The proposal for revitalization measures in the Výškovický Stream

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Abstract. This article deals with the proposal of revitalization measures on the Výškovický Stream. The area where the measures are to be executed is heavily transformed by anthropogenic activity. Anthropogenic activity in the area in question consists mainly of deflecting the stream into a prefabricated concrete trough. The actual proposed revitalization measures are based on the use of meanders along the stream route, which will extend the route by 114 meters. 2 pool meanders and 5 pools have been designed along the route.

1. Introduction
The landscaping and ecological function of the territory of the Czech Republic has witnesses some negative impacts in the past decades. The main phenomena included soil erosion, contamination of groundwater and surface water with heterogenous substances, a decrease in soil biological activity and other negative effects. In order to prevent further devastation of the landscape, it is necessary to make efforts to restore its natural function through technical measures and research studies [1, 2, 3]. The technical revitalizations have to be based on a research, which shows that the use of secondary and non-traditional materials in building materials [4, 5, 6, 7, 8, 9], which are subsequently used in the building industry segment, is becoming increasingly important nowadays.

2. Proposed revitalization measures
2.1. General revitalization of watercourses
If in the past, the stream channels were straightened up to much or they were made too deep, it is necessary to rectify it by means of revitalization, because these adjustments are not natural for the watercourse. The negative consequences became evident mainly in the form of the loss of stream channel range, while the active wet surface of stream channel decreased. It also resulted in the loss of its rugged character, which supported faster water run-off, because the routes were shortened and the stream channel roughness was reduced. Finally yet importantly, it was the loss of stability, where the floodplains had problems to cope with excessive water as well as with water shortages [10, 11]. All the negative consequences imply that the ecological functions of the watercourses need to be restored. Before the revitalization itself, a detailed inspection of the site is required in order to obtain the necessary information and documentation. The vegetation along the stream channel and the current state must also be assessed using appropriate methods. The river network must be addressed in a complex way. If the water management function of the watercourse is impaired, the interventions must be carried out in a sensible manner. It is possible to build pools, wetlands or small water reservoirs.
Advances in Environmental Engineering

IOP Conf. Series: Earth and Environmental Science 444 (2020) 012037
doi:10.1088/1755-1315/444/1/012037

[11, 12]. The benefit of the revitalization of stream channels is the creation of a stream channel that is more rugged when compared to the usual artificially channelled riverbed. This can be achieved by means of various individual measures or their combination. These measures include increasing the biologically active surface, strengthening the stability of the stream channel, extending the time when water is running through the stream channel, increasing the current water reserve in the stream channel, softening the impact of floods and other [10].

2.2. Description of the area affected by the revitalization treatment

The Výškovický Stream springs from the Bělský Forest at an altitude of about 243 m above sea level. There are water holes near the spring. The stream flows through a forest stand and there is a bike path in its vicinity. After that, it flows through a reservoir, which has the function of a detention basin. From there, it flows into a prefabricated concrete trough and then it flows through a forest stand and continues in open nature around a built-up area. When the stream is further away from its spring, it reaches an urban area where it runs in a pipeline, because it is not possible for the stream to flow through free stream channel in this part. After this part, it flows into the Odra River as its right tributary in Ostrava Jižní Město. The watercourse belongs to the Odra drainage basin, and the state company of Povodí Odry manages it. The drainage basin area of the Výškovský Stream is 13.39 km², and the indication of the hydrological order of the stream is 2-01-01-01560-0-00-00. From a climatic point of view, the stream flows through the area of MT 10, which belongs to a slightly warm, very humid climate region [13].

2.3. Proposed stream channel route

Because part of the stream was taken into a prefabricated concrete trough during the previous reconstructions, it is necessary to change this unnatural and inappropriate modification. Within the scope of the proposed revitalization reconstruction, the watercourse was extended by 114 meters to the length of 614 m, because the straightened sections of the watercourse were released. Due to the prolongation of the watercourse route, the flow rate will be reduced, the runoff time will be prolonged, and the designed pools will cause the retardation of water in the watercourse channel. All the modifications will be carried out in accordance with the requirements for revitalization of watercourse channels, as well as within the scope of the possible spatial layout, see Table 1.

