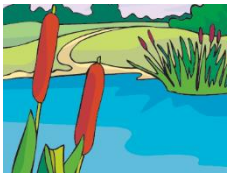
Part C

WATER JOINT PROGRAMMING INITIATIVE

WATER CHALLENGES FOR A CHANGING WORLD

2018 JOINT CALL
Closing the Water Cycle Gap

Research-based Assessment of Integrated approaches to Nature-based SOLUTIONS
RainSolutions



RainSolutions

Table of Contents

1. EXCELLENCE

1.1. Introduction

There is a need to ***close the demand and supply gap in terms of both quantity and quality of water resources***. For urban areas, there is a challenge of ***increasing*** (quantity) ***water demands*** (indirectly from food production in rural areas), and direct water use (drinking and other uses). Urbanisation leads to an increase in the built environment, and urban citizens most likely face specific environmental challenges such as ***water pollution*** (quality) and ***deterioration of urban habitats***. Additional problems linked to ***climate variability*** are expected to increase the threat to humans, urban settlements as well as their natural and built environment. This leads to ***degradation of urban water resources both in terms of quantity, quality and biodiversity*** as well as related services for the community.

1.2. State-of-the-art and relation to the work programme

RainSolutions assesses innovative ***nature-based solutions*** (NBS) for the sustainable management of nature, addressing a combination of societal challenges such as ***climate change***, ***water security***, ***water pollution***, ***human well-being*** and ***risk management***. With specific focus on drought alleviation (water supply and management), different relevant NBS products and technologies such as sustainable flood retention basins, integrated constructed wetlands as well as rainwater harvesting and reuse techniques will be evaluated. In order to evaluate the benefits of NBS in terms of urban flood risk mitigation, sustainable drainage systems concepts will be considered, thus including the use of blue-green infrastructure such as wetlands, ponds, green roofs, detention structures and permeable pavements.[1]

There is a timely need for the development of a new governance approach including a framework to address various ***stakeholder needs*** in NBS planning and design for periods of increased drought and flood risks as well as ***end-user attitudes in accepting and supporting the development of such solutions to improve urban water resources management***. Close cooperation with municipalities to develop a practical framework to sustainably protect citizens, industry and urban ecosystems from the consequences of pressures such as population increase and climate variability is required.[1] The ***human health risks***, ***socio-economic, cultural, environmental and other evaluation criteria*** of interest to a decision-support framework should be identified and assessed. A tool library of criteria linked with socio-economic aspects will be populated to identify measures, for example, supporting the restoration and rehabilitation of urban water resources by finding integrated solutions balancing different needs.

The framework will identify new scenarios of change that are relevant to NBS products and technologies. This would involve different climate change, urbanisation, socio-economic development and other related scenarios of future change. A novel ***scenario repository*** (reference framework) will be used to identify robust technologies to enhance urban ecosystems in different international case studies. Moreover, the assessment of urban wetland systems located in climate control chambers simulating future climatic scenarios would greatly help to refine the scenario repository with real and not estimated data.

1.3. Objectives and overview of the proposal

RainSolutions aims to develop an ***integrated framework of methodologies to assess NBS*** for the ***restoration and rehabilitation of urban water resources systems***. The objectives are as follows:

a. to identify ***stakeholder and urban ecosystem needs*** to inform planning/design (addressing WP1,2&4; see below);
b. to review and capitalize upon ***existing experiences of good practices*** (addressing WP1–4);
c. to ***simulate the impact of climate variability*** and existing urban infrastructure on NBS within scaled ***pilot laboratory and field installations*** (addressing WP2,3&5);
d. to develop an integrated ***indicator system*** for the evaluation of key NBS in terms of closing the ***water quantity and quality*** gap addressing also ***socio-economic*** aspects such as well-being and costs (addressing WP2,4&5);
e. to map ***ecosystem services*** delivered by NBS for an evaluation of the best technology to implement in different urban contexts to support sustainable water management (addressing WP1–6);
f. to create a ***NBS planning and design framework supported by machine learning to generate recommendations*** addressing challenges associated with climate resilience and well-being in urban areas (addressing WP5&6); and
g. to ***disseminate the self-sustainable web-based framework*** in collaboration with national stakeholders fostering the transfer of NBS knowledge ***and communicate the project impact*** (addressing WP4&7).

[1] Scholz M. (2015). Wetlands for water pollution control. 2nd edition, Elsevier, Amsterdam, The Netherlands.

