BIRKHÄUSER

River. Space. Design.

Third and Enlarged Edition

Planning Strategies, Methods and Projects for Urban Rivers

Martin Prominski
Antje Stokman
Susanne Zeller
Daniel Stimberg
Hinnerk Voermanek
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Birkhäuser · Basel

1

Fundamentals

2

Design Catalogue

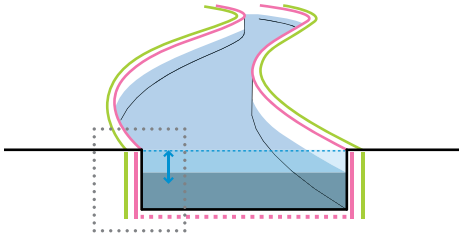
3

Project Catalogue

Design Catalogue

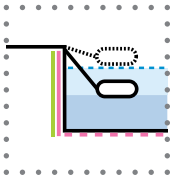
A

Embankment Walls and Promenades



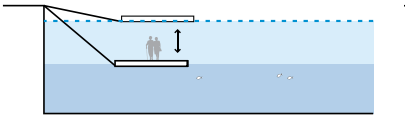
A6

Adapting



A6.2

Floating islands



Introduction

The following Design Catalogue is the heart of this book – a collection that abstracts and identifies the ideas and design approaches from the projects we examined and presents them in the form of design tools and measures that are transferable to future projects. Thus it becomes easier for designers to discover appropriate measures for their specific contexts. To this end, the catalogue groups the design tools into five 'Process Spaces' in which they are applied. Within each Process Space the tools are subdivided into groups of design strategies.

Process spaces

One of the greatest challenges of compiling this catalogue was to distil the common features from the multifarious urban river spaces we examined, and to summarise them in the form of a reasonable number of spatial types – it is only by means of such abstraction that it becomes possible to transfer and apply the many and various design tools to the most diverse design tasks. As a basis for the categorisation, specific urban river space situations were examined where the spatial conditions and river processes (from fluctuations in the water level to morphodynamic processes, see Part 1) are readily identifiable in clearly defined relationships to one another that vary according to the Process Space. We call these areas of the riparian space Process Spaces, and make a fundamental distinction between five types.

In Process Space A, 'Embankment Walls and Promenades', the banks are very steep and there is hardly any flood area available. For this reason fluctuations in watercourse conditions are mainly vertical and morphodynamic processes are consequently excluded.

In Process Space B, 'Dikes and Flood Walls', large vertical elements limit the flood area at some distance from the normal watercourse. Both horizontal and vertical fluctuations in the watercourse conditions take place, whereby the borders of this Process Space only permit very small-scale morphodynamic processes.

Process Space C, 'Flood Areas', comprises spaces near the watercourse that are regularly submerged under its horizontal expansion and in which spatial design has to work with these processes.

In these three Process Spaces A–C no alterations to the water space itself is intended; water flow fluctuations alone bring about their constantly changing appearance. In Process Spaces D and E, by contrast, morphodynamic processes dominate, such as the shifting of sediment or changes to the river's course; the fluvial dynamics can be read not only in the changing water level but also in changes to the river itself.

In Process Space D, 'Riverbeds and Currents', when the river is not sealed in places, reversible aggradation and erosion processes can happen along the riverbed, with consequences for the form of the riverbed and also the banks.

Process Space E, 'Dynamic River Landscapes', is shaped by processes that are to be found in natural watercourses. By including the flood areas in the erosion and aggradation processes, the river can shift its entire course.

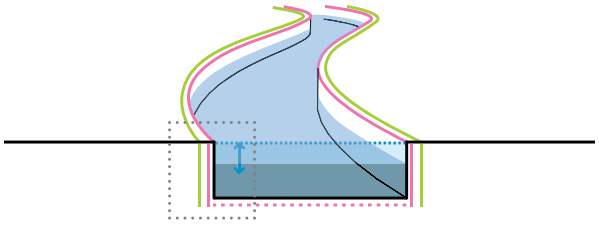
In the graphic presentation of each Process Space, the processes that occur within the space and their limits are indicated in the same way as in Part 1: the flood limit is marked by a green line and the limits of a river's self-dynamic development by a red line, while the location and extent of the Process Space is delineated by a grey rectangle.

Most of the projects presented in this book can be categorised within one Process Space type, but very extensive projects can encompass several Process Spaces. For example, the project on the River Isar in Munich focussed on the revitalisation of the watercourse, and design measures can be assigned to Process Space E, 'Dynamic River Landscapes'. However, the project also involved reinforcing the dikes, and this spatial situation comes under Process Space B, 'Dikes and Flood Walls' and employs its own particular design repertoire. Within a single project, then, design tools and measures from various Process Spaces can appear. As a rule, however, the design tools applied correspond with the Process Space to which the project is assigned in Part 3 of the book.

