transformed into CO₂. Therefore the global warming impact of methane could be reduced.

This process is effective at a rate of 99.5% due to Shimizu Corporation Experience⁵. A installation like a gas flare is also incorporated in the calculation method as input data requirement. Other parameters like the management of the site and oxidation of methane within the landfill body or the fraction of methane in the landfill gas are incorporated in order to achieve a realistic estimation as far as possible.

The baseline of CH₄ is regarded by the methane generation potential. The sum of 300.000 tons/year would produce emissions of CH₄ if no technical measures are taken into account.

In chapter 6.1.2.3, the calculation for the project impact as well as the "Zero-option" is explained. From 300,000 tons of waste per year, an amount of approximately 9,479 tons methane per year would be emitted what corresponds to 199,052 tons of CO₂ equivalents per year.

5.1.4 Vibration

The previous impact due to vibration does not play an important role and is mainly limited to a distance of up to 10 m in the vicinity of a road.

Existing damages were not recorded during the field trip (no motorable road closer than 10

⁵ Shimizu Corporation: Nubarashen Landfill Gas Capture and Power Generation Project in Yerevan: Project Design Document, 2005.

m to vulnerable objects).

5.1.5 Odour

With reference to the chapter landscape (see chapter 5.2.1), the current situation is characterized by two main sources of odour:

- Firstly, “wild” gas emissions from uncovered waste. Uncontrolled microbiological activity in mixed wastes, including organic components, results in the development of hydrogen sulphide (H_2S) which causes additional characteristic sewer gas. Moreover hydrogen sulphide gas is extremely toxic. Lower concentrations are perceptible as odour, higher concentrations affect the nasal nerves and therefore are not perceptible any more.
- Secondly, uncontrolled burning. A trail of smoke is currently visible at the active landfill zone. The burning process is more or less continuous. This kind of burning of waste involves low temperature fires, which receive little oxygen and therefore produce a lot of smoke. Under such conditions toxic substances are readily produced and released into the atmosphere to be subsequently inhaled by people. Smoke is noticed as odour within the surrounding environment.

In Yerevan wind direction varies seasonal and there is no prevailing direction. The annual mean for wind speed is 1.13 m/s.

However, odour sources are perceptible within the outer investigation area depending on the local wind situation. Odour nuisance is reported among the residential areas of the adjacent town of Nubarashen.

5.1.6 Diseases

This indicator is described within the social environment, see section 6.3.11.

5.1.7 Accidents

Besides the issue occupational health and safety (OHS), accidents are an issue of interest concerning human health. A significant dangerous area is located south of the entrance to the landfill site up to the crossing with the MN 15. Within this area the road is inclined and winding. Traffic speed is around 70 - 80 km/h. The amount of waste trucks is approx. at 12%. In 2013, three fatal accidents with pedestrians were recorded from this section of the road (information from interview with head of district of Erebuni, October 2014).

The risk of accidents constitutes in the fact that in this section of the road people (waste pickers) walk along the roadside to enter the landfill site or to collect reusable material directly at the roadside (also from uncontrolled dumping). Another risk is the technical infirmity of many waste trucks and vehicles in poor maintenance condition. This situation leads to congestion and sudden stops along the road. Often trucks are driving without any light in the dark.

Currently this junction area is not illuminated by street light and no street boundary is marked on the asphalt. The asphalt road has a width of approx. 9m.



Figure 13: Dangerous bends south of the entrance (access road) of the landfill site. Broken down waste trucks cause dangerous situations in blind road curves

Figure 14: Waste-pickers collect recyclable materials directly at the roadside of Nubrashen road



Figure 15: Junction area at Nubarashen road. On the left side is the entrance to the extant landfill including Access road

5.2 Landscape

5.2.1 Landscape and visual resources

5.2.1.1. Material References

- Reconnaissance visit (September/ October 2014)
- Topographical maps, aerial photography

5.2.1.2. Description of Landscape

The topography of the Nubarashen area inclines gently towards the outskirts (industrial area) in the south-east of the city of Yerevan. The current landfill site and the extant landfill slopes

are situated at a higher altitude than the industrial area. Furthermore, the area is characterized by parallel valleys leading towards the city and the outskirts of Yerevan. On one hand the area is characterized by the city's outskirts and on the other hand by the influences of surrounding rural areas. For example grazing of livestock and travelling herdsmen were observed during the field visit. Distance views in direction of the city and rural surroundings are possible. The potential of the landscape has to be evaluated in the context of urban periphery.



Figure 16: Inclination of outer investigation in the direction of the city of Yerevan (background). View: Northern Direction from project site. Project location in urban periphery of Yerevan.

Uncontrolled dumping and wind-blown lightweight plastics, as recorded in many places and other previous impacts as electricity poles (Figure 17), gas pipelines, and industries of southern Yerevan (Erebuni) do already strongly limit the visual attractiveness of the area. Nevertheless, some open space and untouched areas offering visual axes are remaining in the area (Figure 16).



Figure 17: Uncontrolled dumping and electricity poles (Industrial areas of Erebuni in the background)

Distance views from elevated points in the direction of the surroundings (City of Yerevan, Nubarashen and hill chain behind Nubarashen) are possible from the Nubarashen road east of the old landfill. The Nubarashen landfill is visible from the surrounding hilltops. One hillside is occupied with informal settlements. Among the parallel valleys visibility is limited towards the city.



Figure 18: Hotel in a parallel valley north of the landfill site. Limited visibility towards neighboring valleys.



Figure 19: Limited visual axes due to valley structure. At the end of the valley the Extant landfill slope (arrow) of the old landfill. Remaining open spaces in the foreground (projected landfill area).

A crucial point concerning visibility and landscape is the trail of smoke which is present and visible for long distances. Uncontrolled burning and spontaneous combustion of waste is resulting in smoke emissions far visible.



Figure 20: Uncontrolled burning of waste generates a trail of smoke. Low temperature fires receiving little oxygen result in high smoke emissions.



Figure 21: View from above the active landfill zone. Distance views from Nubarashen road are disturbed (visual and by odour).

The trail of smoke is widely visible. The intensity of smoke changes daily but burning is observed continuously (refer to chapter 5.1.5). The Nubarashen landfill site is visible from elevated points from the city center of Yerevan.



Figure 22: Trail of smoke visible from Yerevan city center, approx. 8 km distance

The landscape is classified as being not sensitive, due to aforementioned previous impacts within the context of urban periphery. Another factor is the odour nuisance emitted from the landfill site.

5.3 Biodiversity

5.3.1 Flora

5.3.1.1. Material References

A field reconnaissance survey was undertaken during the field visit in October 2014. Features of interest were identified within the project area (inner and outer investigation area). A literature research concerning the species level and the presence of vulnerable or endangered species was conducted for this part of Armenia.

5.3.1.2. Methodology of Baseline and Assessment

The baseline survey for the asset flora was carried out in detail for the inner investigation area due to expected land consumption and, as a consequence thereof, a loss of the actual vegetation covers.

The situation is described for the inner investigation area which includes a minimum buffer zone of 350 m beyond the project boundary. Therefore broader impacts on vegetation types are also assessed.

5.3.1.3. Description of Flora

The setting is characterized by a highly continental climate with low rainfall rates and high temperature amplitudes. This physical stress has to be taken into account regarding its seasonal and daily variations. The average annual rainfall is 360 mm.

Summers tend to be very hot and dry, whereas winters are commonly cold and do not offer much more humid conditions than summers. Temperatures below the freezing point are frequently observed in the project area.

This climatic setting and the human use implies different types of steppic vegetation including xerophytic grasslands and scattered xerophytic woodlands. Woodland as a potential dense formation would not cover the area due to the aforementioned climatic restrictions, even if disturbances by man and by livestock were absent.

The habitats of the planned landfill area and its surroundings can mainly be identified as different degradation stages of steppic farming areas. Due to the specific biogeographic conditions and the long lasting cultural tradition of Armenia these areas show a high richness of species, including many characteristic and also endangered species.

The rural habitats of the surrounding include rocky pastures with sheep and cattle grazing, former fields and orchards with mulberry, apricot and almond trees. In extended parts along roads these habitats are affected by illegal waste dumping. Other parts inside and around the planned landfill have been irrigated and forestated with trees as *Ulmus minor*, *Fraxinus excelsior*, *Malus domestica* and *Acer negundo*.

In the wetlands of the lowest parts there are local populations of *Tamarix octandra* and *Arundo donax*. Similar small wetlands exist also in other neighbouring valleys.

Within the inner investigation area, steppic vegetation is predominate. However, the entire project area can be differentiated into three different vegetation types that were identified during the site visit.



Figure 23: General overview of the vegetation within the project area

Firstly, areas covered with steppic herbaceous grasslands and very dry steppic herbaceous grasslands on southerly exposed slopes. On southern exposed slopes from volcanic ashes and tuffs vegetation coverage is scattered. Moreover grazing activities (cows and sheep) interfere with the recovery of plants.



Figure 24: Steppic herbaceous grasslands on volcanic ashes and tuffs. In the foreground a seabuck thorn (*Hippophae rhamnoides*)

Figure 25: Steppic herbaceous grasslands under pastoral use

Secondly, within small valleys vegetation appears denser including a greater variety of herbs and reed zones. Within this type of vegetation soil offers more humidity.

Nevertheless, increased moisture results mostly from a leaking drinking water pipe. Therefore, the area has to be considered as non-natural wetlands, due to unintended irrigation. The water coming from the drinking water pipe is not contaminated with leachates.

However, according to the observations of the feasibility study consultants at the contour of the valleys, reed zones have managed to develop since then.



Figure 26: Spacious reed zone in a small valley.

Figure 27: Herbaceous plants (foreground), reed zones of (*Arundo donax*) (background)

Thirdly, shrubs and small trees are rare (information concerning the reforestation project, see chapter 5.3.3.3) within the inner investigation area. Areas providing more soil depth and a deeper humic layer are populated with drought-resistant shrubs like tamarisks.

Other shrubs and cultivated trees are present in abandoned fallow terraces. Cultivation ended decades ago. These areas are covered with seabuck thorns (*Hippophae rhamnoides*), mulberry trees (*Morus alba*), walnut trees (*Juglans regia*).



Figure 28: Scattered shrubs (*Tamarix octandra*) accompanied by reed zones within the small valley



Figure 29: *Tamarix octandra* shrubs, partially with drought damages



Figure 30: Abandoned gardens with seabuck thorn shrubs



Figure 31: Abandoned gardens with sawtooth thorn and mulberry (*Morus alba*)

The herbaceous grasslands of the southern Caucasian mountains tend to be rich in species.



Figure 32: Caper (*Capparis spinosa*)



Figure 33: Myrtle spurge (*Euphorbia myrsinites*)

At the landfill site and the surrounding there are no relevant populations of specific or protected flora. The project design includes rehabilitation of disturbed and polluted steppic areas.

5.3.2 Fauna

5.3.2.1. Material Reference

A field reconnaissance survey was undertaken during the field visit in October 2014. Furthermore interviews were held with fauna experts. Features of interest were identified for the vicinity of the project area (inner and outer investigation area). The investigation included resident and migratory vertebrates as well as invertebrate fauna. A literature and internet research (e.g. IUCN data base) concerning the species level and the presence of vulnerable or endangered species was also conducted for this part of Armenia.

5.3.2.2. Methodology of Baseline and Assessment

The baseline for the asset fauna is detailed for the inner investigation area due to expected land consumption and as a consequence thereof a loss of the actual animal habitats. The area was surveyed 3-times during the field visit in 10/2015.

The situation is described for the inner investigation area which includes a minimum buffer zone of 350 m beyond the project boundary. With the investigation of the buffer zone, broader impacts on habitat types were also assessed.

5.3.2.3. Description of Fauna

The animal species community is represented by species of different stages of degraded steppic farmland habitats in the area of the landfill site. The habitat patterns follow the vegetation zones with dry and normal moisture conditions.

- The dry slopes and higher areas are characterized by very sparse vegetation. These conditions are of high importance for grasshoppers, butterflies and snails. So these invertebrate species are represented in rather high diversity. Reptile and bird populations found on the fundement of this nutrient base. Endangered reptile species are *Eremias pleskei* and *Eremias strauchi*. These lizards are of high regional value for the biodiversity. This area is characterized by old gardens. This area is not situated in the project area.

Within the bird community *Anthus sp.* find suitable habitat conditions. (not sensitive to noise) To avoid negative impacts by the project, relevant amounts of open habitats should be provided by the project implementation.

Specific animals are considered on the basis of own field investigations and habitat analysis. The invertebrate fauna is represented by typical steppic species, such as *Calliptamus italicus*, *Sphingonotus caeruleans*, *Oedipoda caeruleans*, *Stenobothrus sp.* Typical snail species of these steppic grasslands are *Xerolenta obvia* and *Monacha cantiana*.

- The medium dry former farmlands with small persistent orchards are the habitat of the endangered reptiles *Zamenis hohenackeri* and *Testudo graeca*. Especially these orchards with apricot, fig and mulberry are relevant wintering habitats for these reptiles. There are also small stone walls around them as historic protection against grazing animals. These old habitat elements should be integrated to the further development of the area.

As these orchards contain the only trees remaining in this former cultural landscape, they are breeding places for passerine birds like *Miliaria calandra* and *Emberiza sp.*



Figure 34: *Oedipoda caerulans*, a characteristic species of xerotherm steppic habitats



Figure 35: typical snail species of steppic grassland: *Xerolenta obvia* (left), *Monacha cantiana* (right).



Figure 36: Characteristic grasshoppers of steppic grasslands: *Stenobothrus sp.*



Figure 37: *Sphingonotus caerulans*

The wide open habitats are hunting areas for both resident birds of prey like *Milvus migrans* and migrating and wintering species like Merlin (*Falco columbarius*). Both were recorded in the field. Several more are to be expected.

- The reeds along the valley are step habitats for migrating birds like Reed Bunting (*Emberiza schoeniclus*), *Motacilla alba*, *Hirundo rustica*.

Based on desktop review and a field survey, the animal community could potentially include endangered and protected species in the close-by area of the project. Among the endangered species there are *Testudo graeca* (IUCN Red List "vulnerable") and *Eremias pleskei* (IUCN Red List "Critically endangered") to be considered during the baseline assessment.

The animals could find suitable habitats in the former gardens, which are left fallow. These animals were not recorded during the site-visit. Therefore these old gardens have to be considered only as "potential" habitats. (see also map YSW-ESIA-A1-01). Nevertheless, the reptiles do not find suitable habitats in the footprint of the envisaged project area for the solid waste project. Therefore they are not affected. In order to avoid the loss of migrating animals mitigation measures during the construction time are foreseen (See Chapter 10 EMP).

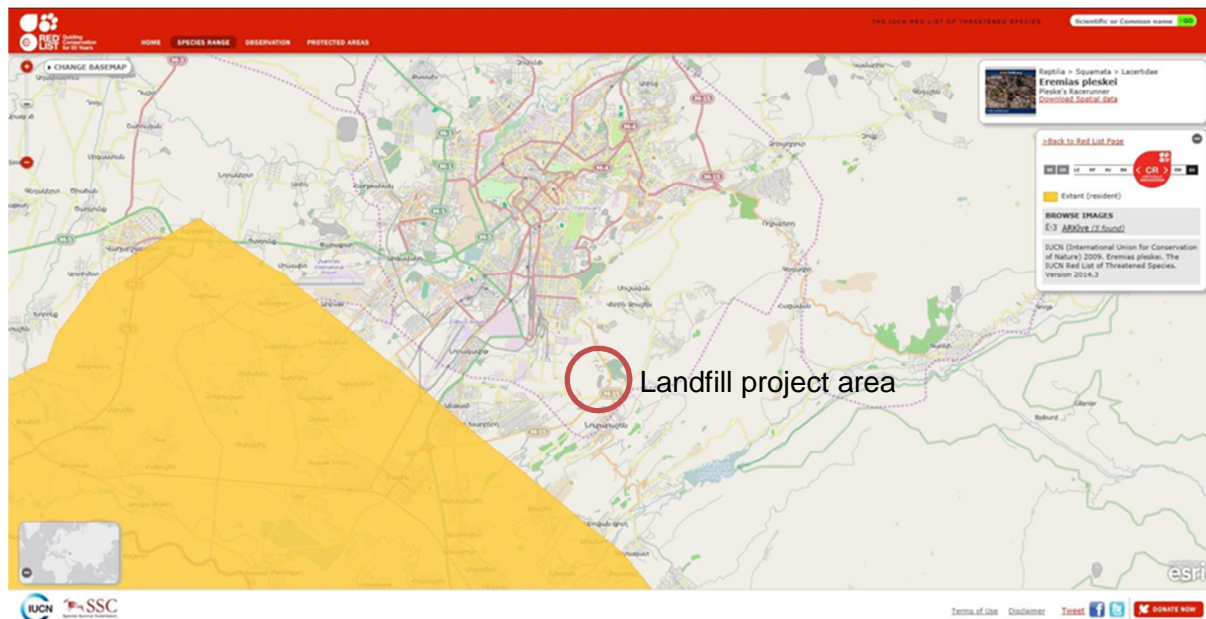


Figure 38: Habitat of *Eremias pleskei* according to IUCN red list (<http://maps.iucnredlist.org> as of March 12th, 2015)

However, the project is expected to have positive impact on these species by:

- Restoration of the new site sealing as steppic habitat
- Rehabilitation of the uncontrolled dumping area
- Reforestation with natural tree and shrub species without permanent irrigation
- Conservation of the still existing orchard and pastures as relicts of traditional farmland

5.3.3 Forest

5.3.3.1. Material References

A field survey was undertaken during the field visit. Features of interest were identified for the vicinity of the project area (inner and outer investigation area).

A Consultation of Hye Antar (Armenian Forestry Agency under the Ministry of Agriculture) including field reconnaissance visit was undertaken on 29th October 2014.

5.3.3.2. Methodology of Baseline and Assessment

The baseline for the asset forest is detailed for the inner investigation area due to project-related land consumption and as a consequence losses of land subject to Armenian forest law.

The situation is described qualitatively for the inner investigation area which includes a minimum buffer zone of 350 m beyond the project boundary. Therefore broader impacts on vegetation types are also assessed.

5.3.3.3. Description of Forest

The claimed area is currently in possession of the city of Yerevan and in possession of the state of Armenia. A part of the claimed area for the new landfill is called “state owned”: This

area is currently under the purview of the Armenian State Forestry Agency “Hye Antar” which has started a large-scaled “Green-Belt Project”.

The intention of this project is to plant forests for the city of Yerevan around the whole landfill area, also in order to avoid visual impacts. Partly the Green-belt areas are situated on land owned by the city respective the old landfill.

The Greenbelt-project was implemented with extensive irrigation system and plantations. The vast majority of the reforestation was not successful. Only up to 15 % of the area covered by reforestation activities was successful. Nevertheless, the remaining scattered few plots of forest are depending on periodically irrigation due to the chosen tree species. In total an area of 42 ha has been equipped with irrigation network and planting rows.

The irrigation system working as a “surface irrigation” and the water is pumped through pipes parallel to the plantation rows. Integrated outlets for the planting rows cause erosion of the often dry soil. Within the continental climate drying-up process promotes the salinization of the soil.



Figure 39: Failed planting rows on the area of the new landfill.



Figure 40: Up to maximal 15 % of reforestation of survived. In the foreground *Ulmus minor*.

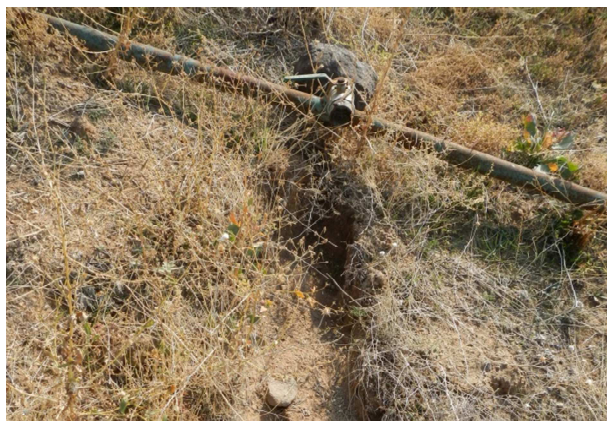


Figure 41: Irrigation system for planting rows



Figure 42: Irrigation leading to Erosion and salinisation.

5.3.4 Protected Areas

There are no nature protection areas within the project area. The protected area Erebuni

reserve is located in 5.2 km distance. Interferences can be excluded due to sufficient distances from the new landfill site.

5.4 Geology

5.4.1 Geology

5.4.2 Geology: Literature Survey

A literature survey was performed with the objective to collect available existing geological data which are relevant for the current project.

5.4.2.1. Material References

Several data, maps, reports have been obtained from the Geological Fund of the Geological Agency of Republic of Armenia (Ministry of Energy and Natural Resources) e.g.:

- Geological Map of Republic Armenia; Scale 1:500.000; (Ministry of Nature Protection of Republic Armenia); year 2005; English Version
- Hydrogeological Map of Republic of Armenia; Page K-38-XXXIII (Yerevan); Scale 1:200.000; year 1963; (unofficial English translation)
- Especially: "REPORT on engineer-geological studies in the landslide section of territory radioactive waste storage in Sovetashen region, Yerevan, Armenian SSR in 1980" (EXP. N2 / Republic registration N 3-80-19/27); Ministry of Geology of USSR - Geology Management of Armenian SSR. (unofficial English translation). This report hereinafter is called "SOVIET STUDY 1980"
- Report on Environmental Audit for the Nubarashen Landfill in the City of Yerevan, prepared by ATMS Solutions LLC, February 2010 [herein called short: "ATMS"]
- Yerevan Solid Waste Project – Technical Feasibility Study, prepared by Consortium RCE Ringhofer Consulting, Kommunalkredit Public Consulting and Hydro Ingenieure Umwelttechnik, September 2012 [hereinafter called: "Technical Feasibility Study"]

5.4.2.2. Methodology of Baseline and Assessment

Information gathered from the collected data is focused primarily on the area of (or near) the site of the new landfill of Nubarashen.

The "SOVIET STUDY 1980" includes a geological investigation of the "Sovetashen" region. The wording "Sovetashen" is the former name for Nubarashen. The territory of this investigation is located eastwards of the new landfill area and south of the current cemetery. See below Figure 43. Due to the short distance of approx. 1,5 km to the new landfill area, selected conclusions of the SOVIET STUDY 1980 can be considered for the area of the new landfill.



Figure 43: Location of the area of the performed geotechnical SOVIET STUDY 1980

5.4.2.3. Description of Geology, Hydrogeology

The “**Geological Map of Armenia** scale 1:500.000” gives a rough overview regarding the geologic situation of the project area.

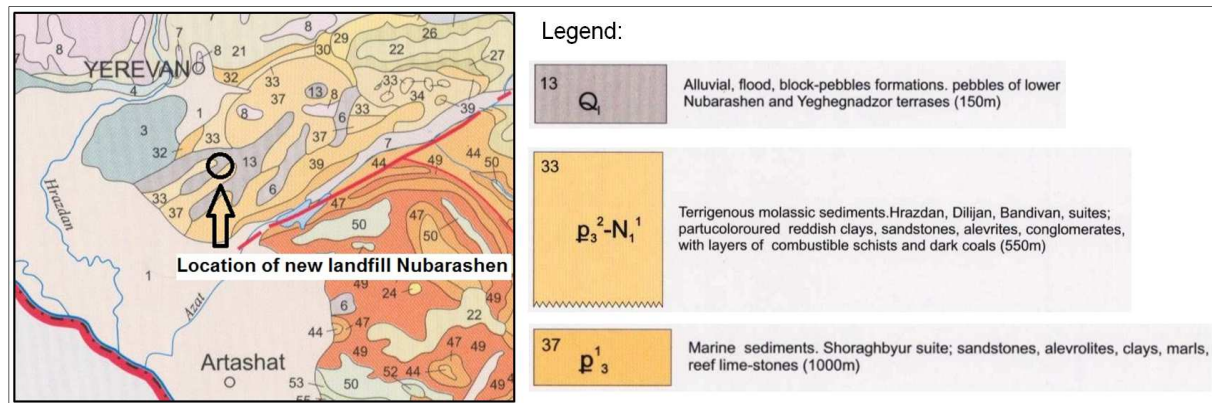


Figure 44: Excerpt of “Geological Map of Armenia scale 1:500.000; year 2005” including location of new landfill

According to the above figure following geologic layers are situated in the surrounding of the new landfill Nubarashen:

- Q_1 (No 13 acc. CN&R IV-5-82) from Quaternary era -> Eoplestocene
- $p_3^2-N_1^1$ (No 33 acc. CN&R IV-5-82) from Cenozoic era -> early Miocene and late Oligocene
- p_3^1 (No 37 acc. CN&R IV-5-82) from Cenozoic era -> late Oligocene

The “**Hydrogeological Map of Armenia**” gives a rough overview regarding the characteristic of the groundwater issue.

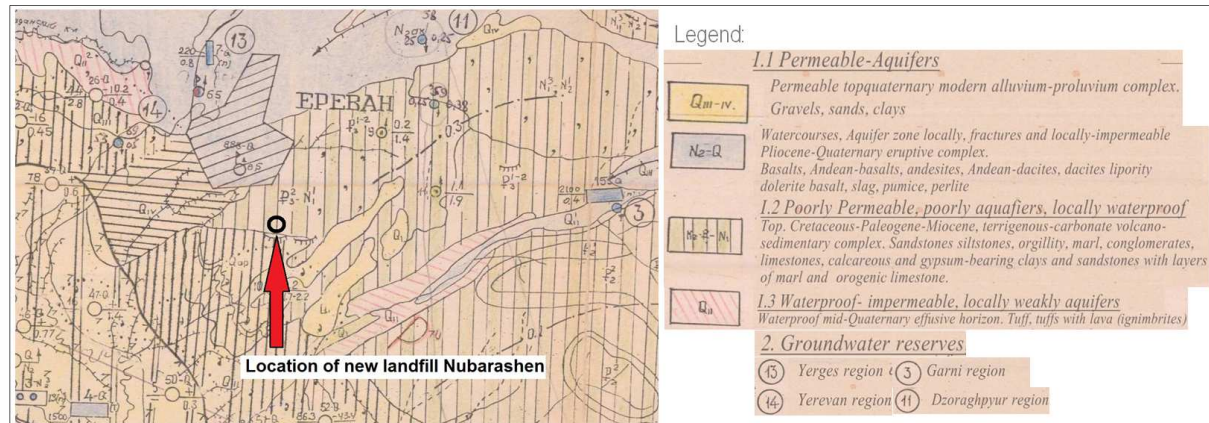


Figure 45: Excerpt of “Hydrogeological Map of Armenia scale 1:200.000; page K-38-XXXIII (Yerevan); year 1963” (unofficial English translation of the Legend) including location of new landfill

According to above figure, in the area of the new landfill Nubarashen the soil has the following general characteristic:

- **Poorly Permeable, poorly aquifers, locally waterproof:**
 Top, Cretaceous–Paleogene-Miocene, terrigenous-carbonate volcano-sedimentary complex. Sandstone siltstones, argillite, marl, conglomerates, limestone, calcareous and gypsum-bearing clay and sandstones with layers of marl and orogenic limestone

In the direct surrounding of the location of the new landfill Nubarashen there is no groundwater catchment infrastructure for potable water; the closest ones are located far away, like: “Garni”, “Yerges region”, “Yerevan region” and “Dzoraghyur” (based on above hydrogeological map).

Summary of relevant information from the SOVIET STUDY 1980:

Geotechnical investigations were performed in the year 1980. Their main objective was the investigation of the reasons of the landslides which occurred locally at the area where radioactive waste was stored in 1980. The investigated area is situated outside the project area (Figure 46). The survey was located on the opposite side of the Nubarashen road.

The very detailed geotechnical investigations comprised among others several drillings with a borehole **depth up to 100m**.

Groundwater:

Two ground water layers were detected according to SOVIET STUDY 1980:

- Upper ground water layer associated with peddle sediments of “Sovetashen” terraces in a depth of 5 to 12m
- Lower confined groundwater layer dedicated to weathered sandstone in the depth of approx. 60m (due to pressure of the water, the water level increased in the borehole up to 16m depth). This groundwater layer is situated below a solid impermeable loam layer of up to 50m thickness.

The upper groundwater layer is fed mainly from rain, snow melt and especially from infiltration of excessive irrigation performed on the upside situated hospital complex. The lower confined groundwater originates from the south western slopes of volcanic highlands

of Geghama (25km away).

Landslides:

The landslides result from water saturation in the upper soil layers (generated from infiltration of excessive irrigation). The deformation of clay soil results from the change of consistency from stiff to soft and flow-able plastic. The measure for preventing future landslides comprises, besides several complex constructive measures, the prohibition of excessive irrigation and construction of drainage ditches.

