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# CHANGES IN THE LANDSCAPE OF GEDIMINAS HILL'S SLOPES

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**Abstract.** Gediminas Hill has transformed significantly from medieval times to the present. In early history, its slopes were forested and served as a natural defensive barrier. As stone fortifications replaced wooden ones, the slopes were cleared, making the Hill more visible within the growing city. By the Renaissance, artistic depictions showed open, grassy slopes shaped by both nature and human activity. In the 19th century, Romantic artists portrayed the Gediminas Hill as a national symbol, even as erosion began to threaten its stability. Early conservation efforts emerged but were limited in effectiveness. During the Soviet era, landscaping and terracing gave the slopes a more controlled, manicured appearance. Increased tourism and urban development further altered the landscape. In the 21st century, severe erosion and landslides dramatically changed the slopes, exposing their fragility. Recent restoration efforts have reshaped the Hill once again, blending engineering solutions with ecological renewal.

**Keywords:** Gediminas Hill, slope stability, culture heritage, Vilnius monument, landscape changes.

## 1. Introduction

Gediminas Hill is a ~40 m high geomorphological feature composed of interlayered Quaternary glacial, glaciolacustrine and glaciofluvial deposits overlain in places by technogenic (cultural) fills. This heterogeneous stratigraphy produces variable mechanical properties across the slopes and predisposes them to shallow, surface-type failures (Mikulėnas et al., 2016).

Recent shallow landslides and emergency stabilizations (notably in the 2010s–2020s) underscore the need for integrated geotechnical and heritage-sensitive management. Shallow landslides formation events in 2022 and 2024 prompted emergency remediation and renewed long-term stabilization planning. Gediminas Hill's slopes continue to change through a mix of natural erosion, groundwater and weather-driven shallow landslides, and cumulative human impacts. The landscape has shifted from natural glacial formations to a fortified medieval stronghold, then to a modern heritage site requiring advanced engineering care. Today, the Hill stands as both a cultural symbol and a reminder of the delicate balance between nature and human intervention.

Gediminas Hill was treeless for the obvious reason that defensive fortifications cannot be overgrown with trees or shrubs. Trees and bushes began to grow there naturally after the 18th century, when Gediminas Castle was last used for its original purpose – the Vilnius city's defence. Later, Gediminas Hill and the Castle became a city park. Today it is a city symbol with slopes largely devoid of vegetation, whose collapses only recall former times and past glory.

The aim of this article is to review the changes in the slopes of Gediminas Hill over the past decades and to analyse landscape changes related to technogenic soil layer and vegetation on the slopes.

## 2. Some historical view's of Gediminas Hill

In this section it is given only a few main views of Gediminas Hill, showing that the appearance of Gediminas Hill varied over time and was in constant flux. One of the earliest views of Gediminas Hill is shown in the plan of Vilnius city prepared by Braun and Hogenberg for the *Civitates Orbis Terrarum* atlas in 1581 (Figure 1).

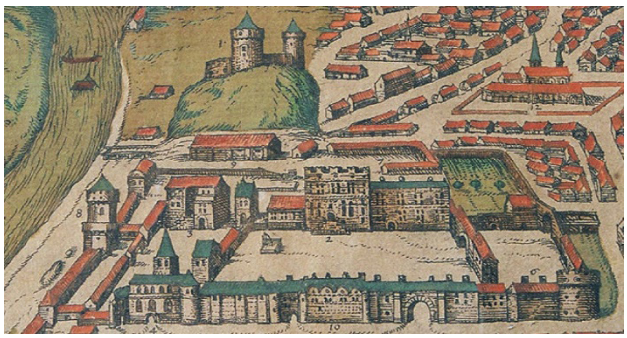

Figure 1. Gediminas Hill view in 1581 (Rekevičius, 2010)

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As late as 1785 (Figure 2) and 1827 (Figure 3), trees were still not growing on the slopes of Gediminas Hill. The Ruins of the Lithuanian Grand Dukes palace and Gediminas castle is captured in 1864 Ivanas Trutnevas painting (Figure 4). In Figure 3, it can be seen that trees have already started to cover the slopes of Gediminas Hill. In lithographs from the 1868–1885 period, growing trees on the slopes of Gediminas Hill are also already depicted (Figure 5).

