

Integration of geothermal energy potential into a sustainable land use plan as part of the heat transition at the northern campus of the University of Göttingen

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Introduction

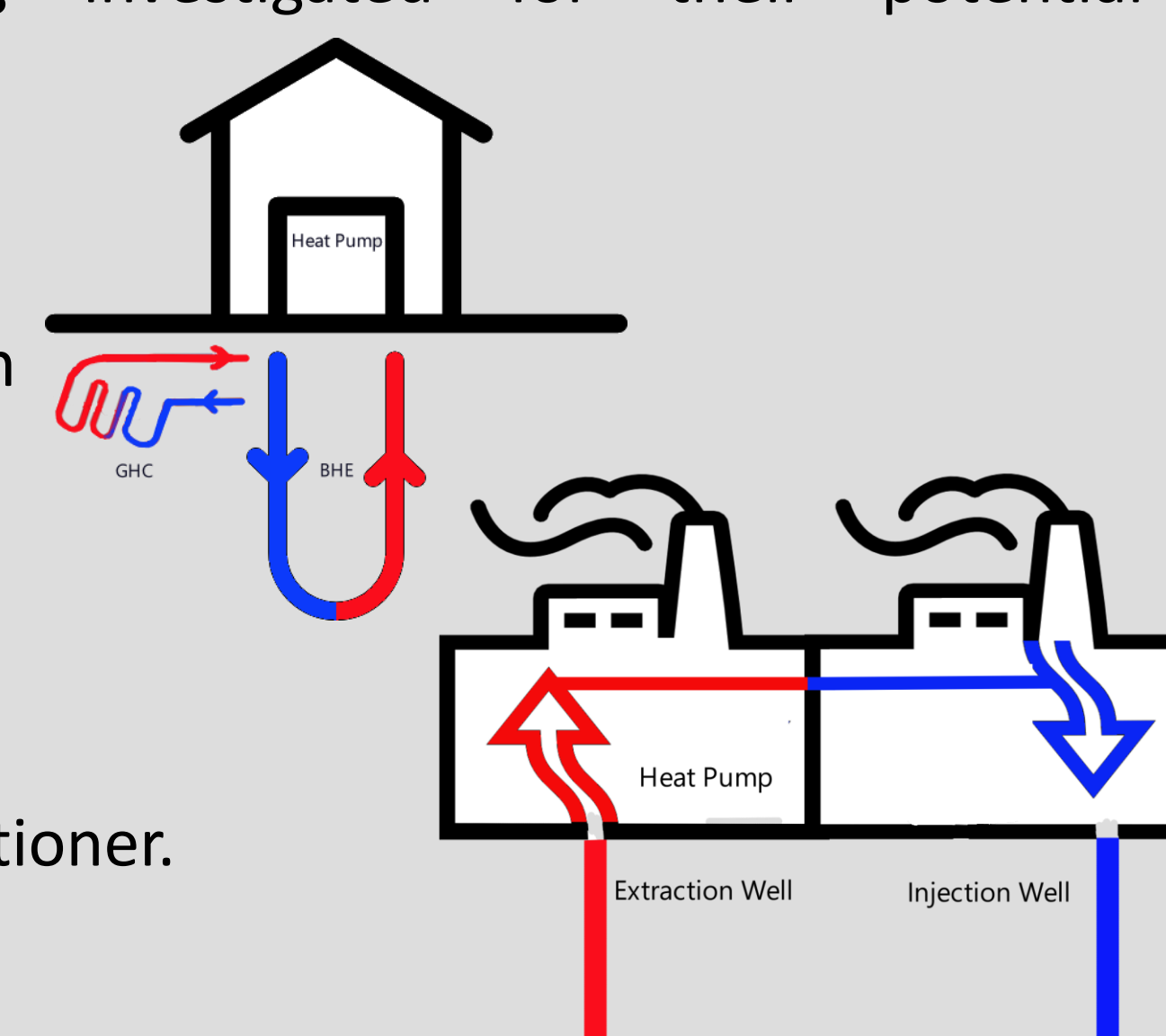
At the northern campus of the University of Göttingen, a low-temperature district heating net fed by geothermal energy, as well as waste heat from the local computer centre, is under investigation for its potential to supply the required heat each year. The change to renewable heat is needed, to reach the climate neutrality goals of Germany by 2045. The accompanying infrastructural changes present an opportunity to comprehensively develop a sustainable campus, including environmental and climate protection as well as social aspects. With the results from a student survey as well as permaculture design methods, the potential of geothermal energy on campus is evaluated and integrated into a sustainable land use plan, using ArcGIS.