The SOVIET STUDY 1980 contains a map of engineering-geological zoning of the land-slide area where the area is classified in three different zones. Refer to below figure (Note: The old road shown on this map does not coincide with the current Nubarashen asphalt road).

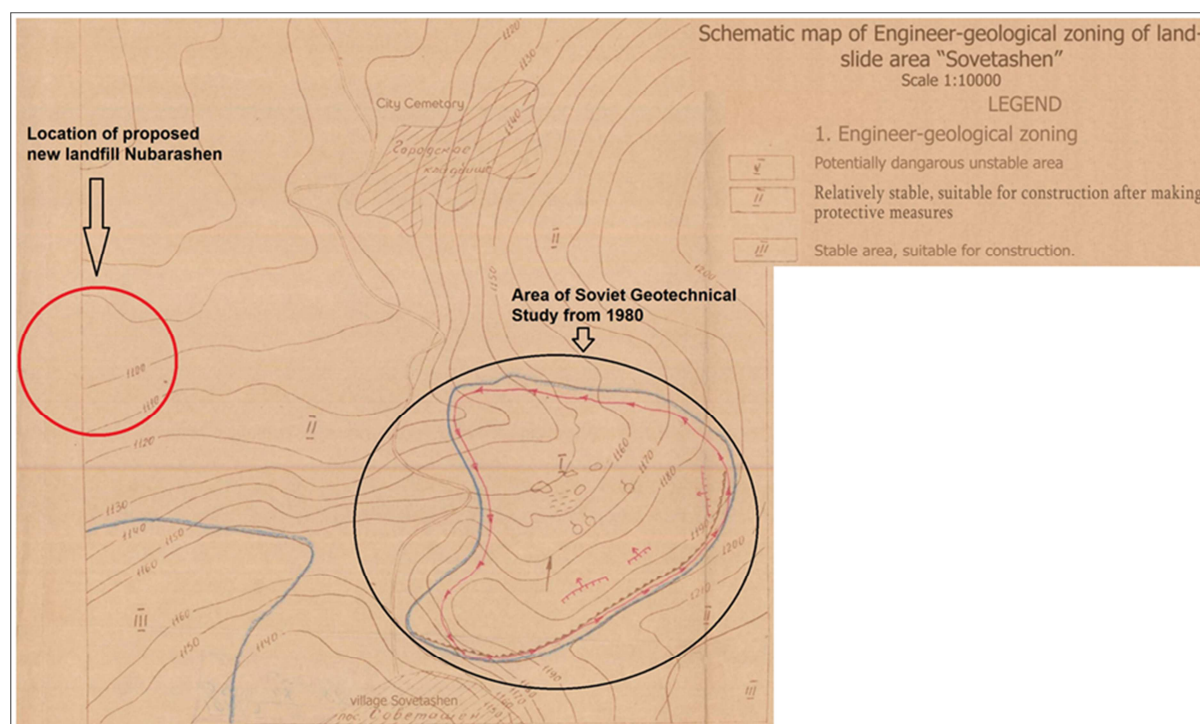


Figure 46: Excerpt of "Schematic map of Engineer-geological zoning of landslide area Sovetashen Scale 1:10.000" (unofficial English translation) of SOVIET STUDY 1980 including location of new landfill

The zone directly affected by landslides is categorised with "**zone I**", which is described as "potentially dangerous unstable area, unsuitable for constructions".

Based on this zoning map, the location of the proposed **new landfill of Nubarashen is located in "zone II"** which is described as "relatively stable, suitable for constructions after making protective measures".

Information regarding ATMS Study from 2010

The authors of the ATMS Study performed geotechnical investigations on the site of the new landfill. The Technical Feasibility Study from 2012 already mentioned some discrepancies regarding geotechnical results/descriptions and recommended to organise the detailed results of the AMTS drillings (which are not included in the ATMS Study made

available).

Since it was not possible to obtain these ATMS drilling results, the geotechnical information from the ATMS Study could not be considered, except following:

- According to the ATMS Study *“no groundwater was discovered”* in the drillings with a depth up to 11 m,
- but *“a leachate stream”* was detected in the soil layers near the leachate ponding area;
- and: *“There was no ground water detected during previous drilling programme of 7 boreholes with depth of 20 m each by Shimizu Corporation in 2006 as well.”*

5.4.3 Geotechnical Field Survey / (“Soils”)

5.4.3.1. Material References

- Geotechnical investigations performed in October and November 2014 on the proposed area of the new landfill
- Information obtained by geological literature survey (see previous chapter)

5.4.3.2. Methodology of Baseline and Assessment

During the engineering geological investigations carried out in 2014 on the new Nubarashen landfill area, the geological structure and engineer-geological properties of soils were investigated. For this purpose, surveying, drillings, excavating pits, experimental-filtration works and laboratory investigations were carried out.

For the first stage of works, a detailed layout was designed. It includes the locations of boreholes and pits in preparation for the scheduled field works. During the execution of boreholes and pits, soil samples and monoliths were taken from the bore cores and pits for laboratory physical-mechanical tests.

Field and laboratory works started in October 2014 and were finished in November 2014, performed by the company TRANSPROJECT “CJSC”. Laboratory works were performed at the Geotechnical Laboratory of Geotechnical department at the Yerevan State University.

Drillings and Pits

On the proposed new landfill area the following geotechnical investigations were carried out, in order to obtain conclusions about the existing soil:

- 9 Boreholes to a depth of 5.0 meters by rotation drillings with a diameter 150 mm
- 11 Pits to a maximum depth of 4.0 Meters by excavator

The position of boreholes and pits are shown in below figure (as well in the detailed plan in annex X, Map 4 - Location of boreholes and pits).

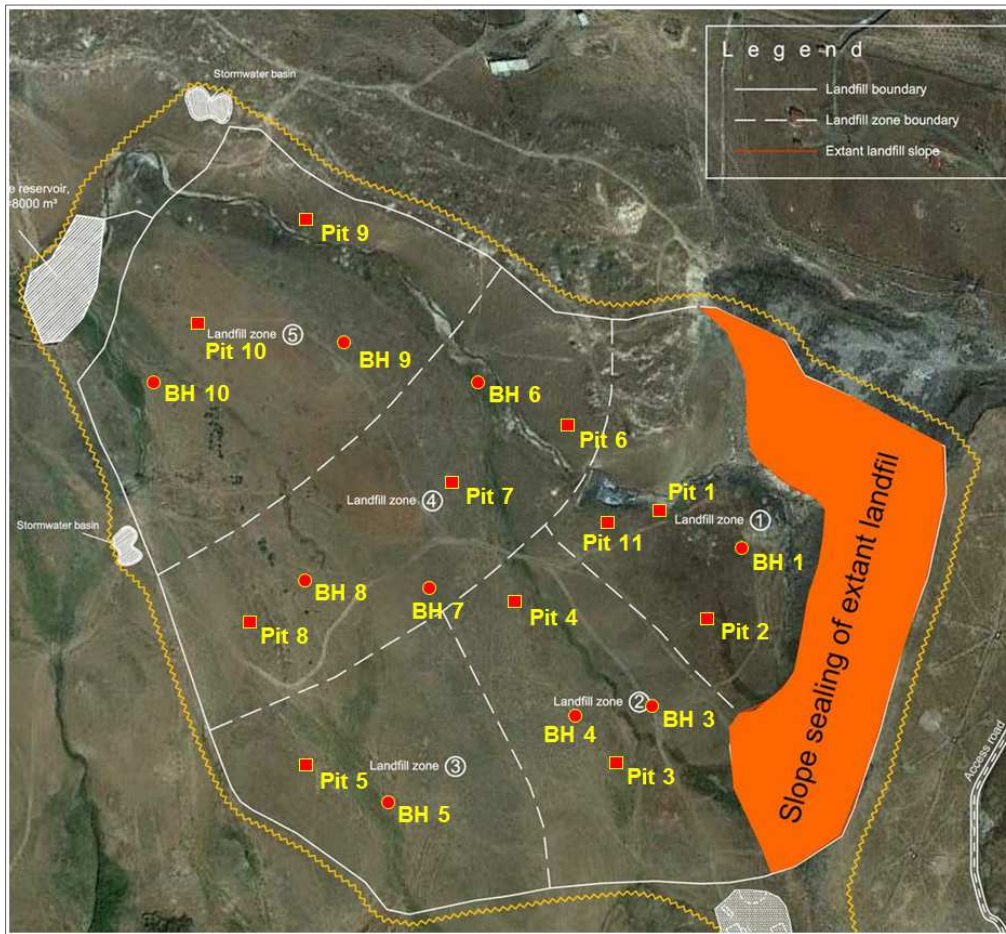


Figure 47: Overview of positions of boreholes (BH) and pits performed in Oct 2014 at the new landfill area in the course of geotechnical investigation



Figure 48: Drilling procedure of boreholes on new landfill area in Oct 2014

Geotechnical Tests

Natural subsoil was confirmed in all drillings and pits. From the cores and the pits samples which were taken from the site, the following geotechnical tests were carried out:

- Permeability coefficient in laboratory at borehole samples
- Field tests during the excavation works for identifying the permeability of soils in 0.5m and 1.0m.
- Grain size composition by sieve analyses
- Water content
- Density specification
- Plasticity: Liquid limit, liquidity index according to Atterberg limits
- Tri-axial tests
- Soil type specification according GOST25100-95

5.4.3.3. Results of Geotechnical field survey

The detailed results of the geotechnical tests are shown in Annex 2 / 2.1. Further, the sketches with the results of the boreholes and pits are attached in Annex 2 / 1.

The permeability values of the investigated soil samples⁶ generally show impermeable soil layers (coefficient of permeability of non-disturbed samples within the range from $2,2 \times 10^{-10}$ to $9,7 \times 10^{-10}$ meter/second). The low permeabilities are plausible in relation to the high content of clay and silt in the investigated soil samples.

Density and shear strength, as a result of Tri-axial test and Atterberg limit tests, are in the range of natural soils.

According to the EU Landfill Directive (1999⁷) the coefficient of permeability $K < 1,0 \times 10^{-9}$ meter/second for landfills for non-hazardous waste can be maintained. The EU directive requires a mineral layer of $> 1\text{m}$.

Geological structure of the area of the new landfill

According to the statements of the geologist, quaternary and modern sedimentary soils are participating in geological structure.

Stratigraphy sequence: Quaternary system: Quaternary formations are widespread in the area of the village Nubarashen, as well as the surrounding regions. This system consists of basaltic lavas, andesite-basalt compositions, limestone tuffs, calcareous tuffs and modern alluvial-diluvial-proluvial formations. The modern alluvial-diluvial-proluvial formations in the ratio of the occupied area have inhibited development.

Quaternary lava's composition is mainly basalts and basaltic andesites. Each of them belongs to a certain stage of effusion.

⁶ Note: The tests have been carried out at samples which were selected out of the bore core(s) with high clay content.

⁷ Official Journal of the European Communities. Council Directive 1999/31/EC of April 1999 on the landfill of waste.

However, the soil structure is inhomogeneous and shows an alternating layer structure.

Based on the data obtained from the investigation of the area by drilling boreholes, mining works (pits) and visual inspection of the natural outcrop, the following types of soils have been identified (see table below):

SOIL TYPE	DESCRIPTION
A	Vegetation-soil layer with a mixture of fragments up to 20% Group of development by CN&R IV-5-82, 9c-II, volume weight $\gamma=1.4\text{t/m}^3$
B	Loam from stiff to half dense consistency, little moist, dense, with fragments up to 10-15% Group of development by CN&R IV-5-82, 33d-III, volume weight $\gamma=1.95\text{t/m}^3$
C	Pebble-soil with sand and sandy loam filling 15-20%, dense, moist. Group of development by CN&R IV-5-82, 6d-IV, volume weight $\gamma=2.0\text{t/m}^3$
D	Siltstones pinkish-gray color, with low-strength, in some places unconsolidated Group of development by CN&R IV-5-82, 1b-V, volume weight $\gamma=2.2\text{t/m}^3$

Table 13: Identified soil types according geotechnical field investigations at the proposed new landfill area Nubarashen in Oct and Nov 2014

The soil types A, B and D appear at all boreholes and pits. Soil type B is characterized by low permeability.

The soil type C appears at Borehole 9, Pit Nr. 1, Pit Nr. 3 and Pit Nr. 7. Soil type C is characterized by good permeability.

The soil types A, C and D belongs to the Quaternary era, while soil type B is ranked in the Early Miocene and late Oligocene.

Note: Referring to the recommendations of the Technical Feasibility Study, it has to be noted that in the actual performed geological investigation the “Upper-Eocene Clay” with its undesirable characteristics was not found.

The figure below shows exemplary the profile of borehole BH9 and Pit 1. For further profiles of boreholes and pits refer to Annex 2 / 1.

The soils do not have any value for agriculture. Their potential productivity is threatened by the inefficient irrigation system in the area which promotes salinisation processes.

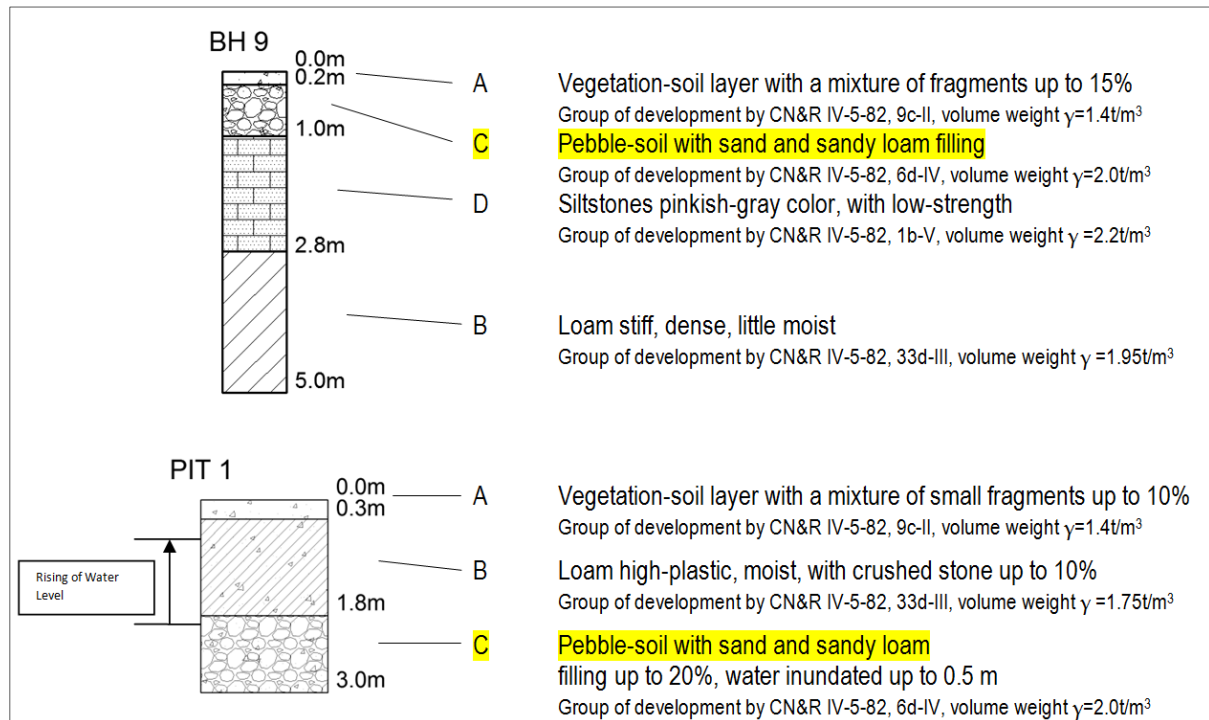


Figure 49: Profiles of borehole BH9 and Pit 1 according to geotechnical field investigations at the proposed new landfill area Nubarashen in Oct and Nov 2014

For detailed results refer to Annex 2 – Geotechnical investigations:

- 2/1 Profiles of Boreholes and Pits
- 2/2.1 Geotechnical Test Results
- 2/2.2 Compression Test Results
- 2/3 Water Analyses
- 2/4 Structure of the Base Seal
- 2/5 Photo Documentation2/
- 2/6 Map of Position of Boreholes and Pits

5.4.3.4. Conclusions of Geotechnical field survey

The Conclusions of the geotechnical field survey are incorporated in chapter 10“Tabular Environmental management plan”

5.4.4 Brownfields

5.4.4.1. Material References

- Geotechnical investigations performed in October and November 2014 on the proposed area of the new landfill
- Field investigations in October 2014
- Report on Environmental Audit for the Nubarashen Landfill in the City of Yerevan, prepared by ATMS Solutions LLC, February 2010 [hereinafter called: “ATMS”]

5.4.4.2. Methodology of Baseline and Assessment

During field trips in October 2014 the soil was investigated by drillings, pits and by visual inspections.

5.4.4.3. Description of Brownfields

Brownfields occur on the area of the new landfill at the locations where the soil is contaminated by leachate (regarding leachate refer to chapter 5.5.2.4). Due to infiltration, the soil below and within approx. 1m beside leachate streams and the leachate pond is contaminated.

Analyses of the topsoil at similar location as above mentioned showed according to the ATMS Study a high contamination.

Analyses of water samples taken in October 2014 confirmed the high contamination of the leachate with **high contents of sulphate**. Therefore the topsoil in the vicinity of leachate streams can be assumed to be contaminated as well.



Figure 50: Left side: topsoil contaminated by leachate infiltration; Right side: Contaminated soil besides leachate stream

5.4.5 Radioactivity

5.4.5.1. Material References

- “REPORT on engineer-geological studies in the landslide section of territory radioactive waste storage in Sovetashen region, Yerevan, Armenian SSR in 1980” (EXP. N2 / Republic registration N 3-80-19/27); Ministry of Geology of USSR - Geology Management of Armenian SSR. (unofficial English translation). This report hereinafter is called “SOVIET STUDY 1980”
- Report on Environmental Audit for the Nubarashen Landfill in the City of Yerevan, prepared by ATMS Solutions LLC, February 2010 [hereinafter called: “ATMS”]

5.4.5.2. Methodology of Baseline and Assessment

Background

Indications from the literature mentioned above several indications generated the

assumption that there might be radioactive waste stored at the area of the extant landfill in Nubarashen or in the surroundings. Therefore it was decided to perform a measurement for detection of possible radioactive radiation.

According to the SOVIET STUDY 1980, in the year 1980 there was an existing radioactive waste storage which is described as follows: *“The Storage of radioactive waste is a concrete bunker 4.5x12m sizes, and the depth of 3-3.2m divided into individual cells with rubble concrete walls.”* Due to geological weak situation of the area of the radioactive storage, the SOVIET STUDY 1980 recommended an urgent evacuation of the radioactive waste storage. The investigated area is situated outside the project area (Figure 46). The survey was located on the opposite side of the Nubarashen road.

Refer to chapter 5.4.2.2 regarding detailed information of SOVIET STUDY 1980.

The ATMS Study mentioned that *“Repository of radioactive wastes with office buildings is located close to the northern part of proposed extension area (Zone C)”* (Zone C is located in the northern part of the existing landfill of Nubarashen).

Target of the measurement

In the course of this ESDD it is required to know whether there are any potential health impacts on the personnel who will work during operation and during the construction phase at the area of the landfill Nubarashen. Note: The target of the measurement was not to search possible locations of radioactive waste, as the (biological) impact of radiations on humans is the priority.

Selection of device for measurement of the biological effect of radioactivity

There are four measurement units for radiation:

- “Becquerel” measures radioactivity (refers to the amount of ionizing radiation released by a material)
- “Roentgen” measures the exposure (describes the amount of radiation traveling through the air)
- “Gray” measures the absorbed dose (describes the amount of energy that radioactive sources deposit in materials through which they pass)
- “Sievert” measures the dose equivalent or effective dose (combines the amount of radiation absorbed and the medical effects of that type of radiation)

Sievert (Sv) evaluates the effects of ionizing radiation on living material. At equal doses, the effects of radioactivity on living tissue depends on the type of radiation (alpha, beta, gamma, etc.), on the organ concerned and naturally on the length of exposure.

For the above mentioned target the following Geiger-counter was used, which measures the unit “Sievert” to evaluate the biological effect: ATOMTEX dosimeter - radiometer: MKC-AT1125

Measurement Procedure

For detailed explanation of the measurement procedure refer to Annex 3.

At the following points at the area and surrounding of the new landfill radioactive measurements were performed.

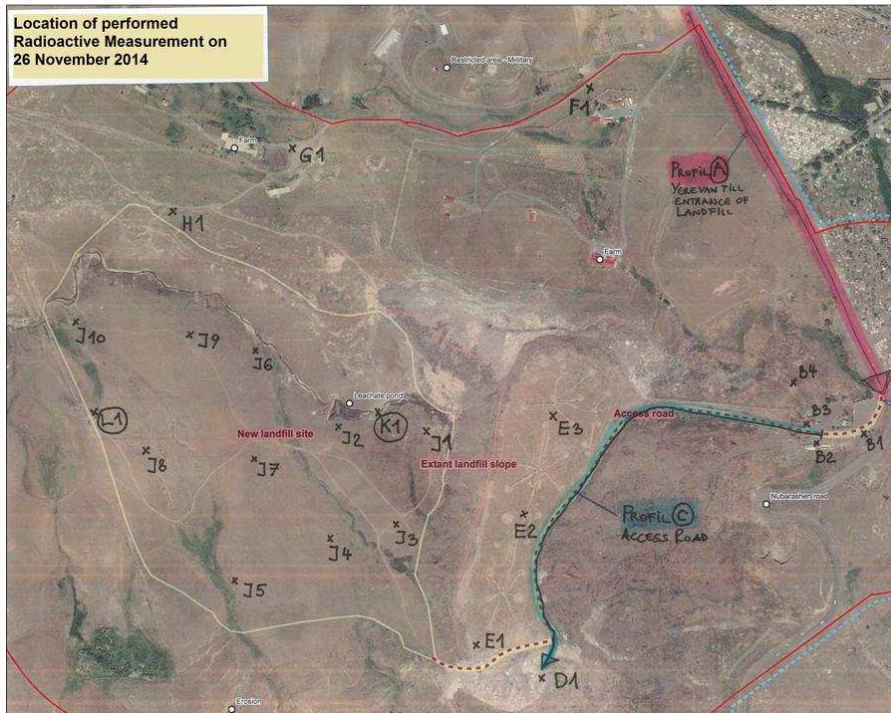


Figure 51: Points of performed radioactive measurements on 26 November 2014



Figure 52: Measurement of radioactivity at point J7 (this is the location of borehole BH 7)

5.4.5.3. Results

The values of measured radioactive radiation range between **27 and 70 nSv/h** (nano Sievert per hour). Refer to Annex for detailed results.

According to the International Atomic Energy Agency (IAEA) the dose limit for planned exposure situations for the effective dose for public is 1 mSv per year (milli Sievert per year)

TABLE 4.6 DOSE LIMITS FOR PLANNED EXPOSURE SITUATIONS (ICRP 2007)		
Type of limit	Occupational	Public
Effective dose	20 mSv per year *)	1 mSv per year **)
Annual equivalent dose		
In lens of the eye (under revision)	150 mSv	15 mSv
Skin ***)	500 mSv	50 mSv
Hands and feet	500 mSv	--
*) the 20 mSv value applies to the average value over a period of 5 years with the additional provision that in any one year the dose should not exceed 50 mSv. Moreover, once a woman has notified pregnancy to the employer, her exposure for the remainder of the pregnancy should not exceed 1 mSv since the embryo/foetus is considered the same as the public.		
**) the 1 mSv value applies to the average value over a period of 5 years.		
***) skin dose average over 1 cm ² area of skin		

Table 14: Dose limits for radioactivity (Source: IAEA)

For information: 1 mSv /year equals to 114 nSv/h

The highest measured value of 70 nSv/h is lower than the IAEA limit of 114 nSv /h.

Conclusion: The radioactive radiation measured on 26 November 2014 is below the specified dose limit of the IAEA, therefore this radiation can be considered harmless.

Note: The results of the radioactive measurement reflects the situation at the time of measurement, therefore potentially harmful radioactive radiations in the future caused by e.g corroded containers of radioactive waste cannot be excluded.

5.4.6 Mining Resources

No mining is performed at the site of the new landfill.

5.5 Water

5.5.1 Groundwater

5.5.1.1. Material References

- Geotechnical investigations performed in October and November 2014 on the proposed area of the new landfill
- Information obtained by geological literature survey (refer to chapter 5.4.2)

5.5.1.2. Methodology of Baseline and Assessment of Groundwater Field Survey

The groundwater investigation is based on one hand on the performed field work in 2014 (boreholes and pits) and on the other hand on previous hydrogeological investigations (SOVIET STUDY from 1980) in the area where drilling up to 100m depth have been performed.

5.5.1.3. Results of Groundwater Field Survey

During the geotechnical explorations in the pits Nr. 1, Nr. 4, Nr. 7 and in borehole 10, water was detected. The encountered groundwater was detected in the layer with soil type C – “pebble-soil with sand and sandy loam”, which is recorded in Borehole 9, Pit Nr. 1, Pit Nr. 3

and Pit Nr. 7.

This, probably minor, groundwater layer was detected only at 4 location out of 20 performed boreholes and pits. Mostly it appeared in the soil type C. This local groundwater originates from a permeable layer, which originates from higher-lying terrain layers from which the water seeps in. This local groundwater layer may appear temporarily either from seeping rainwater, (in winter by snow melt) and/or by irrigation and the leachate of the extant landfill.

Note: The groundwater detected in BH 10 has been infiltrated in the vegetation-soil layer from the small clear water stream which runoff on the top surface approx. 10 m beside the location of BH 10. This small clear water stream derives from the leaking water supply pipe (diameter 800 mm) which is located in a distance of approx. 130 m from BH 10.

Based on the field investigations from 2014 it can be concluded that there exists a

- **discontinuous upper local groundwater layer** locally detected at few locations in approx. **2m depth** from the top surface at the new landfill area

Referring to the available hydrogeological data from the SOVIET STUDY 1980 there exists a

- **lower confined groundwater layer** in the **depth** of approx. **60m** from the top surface, detected approx. 1,5 km close to the new landfill area (according SOVIET STUDY 1980) (below compact soil layer)

It can be assumed that the ground water from layer C is not directly connected with the significantly lower lying confined groundwater aquifer.

No drinking water ponds are in the vicinity of the project area. Flooding is irrelevant.

Therefore the sensitivity of groundwater, which can be potentially contaminated by accidents, is very low. due to the of the lack of a continuous groundwater layer in the upper geological layers. (continuous groundwater can be detected just in a depth of 60m)

5.5.1.4. Conclusions of Groundwater Field Survey

The conclusions of the groundwater field survey are incorporated in chapter 10 "Tabular Environmental management plan".

5.5.1.5. Methodology of Baseline of Chemical Water Analyses

For analysis of the groundwater quality and the surface water quality in the area of the new landfill, water samples have been taken at following locations:

- Pit 1
- Pit 4
- Leachate pond inner investigation area
- Leachate pond outer investigation area

The following parameters were analysed in above mentioned water samples:

- Water Hardness
- PH
- Nitrite NO_2
- Nitrate NO_3
- Ammonium NH_4
- Phosphate PO_4
- Alkalinity HCO_3
- Chloride Cl
- Sulphate SO_4
- Calcium Ca
- Magnesium Mg
- Sodium, Potassium Na+K

5.5.1.6. Results of Chemical Water Analyses

Detailed Results of the water analyses are shown in Annex 3.

Based on the results it is evident that all analysed water samples show **typical contaminations of leachate with high levels of sulphate**. It is noted that the water from the pits has similar quality like the sample “leachate pond inner investigation area”. It can be assumed that these contaminations have their origin in the extant landfill.

With increasing distance from the extant landfill the contamination decreases. The contamination in the “leachate pond outer investigation area” is lower due to the greater distance (approx. 1,2 km) to the extant landfill which results in dilution generated by a wider catchment area of precipitation.

Radioactive measurements at the water samples' sites regarding possible (biological) impact of radiations on humans (refer to chapter 5.4.5) were performed. The measured radiation is considered as harmless.

Note: The results of the radioactive measurement reflects the situation at the time of measurement, therefore potentially harmful radioactive radiations in the future caused by e.g. corroded containers of radioactive waste cannot be excluded.

5.5.2 Surface Water

5.5.2.1. Material References

- Water sampling in the course of geotechnical investigations performed in October and November 2014 on the proposed area of the new landfill
- Field investigations in October 2014

5.5.2.2. Methodology of Baseline and Assessment

During field trips in October 2014 the current surface water was investigated. Water samples of the surface water were taken and analysed for following locations.

