Ministry of Environment and Physical Planning, Republic of Macedonia

Swedish Environmental Protection Agency, Sweden

"Capacity building for implementation of EU-landfill directive – closure of non-compliant landfills and inspections"

Skopje, 2012

Contents

List of abbreviations

EIA	Environmental Impact Assessment
EU	European Union
IPPC	Integrated pollution prevention and control
LMW	Law on waste management
MoEPP	Ministry of Environment and Physical Planning
MoH	Ministry of Health
MoTC	Ministry of Transport and Communications
PCB	Polychlorinated biphenyls
UNDP	United Nations Development Program

1 INTRODUCTION

The solid waste management situation in the Republic of Macedonia is characterized primarily as substandard and inefficient and system is hampered by serious organizational and technical weaknesses. This has resulted in various dysfunctional systems at national and municipal level and related negative effects on the environment and public health, such as illegal dumping of waste and littering.

The European Union is working to minimize the environmental impacts from waste management and decrease the waste sent to landfill. In order to do this, strict criteria for landfill management has been set up. However, landfills can provide a basis for waste management, to give time to develop more sustainable treatment options

1.1 Principe of landfilling

Landfill site is a site for the disposal of waste materials by burial and is the oldest form of waste treatment. Historically, landfills have been the most common methods of organized waste disposal and remain so in many places around the world.

Typically, in non hazardous waste landfills, in order to meet predefined specifications, techniques are applied by which the wastes are:

1. Confined to as small an area as possible.
2. Compacted to reduce their volume.
3. Covered (usually daily) with layers of soil.

During landfill operations the waste collection vehicles are weighed at a weighbridge on arrival and their load is inspected for wastes that do not accord with the landfill's waste acceptance criteria. Afterward, the waste collection vehicles use the existing road network on their way to the tipping face or working front where they unload their load. After loads are deposited, compactors or dozers are used to spread and compact the waste on the working face. Before leaving the landfill boundaries, the waste collection vehicles pass through the wheel cleaning facility. If necessary, they return to the weighbridge in order to be weighed without their load. Through the weighing process, the daily incoming waste tonnage can be calculated and listed in databases.

Typically, in the working face, the compacted waste is covered with soil daily. Alternative waste-cover materials are several sprayed-on foam products and temporary blankets (soil coverage). Blankets can be lifted into place with tracked excavators and then removed the following day prior to waste placement. Chipped wood and chemically 'fixed' bio-solids may also be used as an alternate daily cover. The space that is occupied daily by the compacted waste and the cover material is called a daily cell. Waste compaction is critical to extending the life of

the landfill. Factors such as waste compressibility, waste layer thickness and the number of passes of the compactor over the waste affect the waste densities.

A large number of adverse impacts may occur from landfill operations. These impacts can vary: fatal accidents (e.g., scavengers buried under waste piles); infrastructure damage (e.g., damage to access roads by heavy vehicles); pollution of the local environment (such as contamination of groundwater and/or aquifers by leakage and residual soil contamination during landfill usage, as well as after landfill closure); offgassing of methane generated by decaying organic wastes (methane is a greenhouse gas many times more potent than carbon dioxide, and can itself be a danger to inhabitants of an area); harbouring of disease vectors such as rats and flies, particularly from improperly operated landfills, which are common in Third-world countries; injuries to wildlife; and simple nuisance problems (e.g., dust, odour, vermin, or noise pollution).

Environmental noise and dust are generated from vehicles accessing a landfill as well as from working face operations. These impacts are best to intercept at the planning stage where access routes and landfill geometrics can be used to mitigate such issues. Vector control is also important, but can be managed reasonably well with the daily cover protocols.

Most modern landfills in industrialized countries are operated with controls to attempt to manage problems such as these.

1.2 Situation in Macedonia with landfilling

Since starting up the provision of solid waste management service in urban areas in the sixties the municipalities have been dedicating the areas for daily disposal of collected waste. Criteria applied usually involved the issues as the public ownership of land, site to be sheltered and preferably not exposed to direct views, located closely to the collection area etc. without considering the environmental aspects. In the seventies there were 34 municipal landfills serving predominantly the disposal purposes of urban areas. Following the establishment of 123 independent municipalities (1996) and foundation of rural solid waste management services about 20 new municipal landfills were created.

The diligence applied with regard to disposal varies as dramatically as most other aspects of operation. In some cases disposal takes place at what may be described as some kind of makeshift landfill, up to 25 km away from the center of town. In most cases, however, the collected waste is simply dumped on an open area, on the slopes of a mountain hill, or along a riverbank just outside town. All waste collected including the industrial and household hazardous and medical waste are mixed and disposed at the same place. Once the void space is filled in, the dumpsite is abandoned (without any closure); another site is selected and exploited.

Previously the MoEPP does not participate obligatory in selection of the new sites, but it happens often that the municipality requests an opinion on the site suitability. Under a special Decision issued by the Government, the MoEPP is in charge of issuing agreement for establishment of so-called “temporary” landfills for which some provisional landfill design is to be prepared by the municipality and followed (not mandatory) by EIA. The procedure is neither standardized nor the technical aspects of the landfill design specified. These “temporary “landfills do have in common that the disposal in technical and operational terms is not in compliance with any international standards for landfills, however the site is

selected in consent with the MoEPP. Very few municipal landfills have the status of "temporary" landfills and encompass only those which have been established recently (last 10 years).

In areas, mostly rural areas, where the waste collection is not organized, the population disposes their wastes by tipping it in the outskirts of the settlements. In that way about thousands dumpsites have been created in quarries, pits and in the natural landscape (in river beds, along the roads, in valleys, on slopes etc.). The municipal waste often mixed with demolition waste is dumped at these places as well. Illegal dumps are sometimes cleaned up through occasional campaigns organized by municipalities and sometimes financed either by the national budget or by grants from international sources (UNDP and similar). Unfortunately, the cleaning campaigns do not improve the situation since the principal cause for creating of those dumpsites remains in place; hence the population receiving no service continues the illegal dumping mainly at the same areas. Although spread all over the country, the small dumpsites do not require intensive immediate measures since they do not create a serious environmental risk. Therefore the consideration of municipal landfills due to their size, complexity of closure activities and related is regarded as priority.

Figure 1 Landfill in Sveti Nikole

Figure 2 Landfill in Gostivar

Figure 3 Landfill in Kocani

Figure 4 Landfill in Kicevo

Since the disposal was considered as a communal responsibility to be performed by Public Enterprises (before enacting of the Law on Waste Management) the Communal Inspectorate (under the MoTC) was in charge of monitoring the disposal practice. The Sanitary inspectorate (MoH) also took part in inspections whenever some interventions were required (extermination of vermin etc.). Under the new environmental legislation the Environmental Inspectorate is responsible for monitoring over the closure of non – compliant landfills and the transition measures towards compliance with EU disposal standards for operating landfills. It will require additional resources than being currently available in terms of qualified staff at national and local / regional level.

2 WASTE LEGISLATION WITH A REFERENCE ON LANDFILLING

2.1 Macedonian Legislation

In 2003, Macedonia started the harmonization of the national environmental legislation with the legislation of EU. Drafts on five basic laws (Law on the Environment, Law on Waste Management, Law on Waters, Law on Nature and Law on Ambient Air Quality) and several sub-laws (EIA Decree for determining the projects for which an environmental impact assessment should be carried out, EIA Ordinance for regulating the procedure for carrying out Environmental Impact Assessment, IPPC Decree for determining the Installations for which an Integrated permit is required and time schedule for submission of the adjustment plans, IPPC Ordinance regulating the procedure for A integrated environmental permit, Regulation on Hazardous Waste Management, Regulation on Transportation, Recording and Reporting on Wastes, List of Wastes, Regulation on Waste Oils and Regulation on phasing-out PCBs) were prepared with broad participation of the stakeholders from all concerned sectors, institutions, local authorities and general public. During 2004/2005, Law on Waste Management, Law on Environment, Law on Nature and Law on Ambient Air Quality were adopted by the Government and promulgated in the Official Gazette of the Republic of Macedonia. All of the above mentioned laws and sub-legislation refer completely or to some extent to waste management.

The Law on Waste Management (LWM) focuses on the institutionalization of instruments supporting the sustainable development by way of promoting the rational use of the natural resources and preventing and eliminating the dangers to the human health and the environment arising from the waste and its management.

It was developed in accordance with the respective EU Directives, i.e., transposing the EU framework Directive on Waste Management, EU Directive on landfills, as well as basic elements of other waste-related EU Directives.

The LWM provides a prevention-oriented hierarchy of obligations (quantitative and qualitative prevention of the waste before recovery, disposal as the last final solution without endangering the environment and human health) and relies on the Polluter pays, Proximity, Universal services, Precautionary, Preventive and Extended Producer Responsibility Principles. It provides obligations that

will allow qualifying and quantifying the whole life of the wastes (from cradle to grave) which has been the main missing chain to produce reliable analyses and right planning up until now.

Chapter 6 of the Law focuses on the landfills. Waste could be disposed of on the landfills according to it characteristics. Thus, the landfills are classified in three categories: landfills for (i) inert waste, (ii) non-hazardous waste, and (iii) hazardous waste. The municipalities, as competent authorities for non-hazardous and municipal waste management issues and in compliance with the National Waste Management Plan, could establish a landfill for non-hazardous waste. The law also prescribes the conditions / procedures for establishment and construction of landfills, as well as conditions for the entities that can engage in the business of landfilling. The operator of the landfill must have a license issued by the body of the public administration responsible for environmental affairs, i.e. MoEPP. Further, the Law defines the obligation for monitoring and reporting to the competent authorities, the procedures for termination of the operations of a landfill and after-care activities.

Also, five sublaws are adopted araising from the law on Waste Mnagement, which focuses on the technical means and equipment for waste removal, training program for employees, rulebook on the conditions to be fulfilled for landfills, rulebook on the criteria for acceptance of waste in landfills each class, preparatory procedures for acceptance of waste, general procedures for testing, sampling and acceptance of waste, Rulebook on the form and content of the request for establishment of a landfill for hazardous and inert waste and Rulebook on monitoring the workof the landfill and control during operation, closure and after-care phase after the closing, as well as the manner and conditions of concern for landfills after they stop working.

Regarding the existing municipal landfills, the law defines an obligation for obtaining an environmental permit for harmonization with operation plans according to the Law on Environment.

In the article 144, Chapter 14 Transitional and final provisions, the Law specifies that:

- The MoEPP and the municipalities shall undertake all necessary measures to close the landfills that do not posses permit for performing the activity of waste disposal.
- The municipalities shall, within one year from the day of entry into force of the Law, close and recultivate illegal landfills.
- The Government, at the proposal of the MoEPP, shall by means of a separate act specify the manner of operation and treatment of existing sites for waste disposal, and shall specify temporary sites for waste disposal up to the period of landfills construction.

2.2 Legislation in the European Union

2.2.1 General Framework

The objective of the Council Directive 75/442/EEC of 15 July 1975 on waste and its amendments is to set up a system of measures for the coordinated management of waste within the Community in order to limit waste production.
These measures apply to all substances or object that the holder disposes of or is obliged to dispose of in pursuance of the national provisions in force in the Member States. They do not apply to radioactive waste, mineral waste, annual carcasses and agricultural waste, wastewater, gaseous effluents and wastes that are subject to specific Community Regulations.

Member States must prohibit the uncontrolled discarding, discharge and disposal of waste. They shall promote the prevention, recycling and conversion of wastes with a view to their reuse.
The measures provide cooperation between the Member States with a view to setting up an integrated, adequate network of disposal installations (taking account of the best technologies available) which would enable the Community itself to dispose of its wastes and the Member States individually to work towards that aim. That network would have to enable waste to be disposed of in one of the closest installations that guaranteed a high level of environmental protection.
Member States shall ensure that all holders of wastes shall hand them over to a private or public collection agency or to a disposal company, or else shall themselves conduct the disposal in compliance with the requirements of the current measures.
Entities treating, storing or dumping waste for another party must obtain an authorization from the competent authority which concerns, in particular, the types and quantities of waste to be treated, the general technical requirements and the precautions to be taken. The competent authorities may routinely check compliance with those authorization conditions. The same monitoring by the competent authority is reserved for transport, collection, storage, dumping or treatment companies working on their own account or for third parties.
The cost of disposal of waste must be borne by its holder, who will hand over his waste to a collector or company and/or else by earlier holders or by the producer who has generated the waste in accordance with the "polluter pays" principle.
The competent authorities appointed by the Member States in order to implement the current measures shall draw up at least one management plan governing, in particular, the types, quantities and origins of the wastes to be upgraded or disposed of, the general technical requirements, all of the special arrangements concerning specific wastes, and the appropriate locations and installations for the disposal.

2.2.2 Landfilling of Waste

Council Directive 99/31/EC of 26 April 1999 on the landfill of waste entered into force on 16.07.1999.
The objective of the Directive is to prevent or reduce as far as possible negative effects on the environment from the landfilling of waste, by introducing stringent technical requirements for waste and landfills.
The Directive is intended to prevent or reduce the adverse effects of the landfill of waste on the environment, in particular on surface water, groundwater, soil, air and human health.
It 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: (i) landfills for hazardous waste; (ii) landfills for non-hazardous waste and (iii) landfills for inert waste. A standard waste acceptance procedure is laid down so as to avoid any risks:

- waste must be treated before being landfilled;
- hazardous waste within the meaning of the Directive must be assigned to a hazardous waste landfill;
- landfills for non-hazardous waste must be used for municipal waste and for non-hazardous waste;
- landfill sites for inert waste must be used only for inert waste.

The Directive sets up a system of operating permits for landfill sites.
The directive also sets targets for the control and reduction of waste disposed on landfills. The targets for the reduction of waste relate specifically to biodegradable municipal waste and are based in 1995 landfilling rates:

- Reduce to 75% of the 1995 level by 2010;
- Reduce to 50% of the 1995 level by 2013, and
- Reduce to 35% of the 1995 level by 2020.

The following wastes may not be accepted in a landfill: liquid waste; flammable waste; explosive or oxidising waste; hospital and other clinical waste which is infectious; used tyres, with certain exceptions; any other type of waste which does not meet the acceptance criteria.

3 OVERVIEW OF THE SITUATION IN THE COUNTRY

3.1 Reviewing existing reports and data

For the selection of the non – compliant municipal landfills, a desk study was carried out and the following documents were consulted and reviewed:

- NEAP I; Part "Analyses and Estimation of the Conditions and the Solid Waste Management", 1996
- National Solid Waste Management System, Krueger/VKI/Symonds, 1999
- NEAP II; Draft DPSIR Report – Waste; 2004
- Concept and Feasibility Study on SWM in South West Macedonia (2002/2003, ERM GmbH, KfW)
- National Waste Management plan, 2009
- Waste plan and programs of different municipalities 2008-2010 (MOEPP)
    - Municipality of Ohird;
    - Municipality of Stip;
    - Municipality of Dojran;
    - Municipality of Skopje;
    - Municipality of Veles;
    - Municipality of Kochani;
    - Municipality of Kriva Palnka;
    - Municipality of Tetovo;
    - Municipality of Bitola;
    - Municipality of Makedonska kamenica;
    - Municipality of Dechevo;
    - Municipality of Chesinovo-Obleshevo;
    - Municipality of Rankovce;
    - Municipality of Gostivar.
- Project CARDS 2005 – annex for waste,
- Pre - feasibility study for integrated waste management for Polog and Strumica region – 2009;
- Other relevant documents providing the data on municipal landfills (inventories of the Communal and Environmental Inspectorate, etc.)

Waste management is one of the most serious environmental issues in the Republic of Macedonia. The solid waste generated in Macedonia is mostly disposed of by landfilling. The landfill Drisla, serving the Skopje region, is the only landfill in Macedonia which is relatively well managed. Nevertheless, plans to install an impermeable lining to prevent possible groundwater contamination have not yet been realized. The area surrounding the landfill consists of permeable sand and gravel deposits. No special construction measures, however, are taken to prevent possible percolation of leachate into the upper and lower aquifers.

Municipal waste registration takes place only at the Drisla landfill and nowhere else in Macedonia. At the Drisla landfill a disposal fee per ton of deposited waste is charged and paid by municipalities outside the Skopje area using the disposal service. At the landfills in Veles, Bitola and Vinica a flat disposal fee is

charged to other municipalities using the landfills regardless of quantities disposed of. In Gostivar the Communal Enterprise pays occasionally to a private company for temporary compaction and cover of waste at the landfill. Compaction and soil covering is executed only at a number of bigger municipal landfills.

At the municipal landfills (or dump sites) in rural areas, the waste is simply dumped by the Communal Enterprises with no operational costs, except for some overheads (paid to guardians, if any) and occasional water consumption costs for extinguishing of spontaneously emerging landfill fires.

The present solid waste management situation in Macedonia can be characterised as sub-standard, insufficient and inefficient and hampered by serious lacks (such as on public awareness, enforcement), resulting in various dysfunctional systems and many related negative effects on the environment and public health. A clear example is the problem of the lack of enforcement of the legislation with respect to various waste management issues. The principle cause is identified as:

- Resources, both human and financial, and procedures for monitoring and enforcement are insufficient and ineffective;
- Enforcement is apparently not considered as a (political) priority.

This results in the following effects:

- Littering and illegal tipping of waste continues in areas not receiving any waste collection services;
- Uncontrolled dumping of municipal wastes will continue, including potentially hazardous industrial and medical wastes;
- The ill equipped Inspectorate is not able to adequately and effectively monitor and control essential waste management activities.

The data extracted from above mentioned documents is presented in the next table; together with the feedback from the questionnaire send to all municipalities in RM (the questionnaire is in Annex 1).

