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MINISTRY OF NATURAL RESOURCES AND SPATIAL PLANNING

THE WATER DIRECTORATE OF THE REPUBLIC OF SLOVENIA

EVROPSKA UNIJA
KOHEZIJSKI SKLAD
NALOŽBA V VAŠO PRIHODNOST

FLOOD PROTECTION REGULATION OF THE GRADAŠČICA RIVER BASIN - STAGE 1A

The project "Flood management of the Gradaščica river basin" is co-financed by the Republic of Slovenia and European Union Cohesion Fund

GRADAŠČICA

CONTENTS:

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About the project

The Gradaščica project is implemented under the Operational Programme for the Implementation of the European Cohesion Policy 2014-2020, Priority Axis 5 "Promoting Adaptation climate change and risk prevention and management', the priorities of the Investment 5.1 "Supporting investments for climate change adaptation, including ecosystem-based approaches" and contributing to the specific objective "Lower flood risk in areas of significant flood impact". Co-funded by The Republic of Slovenia and the European Union from the Cohesion Fund.

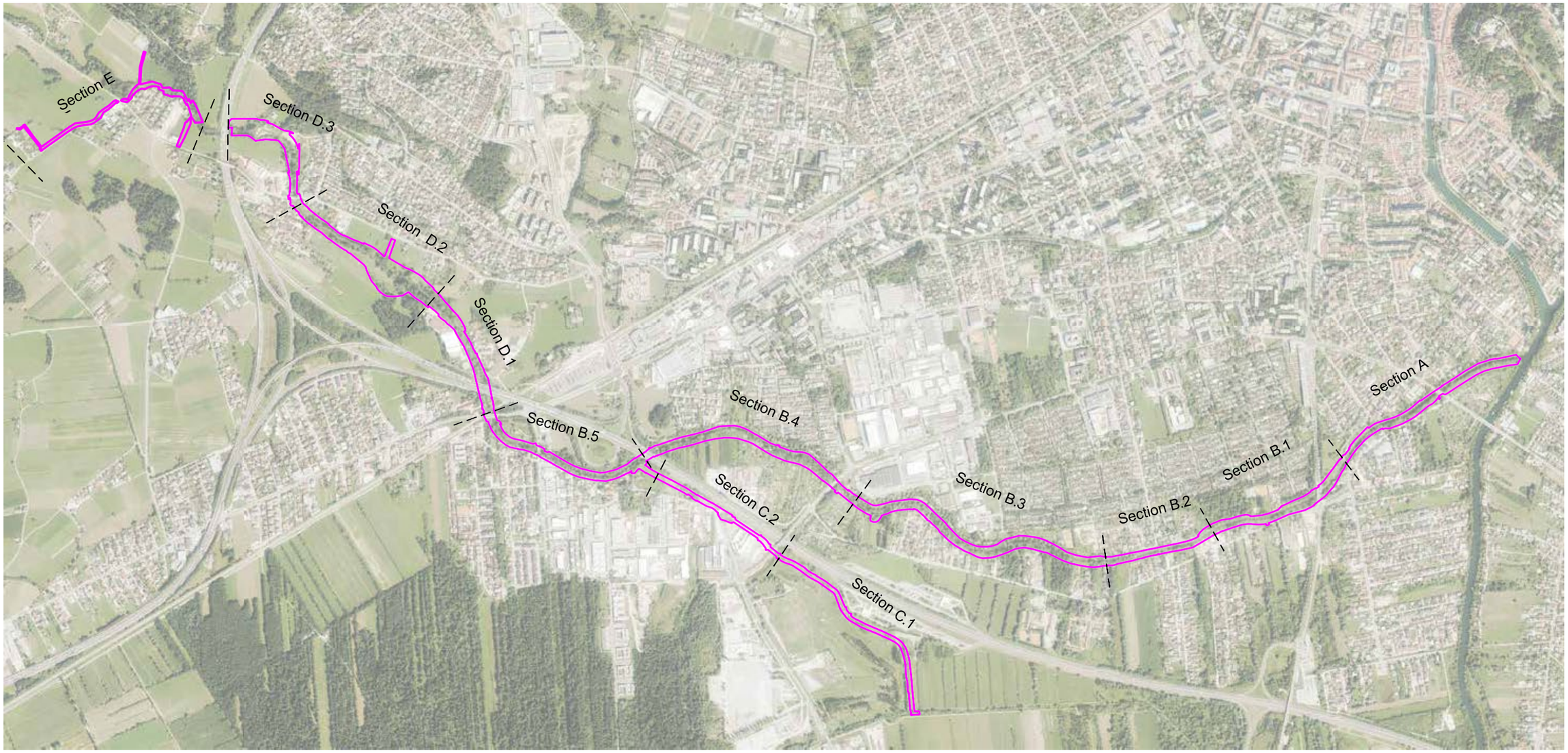
The entire area of the valley floor of the Gradaščica and Horjulka rivers is flood-prone, when heavy rainfall occurs, forming a natural retention area for high waters. It feeds the Gradaščica river basin, which flows through the valley during heavy rainfall and empties into the Ljubljanica River through Mali graben River. The south-western part of Ljubljana, including the settlements along the Gradaščica and Horjulka rivers, is one of the most flood-prone areas in Slovenia due to its dense population and damage potential. At intense rainfall, water from the entire Gradaščica catchment area above the Bokalce Weir draines into the Gradaščica River and flows down the Mali graben towards the Ljubljanica River. At the onset of high waters, suburban and urban areas in the south-western and southern parts of Ljubljana are flooded.

