

# CHANGES OF DAMAGED LAND IN KAUNAS COUNTY, LITHUANIA

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## Abstract

The article presents the analysis of the current situation of the damaged land in Kaunas County. The methods of comparative, analytical as well as statistical and logical analysis were used for the investigation. The aim of the investigation is to carry out the analysis of the damaged land area in Kaunas County during the period between 2005 and 2017. The object of the investigation is Kaunas County damaged land. The study found that the number of affected areas in the county is 409. Because the damaged areas consist of mineral quarries and territories occupied by dumps, the article contains the description and condition of these areas. By 2009, there were 98 landfills in Kaunas County. Kaunas municipal waste management region comprises 6 municipalities; 58 old landfills and dumps were shut down, at present two regional non-hazardous waste landfills have been arranged. In 2017, the damaged land occupied 3,447.36 hectares and amounted to 14.15 percent of all Lithuanian damaged land and accounted for 0.43 percent of the county's area. During the period between 2005 and 2017 the damaged land area in Kaunas County increased by 236.48 hectares or 6.86 percent. The analysis of the damaged land area of the municipalities situated in the Kaunas County showed that the largest of these areas during the period between 2005 and 2017 was in Kaunas district municipality.

Key words: damaged land, landfills, mineral quarries.

## Introduction

*Article relevance.* Survey of the current situation and change determination of damaged lands as well as their recultivation and ecological restoration is the global challenge of the twenty-first century: to unite science and practical achievements in order to improve ecological status of the planet, individual regions or local areas and ensure the landscape's ecological balance, natural resources, sustainable use and restoration.

In the Journal of the National Land Service "Land Fund of the Republic of Lithuania by January 1, 2017" the damaged land is described in the following way: operating and depleted mineral quarries, peat bogs and landfill areas (Nacionalinė..., 2005-2017).

According to the type of use, damaged land parcels are divided into (Aleknavičius, 2012):

- mineral areas, the usage natures of which are the following: mineral mining open workings (pits) (land parcels used for minerals, stratifying close to the ground surface, mining waste facilities); mineral extraction underground workings (shaft) and the wells (land parcels, in which are actual or intended to be equipped facilities for the manufacturing process maintenance and storage of minerals, stratifying in deeper soil layers);
- waste storage, sorting and disposal (landfills) areas subject to perpetual waste (hazardous, non-hazardous or inert) accumulation, storage indefinitely in the special device or territory, in order to use them, remove or sort waste collected by materials for recycling or further use.

Minerals are natural materials existing in the earth's crust that can be used for substantive production or other uses (Lietuvos..., 2001). The landfill is assigned to a group of sources of pollution that pose a potential threat to groundwater users and other environmental objects. The use of subsoil resources is an important element when meeting the needs of society, but this activity has a negative impact on the environment because during the open mining of the extraction of useful subsoil resources (solid minerals, including peat) in industrial and small quarries, peatland areas are usually damaged. These damaged but not recultivated areas spoil the landscape and pose a threat to humans (Lietuvos..., 2012). The Waste Management Law of the Republic of Lithuania (Lietuvos, 2002) provides that *the landfill* is a waste disposal facility for the deposit of the waste onto or into land (i.e. underground). It is the object, due to economic activities of which directly or indirectly materials and chemical compounds fall in the underground hydrosphere, therefore the change in the chemical composition of the groundwater occurs. The main factor affecting the underground hydrosphere is the likely access of various pollutants into the environment during the degradation of collected garbage (Tinkamai..., 2016).

15 waste disposal methods are foreseen in the European Parliament and Council Directive 2008/98/EC (The European..., 2008) and the above-mentioned Lithuanian Republic Waste Management Law. Waste placement in a landfill is the least desirable option, but still the dominant method of Lithuania. Rational, innovative models should be selected in planning, managing and rehabilitating damaged land

areas that ensure the sustainable use of natural resources and ecosystem conservation and management.