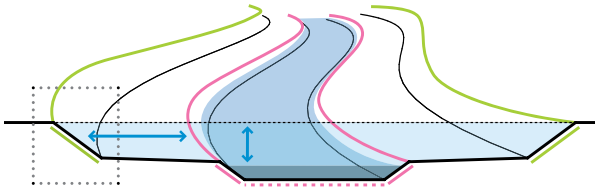
Design strategies The design strategies illustrate ways of responding to river processes in the design of waterside spaces. They describe an approach or an attitude that the designer adopts towards the water: for instance, to tolerate it, go with it, divert it, or do many other

PROCESS SPACES

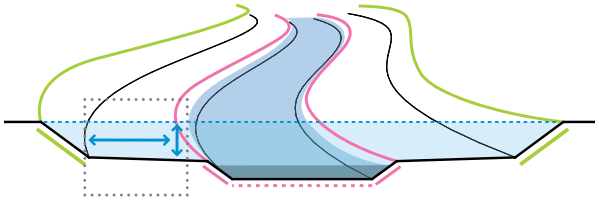
A **Embankment Walls and Promenades**



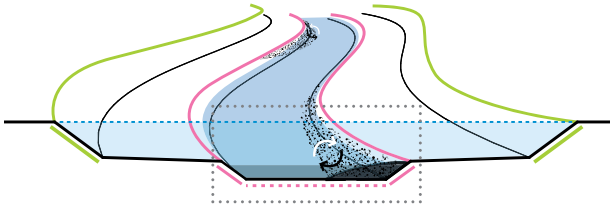
B **Dikes and Flood Walls**



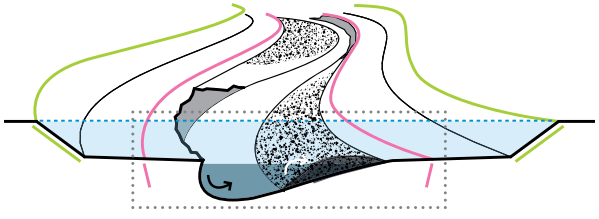
C **Flood Areas**



D **Riverbeds and Currents**



E **Dynamic River Landscapes**



Limits

- Limits process space
- Flood limits
- Limits of self-dynamic river channel development
- Riverbed reinforcement
- Limits of vertical water level fluctuation

Processes

- Limit of vertical water level fluctuation
- Horizontal spread
- Sedimentation shift
- Sedimentation
- Erosion
- Undercut bank
- Sediments

things. Each design strategy combines several practical design tools or measures that have all been influenced by this attitude.

In Process Space A, for example, all the designs primarily address vertical fluctuations in the watercourse. One design strategy is to shape elements in such a way that they can be submerged when the water level rises without su'ering damage. They ar e capable of 'tolerating' the rising water. Another strategy is to design elements to 'adapt' to rising water levels, as houseboats or floating jetties do. The spectrum of various design strategies makes it clear how many di'er ent ways there are within each Process Space of dealing with the respective water dynamics through design. Analysing the case studies made it possible to identify between four and six discrete strategies for each Process Space.

Design tools and measures The individual design measures employed on site were identified using plans, literature, discussions and visits, subsequently abstracted in the form of transferable design tools and depicted in schematic sections or plans. Design tools can range from the smallest of measures such as individual seating areas by the riverside through to large-scale interventions such as the construction of retention areas.

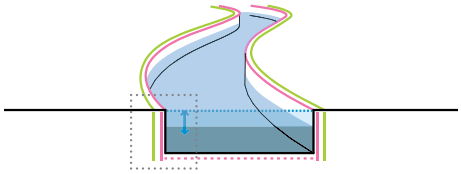
Two significant criteria had to be met before a design tool was included in the catalogue: constructive examination of and involvement with the watercourse dynamics, and multifunctional intervention. Preference was given to tools that responded creatively to the complex demands of urban water spaces and that could serve as a source of inspiration for future projects. The catalogue makes no claim to be a comprehensive list of all the possible design measures for watercourses, but is intended to o'er many and varied suggestions for use in other designers' work on water projects through its transferable design approaches and practical examples.

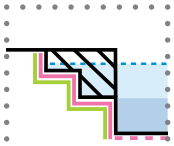
The principle of each design tool is presented with a sectional or plan drawing and illustrated with a photograph of a project example. Links with page numbers are indicated under design tool and refer to the projects in Part 3. Vice versa, the design tools listed for each case study in Part 3, the Project Catalogue, can easily be found in Part 2, the Design Catalogue, which provides a detailed explanation and identifies other projects using the same tool.

Combinations of design tools Hardly any design task for urban water spaces can be resolved using a single design tool; frequently, several design tools are combined within a Process Space. Proceeding from the experience gathered through our analysis of the case studies on combinations that often occur in practice or complement each other well, suggestions for combining design tools are made in the Design Catalogue. Each design strategy has a list of recommended combinations with design tools from other strategies: for example, flood protection walls (B2.1) from the list of B2 (Vertical resistance) strategies can be easily combined with a dike park concept (B1.1 Dike parks) by integrating the wall as a seating element or spatial organisation feature. The wall could just as easily be enhanced with mobile flood protection elements (B5.1–5.3) that make openings and windows in the wall possible.

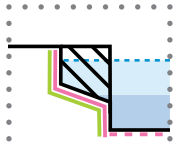
List of process spaces and design strategies