The reason for this flood risk in the south-western area of Ljubljana is the insufficient conductivity of the Mali graben River from the Bokalce Weir to its outlet into the Ljubljanica River, the undersized drainage system, the interruption of flood water corridors towards the Ljubljansko Barje marshes and the Ljubljanica River, and the reduction of floodplains as a result of urban development.

The Gradaščica project plans to implement all key water management and accompanying measures to reduce flood risk in the Gradaščica River basin. The conveyance capacity of the Mali graben channel will be increased from 80-100 m^3/s to 200 m^3/s. In addition to the construction of hydraulic structures, the project also includes non-structural flood protection measures such as habitat management to increase biodiversity. The planned 6A relief channel and the Razori dry detention basin will control flood discharges and the establishment of new gauging points will ensure reliable management of the system as a whole.

An overview of flood protection of Mali graben River (Stage 1A)

The following works are being carried out in the area of the Municipality of Ljubljana on the Mali graben River: regulation of the riverbed with all river structures and associated landscaping from Kozarje to the outlet into the Ljubljanica River, construction of the 6A relief channel from the outlet of Mali graben River to the outlet into the Curnovec Stream with associated landscaping, relocation and installation of public utility infrastructure, and appropriate environmental and nature conservation measures.



Section A with horticultural planting

Construction work on section A is complete and the landscaping was completed at the end of November 2022. The planting of tree and shrub seedlings was carried out taking into account the previous situation, the planned design guidelines and the existing landscape patterns.

The landscape-architectural solutions at Mali graben River are adapted to flood protection measures and at the same time include planting elements in accordance with the principles of landscape design. In areas where the channel of the Mali Graben is widening and new banks are being formed, these have been rehabilitated by planting tree and shrub features that mimic existing landscape vegetation patterns.

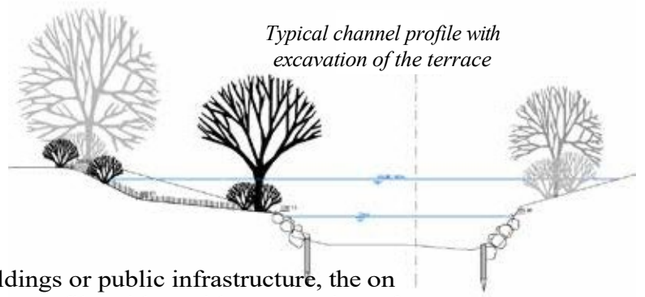
The selection of plants for new planting was based on an analysis of the vegetation conditions in the area and on the desired design effects. Locally characteristic plants suitable for by-pass planting are used, as well as species that already create an important identity for the area.

The planting is sometimes more compact, sometimes more fragmented. The choice of tree and shrub species, planting in strips and proper maintenance will allow smooth flow during high water. The landscape-architectural solutions also include planting to visually conceal the exposed heights of the embankments by planting climbers on the outer sides of the high-water walls.

Wide terrace excavation

The flood protection measures implemented have proven their effectiveness

Water management



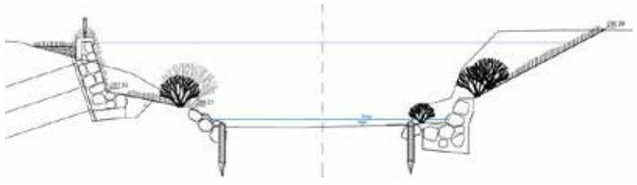
Typical channel profile with excavation of the terrace

In order to ensure the flow capacity of the channel, a widening of the high-water profile of the channel was carried out in section A, in a length of approximately 800 m. The current width of the main channel of the Mali graben River (at normal water level) and the existing left bank were maintained (with riparian vegetation).
In the section, where there are no residential buildings or public infrastructure, the on the right bank, create a high-water section of the profile with a wide excavation of the terrace.