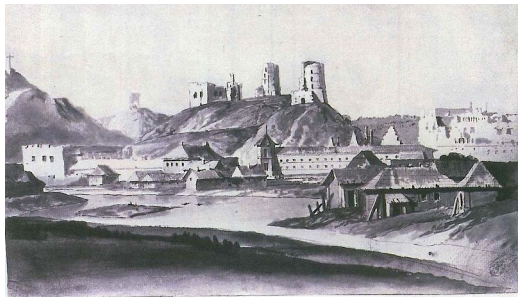

Figure 2. Gediminas Hill view in 1785
(P. Smuglevičius painting)

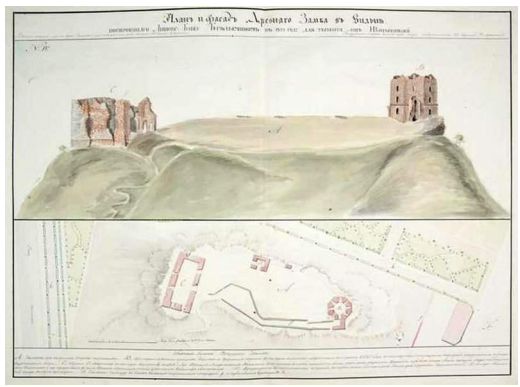

Figure 3. The view of Gediminas Hill in the Imperial Vilnius Governorate Castle Atlas (1827)

Later, when photographs became available, Gediminas Hill was captured in one of the well-known photographs taken by the photographer D. Vizūnas (Figure 6). In this image, it can be seen that trees are present not only on the slopes but also on the top of Gediminas Hill. The same situation is observed in (Figure 7). The slopes of Gediminas Hill were predominantly covered by deciduous trees, with maple being the dominant species. During intense storms or periods of strong winds, some trees exhibited substantial oscillation, and together with their root systems contributed to the mechanical disturbance of the slopes. Following severe storm events, individual trees occasionally collapsed. The fallen trees were not replaced by new plantings, which led to the initiation and subsequent development of landslide processes in those areas.

Nowadays, Gediminas Hill is having no trees on the slopes (Figure 8), and slopes are also used for the art performances.

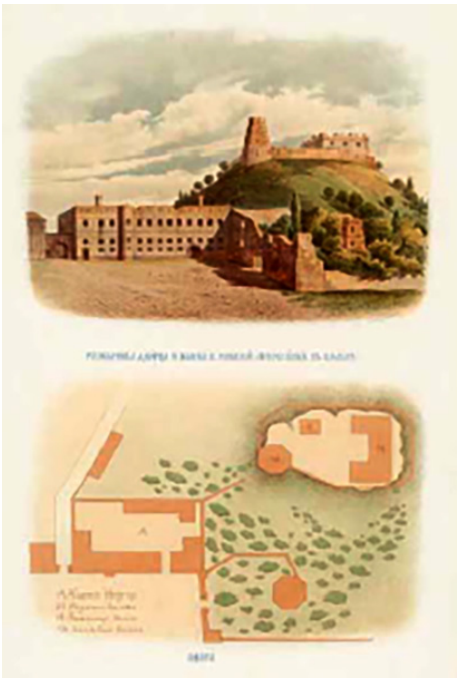

Figure 4. The Ruins of the Lithuanian Grand Dukes palace and Gediminas castle, 1864 (Povilaitytė-Leliugienė, 2017)

Figure 5. Gediminas Hill view in 1868–1885 period
(I. Trutnev painting)


Figure 6. Gediminas Hill view in 1910–1914 period
(D. Vizūnas photograph)

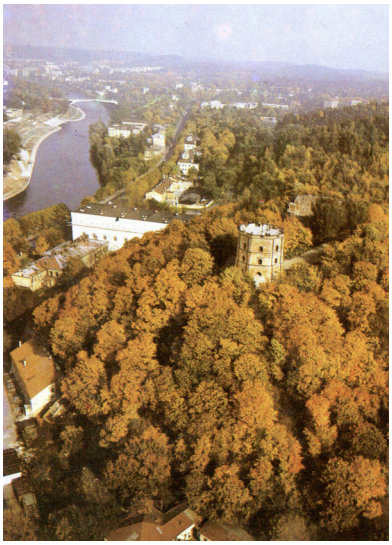

Figure 7. Gediminas Hill view in 1987 (J. Polis photograph)

Figure 8. Gediminas Hill view in 2025
(P. Peleckis photograph)

## 3. Landscape changes overview from 2002 till 2023

Contemporary analyses of landscape change at Gediminas Hill can be conducted using satellite imagery (e.g., Google Earth, n.d.). An early available image from 2002 (Figure 9) indicates that trees then covered nearly the entire Hill. In 2008 a landslide on the eastern slope of the Hill at the spring (Figure 10) was cleared, but the effects of this landslide are not visible because of the dense tree cover (Figure 11).