A Embankment Walls and Promenades

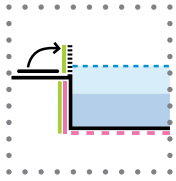




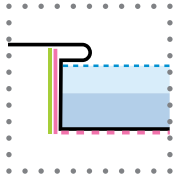
A1
Linear spatial expansion
↗ 52



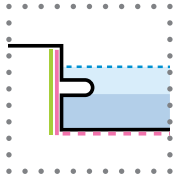
A2
Selective spatial expansion
↗ 54



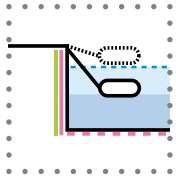
A3
Temporary resistance
↗ 56



A4
Placing over the water
↗ 58

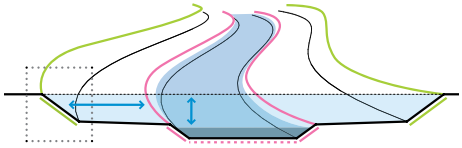


A5
Tolerating
↗ 60

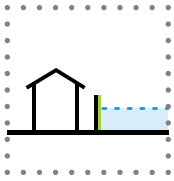


A6
Adapting
↗ 64

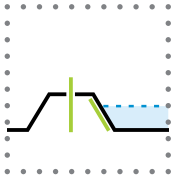
B Dikes and Flood Walls



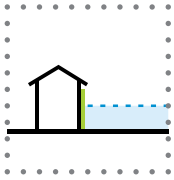
B1
Differentiating resistance
↗ 72



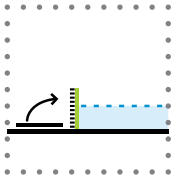
B2
Vertical resistance
↗ 76



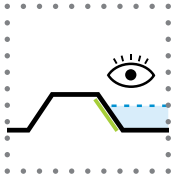
B3
Reinforcing resistance
↗ 78



B4
Integrating resistance
↗ 80

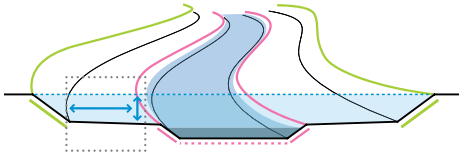


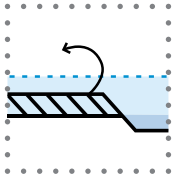
B5
Temporary resistance
↗ 82



B6
Making river dynamics evident
↗ 84

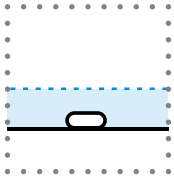
C Flood Areas



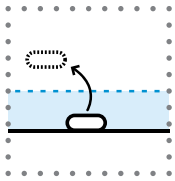


C1
Extending the space
↗ 92

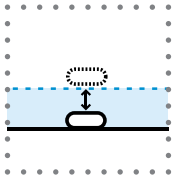
C2
Placing over the water
↗ 96



C3
Tolerating
↗ 100

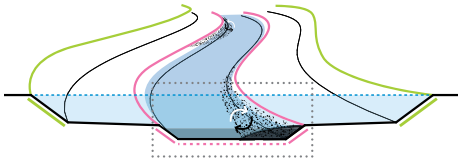


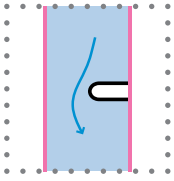
C4
Evading
↗ 104



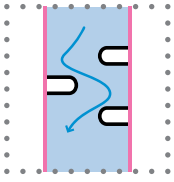
C5
Adapting
↗ 106

D Riverbeds and Currents

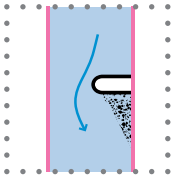




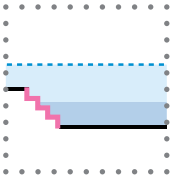
D1
Deflecting the current
↗ 114



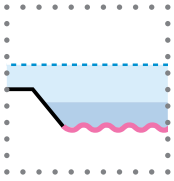
D2
Grading the channel
↗ 118



D3
Varying the riverbed
↗ 120

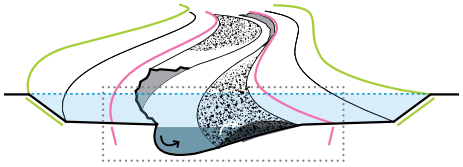


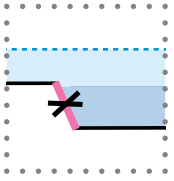
D4
Varying the bank reinforcement
↗ 122



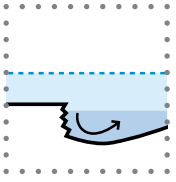
D5
Varying the riverbed reinforcement
↗ 126