Table 1 Identified non-compliant landfill sites in RMacedonia (desk study)

		Location	Population served	Start working	Total volume of the waste disposed of [m^3]
	Municipality				
1	Kicevo	Kicevo	21.097	1998	50.000
2	Gevgelija	"Suva Reka"	14.253	1976	20.000
3	Gostivar	v. Dolna Banjica "Susicki Most"	34.682	1971	720.000
4	Meseista	Meseista	1.284	2002	6.240
5	Karbinci (1)	v. Karbinci	673	1998	1.456
6	Karbinci (2)	v. Tarinci	905	1998	5.824
7	Krusevo (1)	"Kole Nalco"	6.779	1970	5.400
8	Krusevo (2)	"pod Avtoturist"	6.779	1970	3.600
9	Karbinci (3)	v. Radanje	471	2004	416
10	Kriva Palanka	v. Konopnica	14.574	1982	120.000
11	Radovis	City Landfill	17.149	/	50.000
12	Sveti Nikole	v. Nemanjeci	12.948	1977	60.000
13	Valandovo	"Suvodolica"	8.323	1972	80.000
14	Ohrid	"Bukovo"	38.066	1972	200.000

	Municipality	Location	Population served	Start working	Total volume of the waste disposed of [m^3]
15	Belcista + 3	"Belcista"	1.470	2002	5.000
16	Murtino	"Dineva Bara"	3.272	1999	5.000
17	Mak. Brod	"Barbaras"	3.912	1995	12.000
18	Struga (2)	v. Vishni	25.824	/	50.000
19	Mak. Kamenica	"Kamenicki Rid"	5.677	1986	10.000
20	Pehcevo	"Suvi Dol"	3.862	1974	20.000
21	Negotino	v. Dubrovo (Buceto)	13.448	1978	50.000
22	Berovo	"Iljadin Valog"	9.759	1992	16.000
23	Novo Selo	loc. Solena Reka	5.983	2004	480
24	Blatec	"Pocivalo"	1.012	2000	3.840
25	Oblesevo (1)	"Progon"	2.535	2002	180
26	Stip (2)	"Krstot"	33.457	1960	150.000
27	Bitola	"Meglenci"	60.486	1982	1.500.000
28	Kumanovo	"Krasta"	72.243	1960	1.832.200
29	Strumica	17 km northern	31.561	1986	350.000
30	Delcevo	"Ostrec"	12.254	1989	175.000
31	Kratovo	"Zeliznica"	7.309	1968	20.000
32	Vinica	v. Leski	12.540	1971	30.000
33	Veles	"Bunardere"	43.716	1980	620.000
34	Prilep	v. Alinci ("Omec")	51.346	1974	530.000
35	Kavadarci	"Melci"	26.874	1978	480.000
36	Struga (1)	v. Kjafasan (Mali Vlaj)	25.824	/	50.000
37	Demir Kapija	"Pcenicni Dupki"	3.181	1982	101.200
38	Resen	"Alchevi koshari"	11.777	1966	200.000
39	Probistip	v. Neokazi (Strmos)	8.935	1975	12.000
40	Zletovo	"Meliste"	2.477	1974	72.000
41	Krivogashtani	"Livadski Pat"	3.003	2004	800
42	Karbinci (4)	v. Krupiste	336	2004	416
43	Kocani	"Belski Pat"	23.582	1975	300.000
44	Debar	"Krivici"	12.566	1971	60.000
45	Dolneni (2)	v. Crniliste	5.792	2004	1.000
46	Bogdanci	"Brdanov Kamen"	6.095	1967	50.000
47	Orizari	"Bel Kamen"	2.202	1997	7.000
48	Dolneni (1)	"Debreshte"	5.792	2004	1.300
49	Miravci	"Karaivanovi kurii"	1.313	1998	2.000
50	Dojran	"Dekil-Tas"	1.713	1975	40.000

	Municipality	Location	Population served	Start working	Total volume of the waste disposed of [m^3]
51	Stip (1)	v. Penush ("Trestena Skala")	33.457	2004	8.000
52	Novo Selo	(the old one) "Sopov Rid"	5.983	1997	80.000
53	Oblesevo (2)	v. Banja ("Jaz")	2.535	/	
54	Lipkovo + 3	v. Nikustak	13.529	1998	16.536

Based on this information and in consultation with the MOEPP, 54 municipal landfills have been selected for further investigation. The map with the locations of the municipal landfills identified is presented in Figure 5.

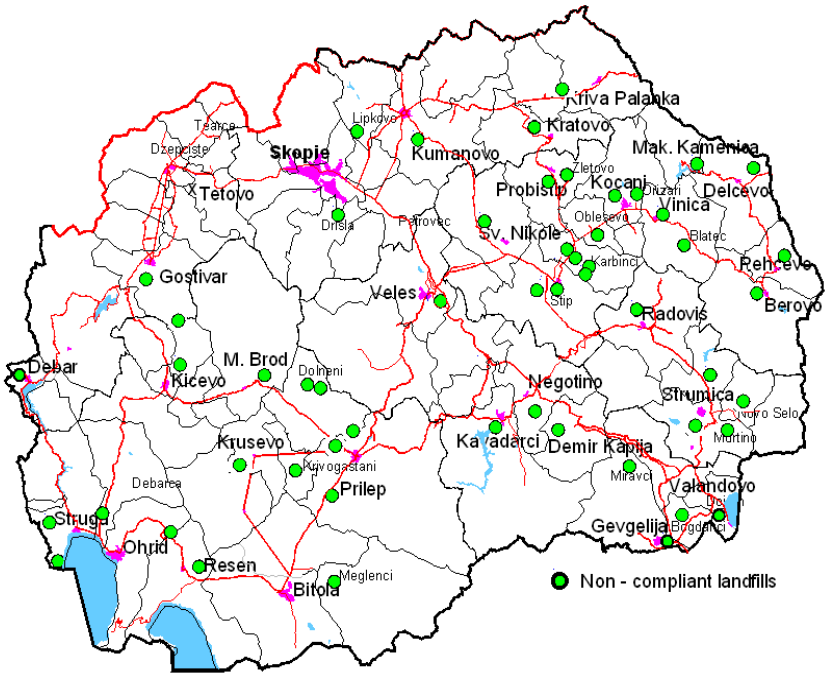

Figure 5 Location of non-compliant landfills in Macedonia

Regional overviews of the non-compliant landfill sites are present in the following figures.

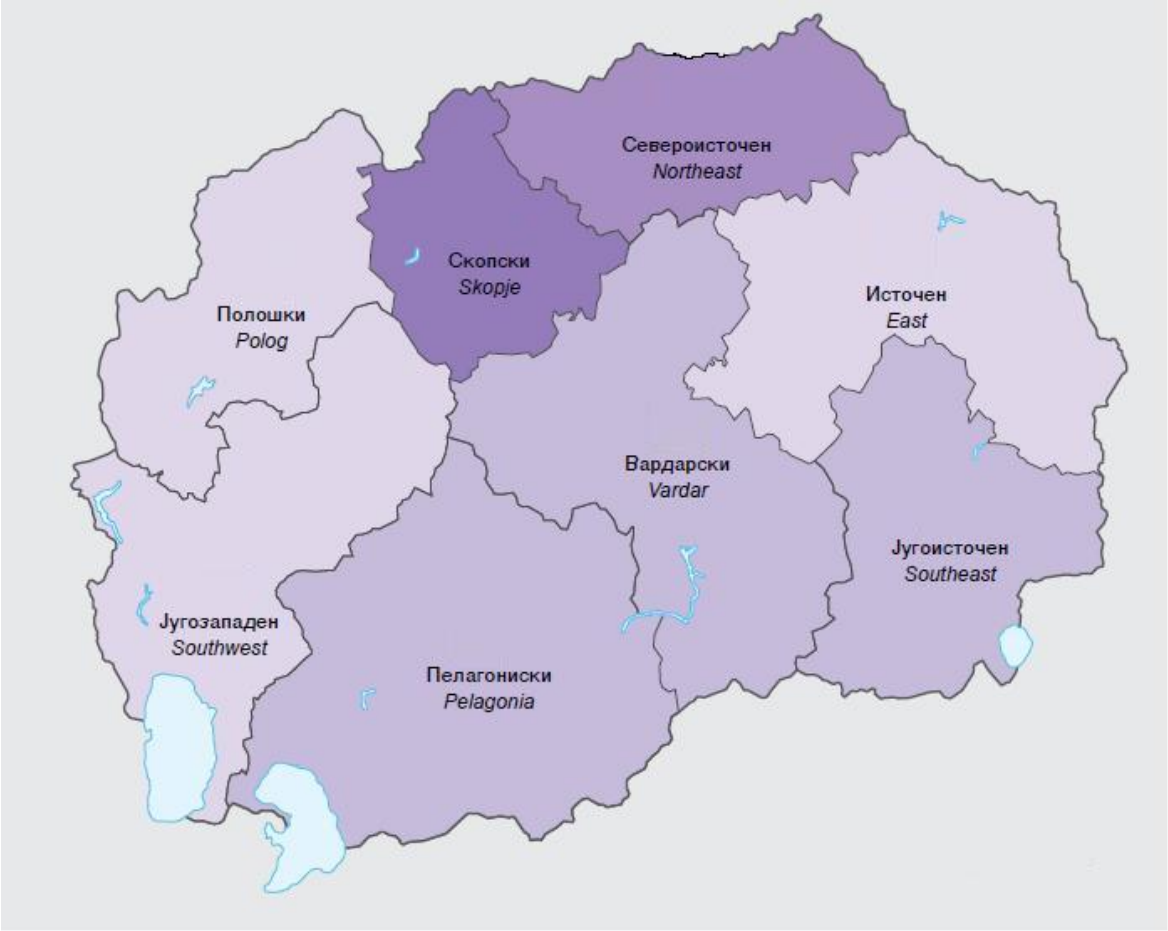

Figure 6 Regions in Republic of Macedonia

Region	Population	Waste generated (t/a)
SOUTHWEST	221.651	55413
Ohrid	55.749	13937
Debarca	5.507	1377
Struga	63.376	15844
Vevcani	3.656	914
Drugovo	3.249	812
Centar zupa	6.519	1630
Kicevo	30.138	7535
Oslomej	10.420	2605
Zajas	11.605	2901
Makedonski Brod	7.141	1785
Vranestica	1.322	331
Debar	19.542	4886
Plasnica	4.545	1136

Figure 7 Southwest region

Region	Population	Waste generated (t/a)
VARDARSKI	133.248	33312
Sveti Nikole	18.497	4624
Veles	55.108	13777
Lozovo	2.858	715
Caska	7.673	1918
Gradsko	3.760	940
Rosoman	4.141	1035
Negotino	19.212	4803
Demir Kapija	4.545	1136
Kavadarci	38.741	9685

Figure 8 Vardarski region

Region	Population	Waste generated (t/a)
SOUTHEAST	171.416	42854
Gevgelija	22.988	5747
Bogdanci	8.707	2177
Valandovo	11.890	2973
Dojran	3.426	857
Novo Selo	11.567	2892
Bosilovo	14.260	3565
Vasilevo	12.122	3031
Konce	3.536	884
Radovis	28.244	7061
Strumica	54.676	13669

Figure 9 Southeast region

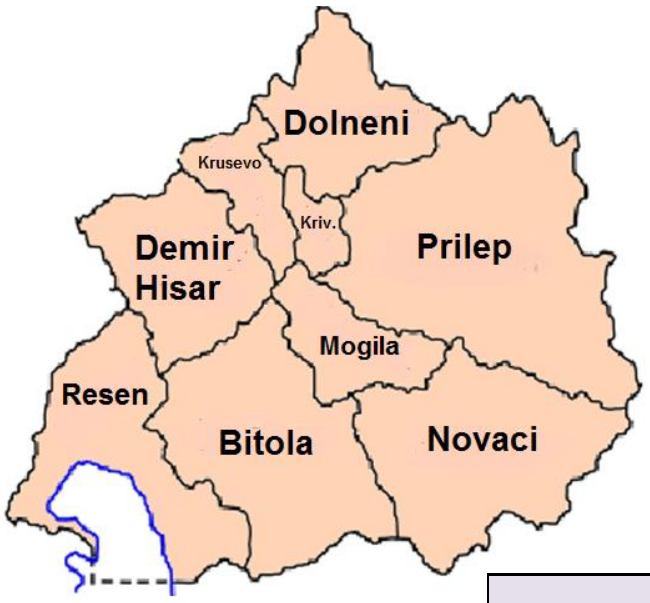

Figure 10 Pelagoniski region

Region	Population	Waste generated (t/a)
PELAGONISKI	221.019	55255
Resen	16.825	4206
Bitola	95.385	23846
Novaci	3.549	887
Mogila	6.710	1678
Demir Hisar	9.497	2374
Krivogastani	6.150	1538
Prilep	76.768	19192
Dolneni	13.568	3392
Krusevo	9.684	2421

Region	Population	Waste generated (t/a)
POLOSKI	304.125	76031
Mavrovo i Rostusa	8.618	2155
Gostivar	81.042	20261
Brvenica	15.855	3964
Vrapciste	25.399	6350
Zelino	24.390	6098
Bogovinje	28.997	7249
Tetovo	86.580	21645
Tearce	22.454	5614
Jegunovce	10.790	2698

Figure 11 Poloski region

Figure 12 Northeast region

Region	Population	Waste generated (t/a)
NORTHEAST	173.814	43454
Lipkovo	27.058	6765
Kumanovo	105.484	26371
Staro Nagoricane	4.840	1210
Rankovce	4.144	1036
Kratovo	10.441	2610
Kriva Palanka	20.820	5205

Figure 13 Skopje region

Region	Population	Waste generated (t/a)
SKOPSKI	571.040	142760
Aerodrom	72.009	18002
Butel	36.154	9039
Gazi Baba	72.617	18154
Gjorce Petrov	41.634	10409
Karpos	58.359	14590
Kisela Voda	57.236	14309
Saraj	35.408	8852
Cair	64.823	16206
Centar	45.362	11341
Suto Orizari	20.800	5200
Sopiste	9.522	2381
Studenicani	17.246	4312
Zelenikovo	4.077	1019
Petrovec	8.255	2064
Aracinovo	15.000	3750
Ilinden	15.894	3974
Cucer - Sandevo	8.493	2123

Region	Population	Waste generated (t/a)
EAST	203.213	50803
Stip	47.796	11949
Karbinci	4.012	1003
Zrnovci	3.264	816
Cesinovo - Oblesevo	7.490	1873
Probistip	16.193	4048
Kocani	38.092	9523
Makedonska Kamenica	8.110	2028
Delcevo	17.173	4293
Pehcevo	5.517	1379
Vinica	19.938	4985
Berovo	13.941	3485

Figure 14 East region

The calculations of the waste generated in the municipalities were done via suggestion from the National waste strategy, where the quantities for the urban areas is 350 kg/year/inhabitant and for rural area 190 kg/year/inhabitant.

The findings of the reviewed documents indicated that most of the common issues concerned operational activities. The following issues were identified.

Operational activities not being performed in a proper and efficient manner:

- ✓ Disposal of waste;
- ✓ covering of waste;
- ✓ screening of waste, specially hazardous waste and medical waste;
- ✓ control of litter on site;
- ✓ disposal of chemicals such as diesel oil and lubricants;
- ✓ disposal of waste oil and used batteries;
- ✓ capping and revegetation of previously filled areas;
- ✓ maintenance and operation of plant and equipment.

Water management issues:

- ✓ surface or ground water not being monitored in a proper and efficient manner;
- ✓ leachate not being managed in a proper and efficient manner;
- ✓ occurrence of pollution of waters and the potential for the pollution of waters;
- ✓ inadequate surface-water management practices.

Air management issues:

- ✓ inadequate dust suppression;
- ✓ lack of landfill-gas catchment and monitoring.

Legislative requirements:

- ✓ works carried out without obtaining license approval.

Administration and management issues:

- ✓ records of complaints received by the enterprises not being kept properly
- ✓ enterprises not providing the MOEPP with reports required by the law on waste.

3.2 Industrial waste and contaminated sites

Decades of industrialization and extensive exploitation of natural resources have left a certain number of areas in the country heavily polluted. Over the past decade, Macedonia has moved from centrally planned economy, with government ownership and management of the means of production, towards free market economy, with varying level of privatisation. Within the process of privatisation, it is essential that old environmental burdens left behind by state-controlled industry are addressed: problems that were once (theoretically) the government's have now been transferred over to new owners, in most cases without clear specification of environmental responsibility. Old environmental contaminated industrial sites represent a serious risk for humans who live in or near the contaminated areas, because of either their direct negative impact on the human health or, indirectly, through pollutants in the food chain production. Currently, Macedonia has no systematic approach or policy for addressing and remediating these environmental hotspots. Their impact is not fully known, clean up costs not systematically estimated; funding for the most part is unavailable; and even "ownership" of these environmental burdens in a post-privatised setting is not clear.

In total 16 Industrial Contaminated Sites- "hotspots" are identified:

1. OHIS A.D (organic chemical industry) at Skopje
2. Bucim copper mine at Radovis
3. MHK Zletovo (lead and zink smelter) at Veles.
4. Lojane (former chromium, arsenic, antimony mine) at Kumanovo
5. Sasa (lead and zinc mine) at Mak. Kamenica
6. Silmak ferro-silicon plant (former HEK Jugochrom) at Jegunovce
7. Toranica (lead and zink mine) at Kriva Palanka
8. Makstil (iron & steel plant) at Skopje
9. Zletovo mine (lead and zink mine) at Probistip
10. REK Bitola (Thermal power plant and lignite mine) at Bitola.
11. Feni Industry (ferro-nickel smelter) at Kavadrci
12. MHK Zletovo (fertiliser factory) at Veles
13. REK Oslomej - ESM (Thermal power plant and coal mine) at Kicevo
14. Godel tannery at Skopje
15. OKTA Rafinerija AD (oil refinery) at Skopje
16. Tane Caleski (metal surface treatment) at Kicevo.