**The object of the investigation** is damaged land of Kaunas County.

**The aim of the investigation** is to carry out the analysis of the Kaunas County damaged land area during the period between 2005 and 2017.

**Tasks of the investigation:**

1. To describe the status quo of the damaged land in Kaunas County.
2. To analyze and compare the damaged land change in Kaunas County during the period between 2005 and 2017.

**Methodology of research and materials**

Comparative, analytical as well as statistical and logical analysis methods were used for the investigation. The land fund statistics of the Republic of Lithuania (Nacionaline zemes..., 2005-2017), graphically depicted in figures were used for the fulfilment of the research of the damaged land change in Kaunas County for the years 2005 - 2017.

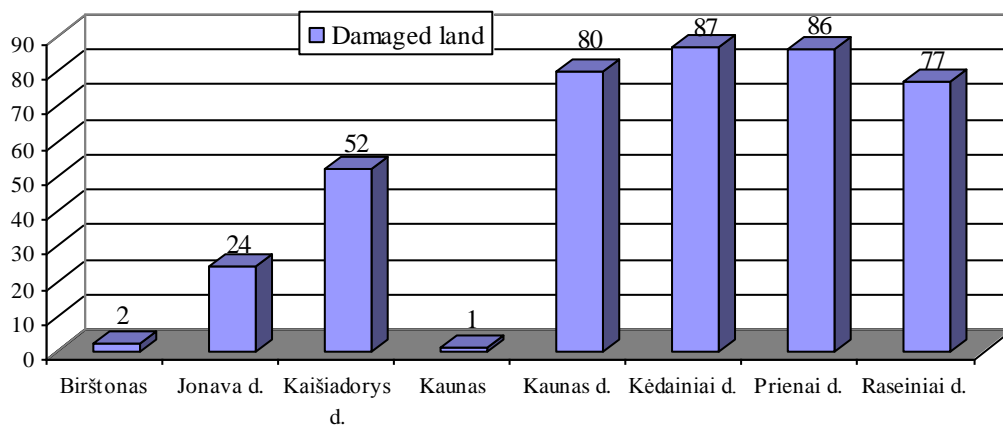
The article analyzed and assessed the current state of the damaged land in the County of Kaunas, i.e., the current state of the mineral deposits and dumps was analyzed, the statistics were presented and systemized to structure and present graphs. The study provides the damaged land change analysis in Kaunas County. The ten-year period, i.e., the period between 2005 and 2017 was selected for the determination of the change. For the fulfilment of the analysis, statistics of the land fund and other sources of the Republic of Lithuania (Geological Survey of Lithuania, the Ministry of Environment, county and regional waste management centres) were used. They were systematized, analyzed and expression of the percentage was calculated during the preparation of the research.

**Discussion and results**

*Characterization of Kaunas County.* Kaunas County is located in the geographical center of Lithuania. It is an industrial and agricultural region. Kaunas County occupies 808 624.92 ha or 12.5 percent of the whole territory of the country. Kaunas County has a definite structure of population concentration centre with a top-level centre of Kaunas City and 5 lower-level centres, which coincide with the municipal administrative centres. Kaunas County is an industrial, agricultural and tourist region. More than a half of the county's territory is occupied by agricultural lands. These lands are one of the most productive ones in Lithuania – only 5.8 percent of lands consist of low productivity ones (Kauno regiono..., 2014). Kaunas County landscape is constantly changing due to human activities and natural processes, but at present the direction and magnitude of these changes are not exactly known. Therefore, it is more and more difficult to implement the principles of sustainable development (Lietuvos Respublikos..., 2009).

The system of protected areas in Kaunas County consists of protected areas category foreseen in the statutory of all protected areas of the Republic of Lithuania. Protected areas cover about 13 percent of the county's territory. In the Republic of Lithuania, protected areas account for 15.71 percent of the country's area (Saugomų teritorijų..., 2016). Kaunas County is rich in mineral resources used in the construction industry with enough reserves for the long time period. Many products from peatlands are suitable for fuel.

