

Pilot case:

**Reconstruction of
Melina Merkouri
Avenue roundabout**

19-20 April 2021 - Lakatamia Municipality



- The Municipality of Lakatamia, under the Life project, upgraded the roundabout of Melina Merkouri Avenue.
- A dominant element in the design of the project was the use of permeable materials such as permeable concrete. In addition, the element of collection and use of rain water was added. Cyprus, according to the European Environmental Agency, holds a high position on soil sealing in the European Union.
- Indicative of the current situation are Figures 1 and 2.



Figure 1. Mean soil sealing in European Capitals (UMZ – Urban Morphological Zone) and soil sealing per inhabitant (EEA, 2011).

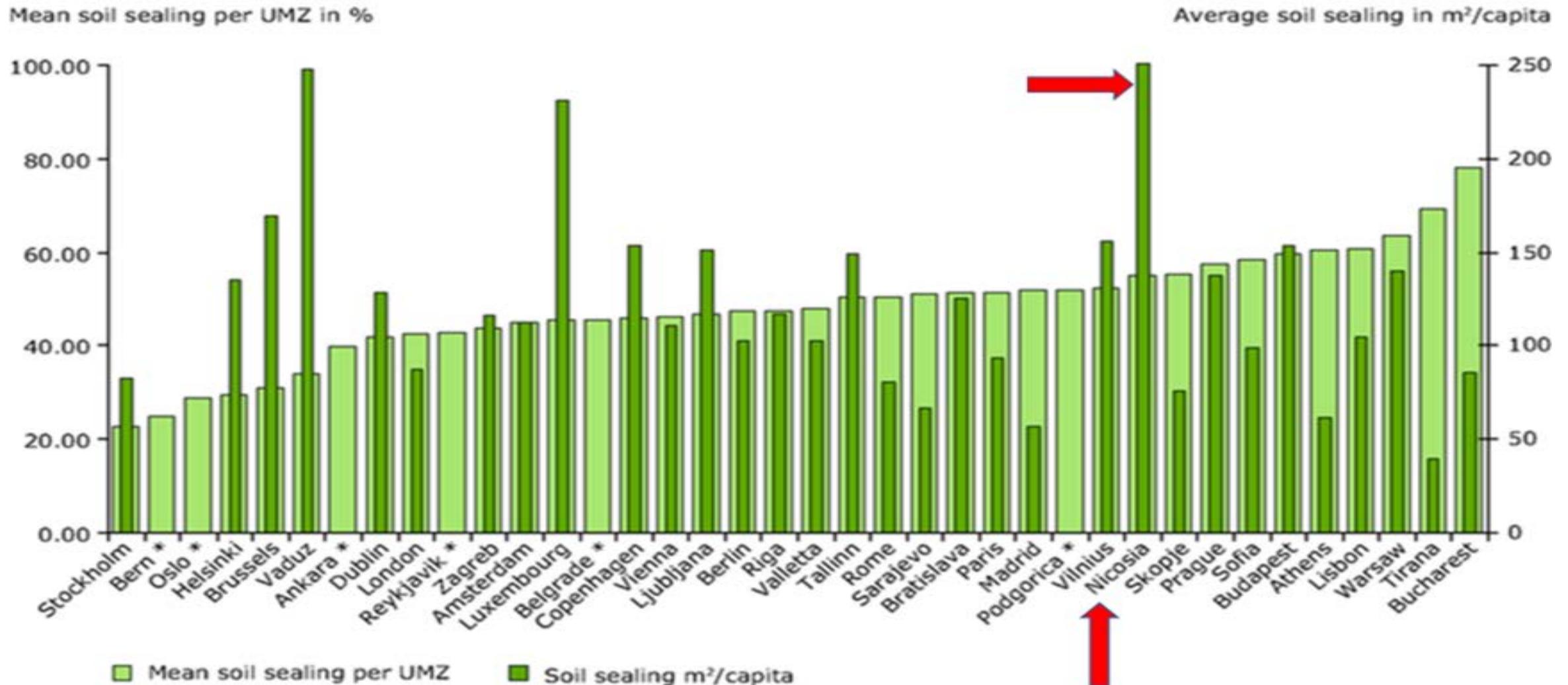
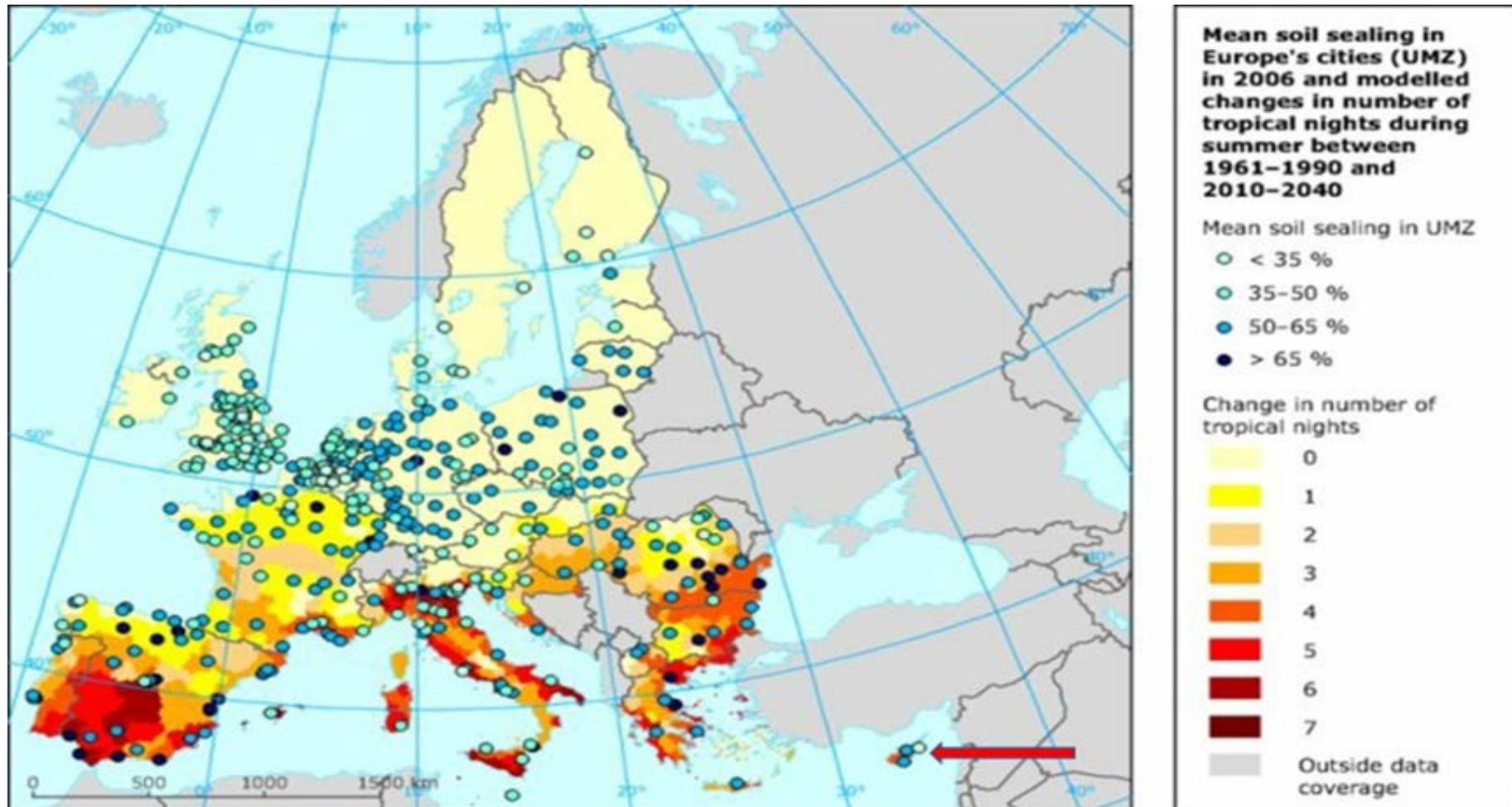


Figure 2. Degree of mean soil sealing in Europe's cities (UMZ – Urban Morphological Zone), in 2006 and modelled change in number of tropical nights ($T_{min} > 20^{\circ}C$) during summer between 1961-1990 and 2010-2040 indicating higher risks for heat waves (EEA, 2011).