E Dynamic River Landscapes



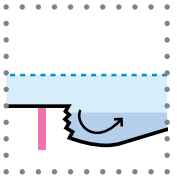


E1
Allowing channel migration
↗ 134



E2
Initiating channel dynamics
↗ 136

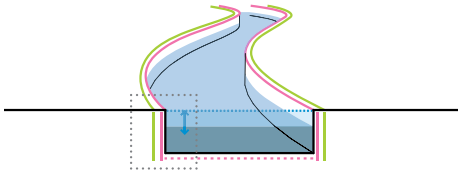
E3
Creating new channels
↗ 138



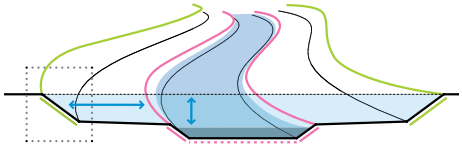
E4
Restricting channel dynamics
↗ 140

List of design tools and design measures

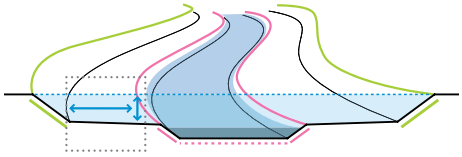
A Embankment Walls and Promenades



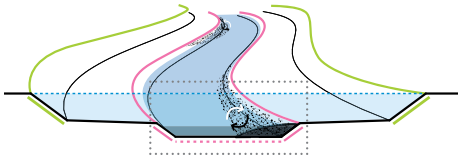
B Dikes and Flood Walls



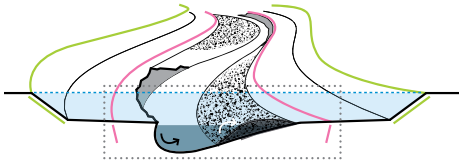
C Flood Areas



D Riverbeds and Currents



E Dynamic River Landscapes

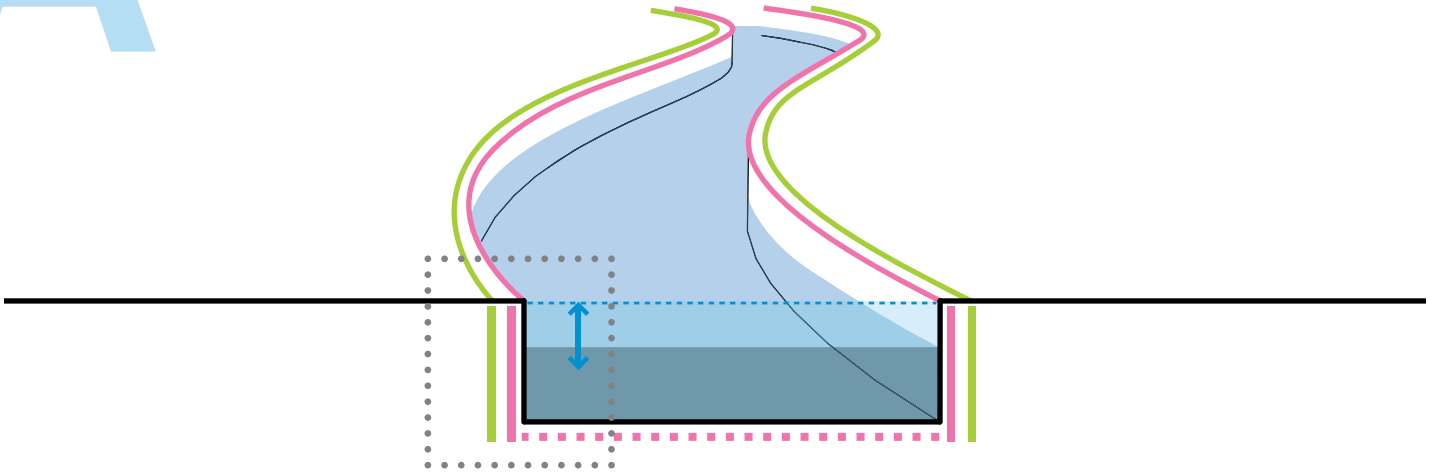


A Embankment Walls and Promenades

Leine, Hanover

From a hard embankment edge to a differentiated riverside area. Through the transformation, the boundary lines lose their separating character and a usable transitional area between water and land emerges. The scope for action is frequently limited to the steep embankment wall itself.

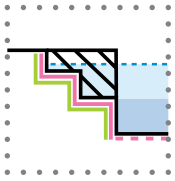
A Embankment Walls and Promenades



Spatial situation Process Space A comprises the vertical, artificially formed embankments often found in inner-city areas. Embankment walls serve both as flood protection and as riverbank reinforcement. Most of them were constructed centuries ago and thus exist in the context of a historical town centre or former industrial and harbour areas. They were the embryonic cells of the town's development, the location of the earliest settlement where goods were loaded and unloaded from boats. They are to be found not only on former quays but also along old millraces where hydroelectric power was and sometimes still is harnessed. One special situation is that of rivers that, after being completely banished to underground culverts, are now being daylighted.
The e'ect of these high, vertical banks, b etween which the water is constrained and runs far below ground level, is that rivers have e'ectively disapp eared from the townscape. The water level at the mean or low water is so low that it is barely noticeable. Nevertheless, it is precisely these river settings that are crucially important for urban transformation and the development of high-quality inner-city open space. Additional physical space for all these watercourses and their banks is usually limited, and most of the vertical edges must therefore be retained during restructuring.

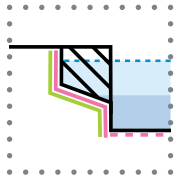
Operative processes In stretches of a river located in Process Space A, characterised by vertical banks and no flood plain areas, variations in the discharge flow rate are seen only in vertical fluctuation; any horizontal spreading of the water is prevented. The flood limit (green line) is thus congruent with the limit of self-dynamic river channel development (red line) and defined by a single built element, as the embankment wall serves both as flood protection and as a riverbank retaining wall. Permitting morphodynamic channel development is, in these spaces, virtually excluded as a possibility. Small-scale current variations and sedimentation zones are, however, achievable through installations on the edge of the channel and by piercing the boxed profile at specific points.

Design approaches The appropriate design tools and interventions for this Process Space transform its outer boundaries in sections or at periodic points, turning the narrow boundary line into an interface or a border zone. Restructuring this border area leads both to a stronger awareness of the river with its fluctuations in water level and to more di'er entiated usability. Rising water submerges the zoned border area successively and thus makes the spread of the river apparent.



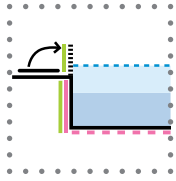
A1
Linear spatial expansion

A1.1 Intermediate levels
A1.2 Terraces
A1.3 Broad riverbank steps



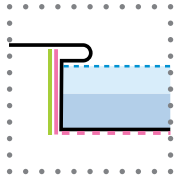
A2
Selective spatial expansion

A2.1 River access parallel to the bank
A2.2 River access perpendicular to the bank



