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Sustainable Stormwater Management at Urban Expansion Areas of Potential Significant Flood Risk

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The Problem – Stormwater Quantity

Urbanization

Soil Sealing

Floods

The Problem – Stormwater Quality

Urbanization

Human Activities

Pollutants

Directive 2007/60/EC

The Preliminary Flood Risk Assessment (PFRA) for the Greek territory, according to European Directive 2007/60/EC, was completed in 2012 and was revised in 2019.

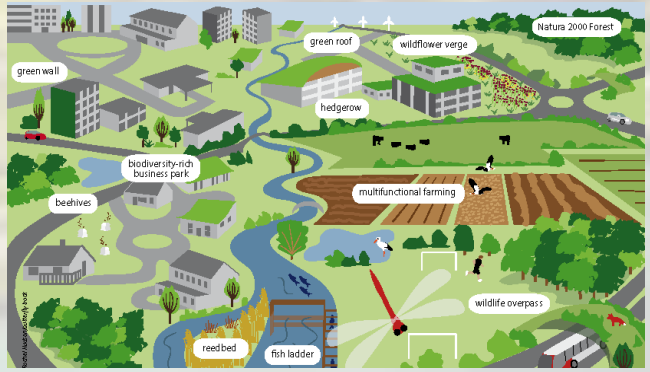
Areas of Potential Significant Flood Risk (APSFR) were defined (and revised) for each River Basin District (RBD). Meanwhile, in 2018, the Flood Risk Management Plans (FRMPs) were approved - by Greek Authorities - for each RBD.

In the FRMPs specific measures are proposed for funding of SM projects that will be designed according to the principles of SSM, i.e.:

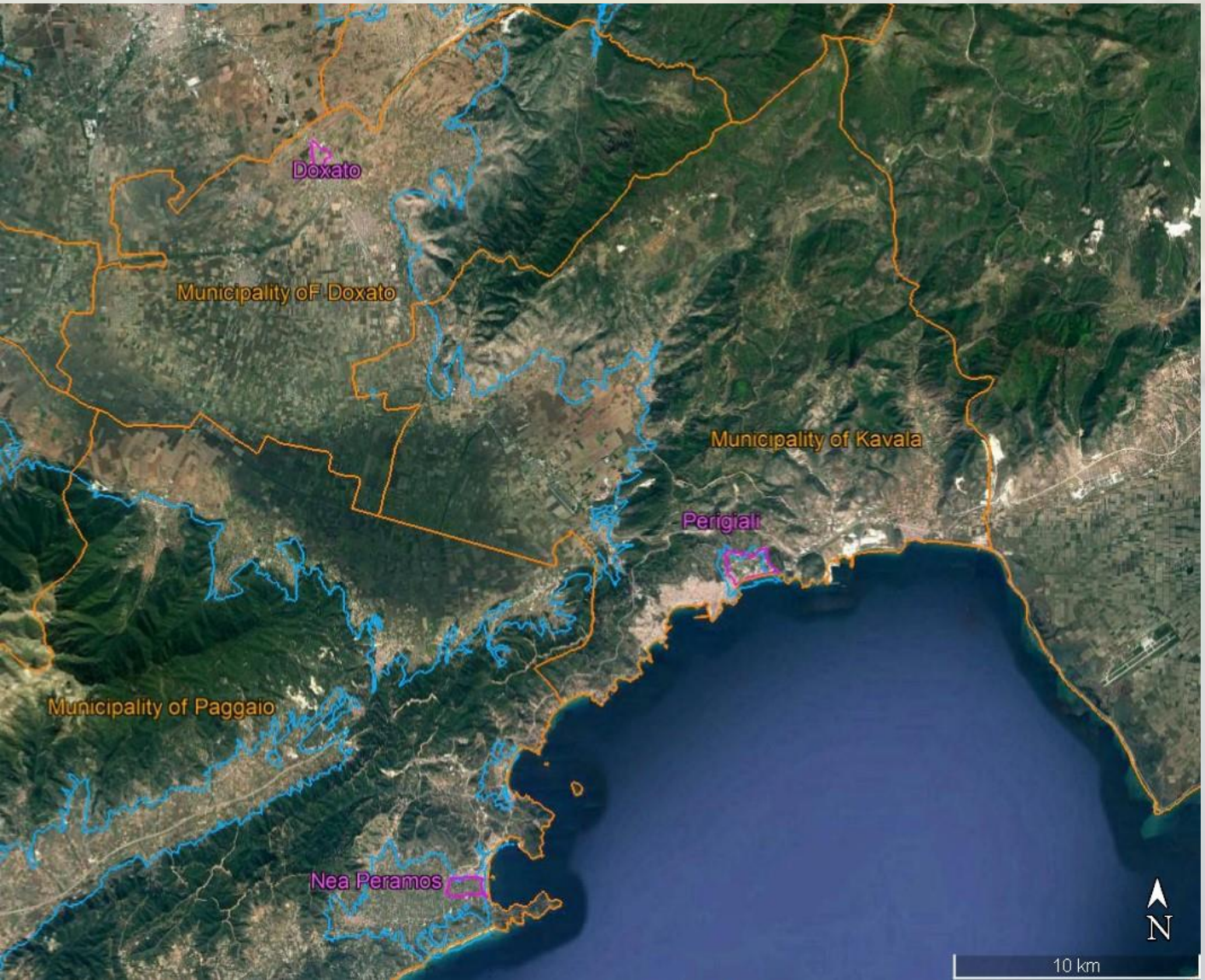
- Best Management Practices (BMPs)
- Green Infrastructure (GI)
- Low Impact Development (LID)
- Urban Natural Water Retention Measures (NWRM)
- Sustainable Drainage Systems (SuDS)