Situation before the modifications

Situation after the modifications

In the section where a wide arrangement was not feasible due to space constraints, a by-pass and high-water wall made of crushed stone in concrete was constructed.



Existing bridges

Some of the existing bridges in section A, such as the bridge on Opekarska Road (left), are undersized and are subject to replacement. The Water Directorate of the Republic of Slovenia, as co-financer together with the Municipality of Ljubljana, has signed a contract with the contractor. The demolition of the bridge and the construction of a new one will take place in 2023.

Section B4 - Sustainable development with biodiversity

After the completion of the works, the riverbed of the Little Graben in section B4 will b e upgraded from t h e bridge on the Mestni log Road to the crossing of the Little Graben and the southern Ljubljana bypass, for a total length of 905 m.

In order to ensure a sufficiently high flow capacity, the channel capacity had to be significantly increased in this section, and therefore the high-water (upper) part of the channel was widened practically in its entirety, with terraces on both banks.

The current width of the main channel of the Little Graben (at the level of the normal water level) is maintained. The widening of the upper (high-water) part of the bank has been planned on both banks along the entire stretch. The excavation of the terrace on both banks was carried out at a slope of 1:10 for most of the section (the slope above the main channel of the Little Graben), with a slope of 1:20 in places only in the area downstream of the planned gravel pit and on the gravel pit itself). Above the terrace, a bank with a slope of 1:2 was constructed until the termination on the existing terrain. The width of the terrace varies depending on the space available.

First, a 0.1 to 0.2 m thick humus layer was removed, followed by excavation of the flow cross-section to the design shape. After the excavation, the surface was flattened, the humus was raked back, grass was sown, followed by planting of the perimeter vegetation in the manner envisaged in the landscaping plan.

The main, lower part of the channel of the Little Graben was preserved, and the riparian protection of the main channel was supplemented or rebuilt.

The bed of the Little Graben has been preserved naturally, in the form of the existing bed. The bank protection with rubble and anchored with piles was completed and rehabilitated along the entire stretch. The bank protection was carried out in a very rough, undulating form (coarse folding), so that pools and fish hiding places could be created between the rocks.

Existing rock thresholds have been preserved or restored.

The removal of the peripheral tree cover only preserved intact trees located at the junction of the main channel and the high-water profile of the Little Graben. Around the preserved trees, the root system area has been landscaped with protrusions. The shrub cover will have to be kept flexible on the whole section even after construction (annual thinning, cutting of branches every 2 years).

Ensuring flood safety also ensures an adequate level of protection for nature and the environment. Sustainable solutions offer both well-being and biodiversity benefits, so particular attention is paid to avoiding impacts on water quality and to avoiding impacts on the water regime.
Measures that include the protection and restoration of natural ecosystems bring more diverse nature to cities and landscapes.

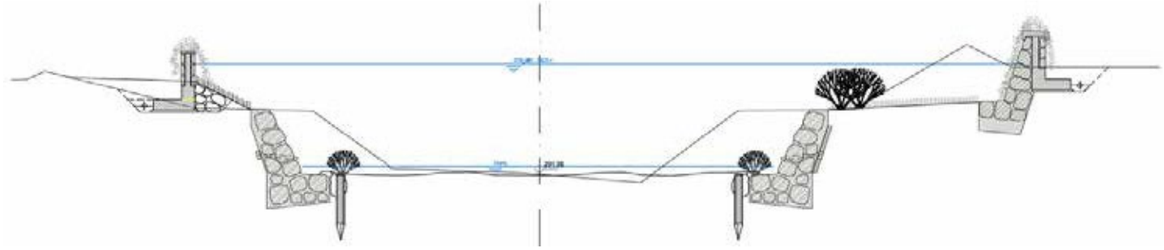
sustainable solutions

Sections D1 and B5

In the section between the Long Bridge and the junction with the Southern Bypass, the Little Graben runs along the southern side of the bypass. Therefore, relieving part of the high water towards Barje is only possible in this section. In order to ensure the flow capacity, it is necessary to increase the flow cross-section and to prevent uncontrolled relief to the south. The entire section is to be protected by high-water walls and a controlled outflow towards the Bar at the inlet to the R6a reliever.

The D1 section of the Mali graben riverbed will be upgraded from the bridge over the Mali graben River (on the railway line Ljubljana - Brezovica) to the area of the sports centre at Dolgi Most, for a total length of 482m. In order to ensure better channel flow, the entire section will be widened with double walls on both banks (bypass and high-water walls) for most of the section. The main, lower part of the Mali graben River channel will also be widened and slightly deepened. The Mali graben River bed will be kept natural. A minor deepening of the current bed is foreseen only in the section next to the railway bridge, for the full width. The perimeter walls are designed as stone gravity

walls. The high-water walls are of mixed types and will be constructed as stone piles, AB structures or a combination of both types, with drainage along the foundations on the air side of the AB walls, with discharges into the Mali graben River.