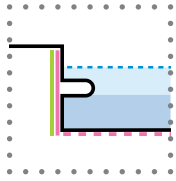
A3
Temporary resistance

A3.1 Closable access
A3.2 Retaining sightlines



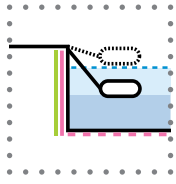
A4
Placing over the water

A4.1 Piers and balconies
A4.2 Overhangs
A4.3 Suspended pathways



A5
Tolerating

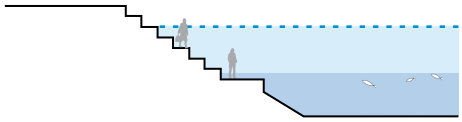
A5.1 Underwater steps
A5.2 Boulders and stepping stones
A5.3 Foreshores
A5.4 Submergible riverside paths
A5.5 Submergible boardwalks
A5.6 Surmounting the embankment wall
A5.7 Submergible furniture
A5.8 Submergible planting
A5.9 New embankment walls



A6
Adapting

A6.1 Floating jetties
A6.2 Floating islands
A6.3 Moored ships

A5.1
Underwater steps



Limmat, Zurich, Wipkingerpark

A flight of steps or a platform whose lowest step is below mean water level facilitates uses at various water levels and, especially, contact with the water. In Zurich, the shallow water on the last step o'er s tempting opportunities for paddling. Such a solution also presents important safety aspects – as the distance one could fall from the bank into the water is very short it is often possible to dispense with visually intrusive and obstructive railings or parapets.

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Wupper, Wuppertal ↗ 176
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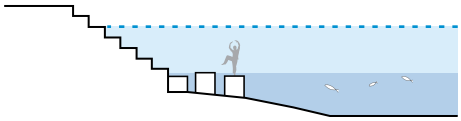
A5.2
Boulders and stepping stones



Limmat, Zurich, Wipkingerpark

Boulders and stepping stones which rise above the mean water level enhance the experience of flowing water by making direct contact possible. On the River Limmat in Zurich, stones have been set several metres out into the water. They are of varying height and thus make fluctuations in the water level vividly apparent. Water flowing over their rough upper surfaces creates interesting ripples.

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Sieg, Siegen ↗ 204
Guitang River, Changsha ↗ 232
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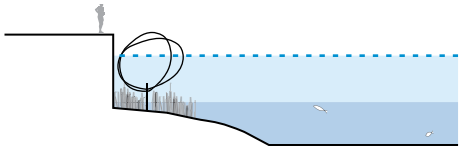
Soestbach, Soest ↗ 298

A5.3
Foreshores



Seine, Choisy-le-Roi

Zones along the edge of a watercourse are elevated by depositing soil material which is then planted; sometimes the new substrate must be secured until it is suÿciently colonised by plants, for example with a geotextile layer. A green riparian corridor develops along the hardscape edge. Such shallow, calmer zones in large rivers o'er ecological stepping-stone biotopes for migratory fish and amphibians. They are particularly suitable for inner-city rivers and waterways with a hard, uniform, boxed cross section, and are also very aesthetically appealing thanks to the contrast they provide with their mostly hardscape surroundings. On the River Seine in Choisy-le-Roi, a suburb of Paris, the shoreline has been restored at the waterside: a marginal planting zone serves as an intermediary between the boardwalk and river, and reduces the danger of falling into the water.

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Seine, Choisy-le-Roi ↗ 172
Wupper, Wuppertal ↗ 176
Josefsbach and Rems, Schwäbisch Gmünd ↗ 188
Guadalupe River, San Jose ↗ 228
Soestbach, Soest ↗ 298

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B

Process Space B: Dikes and Flood Walls

Introduction

Process Space C: Flood Areas

C

Process Space D: Riverbeds and Currents

D

Process Space E: Dynamic River Landscapes

E

B Dikes and Flood Walls

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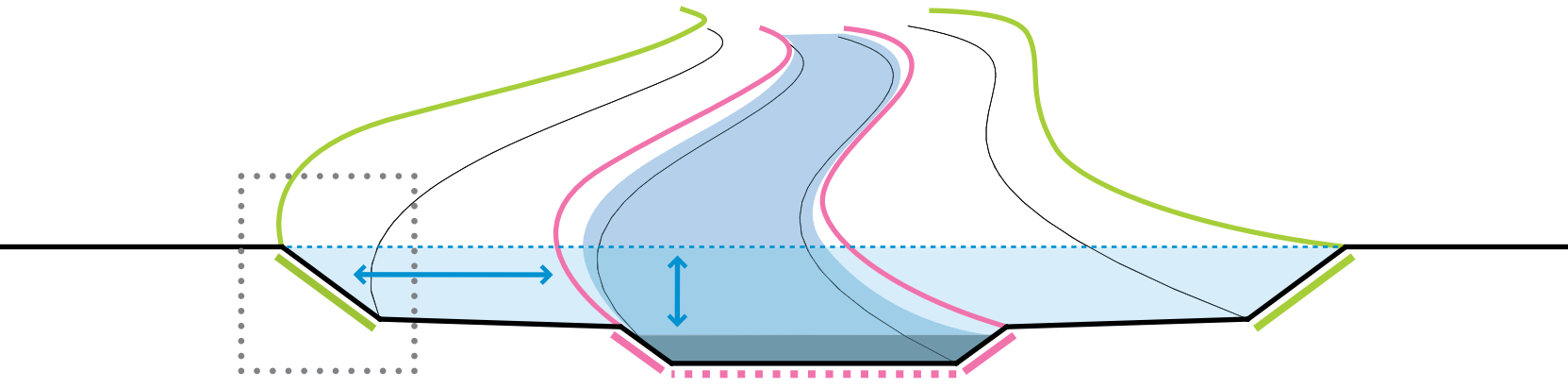
Project Catalogue
Dikes and Flood Walls