The Challenge

Sustainable Stormwater Management (SSM)



The Challenge



A preliminary study is drawn up in order to specify some innovative proposals for SSM in 3 areas located into the APSFR of RBD 'EL11' (Eastern Macedonia, Northern Greece), where urban expansion plans are approved for each area. Two of these areas, Perigiali and Nea Peramos (approximate surface area of 1.8 and 1.0 km^2, respectively) are coastal, while the third one, Doxato (approximate surface area of 0.5 km^2), is a continental, plain area. The areas are sited at 3 adjacent municipalities:

- Municipality of Doxato (Doxato)
- Municipality of Paggaio (Nea Peramos)
- Municipality of Kavala (Perigiali)

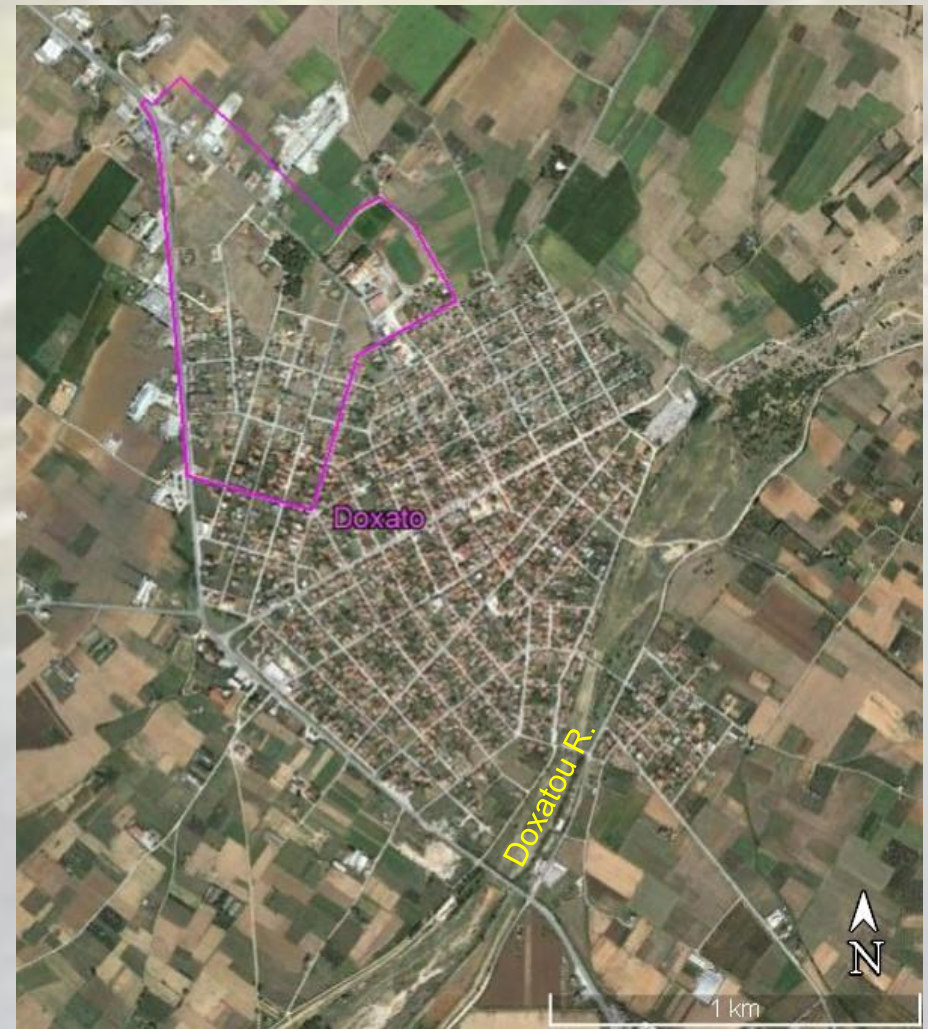
The Challenge

The fact that these areas have not yet been fully covered, gives us the chance to study and implement an appropriate Stormwater Management System (SMS), relying on the principles of Sustainable Development (SD). In fact, the study proposes the implementation of an Innovative Stormwater Management Plan (ISMP) for each area.

The Management Plan of the Water Basin of East Macedonia Water District (WMP), which was elaborated in 2011, approved in 2013 and revised in 2017, proposes a Sampling Program (SP) at the stormwater sewers outfall, as well as at other point sources of pollution. The FRMPs propose measures for setting up new design standards based on SSM. The implementation of an ISMP may will be able - along with the implementation of the SP - to upgrade the ecological status of the Water Bodies that are affected by Nonpoint Source Pollution (NSP) coming from the stormwater.

Study Areas

Doxato (Municipality of Doxato)



The Urban Development Plan (UDP) of Doxato was approved in 1995. By this Plan, a new zone of approximately 0.5 km^2, was added into the boundaries of Doxato. All the area is located inside the APSFR 'EL11APSFR003'. For this area a final study of wastewater and stormwater sewer networks has been accomplished. According to the WMP, the ecological status of the River Water Body of Doxatou R. (EL1106R0002060326N) is 'moderate'. Macroinvertebrates degradation was observed at this Water Body.