Given the lack of regulatory provisions, both in the privatisation law and in environmental law, as well as the present lack of the institutional framework and funding mechanism, there seems to be no other choice than to solve this problem on a case-by-case approach. However, it is the Government's responsibility to make some additional implementing regulations in this respect.

4ENVIRONMENTAL ASPECTS OF NON – COMPLIANT LANDFILLS

A risk assessment process can assist in drawing a cost-effective compromise between economic and environmental costs, thereby assuring that the philosophy of 'sustainable development' is adhered to. Risk assessment is also applied to other subjects including health and safety, food, finance, ecology and epidemiology.

Figure 15 shows a schematic diagram of a typical landfill site and indicate how the key terms of The Landfill Directive relate to the framework risk assessment to be used for landfill sites in the country.

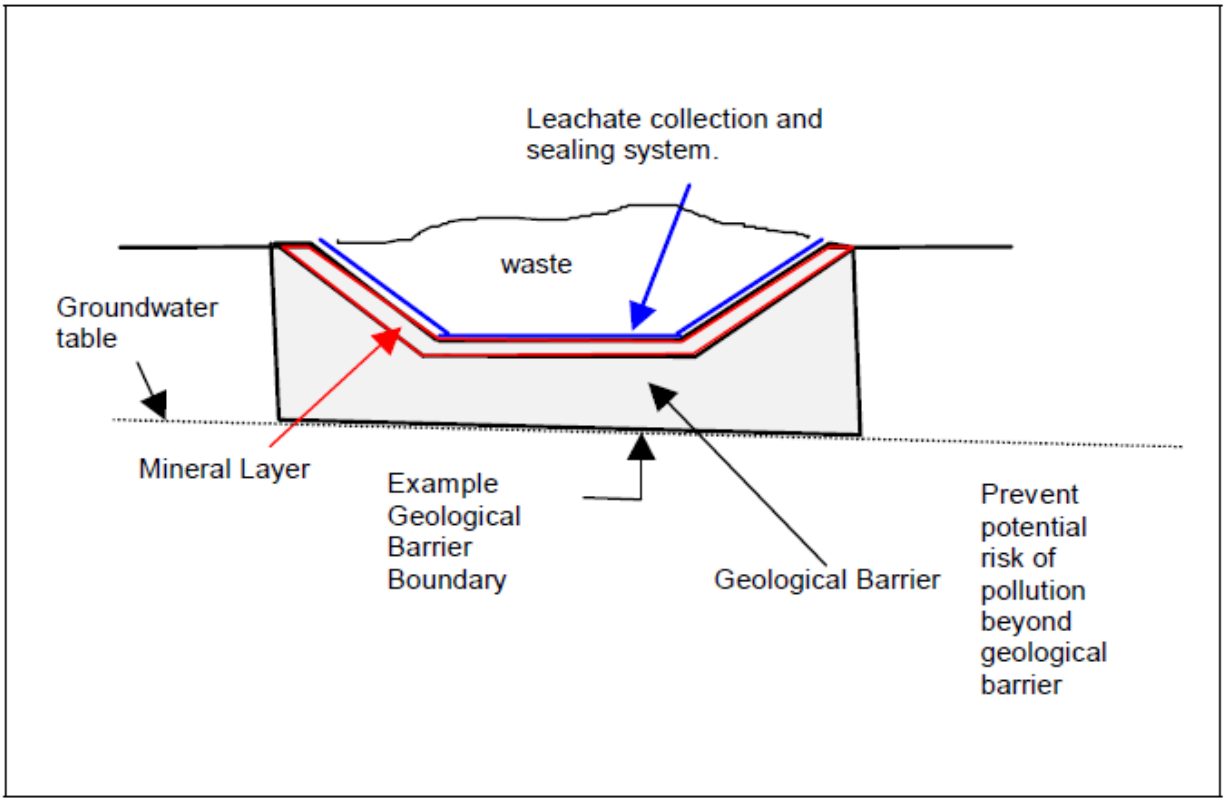

Figure 15 Proper landfill site

The main environmental risks of uncontrolled municipal dumpsites are:

- Contamination of freatic groundwater under and downstream of the dumpsite by percolating and runoff rainwater (generally referred to as 'leachate').
- Contamination of surrounding land by infiltration of runoff rain water.
- Contamination of nearby surface water through direct discharge of runoff water or contact/exchange with contaminated groundwater.
- Contamination of air by uncontrolled burning of the waste, as well as odour emission.
- Greenhouse effect as a result of landfill gas with high concentration of methane.

The main possible impacts of above listed risks are:

- Contaminated well water intended for drinking water, livestock feed, and irrigation water thus threatening the health of humans and animals.
- Contaminated surface water causing damage to aquatic life and limiting the use as feedstock for drinking water preparation.
- Contaminated air thus threatening the health of humans and biodiversity.
- Bioaccumulation of toxic substances in the food chain, and in the natural flora and fauna.
- Deterioration of the quality and decrease of the value of agricultural land and urban development land (loss of property).

4.1 Assessment of the landfill sites

The inventory of old landfills can be carried out in 4 main areas. When assessing the four areas together, the landfills can be classified according to risk and the plan for treatment and after-care of the landfills can be prioritized accordingly.

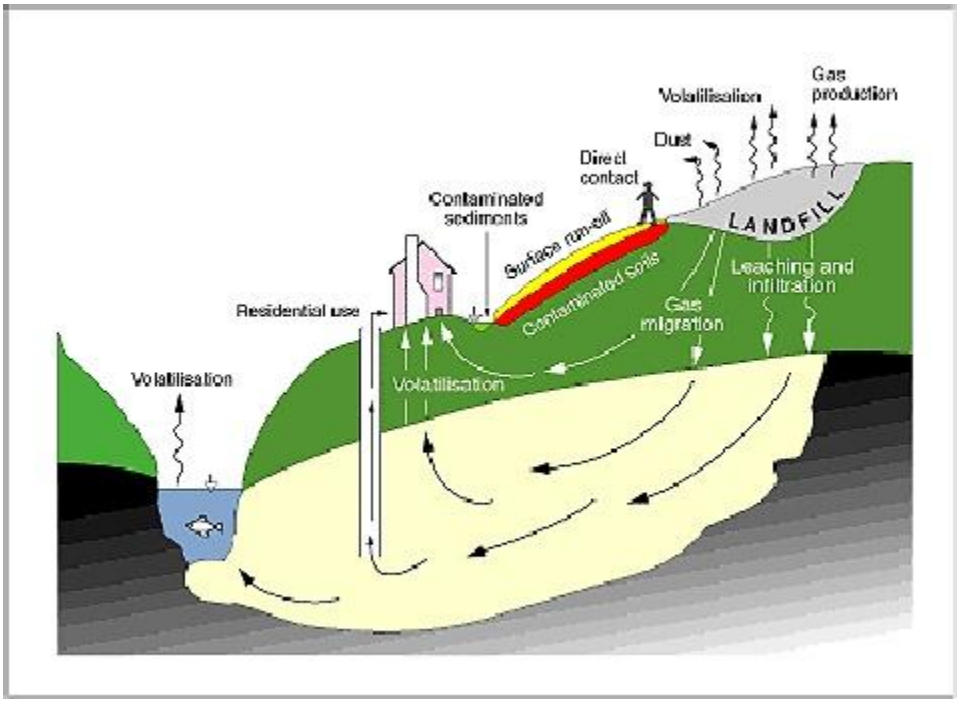

Figure 16 Risk assessment to the environment

4.2 The hazardousness of the contaminants

In order to assess the hazardousness of the contaminants, the following questions should be answered.

- What types of waste has been put on the actual landfill? In what amounts?
- Has hazardous waste been disposed of at the landfill?
- Has industrial waste been disposed of at the landfill?
- Approximately how many % of the landfill consists of household/hazardous/industrial waste?
- How has the waste been landfilled? In containers? Could they start leaking in the future? Has the waste been treated to make it less hazardous before landfilling?
- What contaminants/hazardous properties does the waste have?
- When were different types of waste landfilled and in what amounts?
- When was the landfill started and when was it closed?
- Has combustion of waste been occurring at the landfill? (higher risk of dioxins and PAH)

Experiences from previous investigations, facts from employees and/or other observers are useful. If no information is available about the waste landfilled it can be necessary to excavate some samples to get an idea of what has been landfilled.

4.3 The level of contamination

Here it should be estimated how contaminated the object is, i.e. how large the volumes/amounts of contaminated material are as well as the level of contamination. If the landfill has high levels of contaminants in large volumes the level of contamination should be assessed as high. If the levels of contaminants are low as well as the volumes of material, the level of contamination should be assessed as low. A landfill with a few hot spots but small amounts of contaminants in total has a lower level of contamination than if the same levels are found in a landfill with larger amounts. Each contaminant can be assessed individually where after a joint assessment for the landfill can be made. In order to do the assessment all previous investigations and measurements are of interest - Has any analysis been made on leachate from the landfill? Has any analysis been made on the water in the recipient? Or the groundwater? If so, what did these analysis show?

4.4 Conditions of dissemination

The conditions of dissemination are depending on

- The cover of the landfill (when, how and how high/dense is it? Is it vegetated? Is it affected by erosion or other damages?)
- What types of waste are landfilled? (Organic? Does it contain volatile compounds? What are the hydrological prerequisites of the waste)
- Leachate collection and treatment (Is it collected? How? Is it treated? How?)
- Collection of methane gas (Has any measurements been made at the landfill to see how much landfill gas that is produced? Is any landfill gas collected? Are there transport ways for the gas – liners, sealed ditches, etc?)
- Cleaning of the site
- The land use (today as well as expected in the future)
- The localisation of the landfill
- The geology under and around the landfill, especially downstream the landfill
- The hydrology under and around the landfill (water carrying layers, distance to the recipient, type of recipient, depth to groundwater, distance to well, if the landfill is located in an area where water streams to refill groundwater or where groundwater flows in, the speed of the flow)
- Soil chemistry
- Topography of the landfill (slopes in %)
- The localization of the contaminants today and how they spread in the environment
- Technical installations and protective measures such as drainage,
- Is there a risk for disseminations to buildings? How far are the buildings?

The conditions should be analysed for dissemination to buildings, to soil and groundwater, from soil and groundwater to surface water, in the surface water and to air respectively.

4.5 Sensitivity and level of protection

The level of sensitivity should be assessed for buildings, soil/groundwater and surface water/sediment. The level of protection value should be assessed for soil/groundwater and surface water/sediment. Here it

should be assessed how serious it is that humans, animals and plants will be exposed to the contaminants today and in the future. Examples on factors that are influencing the risks are if wells in the area are used for drinking water, if vegetables and berrys are harvested in the area, if children are spending time in the area, if there is water used for swimming nearby, if the area is planned for development of housing areas, if it is a recreation area or if there are protected areas or habitats around the landfill.

4.6 Useful sources of information for the inventory

Useful sources of information for the inventory are for example soil maps, economical maps, topographical maps, geological maps, hydrogeological maps, groundwater maps, archive studies for facts about the actual landfill and about industries nearby that might have used the landfill, fly photos. Also interviews with previous workers or people living in the area can be of great value.

4.7 Inventory on site

When visiting the landfill, facts from the previous studies can be verified. An inventory should be performed at the grounds to see what kind of soils that is present - sandy, rocky, muddy, etc? An inventory should also be made of the surface – is it vegetated? Has the landfill been covered in some way? Is waste visible? Where are the limits of the landfill, where does it start and finish? What is the topography (slopes in %)? Also, pits and pipes for drainage/leachate/storm water and wells or other sensitive objects should be checked for. Measurements can be made in nearby recipients - for example conductivity – if it is high this is an indication of leachate. What are the relevant recipients? Is it a big lake or small ponds, rivers? How do they look; colour, turbidity, is there a thin "film" on the surface of oil or iron bacteria? Does the surface water stand in contact with the groundwater? Are there any buildings nearby the landfill?

If excavation of testing pits is performed they should be made carefully so that fire is avoided, so that no containers with waste are destroyed or so that no new transport ways for leachate are created by destroying sealing layers, etc.

When excavating the pits, the following should be noted;

- What the material consists of (Is it a lot of organic material? Level of degradation? Are there larger objects present? How has the waste been landfilled, etc?)
- Are there any separating layers? How many meters of waste are there? What kind of soil is present under the waste?
- Is there any smell?
- Does water show in the pit? How fast does it occur? What does it look like?
- Photograph of the site.

5 EVALUATION OF THE "HAZARD POTENTIAL" OF NON – COMPLIANT LANDFILLS

5.1 Inventory and Data Collection

Based on the review of the available documents, discussions with the MoEPP and results of the survey initiated, the various data of the municipal landfills have been inventoried (the questionnaire used for the survey can be found in the Annex 1). Subsequent visits of selected landfills were organized in order to check the data accuracy obtained in the desk survey and to assess visually whether the environmental risks where appropriate. Field visits report are given in the Annex 2. A database of the landfills has been prepared and the summary of all inventoried municipal landfills is given in Annex 3.

The following key information was assessed in the desk study and field visits:

1. Presence of the hazardous and/or medical waste on the municipal landfills
2. Size ranges:
   2.1 Area occupied, and
   2.2 Volumes of wastes disposed of
3. Morphology types;
4. Hydro – geological conditions presented through permeability coefficients, and
5. Distance from watercourses.

In addition, as an excluding criterion, vicinity of housing area(s), road and railway was investigated.

The data collected from various sources mentioned in the Section 3.1 varied significantly with regard to the waste volumes and disposal area in particular. Final checks were made upon the visits using visual methods, or by contacting the interviewed persons. Morphology was also analysed in detail on the site since this factor could not be integrally recognized from the data collected through the survey. The parameters on the subsoil permeability, which are an important indicator for potential groundwater contamination, were taken from the inventory established in the Kruger study, but corrected if necessary in consultation with experts from the MoEPP.

5.2 Evaluation of the Data Collection and Site Visits

Many crucial data were missing in the reviewed documents. For most of the non – compliant landfills data on the size of the area varied significantly. Groundwater samples have not been taken at any site and rough estimations on the potential for groundwater contamination were based on regional hydro-geological situation taken from maps available at the MoEPP. As a consequence there is no evidence of substantial groundwater pollution caused by inappropriate dumping.

Besides the municipal waste certain quantities of hazardous waste deriving from industries and hospitals (difficult to assess in terms of composition and hazardous properties) are inappropriately disposed of at municipal landfills serving mainly the urban areas. This is the case almost for each landfill site.

For the quality of the water body near the landfill sites, 3 random selection of the landfill sites were investigated. The analyses were made by Central environmental Labaratory (MoEPP) and the results can be found in Annex 4.

Although systematic and computerised models exist for risk assessment of soil & groundwater contamination, no universal methodology is known for prioritisation of non – compliant landfills. The risk models require pertinent and detailed data of the pollutant concentrations in soil and groundwater, and geophysical and morphological characteristics of the subsoil and groundwater hydrology.

5.3 Risk classes

The risk assessment method as described above was not appropriate for the present status of data availability and reliability. For this reason, a specific methodology was developed in consultation with international and local experts in the fields of geology, geo-hydrology and landfill engineering.

The method is based on the following main criteria for which weighted scoring factors on a scale of 1%-100% (factors 0.01-1) are applied:

1. Participation of the hazardous/medical waste in the total volume disposed (0,05 factor of the final score)[1]
2. Extent of the landfill (0,35 factor of the final score)
    - Area of the landfill (0,15 factor)
    - Volume of wastes disposed of the site (0,20 factor)
3. Site characteristics and sensitivity
    - Morphology of the landfill (0,25 factor)
    - Hydro-geological conditions / permeability of subsoil (0,20 factor)
    - Distance from water courses (0,15 factor)

A template for scoring per site was used and all municipal landfills were compared and weighed accordingly. The data available were evaluated for every site while the prioritization of all considered landfills required establishment of relevant classes of risk.

The template for the scoring exercise is presented in Annex 5.

The classes of risk (low, medium and high) were established upon the magnitude of the total scores, by introducing thresholds for each next higher class of environmental risk as following:

- 12,75 – 24 for the lowest environmental risk
- 24 – 30 for the medium environmental risk
- 30 – 53.25 for the highest environmental risk

As it can be seen from the ranges determined the broad score magnitude given to highest risk landfills intends to include within this group all highly suspected landfills in terms of the environmental risk for which data available at present is not reliable. Further field investigations will be required for particular cases prior to adoption of the closure method, its technical design and the after closure monitoring.

Using the existing data for the landfill sites and the answered questionnaire the hazardousness potential of existing municipal landfills can be defined by the following parameters:

- Hazard and toxic characteristics of the disposed waste
- Leacheability of the waste
- Area of the landfill and volume of the waste
- Height or thickness of the waste deposit
- Level of the freatic groundwater

[1] Due to the information that on each landfill site there is industrial waste and medical waste, the score factor is lower

- Permeability of the sub-soil (k-factor)
- Presence of nearby surface water

5.4 Set of criteria

Each site (landfill) was scored according to a set of criteria, allowing a priority ranking of the most polluted or potentially environmentally dangerous sites. The criteria was developed by the consultant and MOEPP with support from the Swedish experts,. The Swedish practice was used to prepare a check list for each municipality landfill site.

The rationale of the used criteria and weighted scores is as follows.

