STW Perspectief

Nieuwe technologie mogelijk maken in de topsectoren

RONDE 2012/2013

Number of the programme	**P12-14**
Title of the programme and acronym	RiverCare: towards self-sustaining multifunctional rivers
Programme leader	prof. dr. S.J.M.H. Hulscher, Water Engineering and Management, Faculty Engineering Technology, University of Twente
Participating organisations	**Applying research institutes**: - University of Twente, Water Engineering and Management (WEM, UT) - University of Twente, Laboratory of Design, Production and Management (DPM, UT) - Utrecht University, Physical Geography (PG, UU) - Radboud University Nijmegen, Institute for Water and Wetland Research (IWWR, RUN) - Radboud University Nijmegen, Institute for Science, Innovation and Society (ISIS, RUN) - Delft University of Technology, Environmental Fluid Mechanics (EFM, TUD) - Wageningen University, Hydrology and Quantitative Water Management (HWM, WU) - Wageningen University, Soil Geography and Landscape Group (SGL, WU) **Potential users**: - **Knowledge institutes:** Deltares, RIVM, Alterra - **Companies:** Arcadis, Bureau Waardenburg, CSO, HKV_consultants, Royal HaskoningDHV, Witteveen+Bos, Tygron, T-Xchange - **Other organisations:** Rijkswaterstaat, Province of Gelderland, DLG, OBN, Staatsbosbeheer, US Army Corps of Engineers, Bundesanstalt für Wasserbau, Topsector Water, Directoraat-Generaal Ruimte en Water
Duration of the programme	6 years
Budget Personnel positions: 13.5 PhD students 5.3 Postdocs (3 yr)	**Requested budget from STW (€)** - programmatic activities: 49.329,- - personnel costs: 3.417.891,- - Material costs: 580.205,- - Travels 161.000,- - Investments: 378.000,- - **Total**: € 4.586.425,- **Contribution by users / other parties** - *in cash*: 1.248.500,- - *in kind*: 1.013.328,- - **Total**: € 2.261.828,-

Keywords:
River management, river morphology, river ecology, ecosystem services, uncertainty, river governance, communication

A. Description of the programme

1. Summaries

1.1 Summary of the programme objectives, focus and ambitions

Rivers *live*, i.e. rivers are inherently dynamic water systems involving complex interactions among hydrodynamics, morphology and ecology. In many deltas around the world lowland rivers are intensively managed to meet objectives like safety, navigation, hydropower and water supply. With the increasing pressure of growing population and climate change it will become even more challenging to reach or maintain these objectives and probably also more demanding from a management point of view. In the meantime there is a growing awareness that rivers are natural systems and that, rather than further regulation works, the dynamic natural processes should be better utilized (or restored) to reach the multifunctional objectives. Currently many integrated river management projects are initiated all over the world, in large rivers as well as streams. Examples of large scale projects in the Netherlands are 'Room for the River' (Rhine), the 'Maaswerken' (Meuse), the Deltaprogramme and projects originating from the European Water Framework Directive (WFD). These projects include innovative measures executed never before on this scale and include for example longitudinal training dams, side channels, removal of bank protection, remeandering of streams, dredging/nourishment and floodplain rehabilitation. Although estimates have been made on the effects of these measures for many of the individual projects, the overall effects on the various management objectives remains uncertain, especially if all projects are considered in connection. For all stakeholders with vested interests in the river system it is important to know how that system evolves at intermediate and longer time scales (10 to 100 years) and what the consequences will be for the various river functions. If the total, integrated response of the system can be predicted, the system may be managed in a more effective way, making optimum use of natural processes. In this way, maintenance costs may be reduced, the system remains more natural and more self-sustaining and ecosystem services such as safety, navigability, biodiversity and climate buffering can be safeguarded or even enhanced.
The unprecedented extent of these interventions, together with comprehensive in-situ monitoring now offer an excellent opportunity to gain extensive knowledge about their intermediate and long-term impacts.
The key objectives of the programme are therefore to get a better understanding of the fundamental processes that drive ecomorphological changes, predict the intermediate and long-term developments, make uncertainties explicit and reduce them where possible and develop best practices to reduce the maintenance costs and increase the benefits of interventions. The projects currently or soon to be carried out in the Netherlands provide a unique opportunity to achieve these objectives and use the results to develop or improve models, guidelines and tools that can be used for river management in the Netherlands and abroad.