Study Areas

Nea Peramos (Municipality of Paggaio)

The UDP of Municipal Unit of Eleftheres of the Municipality of Paggaio is ongoing. Phase B1 of the UDP has been approved. According to the UDP, a new zone of approximately 1.0 km^2, will be added into the boundaries of Nea Peramos. Part of this the area belongs to the APSFR 'EL11APSFR002'. The SM measures on this zone must be established before public and private sector works are constructed. According to the WMP, the ecological status of the Coastal Water Body of Nea Peramos (EL 1106C0003N) is 'moderate'. So, the problem in this case is not only the floods (water quantity), but also the water quality in the Coastal Water Body of Western Nea Peramos.

Study Areas

Perigiali (Municipality of Kavala)

The New Urban Development Plan of Kavala City was approved in 2013. By this Plan, a new zone of approximately 1.8 km2, called ‘Perigiali’, was added into the boundaries of Kavala City. Part of this area belongs to the APSFR ‘EL11APSFR002’. The stormwater management of this zone is a crucial topic because major construction works have been made in its catchment area, such as Egnatia Motorway, as well as public and private sector infrastructure (landfill, roads, buildings, etc.). According to the WMP, the ecological status of the Coastal Water Body of Western Kavala Gulf (EL1106C0004N) is ‘moderate’. Many studies have shown that pollution may come from transportation (Egnatia Motorway, etc.). Furthermore, the authorities propose a perimeter road that may compound the problem. So, in this case there is also a water quality problem (except the floods problem).

Available Urban SSM Construction Measures

- Green Roofs
- Rainwater Harvesting
- Permeable Paving
- Swales
- Channels & Rills
- Filter Strips
- Soakaways
- Infiltration Trenches
- Rain Gardens
- Detention Basins
- Retention Ponds
- Infiltration Basins