- The extent of the landfill determined by:
    - Area of the dumpsite in m^2: this is an important parameter for the assessment of the extent of possible groundwater contamination (the so-called 'dispersion cloud'); the larger the site the greater the risk and extent resulting in higher remediation cost; dumpsites larger than 10,000 m^2 (1 Ha) are regarded as the highest risk for potential contamination of groundwater.
    - Volume of the waste in tonnes or m^3: the total amount of the deposited waste is of importance for the evaluation and cost of remediation method in case of desired removal and also for risk assessment and on-site remediation.
- The site characteristics and sensitivity determined by:
    - Morphology of the site: it makes an important difference where an uncontrolled dumpsite is located; the following situations are distinguished in descending order of risk:
      a) on river bed / in pit / in quarry;

The morphology types listed above suggest a high sensitivity of the site. A landfill on a river bed allows for direct contamination of surface and groundwater by the leachate and via the contact of water with waste in case of flood as well as variations of the water table. Pits and quarries are sensitive due to the removal of the natural soil barrier upon excavations. Risks can occur in case of a shallow water table. Since the data on the groundwater level are not known these morphology types are taken as an indication of the potential risk.

b) on surface / on slopes / in valley or unknown

The morphology types listed above may indicate medium sensitivity since this factor is to be observed in relation to other site characteristics. However, due to the irregular disposal method utilized at all sites potential risk can be assumed.

c) constructed / covered / contained / sanitary

In case of engineered landfills the morphology types are irrelevant since the protection measures are applied. None of sites was classified under this category however.

- Permeability of the subsoil is of great influence on the risk of dispersion of contaminated groundwater. Hydro-geologists recommend the following rating of risk:

  high: $K = > 10^{-5}$ cm/s or sandy soil

  medium: $10^{-5} > K > 10^{-7}$ cm/s or standard soil

low: K = < 10^{-7} cm/s or clay(ish) soil

- Depth of freatic groundwater table: the deeper the groundwater tables the smaller the risk of leachate and runoff to reach it. Practical experience in a.o. in the Netherlands it was indicated that a depth of 0 to minus 5 m poses the highest risk; minus 5 to minus 15 m has reduced risk, and deeper than minus 15 m is almost free of risk due to the absorptive and assimilative capacity of the sub-soil. For sites where this data was available the criterion was taken as additional / corrective, but did not enter in the final score.
- Distance to surface water: this is an evident criteria, the closer sensitive objects are to a possible source of pollution, the greater the risk. The following distances have been applied based on experience elsewhere:

  high: < 100 m

  medium: 100 - 500 m or unknown

  low: > 500 m

Land Use of location up to 500 m off the site: the distance of the site to sensitive objects is of importance for exposure to humans, animal and crops to hazardous substances; an arbitrary safety distance of 500 m is applied towards surrounding settlements, agricultural land and other amenities. This criterion did not participate in the total score but was considered as additional / corrective factor for scores in the transition between different classes.

5.5 Main Conclusions and Recommendations

- In total 54 municipal landfill sites were identified and evaluated. The list does not contain the small dispersed wild dumps which can be found everywhere in the country close to the populated areas.
- The landfills were categorized according to the assessment of their environmental risk. Quantification of the risk was done through desk survey and field visits. The following set of criteria and weighted scoring factors were used:

Criteria:	Weight / Score:
1. Waste stream (Hazardous / medical waste)	0.05
2. Area of the landfill [m^2]	0.15
3. Operation – Volume of the waste [m^3]	0.20
4. Morphology of the landfill	0.25
5. Hydro-geological conditions (permeability)	0.20
6. Distance from surface water [m]	0.15

- None of the municipal landfills meet the requirements for sanitary operation and environmental protection. Due to the lack of sufficiently pertinent data on existing soil and groundwater pollution proven contamination could not be confirmed. Nevertheless, the landfills pose potential hazard for pollution of the soils, surface water and groundwater and air, as well as risk for the biodiversity, agricultural land and human health.

- A priority list of 54 non-compliant landfills was developed and three classes of environmental risk were established, i.e. low, medium and high. The following table shows the number of landfills categorized in each of the risk classes.

Table 2: Number of municipal landfills per risk class

Risk Class	Number of landfills
High risk landfills	16
Medium risk landfills	16
Low risk landfills	19

Rank	Municipality	Municipal landfill	Score	Deposit [m^3]
1	Kicevo	City Landfill	53,25	50.000
2	Gevgelija	"Suva Reka"	53,25	17.000
3	Gostivar	v. Dolna Banjica "Susicki Most"	47,75	720.000
4	Meseista	Meseista	46,75	6.240
5	Krusevo (1)	"Kole Nalco"	46,75	5.400
6	Karbinci (1)	v. Karbinci	46,75	1.456
7	Karbinci (2)	v. Tarinci	46,75	5.824
8	Krusevo (2)	"pod Avtoturist"	43,75	3.600
9	Karbinci (3)	v. Radanje	43,75	416
10	K. Palanka	v. Konopnica	38,75	130.000
11	Radovis	City Landfill	37,50	50.000
12	Belcista + 3	"Belcista"	37,25	16.250
13	Sveti Nikole	v. Nemanjeci	36,25	60.000
14	Valandovo	"Suvodolica"	35.00	80.000
15	Ohrid	"Bukovo"	34,25	200.000
16	Murtino	"Dineva Bara"	31.00	5.000
17	Mak. Brod	"Barbaras"	29,75	12.000
18	Struga (2)	v. Vishni	28,25	50.000
19	M. Kamenica	"Kamenicki Rid"	28.00	50.000
20	Pehcevo	"Suvi Dol"	27,75	20.000
21	Vinica	v. Leski	27,75	430.000
22	Negotino	v. Dubrovo (Buceto)	27,25	120.000
23	Berovo	"Iljadin Valog"	25,50	22.000
24	Novo Selo	loc. Solena Reka	25,25	480
25	Blatec	"Pocivalo"	25,25	3.840
26	Oblesevo (1)	"Progon"	25,25	180
27	Stip (2)	"Krstot"	25.00	300.000
28	Bitola	"Meglenci"	25.00	1.500.000
29	Kumanovo	"Krasta"	25.00	1.832.200
30	Strumica	17 km northern	24,50	350.000
31	Prilep	v. Alinci ("Omec")	23,75	530.000
32	Delcevo	"Ostrec"	24,50	175.000
33	Kratovo	"Zeliznica"	24,25	35.000

Rank	Municipality	Municipal landfill	Score	Deposit [m^3]
34	Veles	"Bunardere"	23,75	620.000
35	Kavadarci	"Melci"	23,75	480.000
36	Zletovo	"Meliste"	23,75	72.000
37	Struga (1)	v. Kjafasan (Mali Vlaj)	22,75	50.000
38	Kocani	"Belski Pat"	22.00	300.000
39	Demir Kapija	"Pcenicni Dupki"	22.00	101.200
40	Resen	"Alchevi koshari"	22.00	200.000
41	Debar	"Krivici"	22.00	150.000
42	Probistip	v. Neokazi (Strmos)	22.00	22.000
43	Krivogashtani	"Livadski Pat"	21.00	800
44	Karbinci (4)	v. Krupiste	21.00	416
45	Orizari	"Bel Kamen"	20,75	7.000
46	Dolneni (2)	v. Crniliste	16,75	1.000
47	Bogdanci	"Brdanov Kamen"	16,75	50.000
48	Dolneni (1)	"Debreshte"	15,50	1.300
49	Miravci	"Karaivanovi kurii"	15.00	2.000
50	Dojran	"Dekil-Tas"	14,50	40.000
51	Stip (1)	v. Penush ("Trestena Skala")	12,75	8.000
52	Novo Selo	(the old one) "Sopov Rid"	12,75	80.000
53	Oblesevo (2)	v. Banja ("Jaz")	12,75	5.000
54	Lipkovo + 3	v. Nikustak	12,75	16.536

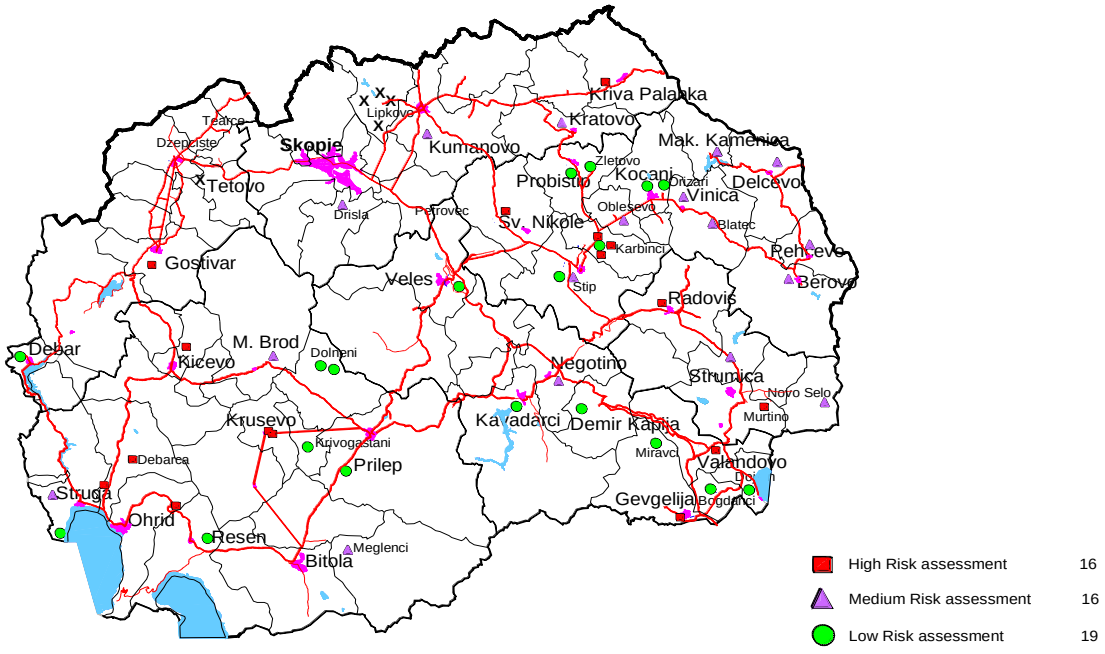

Figure 17: Municipal landfills according to their environmental risk

Below are given tables of priority ranking for each of the seven region (Skopje Region is not mentioned since there is one regional landfill Drisla and is not in the list of non-compliant landfills):

Table 3: Summary of the seven planning regions

Rank	Municipality	Municipal landfill	Score	Deposit [m^3]
1	Gostivar	v. Dolna Banjica "Susicki	47,75	720.000

1.Polog planing region

Rank	Municipality	Municipal landfill	Score	Deposit [m^3]
1	Kicevo	City Landfill	53,25	50.000
2	Ohrid	"Bukovo"	34,25	200.000
3	Mak. Brod	"Barbaras"	29,75	12.000
4	Struga (2)	v. Vishni	28,25	50.000
5	Struga (1)	v. Kjafasan (Mali Vlaj)	22,75	50.000
6	Debar	"Krivici"	22.00	150.000
7	Belcista + 3		3	Belcista + 3
8	Meseista		5	

2. Southwest planning region

Rank	Municipality	Municipal landfill	Score	Deposit [m^3]
1	Krusevo (1)	"Kole Nalco"	46,75	5.400
2	Krusevo (2)	"pod Avtoturist"	43,75	3.600
3	Bitola	"Meglenci"	25.00	1.500.000
4	Prilep	v. Alinci ("Omec")	23,75	530.000
5	Resen	"Alchevi koshari"	22.00	200.000
6	Krivogashtani	"Livadski Pat"	21.00	800
7	Dolneni (2)	v. Crniliste	16,75	1.000
8	Dolneni (1)	"Debreshte"	15,50	1.300

3. Pelagonija planning region

Rank	Municipality	Municipal landfill	Score	Deposit [m^3]
1	Gevgelija	"Suva Reka"	53,25	17.000
2	Radovis	City Landfill	37,50	50.000
3	Valandovo	"Suvodolica"	35.00	80.000
4	Murtino	"Dineva Bara"	31.00	5.000
5	Novo Selo	loc. Solena Reka	25,25	480

Rank	**Municipality**	**Municipal landfill**	**Score**	**Deposit [m^3]**
6	Strumica	17 km northern	24,50	350.000
7	Bogdanci	"Brdanov Kamen"	16,75	50.000
8	Miravci	"Karaivanovi kurii"	15.00	2.000
9	Dojran	"Dekil-Tas"	14,50	40.000
10	Novo Selo	(the old one) "Sopov Rid"	12,75	80.000

4. Southeast planning region

Rank	**Municipality**	**Municipal landfill**	**Score**	**Deposit [m^3]**
1	Sveti Nikole	v. Nemanjeci	36,25	60.000
2	Negotino	v. Dubrovo (Buceto)	27,25	120.000
3	Veles	"Bunardere"	23,75	620.000
4	Kavadarci	"Melci"	23,75	480.000
5	Demir Kapija	"Pcenicni Dupki"	22.00	101.200

5. Vardar Planing region

Rank	**Municipality**	**Municipal landfill**	**Score**	**Deposit [m^3]**
1	Karbinci (1)	v. Karbinci	46,75	1.456
2	Karbinci (2)	v. Tarinci	46,75	5.824
3	Karbinci (3)	v. Radanje	43,75	416
4	M. Kamenica	"Kamenicki Rid"	28.00	50.000
5	Pehcevo	"Suvi Dol"	27,75	20.000
6	Vinica	v. Leski	27,75	430.000
7	Berovo	"Iljadin Valog"	25,50	22.000
8	Blatec	"Pocivalo"	25,25	3.840
9	Oblesevo (1)	"Progon"	25,25	180
10	Stip (2)	"Krstot"	25.00	300.000
11	Delcevo	"Ostrec"	24,50	175.000
12	Zletovo	"Meliste"	23,75	72.000
13	Kocani	"Belski Pat"	22.00	300.000
14	Probistip	v. Neokazi (Strmos)	22.00	22.000
15	Karbinci (4)	v. Krupiste	21.00	416
16	Orizari	"Bel Kamen"	20,75	7.000
17	Stip (1)	v. Penush ("Trestena Skala")	12,75	8.000
18	Oblesevo (2)	v. Banja ("Jaz")	12,75	5.000

6. East Region

Rank	Municipality	Municipal landfills	Score	Deposits [m^3]
1	K. Palanka	v. Konopnica	38,75	130.000
2	Kumanovo	"Krasta"	25	1.832.200
3	Kratovo	"Zeliznica"	24,25	35.000
4	Lipkovo + 3	v. Nikustak	12,75	16.536

7. Northeast region

6 PLAN FOR CLOSURE AND AFTER-CARE OF NON-COMPLIANT LANDFILLS

There are currently 54 operating landfills in Macedonia, none of which have been developed and are operated to the standards required by the Landfill Directive 1999/31/EC.

In addition there are approximately hundreds illegal or 'wild' dumpsites.

The National Waste Management Plan envisages the closure of all the existing landfills and their replacement by Regional Landfills that will be constructed and operated to the standards required by the Landfill Directive.

The existing municipal landfills and the illegal dumpsites (i.e. 'wild' dumpsites) continue to cause pollution and the ultimate costs for clean-up and closure continue to increase on a daily basis. The measures set out are for the phased closure of existing landfill sites and for the phased clean-up of the 'wild' dumpsites on the basis of perceived environmental risk.

6.1 Identification of the Responsible Inspection Authority

The authorities responsible for inspecting the main waste treatment facilities in the Country are as follows:

Type of Waste Management Facility	Inspecting Authority
• Existing Municipal Waste Landfills	• The State Environmental Inspectorate (SEI). A specific recommendation is that, a Unit for Waste – a dedicated Department for the enforcement of waste regulation within the State Environmental Inspectorate (SEI) is established. The Unit should be assisted as appropriate by the Authorised Inspectors of Environment.
• Existing Illegal or 'Wild' Dumpsites	• The Municipality in question, specifically the Authorised Inspectors of Environment acting under the guidance and supervision of the Unit for Waste

Authority Responsible for the Inspection of Waste Facilities

6.2 Conditioning Plans, Closure Plans and Clean-up Plans

In the case of the landfills that will remain in operation pending the development of the new Regional Landfills, the relevant Municipalities should prepare more sophisticated conditioning plans to bring operations as closely in line with the requirements of the EU Landfill Directive,

1999, as practicable. In addition Closure Plans should also be prepared for each of these landfills, taking into account the planned construction of the new Regional Landfills.

In the case of the illegal or 'wild' dumpsites, the Municipality in question, within whose territory the site is located, should undertake an environmental risk assessment for each of the sites, prioritise the sites in terms of risk to the environment and prepare a Clean-up Plan with priority given to the 'High Risk' sites.

6.3 Key Milestones

The following key milestones are suggested for the next 8 years,and should be taken in consideration in the Regional waste Management palns for every region:

- Within 12 months - selection of the existing Municipal Landfills that should be closed. This exercise to be carried out by the Regional Waste Management Bodies, in consultation with the respective Municipalities, the State Environmental Inspectorate (SEI) and the Department for waste within the Environmental Administration;
- Closure Plans for the selected Municipal Landfills are to be prepared by the respective Municipality within 2 years from the date of the adoption of this plan.
- Closure of the selected Municipal Landfills within 8 years (i.e. by the end of 2020[2]). The process will be carry out in paralel with the opening of the new regional landfills.;
- Closure and clean-up of all of the illegal/wild dumpsites by 2020. The process will be carry out in paralel with the opening of the new regional landfills;

6.4 Current Position in Macedonia

The National Waste Management Plan (2009- 2015) recognizes the need for major investment in landfills and foresees the development of modern regional landfill sites for 50% of the collected MSW by 2014. All of the regional landfills should ideally be in place by 2018.