- Global rapid urbanization resulted in considerable soil sealing.
- Paddy soils of the highest quality were the most vulnerable to be sealed.
- Quantitative changes of soil landscapes under urbanization were identified (Xiao et. al, 2013).
- Sealing has a strong impact on soils. The degree of sealing is related to the type of land use and to the population density. Sealed areas are still increasing, and it is often the most fertile soils which are sealed (Burghardt, 2006). Artificial soil sealing in urban areas has attracted increasing attention because of its potential hazard to urban ecosystem (Długosz and Charzyński, 2015).



- Covering soils with impervious materials has a significant impact on their properties and is essentially an irreversible process. In contrast to natural, open soils, sealed soils undergo a significant alteration of their physicochemical properties, and in turn, negatively influence microbial biomass and enzymatic activity. The artificial sealing in urban areas can significantly alter the soils by reducing their carbon and nitrogen content as well as microbial biomass and its activity compared with open soils (Długosz and Charzyński, 2015).
- Beside the loss of fertile soils with a direct impact on food security, soil sealing modifies the hydrological cycle. This can cause an increased flooding risk, due to urban development in potential risk areas and to the increased volumes of runoff (Ungaro, Calzolari, Pistocchi and Malucelli, 2014).



- As a solution to the soil sealing, permeable concrete is presented as an alternative pavement material, which has an astonishing significance in the field of environmentally friendly pavement design because of its overall hydrological and environmentally beneficial aspects (Debnath and Sarkar, 2018).
- The increasing use of pervious concrete as sustainable and environment-friendly paving materials is primarily owed to its ability to reduce pavement runoff (El-Hassan and Kianmehr, 2016). Pervious concrete typically has an infiltration rate far exceeding any expectation of precipitation rate (Tyner, Wright and Dobbs, 2009). In comparison to ordinary cement concrete, pervious is a more sustainable paving solution, offering a decrease in cost, heat island effect, and embodied energy, while also reducing carbon emissions by 54% (El-Hassan and Kianmehr, 2016).
- This permeable pavement system allows storm water runoff to infiltrate through the pavement and percolate into the subdrainage system or directly into the subgrade soil. The permeable pavement system is gaining popularity in municipal applications across the United States (Nantasai and Nassiri, 2017). Concreting everywhere leads to environmental issues such as reduction in recharge of rainwater into the ground hence constant fall of water table which degrades the quality of life.

The benefits of pervious concrete are:

- a) it reduces the storm water runoff,
 - b) eliminates the need for detention ponds and other costly storm water management practices,
 - c) replenishes the aquifers and water table,
 - d) allows for more efficient land development,
 - e) minimizes flash flooding and standing water
 - f) prevents water and polluted water from entering into stream and
 - g) mitigates surface runoff.
- ✓ Consequently, permeable concrete can be used to manage intense precipitation in pavements, walkways, driveways and parking lot (Ganpule and Pataskar, 2011).



- it is necessary to present new ways to the public for soil sealing and the collection of rainwater for other uses such as irrigation purposes.
- The soil sealing by impermeable materials is, as a rule, detrimental to the ecological functions of the soil.
- The presentation of permeable concrete to the public, may be an example for use in both private and public spaces.

The Design.. of the roundabout

- An important role is played by the presentation of the traditional way of irrigation, which in the past was widely used in the area.
 - That is, the used of irrigation channels, tanks and wells, which is also the emblem of the Municipality.
 - Consequently, an irrigation channel, reservoir and an artificial well will be constructed at the roundabout which is operate with photovoltaic panels.
 - The artificial traditional irrigation system have pass through the plantings.
- The water needs of the irrigation channel and the well has be covered by the collection of rainwater through the rainwater collection channel.
 - From there it have been stored in, an underground tank. Noted that in cases where additional water is needed for irrigation only recycled tertiary treatment water will be used, for which there is a pipeline at the roundabout.
 - This is an example of safe use of recycled water to the public.
- For the plantations of the roundabout has been used endemic plants and trees of the area.
 - A presentation has be made to the public on how to plant endemic trees and shrubs.
 - Soil cover with low shrubs and ground cover plants reduces the requirements of larger trees in water.
 - This way of planting is expected to be a good practice for the public to create private gardens with plants and ways that have lower water requirements.

Figure 3. Traditional way of irrigation in the area of Lakatamia



Figures 4 and 5 show the position of the roundabout as it is today. Specifically, the roundabout is at the main point of the Municipality, where a significant percentage of the people of Lakatamia passes daily, as well as those who want to head south.

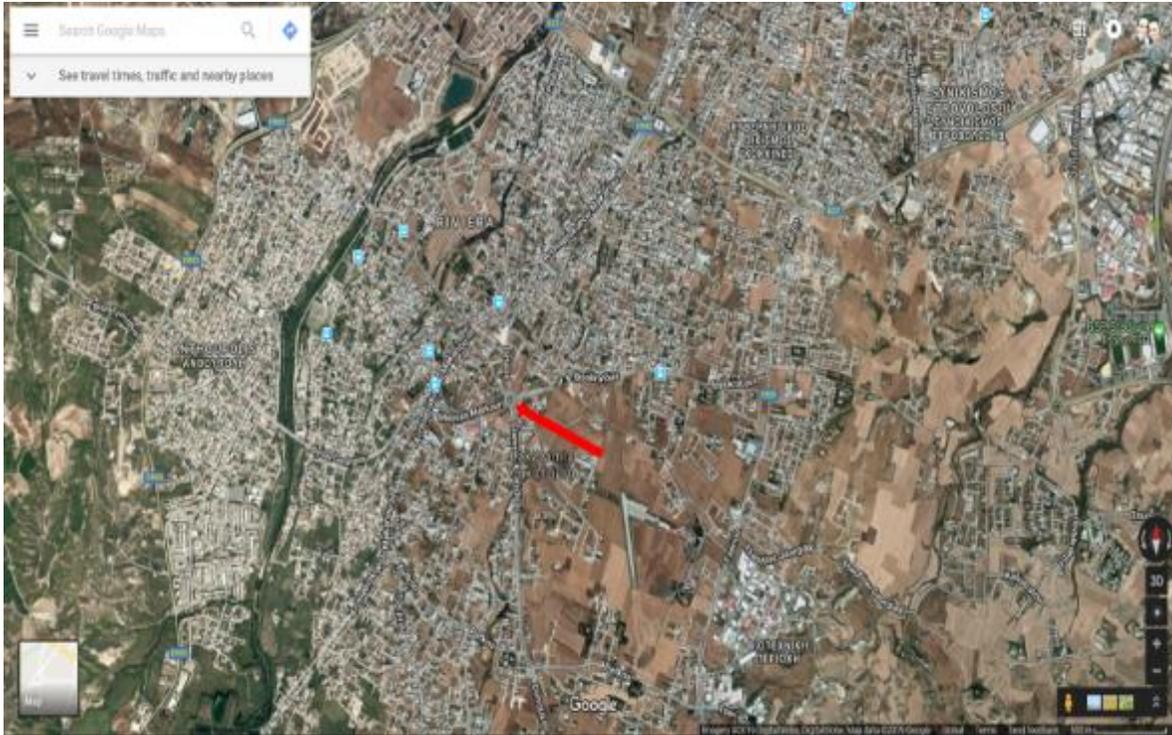


Figure 4. Location of the roundabout (Google Maps, 2019).