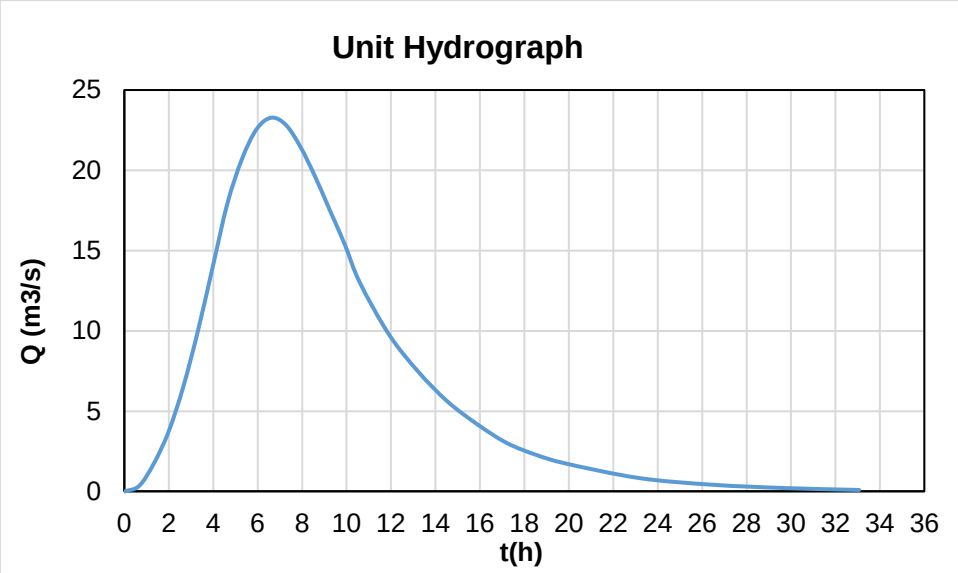






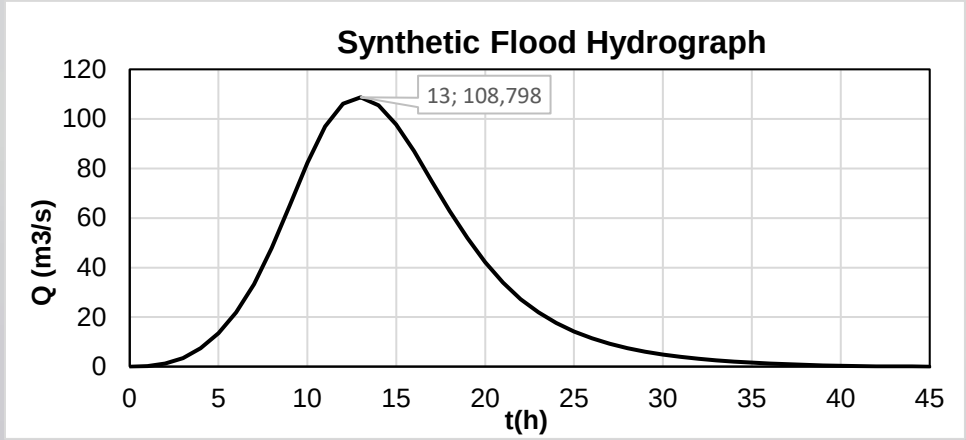

Hydrological Calculations

IDF Curves given by the Flood Risk Management Plan



SCS Method

Design Discharge

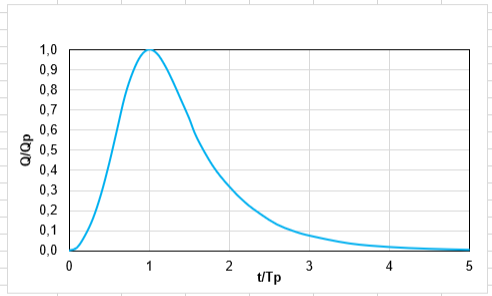


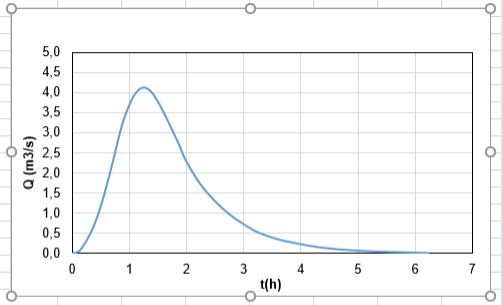
Hydraulic Calculations

Bibliography

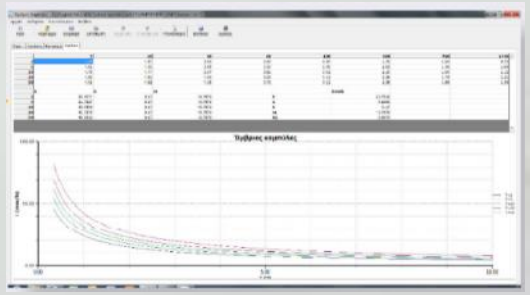
Spreadsheets

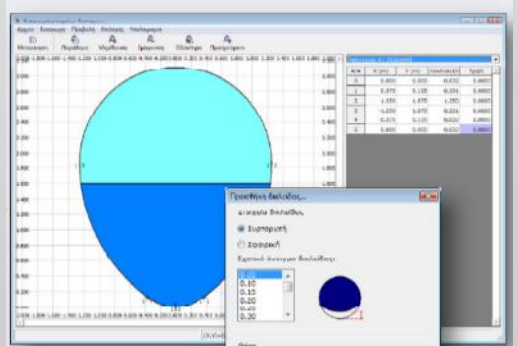
t/T_p	Q/Q_p	t (h)	Q (m^3/s)
0,0	0,000	0,0	0,000
0,1	0,015	0,1	0,062
0,2	0,075	0,2	0,309
0,3	0,160	0,4	0,660
0,4	0,280	0,5	1,155
0,5	0,430	0,6	1,773
0,6	0,600	0,7	2,474
0,7	0,770	0,9	3,176
0,8	0,890	1,0	3,670
0,9	0,970	1,1	4,000
1,0	1,000	1,2	4,124
1,1	0,980	1,4	4,042
1,2	0,920	1,5	3,794
1,3	0,840	1,6	3,464
1,4	0,750	1,7	3,093
1,5	0,660	1,9	2,722
1,6	0,560	2,0	2,310
1,8	0,420	2,2	1,732
2,0	0,320	2,5	1,320
2,2	0,240	2,7	0,990
2,4	0,180	3,0	0,742
2,6	0,130	3,2	0,536
2,8	0,098	3,5	0,404
3,0	0,075	3,7	0,309
3,5	0,036	4,4	0,148
4,0	0,018	5,0	0,074
4,5	0,009	5,6	0,037
5,0	0,004	6,2	0,016

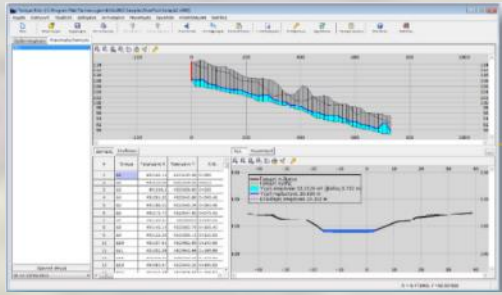


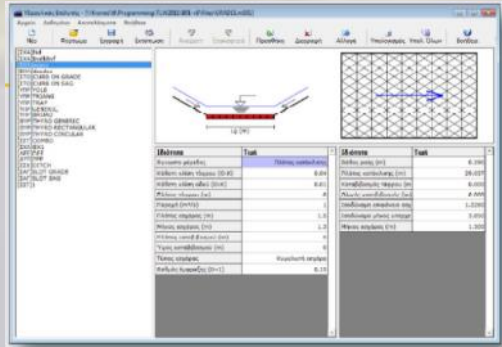


Specialized Software









Proposed Measures

Doxato (Municipality of Doxato)

For Doxato's expansion area infiltration trenches and detention basins are proposed. Particularly, the construction of 3 infiltration trenches is proposed in places where simple trenches are located nowadays. Furthermore, 2 detention basins are planned in communal sites.

Proposed Measures
Nea Peramos (Municipality of Paggaio)

At Nea Peramos' expansion area there is no provision for communal sites. So, green roofs and rainwater harvesting are proposed for new residencies. Additionally, 2 detention basins are proposed near the expansion area, at communal sites, which are located into current limits of the town.