There is a need for the existing landfills to continue to operate until the new regional landfills become operational. According to the present situation in RM this obligations should be posponded for 2020. The National Waste Management Plan (2009-2015) is going to be revised.

6.5 Outline of Proposed Closure Strategy

It is suggested that two separate approaches should apply:

- One approach for the 54 existing authorized municipal landfills; and

[2] Table 7 of the National Waste Management Plan (2008 – 2014) of the Republic of Macedonia requires 50% of the collected MSW to be landfilled in EU compliant landfills, by 2014 the Plan is going to be revised

- A second approach for the approximately 320 illegal or 'wild' dumpsites.

In the case of the 54 existing authorized municipal landfills the overall aim should be to progressively introduce improved management practices in order to reduce the adverse environmental effects of their operation, to reduce the costs associated with their closure to the greatest extent possible, and to provide an adequate landfill service until the new regional landfills become operational.

In the case of the illegal or 'wild' dumpsites, the overall aim should be to close these sites as soon as practicable thus ensuring no additional clean-up costs will arise beyond those already required and to ensure that the clean-up of these sites is undertaken according to an environmental risk-based system of prioritization.

6.6 Strategy for Existing Municipal Landfills

As indicated above, the National Waste Management Plan, 2008, foresees the development of modern regional landfill sites for 50% of the collected MSW by 2014. All of the compliant regional landfills should ideally be in place by 2018. Accordingly, the necessary measures should be undertaken to progressively close some of the existing municipal landfills as soon as possible. The existing municipal landfills should be prioritized for closure on the basis of environmental risk and on economic factors and appropriate landfills should be selected for closure.

6.7 Strategy for Wild Landfills

There are currently approximately hundreds illegal or 'wild' dumpsites in the Country. The first priority for these 'wild' dumpsites should be to prevent any further activity at these sites as soon as possible.

Prevention of activity may require the provision of alternative options such as:

- The provision of large communal containers for acceptance of waste;
- The provision of a household waste collection system;
- The provision of fencing: and
- Sophisticated measures, such as hidden cameras and strong and effective enforcement measures (may be required in extreme cases).

In each case, the reason why the wild dumpsite has become established should be identified if possible. A wild dumpsite may have become established due to the lack of waste collection services in the area. It may be due to lack of awareness among the citizens or it may be because of cost considerations. An understanding of the reason for the wild dumpsite should assist in identifying the methodology required to perform its elimination.

All wild dumpsites should be cleaned up, unless it can be shown that closure of the site and in situ capping of the remaining waste deposited on the site is a better environmental option.

6.8 Planning Closure

It is suggested that all sites should be required to produce Conditioning Plans within 24 months. The Conditioning Plans for those landfills prioritized for closure should be focused on preparing for closure within a maximum of 8 years (i.e. by 2020). Such Conditioning Plans for closure (i.e. Closure Plans) should focus on achieving appropriate site profiles for closure (i.e. allowing deflection of rain water, together with appropriate capping measures).

The Conditioning Plans for the remaining municipal landfills should focus on the adoption of many of the operational measures, as required by the EU Landfill Directive, to the maximum extent practicable and over an appropriate timeframe. These Conditioning Plans should also plan the ultimate closure of the sites.

6.9 Rehabilitation Measures

General

Rehabilitation measures will differ depending on whether the site in question has been a large landfill operated by a municipality or an illegal or 'wild' dumpsite used because of the lack of a collection service in an area. The measures will vary from covering of the deposited waste with inert material at one end, to excavation of the deposited material at the other end. Other solutions may involve installing leachate collection and landfill gas collection systems. The appropriate solution in each case should be based on the risk evaluation carried out for the specific landfill and should take into account the following aspects in particular:

- The nature and sensitivity of the possible receptors or targets at risk; and
- The age and size of the landfill or dumpsite, in particular the depth of waste deposited. This will determine the potential for leachate production and landfill gas emissions.

The options considered in the following Sections include:

i. Covering of the deposited waste;

ii. Covering and capping of the facility;

iii. Installation of leachate management and landfill gas management measures in addition to covering and capping of the deposited waste; and

iv. Excavation of the deposited waste

In addition further measures which should be implemented are monitoring and aftercare procedures.

In all cases the sites, following rehabilitation, should be closed and with signs to inform the general public that dumping of waste material on or near the sites will constitute an offence and will result in a serious fine. The rehabilitated sites should be surrounded by a fence and access to the site should be controlled. One of the employees of the municipality or the public communal enterprise (PCE) should be given responsibility to carry out regular routine inspections of the closed site to ensure that no further illegal dumping is taking place.

A cornerstone in the concept of regional waste management is that the local municipal landfills will be closed and replaced by a Regional Waste Management Centre with a sanitary landfill and possibly waste treatment.

Wild dumpsites are generally present close to villages and settlements where there is no waste collection service. The extension of the waste collection services to such towns and villages will provide an opportunity for the municipality to launch a campaign to clean-up these wild dumpsites and define the dawn of a new era. Each municipality should publicize the new approach to municipal solid waste management and endeavor to mobilize the civil society to participate in such clean-up operations.

Option 1: Covering of the Deposited Waste

In the case of small landfill sites and/or 'wild' dumpsites where the depth of the deposited waste is relatively shallow, and where there are no targets at risk of a particularly sensitive nature, the most appropriate solution may be to cover the deposited waste material with a layer of inert material, such as subsoil, and a final layer of topsoil or humus. The topsoil layer should be 150 to 300mm thick and where possible the combined thickness of the topsoil and subsoil layers should be approximately 1,000 mm. The top layer should be properly grass seeded during the appropriate growing season. This type of solution may be appropriate in the case of low risk landfill sites and some of the small 'wild' dumpsites where the type and depth of waste material is such that the risk of leachate generation or landfill gas migration is relatively small.

It may also be necessary to re-shape the mounds of deposited waste and/or to apply an additional inert regulating layer of subsoil material, in order to put some shape on the final profile of the site. This will improve the setting of the site in relation to the adjacent landscape. This type of profiling can generally be done with a bulldozer.

In an EU-funded Project in Kosovo carried out in 2010/2011, eight 'wild' dumpsites were rehabilitated by applying the type of capping measures outlined above. The sites varied in size from 9,000 m^2 to 111,000 m^2 with a total capped area of 260,000 m^2. The cap was consisted of 800 mm depth of compacted clay subsoil and 200 mm topsoil on top of regulating layers to achieve the required profiles. Drainage and minimum attenuation measures were installed. The

overall cost of the Works Contract was €2,600,000. This equates to approximately €10/$m^2$of capping.

This option is generally the lowest cost option and it may be suitable for 'Low Risk' sites (i.e. sites where the deposited waste material is predominately inert). However, it is unlikely to be suitable for sites where there is a significant depth of waste, or that contains a large amount of organic waste, biodegradable material or non-inert waste that contains contaminants/is hazardous.

Where Option 1 is being considered, a landfill gas survey (including a landfill gas migration survey) should be undertaken to establish the degree of stability of the deposited waste. In addition consideration may be given to the effect of on-going rainfall on the site in terms of bio-reactor effect.

Option 2: Covering and Capping of the Deposited Waste

In the case of some landfill sites and 'wild' dumpsites it may be necessary to install a capping layer over the deposited material in order to prevent or reduce the amount of rainfall penetration.

The main purposes of the surface sealing system (i.e. a capping layer) would be:

- To control the amount of rainwater filtration into the waste to reduce the amount of leachate generated;
- To prevent erosion;
- To minimise the migration of the greenhouse gasses into the atmosphere; and
- To minimise other emissions causing negative impacts on the environment.

When rainfall (or other liquids) mixes with the biodegradable material in municipal solid waste it generates leachate and enhance degradation and thereby the generation of landfill gas generated. These are the two main by-products of the biological decomposition of waste and they can give rise to a significant impact on the environment and on human health.

The main constituents of landfill gas (LFG) are Methane (CH_4- typically 60% by volume) and Carbon Dioxide (CO_2 - typically 40%). Methane is explosive between a lower explosive limit (LEL) of 5% in air and an upper explosive limit (UEL) of 15% in air. A mixture of Methane and air in a confined space between the LEL and the UEL concentrations will explode if ignited. Landfill gas has caused a number of serious explosions most notably the Loscoe, explosion in the United Kingdom in the 1950s. The other major constituent in landfill gas is Carbon Dioxide (CO_2).

Landfill gas can give rise to odor nuisance and can also give rise to nausea and headaches. Landfill gas can also contain Volatile Organic Compounds (VOCs) which are of increasing concern because of their long-term toxicity. Therefore, if there is a risk of further degradation of

biodegradable material by the addition of moisture, it may be possible to mitigate this risk by installing a capping layer above the waste material.

Where it is considered that further decomposition of the waste material is slow, provided that rainfall is prevented from penetrating the waste mass, the installation of such a capping layer may be an effective and cost-efficient solution.

The major components of a capping system consist of topsoil, subsoil, a drainage layer, and a barrier (infiltration) layer, as follows (from the top to the bottom):

- A topsoil layer, (150 to 300mm thick) with a minimum slope of 1 to 20 to prevent surface water ponding and to promote surface water run-off, and a recommended maximum slope of 1 in 3;
- A subsoil layer such that the combined thickness of the topsoil and subsoil layer is approximately at least 1m
- (Where considered necessary) A drainage layer of 0.5m thickness having a minimum hydraulic conductivity of $1x10^{-4}$ m/s. The drainage layer can be replaced by a geosynthetic drainage medium.
- A compacted mineral layer (barrier layer) with a minimum thickness of 0.6m having a hydraulic conductivity of less than or equal to $1x10^{-9}$m/s or a geosynthetic material (e.g. GCL) or flexible membrane liner (e.g. LLDPE) that provides equivalent protection. Where geomembranes are used they should be able to withstand high tensile strains induced by differential settlement, LLDPE (linear low density polyethylene) is particularly suitable.

It is important to take the settlement of the waste mass into account, particularly where the depth of biodegradable municipal solid waste (MSW) deposited is significant. Settlement values of between 10% and 25% can be expected. When substantial settlements can be expected, it could be better to use a temporary cover first and await the degradation process until the final cover can be added without being damaged by large settlements in the near future.

When deciding on how dense the final cover should be, it is also important to consider how dense/permeable the bottom of the landfill is. If the bottom is more dense than the top, water will gradually build up within the landfill, making it unstable. This can be solved by constructions that makes it possible to collect the overflow of leachate at the end of the landfill slope.

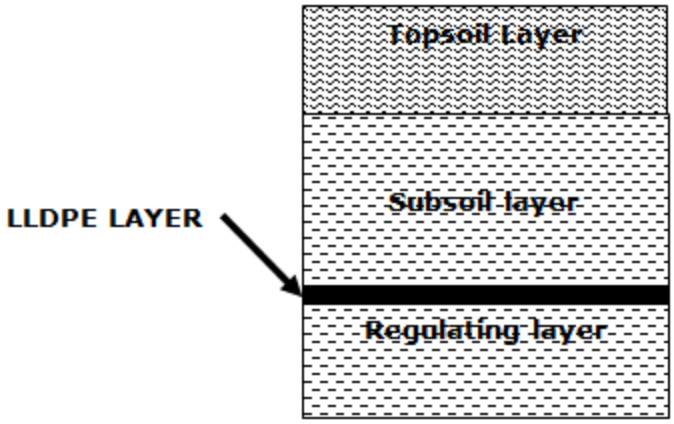

Figure 19: Cross-Section Through Capping Layer

The installation of the capping layer should be subject to Construction Quality Assurance (CQA) and Construction Quality Control (CQC) to ensure that materials and workmanship meet design specifications (e.g. LLDPE capping layer, etc.). Where there is a risk that the subsoil layer will contain large or sharp stones, a protection layer of geotextile should be placed underthe LLDPE capping layer.

One of the issues to be considered in determining whether or not to install a capping system over the waste mass is the 'dry tomb' effect of such an installation. Where moisture (i.e. rainfall) is permitted to penetrate the waste mass in a conventional landfill the biodegradation process and ultimate stabilisation of the waste may take a period of approximately 30 to 50 years. Where the facility is capped and where rainfall is prevented from penetrating the waste, the biodegradation process will be delayed significantly and the time period before the material is stabilised will be extended. Accordingly the amount of biodegradable material in the waste mass should be taken into account in determining whether or not to apply a capping layer to one of the municipal landfills or 'wild' dumpsites. If no capping is performed, leachate collection and treatment should be installed where there is a risk for contamination of the surroundings.

Option 3: Installation of Leachate Management and Landfill Gas Management Measures in Addition to Covering and Capping Layers

In the case of significant facilities (i.e. where large amounts of municipal solid waste has been deposited over a considerable period) it is be appropriate to consider the installation of leachate management and landfill gas management measures, in addition to the covering and capping measures described above.

Such measures should be considered in particular where:

- On-going production of leachate will continue to pose a risk to the environment (e.g. to groundwater underneath the site and/or to surface waters downstreams of the site);

- On-going production of landfill gas (LFG) will continue to pose a risk to sensitive receptors adjacent to the facility in question due to off-site migration of such gases;

- The on-going biodegradation of the biodegradable fraction in the waste is likely to give rise to on-going odour nuisance and consequent complaints from residents and those working close to such facilities.

In such circumstances it may be appropriate to install leachate management measures and/or landfill gas (LFG) management measures. Such measures will generally be expensive.

Leachate Management Measures

Where leachate is to be managed it must be collected, stored and then treated. It may be difficult to install a leachate collection system at the base of the existing landfill or dumpsite, particularly where design drawing or 'as-built' drawings are not available. Indeed it may only be practicable to consider such measures where there is a natural impermeable barrier such as clay underneath the landfill and where the leachate is currently building up within the waste mass.

The leachate collection pipes should be laid at a fall of between 1% and 2%. The most common reason for failure of the drainage system is clogging of the pipes, the drainage layer or the filter layer. The system should ideally include features that allow for pipe system cleanings.

Leachate can be removed from the landfill through leachate collection sumps or via a leachate collection header pipe system. Monitoring is required to ensure that the depth of leachate in the waste mass is being properly controlled (i.e. maintained at a level of less than 1.0m over the base of the landfill (i.e. clay liner). This condition is to ensure that the hydraulic head of the leachate is kept to a reasonable level and thus reduce the amount of leakage of leachate underneath the waste mass to the environment. If the leachate is collected in for example a pond, it is important to add oxygen in the water mass in order to reduce the risk of problems with odour.

Leachate can be recirculated through the waste mass and it can provide a medium for additional microbial degradation. The potential benefits of leachate recirculation are:

- Increased production of landfill gas (i.e. in terms of quantity and quality) for use in energy recovery projects and enhanced stabilisation of the landfill;
- Reduction of the costs of leachate collection and disposal;
- Reduction of the volume of leachate through evaporation and transpiration;
- Enhancement of landfill settlement; and

- Enhanced stabilisation of the landfill leading to reduced post-closure time (i.e. consistent with the Principle of Sustainability) and cost.

Concerns about leachate recirculation programmes include:

- The risk of heavy equipment crushing leachate recirculation pipework and associated components;
- Resulting leachate concentrations affecting agreements to treat leachate at offsite wastewater treatment plants (WWTPs); and
- Leachate outbreaks along the side slopes of the landfill.

After collection and storage on site (usually in an aerated pond) the leachate must be treated. The objective of leachate treatment is to attain the standard required for the discharge of the resultant effluent. The standard required will vary depending upon the receiving water or sewer system. The main options for leachate treatment are summarised below[3]:

- Physical/Chemical Pre-Treatment (e.g. flocculation, coagulation, filtration/adsorption, reversed osmosis, evaporation and/or settlement). These treatment methods are best suited for treating leachate from older/closed landfills that have lower biodegradable organic carbon;

- Biological Treatment (e.g. systems such as activated sludge systems, sequencing batch reactors, extended aeration lagoons, constructed wetlands and rotating biological contactors)

- Combined Treatment (i.e. a combination of physical/chemical and biological treatment in one system); and

- Tertiary Treatment (e.g. reed bed systems)

The quantity and characteristics of leachate are a function of the landfill's contents and age, as well as the site's prevailing weather conditions and geology. Depending on the type of facility it may prove difficult to install an effective leachate collection system in the case of an old landfill.

[3] Rulebook on the conditions that need to meet the landfill ("Official Gazette of the Republic of Macedonia" no. 78/09.)

Landfill Gas Management Measures

The major components of landfill gas are Methane (CH_4) and Carbon Dioxide (CO_2), typically in a 60%:40% ratio, respectively. Methane is flammable and can be an asphyxiant as can carbon dioxide.

Methane is estimated to be 20 to 30 times more damaging than carbon dioxide to the global climate due to its more powerful greenhouse effect, and thus the provision of utilizing or flaring the landfill gas should be considered, particularly at larger sites.

Where there is a risk that landfill gas can migrate from an old landfill or where odours from a landfill are causing a significant nuisance, consideration should be given to collecting the landfill gas. Methane has a high calorific value and landfill gas can therefore be flared or converted to energy (i.e. used for power generation and/or process heating). Typically about $600m^3$ - $700m^3$ of landfill gas (containing approximately 50% methane) is required to generate 1 MW of electricity.

The primary function of a landfill gas control system is to prevent the migration of landfill gas. The main options for managing landfill gas are the following:

Barriers: Landfill Gas Barriers are physical barriers such as ventilation trenches to vent the landfill gas to air or cement/bentonite slurry cut-off trenches which are used to control landfill gas migration and to protect a potential target or receptor (See Figure 1 above).

Venting: Gas venting is used to reduce the accumulation of landfill gas or odours behind the barrier. Venting Systems have been used to dissipate landfill gas where the gas concentration was considered too low for flaring or utilisation. Examples of venting systems include vent stacks or gravel filled trenches. The vent stacks are installed in the waste mass and they extend upwards through the capping system. There are concerns about the practice of passive venting because of the gas's greenhouse/ozone depletion potential.