- Leachate pond inner investigation area
- Leachate pond outer investigation area

The following parameters have been analysed in above mentioned water samples:

- Water Hardness
- PH
- Nitrite NO_2
- Nitrate NO_3
- Ammonium NH_4
- Phosphate PO_4
- Alkalinity HCO_3
- Chloride Cl
- Sulphate SO_4
- Calcium Ca
- Magnesium Mg
- Sodium, Potassium Na+K

5.5.2.3. Results of Chemical Surface Water Analyses

Refer to chapter 5.5.1.6 where the results of the chemical water analyses are summarized.

5.5.2.4. Description of Surface Water

During field visits from 27 October until 31 October 2014 the current visible surface water at that time have been documented. The results are shown in the figure below:

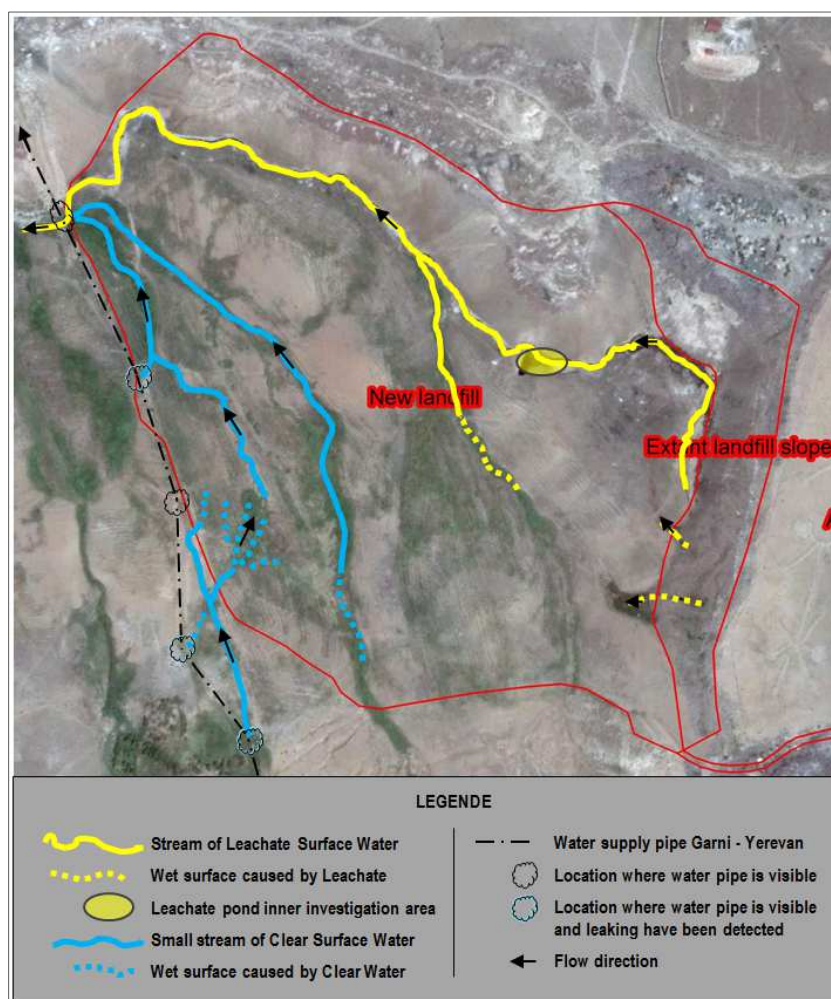


Figure 53: Map of surface water detected during field visits in October 2014 at new landfill Nubarashen

Two types of surface water were discovered at the area of the new landfill:

- **Leachate surface water**
- **Clear surface water**

The **leachate surface water** originates from the western slope foot of the extant landfill where it appears at the surface and flows as a leachate stream to the “leachate pond inner investigation area”, continuing further westwards. After approx. 1.2 km from the new landfill westwards the leachate stream reaches the “leachate pond outer investigation area”. By visual inspection it seems that this outer leachate pond has no outlet. Gas transmission pipelines are passing by directly at the west side of the outer leachate pond. At the west side of these gas pipes is a swampy area which forms a lake with reeds. It can be assumed that leachate is infiltrating through the ground into this lake, as by visual inspections the colour and smell was similar to the leachate of the “outer leachate pond”.



Figure 54: Left side: Leachate stream; right side “leachate pond inner investigation area”



Figure 55: “Leachate pond outer investigation area”

Clear surface water was detected in the western part of the new landfill area. Several leakages in a water transmission pipe could be identified as the origin of this clear surface water. This transmission water supply pipe (diameter approx. 800mm) which supplies Yerevan city from Garni, passes by the area of the new landfill at the south western part.

From these leakages the clear water runs off in small streams and partly extensively towards the area of the new landfill, where it forms two streams which are passing towards northwest, where it unites with the above mentioned stream of leachate surface water.



Figure 56: Left side: Clear surface water; right side: leaking water supply pipe



Figure 57: Leaking water supply pipe

Water supply pipe Garni - Yerevan

Parallel to the west side of the project area of the new landfill, the water supply pipe Garni – Yerevan is passing by (refer to figure map of surface water). The owner of this pipe is the company VEOLIA Djur. The Armenian construction regulation “2.04.02.84” regarding sanitary protection zone of 10 m is full-filled, except at the area of the proposed storm water basin, where the project has to be adapted in the course of the detailed design of the new landfill.

At several locations this water pipe line (approx. diameter 800mm) is excavated and visible (refer to above photo). At some of these locations water is leaking out of the water supply pipeline and runs off to the area of the new landfill.

Existing irrigation infrastructure for trees

As already mentioned in the Technical Feasibility Study, on the whole area of the new landfill an irrigation system was installed with the aim of growing trees. The irrigation system consists of welded steel pipes which are laid on the surface. At the time of field investigation in October 2014 this irrigation system was not in operation. But extensive erosion due to previous extensive irrigation was noticed in the whole area (refer to photo below):



Figure 58: Extensive erosion caused by water from irrigation pipes

In case the irrigation system were activated, the quantity of clear surface water would obviously increase.

Obviously due to the impact of the irrigation system during the last three years, the vegetation on the surface of the new landfill increased. Compare both photos below (growth of reed and grass):



Figure 59: from April 2011 sparse vegetation before irrigation system started



Figure 60: from Oct 2014 grass and reed vegetation due to irrigation system

Overall the sensitivity of the existing surface water is low due to the existing contamination. The entirety of surface water is contaminated. The origin of contamination is the old landfill.

5.5.3 Protected Water Areas

There is a water supply reservoir of the municipality Yerevan (VEOLIA Djur) located approx. 600m north of the new landfill in the outer investigation area. According to the Armenian legislation the area of the water supply reservoir is protected.

5.6 Climatic Conditions

A desk-based study and assessment was undertaken using available data from Yerevan-Erebuni metrological station, National Atlas of Armenia (2007) and “Construction climatology” HShN II-7.01-96 database. From these data it was established that the minimum temperature is -30°C and the maximum temperature 42°C . The average air temperatures for the study area are presented below in Table 15 and the relative humidity data are given in Table 16.

AVERAGE TEMPERATURE ($^{\circ}\text{C}$)												
January	February	March	April	May	June	July	August	September	October	November	December	Average yearly
-3.4	-0.9	5.3	12.4	17.4	21.6	25.5	25.2	20.5	13.5	6.5	-0.2	12

Table 15: Average air temperatures by months

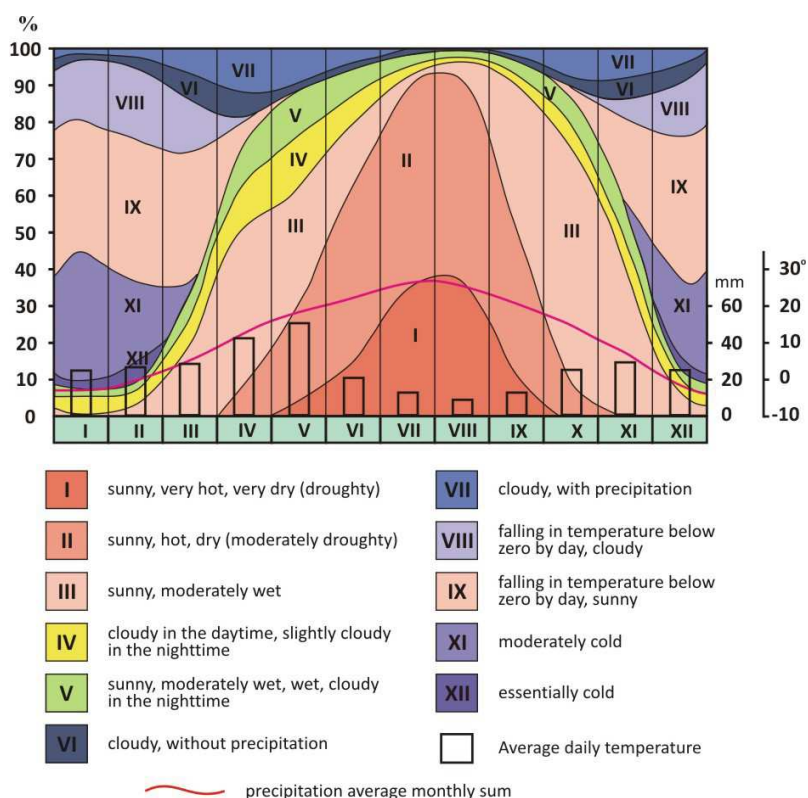
RELATIVE HUMIDITY (%)

January	February	March	April	May	June	July	August	September	October	November	December	Average yearly
78	73	63	55	55	49	45	44	49	60	72	78	60

Table 16: Relative humidity data by months

The region is characterized by low rainfall. The average annual rainfall is 360 mm.

Evaporation rate in the area is significantly exceeds that of rainfall, therefore the climate is dry continental. Description of seasonal variations for the city of Yerevan is depicted in Table 17.

**Table 17: Types of seasons in Yerevan**

The snow cover maximum height for ten-day period is 58 cm; snow pressure is 70 kg/m². The soil frost line is 60 cm. The average number of days with snow cover is 48. Permanent snow cover will not occur every year.

The wind blowing direction varies and there is no prevailing direction. North easterly and south easterly winds dominate in April, south westerly winds – in June, north easterly winds – in July and north easterly, south and south easterly winds – in October. The annual mean for wind speed is 1.13 m/s. Solar radiation balance exceeds 60 kcal/cm².

Climatic conditions have an impact on leachate generation. For the Yerevan region and its precipitation regime the rainfall-induced leachate generation is low.

5.6.1 Micro-Climatic Conditions

5.6.1.1. Material References

- Site visit (May 2014);
- Secondary sources.

5.6.1.2. Methodology of Baseline and Assessment

The situation is described qualitatively within the outer area of investigation.

5.6.1.3. Description of Micro-climatic Conditions

Referring to description of the chapter 5.2 the topography of the Nubarashen area inclines gently towards the outskirts (industrial area) in the south-east of the city of Yerevan. The current landfill site and the extant landfill slopes are situated at a higher altitude than the industrial area. Towards eastern direction rural areas form a fresh and cold air production area. With the inclined topography towards Yerevan the cool-air currents towards the city respectively the industrial area are expected.

5.7 Cultural Heritage

The cultural heritage baseline data collection comprised a literature review, consultation and interpretation of available aerial photographs, a walkover field reconnaissance survey, and monitoring during the geotechnical site investigation works. Features of interest were not identified at and in the vicinity of the site.

The following map shows the nearest cultural heritage and other protected areas. The fortress of Yerebuni (8th -3rd century B. C.) is located in 3.1 km distance. The protected area Yerebuni reserve is located in 5.2 km distance. Interferences are unlikely excluded due to sufficient distances from the new landfill site.

Even if it is very unlikely that the cultural heritage will be identified during the clearance of the new project area, any archaeological finding has to be recorded and salvaged adequately.



Figure 61: Nearest protected areas and cultural heritage to the project area

5.8 Administrative subdivisions and potentially affected communities

The current landfill site as well as the area of the projected landfill site is situated in the district of Erebuni. The border to the neighbouring district of Nubarashen is close-by. The southbound passing road MN-15 represents the border between the districts. Erebuni and Nubarashen are part of the community status of Yerevan. Nubarashen district only has a border to Ararat Marz.

The closest settlements are Nubarashen (1.3 km distance in southern direction) and the industrial area of southern Erebuni (1.5 km distance in western direction). Nubarashen as a more residential community is potentially more affected (e.g. by odour) even though the topography between the town and landfill site inhibits direct visibility.

Affected communities close-by (formal and informal waste picker settlements) are described in the social baseline (see chapter 6). Settlements with a very high sensitivity against noise (e.g. hospitals, schools) are not located in the vicinity of the project area.

6. SOCIAL BASELINE STUDY

The Nubarashen district community is located at the southeast part of Yerevan and borders on Erebuni and Shengavit administrative districts as well as to Ararat region (as an external border of the Yerevan). The Nubarashen district covers a total area of 18.11 km² and is developed based on the former rural community.

According to Armenian Statistic Agency the population of Nubarashen district community consists of around 9600 persons (2009), who live in 25 multi-storey buildings (approx. 40% of population) and 750 family households (approx. 60% of population). Most of the population is concentrated in urban areas located at the southwest of Nubarashen community. The population density in the community is 525 persons per square km. Habitants are mainly Armenian; however, there are some representatives of national minorities, such as Yazidis.

6.1 Material References

The study relies on the information obtained from:

- Statistical data on poverty, social situation of Yerevan and Armenia, and in particular Nubarashen districts obtained from the Statistical Service of Armenia and the Ministry of Labor and Social Affairs;
- Observations from the site visit and waste-pickers settlement at Nubarashen 2 – 4 streets, interviews with the families; (sample of 18 people)
- Data by the cadastral service and an interview with the Erebuni municipality deputy head;
- Survey with “formal” and “non-formal” landfill workers engaged in waste picking;
- Interviews with nurses and doctors working in affected communities – Nubarashen and Erebuni;
- Interview with the head of the landfill operator;
- Interview with the head of the Nubarashen Social Service;
- Other secondary sources.

6.2 Methodology of Baseline and Assessment

The social assessment was performed based on the identification of affected groups based on GIS maps provided by the Project team. The status of “Erebuni Maqrutyun” CJSC as a renter from the Yerevan Municipality was clarified with the deputy head of Nubarashen district and the Project GIS expert.

The methodology of the study involved analysis of the secondary official data provided by the Armenian Statistical Service, as well as the data by the Ministry of Labour and Social Affairs. The interviews with the Erebuni deputy community head, the head of the landfill operator “Erebuni Maqrutyun” CJSC, as well as a semi-open-ended survey with waste-pickers, their families and landfill staff were conducted during October 19-24, 2014 (Figure 62). In addition, expert interviews with nurses and doctors were conducted on public health status in Nubarashen and Erebuni communities, and an interview with the head of Nubarashen Service on the social allowance was conducted on October 30, 2014. Secondary sources were consulted when no official data was available.



Figure 62: Interview with a woman who collects waste from the landfill

6.3 Description of Social Situation

This chapter focuses on description of existing social and economic issues relevant for Yerevan and the proposed project's area of influence, including Erebuni and Nubarasheni administrative districts. Yerevan has twelve administrative districts, from which two - Erebuni and Nubarashen are close to the landfill area. According to the National Statistical Service of RA 2014 report "Marzes of the Republic of Armenia and Yerevan city in figures"⁸ the population number is 1.068.300 persons, which comprise 35.4% of the whole population of RA. Erebuni's population is 125.000 persons, whereas Nubarashen's is 9.700. The following sections provide a more detailed overview.

6.3.1 Demography

Yerevan being the capital of Armenia has the largest share of urban population in the country. The population of Yerevan has been increasing since 2003 – 2004, following the decline because of migration in the early years of the independence (Table 18). In 2011, the capital had 1.060.138 inhabitants⁹.

⁸ National Statistical Service of Republic of Armenia. 2014. Marzes of the Republic of Armenia and Yerevan city in figures. URL: <http://www.armstat.am/en/?nid=82&id=1607>

⁹ National Statistical Service of Republic of Armenia. 2011. Population census of Armenia.

YEAR	POPULATION
2001	1,103,488 ¹⁰
2003	1,091,235 ¹¹
2011	1,060,138

Table 18: Population growth in Yerevan

The share of the population per administrative districts is presented in Table 19. (Data of 2011 Census) ¹².

ADMINISTRATIVE DISTRICT	POPULATION NUMBER
Ajapnyak	108,006
Avan	53,507
Arabkir	118,055
Davidashen	41,879
Erebuni	122,683
Kentron	128,004
Nor Nork	120,390
Nork-Marash	12,186
Nubarashen	9,435
Shengavit	136,226
Kanaker-Zeytun	74,464
Total	1,054,698

Table 19: Number of the population per administrative district in Yerevan (present population)

Yerevan is a largely mono-ethnic city, with the majority of population being Armenians (98.9%). Among ethnic minorities are Yazidis (3,268), Russians (4,940), Assyrians (226), Greeks (300), Ukrainians (603), Georgians (264), Iranians (468).

Religious groups are Christians of Armenian Apostolic Church (94.9%), Catholic, Orthodox, as well as Protestants, Jehovah's Witnesses, Molokans. Other religious minorities are followers of Yazdanism and Paganism.

6.3.2 Socio-Economic Status of Population

The section focuses specifically on socio-economic status of population in Yerevan, and when the data is available additionally on Nubarashen and Erebuni districts.

The main share of economy in 2013, according to the Statistical Service¹³ was provision of

¹⁰ National Statistical Service of Republic of Armenia. 2001. Population census of Armenia.

¹¹ National Statistical Service of Republic of Armenia. 2003. Population census of Armenia.

¹² National Statistical Service of Republic of Armenia. 2011. Population census of Armenia.

¹³ National Statistical Service of Republic of Armenia. 2014. Marzes of the Republic of Armenia and

services (84.8%), retail trade (83.9%), construction (58.3%), and industry (40.9%), while agriculture – 0.9%.

The share of women and men in 10000 population comprises 5372 and 4628, respectively.

Main sources of livelihood in Yerevan for the whole population in every age group are care giver (45.0%), employment (25.9%), pensions (14.2%), self-employment (2.5%), social assistance from the state (1.1%), and remittances (1.1%). The rest comprise other sources of income generation (property, agriculture, financial services – 1.0%), social support from non-state and state actors (1.7%), and other livelihood income sources (6.9%)¹⁴.

The overall Gini coefficient is 0.22 in Armenia. It is much lower in urban areas (0.06) than in rural areas (0.32), indicating a more unequal distribution of wealth in the rural population than in the urban population. The lowest Gini coefficient is in Yerevan (0.02), where nearly half of the population (46%) is in the uppermost wealth quintile¹⁵.

According to the results of Demographic and Health Survey¹⁶ in Yerevan 40.5% of women decide on how their earnings are used within the family, with joint (husband and wife decision-making) – 57.2% and solely husband's – 2.3%.

Overall women receive less than husbands (68.5%). The decision on husbands' earnings are mostly managed jointly (79.9%). Around 46% of women in Yerevan do not own a house, the same data for men is lower – 33.2%.

According to the same source there has been a remarkable improvement in attitudes toward wife beating, among both women and men, between the 2005 and 2010, implying an improved understanding of domestic violence's negative aspects.

6.3.3 Poverty and the State Support

According to the latest Statistical Service's Social Snapshot and Poverty (2013) in Armenia¹⁷, upper total poverty line is equal to AMD 37,044 (71.46 Euro roughly), lower total poverty line – AMD 30,547, food or extreme poverty line is AMD 21,713 (roughly 43 Euro). This means that measures of extreme poverty is survival on 1.4 Euro per day.

In Yerevan in 2012 3.2% of the population was considered extremely poor, 14.3% - very poor, 32.5% - poor.

Unemployment rate in Yerevan is close to 10% of the total population, however the actual numbers might be higher. Per 10,000 population, around 1684 are pensioners and 167 families receive poverty social allowance. The average size of pensions is AMD 31460 in 2013, while for overall Armenia – AMD 29,122. Out of 112,796 social allowance receiving families in Armenia in 2013, 17,874 were in Yerevan¹⁸.

Yerevan city in figures. URL: <http://www.armstat.am/en/?nid=82&id=1607>

¹⁴ National Statistical Service of Republic of Armenia. 2011. Population census of Armenia.

¹⁵ National Statistical Service of Republic of Armenia, Ministry of Health, ICF International. 2012. Armenia: Demographic and Health Survey. URL: <http://dhsprogram.com/pubs/pdf/FR252/FR252.pdf>

¹⁶ National Statistical Service of Republic of Armenia, Ministry of Health, ICF International. 2012. Armenia: Demographic and Health Survey. URL: <http://dhsprogram.com/pubs/pdf/FR252/FR252.pdf>

¹⁷ National Statistical Service of Republic of Armenia. 2013. Social Snapshot and Poverty in Armenia. URL: <http://www.armstat.am/en/?nid=539&id=1503>

¹⁸ National Statistical Service of Republic of Armenia. 2014. Marzes of the Republic of Armenia and

The family allowance is provided on the calculation of different factors contributing to vulnerability, including number of family members, number of children before 18 years old, pensioners, and disabled persons. The money per family may range depending on the various factors from 23,500 AMD to 171,500 as the overview of Nubarashen's community allowances available on the Ministry of Labour and Social Affairs demonstrates.

In Nubarashen community around 17 persons receive social allowance, according to the data provided by the Ministry of Labour and Social Affairs, none was registered at Nubarashen streets 2 and 4 (data). At the same community around 200-220 families receive allowance, from which around 10 families living in the area of waste pickers. On the situation of waste-pickers refer to chapter 6.3.5.

6.3.4 Power Relationships and Governance Issues

Yerevan city's current mayor is Taron Margaryan, a representative of the ruling Republican party. The mayor's position is electable by the members of "Council of Elders" in line with the RA law on "On local self-government in the city of Yerevan". The Council of Elders is publicly elected according the RA "Election Code" in every four-year period, and comprises 65 members. The meetings of the Council are regularly held and chaired by the Mayor (when elected), the Deputy Mayor (in the situation of the Mayor's absence), or by an eldest member (during the election period). Normally the meetings of the Council are public, however in certain cases closed discussions can be held according to the Code of the Council of Elders. The minutes of the meetings are available online at the Yerevan Municipality's website (www.yerevan.am).

There are certain commitments for the improvement of transparency and diminishing corruption in Armenia. For example, Yerevan Municipality has improved transparency via updated website, and cooperation with the media. Announcements, land and property auctions, procurement bids and so on are open to public and regularly updated.

There is also a certain degree of cooperation between Yerevan Municipality and civil society organizations. Some NGOs were active in the development of Yerevan's city Strategic Environmental Assessment, cooperating closely with the Municipality.

The majority of active civil society organizations are concentrated in Yerevan. The NGOs are active on environmental and social issues. NGOs together with social movements are actively opposing ongoing construction in the city, reduction of green spaces and demolition of historical buildings. One of the recent civil society's successful struggles are the protection of Masthots garden, and the opposition campaign for the public transportation fare rise.

According to the Transparency International's recent corruption perception ranking Armenia is 94th from observed 177 countries, scoring 36 out of 100 points¹⁹. According to World Bank's Governance Indicators scores, there is a minor but steady improvement in control of corruption, rule of law, political stability and absence of violence. In comparison with the earlier indicators from 1998 – 2005, the indicators for voice and accountability were decreasing with an improvement in the period from 2011 – 2012²⁰. The media freedom in

Yerevan city in figures. URL: <http://www.armstat.am/en/?nid=82&id=1607>

¹⁹ Transparency International. 2014. Corruption by country: Corruption Perceptions Index. Armenia 2013. URL: <http://www.transparency.org/country#ARM>

²⁰ The World Bank Group. 2014. Worldwide Governance Indicators. URL: <http://info.worldbank.org/governance/wgi/index.aspx#home>

Armenia has been declined (-4) compared to 2013²¹. Currently Armenia is 78th from 180 observed countries and scores 29.07. Table 4.3 provides the comparison of governance and power indicators in the three South Caucasus countries.

INDEXES	ARMENIA	GEORGIA	AZERBAIJAN
Corruption control 2013 (World Bank Governance Indicators)	39.7 (100)	18.66 (100)	66.51 (100)
Rule of law 2013 (World Bank Governance Indicators)	45.0 (100)	53.55 (100)	30.33 (100)
Political stability and absence of violence index 2013 (World Bank Governance Indicators)	49.8 (100)	30.81 (100)	33.18 (100)
Voice and accountability 2013	29.4 (100)	54.50 (100)	10.90 (100)
Press Freedom Index 2014 (Reporters Without Borders)	29.07 (78/180)	29.78 (84/180)	52.87 (160/180)
Corruption Perception Index 2014 (Transparency International)	36 (94/177)	49 (55/177)	28 (122/177)

Table 20: Comparison of governance and power indicators across Armenia, Azerbaijan and Georgia

6.3.5 Situation of Waste-pickers

So called waste-pickers are people who collect waste from the landfill, and use it either for their own purposes, or separate and resell it to buyers.

The field survey suggests that - besides the “official” employees - there are also some “unofficial” employees at the landfill.

For those “unofficial” employees of the landfill whose salaries are relatively low the landfill provides extra income. The landfill is the main income source also for socially and economically vulnerable people who occupy the territory around the site. There are huts and shacks made from the waste remains around the area or semi-constructed stone houses, where those people, including also some employees of the landfill live. The Nubarashen streets #2 to #4 are the main areas, other houses and shacks are scattered around the landfill territory.

The number of waste pickers is estimated to be between 160-200 people. This number is derived from a reported number of 40 families having an average number of family members of 4-5, including children. The landfill is used both by some employees and residents of nearby areas as a source of economic income.

As the landfill employees were particularly reluctant to disclose information about their

²¹ Reporters Without Borders. 2014. World Press Freedom Index 2014. URL: <http://rsf.org/index2014/en-index2014.php>

income and type of the work, the exact number of their family members (who benefit economically from the employment and – for some of them – the wastepicking) could not be derived. Thus it is not possible to document the exact number of people who economically depend on the landfill company.

The Nubarashen streets # 2 – 4 have around 40 families, ranging from 1 to 7 family members. While the residents were not able to tell the exact number of people living in the area, they knew the number of families. The majority of these house dwellers have no certificates of ownership. As for many the privatization is expensive and unaffordable, not all inhabitants are registered on Nubarashen streets #2 - 4. Nevertheless the area has centralized electricity and water supply; the inhabitants of the shacks and huts who have no access are assisted by their neighbours. All interviewed attested to having some documents, like passports or birth certificates. The streets are isolated from the town and look more like a settlement or a small village. There is no means of public transportation reaching the street, so going to Yerevan or Nubarashen requires either a car or walking a considerable distance up to the main road connecting Yerevan to Nubarashen.

Normally, men either walk to the landfill or drive a shared car to transport the waste to their backyards. There are no particular waste type collection preferences, and people collect whatever they find, including bread, glass bottles, plastic, metals, and packaging materials. The waste is then separated by type of material origin and sold to buyers, who drive to the settlement to collect the recycled materials. In women-headed households the same tasks are performed by women. Women-headed households, including elderly women are more disadvantaged, since many cannot pay for the waste to be brought by a car, do not drive a car and have to carry it uphill themselves. Nevertheless, there is a sense of community and mutual support and people try to help to each other. The daily income of the families varies, based on the availability of a car and family members' ability to collect and separate waste. The daily income ranges from AMD 1,000 – 4,000 (Euro 2– 7.5), varying from 40,000 to 120,000 per month, depending on the number of family members involved and the availability of a car. The collection also depends on the weather, in summers and winters it is harder to collect the waste because of heat or frost. The community members and those employed at the landfill were wary to disclose the information regarding the income from the landfill, fearing that this can affect their livelihoods (Table 21). Based on the comparison of answers of unemployed people and people employed at the landfill engaged in waste collection, reuse and reselling, one can conclude that the absolute minimum income from the landfill per month should be at around AMD 25,000.

The consultant undertook a survey and interviewed a sample of 18 people of different ages and gender. The sample of 18 people represents about 10% of the wastepickers and was designed to allow conclusions on the entirety of the affected persons. The exact number of man and women is not possible to estimate. Moreover, the exact number is variable due to fluctuations among the waste-pickers.