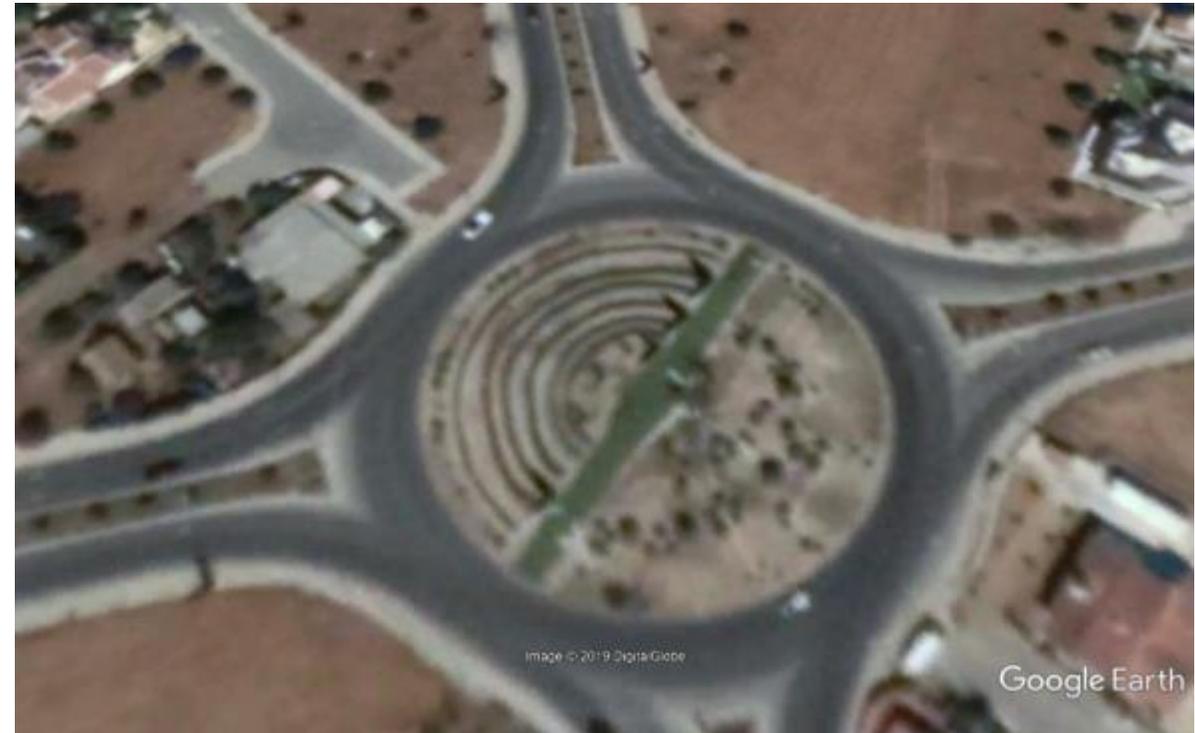


Figure 5. Picture of the roundabout as it was (Google Earth, 2019a).

Figure 6 shows the area as it was in 2005 and is indicative of the human intervention that has taken place.



Figure 6. Picture of the site as it was in 2005 (Google Earth, 2019b).

Figure 7 shows the suggestion for the roundabout reconstruction by applying permeable concrete in various colors and shapes. Has also be compositions with stones that will be permeable.

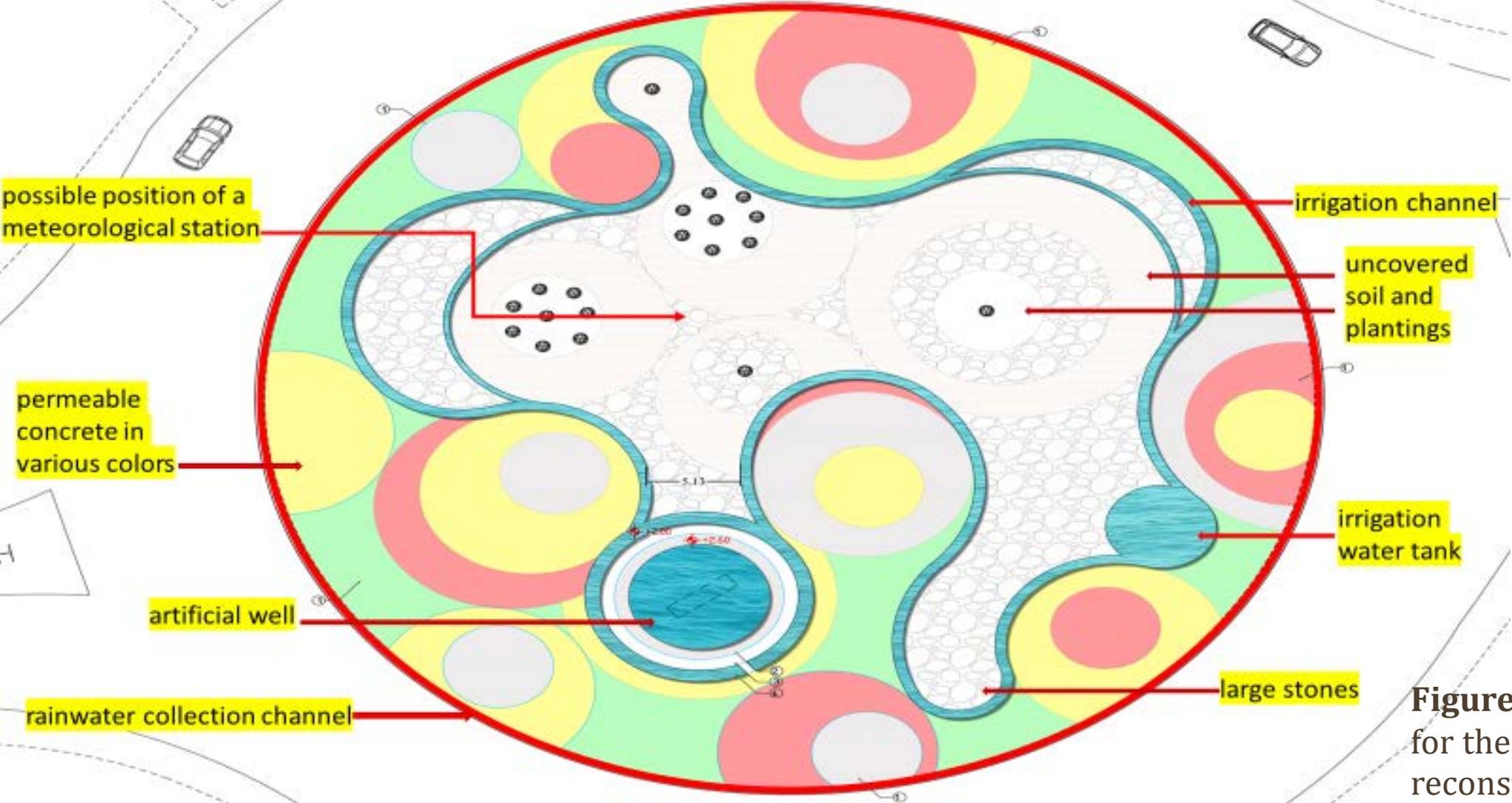


Figure 7. The suggestion for the roundabout reconstruction

Figure 8 shows the detail of the construction of the artificial well.