*The current situation of damage land in Kaunas County.* In Lithuania, the areas damaged by quarries, peat bogs and landfills are several times larger than they should be according to the solid mineral mining open workings scale and the used mining technology. The largest parts of damaged areas of Kaunas County are located in the municipalities of Kėdainiai district (21.27 percent), Prienai district (21.03 percent) and Kaunas district (19.56 percent), while the smallest parts – in Kaunas and Birštonas municipalities (Fig. 1). 409 damaged areas were determined in Kaunas County. This is the third county in Lithuania by the amount of damaged areas.



**Fig. 1.** The number of damaged areas in Kaunas County, in pieces

Mineral deposits occupy 4.3 percent of Lithuanian territory. Lithuania has 17 species of minerals used in the world and investigated at various detail levels (Lietuvos..., 2017). Currently, there are 9 types of exploited mineral deposits (limestone, dolomite, sand, gravel, clay, chalk marl, peat, sapropel and oil). The only explored anhydrite reservoir is situated in Kaunas district. Gypsum resources can be found in the above-mentioned anhydrite reservoir in Kaunas district. Limestone and clay can be found in Kaunas County as well. The most widely spread ones are gravel and sand resources; they are the most explored ones in Kaunas County.

By 2009, there were 98 landfills in Kaunas County. Lapes municipal waste landfill and 12 other municipal waste landfills operate in Kaunas district territory: Gaižėnėliai – 1.7 hectares, Miškiniai (active) – 5.5 hectares, Butkūnai – 2.5 hectares, Dirviniai – 3.2 hectares, Piliuona – 3 hectares, Ilgakiemis – 0.5 hectares, Besmerčiai – 2 hectares, Pagiriai – 2 hectares Muniškiai – 2 hectares, Berlainiai – 1.5 hectares, Ežerėlis – 1.8 hectare, Digriai – 3 hectares.

There were 18 landfills in Kėdainiai district – a total of 53.86 hectares: Babėnai – 17.23 hectares, Čiukiškiai (active) – 8.12 hectares, Šalčimiriai – 1.74 hectares, Čystapolis – 1 hectare, Rekšiai – 0.42 hectares, Milžemiai – 2.44 hectares, Gudžiūnai – 0.46 hectares, Vikaičiai – 2.24 hectares, Pajiesis – 3.97 hectares, Špitolpievis – 0.54 hectares, Labūnava – 3.41 hectares, Jovaišos – 2.91 hectares, Graužiai – 3.4 hectares, Šeteniai – 1.32 hectares, Aristavėlė – 0.6 hectares, Žiogaičiai – 0.66 hectares, Pavermenys – 0.7 hectares, Dotnuva – 2.7 ha.

Currently, one waste landfill site (in Būdiškės) is still operating in Kaišiadorys district. 11 landfills have been rehabilitated in this district, i.e., Graužai, Morkūnai, Klėriškiai, Kalviai, Kruonis, Rumšiškės, Antakalnis, Tarpumiškis, Pakalniškiai, Mikalaučiškės ir Živintos.

10 municipal waste landfills were exploited in Jonava district: the town of Jonava – 11.55 hectares, Biržuliškis – 0.69 hectares, Varpiai – 1.2 hectares, Narauninkiškiei – 2.31 hectares, Paskutiškiai – 0.47 hectares, Kuliškiai – 2.2 hectares, Palokė – 0.5 hectares, Kuigaliai – 1.33 hectares, Čičinai – 2.25 hectares, Akliai – 5.65 hectares.