OFFICIAL USE

Armenia: Yerevan Solid Waste Project ESDD
Environmental and Social Due Diligence

ESIA

GENDER, NAME INITIAL, AGE	EMPLOYMENT STATUS	FAMILY MEMBERS	WASTE- PICKING ACTIVITY	MONTHLY AVERAGE INCOME FROM THE LANDFILL (AMD)	INCOME FROM THE LANDFILL TO THE HOUSEHOLD	OTHER INCOME
Households where one or more members engaged in waste salvaging						
Male A, 75	Retired	Wife (retired)	Shoes, metal, plastic	40,000	60%	Pension of husband and wife
Female R, 30 years old	Unemployed	Husband (unemployed) + 3 children below 18	Husband collects bottles, plastic	90,000	70%	Children allowance 32,000
Female Ts, 53	Unemployed	Husband	Husband collects bread, bottles, metals, clothes	45,000	100%	No
Male K, 41	Unemployed	Wife (unemployed) + 4 children below 18	Bread, copper, aluminium	50,000	70%	Children allowance
Male A, 34	Unemployed	Wife (unemployed)	Copper, paper, bottles, iron	60,000	100%	No
Female S, 54	Unemployed	3 children (2 below 18) – women headed household	Bread, shoes, other items	60,000	100%	No
Male N, 68	Retired	Wife (unemployed) + 2 children (2 below 18)	Collects various items together with two adult sons	70,000	65%	Retirement 40,000
Female Ts, 59	Unemployed	Lives alone	Bread, shoes, bottles, other items	60,000-80,000	100%	No
Female M, 33	Unemployed	Husband + 4 children	Husband, son and herself collect metals, bread, glasses, shoes, other items	60,000	100%	No
Male A, 24	Unemployed	Mother and father	Father and son collect bottles, metals, bread	120,000	100%	No
Female A, 17	Does not attend school	Mother, grandmother + 2 siblings (below	Grandmother and mother collect	50,000	90%	Children allowance

GENDER, NAME INITIAL, AGE	EMPLOYMENT STATUS	FAMILY MEMBERS	WASTE-PICKING ACTIVITY	MONTHLY AVERAGE INCOME FROM THE LANDFILL (AMD)	INCOME FROM THE LANDFILL TO THE HOUSEHOLD	OTHER INCOME
		18), woman-headed household	bottles, bread, metals, old clothes			
Male A, 41	Unemployed	Wife (unemployed) + 2 sons	Iron, bottles, other items	100,000	95%	One son serves in the army
Female M, 26	Unemployed	Husband (unemployed + 2 children below 18)	Iron, bottles, other items	60,000	100%	Probably children allowance
Landfill employees, who also engage in waste salvaging						
Male K, 49	Employed, at the landfill	Wife (farming) + 3 children (1 below 18)	Bread, bottles, glass	25,000	25%	Salary 85,000
Male E, 58	Employed at the landfill	Wife (unemployed) + 2 children	Various items	No answer is provided		Salary 76,000
Male L, 43	Employed at the landfill	Wife + 3 children (2 below 18)	No answer is provided			Salary 59,000
Male H, 47	Employed at the landfill	Wife + 4 children (2 below 18)	No answer is provided			100,000
Female A, 68	Employed at the landfill	Grandchildren (2 below 18) + other members, women- headed household	No answer is provided			50,000

Table 21: Survey results of the landfill operators and waste-pickers

Almost all children of the families surveyed attended or were going to attend school. However, in women headed households older children often have to quit school to look after their siblings while mothers and grandmothers are busy collecting, sorting and reselling waste during the day.

Since the area is isolated from the town, the parents have to pay for a bus which collects children in the morning and then brings them back after the classes. The pay is 150 dram per child per day, which also might put some children under the risk of having to quit school because of its relatively high rates.

The only social assistance the families receive are family allowances (for children, disability, long-term unemployment and poverty), or retirement pensions. According to the data available at the website of the Ministry of Labour and Social Affairs around 10 families are beneficiaries, having additional income around 20,000-30,000 AMD depending on the circumstances. No other sources of social assistance were reported. The family members are not enthusiastic about approaching the state social support agencies, explaining that previously either they had bad experiences, or the lack of registration in their documents makes it difficult to register for any social assistance. The head of local Social Service explained that the eligibility for social assistance is based on an equation which includes

various factors, such as disability, number of children, unemployment, pensioners. According to the interview with the Social Service representative these reasons might have been behind the families' negative experiences in receiving the support. More information is in chapter 6.3.3.

All surveyed members were literate and had either incomplete or complete middle school or secondary professional education. Almost all households, with the exception of elderly ones have a cell phone, which enables communication among each other. Information in the community travels fast, since many of the community members are extended family members, people know who are extremely poor and try to help each other, there are many non-formal support mechanisms, such as sharing resources or based on trust support mechanisms.

When asked about alternative livelihood options, the majority of the waste-pickers reported the willingness to continue the job they have been doing before becoming unemployed or working in the area of their professional education (Table 22). The main reasons for turning to waste-picking was inability to find a suitable job and becoming unemployed or reaching retirement age. Persons over the retirement age reported that the waste-picking is the activity that generates income in the absence of other employment options, very low pensions, and lack of family members who are able to support them financially.

VOCATIONAL TRAINING OPTIONS (OPEN-ENDED ANSWERS)	REASONS FOR NOT NAMING VOCATIONAL TRAINING (OPEN-ENDED ANSWERS)
Driver (previous occupation)	Children to take care in the household (2)
Continue education and study law	Age, retired
Cleaner, waitress	Health issues
Working on a farm (previous job), cleaner	Difficult to answer, preference for vocational or continued education, as well as employment for children (2)
Dish – washer, nanny	Reaching retirement age, has a contract job in the landfill
Builder	
Builder	
Controller at the metro (previous job, now is employed at the landfill, retirement age)	
Driver (previous and current job at the landfill),	
Accountant (currently works at the landfill as a labourer)	
Bulldozer operator (currently works at the landfill)	
Smith, builder (till recently was working at the landfill)	

Table 22: Vocational training preferences by respondents

By summarizing, in the situation of high unemployment in Armenia the waste-pickers have a very weak resilience towards external shocks, such as the closure of the landfill. Most families have one or two breadwinners who almost entirely rely on the collection and reselling of waste. If the access of waste-pickers to the landfill stopped or hampered without provision of alternative livelihood strategies or temporary support, it would highly impact around 40 families (more than 100 adults and children). The highest impact would be on children and women. With already barely affordable transportation costs to school and back, there might be an increase in drop-out rates for children, worsening of sanitary and health conditions, especially among women and children (Figure 63).



Figure 63: Housing of a female-headed family of waste-pickers.

6.3.6 Landownership and Tenure

The proposed landfill does not affect any housing structures. The area under construction and further maintenance belongs to Yerevan Municipality. The territory is currently under permanent lease to a private company “Erebuni Maqrutyun” (Էրեբունի Մաքրություն ՍՊԸ). The director of the company was not able to clarify the specifics regarding the obligations of parties in case of contract termination, but explained that Yerevan Municipality has the power to cease the agreement and the company as a leaseholder has to comply.

A Japanese company operates gas collection facilities on the territory of the landfill. According to the director of Erebuni Maqrutyun most likely the land area of the facilities has been donated by Yerevan Municipality, but there is no definite information or documentation. Shimizu Corporation designed and constructed the flare part in 2009. The operation of the flare plant is performed by a subsidiary company of Yerevan Municipality – Nor Barekargum CJSC. The area will not be affected by the construction or further operation of the landfill.

6.3.7 Present Land Use and proposed Land use

No significant land use changes are expected at the territory of the landfill. The area has already been marked by the Yerevan Municipality for waste management purposes. The landfill established in 1960s during the Soviet times has three sectors: the first one was under the operation from the very beginning of establishment till 1985, the next site is from 1986 till present days, and the third sector has not been used yet.

The State Cadastre indicates 51 ha belonging to the State Forestry “Hye Antar”.

6.3.8 Economic Activities

Besides waste management activities performed by the landfill operator, the main economic activities in the area are waste-removal, waste-picking and reselling. Far from the area there are agricultural lands and recreational sites that will not be impacted by the landfill construction and operation.

6.3.9 Distribution of Income, Goods and Services

The Project area is designated for waste management. The income from the services is distributed between Yerevan Municipality and the landfill operator. The detailed information on other waste related income generation activities is presented in Sections 6.3.4 and 6.3.5. No information is available on non-formal buyers and users of the waste (metals, paper, plastic, and food residues). The buyers keep low profile and understandably not much has been told by waste-pickers about the nature of the businesses or their owners.

6.3.10 Education

The overwhelming majority of women and men in Armenia have gone to school. The number of years of schooling by gender is 9.9 years for women and 9.6 years for men. The level of secondary education is positively related to economic income of the families²². The landfill operator employs persons with school or secondary professional education, non-formal waste-pickers have also certain level of education and are literate (see Section 6.3.5).

6.3.11 Population Health Profile

The data on Yerevan's air pollution is presented in Section 5.1.2. PM₁₀ concentrations are relatively high.

The doctors and nurses interviewed at Nubarashen and Erebuni polyclinics reported that there is an increasing rate of allergies among children and adults. As the main reason they mentioned the worsening ecology of Yerevan. The causes were attributed to a number of factors, including Nubarashen landfill. No studies were conducted to measure the impact of the landfill impact alone. Other reasons for increasing allergy rates along with the landfill were high concentration of dust in the air, lack of green spaces in Yerevan, and weak immune systems due to poor nutrition. In contrast to allergies the staff in both polyclinics has not observed an increase in lung diseases, such as for example asthma. More information on the community health is in Section 6.3.15.

6.3.12 Male and Female Waste Picker

Waste picker community in the area of the affected territory female waste-pickers have vulnerable status: they do not drive a car to transport waste from the landfill to their dwellings for separation, have to do more physical activity and receive lower income. In extremely poor and women-headed households girl children are more likely to drop from school to help raise siblings and do the housework while caretakers and parents are away scavenging in the landfill. Despite being literate and having some sort of occupational education, wives of male waste-pickers have less options for finding a job, having the burden of housework and child care, suffering from restricted mobility by living far away from any public transportation stops (see Section 6.3.5). Women are therefore disproportionality disadvantaged, because they also have the burden to be responsible for purchasing food and other goods for their daily life, while the mobility is poor.

6.3.12.1. Landfill operators

The Erebuni-Makrutyun LTD has 6 employees for the operation of the landfill, of which are 5 men and 1 woman, which correspond to a share of 17% women.

²² National Statistical Service of Republic of Armenia, Ministry of Health, ICF International. 2012. Armenia: Demographic and Health Survey. URL: <http://dhsprogram.com/pubs/pdf/FR252/FR252.pdf>

Concerning the project operator, the municipality of Yerevan, the percentage of employed women is about 53 %.

The total number of municipal employees is 1896, of which 1003 are women and 893 are men. The number of women in the high management level is only 45 (from which 3 head of departments, the rest are head of divisions)

6.3.13 Cultural Specificities

Unlike stereotypical perception of waste-picking common in other countries, in Armenia individuals engaged have certain level of secondary education and are literate. The waste-picking is an alternative livelihood solution in a country with very high unemployment rates. Any kind of vocational training for waste-pickers should be organized with the deep evaluation and consideration of the existing demands and opportunities on the market.

6.3.14 Aspirations and attitudes to the project

Generally there is a positive attitude towards the improvement of the landfill site among the community members of Nubarashen and Erebuni communities. The issue of uncontrolled dumping, scavenging and pollution has been raised many times in the Yerevan media since the early Independence years. With the shift to heavy packaged consumer goods after collapse of the USSR, the overuse of plastic, uncontrolled burning has been numerous raised by environmental NGOs (e.g. Armenian Women for Health and Healthy Environment). The media also regularly covers regularly those issues. Generally, the issue of the waste management continues to be one of the unsolved environmental problems not only in Yerevan, but overall Armenia.

However, as it became clear from the Public Meeting on October 28, 2014 the public is concerned about the lack of waste-management system in Armenia. The construction of the landfill partially solves the problem, leaving the problems of recycling, composting and sanitary waste-removal. The representatives of the municipality confirmed their commitment to an improved waste management strategy that includes recycling and reusing options. As long as the details of the further waste management planning has not been revealed in detail, the scepticism will remain.

6.3.15 Community Health, Safety and Security

Since Nubarashen district has a high ratio of socially and economically disadvantaged people, the issues of public health were more vivid there compared to Erebuni. In Nubarashen socially disadvantaged, including those who collect and separate waste, rarely come to polyclinics for regular check-ups. The doctors and nurses of the polyclinic also confessed that there is a lot stigma associated with people living in the district close to the landfill, which is another reason for them not using the medical services. Even though the majority of services are free of charge, still even small fees and medicine costs according to the doctors are not affordable for many. This was also confirmed during the interviews with the families whose members are engaged in collecting waste from the landfill – many rarely pay a visit to doctor due to costs, even when having serious health issues. The families normally refer to doctors in hospitals of Yerevan only in the situations of emergency.

Many of the families of people engaged in collection and separation of waste from the landfill complain about health issues, but are wary to associate it with their occupation. The road to Nubarashen landfill is not very safe, since the waste transporting trucks are old and not in the best technical conditions. These trucks polluting the environment with the pieces of garbage flying away from the open trucks periodically appear in the traffic accident reports.

The Erebuni community presented a better picture: there the polyclinic serves more people,

it has better equipment and more doctors and nurses. The medical staff was also concerned about the negative carcinogenic effects of burning waste. All doctors and medical personnel agreed that the current status of the landfill as being open and exposed to winds and fires dangerous for public health, and the issue needs an immediate solution. The concerns over Nubarashen toxic waste burial site and its impact on water contamination were raised in both polyclinics by medical staff.

More information on population's health status is in the Section 6.3.11

6.3.16 Occupational Health and Safety

The landfill has no safety signs and no fences. The staffs of the landfill, as well as non-formal waste-pickers have to rely on their own judgment when walking or driving through the landfill. No personnel wearing masks or helmets were noticed during the visits to the landfill.

Also the existing road system (no lighting at the cross section Nubarashen road and access existing landfill site) is a danger for women and men.

6.4 Description of compensation standards in Armenia

Based on the survey with landfill employees and waste-pickers, as well as an interview with the landfill operator no specific compensations are envisioned in line with the Armenian legislation in the frames of the Project. According to the Armenian legislation the compensations are required for the transfer and change of the ownership status of property. The livelihood activities by non-legal owners are not included within the legislation.

The landfill employees should be notified in line with the Armenian Labour Code on the termination of the contracts, when appropriate.

Nevertheless, measures should be taken to avoid social and economic deterioration of the families involved in waste-picking as the main livelihoods income. Those are families residing in Nubarashen #2 – 4 streets and around the landfill areas in small shacks. The identification of households can be done by identifying waste separated in the backyards, additionally by contacting doctors and nurses of the Nubarashen policlinic and confirming the results with the local Social Service authority. The cell-phone numbers of the interviewed waste-pickers are available at the Grand Thornton Armenia Office.

7. ASSESSMENT OF ENVIRONMENTAL IMPACTS

7.1 Introduction to the Methodology of the Assessment of Impacts

Potential impacts identified in the following chapters have been evaluated to determine their significance. To assess the the potential impact the following characteristics have been considered:

- Likelihood
- Sensitivity of the receptor against the specific impact
- Impact level (magnitude)
- Adverse or positive impact

The assessment of impacts is conducted by two different methods.

A quantitative description is applied, where existing and applicable guidelines, decrees or laws define legal or accepted environmental standards which should not be exceeded. . The assessment evaluates whether the project activities would cause legal or accepted environmental standards to be exceeded, e.g. air, water or soil quality, noise levels, greenhouse gases, geohazards, emissions and discharges, or make a substantial contribution to the likelihood of exceedances.

Where decrees, laws or guidelines do not exist or not applicable to allow rating of significance, significance has been evaluated qualitatively by taking into account the magnitude of the impact and the quality ,importance, sensitivity or vulnerability of the affected resource or receptor, e.g., its local, regional, national or international designation, its importance to the local or wider community, its ecosystem function or its economic value.

Major impacts (very high – high) usually result in long-term or irreversible effects on highly sensitive social, manmade and/or natural environment. E.g. if the breeding area of IUCN species would be permanently affected that could endanger the whole population, the signicance of the impact would be considered as “very high.” Another example would be if the morphology (e.g. construction of landfill site) of a pristine area with a diverse landscape and a high visibility would be altered, also the impact would be considered as very high.

Minor impacts (low, very low, insignificant) usually result in short-term and reversible effects on the social, manmade and/or natural environment which do not have high value or sensitivity. As an example loss of common species in a limited area with a high potential of recovery (e.g. plant habitats in the Solid Waste project) is evaluated as a “low” impact

Following the assessment of identified impacts mitigation measures are recommended to avoid, minimise or reduce the potential significance of adverse effects of the project to an acceptable level. The residual impacts will be estimated by identifying the significance of the effects from the project that remain after the implementation of measures. Any residual impact classified as “Major” is considered to be significant and where the impact is negative, requires additional mitigation. Impacts of negligible, minor or moderate significance are considered as being mitigated as far as practicable and necessary, and therefore, do not require further mitigation.

7.2 Description of Main Impacts

The main impacts result from the technical project and its associated facilities (refer to 1.4.4). The main components of the project are:

- New landfill site (5 landfill zones)
- Access Road

In general, only the construction and the operation (up to closure) phase are relevant in the impact assessment, because a municipal landfill project is not planned for demolition. Potential conflicts in the pre-construction phase and construction phase are summarized. The construction phase does not require any temporary land takes. All impact factors are to be seen as permanent.

Positive impacts are described within the impact description also.

Most of the impacts are direct impacts, where specific assets can be affected. Only potential impacts to a local community can be considered as indirect impacts.

Cumulative effects are considered in case project elements cause stronger impacts over an extended duration. According to the information given by the heads of the districts Nubarashen and Erebuni and also the statements of the urban development plan for Yerevan, it is concluded that no other developments are envisaged in the vicinity of the proposed landfill site.

Mitigation and compensation measures are described in chapter 10.-

7.2.1 Impacts by Noise

Increased noise levels are distracting and irritating. The high noise levels could adversely affect wildlife, human activity, or are capable of damaging physical structures on a regular, repeated basis. A sound may be considered as noise pollution if it disturbs any natural process or causes humans harm, even if the sound does not occur on a regular basis.

International standards and guidelines define the level of significance to evaluate the potential impact of noise on human beings. Noise sensitive animals (e.g. certain birds) do not find suitable habitats in the project area.

The Austrian guideline for protection of workers states that an impact on health (permanent damage of hearing capacity) starts with a noise level of 85 dB(A) for a period of 8 hours. The expected noise level at the landfill can cause nuisance, but it will not affect human health.

According to the Austria guideline (ÖAL 3, Austrian Ministry for the Environment 2008), noise levels of 65 dB(A) during daytime are acceptable. In general, the construction works is limited to daytime.

The WHO defines thresholds for the beginning of nuisance with a level of 45 dB(A) at night and a threshold of 55 dB(A) during daytime.

Exceeding values above the mentioned threshold could cause – without any mitigation measures – significant impacts.

7.2.1.1. Description and Evaluation of Impacts

Construction phase

Temporary high noise levels will occur during the construction activities for the landfill site extension. However, these noise levels only occur at specific times or during various construction processes.

The transport of materials for the construction of the access roads also emits noise.

The typical noise levels associated with the various construction activities and equipment are presented in table below.

CLEARING (dB(A))		STRUCTURE CONSTRUCTION (dB(A))	
Bulldozer	80	Crane	75-77
Front end loader	72-84	Welding generator	71-82
Jack hammer	81-98	Concrete mixer	74-88
Crane with ball	75-87	Concrete pump	81-84
		Concrete vibrator	76
EXCAVATION & EARTH MOVING		Air compressor	74-87
Bulldozer	80	Pneumatic tools	81-98
Backhoe	72-93	Bulldozer	80
Front end loader	72-84	Cement and dump trucks	83-94
Dump truck	83-94	Front end loader	72-84
Jack hammer	81-98	Dump truck	83-94
Scraper	80-93	Paver	86-88
GRADING AND COMPACTING		LANDSCAPING AND CLEAN-UP	
Grader	80-93	Bulldozer	80
Roller	73-75	Backhoe	72-93
		Truck	83-94
PAVING		Front end loader	72-84
Paver	86-88	Dump truck	83-94
Truck	83-94	Paver	86-88
Tamper	74-77	Dump truck	83-94

Table 23: Typical Noise Levels of Principal Construction Equipment
Source: U.S. Environmental Protection Agency. Noise from Construction Equipment and Operations. Building Equipment and Home Appliances.

Only a few workers can be affected by noise. The noise intensive works like dumping material on trucks are limited to a few hours per day.

Operation phase

The traffic counts revealed that the total traffic of Nubarashen is estimated at a daily rate of 6661 vehicles/day. The percentage of heavy traffic is estimated at a ratio approx. 12% indicating that presently 571 trucks per day transport the total waste amount of 200,000 tons/year.

The total amount of waste is expected to increase by one third due from a current disposal volume of 200,000 tons/year to a disposal volume of 300,000 tons/year.

As a result more waste trucks heading to the landfill site is coherently increased by around 30 %. The amount of heavy traffic is therefore raised to 16 % with a total traffic volume of 7000 vehicles on Nubarashen road. It is expected that around 1,000 trucks/day will travel to the landfill site in order to carry a disposal volume of 300,000 tons/year.

Sensitive points as the hotel, a farm and waste-picker settlements are not directly situated at the road side. The closest sensitive object is the waste-picker settlement, which is located 95 m distant from the road. The hotel is 270 m and the farm is 140 m distant from the road.

The building at the entrance of the landfill site including the gas flare as well as the entrance buildings of the Nubarashen cemetery are not regarded as sensitive to noise emissions as they serve no residential purpose.

As only heavy traffic which passes to the Nubarashen landfill site during daytime will increase, night time values do not need to be assessed.

The access road is situated on municipal land and no housing areas are located in the potential area of influence. Waste trucks will pass over the access road in order to reach the new landfill.

Noise generation will be lower than the measured values on Nubarashen road due to absence of private car and bus traffic. The speed on this road will be limited.

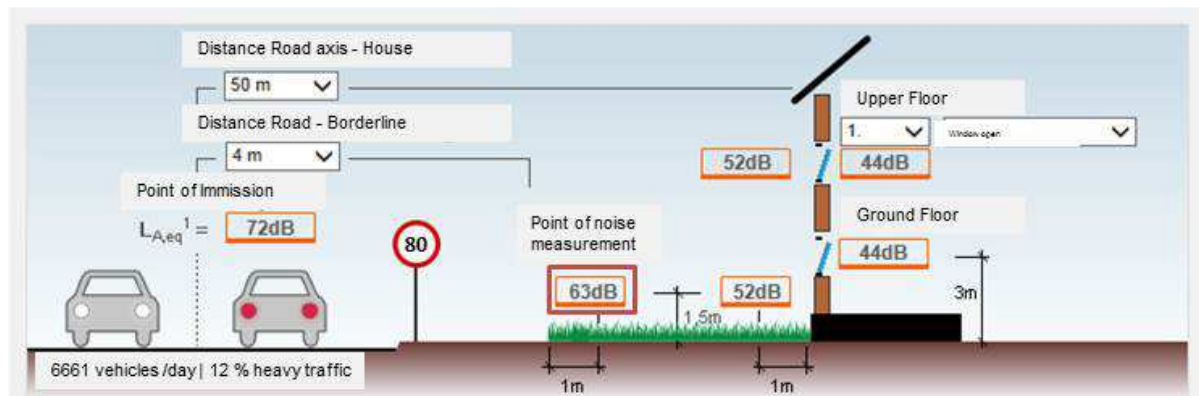


Figure 64: Noise estimation for Nubarashen road (referring to the L day mean of 63 d(A) measured at the roadside at a traffic volume of 6661 vehicles per day at ratio of 12 % heavy traffic (“zero-option”).

Noise predictions taking into account an increased ratio of heavy traffic of 16 % as a projected scenario and a total traffic amount of approx. 7,000 vehicles/day results in a noise value of 58 dB(A) in 50 m distance.

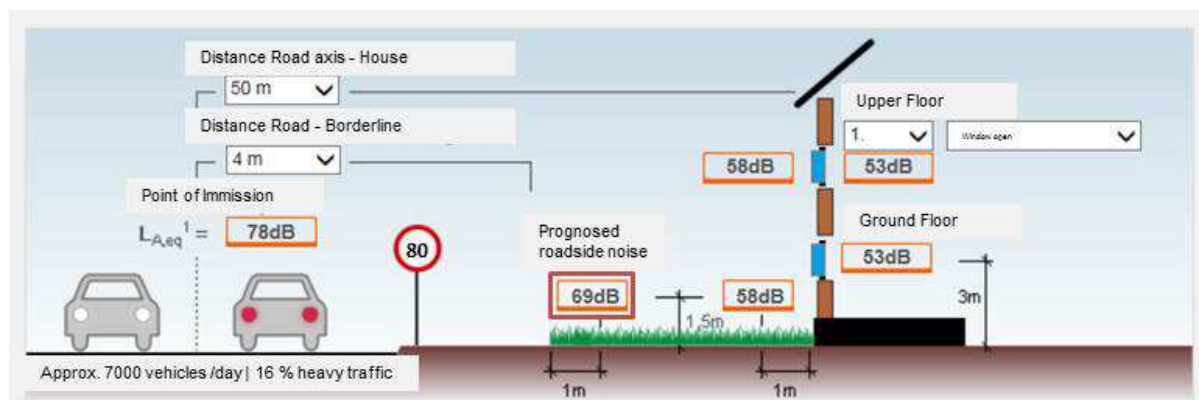


Figure 65: Noise estimation for Nubarashen road (referring to the L day mean of 69 d(A) measured at the roadside at a traffic volume of 7000 vehicles per day at ratio of 16 % heavy traffic.

Due to the distance of sensitive points to the point of emission with more than 50 meters, than noise levels were extrapolated.

The following two tables compare the preload situation (zero-option) with the projected traffic values resulting from the project.

"ZERO-OPTION" NUBARASHEN ROAD				
NOISE SENSITIVE LOCATION	DISTANCE TO ROAD AXIS	WHO DAY (>55)	RARMENIA DAY (>55)	REQUIRED MEASURES
Hotel	270m	L_{day} mean 24,6 dB (A)	L_{day} mean 24,6 dB (A)	Not required
Farm	140m	L_{day} mean 35,4 dB (A)	L_{day} mean 35,4 dB (A)	Not required
Waste-picker settlements	95 m	L_{day} mean 43,5 dB (A)	L_{day} mean 43,5 dB (A)	Not required
Legend		Compliance with WHO standards / Armenian standards		
		Non - compliance with WHO standards / Armenian standards		

Table 24: Noise estimation at sensitive location for "zero-option"

"PROJECTED TRAFFIC VALUES" NUBARASHEN ROAD				
NOISE SENSITIVE LOCATION	DISTANCE TO ROAD AXIS	WHO DAY (>55)	RARMENIA DAY (>55)	REQUIRED MEASURES
Hotel I	270m	L _{day} mean 30,6 dB (A)	L _{day} mean 30,6 dB (A)	Not required
Farm	140m	L _{day} mean 41,4dB (A)	L _{day} mean 41,4dB (A)	Not required
Waste-picker settlements	95 m	L _{day} mean 49,5 dB (A)	L _{day} mean 49,5 dB (A)	Not required
Legend		Compliance with WHO standards / Armenian standards		
		Non - compliance with WHO standards / Armenian standards		

Table 25: Noise estimation at sensitive location for "planned project"

The projected noise levels do not exceed the given thresholds neither from the WHO neither from the Armenian Standards for daytime.

Machine equipment mentioned in the FS is planned to be on duty. The expected noise level of the operation of the equipment is approx. 80 dB(A) and can reach peaks of up 90 dB(A). The staff of the landfill site is exposed to this noise, even though noise peaks are expected to be temporary. Only a few workers can be periodically affected. Usually noise intensive compaction works are limited to a few hours. Therefore the impact is "low".

Due to the distance of the noise origin it is impossible to cause nuisance to surrounding area. (Informal waste picker settlements are 320 m south-east of the new landfill). Therefore the impact is "very low."

The existing gas collection does not emit any significant noise. Therefore cumulative impacts do not play a role for noise. Therefore the impact is "very low."

7.2.2 Impacts by Air Pollution

7.2.2.1. Description and evaluation of impacts on Nubarashen road

Construction phase

The earthmoving and compaction activities are likely to generate dust. The emission of dust is only relevant close to residential or sensitive areas. Also the transport of gravels could generate dust.

The construction phase is just temporary and does not emit any hazardous substances. The emissions are limited to dust. To avoid any nuisance, mitigation measures are described in the EMP (chapter 10). Due to the limited range of air pollutants and the magnitude is limited to the threshold of nuisance²³ and only few workers being affected the impact is considered to be "low.",

²³ The Austrian guidelines (RVS 04.02.12 air pollutants on roads, 1.Juli 2013)

Operation phase

Ambient levels of pollution concerning PM₁₀ already exceed the given thresholds.