Details of Artificial Well

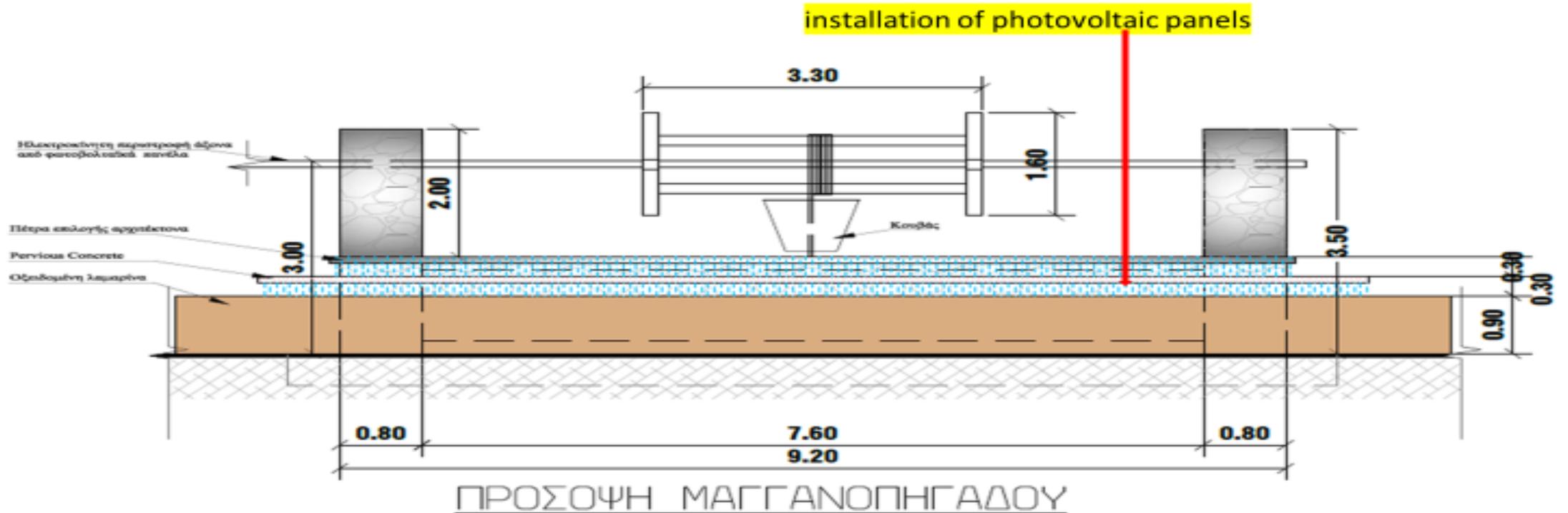


Figure 8. Detail of the construction of the artificial well

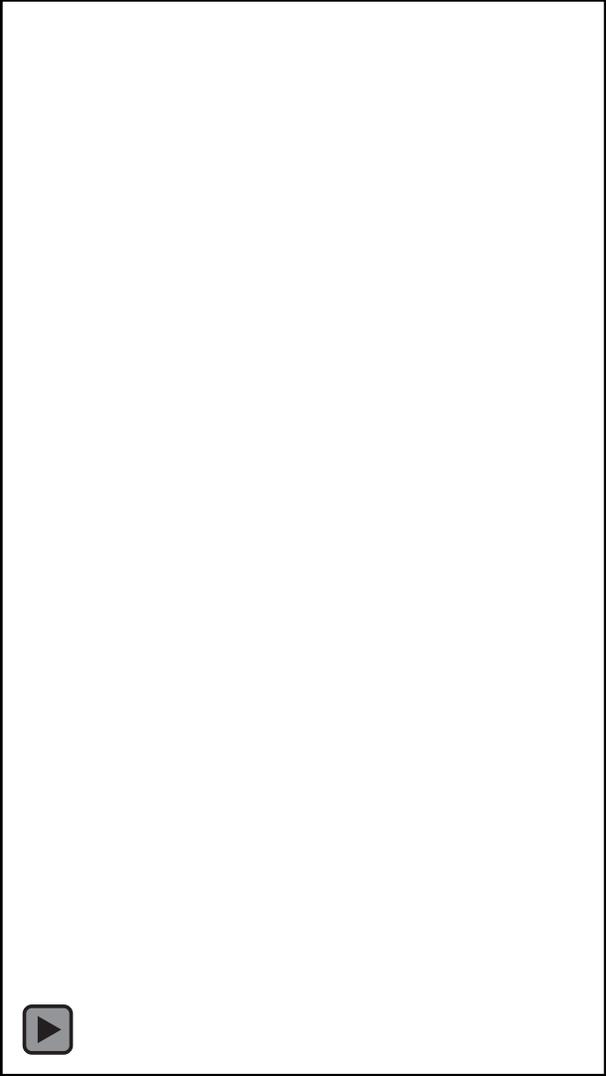
- The above design of the roundabout is expected to be a predominant element for the Lakatamia Municipality.
 - The use of permeable concrete, other permeable materials such as stones, planting of endemic trees and shrubs with low irrigation requirements and the use of recycled water are good practices for use in private and public spaces.
 - In addition to all these uses, the presentation of the traditional way of irrigation of the area is an important additional value to the project.
- These actions are also in line with the climate change adaptation measures presented in the National Climate Change Adaptation Strategy and the Climate Change Adaptation Action Plan of the Department of Environment of Ministry of Agriculture, Rural Development and the Environment