Proposed Measures
Perigiali (Municipality of Kavala)

For Perigiali (Kavala's expansion area) there are many measures that could be implemented, such as:

- green roofs and rainwater harvesting for new residencies
- permeable paving at small communal sites
- swales at the existing streams
- infiltration trenches (instead of conventional sewers) at selected sites
- rain gardens at small communal sites
- detention basins

Conclusions

- The expansion of urban areas requires the adoption of a Sustainable Stormwater Management (SSM) approach that should address stormwater quantity and quality
- The SSM approach must be according to the approved Flood Risk Management Plans (FRMPs) and the Management Plan of the Water Basins (WMPs)
- A preliminary study was drawn up in order to specify some innovative proposals for SSM in three areas located into the APSFR of RBD ‘EL11’ (Eastern Macedonia, Northern Greece), where urban expansion is proposed for all three of them
- The ecological status of the receiving water bodies in all three areas is ‘moderate’ according to the WMP
- The WMP proposes a Sampling Program at the stormwater sewers outfall, as well as at other point sources of pollution
- An Innovative Stormwater Management Plan (ISMP) relying on the principles of Sustainable Development is proposed for each area, along with the Sampling Program, that may will be able to change the ecological status from ‘moderate’ to ‘good’
- The ISMP is also expected to prevent these areas from flood damages

Thank you for your attention!