

The **ECOSPHERE research group** aims to study aquatic and valley ecosystems that are continuously challenged by natural and anthropogenic stressors. The research focuses on acquiring fundamental and applied knowledge at different levels of structural and functional organisation in order to underpin environmental management decisions.

## MASTER THESIS SUBJECT 2023

### Modeling of Ditches and Their Management Using Weirs

**Research group:** ECOSPHERE

**Hosting laboratory:** CDE

**Promotor(s):** Jan Staes ([jan.staes@uantwerpen.be](mailto:jan.staes@uantwerpen.be))

**Daily supervision:** Jayson Pinza ([Jayson.Pinza@uantwerpen.be](mailto:Jayson.Pinza@uantwerpen.be)), Robrecht Debbaut (mainly for field site management and possibly data collection) ([Robrecht.Debbaut@uantwerpen.be](mailto:Robrecht.Debbaut@uantwerpen.be))



Sandbags as “weirs” installed to block off ditches in Breeven Site

```

In [14]: northwest_ditch_ss = HeadLineSinkString(m1_ditches_ss_weir, xy=[[108616.75300056847, 185299.72654028432],[108716.71706161114, 185299.72654028432]
northeast1_ditch_ss_weirs_half = HeadLineSinkString(m1_ditches_ss_weir, xy=[[108716.71706161114, 185373.89336492887],[108916.8107
northeast1_ditch_ss_middle_weirs = HeadLineSinkString(m1_ditches_ss_weir, xy=[[108916.81071958412, 185290.1292132734],[108993.78
northeast1_ditch_ss_weirs_half2 = HeadLineSinkString(m1_ditches_ss_weir, xy=[[108993.78288819343, 185264.40848448083],[108923.58
northeast2_ditch_ss_weirs = HeadLineSinkString(m1_ditches_ss_weir, xy=[[108923.58288819343, 185248.80402845506],[108928.835781894
southeast_ditch_ss = HeadLineSinkString(m1_ditches_ss_weir, xy=[[109028.83578199035, 185288.4059715030],[108866.93175355428, 1854
west_ditch_ss = HeadLineSinkString(m1_ditches_ss_weir, xy=[[108866.93175355428, 185058.01255924153],[108616.75300056847, 185299.7

In [15]: rch_gondebeek_ss2 = CircAreaSink(m1_ditches_ss_weir, xc=108716.71706161114, yc=185373.89336492887, R=1000, N=0.00109589, name='C

In [16]: m1_ditches_ss_weir.solve()
Number of elements, Number of equations: 8 , 7
.....
solution complete

In [17]: m1_ditches_ss_weir.contour(win=[188600, 189100, 185000, 185400], ngr=[10,10], layers=0, labels=True, decimals=2, levels=10)
Out[17]: [CntrPlotLib.Contour.QuadContourSet at 0x271ab10c9108]
  
```

#### Sample Python Code in TTim via Jupyter Notebook Demonstrating the Analytic Element Method (AEM) Background

- This topic mostly contains  literature study,  lab work,  field work,  experimental work,  GIS,  numerical modelling,  other: Coding in Python
- Possession of driver’s license B is  needed,  recommended,  not needed
- Possession of certificates needed:  FELASA C,  other: .....



With the impending climate change, wise water management is critical even for rural areas worldwide. This could include reallocating the waters in ditches to groundwater recharge instead of simply draining them away from the site. This could be possibly done by employing weirs and strategically closing them during certain parts of wet periods to block off the water and let it infiltrate deeper down. We want to investigate its effectiveness using groundwater models.

**Research Question**

The main research question for this is: “How effective can the ditch-weir management be to improve groundwater availability in the Breeven area?”

**Methods**

We propose to perform the analytic element method (AEM), a type of groundwater modelling technique, in TimML and TTim GitHub (made mainly as Python Codes by Mark Bakker). AEM employs analytic elements such as line sinks, which could represent the aforementioned ditches along with weirs, if present. To solve for the groundwater level distributions, the expressions of analytic elements are usually mathematically superimposed, which are then used to backcalculate for the groundwater levels.

The study area is in Breeven, a forest reserve in Municipality of Geel – Turnhout area in the Campine Region in Flanders. The sandbags, which are the makeshift weirs in this study, were already installed in the site. Installing more sandbags could be done if necessary though if one wishes to test for impacts on groundwater levels within specific sites within Breeven.

**Special Request:** Someone with experience or strong knowledge on basics of groundwater hydrology/hydrogeology, together with coding/scripting experience in Python, is preferred. Basic experience or at least knowledge in groundwater modeling (e.g., MODFLOW in ModelMuse or GMS) is an advantage though not required. Driving with license could be useful especially if we need to collect more data but not really required because there is already some groundwater level data available to start with. There could be some fieldwork and experimental work if we want to test for impacts on groundwater levels on certain areas but might only be limited to only adding sandbags or opening them. Most work is concentrated on numerical modeling.



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