19 landfills were operating in Raseiniai region: Andriušaičiai – 3.6 hectares, Numgaliai (Viduklė) – 6.12 hectares, Gėluva – 4.7 hectares, Žvirgždė – 4 hectares, Papelkiai – 0.4 hectares, Jukainiai – 1.2 hectares, Steponkaimis – 0.6 hectares, Girkalnis – 0.4 hectares, Zbaras – 0.6 hectares, Meiliškiai – 1.16 hectares, Tarosai – 1 hectare, Paliepiei – 1 hectare, Paskystūnis – 0.5 hectares, Dautartai – 1.5 hectares, Poškaičiai – 0.6 hectares, Rinkšeliai – 0.6 hectares, Ugionys – 1 hectare, Diržonys – 0.4 hectares, Ančakiai (recultivated).

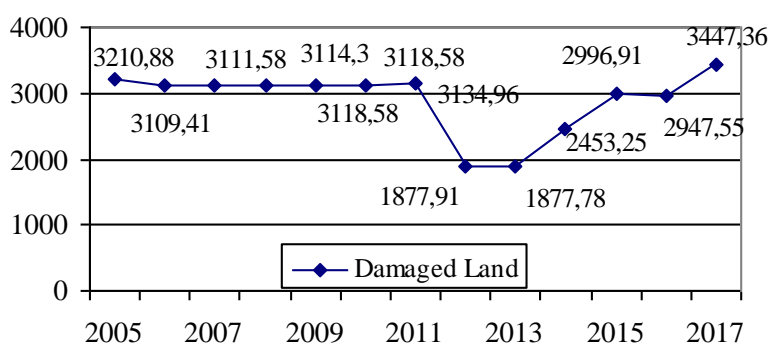
One legal landfill (located in Prienlaukis village, Šilavotas subdistrict) was registered in Prienai district, which, after installing the container waste management system, has not been exploited since the second half of 2001. Other landfills are considered as arbitrary ones. The main ones are: near Jieznas, Beržynai village (1.5 hectares) and Pagirmuonis village, Pakuonis subdistrict (0.2 ha).

Prienai and Birštonas municipal waste was transported to the landfill belonging to Alytus district, since Prienai and Birštonas landfill meet neither landfill installation rules nor the European Union requirements.

Currently, there are two Kaunas regional landfills (Lietuvos Respublikos..., 2009). Kaunas municipal waste management region covers 6 municipalities. The region closed 58 old landfills, dumps. 2 regional non-hazardous waste landfills were arranged: Lapes regional landfill (in Leipšiškiai village of

Kaunas district) and Zabieliškis regional landfill (in Zabieliškis village of Kėdainiai district), 3 waste transfer stations were arranged (in Raseiniai, Kaišiadorys and Jonava regions), 11 bulky waste collection sites, 3 green waste composting sites, mechanical and biological waste treatment plants were built in Kaunas City and Zabieliškis village of Kėdainiai district, 30,000 individual composting containers were purchased.

*The damaged land change in Kaunas County.* In 2017, the damaged land area in Kaunas County covered 3,447.36 hectares, or 14.15 percent of all Lithuanian damaged lands and 0.43 percent of the county's total area. Meanwhile, in 2005 it accounted for 12.99 percent of the country's damaged lands and 0.59 percent of the total county area. During the period between 2005 and 2011, the area decreased by 75.92 hectares, or an average by 12.65 hectares per year. In 2012, the area has decreased additionally by 1,257.05 ha, but in 2014 the area increased and in 2017 it reached 3,447.36 ha (Fig. 2). During the analysed period the damaged land area in the county increased by 236.48 ha, or 6.86 percent.



**Fig. 2.** The damaged land change in Kaunas County in ha from 2005 to 2017

Once the analysis of the damaged land area of the municipalities situated in the Kaunas county had been carried out, it was found that the largest area of these lands during the period between 2005 and 2017 was in Kaunas district municipality: in 2005 the amount was 915.50 ha and in 2017 the amount was 1,090.49 ha or 31.63 percent of the county's damaged land area. During the period of ten years the area in the municipality increased by 174.99 ha, or 16.5 percent. The area increased due to the development of the use of anhydrite and gypsum resources in Kaunas district.