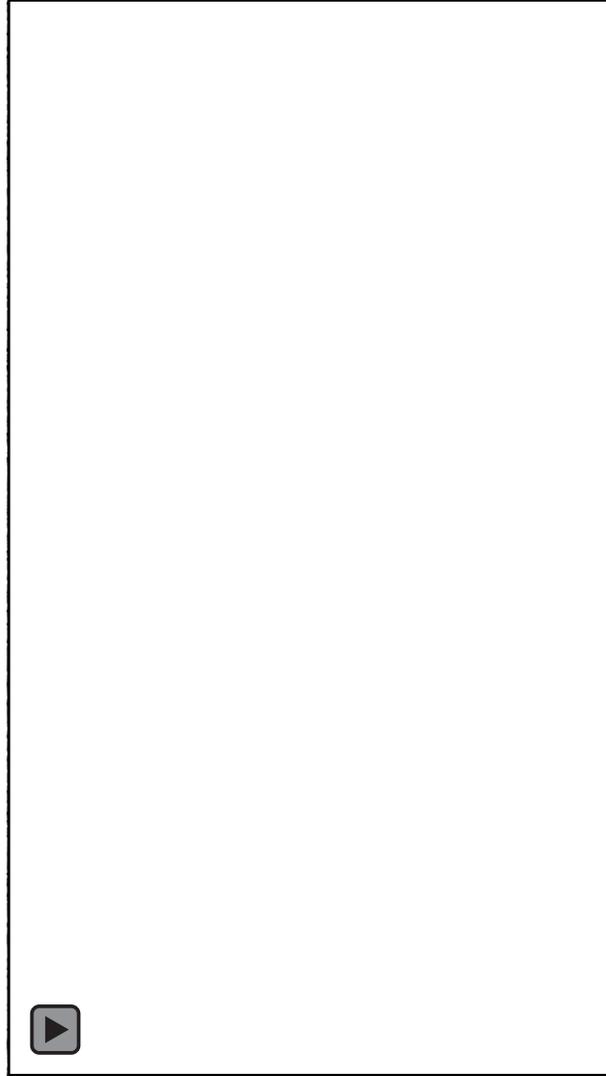
THE RESULT



Video 1



Video 2







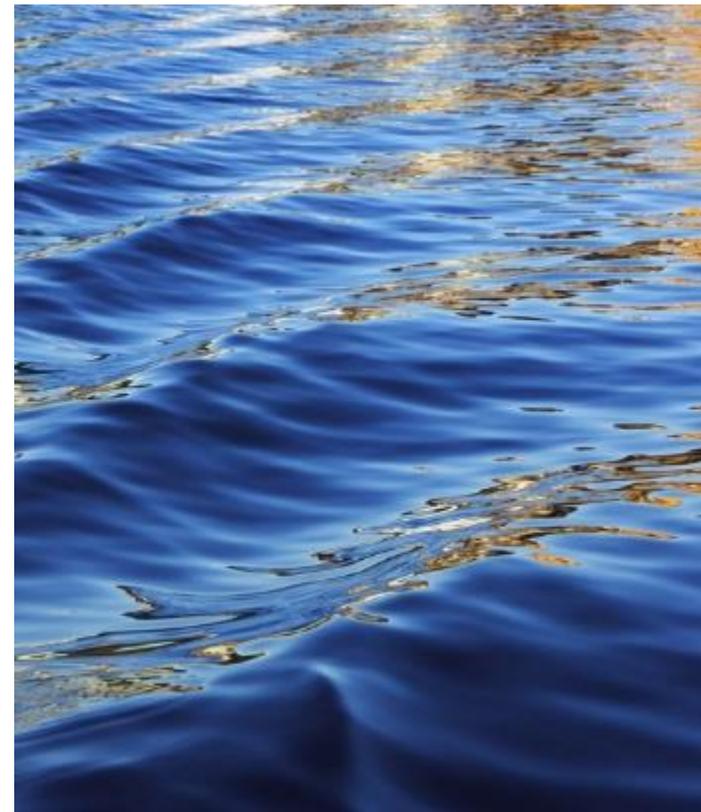
Final step sensors installation

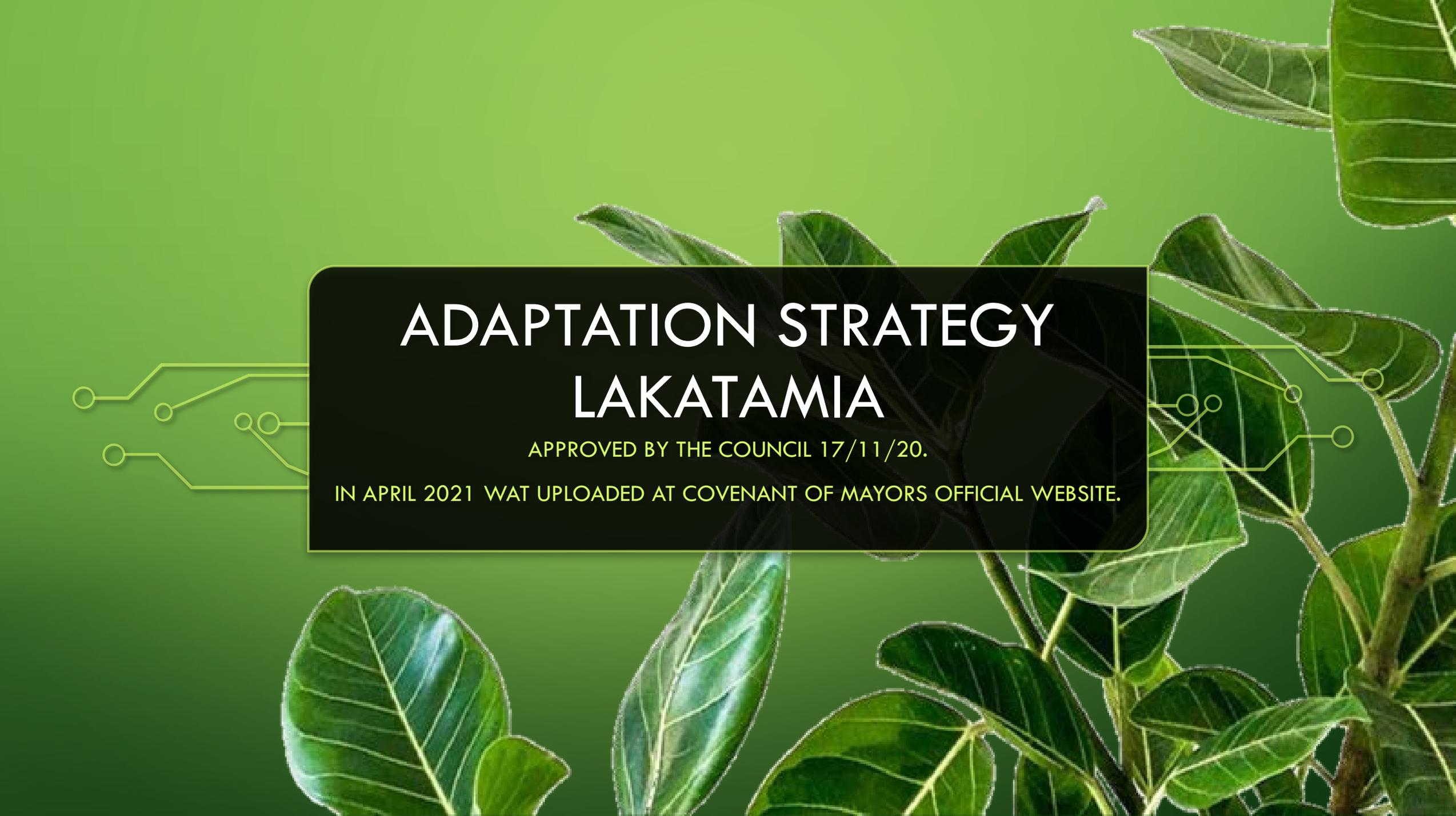




Video

<https://youtu.be/GtBcGVSSlfU>



The background is a vibrant green color. On the right side, there are several large, detailed green leaves with visible veins. On the left side, there are stylized white circuit lines with circular nodes. A dark green rounded rectangle is centered on the page, containing white text.

ADAPTATION STRATEGY LAKATAMIA

APPROVED BY THE COUNCIL 17/11/20.

IN APRIL 2021 WAT UPLOADED AT COVENANT OF MAYORS OFFICIAL WEBSITE.



Introduction

Vision: “By respecting people and environment, to develop a modern, attractive, humane and prosperous city that meets the expectations of citizens and serve their needs by providing high quality services”

Initiatives supporting adaptation actions in the city

- Covenant of Mayors



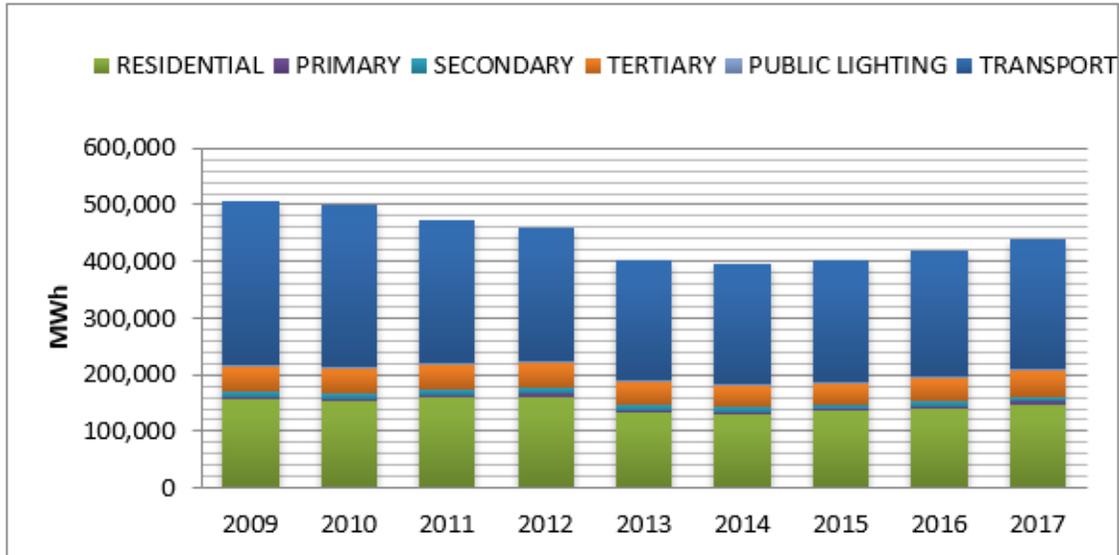
Covenant of Mayors
for Climate & Energy

- ISLE-PACT



- Green Partnerships, Compose





LAKATAMIA	MWh	MWh
	2009	2017
RESIDENTIAL	156,305	147,431
PRIMARY	4,635	4,910
SECONDARY	10,168	8,557
TERTIARY	42,230	45,080
PUBLIC LIGHTING	3,602	3,307
TRANSPORT	290,142	229,836
TOTAL	505,082	439,122

Energy Consumption 2017

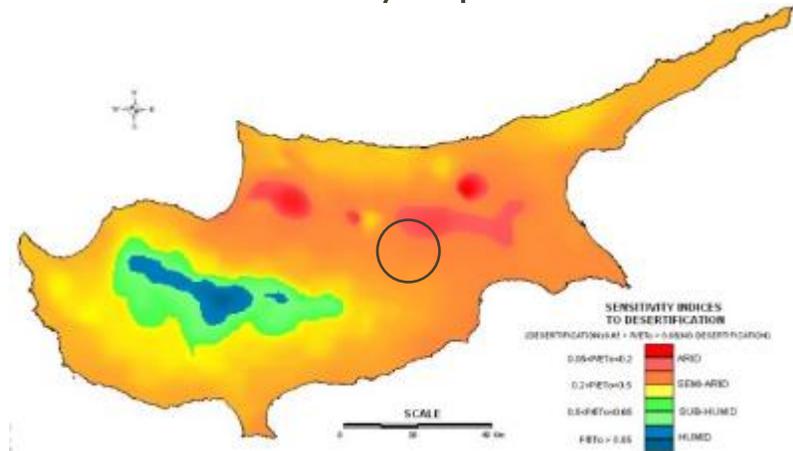


Local Strategy for Adaptation

- Main Challenges Identified
- Climate change risks - Expected impacts
- Adaptation actions proposed