Figure 9. Gediminas Hill view in 10-07-2002 (Google Earth)

Figure 10. Gediminas Hill landslide in 2008 (V. Balkūnas photograph)

Figure 11. Gediminas Hill view in 03-08-2009 (Google Earth)

All Vilnius city residents were used to seeing Gediminas Hill covered with trees (Figures 9, 11, 12), but in 2011 a decision was made to restore the Hill's authentic appearance, and tree removal from the slopes began (Figures 13, 14). Since grass does not grow under dense tree canopies, no adequate grass cover had developed after the trees were cut. Therefore, when trees were removed from the slopes of Gediminas Hill, three-year-old turf was laid to establish a stable vegetation cover (Figure 15).

Figure 12. Gediminas Hill view in 05-06-2011 before tree removal (Google Earth)

Figure 13. Gediminas Hill view in 12-09-2012 with partial tree removal (Google Earth)

Trees cutting continued until 2014 (Figure 16). The authentic view of Gediminas Hill's slopes did not last long, because the loss of root reinforcement (Skuodis & Ng, 2018) from trees caused the surface soil layers to begin sliding. First landslide appeared on 1 February 2016, under unfavourable meteorological conditions, a superficial landslide began to form on the northwest slope of Gediminas Hill. In the zone of thawed and waterlogged soil a sliding surface developed (Figure 17), and on 13 February 2016 the landslide moved downslope.

On 9 October 2016 a layer of water-saturated soil slid out from beneath a covered membrane. As it moved downslope it demolished part of the brick-masonry parapet of the northern retaining wall (Jonaitis et al., 2019).

Figure 14. Gediminas Hill view 2012 with partial tree removal in south-eastern slope (R. Danisevičius photograph)

Figure 15. Three-year-old turf installation on Gediminas Hill slopes view in 2013 (D. Umbrasas photograph)

Figure 16. Gediminas Hill view in 13-08-2014 after tree removal (Google Earth)

Figure 17. Gediminas Hill view in 12-09-2016 with landslide area in northwest slope (Google Earth)

On 29 October of the same year, at the now-exposed landslide site, a layer of liquid mud slipped away. The landslides exposed the 1998 foundation structures on bored piles installed on the northwest slope to stabilize the Gediminas Hill technogenic soil layer. The area of slope damaged by deformation was approximately 3000 $m^2$. The failures developed within a layer of Holocene technogenic soils (Skuodis et al., 2021) fill that had been deposited or dumped onto the Hill's natural geological strata.

On 1 July 2017 a landslide formed on the south-eastern slope of Gediminas Hill. Further deformations and soil-erosion processes were recorded on 25 and 26 July and on 21 August (Figure 18).

Figure 18. Gediminas Hill view in 27-09-2017 with landslide in south-eastern slope (Google Earth)

The restoration and reinforcement of the northwest slope were carried out using gabion structures (Figure 19). This method of slope stabilization is well suited for restoring the slope profile on steep sections of the Gediminas Hill.

Figure 19. Gediminas Hill view in 13-04-2018 with gabions installation in northwest slope (Google Earth)

Despite the remediation works on the northern slope, shallow landslides occurred on other slopes (Figure 20). These landslide zones were treated with temporary measures, filling the landslide sites with crushed stone and covering them with anchored wire mesh.

Figure 20. Gediminas Hill view in 30-04-2019 (Google Earth)

For the new shallow landslides that appeared during the 2020–2023 period, only temporary slope-stabilization measures were applied (Figures 21–23). Comprehensive slope remediation works began in November 2024 and, according to the slope restoration project, are scheduled to be completed in 2028.

Figure 21. Gediminas Hill view in 22-03-2020 (Google Earth)

Figure 22. Gediminas Hill view in 13-08-2022 (Google Earth)

Figure 23. Gediminas Hill view in 21-09-2023 (Google Earth)

## 4. Conclusions

Throughout all historical periods, the entire natural surface of Gediminas Hill has been modified by human activity and covered with technogenic soil. This technogenic layer was long time reinforced only by the roots of trees that began to grow on the slopes of Gediminas Hill from the 18th century onward. Tree roots provide a soil-reinforcement function. However, when trees become too tall, their swaying during strong winds contributes to slope degradation. After the historical appearance of the slopes of Gediminas Hill was restored, with no trees on the slopes or the upper terrace, the slopes were covered with grass. Unfortunately, this decision did not ensure slope stability. Shallow landslides began to appear after tree removal in 2016 and continued until the start of slope-stabilization works in November 2024. Properly restored and maintained slopes can provide not only long-term stability but also serve public needs.

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