Geothermal Technologies

The following technologies are being investigated for their potential implementation at the northern campus:

- Borehole heat exchanger (BHE)
- Ground heat collector (GHC)
- Medium deep geothermal doublet system

Both shallow and medium deep geothermal energy systems are multi-functional and can retain excess heat in the cooler ground during summer, so that attached buildings are cooled without the usage of an air conditioner.



Permaculture Design

Permaculture as a design science was developed in 1974 by B. Mollison and D. Holmgren at the University of Tasmania in Australia. It is a system of "[...] assembling conceptual, material, and strategic components in a pattern which functions to benefit life in all its forms" (3). Any design is based on the three principles

- Care of the earth
- Care of people
- Sharing of surplus

Although initially focused on agriculturally productive ecosystems, the guidelines and ethics can be applied to all areas of life and have been used to integrate the social, ecological and economical aspects into one final design.

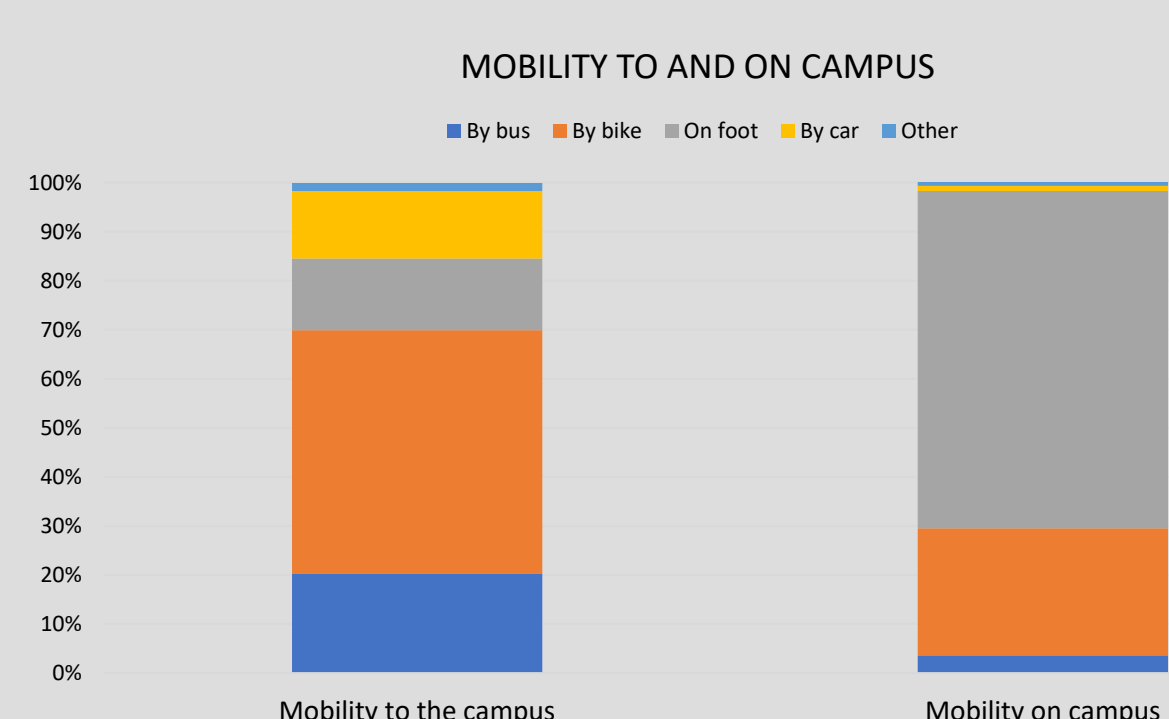
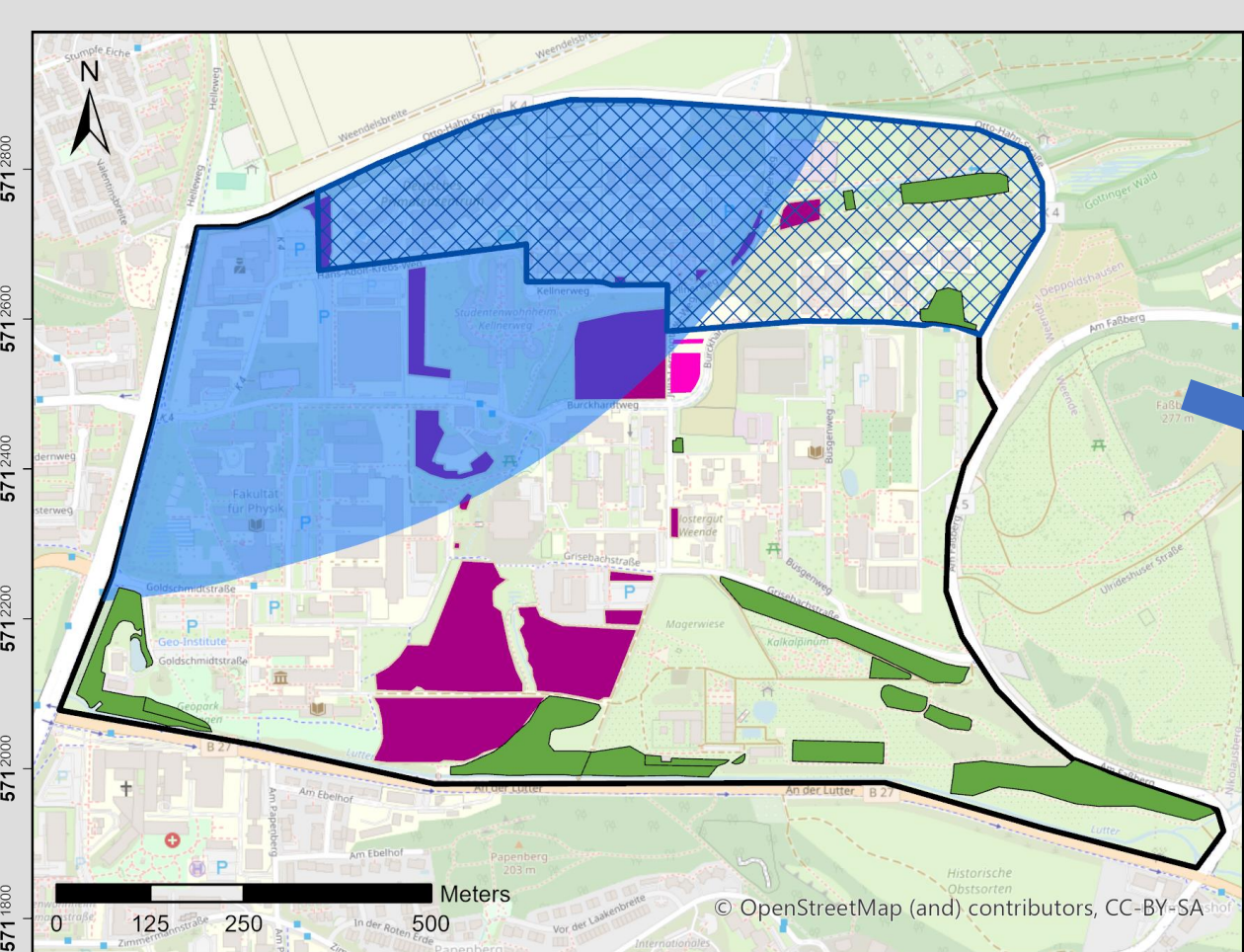
Constraining factors at the northern campus

To determine the different potential of geothermal energy systems, the initial step is to define the available free space. Limiting factors at the campus are the critically endangered European hamster *Cricetus cricetus* L. (2) and the water protection area *Weendespring*.

Since 1999, 7.2 ha acreage of the campus, split up in several areas, are defined as protective zone for the hamster population. A management and cultivation plan for these areas is in place to ensure the continued existence of the population.

Near the north-western border of the research site, the well Weendespring can be found (1), which supplies a part of the drinking water for the city of Göttingen. Three protective zones are defined around the water extraction plant. Different regulations apply to each protective zone.