Main, Wörth am Main



1

Josefsbach and Rems

State Garden Show, 2007–2014
Schwäbisch Gmünd, Germany

River data for project area (at the Rektor-Klaus-Brücke)
Stream type: Mid-sized fine to coarse substrate-dominated siliceous highland river
Catchment area: 163 km²
Mean discharge (MQ): 2.2 m³/s
One-in-100-year flood discharge (HQ 100): 148 m³/s
Width of riverbed: 10–30 m; width of flood plain: 30–50 m.
Location: 48° 48' 1.70" N – 9° 47' 28.00" E

Design tools

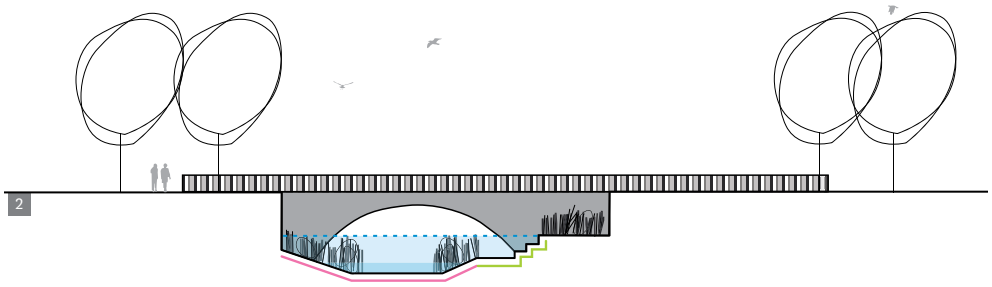
A1.1 Intermediate levels
A5.1 Underwater steps
A5.3 Foreshores
A5.4 Submergible riverside paths
A5.8 Submergible planting
D1.4 Piled stone groynes
D4.2 Living revetment
D4.3 Stone revetment
D4.4 Terraced stone revetment
D5.3 Ramps and slides

The 2014 Baden-Württemberg State Garden Show (Landesgartenschau – LGS) was held in Schwäbisch Gmünd. The core of this project's overall concept was the redesign and reconstruction of the urban sections of the River Rems and its tributary, the Josefsbach.

The forgotten confluence Schwäbisch Gmünd, the biggest town in the Rems valley, is located at the place where the Josefsbach (also known as Waldstetter Stream) flows into the Rems. The Josefsbach was built artificially in the Middle Ages. With its 7–9 m deep gorge-like profile, it not only served well as a moat, but also as a flood channel with extremely high flood protection capacity. During the urban development of recent years, the B29 highway with heavy traÿc r ushed through the old town and strad-dled the mouth, with the result that the river mouth ('Gmünd' in the local dialect) was covered over with concrete and lost in the traÿc noise.

Reopening the 'Gmünd' Followed the urban redevelopment concept, buildings and traÿc in the town centr e have been reorganised. In particular, this involved the relo-cation of the massive four-lane B29 bridge over the mouth of the Josefsbach.

Restoring and revitalising the Josefsbach To restore the deep-cut Josefsbach and improve its flow, accessibility and landscape quality, the level of the riverbed has been raised significantly by filling it in by up to several metres, and the 4 m high weir has been deconstructed to avoid an abrupt jump. Three rock ramps with gradients of 1:25 to 1:30 help to mediate the di'er ence in height. Raising the Josefsbach reduced the inclination



of the previously very steep riverbanks. But due to limited green space on both sides, the Josefsbach's straight water course has been kept within the existing trapezoidal profile. To obtain maximum accessibility and create a more dynamic space experience, a zig-zag pedestrian path has been cut cleverly into the river embankment. This not only adds curves to the straight valley, but also provides seating niches and platforms close to the water. The previously inaccessible ditch has now become an open river space to enjoy.

The restoration of the Rems The first reconstruction phase of the Rems started in 2010. The river cross-section was widened from 15 m to 45 m, and two islands were created. The existing 5 m deep weir was completely dismantled. To overcome the di'erence in height, a 50 m long rough ramp was built. Rock armour (rip-rap) of white Jurassic limestone with boulder weights of up to 3 tonnes was installed to stabilise the riverbed during flood events. Also, a dry weather flow channel with a depth of about 30 cm was constructed to ensure the river's functionality. The second construction followed the first phase with similar measures. The existing riverbed was raised, a 75 m long rough ramp with white Jurassic limestones with boulder weights of up to 6 tonnes was constructed to overcome the di'er ence in height and to provide enough protection against future flood events. In addition to the hydraulic engineering measures, new riverbank walls and three bridge structures were built.

1 People walking under the trees by the Josefsbach.

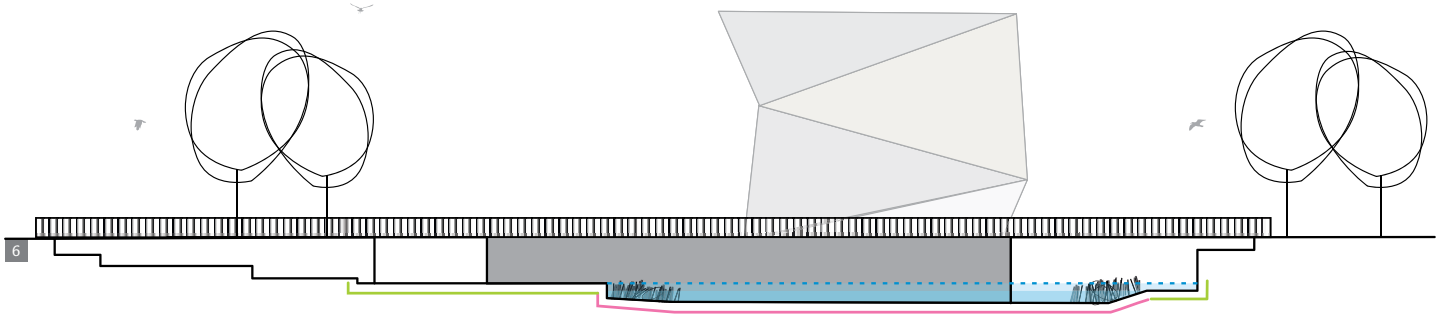
2 Schematic section of Josefsbach: submergible pedestrian path (A5.4) along the creek with steps.