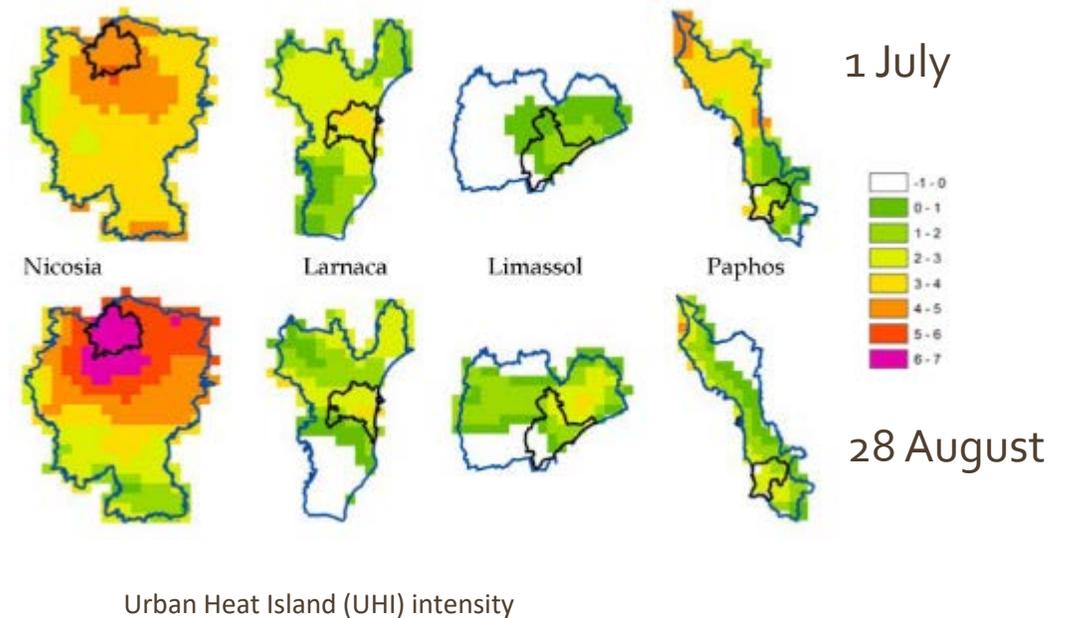
Main Adaptation Challenges

- Drought and water scarcity
- Flooding
- Urban heat waves
 - Intensified by rapid urbanisation



Desertification indices – Lakatamia shown in circle

Source: Areas sensitive to desertification, according to the United Nations Convention to Combat Desertification (IACO, 2007)



Urban Heat Island (UHI) intensity

Source: MODIS – Aqua
(Satellite and Ground Measurements for Studying the Urban Heat Island Effect in Cyprus)

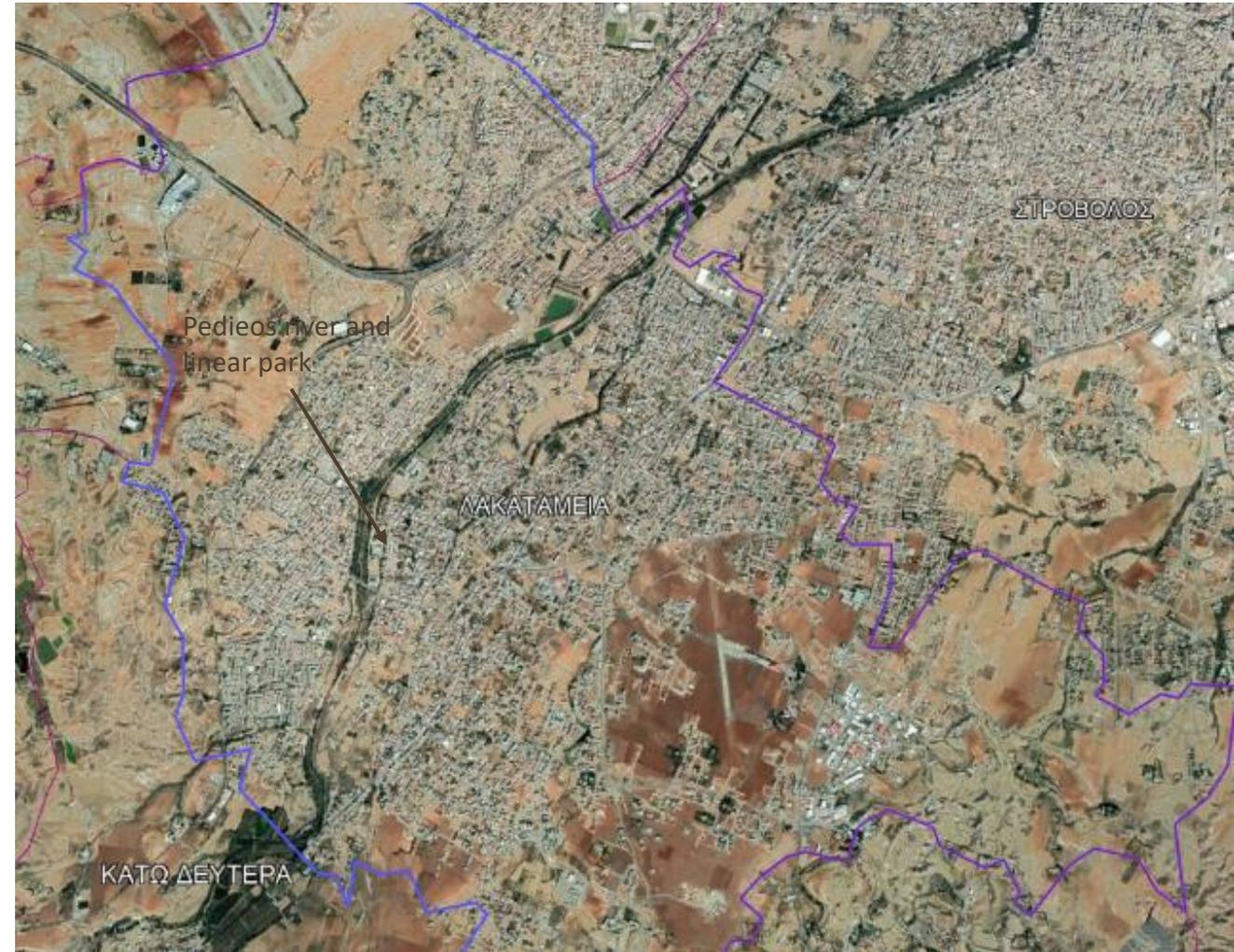
Main Adaptation Challenges

→ Actions needed (like Nature Based Solutions) to reduce urban heat waves, protect the Pedieos river banks, and improve quality of life of the citizens.

→ Pedieos is a river passing through Nicosia. A linear park with pedestrian and cyclist path has been constructed alongside the river, starting from Lakatamia, through Strovolos, until Nicosia city centre.

→ Due to lack of a holistic plan for managing the river, there are issues, including erosion and risk of flooding.

→ Flooding issues were also identified in the city, especially after extreme precipitation



Climate hazard risks

Climate Hazard Type		Current hazard risk level	Expected change in intensity	Expected change in frequency	Timeframe	Risk-related indicators
Extreme Heat		High	Increase	Increase	Current	increase of the frequency and length of heatwaves
Extreme Cold		Low	Decrease	Not known	Long-term	more days with a temperature above 40°C and significantly less days below 0oC
Extreme Precipitation		Moderate	Increase	Increase	Medium-term	increase of the days with extreme precipitation (linked with floods)
Floods		High	Increase	Increase	Medium-term	increase of the river and flash floods
Droughts		High	Increase	Increase	Current	increase of the dry days (2020-2050)
Storms		Moderate	Increase	Increase	Long-term	extreme effects are increased in the last years
Other	Dust	High	Increase	Increase	Current	

Expected impacts in the municipality

Impacted Policy Sector	Expected Impact(s)	Likelihood of Occurrence	Expected Impact Level	Timeframe
Buildings	increased demand for cooling	Likely	High	Short-term
Transport	damage to transport infrastructure	Likely	Low	Medium-term
Energy	damage to electrical infrastructure (cables)	Likely	High	Medium-term
Water	water scarcity	Likely	High	Current
Land Use Planning	desertification of important urban areas, increase of cementing rate	Likely	Moderate	Short-term
Environment & Biodiversity	loss of urban flora and urban species	Likely	High	Medium-term
Health	increase of diseases, reduction of life expectancy	Possible	High	Medium-term

Adaptation Actions

Sector	Title	Short description	Responsible body/department	Implementation timeframe	
				Start	End
Land Use Planning	Green parks, spaces	Increase, upgrade and promoting green parks and spaces in the administrative boundaries of municipality. Abandoned municipal land can be used for the development of green spaces.	Strovolos Municipality, Ministry of Interior, Public Works Department, Department of Environment	2020	2030
Land Use Planning	Adapting the Spatial Planning Act	Make a requirement in the spatial planning act promoting permeable materials in the planning and building permits	Lakatamia Municipality, Public Works Department	2020	2030
Land Use Planning	Adapting the Spatial Planning Act	Make a requirement in the spatial planning act that forbids the further extension of hardened surfaces compared to the baseline both for roads and parking lots	Lakatamia Municipality, Public Works Department	2020	2030
Buildings	Promoting green roofs on buildings	Support the installation of green roofs in the local/public/private buildings (Grant schemes or other initiatives - dissemination)	Lakatamia Municipality, Department of Environment, Cyprus Energy Agency	2020	2030