1.2 Summary of the applications and industrial and/or societal relevance

We come from a tradition of river training and engineering predominantly aimed at one single focus, namely safety, navigability or freshwater supply. Now there is a growing awareness that rivers are multifunctional and, indeed, inherently dynamic. River managers in the Netherlands and elsewhere are interested in combining and optimising river functions while cutting maintenance costs. To do so it is important to know how the river system naturally responds to interventions and to have an appropriate framework to monitor and evaluate the effects, such that better river management decisions can be made. This programme will contribute to this need. It will increase our understanding of the fundamental ecomorphological processes that determine the response to an intervention which will be used to develop or improve existing tools to better predict this response. To be able to evaluate various management options, a framework will be developed that identifies the benefits of the river developments for various river functions based on ecosystem services. The results of the programme will be made available via open-access data and knowledge bases and integrated into a serious game (Virtual River) that can be used to create a setting in which river managers, stakeholders and other users together can take more educated decisions on the management of the river system. All products will be developed in close collaboration with the end users making use of (inter)national experience and case studies to ensure practical relevance and usability. In the programme we included the showcase Wealthy Waal (in Dutch: Waalweelde) in which most of the interventions are carried out. This will illustrate the potential of the RiverCare concepts and help consultancies in advertising it abroad. The RiverCare programme will lead to more optimal management of the river system that fulfils the objectives better, requires less maintenance and hence will save money to society. The improved knowledge, evaluation framework and serious game will be excellent export products for public organisations, knowledge institutes and consultancies.

2. Main scientific challenges and research lines

Now large changes in the river system are created, the system is forced well away from its current state. This provides an unique scientific opportunity to study the first response of the system and combine this with the current knowledge to develop (improved) models, tools and guidelines. As in most natural systems the adaption behaves as a decreasing exponential curve, we expect to get sufficient information in a 3-5 year time period to describe the longer term behaviour. This will assist river managers and other stakeholders to take educated decisions on future interventions, and to embed the results of this programme in their daily practice. To tackle these challenges interdisciplinary research is necessary related to the following aspects:

River morphodynamics: Many human interventions currently taken in rivers and streams, such as longitudinal training dams, construction of side cannels, removal of bank protection, re-meandering of streams, dredging and nourishment and floodplain rehabilitation, initiate morphological changes that may ultimately hamper various river functions. Since most of these measures have not, or not at the current scale, been implemented before, it is unknown from experience what the morphologic evolution will be and how this will impact river functions. Therefore, knowledge of the morphologic effects of these interventions is crucial for a cost-effective management.

River ecology: Ecological processes will also be affected by these interventions. To understand and predict the ecological response, knowledge of biotic and abiotic processes needs to be integrated. The current scientific understanding of the dynamic interactions and feedback mechanisms between these processes is still limited, especially at the quantitative level and when it comes to establishing predictive models. There is also a need for a generic classification system of ecosystem units that is interpretable by and useful for stakeholders with various interests.

Ecosystem services: An integrated way to evaluate the societal effect of human interventions in river systems is by quantifying ecosystem services. River systems provide valuable ecosystem services such as safety, navigability, biodiversity and spatial quality, among others. Suitable approaches, indicators and standards need to be developed in order to quantify these ecosystem services and evaluate the societal impact of human interventions.

Uncertainty: Management decisions rely on predictions of future developments in the river system. These predictions usually involve large uncertainties which tend to be overestimated, thus forcing managers to overly conservative choices. Quantifying and where possible reducing the uncertainties in the prediction of future developments will help managers to take more robust and cost-efficient measures.

River governance: Implementing measures in river systems involves many stakeholders with varying perspectives and perceptions. A better understanding of these frames and the way stakeholders interact may open ways to a new and innovative governance model for river management.

Communication tools: For valorisation of the knowledge, models, tools and guidelines developed in this programme, these products need to be communicated effectively to the end users. The scientific and practical challenge here is how to translate specialist knowledge to practical relevant and useable information. Examples of tools that will be developed in this context are a user-friendly data-access system, a knowledge base (Wiki) and tools for visualisation of the programme results integrated in a serious game environment for collaborative decision-making.

Figure 1 Realisation of a side channel in the Vreugdenrijkerwaard along the IJssel River in 2003 (left, photo: B. Boekhoven, Rijkswaterstaat) and sediment accretion in a side channel near Gameren along the Waal (right, photo: G.W. Geerling, Deltares).