Exclusion zones due to ecological reasons

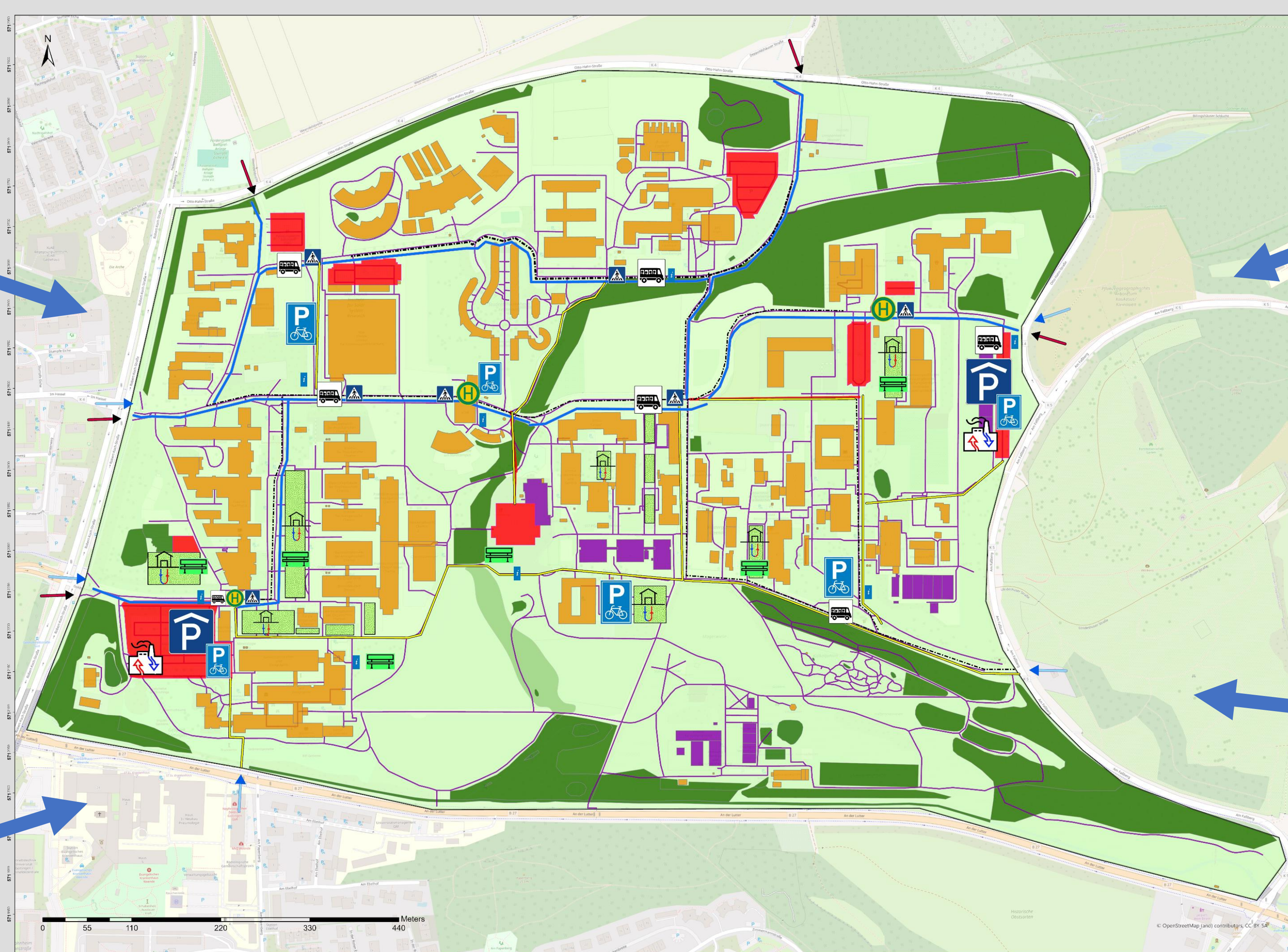


Considerations due to student survey

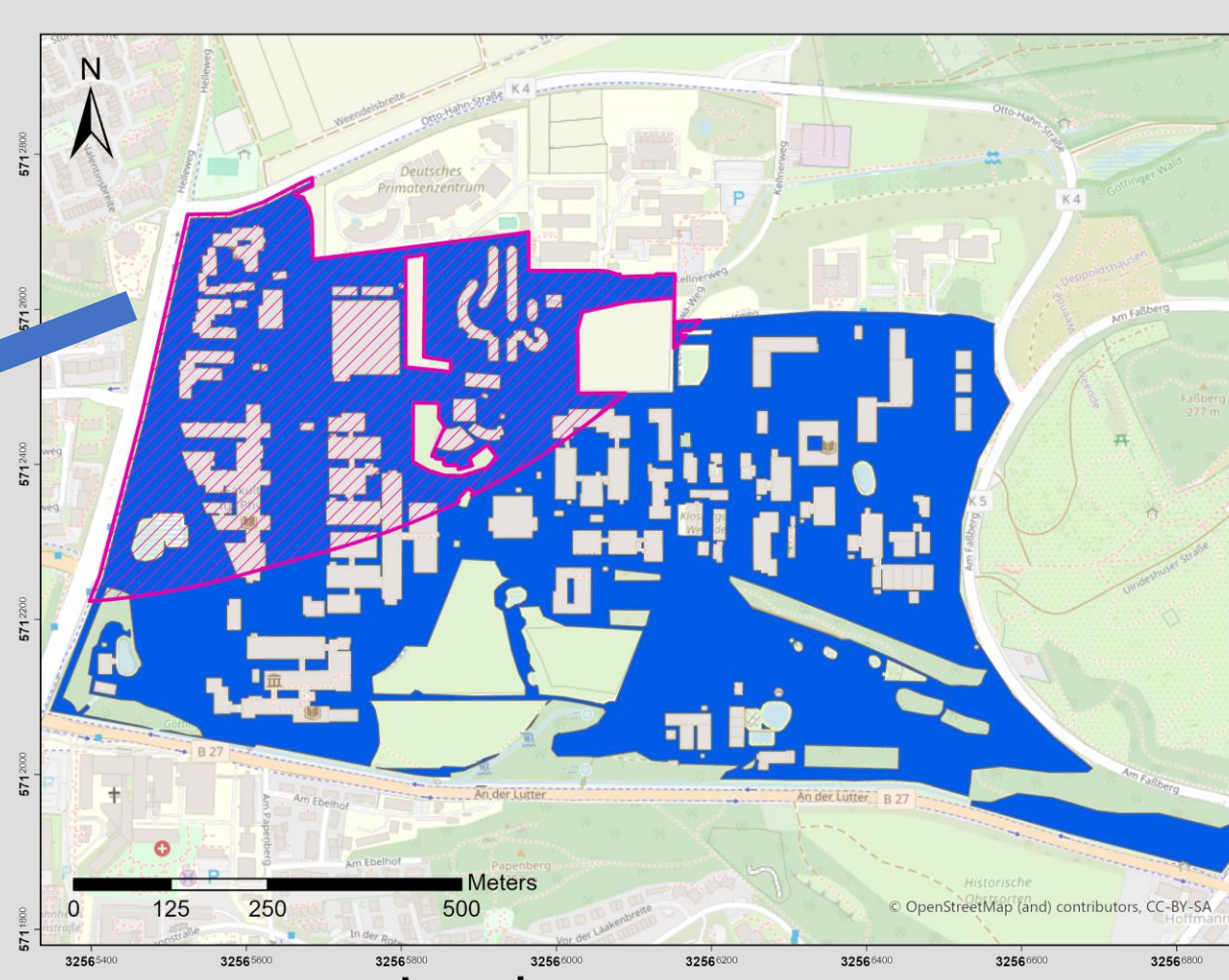
Results

Following natural patterns and movements of the elements integrated into the design, the above layout was developed. The following changes are proposed:

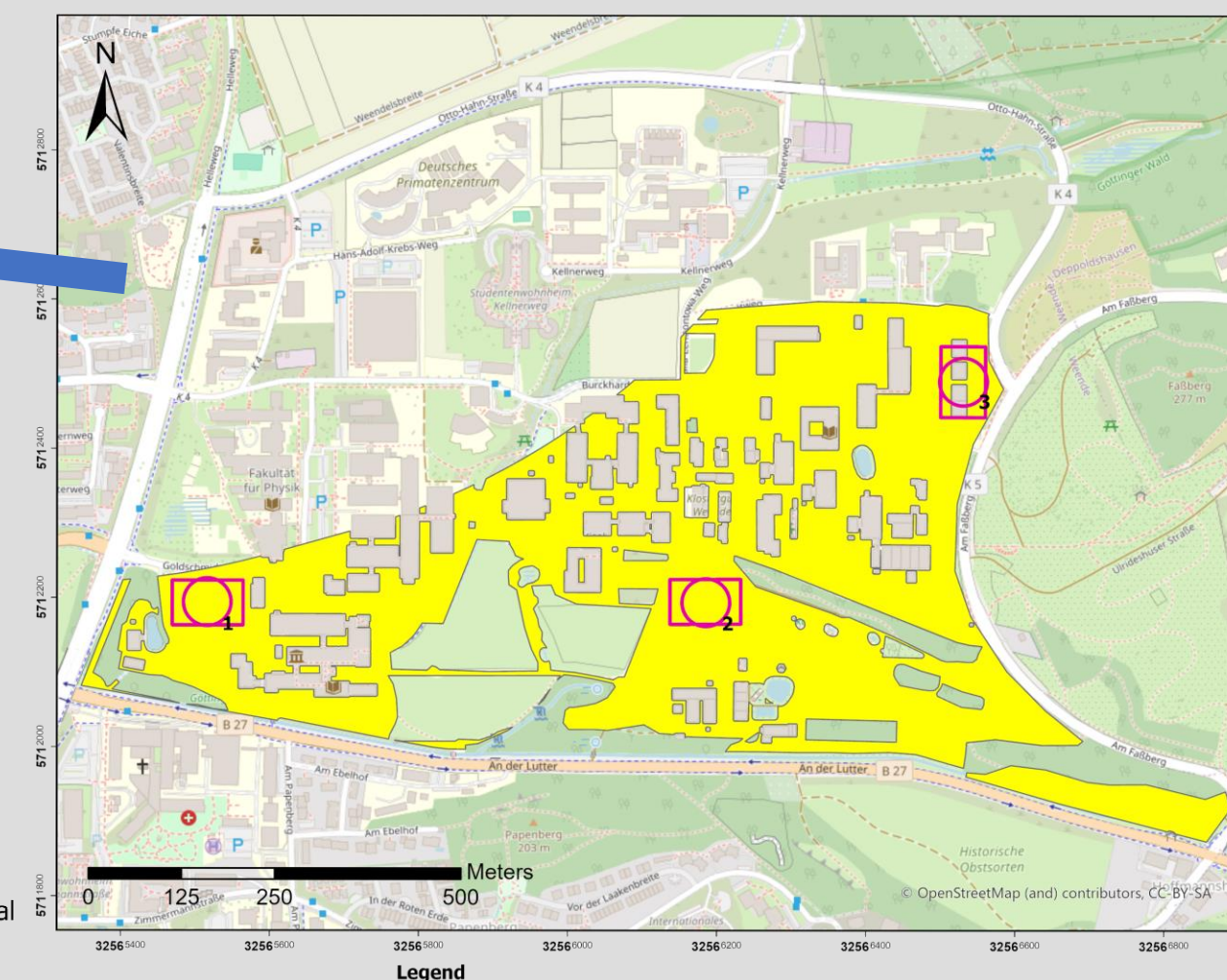
- Addition of new footpaths and bike lanes to all major roads
- Additional connecting footpaths between frequently visited buildings
- Two multi-storey car parking with bike racks near the entrance points
- A local shuttle service
- Solar panels on the roofs of the car parking to supply the heat pumps attached to the geothermal systems
- Outdoor seating areas
- New information boards, including details on the endangered European hamster



Potential area for shallow geothermal energy



Potential area for medium deep geothermal energy



Discussion

Taking all restrictions into consideration, it would still be possible to introduce both shallow and medium deep geothermal systems at the northern campus on about 50% of the area. At the sites for the medium deep system, a change of the parking situation could be carried out simultaneously to the construction of this system. This would free up space that could then be used to fulfil further requests extracted from the student survey such as more bike parking. It would also make the site safer for pedestrians, cyclists and hamsters alike, by removing most individual motorised traffic. With the changes in the parking system, more park-like areas can be introduced to the campus. These areas can be equipped with seating, so that they may be used by the students.

References

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- Mollison B. and Holmgren D. (1980) *Permaculture One: A Perennial Agriculture for Human Settlement*.

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