The measured preload values for SO₂ and NO₂ comply with the model values for polluted Asian cities with high preloads. SO₂ is figured out with a preload value 50 µg/m³ and 70 µg/m³ for NO₂.

The nearest settlements close to the Nubarashen road are the settlements of the waste-pickers. Other places of interest are a fenced farm building and a marriage hotel.

Considering a projected traffic volume of 7,000 vehicles and a percentage of heavy traffic of 16% in the year after the opening of the landfill site, the predicted values for air pollutants at the respective sites are as follows:

NUBARASHEN ROAD	PM ₁₀ (ANN. MEAN)	SO ₂ (ANN. MEAN)	NO ₂ (ANN. MEAN)
Preload	180.00 µg/m ³	50.00 µg/m ³	70.00 µg/m ³
Additional load Nubarashen road (5m)	1.04 µg/m ³ (181.04 µg/m ³)	0.00 µg/m ³ (50.00 µg/m ³)	1.03 µg/m ³ (71.03 µg/m ³)
Total load			
Additional load Nubarashen road (95m)	0.36 µg/m ³ (180.36 µg/m ³)	0.00 µg/m ³ (50.00 µg/m ³)	1.18 µg/m ³ (71.18 µg/m ³)
Total load			
Additional load Nubarashen road (140m)	0.26 µg/m ³ (180.26 µg/m ³)	0.00 µg/m ³ (50.00 µg/m ³)	0.87 µg/m ³ (70.87 µg/m ³)
Total load			
Additional load Nubarashen road (>200 m)	0.17 µg/m ³ (180.17 µg/m ³)	0.00 µg/m ³ (50.00 µg/m ³)	0.58 µg/m ³ (70.58 µg/m ³)
Total load			
Standards (WHO guideline US standard 1996 WHO guideline)	70 µg/m ³	53 µg/m ³	40 µg/m ³
Legend	Compliance with WHO standards		
	Non-Compliance		

Table 26: Projected additional air pollution loads on Nubarashen road for PM₁₀, SO₂ and NO₂

For PM₁₀, and NO₂ the projected additional loads are exceeding the thresholds given by the WHO. Nevertheless, the increase of air pollution is marginal compared to the preload.

All additional loads of air pollutants stay below 3% compared with the preload. Additional loads over 3% are commonly regarded as relevant. Below this value traffic increases are categorized as acceptable²⁴. The waste insertion process is foreseen to be covered as soon as possible. The gas capture system is installed from the beginning of waste insertion.

²⁴ RVS 04.02.12 (2013): Environmental Protection: Air pollution. Dispersion of airborne pollutants from transport and routes and tunnel portals. Austrian Research Association for Roads, Railroads and Transport.

As the additional load is below the level of significance, this impact is considered to be “very low.”

Description and evaluation of impacts by landfill gas migration risk

The gas pipe system generates for a vacuum in the landfill body which largely prevents landfill gas from escaping the landfill. The gas pipeline system is connected to the gas flare. The landfill liner would prevent any landfill gas to migrate through the soil. In the unlikely case of gas migration through soil, there are no nearby communities which might be affected.

Landfill gas emissions are possible at temporary open insertion areas depending on external conditions and availability of humidity. Nevertheless this is shortest possible time frame, because the waste is covered as soon as possible.

In addition to the main components of landfill gas methane, CO₂, oxygen and nitrogen, landfill gas may bear toxic, resp. carcinogenic substances.

- These parts are commonly trace substances at a ratio of Vol. %. 0.1-0.5. the trace substances can originate from: Chemical industry products in residual waste (Benzol-Toluol-Xylol (BTX), aromatic hydrocarbons, halogenated hydrocarbons, Vinylchloride.
- Intermediate products of biodegradation are likely to emit H₂S (produced by sulphate-reducing bacteria) which is the most serious landfill gas component. Problems may occur if residual waste is dumped together with construction waste (including Gypsum).
- Reactivity concerning water and wastes from Aluminium-processing. Reactions are likely to produce hydrogen sulphide, ammoniac, methane, hydrogen phosphide.

It is projected to use new landfill operation equipment. In case the old landfill operator is also in charge of the new landfill, it cannot be excluded that old machinery is still in use. Due to the introduction of a new technology with irrigation and a small open tipping area, high level emissions of the above mentioned pollutants is very unlikely. Still monitoring measures are proposed to prevent any impacts on workers (see chapter10).

7.2.2.2. Description and Evaluation of impacts by Greenhouse Gas Emissions

Calculation Method

In order to determine the Greenhouse gas emission (impact), the emissions are calculated by the following method (refer to EBRD Greenhouse Assessment Methodology, 2010):

$$CH_4 \text{ (t/y)} = [MSW_T \times L_0 - R] \times [1 - O_x]$$

$$L_0 = MCF \times DOC \times DOC_F \times F \times (16/12)$$

The input data requirements are:

MSW_T = Annualised mass of MSW to be deposited (total waste amount per year)

L_0 = Methane generation potential in t CH₄ / t MSW_T.

MCF= Methane Correction Factor

DOC=Degradable organic carbon

DOC_F=Fraction of degradable organic carbon dissimilated

F= Fraction by volume of CH₄ in the landfill gas

R=Mass of CH₄ recovered per year for energy use or flaring

OX= Fraction of CH₄ released

Calculation of Degradable Organic Carbon (DOC) and Assumptions on Waste Composition

CITY	ORGANIC WASTE	PLASTICS	PAPER / CARD-BOARD	METALS	GLASS	OTHERS (UN-DEFINED)
Cities > 100.000 pop	27%	17%	10%	4%	2%	40%
Cities < 100.000 pop	34%	16%	9%	9%	10%	22%
Rural	26%	12%	7%	3%	7%	45%

Table 27: Waste composition (Armenian solid waste management project, ADB, 2013)

The mentioned waste composition and its waste type in the baseline adapted from the Armenian Solid waste management project (chapter 5.1.3) are not directly congruent with the waste categories required by the calculation method of GHG assessment guidelines. Moreover, a share of 40 % of waste remains undefined.

The following tables refer to the data adapted from the Armenian solid waste management project to the required category of the EBRD guidelines. As there are no congruent categories, the percentages have been estimated based on the values from the Armenian solid waste management. In addition to that, a share of organic compounds from the share of yet undefined waste was assumed additionally, in order to consider this share of waste also. These additional shares of waste were estimated at low percentages because of the vast majority of degradable organic carbon (DOC) is expected to be included in the categories Organic Waste and Paper/Cardboard).

CATEGORY	TYPE	SHARE OF TOTAL WASTE
A	paper and textile	10%
B	garden waste	7%
C	food waste	12%
D	wood or straw	9%

Table 28: Estimation of waste containing DOC (Calculation)

CATEGORY	TYPE	PRIMARY SOURCE OF WASTE	SHARE OF WASTE COMPOSITION	SECONDARY SOURCE OF WASTE COMPOSITION	SHARE OF WASTE COMPOSITION
A	paper and textile	paper/cardboard	90%	Others	3%
B	garden waste	organic waste	20%	Others	3%
C	food waste	organic waste	40%	Others	3%
D	wood or straw	organic waste	30%	Others	3%

Table 29: Types of waste (according to EBRD Greenhouse Gas Assessment Methodology - GhGAM)

CATEGORY	TYPE	SHARE OF DOC
A	paper and textile	40%
B	garden waste	17%
C	food waste	15%
D	wood or straw	30%

Table 30: Share of DOC per type of waste (GHG AM p.19 (iii b))

The value of degradable organic carbon DOC for Yerevan Solid Waste Project was calculated with 9,79 %.

Calculation of CH₄

For the calculation of the emission of methane the following parameters L₀ and R are calculated.

FACTOR	DESCRIPTION	VALUE	SOURCE
L ₀	Fraction of CH ₄ from waste	0,0316	GhGAM p.18
MCF	Methane correction factor	0,8	GhGAM p.18 (ii): cat. unmanaged deep
DOC	Degradable organic carbon in waste	9,79%	Calculation DOC
DOCf	Fraction of DOC dissimilated	0,55	GhGAM p.19 (iv): median default limit
F	Fraction of CH ₄ in landfill gas	55%	NEDO Overseas Report 811, Note 2

Table 31: Calculation L₀ [MCF x DOC x DOCf x F x (16/12)]

The calculation of R was enhanced by input data gathered from the project design report of Shimizu Corp. 2005 running the gas flare of the old landfill. The expected efficiency of the gas flare is 99.5% in regard of destruction of methane based on the hereinafter mentioned parameters FTf, Fwf and FE.

FACTOR	DESCRIPTION	VALUE	SOURCE
R	Mass of CH ₄ recovered for flaring	9.431 t/a	Calculation
FTf	Flare operating rate	100,0%	Shimizu project report p.65
Fwf	CH ₄ destruction efficiency	99,5%	Shimizu project report p.65
FE	Flare efficiency	99,5%	Calculation [FTf x Fwf]

FS	Flaring strategy	0 or 1	0 (zero option) / 1 (planning option)
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Table 32: Calculation R [CH₄of x FE x FS]

The calculation of the methane emission is conducted for the “zero-option” without an implementation of a gas flare in comparison with “planned option” including a gas capture and flaring at the site.

FACTOR	DESCRIPTION	VALUE	SOURCE
CH ₄ dest	Methane flared	0 t/a	Calculation
CH ₄ em	Methane emitted	9.479 t/a	Calculation
CH ₄ of	Methane landfill outflow	9.479 t/a	Calculation
MSW _t	Annual mass of waste	300.000 t/a	ASWMP appendix 5
L ₀	Fraction of CH ₄ from waste	0,0316	Calculation L ₀
R	Mass of CH ₄ recovered for flaring	0 t/a	Calculation R
OX	Fraction of subsurface CH ₄ oxidation	0	GhGAM p.19 (vii): not well managed

Table 33: Calculation CH₄ [MSW_t x L₀ - R] x [1 - OX] (“zero-option”)

FACTOR	DESCRIPTION	VALUE	SOURCE
CH ₄ dest	Methane flared	9.431 t/a	Calculation
CH ₄ em	Methane emitted	47 t/a	Calculation
CH ₄ of	Methane landfill outflow	9.479 t/a	Calculation
MSW _T	Annual mass of waste	300.000 t/a	ASWMP appendix 5
L ₀	Fraction of CH ₄ from waste	0,0316	Calculation L ₀
R	Mass of CH ₄ recovered for flaring	9.431 t/a	Calculation R
OX	Fraction of subsurface CH ₄ oxidation	0	GhGAM p.19 (vii): not well managed

Table 34: Calculation CH₄ [MSW_t x L₀ - R] x [1 - OX] (“planned option”)

Calculation of CO₂ Equivalents

CH₄ has a 21 times higher than CO₂ driving force concerning its global warming potential. Comparing the “zero-option” without flaring with the “envisaged option” including flaring there will be 172,121 tons/year reduction in GHG emissions (CO₂ equivalents) considering the differences in molar mass of these components.

Without flaring the landfill gas 9,479 tons methane per year would be emitted what corresponds to 199,052 tons of CO₂ equivalents per year.

Due to the expected effectiveness of gas flare of 99.5% a rest quantum of 47 tons per year is expected to be emitted which corresponds to 995 tons of CO₂ equivalents per year.

COMPONENT	MOLAR MASS	ZERO OPTION	PLANNED OPTION
CO ₂ (flaring CH ₄)	44 g/mol	0 t/a	25,936 t/a
CH ₄ (emitting CH ₄)	16 g/mol	9.479 t/a	47 t/a

Table 35: Emissions per component

COMPONENT	MOLAR MASS	ZERO OPTION	PLANNED OPTION
CO ₂ (flaring CH ₄)	1	0 t/a	25.936 t/a
CH ₄ (emitting CH ₄)	21	199,052 t/a	995 t/a
		199,052 t/a	26,931 t/a
		benefit	172,121 t/a

Table 36: CO₂ equivalents

The GHG assessment guidelines 2013 categorize a municipal solid waste landfill in a Medium-Low category of 20-100 kt CO_{2e}/year. Yerevan solid is emitting up to approx. 200 kt CO_{2e}/year if the landfill gas is not flared. This would fit the medium-high categories which range from 100 kt to 1 Mt CO_{2e}/year, whereby the high amount of waste which is projected to be deposited needs to be acknowledged.

The amount of CO_{2e}/year for the medium low category is not exceeded for the value if the landfill gas is flared. The amount of CO₂ remaining after the flaring process fits in category at a rather low value with 26 kt CO_{2e}/year.

Finally, it has to be noted that the CO₂ fraction of landfill gas and CO₂ from landfill gas flaring are assumed to be GHG neutral as part of the biological cycle.

The efficiency of flaring is expected to be very high considering the results from the neighbouring system operated by Shimizu company. The project will reduce the predicted GHG emissions from now 171 kt/year to 26 kt/year resulting in a “positive” impact. Impacts by Odour

7.2.2.3. Description and Evaluation of impacts by Odour

Construction phase

Odour emission triggered by construction works is not expected. Contaminated soil from the leachate pond is excavated and removed from the site. Odour nuisance resulting for the removal of contaminated material are only temporary. Moreover, within this part of the project area are no sensitive receptors. (no settlements)

Therefore this impact is evaluated as “very low.”

Operation phase

The crucial point for odour nuisance in the project is the temporary open landfill area. Odour results mostly from organic compounds.

The wind direction varies and there is no prevailing direction (refer to 4.1.4). Easterly winds transfer odour to the industrial areas of Erebuni, where no residential areas are present. Nevertheless, a general wind direction transferring odour nuisance to Nubarashen cannot be stated.

The mentioned gas capture system, referring to chapter 6.1.2 which produces a vacuum in the landfill body, also controls the escaping odour. Occurrence of odour is only temporarily

possible in insertion areas depending on external conditions.

Landfill gas emission cannot be fully excluded. Prompt replacement and compaction and covering are regarded as adequate measures. Moreover, waste-acceptance control should avoid the insertion of waste compounds resulting in increased odour emissions as e.g. residual waste being dumped together with construction waste (including Gypsum) which would result in an increased rate of H_2S . (refer to chapter 0). Furthermore, the open areas are kept small.

Measures like chemical treatments of waste in order to avoid odour are not recommended due an additional load of chemicals in the leachate.

Strong odour is not expected as the irrigation system accelerates the degradation of organic compounds. Also the open areas for disposal of new waste will be kept small. Sensitive locations in the vicinity are located in a distance of about 300m. Comparing the new system with the existing operation of a landfill site the new landfill site will have a “positive impact.”

The nuisance from odour for the workers is “moderate” as they will work within the landfill area. But within a modern wheel loader the worker will be covered by an operator’s cab and air supply is filtered, reducing the impact for the workers.

7.2.3 Accidents (Safety)

7.2.3.1. Description and Evaluation of Impacts by Accidents

Construction phase

At the construction area and during construction period, accidents cannot be excluded. Labour safety issues like Personal Protective Equipment (PPE) have to be implemented. First-Aid facilities are required to be available on site. The construction site should be fenced in order to avoid trespassing.

The likelihood of road accidents without any measures is high. Therefore mitigation measures are obligatory (see chapter 10)

Operation phase

At the junction area where the access road of the landfill leads into “Nubarashen road” it was reported that several accidents have occurred with partly lethal outcome and injured locals. The accidents were mainly caused by waste trucks driving without lighting in the dark with high speed and stopping or parking on this road.

Currently this junction area is not illuminated by street light and no street boundary is marked on the asphalt. The asphalt road has a width of approx. 9m.

The likelihood of accidents is low, because only a few people use the road to walk into the city.

7.2.4 Impacts on Landscape

7.2.4.1. Description and Evaluation of Impacts on Landscape

Construction phase

The visibility of the construction works are kept low by the topographical setting. As the construction period is temporary, these disturbances are insignificant. Therefore the impact is “very low.”

Operation phase

The impact on the landscape comprises two issues: The view towards the landfill and the at

present widely visible fume cloud that results from uncontrolled burning processes. The first one is limited due to the geomorphological situation, whereas the cloud is widely visible in surrounding cities and settlements.

By the implementation of the project the asset landscape is ameliorated. With the planned controlled disposal within the 5 landfill zones and their closure after completion as well as the installation of the gas flare the uncontrolled burning processes will stop. This means, there will no longer be a visible cloud.

As an aftercare of the closure phase of each landfill zone a natural soil cover of 1m thickness will be applied by using local sources of topsoil. Soil supply should be arranged with local landscaping companies, which are capable to deliver uncontaminated natural soil. It is possible to use excess materials from other construction sites, whereby the suitability of the soil it has to be guaranteed. Moreover, the soil acquisition for coverage of the landfill may not be accompanied by an environmental impact.

As a result thereof integration within the surrounding scenery of the landfill site is promoted. Referring to the mitigation measure for the asset flora, location-typical biotic communities are promoted.

The overall impact is considered as “moderate”, because of the existing pre-load (old landfill site, Gas station). Nevertheless, in order to mitigate the visibility of the entire landfill facility at a significant view point at Nubarashen road (see YSW_ESIA_A1_01), an alley should be planted in order to enhance the natural scenery and reduce the visibility of the landfill site.

Closure phase

As an aftercare of the closure phase of each landfill zone a natural soil cover of 1m thickness will be rehabilitated by using local sources of topsoil. Natural succession of steppic vegetation of the rehabilitated area is planned to integrate the landfill surface to the landscape and reduce its visibility.

Each closure phase will recreate a natural scenery after a new area is open. Therefore this impact is considered as “positive.” (the current operation leave large areas open)

7.2.5 Impacts of Litter

7.2.5.1. Description and Evaluation of Impacts by Litter

Litter causes a negative visual impact and can cause significant nuisance to those neighbouring a facility, and can in certain circumstances lead to harm of wildlife or livestock. Good litter control is proactive and can greatly reduce the escape of litter.

The envisaged solid waste project will be set up in a continental climate. The wind velocity is low (only 1.13 m/s). Open areas will be restricted and be covered earliest possible. In addition to coverage a fence which is designed to prevent third-party intrusion hinders uncontrolled litter spread.

Moreover, the next communities are within a distance of 300 m to the new landfill site, on top of a ridge. Therefore it is very unlikely that the spread of litter causes a permanent nuisance. Furthermore there is a high preload in the area mainly due to illegal dumping of waste.

Considering the above mentioned arguments, the impact is evaluated as “very low.”

7.2.6 Impacts on Flora (Land Consumption)

7.2.6.1. Description and Evaluation of Impacts by Land Consumption on Flora

Construction phase

All construction works and required facilities remain on the projected area for the new landfill. No additional land will be used for the construction phase (e.g. for the labour camp).

Operation phase

Referring to the technical project and the implementation of the new landfill the impact has to be regarded as permanent. The extant landfill slope can be omitted, the area being already part of the current landfill body and not being covered by vegetation.

Clearing and the total loss of land will be connected with this activity. Clearance is envisaged up to the borders of the project components. The clearance activity will involve a loss of forest land, a loss of structures, loss of soil (natural and contaminated) and a loss of vegetation.

The loss of vegetation is quantified hereafter:

VEGETATION TYPE (PROJECT-RELATED PERMANENT LOSS)	AREA IN HECTARES
Dry vegetation types	
Degradated steppic farmland, very-dry	3.68
Degradated steppic farmland, normal	21.51
Shrubland	0.05
Moist vegetation types	
Anthropogenic reed zones	1.44
Total vegation loss	26.68

Table 37: Loss of vegetation for the New Landfill

The clearance of the area causes a relevant and significant impact even though there are no endangered plant species within the project area. Also the affected habitats do not have a long time-frame for rehabilitation once the landfill is closed. The impact is therefore not considered as irreversible.

Due to the fact that no valuable habitats are affected (most of them former farmland), the impact is evaluated as “low.”

Measures can still be taken to further reduce the magnitude of the impact. (chapter 10 EMP)

Closure phase

As an aftercare of the closure phase of each landfill zone a natural soil cover of 1m thickness will be applied by using local sources of topsoil. Natural succession of steppic vegetation on the rehabilitation area will promote site-specific species. The closure phase has a “positive” impact, because a complete recovery with the existing vegetation is possible. Impacts on Fauna (Land Consumption, Collision).

Soil supply should be arranged with local landscaping companies, which are capable to deliver uncontaminated natural soil. It is possible to use excess materials from other construction sites, whereby the suitability and the origin of the soil it has to be guaranteed. Moreover, the soil acquisition for coverage of the landfill may not be accompanied by an environmental impact.

7.2.6.2. Description and Evaluation of Impacts by Land Consumption and Collision on Fauna

Construction phase

The animal species community is adapted to dynamic land use, so there is no additional disturbance to be expected beyond the impact zone. There will no additional land be used

for the construction phase (e.g. for the labour camp). All construction works and required facilities remain on the projected area for the new landfill.

Within the investigation range there are potential habitats of two endangered species (*Eremias pleskei* and *Testudo graeca*). Relevant habitats exist within a distance of 200 m south of the project area. Potentially suitable core habitats are the old gardens that are left fallow (see map YSW-ESIA_A1_01). These areas are outside the project range and not affected at all. It has to be mentioned that all species have a broader range than the solid waste area itself. Only a few animals could be affected while migrating into other areas during the construction phase. Populations will not be endangered.

As the likelihood of lethal accidents of the protected reptile species is very low and there will be insignificant disruption of the population (potential habitats are the old gardens), the impact on the can be considered as "insignificant". However, due to the high value of these species, mitigation measures (e.g. fencing) will still be required in the construction phase (see chapter 10).

Operation phase

Referring to the technical project and the implementation of the new landfill the impact has to be regarded as permanent. The extant landfill slope can be neglected, due the area being already part of the current landfill body and not being covered by relevant animal habitats.

Clearing and the total loss of land will be connected with this activity. Clearance is planned up to the borders of the project components. The clearance activity will involve a loss of forest land, a loss of structures, loss of soil (natural and contaminated) and a loss of vegetation.

The loss of animal habitats is quantified hereafter:

HABITAT TYPE (PROJECT-RELATED PERMANENT LOSS)	AREA IN HECTARES
Dry habitat types	
Degradated steppic farmland, very-dry	3.68
Degradated steppic farmland, normal	21.51
Shrubland	0.05
Moist habitat types	
Anthropogenic reed zones	1.44
Total habitat loss	26.68

Table 38: Loss of animal habitats for the New Landfill

Within the investigation range there are potential habitats of two endangered species. It has to be mentioned, that all species have a far broader range than the solid waste area itself and main habitats are well outside the project range.

Therefore risk of losing a local population is not significant. Taking into consideration that there is a wider habitat degradation taking place in the region, it is important to take care of the relevant remaining habitats. This is especially important for the described reptile species, which are limited to ground migration and vulnerable to habitat fragmentation.

Among the endangered species potentially occurring in the vicinity of the project area are *Testudo graeca* (IUCN Red List "vulnerable") and *Eremias pleskei* (IUCN Red List "Critically endangered") to be considered within the project from the perspective of species protection. The main habitat of *Eremias pleskei* is well outside the project range in southern direction.

Both species might reach the envisaged solid waste site itself only during migration.

Therefore it is very unlikely that during the operation phase (very few machinery used) animals are killed. Also the migration areas between the old gardens are not affected by the project. The impact has to be evaluated therefore as “low.” No net loss of suitable habitats is considered with the envisaged project.

Closure phase

As an aftercare of the closure phase of each landfill zone a natural soil cover of 1m thickness will be applied by using local sources of topsoil [natural soil delivered by landscaping companies]. Moreover, the soil acquisition for coverage of the landfill may not be accompanied by an environmental impact.

. Natural succession of steppic vegetation of the rehabilitated area will promote site-specific habitats.

7.2.7 Impacts of Birds, Vermin and Insects

7.2.7.1. Description and Evaluation of Impacts by Birds, Vermin and Insects

Regardless of the natural occurrence of species, even protected species, a solid landfill area attracts also undesirable species as certain birds, flies, rodents and insects (in this particular case regarded as vermin). The existing landfill site has shown almost no rats, because prides of dogs cause permanent disturbance.

Also the very limitation of an open area and a subsequent compaction of waste reduces significantly the impacts of animals.

Concerning the expulsion of birds by using acoustic signals it has to be noted that these signals are often regarded as distracting by the landfill employees. For a satisfactory expulsion of birds the signals are required to occur on a regular interval. Other measures deal with the reduction of noise. This measure is therefore not recommended. In the operation phase, monitoring by a pest control specialist will be carried out and – if necessary – measures will be taken. Overall the appropriate management of the landfill site reduces this impact significantly.

Therefore this impact is evaluated, considering the above mentioned circumstances as very low.

7.2.8 Impacts on Forest (Land Consumption)

7.2.8.1. Description and Evaluation of Impacts on Forests by Land Consumption

Construction phase

There are no further impacts on forest land expected during the construction phase. Construction works are planned to be conducted within the boundaries of the project area.

Therefore the impact is insignificant and evaluated as “very low.”

Operation phase

Referring to the technical project and the implementation of the new landfill the impact has to be regarded as permanent. The extant landfill slope is negligible, as the area is already part of the current landfill body and not covered by any forest. Moreover this part of the project is not dedicated as forest land by law.

For spatial extent of the forest land issues refer to map 2. It has to be noted that forest land due to Law amounts to **20.55 ha** within the project area that is affected. (requirement for compensation according to forest law Armenia).

Reforestation efforts were made on an area of 17.91 ha. From this number only 15% of forests trees were grown successfully. Therefore the loss of existing forest culture (< 5 years old) amounts to **2.7ha**.

The area that is actually covered with successfully grown forest is small. (only 2.7 ha; 15 % from total loss). By reasons of the age of the forest, the non-suitability for the natural site, the impact is evaluated as “low.”

Aside from the technical opinion of the value of the forest, the compensation requirements according to forest law cover an affected area of 20.55 ha.

Taking the successful implementation of forest of 2.7 ha and the loss of “potential forests” on a size of 17.85 ha is evaluated as a “very low” impact.

The clearance of the area reduces the potential area for growing forests. Therefore this impact is relevant, significant and irreversible. Measures need to be taken to reduce the magnitude of the impact.

Both losses – existing forests and forest land according to forest law – need to be compensated, respectively negotiated (see chapter 10).

7.2.9 Geology and Soil (Hazard Vulnerability, Erosion)

7.2.9.1. Description and Evaluation of Impacts on Geology and Soils

According to Armenian regulation on construction and design “CN&R of 2.02-94” the area of the new landfill is dedicated to the third zone and according to MSK-64 (Medwedew-Sponheuer-Karnik-Skala) to the intensity scale No 9 regarding earthquakes. Being located within an earthquake prone zone, a geological barrier as a base sealing is required. It has to be established by artificial clay layers according to Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste. For technical details refer to chapter 5.4. The proposal from the technical project will stand the scale of potential impacts

Landslides / Erosion:

Based on the zoning map of the SOVIET STUDY 1980, the location of the proposed new landfill of Nubarashen is located in “zone II” which is described as “relatively stable, suitable for constructions after making protective measures” (refer to Chapter 5.4.2.3).

Neither erosion nor other hazard endangers the proper operation of landfill site. Therefore it is unlikely that the new landfill site is affected. This impact is therefore classified as insignificant. The impact is evaluated as “very low.”

7.2.10 Impacts on Surface Water and Groundwater

7.2.10.1. Description and Evaluation of Impacts on Surface Water and Groundwater (contamination)

During operation of the new landfill, leachate will be generated from the deposited waste. This leachate will be collected in a leachate reservoir from where it will be irrigated on the surface of the landfill zones. This means under normal conditions no leachate has to be treated outside the landfill expect following exceptional situation:

- In case of very heavy rain the leachate reservoir may reach the limit.
- In the beginning of the operation phase of the new landfill when still small amount of waste is deposited, the irrigation of leachate could be not performed so efficient and the leachate reservoir may reach the limit.

The surface water generated by rainwater outside the landfill area would be collected and

bypassed by a storm water channel system. The rainwater which falls on the current operating landfill zone would be collected together with the leachate of the new landfill.

Furthermore, the base sealing prevents uncontrolled penetration of leachate into the ground.

In addition, the landfill site generally has a distance of > 10m to one of the water supply pipelines which passing by (Armenian requirements for sanitation protection zone).

The current leachate stream from the extant landfill will be collected in the course of the slope sealing and the contaminated soil of this leachate stream bed has to be removed, temporarily stored and finally deposited in the new landfill when operation starts.

Without the proper establishment mainly surface water can be polluted. By means of the technical project this potential impact can be reduced significantly. The remaining impact is considered as “very low” and insignificant. Also in the unlikely case of an accident it is impossible that a valuable permanent groundwater aquifer is affected, because the layer are below a massive layer of clay in a depth of > 40m. In order to prevent any negative impact monitoring measures are proposed (see chapter 10).