Table 1 presents the results of the latest research assessment on a scale 1 (poor) to 5 (excellent). Table 2 gives for each research group the principle investigator (PI), his/her publication record and a selection of positions in the scientific arena.

Table 1 Results of research assessment of research groups.

Group	Quality	Productivity	Relevance	prospect	Expertise	Lead in project
WEM, UT	4	5	4	5	Management and physics of rivers and coastal seas	F,G
DPG, UT	4	3	4	3	Development of user-centred design methods & tools	
EFM, TUD	5	5	5	5	Shallow environmental flows and river morphodynamics	B
IWWR/ISIS*, RUN	4	4	4	4	Ecological risk assessment of environmental stressors in river systems / Sustainable use and management of river basins	E,H
PG, UU	4	4	4	5	River and floodplain hydro-morphology and management	D
HWM/SGL, WU	4½	4	4	5	Spatial and temporal variability in fluvial dynamics	A,C

* young institute, first research assessment June 2013

Table 2 Scientific performance (from Web of Science) of principle investigators (PI) of research groups.

Group	PI	Publications	Citations/ Publications	H-index	Position in scientific arena
WEM, UT	Hulscher	78	10	16	VICI laureate; Alumnus KNAW-DJA; chair of conferences MARID (2004) and RCEM (2007); associate editor of JGR-Earth Surface (2004-2005); member committee restoration Afsluitdijk and Hedwigepolder; PI of several STW/ALW-projects.
DPG, UT	Van der Voort	20	9	4	PI of national programme IOP-IPCR Synthetic Environments and of sub-programs of IOP-IPCR Design for Usability, REPAR and PID Teleflex. PI of industry funded PhD projects (Ford).
EFM, TUD	Uijttewaal	46	12	14	IAHR Fluid Mechanics leadership team; chair of several conferences e.g. Euromech 523 Ecohydraulics (2011); PI of several STW, NWO-DfG funded projects; Head of Env. Fluid Mechanics Laboratory at TUDelft.
PG, UU	Middelkoop	56	13	15	PI of several (inter)national programmes (IRMA-SPONGE, NWO-LOICZ, NWO-STW Biesbosch); Member of the Netherlands Commission for Environmental Assessment.
IWWR, RUN	Leuven	96	13	22	PI of several (inter)national programs such as EU interreg IRMA SPONGE & Urban Water, NWO-LOICZ & SSEO; Member of the Netherlands Commission for Environmental Assessment.
ISIS, RUN	Smits	74	14	19	PI of several (inter)national programmes such as EU, FP7 interreg programmes (A,B and C) and NWO-LOICZ & SSEO and NWO VERDUS.
SGL, WU	Wallinga	54	25	20	VENI & VIDI laureate; Director of Netherlands Centre for Luminescence dating; PI of STW project.
HWM, WU	Hoitink	25	7	9	PI of PhD projects funded by NWO-ALW, NWO-Wotro, KNAW and Stowa; Head of the Kraijenhoff van de Leur Laboratory for Water and Sediment Dynamics at Wageningen University.

3. Application perspective at the programme level

Economic and societal relevance: RiverCare will contribute to sustainable river management by reducing lifecycle costs and increasing benefits from ecosystem services. The individual projects, the Virtual River tool and the 'Waalweelde' application will serve as showcases to bolster the forerunner position of Dutch delta technology.

Application perspective: Using the planned and ongoing Dutch interventions as a unique large-scale experiment allows us to generate new knowledge and tools to optimize future river management strategies. This will yield direct economical and societal benefits. In addition, the close cooperation with users in each project will increase the worldwide applicability of the Dutch expertise in river management.

Demand orientation: RiverCare is based on important questions put forward by users.

User commitment: See letters of support.

Technical objectives: Most projects aim at innovative technological solutions towards more sustainable river management and better monitoring. RiverCare will advance the scientific knowledge and technological knowhow needed to forecast the effects of measures in river systems. All projects have their own scientific output and will also contribute to the data abse, Wiki and serious-gaming tool Virtual River.