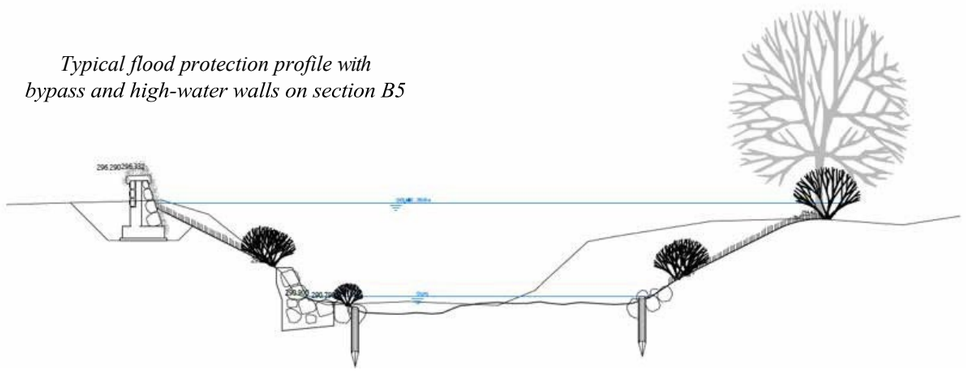


Typical profile with bypass and high-water walls on the D1 section

In order to ensure better channel flow, the entire section B5 (downstream of the railway bridge and the crossing of the Mali graben with the southern bypass) will be widened with double walls on the right bank (bypass and high-water walls). A high-water wall is also being built on the left bank between the railway bridge and the Gorice Road bridge for a length of approximately 180 m, and downstream to the crossing with the southern bypass, the flow profile is being widened by cutting into the bank. A widening and minor deepening of the base, lower part of the channel of the Mali graben will also be carried out.

At the very beginning of section B5 (downstream end), an inlet to the relief channel (relief valve 6a) is foreseen. The inlet to the relief valve is designed as an AB structure with two tabular gates that will control the flow rate at the inlet to the relief valve.
The perimeter walls are designed as stone gravity walls and run along the entire section.

Typical flood protection profile with bypass and high-water walls on section B5



The high-water walls in this section are of a different type than in the downstream sections, as they also extend above the angle of the backwater terrain. Therefore, they are designed as AB structures, and drainage will be provided on the air side of the foundations with outlets to the Little Graben.

Imagery and location survey sections of the arrangements

Section A *- downstream from the bridge on the Opekarska Road to the outlet of the Ljubljanica River.*

Section B1 *- upstream from the bridge on Opekarska cesta to the beginning of the Mokrška Road.*

Section B2 *- improvement of the channel between the bridge on Barjanska Road and the footbridge on Mokrška Road.*

Section B3 - *upstream from Mokrška Street to the bridge on the Road to Mestni log.*

Section B4 *- upstream from the bridge on the Road to Mestni log to the crossing of the Mali graben River and the southern Ljubljana bypass.*

Section B5 *- upstream from the crossing of the Mali graben River and the southern Ljubljana bypass to the railway bridge at Dolgi most.*

Section D1 *- channel improvement upstream of the railway bridge at Dolgi most and the Dolgi most sports centre.*

Section D2 *- upstream from the Dolgi most sports centre to the bridge on Cesta Dolomitskega odreda.*

Section D3 *- Upstream channel improvement from the bridge on the Dolomitskega Odreda Road to the Bokalce weir.*

Section E *- Kozarje area development.*

Section C1 *- downstream from the Road of the Two Emperors, past the Barje rest area to the Curnovec outlet.*

Section C2 *- along the edge of the southern bypass downstream from the entrance to the 6A relief canal to the Road of Two Emperors.*

Flood protection regulation of the Gradaščica river basin

The objective of the Gradaščica River Basin Flood Protection Project is to provide comprehensive flood protection measures in the Gradaščica River Basin, thereby significantly improving the flood risk in the populated areas of south-west Ljubljana, Dobrova, Razori, Stranska vas, Dolenja vas, Šujica and Polhov Gradec.

Project implemented by:	Water Directorate of the Republic of Slovenia
Project duration:	1. 8. 2017 - 31. 12. 2025
Impact area:	Municipality of Dobrova-Polhov Gradec, Municipality of Ljubljana
Project cost:	EUR 67,738,032.10
	Of which co-financed by the Cohesion Fund EUR 49,466,450.12 (85% European Union, 15% Republic of Slovenia).