7.2.11 Impacts on Contaminated Areas

7.2.11.1. Description and Evaluation of Impacts on Brownfields

Contaminated areas occur on the area of the new landfill at the locations where the soil is contaminated by leachate (regarding leachate refer to chapter 5.5.2.4). Due to infiltration, the soil below and within approx. 1m beside leachate streams and the leachate pond is contaminated.

By means of excavating the polluted soils, the release of contaminants can be prevented. Therefore this impact is considered – after the implementation of the above mentioned measures – as “positive.” Furthermore the closure of the existing landfill site will have a positive impact.

7.2.12 Climatic Impacts

7.2.12.1. Micro Climate

7.2.12.2. Description and Evaluation of Impacts on Micro Climate

Referring to the design of the landfill site an impact on the micro climate is not expected. The project design envisages no obstacles like dams or walls of a critical height (higher than 5 meters) which could hinder cold-air currents and air movements towards the city following the inclination of the terrain (see also chapter landscape 5.2). Cold-air blockage which could cause frost injuries to agricultural plantations (e.g. close-by farm area with peach plantation) can also be excluded.

After the closure of the landfill zones, soil of 1m thickness is planned to be rehabilitated on the landfill surface, which has equal thermal properties in comparison with the surrounding area. Therefore over-average heating up and cooling down of the area during certain weather conditions is not expected.

The impacts of the project on the micro climate are insignificant and evaluated as “very low.”

7.2.12.3. Impacts of Climate Change

7.2.12.4. Description and Evaluation of Impacts of Climate Change

Changes in precipitation could have an impact on leachate generation. But the contribution

of the project to the climate change potential is – in particular with consideration to the gas collection system – very low. Therefore the project does not change the precipitation of the region. Considering the current operation the proposed project causes a positive impact on “Climate Change”.

Nevertheless, the landfill zones will be irrigated and leachate generation is therefore controlled.

The example from the neighbouring gas flare from the Shimizu project shows, that the available water is enough to keep the flaring system working, if a landfill site has an efficient base and top soil sealing. Also during summer the system is working.

In case there is a loss of precipitation in the summer and not enough water available in the storm water tanks due to a loss in precipitation, this issue can be solved by technical means. E.g. a well can be drilled down to the permanent groundwater aquifer to fill the storm water basin.

Therefore the risk that the project will not work is “low”. A monitoring system will be installed to record to monitor potential losses of surface water (see chapter 10)

7.2.13 Impacts on Cultural Heritage

Referring to the baseline (chapter 5.7) cultural heritage is not affected. The impacts are insignificant.

7.2.14 Waste Management

7.2.14.1. Description and Evaluation of Impacts of Waste Management

Construction Phase

The waste which is generated during the construction procedure of the new landfill has a subordinated priority, as construction waste could be finally deposited in the new landfill when operation starts. Therefore the impact is considered as “very low”, because no further impact is triggered.

7.2.15 Closure of existing Landfill Site – Dependencies for New Landfill Site

7.2.15.1. Description and Evaluation of Impacts of Closure of existing Landfill Site.

Construction Phase

The implementation of the slope sealing between new and extant landfill will be performed in the construction phase and stepwise during the operation of landfill zone 1 and 2.

A prerequisite of the Bank's support in this project is the closure of the operation of the extant landfill as soon as the new landfill starts to operate. At the same time the implementation of surface sealing at the existing landfill shall start. Therefore the closure of the existing landfill site does not cause any further impact. The close will have a “positive” impact (on e.g. landscape, emission of greenhouse gases).

For the active wastepickers, the closure of the existing landfill means a significant loss of livelihood and economic displacement. The Due Diligence process therefore requires a Livelihood Restoration Framework which gives details for mitigation measures for the wastepickers which have to be carried out in a follow-up process (see ESDD 08). The remaining impact is considered as “low”.

7.2.16 Emergency Planning and Preparedness

7.2.16.1. Methodology for the Evaluation the Level of Significance

The significance of this impact is qualitatively assessed based on expert opinion.

7.2.16.2. Description and Evaluation of Impacts Emergency Plan

In the course of the Detailed Design (which has to be prepared before start of the construction) a detailed emergency plan has to be elaborated which shall include among others following topic:

- Measurements in case the deposited waste sets on fire (local fire brigade; access of extinguishing water; etc)
- Good access to the gas flare for emergency cases and maintenance services. Flares shall not be located near structures that easily ignite.
- Measurements in case gas wells set fire
- Equipment for raising fire alarms
- Detailed described responsibility of action to be taken in case of emergency

The preparation of an emergency plan, is a measure to reduce any risks in case e.g. of an accident. Therefore such planning will have a “positive” impact.

7.2.17 Impacts on Associated Facilities

The construction and operation of the new landfill will affect following associated facilities:

7.2.17.1. Description and Evaluation of Impacts of associated Facilities

Access Road:

The current access road has a length of approx. 1km is property of Yerevan Municipality. The surface of the access road (approx. width 5 to 7m) is not paved and a lot of potholes are visible (refer photo below):



Figure 66: Access road on the territory of the extant landfill

In the course of the detailed design and the construction of the new landfill, following issues shall be considered:

- As the territory of the access road belongs to the Yerevan Municipality there are no problems to be expected regarding the future use for the new landfill. Eventually the lease contract with the private company who operates the old landfill could be adapted.
- Rehabilitation of the surface of access road including surface drainage (e.g. by macadam or asphalt). During rehabilitation of the access road the impact of dust shall be mitigated by sprinkling with water.

The reconstruction will not cause any other environmental impact, because the road will stay within the existing alignment. Therefore the impact is considered as “very low.”

Gas captures installation of the extant landfill:

At the extant landfill there exists an installation which captures gas from the body of the extant landfill. It is operated by Company Shimizu. Currently there are installed gas wells on the extant landfill (refer photo below):



Figure 67: Surface of extant landfill where gas capture equipment is installed

In the course of the Detailed Design and the construction of the new landfill, following issues shall be considered:

- Agreement with the operator of the extant landfill regarding implementation of surface sealing to avoid infiltration of rainwater (which currently generates leachate and seeps out at the slope where the slope sealing between new and extant landfill is planned).
- Impact of above mentioned surface sealing regarding the amount of gas production of Company Shimizu

Even though an exact number was not given, but the predicted emission of the Shimizu project are expected to be in the same range than the proposed new landfill project. The impact is considered therefore as “very low.”

The envisaged project does not have any significant additional impact. The parallel operation needs to be clarified in the course of the detailed design.

Fencing of the old landfill:

The area of the extant landfill is currently enclosed partly by fences (refer to below photo)



Figure 68: Existing fence at extant landfill

In the course of the closure of the operation of the extant landfill, the area of the extant landfill should be secured by fences to avoid unauthorized access.

Therefore the issue of rehabilitation of existing fences respective the installation of new fences of the area of the existing landfill shall be considered.

The implementation of new fences has a “positive” impact, because it prevents uncontrolled access and will reduce accidents.

8. ASSESSMENT OF SOCIAL IMPACTS

The expert opinion is based on the experience of other projects and on existing decrees and guidelines (where appropriate²⁵).

The potential gender related impacts of the project and addressing measures are integrated through out the text as a cross-sectional task in the sense of the below mentioned EU guideline.

8.1.1 Loss of Livelihood

8.1.1.1. Description and Evaluation of Impacts by Loss of Livelihood

Construction phase

The old landfill is not closed before the new landfill site is in operation. Therefore people sorting out recyclable materials (waste-pickers) are not affected until the new landfill is in operation.

Operation phase

The land consumption of the project is quantified hereafter:

LAND ACQUISITION		
"LAND DEDICATION" ACC. CADASTRE	LANDHOLDER	AREA IN HECTARES
New Landfill		
Forest land	State of Armenia, under purview of "Hye Antar"	20.21
Road	State of Armenia, under purview of "Hye Antar"	0.34
Utility land	"Erebuni Maqrutyun" (Էրեբունի Մաքրու թյուն ՍՊԸ).	6.83
Extant landfill slope		
Utility land	"Erebuni Maqrutyun" (Էրեբունի Մաքրու թյուն ՍՊԸ).	3.75
Access road		
Utility land	"Erebuni Maqrutyun" (Էրեբունի Մաքրու թյուն ՍՊԸ).	0.90
Total		32.03

Table 39: Land Acquisition Data for the New Landfill

The loss of land it self – in terms of landownership - has no different impact on men or women. The loss of livelihood though does.

During the social assessment the following groups have been identified being impacted by economic displacement. The sample of 18 people, there under 5 employees of the Nubarashen landfill has shown that the reliance of income of the household from the landfill is nearly all cases more than 60 %.

The average income of from the landfill derived from the sample is approx. 60.000 AMD (110

²⁵ For the evaluation of gender mainstreaming the aspects of the EU directive 2010/41 on the application of equal treatment and women engaged in activity and the derived guidance documents (e.g. Manual for Gender Mainstreaming of Employment Policies, 2007) and the EBRD guidances documents (e.g. Strategic Gender Initiative, 2013) were considered.

€) per person who is involved in waste picking. Moreover, the people are unemployed and “stigmatised”. The overall estimated entirety of people is 160 – 200 including elderly, women and children.

By the implementation of the project and the demands of a modern landfill (fencing, security requirements) the income structure from waste-picking is permanently lost which triggers the project impact of economic displacement. As an adequate mitigation procedure a Livelihood restoration framework (LRF) is required to be designed.

The entirety of people is regarded as vulnerable. The vulnerable groups identified are:

- Unemployed individuals engaged in waste-picking activities,
- Staff of “Erebuni Makrutyun “CSJC” working at the landfill and engaged in waste-picking activities,
- Families of waste-pickers, including women, children and elderly people.

The project can cause significant impacts on the social and economic life of people in the neighbouring communities. The impact is considered as “high” taking the level of impact, the vulnerability and the amount of potentially affected people (up to 200) into account.

Therefore measures (e.g. training) need to be taken to reduce the magnitude of the impact. The measures to mitigate economic displacement and loss of livelihood are outlined in the ESDD 08 Livelihood Restoration Framework.

The impact will disproportionally will affect women. (see reasoning in the following chapter)

8.1.2 Gender Mainstreamings Issues

Gender Mainstreaming issues are mentioned in the sense of the direct effects of their lost of income. But other aspects of the evaluation, if the project is non-discriminative and and if the project has a potential impact of equality issues of men and women are also described in other chapters.

8.1.2.1. Community of waste pickers

8.1.2.1.1 Description and Evaluation of Impacts on the Community of Waste pickers

Among the community of waste pickers the impacts are likely to e felt differently by men and women. . Women comprise a proportion of the project affected people and as stated in the baseline women are especially vulnerable, as the majority of them have not the same income as men.

Moreover, women pursuing waste-picking activities often do not own or drive a car so suffering from restricted mobility promotes inequality. Finding an alternative job is limited due to housework or child care needs which are regarded as female domains.

As mentioned before, the exact number cannot be estimated at this stage. The follow-up process envisaging a full census and cut-off registry for compensation will concretise the exact numbers.

The impact of the project may disproportionately palce a burden on women’s lives, because their mobility is stronger limited than men’s. (due to the lack of public transport and a burden of child care)The project could also intensify inequalities, which is considered as a relevant and significant impact. Therefore this impact is evaluated as “moderate.”

Mitigation measures are needed to compensate the impact (see chapter 9)

8.1.2.2. Landfill Operator and Construction Company – Human Ressources and

Employment**8.1.2.2.1 Description and Evaluation of Impacts by Landfill Operation and Construction**

Concerning the project operator, the municipality of Yerevan, the percentage of employed women is about 53 %.

The total number of municipal employees is 1896, of which 1003 are women and 893 are men. The number of women in the high management level is only 45 (from which 3 head of departments, the rest are head of divisions)

This might suggest that decision-taking process concerning waste process enhancements on a political level is not conducted by women.

The new landfill site will create up to 25 new jobs (see E+S Management review ESDD), which is a positive impact of the project.

For the project, it is proposed to promote equal working opportunities and mitigation of women's situation through the appointment of champions of gender issues both at the landfill company and in the municipality. Not only during the operation of the landfill site, but also for the construction period, equal access for men and women should be envisaged. (equal access to labour market) Therefore companies should be encouraged to tender, whose company philosophy offers equal working opportunities for men and women. (access to jobs and equal payment)

Through this equal involvement, remuneration, creation of part time jobs and so on will be actively promoted. This framework would also be in the sense of the reconciliation policy of the EU directive 2010/41.

The project offers the chance to promote equal opportunities. Therefore this project can have a "positive" impact considering the proposed mitigation measures mentioned in chapter 10.

9. SUMMARY OF IMPACTS

9.1 Summary and Evaluation

The following summary gives an overview of the main impact factors, their likelihood to occur, receptor, sensitivity concerning its impact, duration and level. The Significance is evaluated thereon defining if measures are required. The remaining impact is assessed.

MAIN IMPACT FACTOR/ ASSET	SUB IMPACT FACTOR/ PHASE	IMPACT LIKELIHOOD	RECEPTOR (ASSET)	SEN-SITIVITY CONC. IMPACT	DURATION	LEVEL	EVALUTATION OF SIGNIFICANCE	REQUIRED MEASURES	REMAINING IMPACT
Environmental Impacts									
Noise	Construction phase (landfill site and road)	Likely that noise will be generated	Human being Vulnerable and noise sensitive birds do not occur in the project area	High (settlements; depending on emitted noise level emission time) Very highly sensitive facilities like hospitals are not located within project range	Construction period (12 months)	Ranges between 72 dB(A) and 98 dB(A)	Human settlement: settlements are not affected (distance more than 300 m)	None	Insignificant
							Workers: high noise levels during construction can cause damages to hearing capabilities (significant); only few workers can be affected	PPE, especially Ear protection	Insignificant
	Operation (on landfill site)	Likely	Human being Vulnerable and noise sensitive birds do not occur in the project area	High (depending on noise level per machine)	28 years; but the exposure time to high noise levels is low (2-3 hours/day) for compaction works	High can reach up to 80 dB(A), but exposure time is less than 8 h (in average 2-3 hours/day)	Workers: The potentially significant impact is mainly limited to the driver of wheel loader (significant) Also significant for workers on the landfill site	PPE, especially Ear protection Renewal of equipment Other measures (O1)	Insignificant

MAIN IMPACT FACTOR/ ASSET	SUB IMPACT FACTOR/ PHASE	IMPACT LIKELIHOOD	RECEPTOR (ASSET)	SEN-SITIVITY CONC. IMPACT	DURATION	LEVEL	EVALUTATION OF SIGNIFICANCE	REQUIRED MEASURES	REMAINING IMPACT
	Operation (roads)	Likely	Human being	High: settlements (depending on traffic volume) imission points (hotel, farm)	During whole life span, relevant is only daytime (heavy traffic increasing only during daytime)	Noise level at imission points ranges between 24,6 dB(A) and 49,5 dB(A)	Neither the WHO thresholds nor the Armenian standards for noise are exceeded. Therefore the noise impact is insignificant. Overall the impact is very low.	None	Insignificant
Air Pollution	Nubarashe n Road (constructi on,operatio n phase)	Likely	Human being	High: settlements (operation phase) Moderate: workers during construction phase	Nubarashen road: During whole life cycle of road / construction phase max. 1 year and only periodically during dry weather and windy conditions	Additional input by the project is below 3% of given preload (operation phase / no toxic substances, mainly nuisance due to dust	Very low (operation phase) / low construction phase, because only relevant under certain weather conditions	Sprinkling of haul roads (construction phase)	Insignificant
								None (operation phase)	Insignificant
	Landfill gas migration risk (operation phase)	Likely	Human being	High: Workers	Just under irregular conditions	Just under irregular conditions	Even though the likelihood is very low, the significance is evaluated with "low" due to the high sensitivity of workers	Monitoring	Very low (because people can be evacuated immediately)

MAIN IMPACT FACTOR/ ASSET	SUB IMPACT FACTOR/ PHASE	IMPACT LIKELIHOOD	RECEPTOR (ASSET)	SEN-SITIVITY CONC. IMPACT	DURATION	LEVEL	EVALUTATION OF SIGNIFICANCE	REQUIRED MEASURES	REMAINING IMPACT
	Greenhouse gas emissions (operation phase)	Likely	Global climate	High: (in general existing danger of rising temperatures)	About whole life span of solid waste site (28 years)	26 kt/y	Comparing the contribution of the solid waste site with other CO ₂ emitting facilities and taking into account the very high efficiency of the system the remaining impact is very low	Monitoring	Very low, because by means of monitoring the flaring process can be optimised in a short period of time Positive effect reduction from now 171 kt/y to 26 kt/y
Vibration	Construction and operation phase	Very unlikely	Human being	Very low (could only cause nuisance),	Insignificant	Insignificant	Insignificant	None	Insignificant
Odour	Construction and operation phase	Unlikely – Operation phase – settlements / unlikely construction phase / likely operation phase (workers)	Human being (settlement/workers)	High Very high (hospitals do not exist)	1 year (construction phase)	Very low; construction phase	Positive impact comparing to current situation (settlements)	Monitoring (Methane) Modern equipment for compaction activities (operation equipment and the cabins have to have air	Low
					About whole life span of the project (28 years)	Very low (distance of 300 m to settlements) Moderate	Moderate (operation phase for workers) for workers focussing on compaction activities		

MAIN IMPACT FACTOR/ ASSET	SUB IMPACT FACTOR/ PHASE	IMPACT LIKELI- HOOD	RECEPTOR (ASSET)	SEN-SITIVITY CONC. IMPACT	DURATION	LEVEL	EVALUTATION OF SIGNIFICANCE	REQUIRED MEASURES	REMAINING IMPACT
						(workers in operation phase)		condition)	
Accidents	Constructio n and operation phase	Likely (construction phase)	Human being (workers)	Very high	1 year construction phase years)	High	Due to the potential lethal consequences during the construction period, this impact is evaluated as "high"	OHS measures/Sit e super-vision	Low
		Unlikely (operation phase)	Human being (pedestrian	Very high	About whole life span of project (28	high	Even though the likelihood is low (one accidents during last years), but the consequences can be lethal, the impact is evaluated as "high" (equal danger for men and women)	Speed bumps, street lighting	
Land- scape	Landfill site- change of scenery (constructi on, operation	Likely (operation phase) Unlikely (cons- truction	Landscape, scenery	Moderate (existing preload, geomorphology)	Life span, after each area has reached its capacity it is recovered with natural	high	The impact in the construction phase is very low, because the project stays in the boundaries of the envisaged operation solid waste site	None (construction phase)	Insignificant

MAIN IMPACT FACTOR/ ASSET	SUB IMPACT FACTOR/ PHASE	IMPACT LIKELI- HOOD	RECEPTOR (ASSET)	SEN-SITIVITY CONC. IMPACT	DURATION	LEVEL	EVALUTATION OF SIGNIFICANCE	REQUIRED MEASURES	REMAINING IMPACT
	and closure phase)	phase)			soil		Even though the project covers this valley, the overall impact is evaluated with "moderate." The reason is, that a high preload exist, every area after reaching its capacity is rehabilitated and covered with soil again. Soil supply is envisaged to be conducted by a landscaping company delivering natural soil.	Alley planting and earthworks (visual protection)	Low (reduced visibility)
	Trail of smoke	Likely (operation phase) unlikely (construction phase)	Landscape, scenery	Moderate (existing preload, geomorphology)	Life span	moderate	With the planned controlled disposal within the 5 landfill zones and their closure after completion as well as the installation of the gas flare the uncontrolled burning processes will stop. This means, there will no longer be a visible cloud.	none	Positive effect
	Litter	Unlikely to spread to other areas	Scenery of landscape, next settlements animals	Moderate (area already high preload due to illegal dumping)	About whole life span of project (28 years)	moderate	Wind velocity is very low, settlements are within a distance of 300 m, open areas are small and impact is limited to nuisance. Therefore the impact is considered as	General measures of O_LT	insignificant

MAIN IMPACT FACTOR/ ASSET	SUB IMPACT FACTOR/ PHASE	IMPACT LIKELI- HOOD	RECEPTOR (ASSET)	SEN-SITIVITY CONC. IMPACT	DURATION	LEVEL	EVALUTATION OF SIGNIFICANCE	REQUIRED MEASURES	REMAINING IMPACT
							very low		
Flora (land consump- tion)	Constructio n,- Operation and closure phase	Unlikely (construction phase) Likely (operation phase)	Plants	Low (no valuable habitats)	Life time of the project (28 years)	26 ha (mainly old farmland)	Impact is evaluated a “low” because no valuable habitats for plants will be affected. Furthermore these habitat can be regrown in a very short period of time	Compensatio n and mitigation measures	Very low
Fauna (land consump- tion, colli- sion)	Impacts on natural habitats Constructio n, operation and closure phase	Unlikely (construction phase)	Protected reptiles (potential habitats)	Very high	1 year construction period	Only migration habitats are affected	The impact is considered as “insignificant”, because the potentially valuable habitats are not affected. Collisions could only play a role for a few individuals while migrating (construction period)	Reptile guiding system (const-ruction phase)	Very low (limited to potential habitats in the project area and high efficiency of mitigation measures)

MAIN IMPACT FACTOR/ ASSET	SUB IMPACT FACTOR/ PHASE	IMPACT LIKELI- HOOD	RECEPTOR (ASSET)	SEN-SITIVITY CONC. IMPACT	DURATION	LEVEL	EVALUTATION OF SIGNIFICANCE	REQUIRED MEASURES	REMAINING IMPACT
		Likely (permanent loss, operation phase), unlikely (danger to valuable species)	Ubiquitous species Some protected reptiles; potential habitat	Moderate (ubiquitous species) Very high (protected reptiles)	Life span of the project (28 years)	26 ha	The impact is considered as “low” because habitats of valuable species are not affected. The likelihood of collisions with a strong impact on the population of protected reptiles (potential habitats are the old gardens) is very low. Therefore the overall impact is evaluated as “low” Furthermore with the closure of each area and the coverage with soil again, new suitable habitats will be available.	Compensatio n measure (operation phase)	Very low
	Impacts of birds, vermin and insects (Pest- Control) (Operation phase)	Unlikely	Different assets		Life span	low	The open area is very small and waste will be compacted in a short period of time. Therefore the danger of a spread of diseases e.g. by these animals is low.	Monitoring by pest control specialist	Insignificant
Forests (land consump- tion)	Constructio n and operation phase	Unlikely (construction period; project stays in same borders) Likely	Forests	Very low (only failed forest cultures without appropriate species)	Life span of the project (28 years)	20.55 ha (according to forest law); real existing forests only 2.7 ha (operation	Due to the low ecological value of the forest (< 5 year, no appropriate species have been selected for the natural conditions, therefore failed culture) the impact	Reforestation (due to forest law Armenia)	Very low

MAIN IMPACT FACTOR/ ASSET	SUB IMPACT FACTOR/ PHASE	IMPACT LIKELI- HOOD	RECEPTOR (ASSET)	SEN-SITIVITY CONC. IMPACT	DURATION	LEVEL	EVALUTATION OF SIGNIFICANCE	REQUIRED MEASURES	REMAINING IMPACT
		(operation phase)				phase)	is evaluated as "low."		
Geology and soil (landslide s, natural hazards)	Constructio n and operation phase	Unlikely	Soils, geology	moderate	Life span of the project (28 years)	Earthquakes up to scale no. 9. Area relatively stable	Taking the measure of the technical project into account, the project will stand potential earthquakes and soil is relatively stable. The is therefore evaluated with "very low" (construction and operation phase)	Incorporated already in technical project	Very low
Surface Water and Groundwa ter (conta- mination)	Constructio n and operation phase	Very low	Surface water and ground water	Low (permanent aquifer in 40m depth), surface water contaminated	Life span of the project (28 years)	No protected area, continuous aquifer below a compact clay layer	The impact is considered as "very low", because a compact clay layer on top of base sealing prevents any leakage to the groundwater. Furthermore the surface water will be collected completely.	Monitoring measure (to detect a potential accident)	Very low
Conta- minated areas	Constructio n phase	Likely	Contaminated soils	High due to contamination	1 year (only in construction phase)	Whole bed of leachate stream	The contaminated bed of a leachate stream will be excavated. Therefore the project has a "positive" impact	None	Positive
Climatic impacts	Microclimat e in operation phase	Unlikely	Microclimate	Low (area has no significance for production of cold air)	Life span of the project (28 years)	low	The impact is evaluated as "very low", because the project has no impact on the micro climate	None	Very low

MAIN IMPACT FACTOR/ ASSET	SUB IMPACT FACTOR/ PHASE	IMPACT LIKELI- HOOD	RECEPTOR (ASSET)	SEN-SITIVITY CONC. IMPACT	DURATION	LEVEL	EVALUTATION OF SIGNIFICANCE	REQUIRED MEASURES	REMAINING IMPACT
	Climate Change Constructio n and operation phase	Unlikely	Landfill	Moderate (changes in precipitation)	Life span of the project (28 years)	low	Considering the current operation the proposed project causes a positive impact on "Climate Change". Of importance would be a scenario of reduced precipitation in the summer because of Climate Change and not enough water available in the storm water tanks, this issue can be solved by technical means. E.g. a well can be drilled down to the permanent groundwater aquifer to fill the storm water basin.	None	Insignificant
Cultural Heritage	Constructio n phase	Unlikely	Cultural heritage	Potentially high	1 year construction period	unknown	The impact is "very low", because according to different experts no valuable archaeological remains are expected to be found	Monitoring and preparedness (part of environmental site super- vision to be informed during construction period	Very low; cultural heritage would be salvaged with care immediately

MAIN IMPACT FACTOR/ ASSET	SUB IMPACT FACTOR/ PHASE	IMPACT LIKELIHOOD	RECEPTOR (ASSET)	SEN-SITIVITY CONC. IMPACT	DURATION	LEVEL	EVALUTATION OF SIGNIFICANCE	REQUIRED MEASURES	REMAINING IMPACT
Waste Management	Construction and operation phase	Unlikely	Human being	Low (inert waste)	Life span of the project (28 years)	Unknown	The impact is low, as inert construction waste can be stored in the landfill.	Waste acceptance control	Low
				High (potentially hazardous waste is identified)			Hazardous waste has to be stored at appropriate places and treated appropriately and professionally disposed	Waste acceptance control Appropriate interim storage	
Closure of existing landfill site	Closure Phase	Likely	Human being Climate Landscape Soil	High (waste pickers)	Closure phase of extant landfill	Loss of livelihood / Economic displacement is assessed in follow-up process	High significance, prerequisite for the project.	Livelihood Restoration Plan	Low, at best positive effects
				Moderate (Climate, Landscape, Soil)	Closure phase of extant landfill	Unknown	Positive impacts on Climate, Landscape (stopping of uncontrolled burning, less odour, less visibility, reduction of greenhouse gases compared to current situation, less littering). Positive effects on Humans: higher safety, less accidents, less exposition to dangerous substances. Soil coverage of the landfill	None	Positive effects

MAIN IMPACT FACTOR/ ASSET	SUB IMPACT FACTOR/ PHASE	IMPACT LIKELI- HOOD	RECEPTOR (ASSET)	SEN-SITIVITY CONC. IMPACT	DURATION	LEVEL	EVALUTATION OF SIGNIFICANCE	REQUIRED MEASURES	REMAINING IMPACT
							body		
Emer- gency Planning and Prepared- ness	Constructio n and operation phase	Unlikely	Human being	Potentially high	Life span of the project (28 years)	Unknown	High significance, prerequisite for up-to- date landfill management.	Emer-gency plan	Positive
Asso- ciated Facilities	Access Road Constructio n and operation phase	Likely	Human being	Moderate	Life span of the project (28 years)	Unknown	Improvement in regard to current state and safety of the road.	Part of technical planning	Very low
	Gas capture installation of the extant landfill Constructio n and operation phase	Likely	Climate; Human being		Life span of the project (28 years)	Unknown	The envisaged project does not have any significant additional impact. The parallel operation needs to be clarified in the course of the detailed design.	None	Very low
	Fencing of the old landfill	Likely			Life span of the project (28 years)	unknown	Currently not effective, risk of accidents for trespassers. Therefore this impact is evaluated	Renewal of fences	positive

MAIN IMPACT FACTOR/ ASSET	SUB IMPACT FACTOR/ PHASE	IMPACT LIKELI- HOOD	RECEPTOR (ASSET)	SEN-SITIVITY CONC. IMPACT	DURATION	LEVEL	EVALUTATION OF SIGNIFICANCE	REQUIRED MEASURES	REMAINING IMPACT
							as "positive."		
Social Impacts									
Loss of livelihood	Constructio n and operation phase	Very likely	Human being	High (waste pickers)	Life span of the project (28 years)	More than 20% dependency on income from landfill.	The project can cause significant impacts on the social and economic life of people in the neighbouring communities. Some of them will be directly affected by loss of income and some more indirectly affected. The impact is considered as "high" taking the level of impact, the vulnerability and the amount of potentially affected people (up to 200) into account. The loss of livelihood disproportionately affects women, because of the lack of public transport (considering the mobility needs of women) and the limited range to find a new job. Therefore measures (e.g., training, social welfare assistance) need to be taken to reduce the magnitude of the impact.	The measures to mitigate economic displacement and loss of livelihood are outlined in the ESDD 08 Livelihood Restor-ation Frame-work.	Low, at best positive

MAIN IMPACT FACTOR/ ASSET	SUB IMPACT FACTOR/ PHASE	IMPACT LIKELI- HOOD	RECEPTOR (ASSET)	SEN-SITIVITY CONC. IMPACT	DURATION	LEVEL	EVALUTATION OF SIGNIFICANCE	REQUIRED MEASURES	REMAINING IMPACT
							(considering also gender related assistance)		
Socio-economic well-being (Gender-mainstreaming Issues)	Waste pickers	Very likely	Human being	High (waste pickers)	Life span of the project (28 years)	High vulnerability of women (limited mobility, household duties)	<p>The project could intensify inequalities, which is considered as a relevant and significant impact. Therefore this impact is evaluated as "moderate."</p> <p>The positive effects for Nubarashen itself (community with approximately 15.000 inhabitants) improve the living conditions equally for men and women e.g. reduction of odour, smoke)</p>	<p>Implementation of a champion of gender issues at the Municipality to promote equal opportunities.</p> <p>The measures to mitigate economic displacement and loss of livelihood are outlined in the ESDD 08 Livelihood Restoration Frame-work.</p>	Low, at best positive
	Landfill Operator and Construction Company	Very likely	Human being	High	Life span of the project (28 years)	Promotion of equal opportunities	Positive Impact creation of up to 25 new jobs permanently and jobs in the construction phase.	Implementation of a champion of gender issues at the landfill to promote equal opportunities.	Positive

Table 40: Impact summary and evaluation of significance

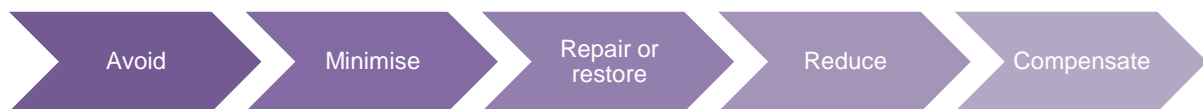
10. ENVIRONMENTAL MANAGEMENT PLAN (EMP)

An Environment Management Plan (EMP) is produced subsequent to an EIA with the principle aim of managing environmental assets identified in the EIA, as well as what and where project-specific mitigation measures should be implemented.