Expected results: The consortium of this programme builds on the Netherlands Centre for River Studies (NCR). This programme extends the existing network and brings many relevant scientists and end users in the field of rivers together and we expect that this collaboration will result in a better transfer of knowledge and questions from end users and lead to scientifically sound and practical tools that will be applied in daily practice to manage the rivers towards a more self-sustaining, multifunctional system with increased benefits worldwide. Each project may contribute to the development of new or improved models, tools or guidelines. We also envision a user-friendly, open-access database and Wiki containing all collected data and all results generated by RiverCare. The Wiki will be continued from the Wiki of the EU-project REFORM. We will develop the Virtual River tool, which will be tested together with Dutch river managers and consultancy firms, and also become available for educational purposes. On the scientific side we expect fourteen PhD theses and a large number of scientific and professional publications. Finally, this programme will provide highly valuable training for PhD, MSc and BSc students, ready to be employed in the water sector.

Contribution to public-private partnerships (PPP): Nationally and internationally, public as well as private stakeholders are involved in water management. The programme's close collaboration with both types of end user will strengthen existing partnerships and likely foster new ones. Also, Rijkswaterstaat is currently experimenting with Design-Build-Finance-Maintain (DBFM) contracts, a new type of long-term contract that includes not only the design and implementation of an intervention but also its financing and maintenance. This will lead to an entirely different relationship between government and private sector. The knowledge resulting from RiverCare will help river managers, consultants and contractors to prepare for DBFM contracts.

Utilisation plan: To strengthen the network and enhance the team spirit, we envisage to start with a three-day field trip with users, researchers and supervisors visiting typical projects in the Netherlands and abroad. We will use the NCR website to keep each other informed about all RiverCare activities and to make the programme's products available. We plan to have an annual full-day meeting with all users and researchers. Researchers will present brief progress reports, to be followed by workshops in which users interact with researchers discussing applications to foreign rivers and new validation possibilities (e.g., Mississippi delta (US), the Danube basin (Romania) and river systems in Colombia and Indonesia), also covered in project H. This day can be linked to the annual NCR days.

Next, we plan to organise at least two two-days courses, with a basic part (for young engineers and scientist from other scientific/engineering areas) and an advanced part discussing the latest insights from the RiverCare programme. These courses will be open for people inside as well as outside RiverCare.

Furthermore, due to the discussions in the RiverCare workshops and the strong involvement of the users in the projects, we expect that RiverCare will spark off many MSc and BSc projects. This is already quite common in our research field, and the high visibility of RiverCare will motivate students even more to formulate projects within this context. This will also lead to more academics to meet the increasing demand for highly qualified river specialists in the government, the private sector, the knowledge institutes and academia.

Exchange of knowledge will also occur through the mobility of everyone working on RiverCare, and through joint supervision of the projects. The researchers will be on user locations part of the time, facilitated by employees of users that hold part-time positions at universities.

The creation of the end products of RiverCare is planned in Project G (knowledge base, communication and Virtual River). The users play a central role in stating their wishes in the first phase of the programme and giving feedback on these products during the programme. The Virtual River tool will also be of use for educational purposes (secondary schools, colleges and universities) and may help increasing public

awareness that rivers have a behaviour of their own that would better be respected. We are also considering launching a computer game called 'Manage the river'.
Market perspectives: The growing awareness of the value of rivers, the increasing exploitation of rivers and the potential impact of climate change worldwide make multidisciplinary knowledge of the behaviour of rivers and associated management issues a valuable commodity. Delta technology is foreseen as an important field for export of Dutch expertise. This programme will boost Dutch expertise on river restoration and management which can be applied in deltas around the world. We include an application to the 'Waalweelde' so that this can act as a showcase and facilitates using the RiverCare knowledge, models, tools and guidelines in other projects in the Netherlands and abroad.
Users community: Most of the relevant stakeholders in Dutch river management are involved in the programme, varying from national and regional authorities, knowledge institutes, consultancies, NGOs to local field managers. In addition some international partners have shown interest in the programme. This variety of end users represents a large range of different expertise from which the programme can benefit and vice versa.