Active Control and Flaring: Active control of landfill gas is provided through an extraction system with subsequent disposal of the gas by flaring or utilisation by conversion to energy. Gas wells can be drilled through the emplaced waste. Gas wells are generally drilled to 75% of the waste depth. The gas wells consist of perforated pipe surrounded by non-carbonaceous aggregate material, all contained in a wire mesh. The section of pipe at the top of the gas wells should not be perforated and a system of collection pipes should direct the collected gas to the landfill gas flare, usually via a manifold. Where possible, landfill gas monitoring points should be established on the perimeter of the site and between the site and sensitive receptors (e.g. houses, schools, nursing homes, etc.). The concentration of landfill gas in perimeter boreholes should not exceed the trigger levels of 1% v/v for Methane and 1.5% v/v for Carbon Dioxide.

Option 4: Excavation of the Deposited Waste

In the case of some small landfill sites and 'wild' dumpsites the best practicable option may be simply to excavate and remove the deposited waste material. One of the prerequisites for this option is the presence of a suitable disposal site for the excavated material.

Further Measure: Implementation of Monitoring and Aftercare Procedures.

Monitoring of old municipal landfills and 'wild' dumpsites is required throughout the post-closure phase. The scope of the monitoring programme should be determined by the presence of sensitive receptors, the likely environmental impacts of significance and the scale and nature of the waste at the site. The following environmental media are typically monitored:

- **Surface Water**: Where there are watercourses and/or streams in the general vicinity (i.e. say within 250m) of the rehabilitated landfill site or 'wild' dumpsite, upstream and downstream, samples should be taken and analysed for a number of parameters associated with leachate, including BOD_7, TOC, total Nitrogen, Ammoniacal, total Phosphor, Arsenic, Lead, Cadmium, Copper, Chrome, Nickel, Zinc, Mercury, Chloride, Nonpolar Aliphatic Hyrdocarbons and PAH.

- **Groundwater**: Where there are wells in the general vicinity (i.e. say within 500m) of the rehabilitated landfill site or 'wild' dumpsite, up-gradient and down-gradient groundwater samples should be taken from these wells and analysed for a number of parameters associated with leachate, including BOD_5, TOC, total Nitrogen, Ammoniacal, total Phosphor, Arsenic, Lead, Cadmium, Copper, Chrome, Nickel, Zinc, Mercury, Chloride, Nonpolar Aliphatic Hyrdocarbons and PAH. Where there are no wells in the vicinity of the rehabilitated site, consideration should be given to the installation of one well up-gradient and one well down-gradient of the rehabilitated site;

- **Leachate**: Where possible the level of leachate in the waste mass should be measured on a regular basis, particularly where leachate management measures have been put in place;

- **Landfill Gas**: This is one of the most important issues in the post-closure phase of an old landfill or 'wild' dumpsite. It is of critical importance to check if landfill gas is migrating from the site and posing a risk to nearby receptors. This can be checked by using perimeter landfill gas monitoring wells, which ideally should be installed at 250m centres between the edge of the deposited material and any sensitive receptors, such as houses, institutional buildings or commercial enterprises.

- **Odours**: Odours from rehabilitated landfills and 'wild' dumpsites can arise from the decomposition of organic wastes. Proper landfill gas and leachate control systems are the most effective ways of reducing odours at source, thus minimising the need to undertake odour monitoring. Periodic Odour Patrols should be carried out and a pro-forma, 'Odour Assessment Report Form' should be completed when these Odour Patrols are carried out. The following aspects should be noted:

    - The extent of odours encountered at specific monitoring points (i.e. None; Local and not persistent; Persistent but fairly localized; Persistent and pervasive up to 50mm from site boundary; Persistent and widespread;

    - Location sensitivity (i.e. presence of sensitive receptors where odours detected);

    - Nature of any odours encountered;

    - Weather factors (e.g. frost and fog; rain; temperature); and

    - Wind (e.g. strength such as Calm; Light air; Light breeze; Gentle breeze; Moderate breeze; Fresh breeze; Strong breeze; Near gale; Gale; Strong gale, and direction)

6.10 Methods for Remediation

In order to have certain cost for remediation, the following groups of remediation measures were determined:

a Earthworks and landscaping:
a1 Move waste, create sloped landfill surface
a2 Spread, evening (supplied soil) on landfill area, avg 10 cm thickness
a3 Even and compacting landfill surface

b Waterproofing and cover layers formation:
b1 Gas collection and removal layer (from 50 cm gravel)
b2 Supply material for mineral insulation
b3 Compacting and quality control of mineral insulation (2×25cm thick, k<1×10-9m/s)
b4 Geotextile separation layer (400 g/m2)
b5 Water collection drain layer from sandy gravel (50cm, k>10-4m/s)
b6 Prepare soil cover from supplied humus topsoil with compacting
b7 Spread humus topsoil, fine grading
b8 Grassing landscaped surface with post-treatment

c Landfill gas collection and extraction:
c1 Build gas collection wells by drilling
c2 Landfill gas suction pipe (DN80 KPE)
c3 Landfill gas suction pipe (DN100 KPE)
c4 Condensed water separation and control manholes (build and assemble pipes)
c5 Gas production equipment and gas burner ancillary facilities, pipe and cable connections
c6 Landfill gas suction and burning equipment

d Leachate collection and treatment
d1 Rainwater drain open ditch
d2 Build wire mesh r.c. pole fencing, restoration
d3 Planting green plants, row of trees
d4 Construct monitoring wells with well head closing, incl. water quality tests
d5 Transport of the waste from site
d6 Supporting bank

Based on above technical measures, three main remediation classes were identified.

Table 4: Remediation classes

Remediation Class		**Short Description [remediation measures]**	**Landfill Category [Waste Quantity (m^3)]**
Class I		Dislocation	less than 3.000 m^3
Class II		Earthworks / waterproof / cover layers [a + (b2 : b8) + (d1 : d4)]	3.000 - 100.000 m^3
Class III	Class III 1	Earthworks / waterproof / passive degasification / cover layers [a + b + c1 + (d1 : d4)]	100.000 - 500.000 m^3
	Class III 2	Earthworks / waterproof / active degasification / cover layers [a + b + c + (d1 : d4)]	more than 500.000 m^3

In addition to these activities required for the on site closure, the option to remove the waste together with the contaminated soil has been proposed for two sites located in the river beds, i.e. the landfills in Kicevo and Gevgelija. These sites are categorized in the remediation class IV Special cases. It encompasses the following activities:

a * Earthworks and landscaping
a*1 Removing of waste from the site
a*2 Transport and disposal of waste within 100 km (on sanitary landfill or for closure)
a*3 Remove and transport, and disposed the contaminated topsoil within 20 km
a*4 Replace the contaminated soil
a*5 Grassing landscaped surface with post-treatment

For each site a selection has been made of the recommended most effective and feasible method or combination of methods. The final choice of method and design of the remediation plan can only be made after detailed soil & groundwater investigation and delineation survey, which were not in the scope of this project.

Aftercare and Future Use of the Location(s)

If a non-sanitary landfill site has been remediated the aftercare phase starts as soon as the final covering and the main remediation activities regarding the non-sanitary landfill site have been finalised. The after-care activities depend on the measures that are taken during remediation. The site should be prepared for its future use taking into account the after-care activities[4].

After-care

During the after-care phase of the landfill site the former operator (when known) or the authorities responsible/operator for the remediation works will be responsible for the maintenance, monitoring and control of the remediation and isolation measures taken and the environmental situation as long as may be required, taking into account the time during which the landfill could present hazards.

The various maintenance, monitoring and control activities, which should be performed, during the after-care period include for instance:

- collection and treatment of the leachate and monitoring of the leachate quality
- maintenance of the leachate treatment facility and/or transport system
- monitoring of the groundwater and surface water in the vicinity of the landfill site
- collection and treatment of the landfill gas and monitoring of the gas quality
- maintenance of the gas collection and equipment

[4] Rulebook on the manner and procedure of operation, monitoring and control of the landfill closure and after-care phase of the landfill after closure, as well as the manner and conditions of concern for landfills after they stoped work (Official Gazette no. 156 /07)

- monitoring and maintenance of the final covering and any other isolation or long-term remediation measures required and installed

Future use

The future use of rehabilitated landfills is subject to certain constraints and limitations that remain in force until the biodegradable fraction of the buried wastes has been almost completely decomposed, and chemical and physical processes going on in the landfill have reached a relatively high degree of stability. The most important factors determining the potential uses include:

- low bearing capacity of the final cover system of the landfill
- extensive (especially uneven) settling
- presence of combustible and explosive gases
- corrosive character of decomposition products and the internal landfill environment in general

These processes and their associated constraints will continue long after the land filling activities have been ended. The installed isolation and remediation measures and the required after-care activities may also be of influence on the selection of the future use of the rehabilitated non-sanitary landfill site. The various alternatives for future use of the landfill may not damage the measures installed or hinder the after-care activities.

It should also be prevented that potential future users of the area can reach and/or damage equipment required for the after-care activities like the landfill gas equipment or the leachate collection and monitoring equipment. Digging activities, which would be a risk for the sealing properties of the top cover system should be prohibited.

Finally the hazard properties of the wastes stored in the landfill may influence the selection of the potential future use. If hazardous wastes have been disposed of in the landfill, the planting of food crops should be prevented and in some cases the use of the location should be prevented all together.

Open space and recreation

Open space and recreation can be considered as the most beneficial of the potential uses of a completed landfill. The list of potential recreational uses is extensive and can vary from parks to sports facilities. However all constraints attending the construction and use of structures also apply to structures erected for recreational purposes.

Regarding the use of plants in recreational areas some precautions have to be taken. The use of grass and bushes generally will not pose any problems. The selection of trees to be used however has to be done very carefully. Deep rooting trees should not be used, because these may damage the sealing layer on top of the landfill and transport harmful substances to the environment. The planting of tall and/or heavy trees, which do not root deep, should also be prevented because they are susceptible to wind throw and may result in damage to the top closing layer. As mentioned

above, if hazardous wastes have been disposed of in the landfill, the planting of food crops should be prevented and in some cases the use of the location should be prevented all together.

Cost Estimates

The costs of all recommended measures are calculated by attributing unit cost to the selected three remediation options. The applied unit costs and their basis are presented in Annex 7. These unit cost are linked to the selected remedial measures and multiplied by the physical properties of the sites (m^2 surface and/or m^3 dumped waste), thus resulting in cost per measure per site, total cost per site, and total cost per type of measure.

The summary of total estimated cost per remediation class is presented in the following table.

Table 5: Overview of the cost estimate for the remediation

				Unit Costs	**Costs per Class [€]**
CLASSES	IV	Special Cases	Kicevo and Gevgelija	/	4.136.640.00
			Ohrid	/	
			Kriva Palanka	/	
	III	III 1	100.000 - 500.000 m^3	32,05 EUR/m^2	8.685.550.00
		III 2	> 500.000 m^3	34,85 EUR/m^2 + 60.000 EUR for facility (per landfill site)	10.529.850.00
	II	Simple Cases	3.000 - 100.000 m^3	26,65 EUR/m^2	5.150.690,50
	I		< 3.000 m^3	20 EUR/m^3 transported in radius of 50 km and more	192.960.00
				TOTAL:	**28.695.690,50**

The summary of the total estimated cost per site is presented in following table.

Table 6: Remediation costs per Region

Rank	Municipality	Location	Quantity (m3)	Surface (m2)	Total Cost (EUR)
1	Gostivar	v. Dolna Banjica, loc. "Susicki Most"	720,000	32,000	1,420,860.00
Total			**720,000**	**32,000**	**1,420,860.00**

1Polog Region

Rank	Municipality	Location	Quantity (m3)	Surface (m2)	Total Cost (EUR)
1	Kicevo	Kicevo city landfill	50,000	30,000	1,213,000.00
2	Meseista	M. L. of Meseista	6,240	3,000	79,950.00
3	Ohrid	loc. "Bukovo"	200,000	60,000	1,961,350.00
4	Belcista	M. L. of Belcista	5,000	1,000	26,650.00
5	Mak. Brod	loc. "Barbaras"	12,000	8,000	219,600.00
6	Struga (2)	v. Visni	50,000	5,000	133,250.00
7	Struga (1)	v. Kjafasan, loc. "Mali Vlaj"	50,000	5,000	133,250.00
8	Debar	loc. "Krivci"	60,000	11,000	293,150.00
Total			**433,240**	**123,000**	**4,060,200.00**

2. Southwest region

Rank	Municipality	Location	Quantity (m3)	Surface (m2)	Total Cost (EUR)
1	Krusevo (1)	loc. "Kole Nalco"	5,400	2,400	63,960.00
2	Krusevo (2)	loc. "Avtoturist"	3,600	2,000	53,300.00
3	Mak. Brod	loc. "Barbaras"	12,000	8,000	219,600.00
4	Bitola	loc. "Meglenci"	1,500,000	75,000	2,633,050.00
5	Prilep	v. Alinci, loc. "Omec"	530,000	38,000	1,449,940.00
6	Krivogastani	loc. "Livadski Pat:"	800	900	16,000.00
7	Resen	loc. "Alcevi Kosari"	200,000	6,000	192,300.00
8	Dolneni (1)	loc. "Debreste"	1,300	1,050	26,000.00
9	Dolneni (2)	v. Crniliste	1,000	800	20,000.00
Total			**2,254,100**	**134,150**	**4,674,150.00**

3. Pelagonija region

Rank	Municipality	Location	Quantity (m3)	Surface (m2)	Total Cost (EUR)
1	Gevgelija	loc. "Suva Reka"	20,000	15 000	619,000.00
2	Radovis	Radovis city landfill	50,000	11,000	293,150.00
3	Valandovo	loc. "Suvodolica"	80,000	15,000	399,750.00
4	Novo Selo	loc. "Solena Reka"	480	600	9,600.00
5	Strumica	17 km northern	350,000	80,000	2,564,000.00
6	Bogdanci	loc. "Brdanov Kamen"	50,000	20,000	533,000.00
7	Miravci	loc. "Karaivanovi Kurii"	2,000	1,300	72,000.00
8	Dojran	loc. "Dekil-Tas"	12,000	6,500	186,745.00
9	Novo Selo	loc. "Sopov Rid"	N/A	N/A	N/A
Total			**564,480**	**149,400**	**4,677,245.00**

4. Southeast Region

Rank	Municipality	Location	Quantity (m3)	Surface (m2)	Total Cost (EUR)
1	Sveti Nikole	v. Nemanjeci	60,000	12,000	319,800.00
2	Negotino	v. Leski	50,000	46,000	1,186,080.00
3	Veles	loc. "Bunardere"	620,000	75,000	2,670,500.00
4	Kavadarci	loc. "Melci"	480,000	60,000	1,923,000.00
5	Demir Kapija	loc. "Pcenicni Dupki"	101,200	35,000	1,121,750.00
Total			**1,311,200**	**228,000**	**7,221,130.00**

5. Vardar Region

Rank	Municipality	Location	Quantity (m3)	Surface (m2)	Total Cost (EUR)
1	Karbinci (2)	v. Tarinci	5,824	4,500	119,925.00
2	Karbinci (1)	v. Karbinci	1,456	5,000	29,120.00
3	Karbinci (3)	v. Radanje	416	850	8,320.00
4	Mak. Kamenica	loc. "Kamenicki Rid"	10,000	3,000	79,950.00
5	Vinica	v. Dubrovo, loc."Buceto"	30,000	10,000	42,640.00
6	Pehcevo	loc. "Suvi Dol"	20,000	4,500	134,780.00
7	Berovo	loc. "Iljadin Valog"	16,000	8,000	228,340.00
8	Blatec	loc. "Pocivalo"	3,840	900	23,985.00
9	Oblesevo	loc. "Progon"	180	500	3,600.00
10	Delcevo	loc. "Ostrec"	175,000	25,000	801,250.00
11	Probistip	v. Neokazi, loc. "Strmos"	22,000	1,600	45,908.00
12	Zletovo	loc. "Meliste"	72,000	3,450	91,942.50
13	Karbinci (4)	v. Krupiste	416	350	8,320.00

Rank	Municipality	Location	Quantity (m3)	Surface (m2)	Total Cost (EUR)
14	Kocani	loc. "Belski Pat"	300,000	50,000	1,602,500.00
15	Orizari	loc. "Bel Kamen"	7,000	4,000	106,600.00
16	Stip (1)	v. Penus, loc. "Trestena Skala"	8,000	6,000	159,900.00
Total			**672,132**	**127,650**	**3,487,080.00**

6. East Region

Rank	Municipality	Location	Quantity (m3)	Surface (m2)	Total Cost (EUR)
1	Kriva Palanka	v. Konopnica	120,000	5,500	343,290.00
2	Kumanovo	loc. "Krasta"	1,832,200	65,000	2,355,500.00
3	Kratovo	loc. "Zeleznica"	35,000	2,500	75,160.00
Total			**1,987,200**	**73,000**	**2,773,950.00**

7. Northeast Region

High risk

Medium risk

Low risk

6.11 Cost Funding

The options for funding the cost of closure/remediation of existing municipal dump sites and other wild dump sites are limited since these cost are to be considered as ‘sunk’ cost, e.g. these costs will not bring any return or future financial benefits. Therefore the options of financing of these costs by the private sector, Commercial Financing Institutions, or through long-term loan capital from International Financing Institutions (IFIs as EIB, EBRD, WB / IFC) are to be considered not feasible.

In principle for covering the costs of closure/reclamation of municipal and other illegal dumpsites, also the Polluter Pay Principle should be applied, e.g. the municipalities, industries (and households) who caused this pollution should pay for the closure/ reclamation of these dump sites.