Mitigation is defined as follows:

- Avoid the impact altogether by not taking a certain action or parts of an action
- Minimising impacts by limiting the degree or magnitude of the action and its implementation, e.g., by implementing construction measures to minimise impact
- Rectifying the impact by repairing, rehabilitating or restoring the affected environment
- Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action, e.g., by changing behaviour
- Compensating for the impact by replacing or providing substitute resources or environments

The sequence of preference for measures is:



10.1 Tabular Environmental Management Plan

The following table comprises following main topic:

- General conflicts and measures - Construction phase (conflict numbers are marked by letter "G")
- Site specific conflicts – construction phase (conflict numbers are marked by letter "C")
- Site specific conflicts – operation (conflict numbers are marked by letter "O"). Conflict numbers are sorted using the main topic letters

Con-flict no.	Asset / Indicator	Impact description	Measure type and mitigation and compensation measures	Respon-sibility	Monitoring measures
General conflicts and measures - Construction phase ("G")					
	Human being	<u>New landfill site, Extant landfill slope, Access road</u>	<u>Mitigation measures</u>		
G_1		<p><i>Accidents</i></p> <p>Life of workers can be endangered during the construction works on the new landfill site and during the construction works along the access road.</p>	<p><i>Accidents</i></p> <p>The construction site should be provided with site supervision for labour safety issues according to Occupational Health and Safety Standards.</p> <p>The following measure should be taken care of:</p> <ul style="list-style-type: none"> - OHS requirements defined in the tender documents. - Avoid mobilization of heavy equipment at night - Fencing-off of site to prevent unauthorized access - Oversize vehicles should display warnings such as flashing lights - Warning and/or precaution signs on safety - Instruction on health and safety - First aid facilities at the construction sites - Use of Personal Protective Equipment (PPE) - Emergency plan and Preparedness plan - Separation of pedestrian zones within project area - Regular training 	<p><u>Construction company</u></p> <p>Site supervision</p>	Site supervision
	Water	<u>New landfill site, Extant landfill slope, Access road</u>	<u>Mitigation measures</u>		<u>Monitoring measures</u>

Con-flict no.	Asset / Indicator	Impact description	Measure type and mitigation and compensation measures	Respon-sibility	Monitoring measures
G_2		<i>Waste</i> Waste and construction material can spoil water quality and the fertility of soils.	<i>Waste</i> Waste has to be separated safely and classified during by a waste acceptance control. Inert waste can be stored at the landfill Hazardous wastes have to be stored separately at an appropriate place. These materials require a follow-up treatment or a professional disposal at a disposal area for hazardous materials.	<u>Construction company</u> Site supervision	Waste acceptance control
G_3		<i>Hazardous material</i> Spills of fuel can also endanger the water (quality of surface and groundwater)	<i>Hazardous material</i> - Fuel will be stored above the surface with catchment pans situated below each fuel storage device to prevent any uncontrolled ingress of fuel into the water and soils. - Accidental spillage of oil and lubricant will be immediately cleared. - To avoid contamination from fuel and lubricants, the vehicle and equipment will be properly maintained and refuelling / maintenance of vehicles will not be done near the bridge sites. Diesel generator set will be placed on a cement concrete platform with oil and grease trap to control the oil ingress into soil/ water bodies.	<u>Construction company</u> Site supervision	
	Geology, Geo-morphology, Soil	<u>New landfill site, Extant landfill slope, Access road</u>	<u>Mitigation measures</u>		<u>Monitoring measures</u>
G_4		<i>Erosion</i> Steep slopes, cuttings, make the terrain	<i>Erosion</i> To prevent any uncontrolled erosion the	<u>Construction company</u>	Site supervision

Con-flict no.	Asset / Indicator	Impact description	Measure type and mitigation and compensation measures	Respon-sibility	Monitoring measures
		<p>prone to erosion (rock slides, rock fall) Intensive rainfall and cloudbursts are likely to increase erosion</p> <p>Furthermore excavated material – without proper use – can enhance erosion.</p>	<p>excavated material that cannot be used, will be stored at a muck disposal site.</p> <ul style="list-style-type: none"> - Minimize major earthworks during the rainy periods - Retaining structures such as gabions, cribs grids of wood or concrete beams filled with earth or rock), or other types of wooden barricades and grid works, usually battered back against the slope. - Install intercepting drainage ditches at the top (to prevent water runoff over slope) and at the bottom (to collect and drain away water) of slopes. Use gutters and spillways to control the flow of the water down slopes. - Cut-off drains to catch water before it reaches critical areas, and diverging drains, which avoids excessive concentration of flow - Use of geotextiles to prevent soil erosion where it is appropriate - Reinforce earth embankment walls as the earth fill is placed, with anchors compacted into the fill material. - At the end of the construction phase, rehabilitation of all cut slopes with an inclination of 1:2.5 in case no other measures (e.g. geotextile) is foreseen 	Site supervision	
G_5		<p><i>Topsoil</i></p> <p>In case the current topsoil is not contaminated it shall be used for cultivation</p>	<p><i>Topsoil</i></p> <p>Storage of soft material and stones separately is sufficient.</p>	<p><u>Construction company</u></p> <p>Site</p>	Site supervision

Con-flict no.	Asset / Indicator	Impact description	Measure type and mitigation and compensation measures	Respon-sibility	Monitoring measures
		at the end of the construction measures	Excavated topsoil layer shall be stored separately in accordance with the technical specifications for later re-use. For rehabilitation it is envisaged to use natural soil delivered by a landscaping construction companies. The soil material has to fulfil certain criteria (natural origin, free of contamination). The soil can be obtained from excess materials of other construction sites as long the mentioned criteria is fulfilled. No further environmental impact may result from the soil acquisition of the soil.	supervision	
Site specific conflicts – construction phase (“C”)					
	Noise	<u>New landfill site, Access road</u>	<u>Mitigation measures</u>		
C_1		<p><i>Transport of construction material and dumping / Construction works</i></p> <p>Construction works can generate single high emissions of noise, which can either cause danger to the physical health (loss of hearing capacity) nuisance and disturbance during the important recreation phase of people.</p>	<p><i>Transport of construction material and dumping / Construction works</i></p> <p>The workers will be provided with PPE, especially ear protection. To prevent avoidable impact the following measure will be executed:</p> <ul style="list-style-type: none"> - Neighbouring people (Nubarashen town) will be informed about the planned and ongoing activities and the expected increase in noise level. The site supervisor will also serve as a contact person, which people can call directly, in case of unexpected disturbance. - A grievance mechanism will be developed and implemented. - No night time construction works will be carried out. 	<p><u>Construction company</u></p> <p>Site supervision</p>	Site supervision

Con-flict no.	Asset / Indicator	Impact description	Measure type and mitigation and compensation measures	Respon-sibility	Monitoring measures
	Air pollutants	<u>Access road, Nubarashen road</u>	<u>Mitigation measures</u>		<u>Monitoring measures</u>
C_3		<i>Emission of dust</i> Potential impact due to the emission of dust during the transport of construction material and construction works (earthmoving).	<i>Emission of dust</i> <ul style="list-style-type: none"> - Sprinkling of water at the dust prone areas will prevent dust emissions. (Dry periods and strong winds), especially on haul roads. - Trucks have to have canvas cover to prevent loss of dust emitting material. - Tyre wash system at the entrance/exit of the construction site. - Neighbouring people (Nubarashen town) will be informed about the planned and ongoing activities. 	<u>Construction company</u> Environmental site supervision	Air pollution monitoring is foreseen to be conducted at site (E&S Management review)
No conflict		<i>GHG emissions</i> See operational impact			
No conflict	Odour	<i>Odour</i> See operational impacts			
No conflict	Landscape	<i>Landscape</i> See operational impacts			
No conflict	Fauna and Flora	<i>Flora</i> See operational impacts			
No conflict		<i>Fauna</i> See operational impacts			
No		<i>Forest</i>			

Con-flict no.	Asset / Indicator	Impact description	Measure type and mitigation and compensation measures	Respon-sibility	Monitoring measures
conflict		See operational impacts			
No conflict		<i>Protected areas</i> No impact			
	Geology, Geomorphology, Soil	<u>New landfill site, Extant landfill slope, Access road</u>	<u>Project-related amendment</u>		
C_4.1		<p><i>Base sealing of the new landfill</i></p> <p>According to the results of the geotechnical investigations the coefficient of permeability of the soil samples taken from boreholes and pits, show a very low permeability.</p> <p>But taking into consideration the knowledge of all performed investigations, the major conclusion of the proposed new landfill area reflects that the soil structure is inhomogeneous with alternating layer structure. The soil profiles (Annex 1) show a permeable layer C, consisting of pebble-soil with sand and sandy loam. A Groundwater layer has encountered in Borehole 10 and Pits Nr. 1, Nr. 4 and Nr. 7.</p>	<p><i>Base sealing of the new landfill</i></p> <p>Due to the</p> <ul style="list-style-type: none"> • inhomogeneous underground structure with a permeable layer and the • encountered water layer in Borehole 10, Pit 1, Pit 4 and Pit 7 <p>The existence of a coherently homogenous natural geological barrier <u>cannot</u> be assumed.</p> <p>Therefore, for the construction of the base sealing for the new landfill, a geological barrier has to be established by artificial clay layers according to Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste.</p> <ul style="list-style-type: none"> • Proposal for the construction of the base seal (top to bottom): 0,5 m drainage layer, Gravel • Geotextile 1200 Gramm/m² • 2,5 mm HDPE liner • Geosynthetical layer (bentonite mat) is recommended in accordance with the Technical Feasibility Study from 2012) • 0,5m (2 x 0,25 m) artificially established clay 	<p><u>Client (Detailed design)</u></p> <p><u>Construction company</u></p>	Site Supervision

Con-flict no.	Asset / Indicator	Impact description	Measure type and mitigation and compensation measures	Respon-sibility	Monitoring measures
			<p>layer with coefficient of permeability $1,0 \times 10^{-9}$ meter/second (according to Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste)</p> <ul style="list-style-type: none"> Levelled and compacted subsoil <p>The base seal must have not less than 1.5 m distance to the aquifer level²⁶ of layer C. For the construction phase it is recommended to verify the level of the groundwater aquifer in the new landfill area with a grid of pits.</p> <p>Structure of the base seal Annex X.</p>		
C_4.2		<p><i>Erosion</i></p> <p>Due to cutting slopes for the clearance of the access road during heavy rainfall, erosion could occur.</p>	<p><i>Erosion</i></p> <p>Cutting and immediate slope support in dry season. Erosion measures are undertaken during dry weather conditions</p> <p>During construction the slopes shall be flatted (proportion: 1:2.5) to avoid erosion and possible landslides.</p> <p>Construction of storm water channels around the new landfill (refer to the Technical Feasibility Study)</p>	<u>Construction company</u>	Site Supervision
C_4.3		<p>Landslides</p> <p>Based on the zoning map of the SOVIET</p>	<p>Landslides</p> <p>During construction the slopes shall be flatted</p>	<u>Construction company</u>	Site Supervision

²⁶ According to the Austrian Landfill directive 2004, the distance is not less than 1.0 m to the highest groundwater level. Due to the lack of information about the highest groundwater level in the area of Nubarashen, we recommend a distance not less than 1.5 m between the bottom of the basic seal and the groundwater level.

Con-flict no.	Asset / Indicator	Impact description	Measure type and mitigation and compensation measures	Respon-sibility	Monitoring measures
		STUDY 1980, the location of the proposed new landfill of Nubarashen is located in "zone II" which is described as "relatively stable, suitable for constructions after making protective measures"	(proportion: 1:2.5) to avoid erosion and possible landslides. In the course of the detailed design, for each construction object the respective construction regulation shall be applied according to the possible earthquake impact	Client (detailed Design)	
No conflict	Impacts on mining	No impact			
	Impacts on contaminated areas	<u>New landfill site, Extant landfill slope, Access road</u>	<u>Mitigation measures</u>		
C_5		<i>Contaminated areas</i> Contaminated areas occur on the area of the new landfill at the locations where the soil is contaminated by leachate (regarding leachate refer to chapter 5.5.2.4). Due to infiltration, the soil below and within approx. 1m beside leachate streams and the leachate pond is contaminated.	<i>Contaminated areas</i> The contaminated soil around the area of the leachate creek has to be replaced by natural soil. The contaminated soil shall be finally deposited at the new landfill when it starts operating.	<u>Construction company</u>	Site supervision
	Groundwater	<u>New landfill site, Extant landfill slope</u>	<u>Project related amendment</u>		
C_6.1		<i>Groundwater</i> According to the field investigations from 2014 the soil profiles show a permeable layer consisting of pebble-soil with sand and sandy loam (Annex 1, Layer C). It can be concluded that there exists a discontinuous upper local groundwater layer locally detected at few locations in approx. 2m depth from the top surface at	<i>Groundwater</i> The remediation of this water layers is required by covering (Slope sealing) the extant landfill and by reduction of surface water penetration. As a result of the covering of the extant landfill, the contamination in the water layer on the area of the new landfill will decrease, since no surface water can penetrate into the extant landfill.	<u>Client (Detailed Design)</u> <u>Construction company</u>	Ground water monitoring


Con-flict no.	Asset / Indicator	Impact description	Measure type and mitigation and compensation measures	Respon-sibility	Monitoring measures
		<p>the new landfill area. This layer contains contaminated waters from the extant landfill.</p> <p>The analyzed water samples show the typical contamination of leachate with high contents of sulphate and chloride</p> <p>It can be concluded that the upper local water layers in the area of the new landfill are already contaminated by the extant landfill. The analyzed water samples show the typical contamination of leachate with high contents of sulphate and chloride.</p>	<p>Due to the</p> <ul style="list-style-type: none"> inhomogeneous underground structure with a permeable layer and the encountered water layer in Borehole 10, Pit 1, Pit 4 and Pit 7 <p>the existence of a coherently homogenous natural geological barrier cannot be assumed.</p> <p>Therefore, for the construction of the base sealing for the new landfill, a geological barrier has to be established by artificial clay layers according to Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste.</p> <p>Due to these measures no groundwater will be additionally contaminated.</p> <p>The irrigation measures beside the area of the new landfill have to be stopped to reduce the water penetration into the soil.</p>		
C_6.2		<p><i>Groundwater</i></p> <p>Problems of spills on the ground and infiltration of contaminants to ground water table</p>	<p><i>Groundwater</i></p> <p>Stockpile areas and storage areas for hazardous substances shall be located away from water bodies.</p> <p>Washing of machinery and vehicles in surface waters shall be prohibited in order to avoid infiltration.</p>	<p><u>Construction company</u></p> <p>Site supervision</p>	Site supervision
	Surface water	<u>New landfill site, Extant landfill slope</u>	<u>Project-related amelioration</u>		
C_7.1		<p><i>Leachate surface water</i></p> <p>The Leachate surface water originates</p>	<p><i>Leachate surface water</i></p> <p>During construction a temporary drainage shall be</p>	<p><u>Client</u></p> <p><u>(Detailed)</u></p>	Leachate surface

Con-flict no.	Asset / Indicator	Impact description	Measure type and mitigation and compensation measures	Respon-sibility	Monitoring measures
		from the western slope foot of the extant landfill where it appears at the surface and flows as a leachate stream to the "leachate pond inner investigation area"	implemented to collect the leachate surface water until the base sealing and the first step of the slope sealing is implemented	<u>Design)</u> <u>Construction company</u>	water monitoring
C_7.2		<p><i>Clear surface water</i></p> <p>The clear surface water was detected in the western part of the new landfill area. As origin of this clear surface water, several leakages in a water transmission pipe could be identified. This transmission water supply pipe (diameter approx. 800mm) which supplies Yerevan city from Garni is passing beside the area of the new landfill at the south west part.</p> <p>From these leakages the clear water runs off in small streams and partly extensively towards the area of the new landfill, where it forms two streams which are passing towards northwest, where it unites with the above mentioned stream of leachate surface water.</p>	<p><i>Clear surface water</i></p> <p>As a prerequisite for the construction of the new landfill the origin of this clear surface water has to be eliminated by repairing of all leakages in the water supply pipe Garni - Yerevan.</p> <p>Further temporary storm water channels shall be constructed at the border of the project area to avoid runoff of surface water into the area of the new landfill</p>	<p><u>VEOLIA Djur</u></p> <p><u>Client (Detailed Design)</u></p> <p><u>Construction company</u></p>	Surface water monitoring
C_7.3		<p><i>Surface Water</i></p> <p><i>Quantitative effects</i></p> <p>Contamination of surface water by waste water from the construction and accommodation facilities.</p>	<p><i>Surface Water</i></p> <p><i>Quantitative effects</i></p> <p>Contamination of surface water by waste water from the construction and accommodation facilities.</p>	<p><u>Construction company</u></p> <p>Site supervision</p>	Surface water monitoring
No conflict	Climatic conditions	<p><i>Micro-climate</i></p> <p>No impact</p>			

Con-flict no.	Asset / Indicator	Impact description	Measure type and mitigation and compensation measures	Respon-sibility	Monitoring measures
	Cultural heritage	<u>New landfill site, Extant landfill slope</u>	<u>Precautionary measure</u>		
C_8		<i>Cultural heritage</i> Unexpected discovery of cultural heritage (archaeological site) through the conduction of construction works	<i>Cultural heritage</i> - Preparedness - Recurring inspections - Rapid assessment and salvage if appropriate	<u>Construction company</u> Site supervision	Recurrent inspections by expert
No conflict	Social and Economic impacts	<i>Social and economic impacts</i> See operational impacts			
Site specific conflicts – operation phase (“O”)					
	Human being	<u>New landfill site</u>	<u>Mitigation measures</u>		
O_1		<i>Noise and (Vibration)</i> Due to the partially poor technical standard of the equipment which will be still in use, the people who are working there are exposed noise emission and other health risks caused by noise.	<i>Noise and (Vibration)</i> <ul style="list-style-type: none"> • PPE (especially ear protection) • Renewal of equipment with low noise output (trucks, wheel loader, excavator, tools) • Regular maintenance of the equipment • Special protection wear for the employees on working stations with relevant noise sources (ear protection) • Insulate the windows of the office building and other working stations against noise • Speed limits on the landfill site 	<u>Operator of New Landfill site</u>	
		<u>New landfill site</u>	<u>Mitigation measures</u>		<u>Monitoring measures</u>
O_2		<i>Air pollution (Landfill gas migration risk)</i>	<i>Air pollution (Landfill gas migration risk)</i>	<u>Operator of New Landfill</u>	Climate control

Con-flict no.	Asset / Indicator	Impact description	Measure type and mitigation and compensation measures	Respon-sibility	Monitoring measures
		<p>In addition to the main components of landfill gas methane, CO₂, oxygen and nitrogen, landfill gas may bear toxic, resp. carcinogenic substances.</p> <p>Landfill gas emissions are only possible at temporary open insertion areas depending on external conditions and availableness of humidity. However, short-terms emissions are possible to occur.</p>	<ul style="list-style-type: none"> Cover waste as soon as possible to keep the time where emissions can outgas as short as possible. Minimisation of open tipping areas. Prevent landfill gas from migrating outward of the landfill body by the proposed gas capture system including flaring. The system creates a vacuum within the landfill body, which hinders gas migration. Conduct waste acceptance control in order to avoid waste compositions which are known to cause elevated levels of trace substances in the landfill gas. Apply limits concerning the air quality on the landfill site and indoor. Cabin air condition of landfill machinery Irrigation of the waste moist and to prevent dust formation by working with trucks and bulldozers. The irrigation also serves to maintain the biological degradation processes and ensures continuous gas production. 	<u>site</u>	<p>points: measuring of the temperature precipitation and evaporation</p> <p>Air Quality monitoring: dust measure-ment / outside and indoor air quality monitoring.</p>
		<u>New landfill site, Extant landfill slope, Access road</u>	<u>Project-related amendment</u>		
No conflict		<p><i>GHG emissions</i></p> <p>CH₄ has a 21 times higher than CO₂ driving force concerning its global warming potential.</p> <p>Without flaring the landfill gas 9,479 tons methane per year would be emitted what corresponds to 199,052 tons of CO₂</p>	<p><i>Gas capture and gas flare</i></p> <p>Comparing the “zero-option” without flaring with the “planned option” including flaring the benefit covers 172,121 tons/year CO₂ equivalents considering the differences in molar mass of these components.</p> <p>Due to the expected effectiveness of gas flare of</p>	<u>Operation company</u>	Monitoring of flaring efficiency

Con-flict no.	Asset / Indicator	Impact description	Measure type and mitigation and compensation measures	Respon-sibility	Monitoring measures
		equivalents per year.	99,5% a rest quantum of 47 tons methane per year is expected to be emitted which corresponds to 995 tons of CO ₂ equivalents per year. <i>EBRD categorisation of municipal landfills</i> Altogether 26 kt of CO _{2e} /year are emitted by the project considering the landfill gas flaring. The given range of the EBRD Greenhouse Methodology of GHG emissions 2010 is not exceeded.		
		<u>New landfill site, extant landfill slope, Nubarashen town</u>	<u>Project-related amendment</u>		<u>Monitoring measures</u>
No conflict		<i>Odour</i> Uncontrolled burning and uncontrolled degradation of organic matter cause odour nuisance within the nearby surroundings. Especially in the town of Nubarashen. A trail of smoke is widely visible. Traces of the landfill gas H ₂ S especially cause odour nuisance	<i>Odour</i> <ul style="list-style-type: none"> Coverage as soon as possible Minimisation of open tipping area. Conduct waste acceptance control in order to avoid waste compositions which are known to cause elevated levels of trace substances in the landfill gas. In case of the avoidance of odour the focus has to be set on degradable materials and material contain sulphates (e.g. from construction wastes). Concerning the open landfill zones, which are the crucial point for odour nuisance the project, foresees the waste and its organic compounds are continuously irrigated. This technique will accelerate the degradation of organic compounds and reduces the volume of waste. Prevent landfill gas from migrating outward of 	<u>Operator of the new landfill</u>	Regular review of landfill gas measurements and management protocols

Con-flict no.	Asset / Indicator	Impact description	Measure type and mitigation and compensation measures	Respon-sibility	Monitoring measures
			the landfill body by the proposed gas capture system including flaring. The system creates a vacuum within the landfill body, which hinders gas migration. • Cabin air condition of machinery		
		<u>Nubarashen road (entrance to landfill site)</u>	<u>Mitigation measures</u>		
O_3		<p><i>Accidents</i></p> <p>At the junction area where the access road of the landfill leads into “Nubarashen road” it was reported that accidents have occurred with partly lethal output (three victims) and injured locals. The accidents mainly caused by waste trucks which are driving unlighted in the dark with high speed on this road and who are stopping /parking on this road.</p>	<p><i>Accidents</i></p> <p>At the latest when the operation of the new landfill begin the following measures should be already implemented to avoid accidents:</p> <ul style="list-style-type: none"> - Installation of Speed bumps at “Nubarashen road” in the area of 200m north and 100 south of the entrance to the landfill  <p><i>Photo: sample of speed bumps.</i></p> <p>According to Yerevan Municipality, traffic management unit of transport department the “normative 2008 No 113-N 5th appendix” shall be applied for installation of speed bumps. Further for</p>	<p>Client (Detailed Design)</p> <p>Municipality, traffic management unit of transport department: Road police</p> <p>(The measures are agreed with the Yerevan Municipality)</p>	

Con-flict no.	Asset / Indicator	Impact description	Measure type and mitigation and compensation measures	Respon-sibility	Monitoring measures
			<p>installation of speed bumps the existence of a speed limit of 40km/h on the respective road section is a prerequisite. (agreed with Municipality Yerevan)</p> <ul style="list-style-type: none"> - Installation of streetlights at "Nubarashen road" in the area of 200m north and 100m south of the entrance to the landfill - Marking of street boundaries on the asphalt at "Nubarashen road" in the area of 1,4km north and 600m south of the entrance to the landfill <p>By this measurement the waste lorries and other vehicles have the possibility to park on the side strip not hindering the main traffic. Both men and women would benefit equally from this measure.</p>		
	Landscape	<u>Area of investigation</u>	<u>Mitigation measures; project-related amelioration</u>		
O_6		<p><i>Landscape</i></p> <p>Loss of open area; loss of vegetation structures; disruption of visual axes, changing of relief.</p> <p>Uncontrolled burning is causing a trail of smoke widely visible.</p>	<p><i>Landscape</i></p> <p>As a project related amelioration, uncontrolled burning will stop.</p> <p>As an aftercare of the closure phase of 5 landfill zones a natural soil cover of 1m thickness will be rehabilitated by using local sources of topsoil. As a result thereof integration within the surrounding scenery of the landfill site is promoted. Referring to the mitigation measure for the asset flora, location-typical biotic communities are promoted. Natural soil has to be acquired in the adjacent area.</p> <p>An alley should be planted in order to enhance the natural scenery and reduce the visibility of the landfill site. 50 trees of White and Black Mulberry</p>	<u>Operator of the new landfill</u>	

Con-flict no.	Asset / Indicator	Impact description	Measure type and mitigation and compensation measures	Respon-sibility	Monitoring measures
			are planted in one row alley. This measure helps to reduce the visual impacts until the closure is completed. A surplus of soil remaining from the clearance should be used as an earthwork for protection of the alley. The earthworks also have a shielding effect towards the landfill. The earthwork should be located and conducted parallel to the alley planting.		
		<u>New Landfill, Access road</u>	<u>Mitigation measures</u>		
O_6.1		<i>Litter</i> Litter causes a negative visual impact and can cause significant nuisance to those neighboring a facility, and can in certain circumstances lead to harm of wildlife or livestock. Good litter control is proactive and can greatly reduce the escape of litter	<i>Litter</i> The use of techniques such as the following may be used to help eliminate loose litter at landfills: Renewal of waste trucks, coverage of waste trucks (Bailing of waste) Daily cover of the tipping area Using appropriate cover materials and quantities to ensure that deposited waste is held in place - more frequent application of cover may be required during high winds or in exposed areas Full enclosure of the tipping area within a mobile litter net system Strategically placed mobile catch fences close to the tipping area or on the nearest downwind crest.	<u>Operator of the new landfill</u>	
	Fauna and Flora	<u>New Landfill site,</u>	<u>Mitigation measures</u> <u>Compensation measures</u>		