3 The broad steps next to the submergible path provide places for visitors to sit and linger.

4

River restoration as reactivation leverage The ecologically restored Rems River and Josefsbach have become river promenades that extend through the densely built town centre, allowing people to rediscover the town's history and o'ering a r ange of recreational facilities, also for the elderly and children. The reopened confluence has become the new attraction and central stage in the middle of town, with the Ledergasse, Remspark and the city garden leading to the confluence waterfront. Here, a wide variety of designed open spaces o'er amazing views fr om each side. The old town centre, previously cloaked in noisy traÿc, is now an attr active and pleasurable focus for citizens and has once again become the showpiece of Schwäbisch Gmünd.

5



4 Ramps and slides on the riverbed bridge the longitudinal di'er ences in height and avoid a weir and other water facilities.

5 The city centre of Schwäbisch Gmünd was once dominated by traÿc.

6 Schematic section of the Rems: on one side of the river, a wide beach next to the Rems provides recreational space, on the other bank a pedestrian path accompanies the river.

7 The sculptural building of the Gold and Silver Forum stands at the confluence of Josefsbach and the Rems.

8+9 Josefsbach before (8) and after revitalisation (9).

10 The city centre, previously ruled by cars (5), has been transformed into an urban river park.

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IJssel

Vreugderijkerwaard

Zwolle, the Netherlands

Client: Ministry for Agriculture, Nature and Food Quality (MLNV); Ministry of Transport and Water (MV&W)

Project partner, planning and construction: Dienst Landelijk Gebied; Rijkswaterstaat; Overijssel Province; Zwolle Municipality; Waterschap Groot Salland

Maintenance: Vereniging Natuurmonumenten

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Isar

Isar-Plan

Munich, Germany

Client: Free State of Bavaria; City of Munich

Project management, partial planning: Munich Water Authority, Munich Department for Construction

Landscape architect: Winfried Jerney, Bad Griesbach im Rottal

Engineering: Dr. Blasy + Mader, Eching; Prof. Dr.-Ing. W. Bechteler, Universität der Bundeswehr, Munich

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Josefsbach and Rems

State Garden Show

Schwäbisch Gmünd, Baden-Württemberg, Germany

Client: Landesgartenschau Schwäbisch Gmünd 2014 GmbH

Landscape architects: A24 Landschaft Landschaftsarchitektur GmbH

Water engineering: BGS Wasser GmbH

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Kallang River

River Revitalisation and Park

Bishan, Singapore

Landscape architects: Ramboll Studio Dreiseitl

Client: Public Utilities Board & National Parks Board

Engineering: CH2M Hill, Geitz & Partner

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Kyll

Renaturation of the Kyll Mouth

Trier, Germany

Client: Landesbetrieb Mobilität Rheinland-Pfalz, Trier; Zweckverband Wirtschaftsförderung im Trierer Tal, Flöhren

Planning: BGHplan Landschaftsarchitekten, Trier

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Leine

Leine Suite

Hanover, Germany

Client: Rainer Aulich, Hanover

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Leutschenbach

Restoration Leutschenbach

Zurich, Switzerland

Client: City of Zurich, Public Works Department

Landscape architects: Dipol Landschaftsarchitekten GmbH, Basel

Water engineering: Staubli, Kurath und Partner AG, Zurich

Project management: Gruner AG, Zürich

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Limmat

Factory by the Water

Zurich, Switzerland

Client: City of Zurich, Grün Stadt Zurich

Landscape architects: Schweingruber Zulauf Landschaftsarchitekten, Zurich

Water and civil engineering: Staubli, Kurath & Partner AG, Zurich

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1.1 Fundamentals

8 photo: HafenCity Hamburg GmbH
14 photos: Michael Aggeler, Böhringer AG, Oberwil
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18 Charte des alten Flußlaufes im Ober-Rhein-Thal, published by BRAUN in Karlsruhe. Source: http://de.wikipedia.org/wiki/Datei:Rheinkarte.JPG 22 top Drawn after: Lange, Gerd Lecher, Kurt (ed.), 1986. *Gewässerregelung, Gewässerpflege. Naturnaher Ausbau und Unterhaltung von Fließgewässern*. Hamburg: Parey Verlag, p. 59.
23 top right Drawn after: Scha'ernak, F riedrich 1950. Grundriss der Flussmorphologie und des Flussbaues. Vienna: Springer, p. 45.
24 bottom Drawn after: Schwanke, Karsten, 2005. *Landschaftsformen. Unsere Erde im Wandel – den gestaltenden Kräften auf der Spur*. Berlin: Springer, p. 125.
25 aerial view: Blom Deutschland GmbH, Neubrandenburg
26 drawn after: LAWA Länder Arbeitsgemeinschaft Wasser. Karte der biozönotisch bedeutsamen Fließgewässertypen Deutschlands (December 2003).
27 drawn after: Federal Interagency Stream Restoration Working Group (FISRWG), 1998. Federal Stream Corridor Restoration Handbook. Principles, Processes, and Practices. Washington, DC: self-published, chapter 1, p. 24.
35 photo: Engler, City of Wörth am Main