Adaptation Actions

Sector	Title	Short description	Responsible body/department	Implementation timeframe	
				Start	End
Water	Support the collection of rainwater	Incentives, such as reduced fees and taxes on the installation of rainwater collection systems in homes.	Lakatamia Municipality	2019	2025
Water	Maintenance and repair of water systems	Continuous replacement and repair of all old and poorly maintained water distribution networks and leakage detection	Lakatamia Municipality, Water Development Department	2019	2030
Water	Strengthening the efficient use of water in buildings and industry	Workshops for the use of low water consumption equipment and more efficient household appliances.	Lakatamia Municipality	2019	2020
Environment & Biodiversity	Protecting the Pedieos river banks	Implementation of a holistic Management Plan and promotion of Nature Based Solutions for protecting and enhancing the habitats and wildlife of the river	Lakatamia Municipality, Department of Environment, Water Development Department	2019	2030

Adaptation Actions

Sector	Title	Short description	Responsible body/department	Implementation timeframe	
				Start	End
Health	Provide instructions for individual protection against the effects of climate change	Information material and training seminars on the impacts of climate change on health and how to deal with them	Lakatamia Municipality, Cyprus Energy Agency	2020	2025
Health	Empowerment / creation of local health centres	Identification of areas where the vulnerable population groups can be protected from heatwaves, dust, floods etc	Lakatamia Municipality, Cyprus Energy Agency	2020	2030
Energy	"Greening" of local authorities	Greening the local authorities to avoid / reduce the thermal isle effect with the aim of reducing energy consumption for cooling.	Lakatamia Municipality, Department of Environment, Cyprus Energy Agency	2019	2030

Example: Proposed measures in the flooding areas inside the city

- Regulations for building permits (mandatory use of permeable materials – if applicable)
- Use of permeable materials in the sensitive areas and other (cycle/pedestrian paths)
- Rain gardens
- Retention ponds/floodable park



Adaptation measures	Criteria				Total score
	Efficiency in addressing the impact	Environmental Friendliness	Economic Viability	Job growth	
Water saving appliances for buildings	4.1	4.3	2.4	2.7	3.4
Rain gardens	3.1	4.1	2.7	2.3	3.1
Greywater re-use (domestic)	3.4	3.9	3.1	1.6	3.0
Lake restoration	3.4	4.2	1.3	3.1	3.0
Water metering systems	3.3	4.0	2.6	1.9	2.9
Infiltration / Detention basins	3.3	3.7	2.5	2.1	2.9
Rehabilitation of water distribution network	3.3	3.5	2.5	2.5	2.9
Rainwater harvesting at buildings	3.0	3.9	2.8	1.7	2.8
Wastewater treatment plants	3.5	3.4	1.7	2.7	2.8
Riverbed material restoration and re-naturalization	2.9	4.0	1.9	2.4	2.8
Permeable paving	2.8	3.6	2.6	2.1	2.8
Infiltration trenches and Swales	3.1	3.6	2.2	2.2	2.8
Artificial groundwater recharge through wells	2.8	3.3	2.9	1.7	2.7
Soakaways	3.1	3.3	2.2	2.1	2.7
Desalination	3.6	2.4	1.9	2.7	2.7
Water restrictions	2.7	3.6	3.8	0.5	2.6
Re-meandering	2.8	3.4	1.1	2.8	2.5
Dikes and dams re-enforcing	2.6	2.1	1.5	2.5	2.2

Table 26: Evaluation results of water availability adaptation measures

Adaptation measures	Criteria				Total score
	Efficiency in addressing the impact	Environmental Friendliness	Economic Viability	Job growth	
Trees in urban areas	3.3	4.6	3.3	2.0	3.3
Retention ponds	4.1	3.6	1.8	2.8	3.1
Forest riparian buffers	3.3	4.5	2.3	2.0	3.1
Riverbed material restoration and re-naturalization	3.8	3.9	1.5	2.9	3.0
Lake restoration	3.8	4.2	1.1	2.8	2.9
Channels and rills	3.4	3.6	1.8	3.0	2.9
Filter strips	3.2	3.8	2.3	2.4	2.9
Green Roofs	3.1	4.0	1.6	2.9	2.9
Permeable paving	3.4	3.3	2.2	2.6	2.9
Infiltration trenches and Swales	3.7	3.3	2.3	2.2	2.9
Rain gardens	3.3	3.6	2.5	2.1	2.8
Infiltration / Detention basins	3.8	3.2	1.8	2.3	2.8
Sediment capture ponds	3.5	3.2	2.3	2.0	2.7
Re-meandering	3.5	3.3	1.4	2.6	2.7
Soakaways	3.1	2.6	1.6	2.5	2.5
Dikes and dams re-enforcing	2.6	1.8	0.7	2.7	2.0

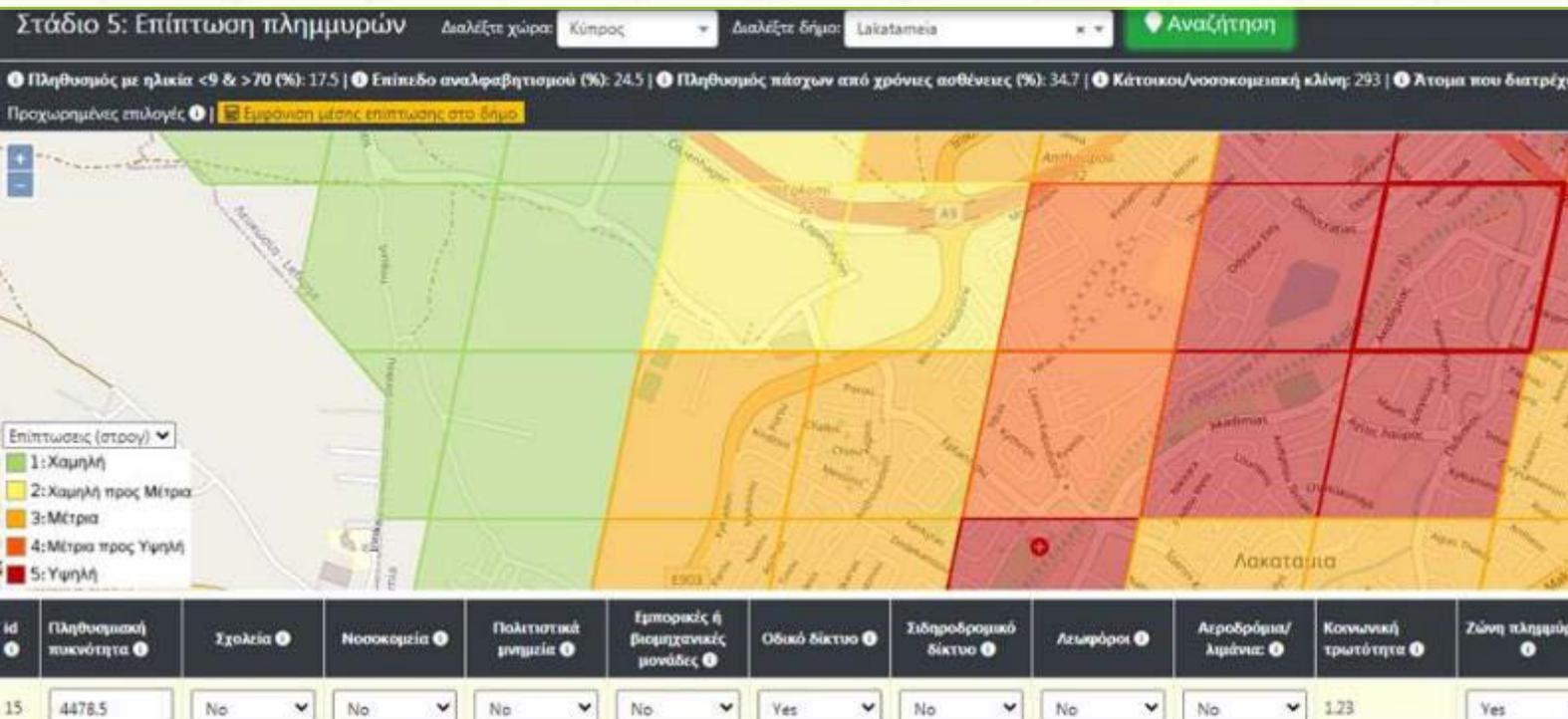
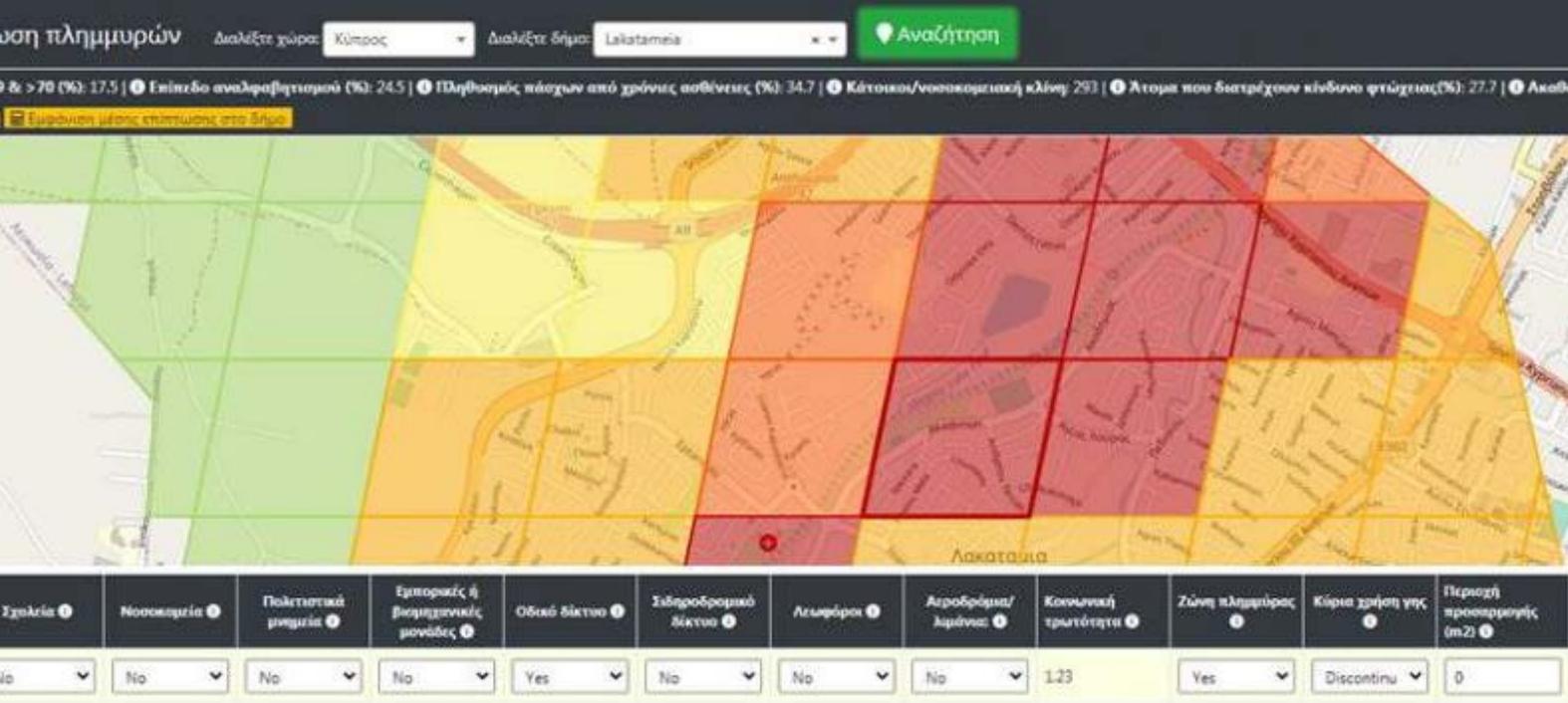
Table 27: Evaluation results of flood adaptation measures