Con- flict no.	Asset / Indicator	Impact description	Measure type and mitigation and compensation measures	Respon- sibility	Monitoring measures														
O_7.1		<p><i>Flora</i></p> <p><i>Loss of vegetation types</i></p> <p>Clearing and the total loss of land for the new landfill site will be connected with this activity. Clearance is envisaged up to borders of the project components., a loss of structures, loss of soil (natural and contaminated) and a loss of vegetation.</p> <table><tr><th>Vegetation type (project-related permanent loss)</th><th>Size in Ha</th></tr><tr><td colspan="2">Dry vegetation types</td></tr><tr><td>Semi-natural steppic herbaceous grasslands, very-dry</td><td>3.68</td></tr><tr><td>Semi-natural steppic herbaceous grasslands</td><td>21.51</td></tr><tr><td>Shrubs</td><td>0.05</td></tr><tr><td colspan="2">Moist vegetation types</td></tr><tr><td>Anthropogenic reed zones</td><td>1.44</td></tr></table>	Vegetation type (project-related permanent loss)	Size in Ha	Dry vegetation types		Semi-natural steppic herbaceous grasslands, very-dry	3.68	Semi-natural steppic herbaceous grasslands	21.51	Shrubs	0.05	Moist vegetation types		Anthropogenic reed zones	1.44	<p><i>Flora</i></p> <p><i>Loss of vegetation types</i></p> <p>Due to technical restrictions the top sealing of the new landfill body is not foreseen to be rehabilitated by planting of trees. To meet nature protection requirements the rehabilitation of the new surface shall be as steppic grassland. Soil should only be used from the sites in the vicinity to avoid the introduction of invasive alien species. Vegetation will follow the natural succession process and come up spontaneously. Soil remaining from the clearance is used for earthworks (see measures for landscape)</p> <p>Cleaning of the uncontrolled dumping site to improve the habitat structure of steppic herbs.</p> <p>The compensation of shrubs is implemented within a plantation of trees at the roadside of Nubarashen road oriented towards the landfill. 50 trees of White and Black Mulberry are planted in an one row alley. This measure is also referring to the mitigation needs of the asset landscape.</p>	<p><u>Operator of the new landfill</u></p> <p><u>Hye Antar: Armenian Forestry Agency under the Ministry of Agriculture</u></p>	.
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O_7.2		<p><i>Fauna</i></p> <p><i>Loss of animal habitats</i></p> <p>Clearing and the total loss of land for the new landfill site will be connected with this activity. Clearance is envisaged up to borders of the project components. The clearance activity will involve a loss a loss of structures, loss of soil (natural and</p>	<p><i>Fauna</i></p> <p><i>Loss of animal habitats</i></p> <p>Due to technical restrictions the top sealing of the new landfill body is not foreseen to be rehabilitated by planting of trees. To meet nature protection requirements the rehabilitation of the new surface shall be as steppic grassland. Soil should only be used from the site to avoid the</p>	<p><u>Operator of the new landfill</u></p> <p><u>Hye Antar: Armenian Forestry Agency under the Ministry of Agriculture</u></p>															

Con- flict no.	Asset / Indicator	Impact description	Measure type and mitigation and compensation measures	Respon- sibility	Monitoring measures														
		<p>contaminated) and a loss of habitats.</p> <table><tr><th>Faunistic type (project-related permanent loss)</th><th>Size in Ha</th></tr><tr><td colspan="2">Dry habitat types</td></tr><tr><td>Degradated steppic farmland, very-dry</td><td>3.68</td></tr><tr><td>Degradated steppic farmland, normal</td><td>21.51</td></tr><tr><td>Shrubland</td><td>0.05</td></tr><tr><td colspan="2">Moist habitat types</td></tr><tr><td>Anthropogenic reed zones</td><td>1.44</td></tr></table>	Faunistic type (project-related permanent loss)	Size in Ha	Dry habitat types		Degradated steppic farmland, very-dry	3.68	Degradated steppic farmland, normal	21.51	Shrubland	0.05	Moist habitat types		Anthropogenic reed zones	1.44	<p>introduction of invasive alien species. Vegetation will follow the natural succession process and come up spontaneously.</p> <p>The most effective balancing measures are a) protect the central habitats in former farmland areas within the reforestation zone, b) restore degraded habitats by cleaning from waste and c) create new habitats on top of the solid waste site as already integrated into the project. These measures make sure that a long lasting presence of these species and the whole species community is possible in the area.</p> <p>The compensation of shrubs is implemented within a plantation of trees at the roadside of Nubarashen road oriented towards the landfill. 50 trees of White and Black Mulberry are planted in an one row alley. The trees are creating a guiding structure for migrating mammals. This measure is also referring to the mitigation needs of the asset landscape.</p>		
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O_7.3		<p><i>Endangered species (IUCN red list)</i></p> <p>Old garden structures outside the project area are potential habitats for endangered species <i>Testudo graeca</i> (IUCN Red List "vulnerable") and <i>Eremias pleskei</i> (IUCN Red List "Critically endangered"). The species and their potential occurrence are to be considered by mitigation measures</p>	<p><i>Endangered species (IUCN red list)</i></p> <p>In order to mitigate any impact on the potentially occurring species:</p> <ul style="list-style-type: none">- Use of a mobile reptile guiding system (consisting of the same material that is used to avoid collision with amphibians); the location of the fence is displayed in map YSW_ESIA_A1_01.- Relocation of animals – in the unlikely case – the animals are found at the landfill area.	<p><u>Operator of the new landfill</u></p> <p><u>Hye Antar:</u> <u>Armenian Forestry Agency under the Ministry of Agriculture</u></p> <p><u>Yerevan Municipality</u></p>	<p>Site supervision</p> <p>Recurrent inspections by expert</p>														

Con-flict no.	Asset / Indicator	Impact description	Measure type and mitigation and compensation measures	Respon-sibility	Monitoring measures
			- Protection of the gardens for the animals that might be found in the landfill area need to be relocated to the suitable habitats (old gardens marked out as a no-go area)		
	Pest-Control	<u>New Landfill site,</u>	<u>Mitigation measures</u>		Monitoring measure
O_7.4		<p><i>Pest-Control</i></p> <p>Solid landfill attract are likely to undesirable species as birds, flies, rodents and insects (regarded as vermin).</p>	<p><i>Pest-Control</i></p> <ul style="list-style-type: none"> - Covering of waste as soon as possible - In case of long extended waste collection periods, redress at waste collection company. - Careful use of insecticides - Be aware of waste that attracts rodents (meat, cooked foods. Prompt covering, compaction and covering of food wastes helps rodent infestation. - Covering or burial of waste excavated. 	<u>Operator of the new landfill</u>	Site supervision
O_8		<p><i>Forest</i></p> <p>Forest land due to Law is at an amount of 20.55 ha is affected by the new landfill project.</p> <p>Reforestation efforts were made on an area of 17.91 ha. From this number only 15% of forests trees were grown successfully. Therefore the loss of existing forest culture (< 5 years old) amounts to 2.7ha.</p>	<p><i>Forest</i></p> <p>The loss of forest land is and consequential compensation and reforestation issues are to be negotiated between the Yerevan Municipality and the Armenian State Forestry Agency under the Ministry of Agriculture. The compensation of forest land is in Armenia follow the ratio 1:2 (information according to the Hye Antar)</p> <p>A suitable location for reforestation around the landfill site are situated on the slopes toward the compressor station (refer to map 2).</p> <p>It has to be noted that the issue of forest losses (remaining 15% of plantations) and "Greenbelt-</p>	<p><u>Hye Antar: Armenian Forestry Agency under the Ministry of Agriculture</u></p> <p><u>Yerevan Municipality</u></p> <p>Clearances including tree cutting will require prior permission</p>	

Con-flict no.	Asset / Indicator	Impact description	Measure type and mitigation and compensation measures	Respon-sibility	Monitoring measures
			<p>structures" (irrigation systems, fences) are up to negotiations between the Yerevan Municipality and the State of Armenia (respective the Forestry Agency Hye Antar).</p> <p><i>Reforestation</i></p> <p>The reforestation has to follow the natural semi-arid conditions. To avoid soil degradation by salinization as a result of the surface irrigation only climate adapted regional tree and shrub species shall be used. This needs to develop nurseries of these species in time. Artificial irrigation is given during dry periods only within the first five years.</p> <p>Normal habitats and slopes, eg.:</p> <p><i>Acer campestre</i></p> <p><i>Pyrus complexa</i></p> <p><i>Quercus sp.</i></p> <p><i>Sorbus hajastana</i></p> <p><i>Staphylea pinnata</i></p> <p><i>Ulmus minor</i></p> <p>Dry habitats, eg.</p> <p><i>Hippophae rhamnoides</i></p> <p><i>Tamarix octandra</i></p> <p>No invasive species like <i>Acer negundo</i> shall be planted. Other critical species as <i>Ailanthus altissima</i> and <i>Robinia pseudacacia</i> shall be</p>	from forest department	

Con- flict no.	Asset / Indicator	Impact description	Measure type and mitigation and compensation measures	Respon- sibility	Monitoring measures
			controlled and – in case of occurrence – eradicated.		
No conflict	Protected areas	<i>Protected areas</i> No impact			
	Geology / Geo- morphology/ Soil	New Landfill site, Extant landfill slope, <u>Access road</u>	<u>Project-related amendment</u>		
O_9.1		<i>Landslide / Erosion</i> Based on the zoning map of the SOVIET STUDY 1980, the location of the proposed new landfill of Nubarashen is located in “zone II” which is described as “ relatively stable, suitable for constructions after making protective measures ”	<i>Landslide / Erosion</i> <ul style="list-style-type: none"> Maintenance of storm water channels around the new landfill Implementing of slope sealing at extant landfill during operation of landfill zone 1 and 2 Surface sealing of other part of extant landfill 	<u>Client</u> <u>(Detailed</u> <u>Design)</u> <u>Operation</u> <u>company</u>	
O_9.2		<i>Earthquake</i> According to Armenian regulating the construction and design “CN&R of 2.02-94” the area of the new landfill is dedicated to the third zone and according to MSK-64 (Medwedew-Sponheuer-Karnik-Skala) to the intensity scale No 9 regarding earthquakes	<i>Earthquake</i> Possible damages in the clay liner of the base sealing will be closed due to the self-healing processes of clay by absorbing water and swelling up.	<u>Client</u> <u>(Detailed</u> <u>design)</u>	
No conflict	Impacts on mining	No impact			
	Impacts on	New landfill site, Extant landfill slope,	<u>Mitigation measures</u>		

Con-flict no.	Asset / Indicator	Impact description	Measure type and mitigation and compensation measures	Respon-sibility	Monitoring measures
	brownfields	<u>Access road</u>			
O_9.3		<p><i>Brownfields</i></p> <p>Besides all safety measurements due to unforeseen circumstances soil could be contaminated.</p>	<p><i>Brownfields</i></p> <p>In such cases contaminated soil shall be deposited at the new landfill which is in operation.</p>	Operation Company	
	Groundwater	<u>New landfill site, Extant landfill slope</u>	<u>Project-related amendment</u>		
O_10		<p><i>Groundwater</i></p> <p>Based on the field investigations from 2014 it can be concluded that there exists a discontinuous upper local groundwater layer locally detected at few locations in approx. 2m depth from the top surface at the new landfill area.</p> <p>It can be concluded that the upper local water layers in the area of the new landfill are already contaminated by the extant landfill. The analyzed water samples show the typical contamination of leachate with high contents of sulphate and chloride.</p>	<p><i>Groundwater</i></p> <p>To mitigate further contamination of these water layers it is required to cover (by Surface sealing) the extant landfill and to reduce the surface water penetration.</p> <p>As a result of the covering of the extant landfill, the contamination in the water layer on the area of the new landfill will decrease, since no surface water can penetrate into the extant landfill.</p>		
No conflict	Surface water	<u>New landfill site, Extant landfill slope</u>	<u>Project-related amendment</u>		
O_11.1		<p><i>Leachate surface water</i></p> <p>The Leachate surface water originates from the western slope foot of the extant landfill where it appears at the surface and flows as a leachate stream to the <u>"leachate pond inner investigation area"</u></p>	<p><i>Leachate surface water</i></p> <p>The remediation is required by covering (surface sealing) the extant landfill and by reduction of surface water penetration.</p> <p>As a result of the covering of the extant landfill, less leachate will seep out of the extant landfill</p>	<p><u>Client</u> <u>(Detailed Design)</u></p> <p><u>Operation company</u></p>	

Con-flict no.	Asset / Indicator	Impact description	Measure type and mitigation and compensation measures	Respon-sibility	Monitoring measures
			and runoff into the new landfill in the area where the slope sealing is still not implemented		
O_11.2		<p><i>Leachate in the new landfill</i></p> <p>During operation of the new landfill, leachate will be generated from the deposited waste. This leachate will be collected in a leachate reservoir from where it will be irrigated on the surface of the landfill zones. This means at normal conditions no leachate has to be treated outside the landfill except following exceptional situation:</p> <ul style="list-style-type: none"> In case of very heavy rain the leachate reservoir may reach the limit. In the beginning of the operation phase of the new landfill when still small amount of waste is deposited, the irrigation of leachate could be not performed so efficient and the leachate reservoir may reach the limit. 	<p><i>Leachate in the new landfill</i></p> <p>In case the leachate reservoir reaches the upper limit a tank lorry has to collect the leachate from the leachate reservoir and deliver it to a waste water treatment plant.</p> <p>The mitigation of above mentioned circumstance could be avoided / delayed by restrictive application of the operation manual of the new landfill (e.g. in summer more amount of leachate could be irrigated to allow more space in the leachate reservoir for the rainy period)</p>	<u>Operation company</u>	
No conflict	Cultural heritage	<p><i>Cultural heritage</i></p> <p>See constructional impacts</p>			
	Social and economic impacts	<u>Settlements of waste-pickers, New Landfill site</u>	<u>Mitigation measures, Compensation measures</u>		Monitoring / Cooperation measures
O_4		<i>Social and economic displacement impacts</i>	<i>Social and economic displacement impacts</i>	Operator of the	LRF Monitoring

Con-flict no.	Asset / Indicator	Impact description	Measure type and mitigation and compensation measures	Respon-sibility	Monitoring measures
		By the implementation of the project and the demands of a modern landfill (fencing, security requirements) the income structure from waste-picking is permanently lost which triggers the project impact of economic displacement.	<p>As an adequate mitigation procedure a Livelihood restoration framework (LRF) is required to be designed.</p> <p>The vulnerable groups identified are:</p> <ul style="list-style-type: none"> - Unemployed individuals engaged in waste-picking activities, - Staff of “Erebuni Makrutyun “CSJC” working at the landfill and engaged in waste-picking activities, - Families of waste-pickers, including women, children and elderly. <p>The LRF will include a full census of all affected people, a cut-off date registry for compensation.</p> <p>The compensation is designed to mitigate economic loss by supporting the affected people to find alternative sources of income through</p> <p>Vocational trainings in order to re-enter other rep. former occupations are envisaged. (refer to ESDD 08. Livelihood Restoration Framework). An experienced person is envisaged to support PAPs during training and job search.</p> <ul style="list-style-type: none"> - Access to social welfare and requirements to benefit from social welfare (as registration, passport, other legal requirements). Support for legal eligibility. - Public transportation system connecting the waste-picker settlement (Nubarashen street 2-4). The bus stop needs to be illuminated to reduce the danger for women during the night. (Yerevan Municipality confirmend the 	new landfill site Yerevan Municipality (Public Transport, Transitional allowance)	and conduction by an independent NGO Full Census Cut-off date registry procedure Vocational training Social welfare aid and access Grievance procedure

Con-flict no.	Asset / Indicator	Impact description	Measure type and mitigation and compensation measures	Respon-sibility	Monitoring measures
			<p>implementation, Rudik Tadevosyan e-mail 04/2015)</p> <ul style="list-style-type: none"> - Transitional allowance (in case other options do not achieve desired access. - Special measures to be given to of PAPs as women, children and elderly people who are disproportionately affected. In regard to the waste picking community, any differentiated impact will be identified as will any measures that might be needed under a LRF to ensure that men and women are given equal opportunities to benefit from any vocational training of job opportunities. - 		
O_4.1		<p><i>Gender issues</i></p> <p>As identified within the operation of the old landfill and within the superordinate operator (Yerevan Municipality) the involvement of women is underrepresented in terms of decision-taking positions, part-time working hours, flexibility and possibilities of child care.</p>	<p><i>Gender issues</i></p> <ul style="list-style-type: none"> - With respect to the municipality, it is foreseen identify a person of responsible for gender and equal opportunities within both the municipality and solid waste company. 	Operator of the new landfill site Yerevan Municipality	By enhance-ment of the gender team can develop Technical Cooperation to support the promotion of equal opportunitie s

Con-flict no.	Asset / Indicator	Impact description	Measure type and mitigation and compensation measures	Respon-sibility	Monitoring measures
O_4.2		<p><i>Social well-being</i></p> <p>Landfill Operator and Construction Company / Human Ressources and Employment</p> <p>The project offers permanent jobs for 25 people (just for the operation of the landfill site, see E+S Management Review)</p>	<p><i>Gender mainstreaming issues</i></p> <p>The selection process for new jobs during the operation phase should offer equal working opportunities for men and women. Furthermore models for working hours should consider the different needs of women. Part-time jobs e.g. should be considered.(to ensure reconciliation policies). Therefore those companies should be encouraged in the following tendering phase for the operation of the landfill site, that consider these aspect in their company. Also during the setting of a organizational structure within the Yerevan Municipality to manage this project in the construction and operation phase also the mentioned aspects should be considered. The monitoring of gender related issues should be monitored by the identified person, who is responsible for gender issues.</p>	Operator of the new landfill site Yerevan Municipality	By enhance-ment of the gender team can develop Technical Cooperation to support the promotion of equal opportunitie s
O_5		<p><i>Land acquisition</i></p> <p>Land acquisition is quantified in total 20.55 ha for the new landfill site, which is not under the purview of the Yerevan Municipality. The land is forest land and belongs of the Hye Antar: Armenian Forestry Agency under the Ministry of Agriculture.</p> <p>The loss of land has no gender related issues.</p>	<p><i>Land acquisition</i></p> <p>The required land for the new landfill site which is not under the purview of the Yerevan Municipality and the current operator (old landfill) needs to be acquired. Compensation is an issue of negotiations.</p> <p>The loss of forest land is and consequential compensation and reforestation issues are negotiated between the Yerevan Municipality and the Armenian State Forestry Agency under the Ministry of Agriculture (refer also to O_8)</p>	<p><u>Yerevan Municipality</u></p> <p><u>Hye Antar: Armenian Forestry Agency under the Ministry of Agriculture</u></p>	

Figure 69: Tabular Environmental Management Plan

10.2 Remaining Impact/Risks and their Management

No residual major or moderate impacts were identified in the ESIA “ESDD4”. All impacts are addressed by respective mitigation and compensation measures. In addition to that several impacts are addressed by project-related amendments.

Considering the above mentioned measures an environmentally and socially compliant project **can be** built and operated.

10.3 Project Benefits and Opportunities for their Enhancement

- Reduction of Air pollutants
- Reduction of Odour (Termination of trail of smoke)
- Elimination of contamination of water and solid resulting from the leachate stream
- Improvement of life quality in Nubarashen and Erebuni
- Reduction of potential danger (Safety, Diseases)
- Know-how transfer during construction Phase
- Improvement of business situation

10.4 Environmental and Social Monitoring

Monitoring activities are required for the whole lifetime of the landfill. For the implementation of an effective monitoring program, in accordance with national and international regulations and the requirements of the EBRD, the following key monitoring activities have to be carried out:

- Environmental Monitoring Program
- Social Monitoring Program

For the monitoring of environmental conditions surrounding the landfill area the following facilities are planned. The sampling and analysis complies with the guidelines set out in the Directive 1999/31/EC of 26 April 1999 for waste landfills (EU Directive).

- Groundwater probes in the groundwater inflow and run-off stream to measure the groundwater quality
- Climate control points: measuring of the temperature, precipitation, evaporation
- Air quality monitoring
- Surface water control point
- Recurrent expert visits for fauna

For the monitoring of social conditions at the landfill area the following actions are planned and the social impacts to the population should be evaluated. The program will include the following elements:

- Monitoring of social benefits from the project
- Tariff monitoring with focus to the monthly household income
- Grievance management from the population and workers
- Monitoring of collection rates

10.5 Preparation and Implementation of Environmental and Social Action Plan

The results of ESDD 3 “E&S Management Review” and ESDD 4 “Environmental and Social Impact Assessment” are gathered in the ESDD 5 “Environmental and Social Action Plan” (ESAP). Within the ESAP, all mitigation, compensation and project-related amendments are compiled. In order to meet the EBRD policy requirements every measure refers to the policy requirements published by the EBRD in 2008.

10.6 Difficulties and Supplementary Environmental and Social Studies to be carried out

No difficulties were identified during the assessment of the environmental and social aspects of the project. No further due diligence documents are recommended to be carried out.

11. LITERATURE

Noise and Air Pollution:

- Austrian Federal Ministry of Environment & University of Graz (2014): Noise estimations for roads. In: <http://www.laerminfo.at/situation/laermrechner.html>
- Berglund, B. Lindvall, T. & D. H. Schwela (1995): Guidelines for Community Noise. World Health Organisation (WHO), Geneva.
- RVS 04.01.11 (2008) - Environmental Examination, Austrian Research Association for Roads, Railroad and Transport.
- RVS 04.02.12 (2013): Environmental Protection: Air pollution. Dispersion of airborne pollutants from transport and routes and tunnel portals. Austrian Research Association for Roads, Railroad and Transport.
- World Health Organisation (2005): WHO Air quality guidelines for particulate matter, ozone, nitrogen, dioxide and sulphur dioxide. Global update 2005. Summary of risk assessment. Geneva.

Flora:

- CHEMONICS INTERNATIONAL INC. (2000): Biodiversity Assessment for Armenia, report to USAID WASHINGTON E&E BUREAU, ENVIRONMENT & NATURAL RESOURCES DIVISION, 65 pp.
- Ministry for Nature Protection (1999): Biodiversity Strategy and Action Plan for the Republic of Armenia, 117 pp. Yerevan
- Ministry for Nature Protection (1999): First National Report to The Convention on Biological Diversity incorporating A Country Study on the Biodiversity of Armenia, 102 pp., Yerevan
- Ministry of Nature Protection (2010): Red Data book of Armenia

Fauna:

- Aghasyan A., L. Aghasyan, E. Yeghiasaryan, S. Amiryan (2013): Amphibians and Reptiles in the New Edition of the Animals' Red Data Book of Armenia, Agriculture, Forestry and Fisheries. Vol. 2, No. 2, 2013, pp. 77-88.
- Aslanyan A, M. Arakelyan, G. Papov, M. Yegisaryan, M. Mnacakanyan, H. Yegoyan & R. Petrosyan (2013): Conservation of critically endangered Species of Reptiles of Araralt Valley, Armenia. Report 12 pp.
- CHEMONICS INTERNATIONAL INC. (2000): Biodiversity Assessment for Armenia, report to USAID WASHINGTON E&E BUREAU, ENVIRONMENT & NATURAL RESOURCES DIVISION, 65 pp.
- Hayrapetyan T. A., A. V. Aslanyan, G. Yu. Papov , A. S. Ghazaryan (2014): New data on small Mammals (Insectivora, Chiroptera, Rodents) in southern part of Armenia, Proceedings of the Yerevan State University: 2014, № 2, p. 43–47
- Ministry for Nature Protection (1999): Biodiversity Strategy and Action Plan for the Republic of Armenia, 117 pp. Yerevan
- Ministry for Nature Protection (1999): First National Report to The Convention on

Biological Diversity incorporating A Country Study on the Biodiversity of Armenia, 102 pp., Yerevan

- V.Yu. Savitsky (2009): Fauna, structure of communities and acoustic signals of grasshoppers (Orthoptera, Acridoidea) in environs of the Dzhanibek Research Station. CAUCASIAN ENTOMOLOGICAL BULL. 2009: 5(1): 29-49

Geology:

- Geological Map of Republic Armenia; Scale 1:500.000; (Ministry of Nature Protection of Republic Armenia); year 2005; English Version
- Hydrogeological Map of Republic of Armenia; Page K-38-XXXIII (Yerevan); Scale 1:200.000; year 1963; (unofficial English translation)
- Especially: *"REPORT on engineer-geological studies in the landslide section of territory radioactive waste storage in Sovetashen region, Yerevan, Armenian SSR in 1980"* (EXP. N2 / Republic registration N 3-80-19/27); Ministry of Geology of USSR - Geology Management of Armenian SSR. (unofficial English translation). This report hereinafter is called "SOVIET STUDY 1980"
- Report on Environmental Audit for the Nubarashen Landfill in the City of Yerevan, prepared by ATMS Solutions LLC, February 2010 [herein called short: "ATMS"]
- Yerevan Solid Waste Project – Technical Feasibility Study, prepared by Consortium RCE Ringhofer Consulting, Kommunalkredit Public Consulting and Hydro Ingenieure Umwelttechnik, September 2012 [hereinafter called: *"Technical Feasibility Study"*]

GHG Emissions:

- Armenia Solid Waste Management Improvement Project, Asian Development Bank), 2013.
- EBRD Greenhouse Gas Assessment Methodology 2010. In: <http://www.ebrd.com/downloads/about/sustainability/ghgguide.pdf>
- Shimizu Corporation: Nubarashen Landfill Gas Capture and Power Generation Project in Yerevan: Project Design Document, 2005.
- Guideline on landfill gas, Ministry for Environmental Protection, Baden-Wuerttemberg, Germany, 1992
- Guideline on landfill gas, Ministry for Environment, North-Rhine Westphalia, Germany, 2004

Social Assessment and Gender Issues:

- National Statistical Service of Republic of Armenia. 2014. Marzes of the Republic of Armenia and Yerevan city in figures. URL: <http://www.armstat.am/en/?nid=82&id=1607>
- National Statistical Service of Republic of Armenia. 2011. Population census of Armenia.
- National Statistical Service of Republic of Armenia. 2001. Population census of Armenia.
- National Statistical Service of Republic of Armenia. 2003. Population census of Armenia.
- National Statistical Service of Republic of Armenia. 2011. Population census of

Armenia.

- National Statistical Service of Republic of Armenia. 2014. Marzes of the Republic of Armenia
- Yerevan city in figures. URL: <http://www.armstat.am/en/?nid=82&id=1607>
- National Statistical Service of Republic of Armenia. 2011. Population census of Armenia.
- National Statistical Service of Republic of Armenia, Ministry of Health, ICF International. 2012. Armenia: Demographic and Health Survey. URL: <http://dhsprogram.com/pubs/pdf/FR252/FR252.pdf>
- National Statistical Service of Republic of Armenia. 2013. Social Snapshot and Poverty in Armenia. URL: <http://www.armstat.am/en/?nid=539&id=1503>
- National Statistical Service of Republic of Armenia. 2014. Marzes of the Republic of Armenia and Yerevan city in figures. URL: <http://www.armstat.am/en/?nid=82&id=1607>
- Transparency International. 2014. Corruption by country: Corruption Perceptions Index. Armenia 2013. URL: <http://www.transparency.org/country#ARM>
- The World Bank Group. 2014. Worldwide Governance Indicators. URL: <http://info.worldbank.org/governance/wgi/index.aspx#home>
- Reporters Without Borders. 2014. World Press Freedom Index 2014. URL: <http://rsf.org/index2014/en-index2014.php>
- National Statistical Service of Republic of Armenia, Ministry of Health, ICF International. 2012. Armenia: Demographic and Health Survey. URL: <http://dhsprogram.com/pubs/pdf/FR252/FR252.pdf>
- National Statistical Service of Republic of Armenia, Ministry of Health, ICF International. 2012. Armenia: Demographic and Health Survey. URL: <http://dhsprogram.com/pubs/pdf/FR252/FR252.pdf>
- European Bank for Reconstruction and Development 2013: Strategic Gender Initiative
- European Union 2010. Directive 2010/41/EU on the application of the principle of equal treatment between men and women engaged in activity in a self-employed capacity repealing Council Directive 86/613 EEC
- European Commission 2007: Manual for Gender Mainstreaming of Employment Policies
- City of Vienna 2006: Manual for the Integration of Gender Mainstreaming during Project Application
- City of Berlin 2011: Women's Promotion Decree