Figure 1. Sketch drawing of the designed revitalization of watercourse.
2.3.1. **Longitudinal profile.** The design of the longitudinal profile was based on the current state of the watercourse and all functional outlet objects. The new longitudinal profile included five flow pools leading to a lower bottom gradient of the watercourse, as shown in Figure 2.

![Figure 2](image-url)  
*Figure 2. Newly designed longitudinal profile of the Výškovický Stream channel.*

2.3.2. **Cross section.** The original cross section of the original watercourse channel had a 1:1 steep slope and a large part of the channel bottom was drained into prefabricated concrete sections. The prefabricated parts already showed many defects, some of them were completely destroyed, which resulted in bank ripping in these sections. The new cross section of the Výškovický Stream was designed as a trapezoid with the gradient of slope of 1:2, see Figure 3. The trapezoidal shape has been chosen as a compromise in terms of the spatial arrangement of the surrounding property with regard to the subsequent spontaneous renaturation.

2.4. **Pool design**

5 pools and 2 pool meanders have been designed on the revitalized stream channel route. The distribution of the pools along the route is in the river log: 0.084 - 0.101 km, 0.195 - 0.211 km, 0.315 - 0.327 km, 0.433 - 0.0461 km and 0.532 - 0.570 km. The design of the pools was based on the assumption that all of them will have a uniform depth - 0.8 m at maximum flow rate. The gradients of slopes of the pools have the ratio of 1:2 for spatial reasons. In the future, however, the gradients of the slopes are expected to decrease due to sediment runoff to the ratio of up to 1:4. The pools are marked with numbers 1 - 5 downstream. The pools will be reinforced with grass in combination with willow tree cuttings. This type of vegetation reinforcement has been chosen in accordance with the character of the surrounding landscape and the principles of the revitalization of watercourses.
2.4.1. **Pool number 2.** Another pool is located in the river log of 0.195 - 0.211 km. The shape of the pool is elliptical with the length of 11.09 m, width of 8.99 m and a water surface area of 78.00 m\(^2\). Since there are spatial limits, it was necessary to design the pool in accordance with these limits, and that is why it is the second smallest designed pool. Only water plant communities can be planted inside the pool, which can also serve as a sanctuary for smaller animals.

2.4.2. **Pool number 3.** The smallest pool with an area of 69.93 m\(^2\) is almost five times smaller than the largest pool number 5. It is located in the river log of 0.315 - 0.327 km and its shape is elliptical again. The size of the pool is also chosen with regard to the spatial limits of the area.

2.4.3. **Pool number 4.** It is located on the edge of a forest in the river log of 0.433 - 0.461 km, which is 0.106 km from pool number 3. It extends over an area of 235.43 m\(^2\). The pool length is 15.89 m, the width is 21.35 m and the shape resembles an irregular ellipse. As it is a pool of larger dimensions, 2 little islands in the form of grass swards are designed in the flooded area, which will serve not only as a sanctuary for aquatic animals but also as a nesting place for birds.

2.4.4. **Pool number 5.** The last designed pool is located in the river log of 0.532 – 0.570 km. Thanks to its location on the edge of a forest, which did not restrict the design of the pool in any way, this pool was designed with the following parameters. The pool length is 21.80 m, its width is 21.35 m, and the water surface area is 339 m\(^2\). It is the largest pool designed on the Vyškovický Stream. One large island with an area of 32 m\(^2\) was designed inside the flooded area. It will serve as a sanctuary for aquatic animals, amphibians and waterfowl.

3. **Conclusion**

The designed revitalization measures on the Vyškovický Stream reflect the requirements for landscape formation and offer a solution for the return of the watercourse to a form that is close to the nature. Thanks to suitable technical interventions, the Vyškovický Stream will be quickly integrated into the surrounding countryside and it will fulfil its landscaping and ecological function. At the same time, a new biotope for fauna and flora will be created and the aesthetic character of the watercourse will be improved as well. Especially the residents of the adjacent family houses will appreciate this.
Acknowledgments
This article was written in connection with:
- Grant of SGS No. SP2019/29, Faculty of Mining and Geology, VSB – Technical University of Ostrava, Czech Republic.
- Project Institute of clean technologies for mining and utilization of raw materials for energy use
- Sustainability program. Identification code: LO1406. Project is supported by the National Program for Sustainability I (2013-2020) financed by the state budget of the Czech Republic.

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