4. Strategic relevance of the programme
Added value: The proposed programme provides the opportunity to collaborate in a large consortium of researchers and end users with a large variety of different expertise. So far, many bilateral projects between researchers and end users have been performed, often on mono-disciplinary topics. This programme should be able to bring river research and its practical application to an integrated level that could not be reached in smaller research groups.
Sense of urgency and importance of programmatic approach: Projects such as 'Room for the River' (Rhine) and 'Maaswerken' (Meuse) and numerous stream restoration projects have been designed without much attention for the large-scale response of the system. The fact that they are currently being carried out presents not only a unique opportunity, but also a must to evaluate the effects of these projects. River management of national and regional waterways has become a complex matter involving multiple disciplines and stakeholders. It can only be addressed properly by integrating these disciplines and actively involving all end users. The fact that for the Netherlands Government has passed a law for the Deltaprogramme, which includes the definition of a long term (2050 and 2100) strategy for river maintenance, only underlines the necessity of RiverCare.
Refreshment of the network: The consortium builds on the Netherlands Centre for River Studies (NCR), a platform in which the involved universities, Rijkswaterstaat, Deltares and Alterra exchange information on ongoing research and projects. This programme provides the opportunity to actually collaborate in research projects with different cross links. In addition, the network is extended by several other end users that enrich the network with their perspectives on the matter.
Long-term perspectives: The Wiki will be hosted by Deltares after the end of RiverCare. The Virtual River game will be applied in the Netherlands at 'Waalweelde' (showcase) and the valorisation abroad will be explored further in project H. In this way we create experience how this instrument can help in exporting the 'Room for the River' and 'Maaswerken' concepts.
Opportunity to excel: Lowland rivers are important economic drivers in deltas all around the world. They provide fresh water for irrigation, industry and domestic use, can be used for shipping, carry sediment downstream to feed the coast and are important ecological corridors. Cut-off or excessive use of these resources leads to major problems in many of these areas. Sustainable river management is a vital component of economically and environmentally relevant delta technology. Bundling the river research capacity in the Netherlands in RiverCare will enhance our position as experts in delta technology.
Practical embedding: Strong involvement and commitment of the end users as expressed in the letters of support will warrant the practical embedding of the programme results.

5. Structure and organisation of the programme
The programme consist of 8 projects:
A. Optimizing longitudinal training dam design (WU-Hoitink)
B. Side channels and erosion of natural banks (TUD-Uijttewaal)
C. Regional river systems: implications of novel stream restoration approaches (WU-Wallinga)
D. Sediment nourishment and floodplain monitoring (UU-Middelkoop)
E. Ecosystem services and floodplain rehabilitation (RUN-Leuven)
F. River governance: uncertainties, participation and collaboration (UT-Hulscher)
G. Communicating programme outcome: knowledge base, visualisation and Virtual River (UT-Hulscher)
H. Self-supporting hydrosystems and valorisation (RUN-Smits)

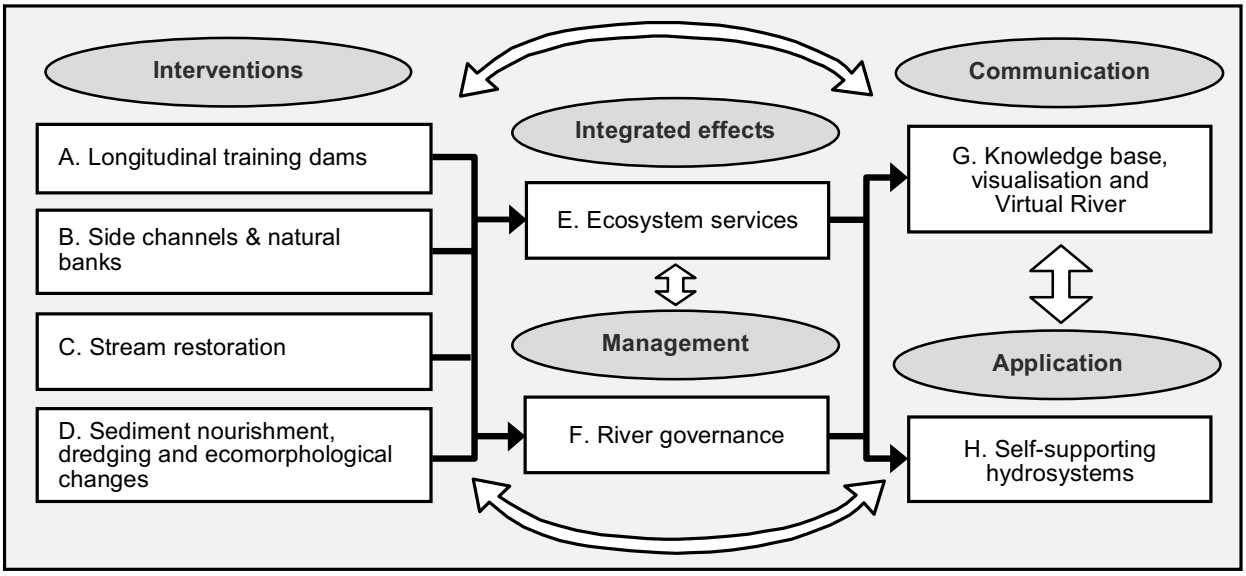

Figure 2 Scheme of projects in the programme.