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1.2 Design Catalogue

61 A5.3 photo: SLG Paysage, Kremlin Bicêtre
62 A5.5 photo: SLG Paysage, Kremlin Bicêtre
66/67 photo: Anja Wölfelschneider, Fotostudio Lichtnis, Lützelbach
73 B1.1 photo: Engler, City of Wörth am Main
74 B1.3 photo: H+N+S Landschapsarchitecten, Utrecht
75 B1.6 right dS+V, City of Rotterdam
79 B3.1 photo: Dr. Klaus Arzet, Wasserwirtschaftsamt Munich
79 B3.2 photo: Aquastop, Neuwied
83 B5.1 photo: Aquastop, Neuwied
83 B5.2 photo: Waterschap Rivierenland
85 B6.3 photo: Fabio Chironi, Superpositions
86/87 aerial view: Expoagua Zaragoza 2008
93 C1.1 photo: Wasser Hannover GmbH
93 C1.2 aerial view: Microsoft Bing Maps
99 C2.5 right photo: Gerd Franke, Cologne
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116 D1.5 photo: Michael Aggeler, Böhringer AG, Oberwil
125 D4.7 photo: Ramboll Studio Dreiseitl

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1.3 Project Catalogue

All schematic sections were drawn by the authors. They document the riverbank structure in principle but do not represent exact to-scale drawings. The sections illustrate an estimated ratio of height to width based on on-site visits and photos.

152–155 1, 3–13, 15, 16 photos: Katarina Bajc
157 3 aerial view: Blom Deutschland GmbH, Neubrandenburg
160/161 1, 4, 5, 6 photos: Mike Roemer, Stoss Landscape Urbanism
161 3 photo: Chris Rand, Stoss Landscape Urbanism
165 4, 5 photos: Schweingruber Zulauf Landschaftsarchitekten, Zurich
167 6 aerial view: Blom Deutschland GmbH, Neubrandenburg
172/173 1, 3, 4 photos: SLG Paysage, Kremlin Bicêtre
174/175 1 photo: Burgold 3, 4 photos: Peter Hellbrück
176/177 1, 3, 4, 5 photos: Martin Richard, Davids | Terfrüchte + Partner, Essen
178/179 photo: Anja Wölfelschneider, Fotostudio Lichtnis, Lützelbach
185 4 aerial view: Microsoft Bing Maps (modified)
187 H+N+S Landschapsarchitecten, Utrecht, Oct. 2010, courtesy of Overijssel Province (key modified)
188–191: 1, 3, 4, 7, 9 photos: Hanns Joosten
190/191 5, 10 photos: Heino Schütte
191 8 photo: A24 Landschaft
192/193 1, 4, 5 Wasserwirtschaftsamt Ascha'enburg
193 3 aerial view: Diephold, courtesy of Wasserwirtschaftsamt Ascha'enbur g
195 4, 5 Wasserwirtschaftsamt Ascha'enbur g
197 9 photo: Engler, City of Wörth am Main
203 4, 5 photos: City of Regensburg, Peter Ferstl
203 3 plan: Wasserwirtschaftsamt Regensburg
204 1 photo: Leonard Grosch, Atelier Loidl
205 3, 4, 6 photos: University city of Siegen
205 5, 7, 8 photos: Nengshi Zheng
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210/211 aerial view: Expoagua Zaragoza 2008
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213 3 aerial view: Microsoft Bing Maps (modified)
213 4, 5 Bos Slabbers Landschapsarchitecten
215 3 aerial view: Microsoft Bing Maps
216 1 photo: Bill Tatham, SWA
217 3, 4, 5 photos: Tom Fox, SWA
218 1 aerial view: Expoagua Zaragoza 2008
221 7 photo: aldayjover, Barcelona
225 3 courtesy of City of Zuera
227 9 plan: aldayjover, Barcelona
228–231 1, 3–5, 8–14 photos: Katarina Bajc
232–235 1, 4–9 photos: Wasser Hannover GmbH
236 1 photo: Börries von Detten
237 9 plan: foundation 5+ landschaftsarchitekten und planer
239 3 aerial view: Microsoft Bing Maps (modified)
240/241 1, 3, 5 BGH Plan, Trier
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244/245 1, 6, 7 photos: Yu Bai, Earthasia International
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251 3 Information sign of the states of Baden-Wuerttemberg and Rhineland-Palatinate, Brühl 2010 (photo: authors)
255 4 aerial view: Microsoft Bing Maps
256/257 1, 3, 4, 7 Photos, Bo'a Miskell
257 5 photo, Jay Farnworth
257 6 photo: Sir George Grey Special Collections, Auckland War Memorial Museum
259 2 aerial view: Microsoft Bing Maps
261 8 plan: H+N+S Landschapsarchitecten, Stroming and TNO, courtesy of Gelderland Province (key modified by authors)
262/263 1, 3, 5 photos: Siebe Swart
263 4 photo: Rijkswaterstaat (ministry of infrastructure and Water Management of the Netherlands)
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264/265 1, 6 Municipality of Dordrecht
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272/273 1, 4–7 photos: Kongjian Yu, Turenscape
273 3 plan: Kongjian Yu, Turenscape
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278–281 1, 4, 6, 9–11 photos: Civil Protection Agency (Bolzano)
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288/289 8–10, 12, 13 photos: Ramboll Studio Dreiseitl
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317 4, 5 photos: Markus Forte/Ex-Press/BAFU
319 3 Aquaplaner, Hanover
321 3 Kasseler Entwässerungsbetrieb (KEB)
323 4 City of Beckum

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