For the municipalities, the main options for raising the required funds are basically:

- Transfers (partly) from the regular State budget.
  It seems highly unlikely that the capital investments required to close and remediate the municipal and wild dump sites will be financed to any significant extent through *transfers from the regular state budget*. Apart from the fact that this issue is primarily a municipal responsibility/liability, the available state budget is already very tight, and financial support from central government may be expected to be confined only to such areas as grant contributions towards feasibility study costs, e.g. further delineation survey costs, or (potentially) the provision of guarantees for international / bilateral loans to finance the construction of major regional facilities for processing municipal wastes.

- Capital grants or long-term loans on preferential terms from an earmarked Environmental Investment Program Budget.
  These programs and/or funds are usually the main sources of state financing for public and private sector environmental investments, primarily in the form of capital grants and soft loans. The Funds' capacities to provide financial support for investment projects are very much determined by their available financial resources, and the revenues they receive from pollution fees and other earmarked charges. Certainly, the overall demand for environmental investment finance will always far exceed the resources available, and so the Funds will need to focus their scarce resources on those projects and investments that are strategically important for achieving compliance with EU directives. Opportunities for using the Funds for providing the co-financing required in order to leverage capital investment finance from foreign and other sources can also be considered.

In case of funding the costs for closure/remediation of municipal and wild dump sites, the instrument of charging dedicated fees is certainly a feasible option. There are basically two options:

- National level:

Introduction of an additional landfill charge/fee on top of existing landfill fee, and to use part of these revenues for the set-up of co-funding arrangements for financing the closure and remediation costs of the municipal dump sites and other wild dumps in the area.

- Local/Regional level:

To increase (partly) the waste fees charged by the municipalities to the households, and to use these revenues for co-funding the required costs for closure / reclamation of the old and illegal landfills.

- Capital grants from the European Union's Instrument for Pre-Accession (ISPA)

This is the European Union's principal mechanism for providing financial assistance for compliance-related investments in the accession countries. Its key features and conditions are:

- ISPA support is available for investment projects in the transport and environment sectors, and is provided in the form of (non-repayable) grant contributions.
- ISPA support is not available to private sector or commercial investors.
- The total cost of the investment project should be Euro 5 million or greater.

- In principle, up to 75% of the total investment cost of a suitable project could be financed by ISPA. In practice, however, ISPA is unlikely to cover much more than 50% of the total cost.

Since Republic of Macedonia is presently not eligible for ISPA funding this isn't short term option yet for closure and reclamation of municipal and wild dumps. In the future, however once Macedonia is eligible for ISPA funding, the cost for closure and reclamation of the old municipal dump sites may be part of a financing package for investment to improve municipal or regional waste management systems.

- Bilateral (Environmental) Co-operation

Many countries, including most of those in Western Europe, the USA, Japan and Canada, provide financial assistance and grants to central and eastern European countries through so-called *bilateral financing institutions and/or co-operation agreements*. Also the EU, and in particular EAR programs, are relevant for possible funding options. These arrangements differ in their areas of interest and *modus operandi* but, in general, operate along similar lines.

This seems also a feasible funding option, however again these costs may be funded as a part of an investment plan to establish improved integrated municipal or regional waste management systems.

Glossary

Biodegradable	Any waste that can be decomposed through anaerobic (no oxygen present) or aerobic waste:(oxygen present) decomposition processes.
Dumpsite:	A site within the municipality were waste is deposited in an uncontrolled way.
Hazardous waste:	Waste the can be classified as hazardous waste according national or international legislation (EU list of Wastes and Basel Convention).
Inert waste	Waste is considered inert if: 1) It does not undergo any significant physical, chemical or biological transformations; 2) It does not dissolve, burn or otherwise physically or chemically react, biodegrade or adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm to human health; and 3) Its total leachability and pollutant content and the ecotoxicity of its leachate are insignificant and, in particular, do not endanger the quality of any surface water or groundwater.
Non-hazardous waste:	Any waste which does not possess the properties of a hazardous waste.
Municipal waste:	Non-hazardous waste generated by individuals in the households, as well as commercial waste.
Commercial waste:	Any other waste generated by legal entities and individuals while performing commercial, industrial, trade, service, administrative and similar activities, which is similar to the waste from households in nature or composition.
Sanitary Landfill:	Landfill designed according EU guidelines (Directive 99/31/EC), and equipped and operated to deposit domestic waste in a controlled way.
Capping:	Covering of a waste deposit or landfill with a multi layer capping, consisting of clay or bentonite, followed by sand or gravel layers, a filter fabric (geotextile) and a final layer of clean, native soil.
Daily cover:	Material, usually soil that is used in a landfill to cover the refuse after it has been compacted at the end of each day. The cover is placed mainly to ward off animals and for odour control.
Bentonite:	A type of soil that swells greatly in the presence of water. Because bentonite impedes the flow of water, it is used for liners, covers, and various other landfill applications.
Geotextile:	A synthetic component that is used as a filter to prevent the passing of fine-grained material such as silt or clay. A geotextile may be placed on top of a drainage layer to prevent the layer from becoming clogged with fine material.
Freatic groundwater:	The often seasonally fluctuating ground package firstly under the surface.
Piezometer:	A filter tube with a diameter of 25 or 50 mm, placed in a borehole with gravel or sand bed, reaching 2 m below the lowest freatic groundwater level, meant to measure the groundwater table and to take representative samples of the freatic groundwater.
Leachate:	Percolation water and runoff rainwater of a landfill or waste deposit.

Annex 1

Questionnaire

LANDFILL QUESTIONAIRE

1. General

1	**Date of survey:**			
2	**Name of settlement:**			
3	**Address, location of landfill:**			
4	**Land cadastre No.:**			

Proprietor

5	**Name:**	
6	**Address:**	
7	**telephone:**	

11. Coordinates

Method	**1 GPS**	**2.map**	**Y**	**X**	**Z**

Operator

8	**Name:**	
9	**Address:**	
10	**telephone:**	

12 Start of operation/year

13 End of operation/year

2. Type of landfill

	Solid	
1	Communal	
2	Debris	
3	Industrial	
4	Agricultural	
5	Food industry	
6	Carcase	
7	Construction & demolition waste	
8	Excavated soils	

	Sludge	
10	Communal sewage	
11	Industrial sewage	
12	Unctuous sludge	
13	Agricultural	
14	Food industry	
15	Other*	

	Fluid	
16	Communal sewage pond	
17	Industrial sewage pond	
18	Fluid manure	
19	Other*	

9	Other*	

specify:_____

2b) If industrial solid waste, sludge or fluid – please state type of industry and waste. If unknown, please give details about nearby located industries that have or may have disposed off their waste at the landfill:

_____

_____

_____

_____

1. dominant 2.eventuate 3.marks

3. The sort of wastes on the landfill

Communal waste		**1**	**2**	**3**
1	Household waste			
2	Construction debris			
3	Plant origin waste			
4	Animal origin waste			
5	manure			
6	Textile			
7	Paper			
8	Sewage			
9	Glass			
10	Plastic			
11	Rubber tyres			
12	Metals, scrap iron, scrap cars, etc.			
13	Ash, slag			
14	Other*			

Hazardous wastes		**1**	**2**	**3**
15	Batteries			
16	Chemicals, pesticides			
17	Oil contaminated objects,			
18	Asbestos			
19	Solvents, ties			
20	Carcasses, meat waste			
21	Pelt			
22	Medicines			
23	Hospital waste			
24	Contaminated soils			
25	Industrial sludge			
26	Ash, slag			
27	Other**:			

* specify:_____

** If relevant – describe hazardous properties

_____

4. Waste and operation

1	Dumped waste m^3/year	
2	The area of the landfill m^2	
3	active area	

5	Thickness of the waste	above surface	average
6	Volume of the waste m^3		

4	open space	

Other remarks:

5. The operation of the landfill

7	Active	
8	Temporary active	
9	Abandoned	

10 Topography of landfill (approx. slopes in%)

10	Reclaimed		
11	Unreclaimed	bare surface	
12		partly vegetated	
13		entirely vegetated	
14		Covered with surface sealing*	

* If relevant – describe properties of cover

Other remarks:

6. Technical installations and methods for landfilling:

1	Drainage			5	Pre-treatment of waste prior to landfilling (state how under remarks below)	
2	Leachate collection			6	Landfilling in containers? (if so, state their properties under remarks below)	
3	Leachate treatment			7	Has combustion been occurring at the landfill? (If so, state the scale of it and types of wastes burnt below)	
4	Collection of landfill gas					

Other remarks:

7. The morphology of the landfill

	Solid waste	
1	Constructed landfill	
2	Dumping on surface	
3	Dumping in pit	
4	Dumping in quarry	
5	Dumping on slopes	
6	Dumping in valley	
7	Other	

	Fluid, sewage	
8	Natural water flow	
9	Artificial water flow	
10	Lake, pond	
11	Artificial pond,pool	
12	Surface	
13	Sealed pond,pool	
14	Concrete pool	
15	Other	

Other remarks:

---

8. Geological hydro-geological conditions

Connection with surface and groundwater

1	In or nearby a ravine	
2	In or on the bank of temporary water flow	
3	On riverbank	
4	On lake shore	
5	on temporary wetland	
6	inundation area	
7	No direct contact	
8	Direction of groundwater flow – to basin/refillment	
9	Direction of groundwater flow – from basin	

Subsurface conditions

8	Permeable	
9	Impermeable	
10	Topsoil, sand	
11	Clay, silt	
12	Solid rock	
13	Fragmented rock, karst	
14	Unknown	
15	Other	

Distance from surface water

16	0-100 m	
17	100-500 m	
18	500 m>	

Depth to groundwater: _____

Distance to well for drinking water_ _____

Type and properties of receiving surface water:
(if visible contamination, please describe. Also state other possible sources for the contamination)

Other remarks:

---

9. Excluding criteria

1	Housing areas >1000 m	
2	Road >100 m	
3	Railway>100 m	
4	Natural protected area or buffer zone	

Land use in the are (today and planned):

Other remarks (for ex; Are fruit and vegetables harvested in the area? Are children spending time in the area? Are surrounding land/water used for recreation? Nearby protected areas or habitats, etc?):

---

10. Results from previous analysis – of leachate, receiving ground water, receiving surface water(s). If available – attach to questionnaire, also state properties of the analysis if possible, i.e. no. of samples, representativity and quality of analysis, etc.

---

11. Interviewed person

Name	**status working place**

12. Photos

	View	**Remarks**
1		
2		
3		
4		

13. If pits are excavated during the inventory – what is shown? Type of waste? Level of degradation? Presence of soil? Smell? Presence of water in the pit?

14. Individual evaluation of risk

small		
medium		
big		

15. General remarks

16. Confirmation

	Name	**Signature**	**Date**
Surveyed by			
Team leader			

Annex 2
Field report

Dolna Banjica – Gostivar (abandoned landfill)

The abandoned landfill of Gostivar is located ca. 1000 m South from D. Banjica, the suburb of Gostivar. The landfill was developed on a hillside, its area covers 28-30000 m^2. Despite the relatively small area the dumpsite is very high, the slopes are very steep and the height of the dump varied between 30-40 m.

Probably the site was not considered to be the landfill for the city for a longer time, because the developing possibilities on both sides are restricted. On one side there is a silicate factory and on the other side a road, which forced the construction of the dump in vertical direction until the end of the minimum of stability of the slopes. The final result is a huge mound which is shaped like a boat, facing the city of D. Banjica. On both sides of the dump a valley opens with temporary creeks. The creeks run into the Vardar river which is contaminated by leachate and dispersed garbage.

In a geological aspect 'the underground layer is prolluvium deposit lying on marble. The prolluvium is consisted of rough materials with clays inside. The subsurface conditions are probably featured by weak permeability and good homogeneity .

The disposed wastes are mostly communal waste mixed with wastes of industrial origin and construction debris. There are considerable amounts of fibre sealers (glass wool, maybe asbestos) in the disposed waste.

There is not any technical protection or infrastructure on the dumpsite, sometimes a dozer try to arrange the dumped waste despite that the landfill is formally closed. A small colony of scavengers is living and surviving on the landfill in unbelievable abject poverty.

Kicevo landfill

The present city landfill of Kicevo was probably developed from a single dump of garbage nearby the Zajaska river, like many other in the country.

Unfortunately the place became very popular within a short time, and the riverbank nowadays is totally covered by garbage. The dump is located just nearby the housing area of the city, at 2-300 m distance from the local clinical centre. The really shocking impression starts at the sport stadium where construction debris is dumped along the bank and into the river. The quantity of the debris could be estimated to 2-2200 m^3. The area of the communal waste disposal covers ca. 2 hectares, the 2-3 m thick dumps strengthen along the river, 550-600 m long and 30-60 m wide. At some places the slopes of the dump form the riverbank. There is direct contact between the garbage and the river. Locals said, springtime, when the river is flooded, 50-80 cm deep water surrounds the dump, and in summertime the odour, and the invasion of flies are unbearable. The landfill is served by a tractor hauled truck and a dozer. The clinical waste from the hospital is directly disposed of with the communal garbage once a week.

The left side of the river is also covered by waste but in a smaller amount. The total volume of the dumped garbage can reach 50 000 m^3. Referring to the geological maps, "the underground layers are marbles, cracked, good permeability". It means the dumpsite of Kicevo hazard the surface and groundwater too, besides the complete pollution of the human environment.

City landfill of Makedonski Brod

The city landfill is a newly constructed dumpsite that opened in 2002 and is located far from urban areas by the main road from M. Brod to Prilep. The site was developed on the hillside and covers an areaof ca. 1.2 hectares, the active landfill covers 8000 m^2. The volume of the disposed waste is 10-12000 m^3. The surrounding area is natural land contaminated by dispersed waste (plastic bags). There is no layer system or leachate management, only a fence around the depot. Ordinary vehicles dump the waste towards the direction of the valley, there is no daily topsoil covering, but the waste is temporary arranged by a dozer. The garbage was burned at the time of the visit and scavengers were collecting scrap metals.

The geological circumstances are not very favourable for the purpose of a landfill. The depot lies on a rocky surface of limestone (actually karstic formation) where the leachate entails a permanent hazard for the subsurface waters.

City landfill of Prilep

The city landfill of the regional centre Prilep is located at 1600-1700 m distance from the nearest settlement Alinci , and 150 m from the main road that leads from Prilep to Bitola. The surrounding area is cultivated land and pasture. There is no endangered surface water within the protective zone of 1000 m.

The geological features of the site is: "Isolated small mass from marble surrounded by gneisses covered with delluvio - prolluvium layer up to 20 m (Clay and dusty sands and sandy and dusty clayes). Weak permeability, Kf = 10^{-3} - 10^{-5} cm/sec, homogenous.

The landfill was probably formed spontaneously on the slope of a mound called Omec in 1973. Since the operating time, two levels can be distinguished. The first level covers ca. 4,5 hectares and its height varied between 8-10 m. The second phase was erected on the first one, its area covers ca. 1,5 hectares, the thickness of the waste is 2-3 m and the calculated quantity of the dumped waste is 500-530 000 m^3. There is no technical protection or leachate management on the site, sometimes the surface is arranged by a dozer. There are some facilities for local workers (a poor hut) a boom gate (opened) and an access road or ramp to the top of the depot. In lack of the regular daily covering by soil or debris, the surrounding agricultural land is covered by plastic bags blown by the wind. A band of young scavengers are operating on the site and the waste is burrned in several "hot spots". The dust can be observed from a distance of kilometres. Like all the landfills of the larger cities of the country, industrial and clinical waste is also dumped to the site, besides the communal garbage.

City landfill of Bitola "Meglenci"

The city landfill of Bitola is located ca. 20 km from Bitola on the hillside of Gradiste-Brajinac mountains. The nearest settlement Meglenci is on 1,5 km distance. The depot was developed on the abandoned spoil banks of the open pit coal mine of Bitola. The surrounding area is disturbed land by industrial use and huge spoil banks with spontaneous vegetation and pits under operation characterize the landscape. The landfill was formed on two terraces, their area is ca. 6 hectares. During the landfilling, the stairs if the spoil bank were used as an access road and waste filling ramp and finally two levels were constructed, the first is 10-12 m high and the second 18-20 m. The site is quite well managed compared to the previously visited ones, there is daily covering on the active area and compaction of the waste by a dozer, but the slopes are barren. The disposed amount of waste could be almost 1 million m^3. The waste also contains industrial and clinical wastes and the huge quantity and high proportion of plastic bottles was surprising too. The manager of the landfill informed that the leachate is connected to the canal system of the run-off water of the mine causing pollution of the "Crna reka" of Bitola. According to a geologist: "The underground layer are micashistes, weak permeability on the first surface layers, nonpermeable in depth" which means that the groundwater is probably not endangered by direct contamination.

The site could be suitable to adjust to the new landfill regulations and develop into a regional landfill because of its geographic condition and the vicinity of the second largest city of Macedonia.

City landfill of Ohrid, "Bukovo"

The landfill of Ohrid was established ca 25 km from the city in the Bukovksi mountains. The site is located just nearby the main road, a boom-gate close the access road to the dumping site which was formed on a hillside over the road. Fortunately the site is not visible from the road because of the dense forest, but the signs of the landfill can be observed in the presence of blown plastic bags.

Geologically "the underground layer is

quartz silicate shales, (clay shale) weak permeability, Kf = 0.00001 to 0.000001 cm/sec, good homogenity", which means the subsurface environment is less vulnerable. The site of the landfill is bordered by two valleys with temporary water flows, which are contaminated by dispersed wastes. The landfill was configured on the hilltop, using its natural ridge to fill it with garbage. The slopes are partly covered by waste. The whole area is 6 hectares, the amount of dumped waste ca. 200000 m^3. At the time of the site visit the waste was burned and pigs were eating from the landfill. A family of scavengers were living nearby the access road among horrendous circumstances.