Projects A-D focus on increasing the fundamental knowledge of the ecomorphological changes after a specific intervention and are coupled to existing monitoring plans that give insight in the first response of the river or stream to the intervention. In project E the most relevant ecosystem services will be quantified and used to develop an integrated assessment framework that is able to evaluate the societal benefits of interventions and management strategies. Project F tries to quantify and reduce the uncertainties inherently involved in the prediction of the river's response to management interventions and looks for optimal ways of stakeholder participation and collaboration in decision-making processes. Both, project E and F will make use of the knowledge generated in projects A-D. In project G the data and knowledge generated in the programme will be made accessible by a user-friendly data-access system and knowledge base (Wiki). Spatial and temporal developments predicted based on the knowledge generated in the programme will be visualised and integrated in a serious game (Virtual River) to facilitate collaborative decision-making. Export pportunities and the showcase 'Waalweelde' are addressed in H. Each project is described in more detail in part B.

Coherence: Coherence in the programme is achieved at three levels: subproject (PhD-trajectory) level, project level and programme level. In each subproject the supervision team consists at least of two scientific groups and one user. This will support the interaction of research groups and end users and warrants that the results are in line with the practical needs of the end users. Because each project consists of at least two subprojects, researchers, supervisors and end users also interact in user meetings at project level. Because supervisors and end users are often involved in more projects this will stimulate coherence among projects. At the programme level a steering committee will guard the objectives of the overall programme.

Programme coordination:

Programme level: Steering committee consists of all project leaders and representatives of the main funding organisations (Rijkswaterstaat, Deltares, Province of Gelderland, STOWA, Alterra)

We propose to have every 3 months a RiverCare information day. All project teams together (scientists and in-kind contributing users) meet in a one-day meeting rotating between the universities and having roughly the following structure:

- Lectures provided by the host university
- Presentations of the scientists reporting their progress
- Game and/or site visit and/or lab visit or social activity

During this day the steering committee meets parallel to the meeting of the scientist e.g. during the lectures.

Project level: The scientist and in-kind contributing users in projects will have meetings every 3 months to provide in-depth discussions.

PhD-trajectory level: managed by the home university, meetings at least bi-weekly with the daily supervisor and bi-monthly with the whole supervising team.

Table 3 Schematic overview of the programme.