Adaptation measures	Criteria				Total score
	Efficiency in addressing the impact	Environmental Friendliness	Economic Viability	Job growth	
Financial incentives for the Holistic Energy Efficient Retrofitting of Residential Buildings	3.9	4.2	2.2	3.3	3.4
Economic incentives for renewables and energy efficiency	4.1	4.2	1.9	3.1	3.3
Renovation of municipality buildings to Nearly Zero-Energy Buildings	4.0	4.1	1.7	3.3	3.3
Demonstration projects and educational programs	3.5	4.0	3.3	2.0	3.2
Urban forest	3.4	4.2	2.9	2.0	3.1
Cool Roofs	3.3	3.5	2.5	2.7	3.0
Economic incentives to reduce urban heat island	3.3	3.6	1.8	2.7	2.9
Green roofs	3.1	3.8	2.0	2.6	2.9
Cool pavements	3.1	3.5	2.0	2.8	2.9

Table 28: Evaluation results of electricity demand for cooling adaptation measures



The UrbanProof Toolkit



Suggestion/example:

- Implementation of NBS pilot actions and solutions to enhance flood protection
- Promotion of Green Roofs



Id	Πληθυσμιακή πυκνότητα (κάτοικοι/km2)	Έκταση κελιού (τ.μ.)	Μέσος HUMIDEX καλοκαιριού στο παρόν κλίμα	Μέσος HUMIDEX καλοκαιριού στο μελλοντικό κλίμα (RCP4.5)	Μέσος HUMIDEX καλοκαιριού στο μελλοντικό κλίμα (RCP8.5)
887	4478	249430.87	40.68	44.19	45.29

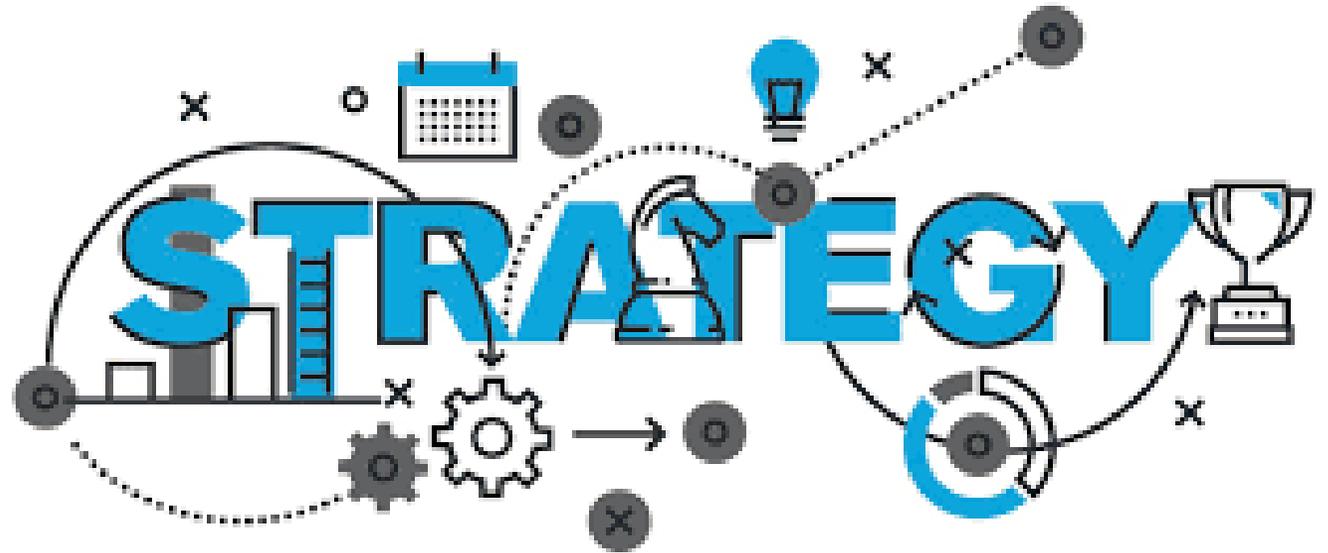


Πληθυσμιακή πυκνότητα (κάτοικοι/km2)	Έκταση κελιού (τ.μ.)	Μέσος HUMIDEX καλοκαιριού στο παρόν κλίμα	Μέσος HUMIDEX καλοκαιριού στο μελλοντικό κλίμα (RCP4.5)	Μέσος HUMIDEX καλοκαιριού στο μελλοντικό κλίμα (RCP8.5)	Περιοχή προ...
3216	249430.39	40.68	44.19	45.29	0

Suggestion/example:

- areas for placement covering soils with impervious materials
- Areas for creation more green areas

- <https://drive.google.com/drive/folders/1g7MERhJBNOsoDMqwRtTfp9Rh-ocg7RUF?usp=sharing>





*Thank
you*