Kumanovo city landfill

The city landfill of Kumanovo is located in the SE direction from the town on a distance of about 5 km from the city. The landfill can be accessed by a paved road, which is also used by the trucks of the nearby (300 m) stone mine. The outskirts of the landfill is cultivated land and the main crops are barley and wheat. The surface of the slope to North the is karstic , covered by dry grassland. The morphology is characterised by long shallow valleys between the hills, the surface of the hills is mostly rocky, and because of the long term erosion processes the valleys differ, "the underlying material is clay-shale, with weak permeability on the surface layer and not permeable in depth". There is good homogenity and a solid rock in the base".

The city landfill was constructed by the direct dumping on the surface in one of the valleys. Kumanovo is the largest city in the NE region and the population number is 70000. The landfill operates since 1966. In the past decades a huge volume of waste were disposed to the area, its volume is estimated to reach 1 200 000 m^3. The landfill covers ca. 6,5 hectares, the total area is 8 hectares, which is fenced. The landfill can be approached directly from the road. There is no gate, weight bridge or other facilities, except a small building for the local workers.

The surface of the landfill is temporarily landscaped by a bulldozer, there are also some temporary (although not daily or even weekly) top covering performed by adding construction debris. The dispersion of the waste cannotbe stopped by the simple compaction of the surface. The plastic bags are blown out with the main direction of the strong wind in the outskirt of the landfill.

During the year of the operation, two big terraces were formed. The first is 400 m long and located towards the direction of the valley , the thickness of the waste reaches 10-12 m. The second terrace was formed on its top, it consists of two large piles with a plant road between them. The thickness of the mounds is 8-10 m. As the only disposal site for a large city, the landfill contains industrial waste and even hazardous wastes as well. Waste from metallurgical companies and the leather industry is supposedly dumped onto the site in previous times. During the visit large amount of organic and slaughter-house waste could be observed.

Due to the inaccurate operation and the activity of the scavengers, the landfill burn continuously and not only on the surface, but probably on the inside of the SE slopes too. The combustionresults in hazardous air pollution.

Other landfill sites

The site of the landfill in **Radovis** is located 1 km north of the city urban zone.For transportation of the waste to the landfill, a local earth road is used which is connected to one of the peripheral city streets.

From a morphological point of view the site is a wide valley which remains active in the rain periods.

Geologically, the field consists of Palaeozoic schist covered with a thin layer of dilapidated clay materials. Because of the low water permeability in this kind of rocks, there is a small risk of contamination of ground waters.

There is a possibility for contamination of Radovis River which is near the landfill.

The landfill in the municipality of **Novo Selo** is located in Solena Reka (river) area, a few kilometres south of the populated spot. There is a local earth road leading to the landfill, which is covered with gravel so that it can be used during all periods of the year. The landfill is located on a side of a hill, north of Solena Reka. But the south of the river is sheer so there is a possibility for waste to fall directly into the river.

The land consists of neogenic sediments from a lake origin covered with claily and sandy gravels. They have a characteristic of medium water permeability, so that ground waters can be located 30 to 50 m under the surface.

Atmospheric rains combined with the fact that the waste falls from the hill into the valley leads up to the conclusion that there is contamination of Solena Reka, which is 0,5 km after the landfill flows into river Strumica, whose alluvial terraces are very rich with surface waters.

The landfill of the city of **Valandovo** is located beside the local road to Calakli village, near the quarry of GP Mavrovo, round 3 km from the city.

The field is a wide valley which lies on the eastern part of Besasica mountain. Surface waters are arisesnearby only in rain periods.

The base of the field is consisted of limestone rocks, covered with alluvial - proluvial sediments, 20 m thick and highly water permeable.

The ground waters contaminated from the landfill can easily pollute the water of Anska River.

The municipality of **Miravci** uses the landfill which is located 300 m south of the village. From the asphalted road to Miletkovo, there is an earth road 1 km long leading to the landfill, which can be used during all periods of the year.

Morphologically speaking, the field is a typical valley, and from geological point of view the fieldconsists of magma rocks - diabases. This kind of field has an attribute of very low water permeability, or none at all. Because of the rocky characteristic of the area there is no earth material that can be used to cover the waste in the landfill. Besides the disturbance of the landscape view there is no other evidence of pollution of the surroundings.

The landfill of the city of **Kavadarci** is situated in the Melci area, a few kilometres west from the city. There is an earth road, connected to the regional road to Prilep, which leads to the landfill site.

The field is a deep valley with a small water shed.

The base consists of clays and sands with neogenic lake origin. The field has a low water permeability and the distance to the ground water level is very high/deep. These kinds of sediments have good characteristics as a material for covering the waste in the landfill. The morphological attributes of the field is the only shortage of the location of the landfill.

The landfill in the municipality of **Kratovo** is located near the old road to Kumanovo, which is close to Zeleznica village. This road is connected to the new regional road.

The field is a typical valley which goes down to river Kratovska. In periods of massive rains there is a possibility for the waste to slip directly into the river.

From a geological point of view the field consists of volcanic rocks - andezites and tuffs, which are a sort of water barrier. There is no evident disturbances in the surroundings, which is characteristically in the Kratovo volcanic area.

The landfill of the city of **Probistip** is located close to Strmos village, approximately 2 km south of the city. There is an earth road on a rock base that leads to the landfill, which is also connected to the regional road to Stip. The field is a hill with direction north - south, which west slopes are sheer and directed to the hydro tailing of the nearby mines. The micro location is situated in a former excavation site with a big volume.

The field consists of volcanic rocks**,** which are typical hydro isolators.

Besides the fact that the landfill is inordinate, there is no evidence of pollution of the surroundings.

Along the visit to the municipality of **Karbinci**, the landfills of the villages Krupiste and Tarinci were also visited.

Karbinci uses a landfill which is east of the village. The site is an open hole that was left after a former sand excavation.

The field is a typical river terrace consisted of sands and gravels with high water permeability. Consequently, pollution of the ground waters can be expected.

The situation with the landfill in Tarinci is very similar, which is also inordinate. It is situated east of the village and very close to surface waters which can result in pollution. The geology here is the same as in Karbinci.

The landfill in Krupiste is 0,5 km east of the village, close to Bregalnica River. The landfill is connected with a local access road through the rice factory.

The field consists of clays of lake origin which are not water permeable. However, the nearby surrounding is agricultural land of high quality.

The municipality of **Oblesevo** uses a landfill which is 0,5 km east of the village, on a land that has a high agricultural quality. The landfill is located near the main irrigation channel. There is pollution of the soil and the surface waters. Because of the clays in the surface there is a low risk of pollution of the ground waters.

The landfill in the municipality of **Belcista** is located 0,8 km down towards the local road to village Zlesti. The location is a former quarry. The basic negative characteristic of the location is that it consists of lime stones with high water permeability. This can result in contamination of the ground waters which has a very high level in the Debarca Basen.

The waste from the area of the municipality of **Meseista** is deposited on the bank of Sateska river, on the left side of the valley, which is about 0,5 km west of Meseista. It is possible that a larger amount of the waste is being thrown directly into the river. In this case, the eco system of this river, part of Crni Drim river and the nearby lake is being polluted. The base of the field is alluvial with great potential of accepting the contaminated fluids from the waste site.

The landfill in **Struga** is closed and should be out of function. Now there are two closed landfills in the area: the older one, near the local road to Visni village and the other one, which is located close to the border to Kafasan. The older landfill is placed on a gravel terrain, in the hydro geological area of the spring Sum, which is a bad solution for a landfill on a local level.

The second location is also chosen without an expert's opinion and endangers the integrity of the Radozda village, which offers good conditions for development of eco tourism.

The municipality of **Dolneni** uses two locations for depositing communal waste. The fist one is located in the area of Crnili village, under the railway to Bitola, where the geological structure of the land is suitable for that. It is consisted of neogenic clay sediments with extremely low levels of filtering, which means that it does not enable an access of contaminated fluids under the surface. Also, according to the available data from the Basic Hydro geological Map, the level of the ground water is deeper than 50 m.

The second location is in the area of Debreste village, near to the road to Makedonski Brod. The terrain of this location is suitable; because it is consisted of marble, which is massive and compact and does not allows water permeability.

Both locations are inordinate and without a fence, which the municipality has the obligation to construct, Consequently, these two sites function as wild dumps.

Annex 3

Results from the laboratory (water quality)

RESULTS OF THE EXAMINATION[5]

Kumanovo landfill site

Laboratory designation of the sample				10027
Designation of the sample client				-
Type of the analyzed form				r.Pcinja before river flows into s. Pcinja
Parameter	**Mesaurement**	**Method of analysis**	**ELV Class II**	**Results of the examination**
pH value	-	M54 ISO 10523	6,5-6,3	6,4
Electrical conductivity	µs/cm	M54 ISO 7888	-	465
COD $_{KMnO4}$	mg/L O_2	M54 ISO 8467	2,51-5,0	2,69
BOD $_{-5}$	mg/L O_2	M54 1216	2,01-4,0	3,21
Ammonia, NH_4^+	mg/L	M54 1113	0,5	1,43
Nitrite, NO_2^-	mg/L	M54 EPA 4500-B	0,5	0,13
Nitrate, NO_3^-	mg/L	M54 ISO 7890/1-E	15	11,9
Phosphates, PO_4^{3-}	mg/L	M54 ISO 6878	-	1,23

Laboratory designation of the sample				10028
Designation of the sample client				-
Type of the analyzed form				r.Pcinja after river flows into s.Pcinja
Parameter	**Measurement**	**Method of analysis**	**ELV Class II**	**Results of the examination**
pH value	-	M54 ISO 10523	6,5-6,3	6,5
Electrical conductivity	µs/cm	M54 ISO 7888	-	440
COD $_{KMnO4}$	mg/L O_2	M54 ISO 8467	2,51-5,0	2,23
BOD $_{-5}$	mg/L O_2	M54 1216	2,01-4,0	1,71
Ammonia, NH_4^+	mg/L	M54 1113	0,5	1,8
Nitrite, NO_2^-	mg/L	M54 EPA 4500-B	0,5	0,13
Nitrate, NO_3^-	mg/L	M54 ISO 7890/1-E	15	11,9
Phosphates, PO_4^{3-}	mg/L	M54 ISO 6878	-	1,23

[5] Analyses were done by the Central Labaratory for environment (MoEPP)

Sveti Nikole landfill site

Laboratory designation of the sample				10034
Designation of the sample client				-
Type of the analyzed form				Orlovska reka (before landfill site)
Parameter	**Mesaurement**	**Method of analysis**	**ELV Class III**	**Results of the examination**
pH value	-	M54 ISO 10523	6,3-6,0	8,1
Electrical conductivity	µs/cm	M54 ISO 7888	-	397
COD $_{KMnO4}$	mg/L O_2	M54 ISO 8467	5,01-10,0	9,68
BOD $_{-5}$	mg/L O_2	M54 1216	4,01-7,00	3,90
Ammonia, NH_4^+	mg/L	M54 1113	10	0,22
Nitrite, NO_2^-	mg/L	M54 EPA 4500-B	0,5	0,13
Nitrate, NO_3^-	mg/L	M54 ISO 7890/1-E	15	9,29
Phosphates, PO_4^{3-}	mg/L	M54 ISO 6878	-	2,76

Laboratory designation of the sample				10035
Designation of the sample client				-
Type of the analyzed form				Orlovska reka (after landfill site)
Parameter	**Measurement**	**Method of analysis**	**ELV Class II**	**Results of the examination**
pH value	-	M54 ISO 10523	6,3-6,0	8,15
Electrical conductivity	µs/cm	M54 ISO 7888	-	453
COD $_{KMnO4}$	mg/L O_2	M54 ISO 8467	5,01-10,0	7,82
BOD $_{-5}$	mg/L O_2	M54 1216	4,01-7,00	2,42
Ammonia, NH_4^+	mg/L	M54 1113	10	0,46
Nitrite, NO_2^-	mg/L	M54 EPA 4500-B	0,5	0,13
Nitrate, NO_3^-	mg/L	M54 ISO 7890/1-E	15	18,14
Phosphates, PO_4^{3-}	mg/L	M54 ISO 6878	-	12,58

Kicevo landfill site

Laboratory designation of the sample				
Designation of the sample client				-
Type of the analyzed form				
Parameter	**Mesaurement**	**Method of analysis**		
pH value	-	M54 ISO 10523		
Electrical conductivity	µs/cm	M54 ISO 7888		
COD $_{KMnO4}$	mg/L O_2	M54 ISO 8467		
BOD $_{-5}$	mg/L O_2	M54 1216		
Ammonia, NH_4^+	mg/L	M54 1113		
Nitrite, NO_2^-	mg/L	M54 EPA 4500-B		
Nitrate, NO_3^-	mg/L	M54 ISO 7890/1-E		

Phosphates, PO_4^{3-}	mg/L	M54 ISO 6878		

Laboratory designation of the sample				
Designation of the sample client				
Type of the analyzed form				
Parameter	**Measurement**	**Method of analysis**		
pH value	-	M54 ISO 10523		
Electrical conductivity	µs/cm	M54 ISO 7888		
COD_{KMnO4}	mg/L O_2	M54 ISO 8467		
BOD_{-5}	mg/L O_2	M54 1216		
Ammonia, NH_4^+	mg/L	M54 1113		
Nitrite, NO_2^-	mg/L	M54 EPA 4500-B		
Nitrate, NO_3^-	mg/L	M54 ISO 7890/1-E		
Phosphates, PO_4^{3-}	mg/L	M54 ISO 6878		

Annex 4

Proposed criteria and values for weights and scores

Prioritization of existing Non-sanitary Landfills / Wild Dumps
Proposed criteria and values for weights and scores

Criteria		Weight / Score	CRITERIA **SCORE**
1. Waste stream **(Hazardous / medical waste)**		0.05	
Dominant		**75**	
Eventuate		**25**	
Marks		**0**	
2. Area of the landfill [m^2]		0.15	
> 10.000 m^2		**50**	
2.500 – 10.000 m^2		**35**	
< 2.500 m^2		**15**	
3. Operation – Volume of the waste [m^3]		0.20	
3.1. Municipal Landfills			
> 500.000 m^3		**50**	
100.000 – 499.999 m^3		**35**	
10.000 – 99.999 m^3		**15**	
< 10.000 m^3		**0**	
3.2. Wild Dumps			
> 10.000 m^3		**50**	
5.000 – 9.999 m^3		**35**	
3.000 – 4.999 m^3		**15**	
< 3.000 m^3		**0**	
4. Morphology of the landfill		0.25	
4.1 on river bed / in pit / in quarry		**75**	
4.2 on surface / on slopes / in valley / inundation		**25**	
4.3 constructed / sanitary		**0**	
5. Hydro-geological conditions (permeability)		0.20	
> E^{-5}		**65**	
E^{-6} – E^{-5}		**35**	
< E^{-7}		**0**	
6. Distance from surface water/dwell water supply [m]		0.15	
0 - 100		**65**	
100 - 500		**35**	
> 500		**0**	
		Total:	

Annex 5
List of checks for carrying out the activity of landfilling municipal waste

STATE INSPECTORATE ON ENVIRONMENT

List of checks for carrying out the activity of landfilling municipal waste

This List is an appendix of the minutes of ascertainment (findings) no. 13 - _____ of ----------20 -- year.

1. Data on physical or legal person that carry out the activity of waste landfilling:
Company name :
Status:
Adress of the company:
Telephone and fax:
Responsible person (or contact person):
Telephone of the responsible person (or contact person):
:

2. Does it possesses the Permit for carrying out the activity of waste landfilling (article 84 of the LWM)?
☐ *Yes* ☐ *No*
3. Has the landfill operator prepared a Program on Waste Management?(article 19 of the LWM)
☐ *Yes* ☐ *No*
4. Is a respobnsible authorised person present on the landfill ?
☐ *Yes* ☐ *No*
5. Number of employed persons at the landfill with description:
6. Is a 24 hours safekeeping (security) service provided on the landfill?
☐ *Yes* ☐ *No*
7. Are there machines for landfilling and compacting of the waste on the landfill?
☐ *Yes* *Description*:

☐ *No*
8. Are the supporting structures (objects) with supply of electricity and water supply and removal present at the landfill?
☐ *Yes* ☐ *No*
9. Has the landfill an entrance/exit ramp and protecting fence?
☐ *Yes* ☐ *No*

10. Has the landfill collecting channels for atmospheric water?
☐ *Yes* ☐ *No*
11. Has the landfill collection channel and lagoon for collection of the leachate from the landfilled waste?
☐ *Yes* ☐ *No*
12. Are the unauthorized persons present at the landfill?
☐ *Yes* ☐ *No*
13. Are there animals on the landfill?
☐ *Yes* ☐ *No*
14. Quantity of received waste:
per day : *tons* m^3
per year : *tons* m^3
15. Total area where the landfilling is carried out:
16. Area used per day:
17. Is the covering with earth material of the landfilled waste carried out ?
☐ *(daily, after several days and other)*:
☐ *No*
19. Is other type of waste accepted at the landfill?

☐ *Yes*
- Description of the other type of waste and quantity :
From which institutions/installations the waste comes:

Who collects and brings the waste :
20. Is the daily evidence (record) kept in the log book on landfills by use of the prescribed form? (in accordance with the article 2 paragraph 4 (Annex 6) of the Rulebook promulgated in Official Gazette 7/2006)) and in accordance with the article 39 paragraphs 4 and 10 of the LWM?
☐ *Yes* ☐ *No*