Projects	Subprojects	Applying research groups	Potential users
A Optimizing longitudinal training dam (LTD) design	A1 Hydraulics of LTDs (PhD)	a. Wageningen University-HWM: Dr. Hoitink b. Delft University of Technology-EFM: Prof. Uijttewaal	Rijkswaterstaat, Deltares, Witteveen+Bos, HKV
	A2 Ecology of LTDs (PhD)	a. Radboud University Nijmegen-IWWR: Dr. Leuven b. Wageningen University-HWM: Dr. Hoitink	Rijkswaterstaat, Deltares, Witteveen+Bos, HKV
B Side channels and erosion of natural banks	B1 Side channels (PhD)	a. University of Twente-WEM: Dr. Schielen b. Delft University of Technology-EFM: Dr. Blom	Rijkswaterstaat, HKV, CSO, RoyalHaskoningDHV
	B2 Natural banks (PhD)	a. Delft University of Technology-EFM: Prof. Uijttewaal b. Utrecht University: Dr. Kleinhans	Rijkswaterstaat, Waterboards, RoyalHaskoningDHV
C Regional River systems	C1 Morphodynamics (PhD)	a. Wageningen University-SGL: Prof. Wallinga b. Utrecht University-PG: Dr. Kleinhans	STOWA, Rijkswaterstaat, Alterra, Witteveen+Bos, Waterboards
	C2 Hydrology (Postdoc)	a. Wageningen University-HWM: Dr. Hoitink b. Wageningen University-SGL: Prof. Wallinga	STOWA, Rijkswaterstaat, Alterra, Witteveen+Bos, Waterboards
D. Nourishment, dredging and floodplain monitoring	D1 Nourishment (Postdoc)	a. Delft University of Technology-EFM: Dr. Blom b. University of Twente-WEM: Prof. Hulscher	Rijkswaterstaat, Witteveen+Bos
	D2 Dredging (PhD)	a. Delft University of Technology-EFM: Dr. Blom b. University of Twente-WEM: Prof. Hulscher	Rijkswaterstaat, Witteveen+Bos
	D3 Floodplain monitoring (PhD)	a. University of Utrecht-PG: Prof. Middelkoop b. University of Twente-WEM: Dr. Augustijn	Rijkswaterstaat, HKV, Witteveen+Bos
E Ecosystem services and floodplain rehabilitation	E1 Floodplain rehabilitation (PhD)	a. University of Twente-WEM: Dr. Augustijn b. Radboud University Nijmegen-ISIS: Dr. Leuven	Rijkswaterstaat, Deltares, Arcadis, DLG
	E2 Ecosystem services (PhD)	a. Radboud University Nijmegen-ISIS: Dr. Leuven b. University of Twente-WEM: Dr. Augustijn	Rijkswaterstaat , RIVM, Deltares, Bureau Waardenburg, Arcadis, DLG
F River governance: uncertainties, participation and collaboration	F1 Uncertainty (PhD)	a. University of Twente-WEM: Prof. Hulscher b. Wageningen University-HWM: Dr. Hoitink	Rijkswaterstaat, HKV,
	F2 Participation (Postdoc)	a. Radboud University Nijmegen-ISIS: Prof. Smits b. University of Twente-WEM: Prof. Hulscher	Rijkswaterstaat , Witteveen+Bos
	F3 Collaboration (0.5 PhD)	a. Radboud University Nijmegen-ISIS: Prof. Smits b. University of Twente-WEM: Prof. Hulscher	Rijkswaterstaat, Province of Gelderland, Witteveen+Bos
G Communicating programme outcome: knowledge base, visualisation and Virtual River	G1 Virtual River/serious game (PhD)	a. University of Twente-DPG: Dr. van der Voort b. University of Twente-WEM: Prof. Hulscher	Rijkswaterstaat, Deltares, Tygron, T-Xchange, consultancies
	G2 Knowledge base & communication (Postdoc)	a. University of Twente-WEM: Prof. Hulscher b. University of Twente-DPG: Dr. van der Voort	Rijkswaterstaat, Deltares, Tygron, T-Xchange, consultancies
	G3 Knowledge base & communication (Postdoc)	a. University of Twente-WEM: Prof. Hulscher b. University of Twente-DPG: Dr. van der Voort	Rijkswaterstaat, Deltares, Tygron, T-Xchange, consultancies
H Self-Supporting Hydrosystems and Valorisation	H1 Wealthy Waal: Morphodynamics (PhD)	a. Utrecht University-PG: Dr. Kleinhans b. Radboud University Nijmegen-ISIS: Prof. Smits	Province of Gelderland, Rijkswaterstaat
	H2 Wealthy Waal: Environment and valorisation (PhD)	a. Radboud University Nijmegen-ISIS: Prof . Smits b. Radboud University Nijmegen-IWWR: Dr. Leuven	Province of Gelderland, Rijkswaterstaat
	H3 Export possibilities(0.33 Postdoc)	a. Radboud University Nijmegen-ISIS: Prof. Smits b. University of Twente WEM: Prof. Hulscher	Province of Gelderland, Rijkswaterstaat, consultancies

Planning:

Table 4 Schematic representation of the research planning

Project	Subproject	0-6 month	6-12	12-18	18-24	24-30	30-36	36-42	42-48	48-54	54-60	60-66	66-72
A	A1 PhD												
	A2 PhD												
B	B1 PhD												
	B2 PhD												
C	C1 PhD												
	C2 PD												
D	D1 PD												
	D2 PhD												
	D3 PhD												
E	E1 PhD												
	E2 PhD												
F	F1 PhD												
	F2 PD												
	F3 0.5 PhD												
G	G1 PhD												
	G2 PD												
	G3 PD												
H	H1 PhD												
	H2 PhD												
	H3 PD (0.3 fte)												