The smallest damaged land area by 2017 was in Kaunas City Municipality and it occupied 11.00 ha, in 2005 the number was 4.52 hectares. During the period between 2005 and 2017, the analyzed area of the municipality increased by 6.48 hectares, or 58.91 percent. During the period between 2005 and 2017, in four counties out of ten (Klaipėda, Šiauliai, Vilnius and Kaunas) of the Republic of Lithuania the area of damaged land increased. Damaged land areas can be located both in private property land and on the state land.

*Analysis of the damaged land of Kaunas region in planning documents.* In Kaunas County General Plan (Kauno..., 2009) it was foreseen to shut down the old, non-compliant landfills and to leave the two municipal waste landfills in the region – the Lapes landfill site near the city of Kaunas and landfill in Zabieliškis, Kėdainiai district. Upon completion of the operation of the Lapes landfill (2020), the entire region is planning to transport the waste to the landfill in Zabieliškis (Kauno..., 2014). Once the management plans was carried out, the accumulated municipal waste are disposed in the regional landfill in Takniškiai village of Alytus district. Another large waste collection site was arranged in Prienai district.

Regional Waste Management Plan (Kauno..., 2010) provides for composting facilities, development of secondary raw materials and other waste collection suitable for the processing in municipalities, Zabieliškis landfill extension (17 ha), or construction and operation of a new landfill in Kaunas region. In order to optimize the management and development of municipal waste management and to use the means from the EU Cohesion Fund efficiently, the regional municipal waste treatment system was established in Kaunas region. Implementing the investment project of the waste framework, the closing and recultivation technical projects of large and small landfills with a total area of 18.5 hectares were established.

Rapidly increasing urbanization level will lead to more intensive use of mineral resources and waste generation, which will increase the impact on the environment. Challenges require sustainable use of mineral resources and avoidance of waste generation, the guidance of high environmental standards, the introduction of new, advanced technologies covering the entire chain of raw materials extraction and processing stages as well as rehabilitation methods.

## Conclusions

1. Kaunas County is located in the geographical center of Lithuania. It is industrial and agricultural region. Kaunas County occupies 808,624.92 ha or 12.5 percent of the whole territory of the country. The largest parts of the damaged areas of Kaunas County are located in the municipalities of Kėdainiai district (21.27 percent), Prienai district (21.03 percent) and Kaunas district (19.56 percent), while the smallest parts are located in Kaunas and Birštonas municipalities. 409 damaged areas were determined in Kaunas County. This is the third county in Lithuania by the amount of damaged areas.
2. Kaunas municipal waste management region covers 6 municipalities. The region closed 58 old landfills, dumps. 2 regional non-hazardous waste landfills were arranged: Lapes regional landfill (in Leipšiškiai village of Kaunas district) and Zabieliškis regional landfill (in Zabieliškis village of Kėdainiai district), 3 waste transfer stations were arranged (in Raseiniai, Kaišiadorys and Jonava regions), 11 bulky waste collection sites, 3 green waste composting sites, mechanical and biological waste treatment plants were built in Kaunas City and Zabieliškis village of Kėdainiai district, 30.000 individual composting containers were purchased.
3. In 2017, the damaged land area in Kaunas County covered 3,447.36 hectares, or 14.15 percent of all Lithuanian damaged lands and 0.43 percent of the county's total area. Meanwhile, in 2005 it accounted for 12.99 percent of the country's damaged lands and 0.59 percent of the total county area.
4. During the analysed period the damaged land area in the county increased by 236.48 ha, or 6.86 percent. Once the analysis of the damaged land area of the municipalities situated in the Kaunas county had been carried out, it was found that the largest area of these lands during the period between 2005 and 2017 was in Kaunas district municipality: in 2005 the amount was 915.50 ha and in 2017 the amount was 1,090.49 ha, or 31.63 percent of the county's damaged land area. During the period of ten years the area in the municipality increased by 174.99 ha, or 16.5 percent. The area increased due to the development of the use of anhydrite and gypsum resources in Kaunas district.

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