RainSolutions ***addresses predominantly Theme 1*** by enabling sustainable management of water resources and developing new guidelines and knowledge management approaches. In particular, RainSolutions is concerned with ***Sub-theme 1.1*** on promoting adaptive water management for global change and ***primarily Sub-theme 1.2*** on integrative management by implementing natural water retention measures including groundwater recharge. RainSolutions also ***touches on Theme 2*** by strengthening socio-economic approaches to water management particularly for disadvantaged communities. Specifically, the consortium will address ***Sub-theme 2.1*** by integrating economic and social analyses into decision-making processes, ***Sub-theme 2.2*** by promoting the reuse of water and ***Sub-theme 2.4*** by promoting new governance and knowledge management approaches. Finally, RainSolutions will also ***focus on Theme 3*** by providing numerical tools for sustainable integrative water management, ***supporting particularly Theme 1***.

RainSolutions will enable the ***sustainable management of urban water resources*** by developing guidelines and knowledge management approaches. The focus will be on the promotion of adaptive water management for transformations such as climate change and on integrative management by implementing ***natural water retention and purification measures*** including groundwater recharge. RainSolutions will strengthen socio-economic approaches to water management. The consortium will ***integrate economic and social analyses into decision-making processes***, focusing on local stakeholder perceptions of NBS and their possibilities of promoting social inclusion as well as promoting the ***reuse of water***. Finally, RainSolutions will provide a framework for ***sustainable integrative management of urban water resources***.

1.4. Research methodology and approach

The methodology is split into eight work packages (WP; Fig. 1). WP1 informs WP2–4 supporting innovations including framework development (WP 5). Impact will be created and showcased in WP6 and WP7. RainSolutions will be managed in WP8. The team comprises the following institutions: Lund University (ULUND; supported by Malmö Stad (MALMO) as a subcontractor), University of Johannesburg (UJ), University of Pretoria (UP), VESI Environmental (VESI), Federal University of Technology (UTFPA), Arctic University of Norway (UIT; supported by the Centre for Sustainable Development and Innovation of Water Technology (CSDI) as a subcontractor; see attached letter of support), Wageningen University (WUR), Técnica y Proyectos S.A. (TYPSA; see attached letter of support), University of Tartu (UT) and Danube Delta National Institute for Research and Development (DDNI).

WP1. Building on existing knowledge to support ***Themes 1.1, 1.2, 2.1, 2.2 and 2.4*** (led by UT; supported by all partners, except TYPSA for theme 2.1). Starting from the current state-of-the art of NBS in urban areas, this WP intends to explore existing successful implementations of the key nature-based technologies and challenges of their implementation, and investigate stakeholder and end user's attitude to adopt the NBS, as a way to identify catalysers, but also the main barriers such as costs, which were limiting the installation in urban areas. The WP will assess previous projects concerning social inclusion through NBS, and assess existing guidelines for planning and design of the different cost-effective solutions, as well as the potential for their transferability and training.

WP2. Improving landscape, environmental and water quality aspects of urban water resources to support ***Themes 1.1 and 1.2*** (led by DDNI; supported by WUR, VESI, UJ and ULUND). This WP is concerned with NBS for integrated and ecologically coherent urban landscape planning. The main task is to identify appropriate up-to-date ***indicators*** for evaluation of ecosystem services of key NBS implementation.

Ecological characteristics of the sites will be assessed and a review of knowledge about ecosystem restoration in urban water as well as their success and failure from the ecosystem point of view will be performed. Connectivity between existing, modified and new ecosystems as well as restored and rehabilitated ecosystems will be the focus. Indicators to measure the positive impacts of the selected blue-green solutions on the urban ecosystems will be identified, and will include water purification, water supply, habitat improvement, aquatic flora and fauna enhancement, microclimate regulation, food and organic matter production, waste disposal, as well as the improvement of green and blue corridors.

WP3. Increasing urban resilience to climate pressures to support ***Themes 1.1 and 1.2*** (led by WUR; supported by UIT, UP and ULUND). This WP integrates the multiple function of NBS to enhance urban resilience towards climate change and potential water resource depletion. A geo-spatial and temporal model will be built to support interactive, participatory planning of NBS for mitigating multiple climate-change hazards including flood, drought and combined sewer overflows in cities. Moreover, building on WP2, knowledge gaps for matching ***urban storm water supply and potential demand*** by urban ecosystem services based on water quality as well as both spatial and

temporal quantity will be identified and reflected through a participatory approach with multiple related urban actors.[2] The water quality degradation over transportation will be integrated to the model to ensure the safe re-use for urban ecosystem services. New insight into the scientific process such as the use of NBS for mitigating flood and combined sewer overflows, the minimisation of water quality degradation during transportation and quality-oriented non-portable water reuse within the city will be addressed via geo-spatial modelling and validated via field monitoring.

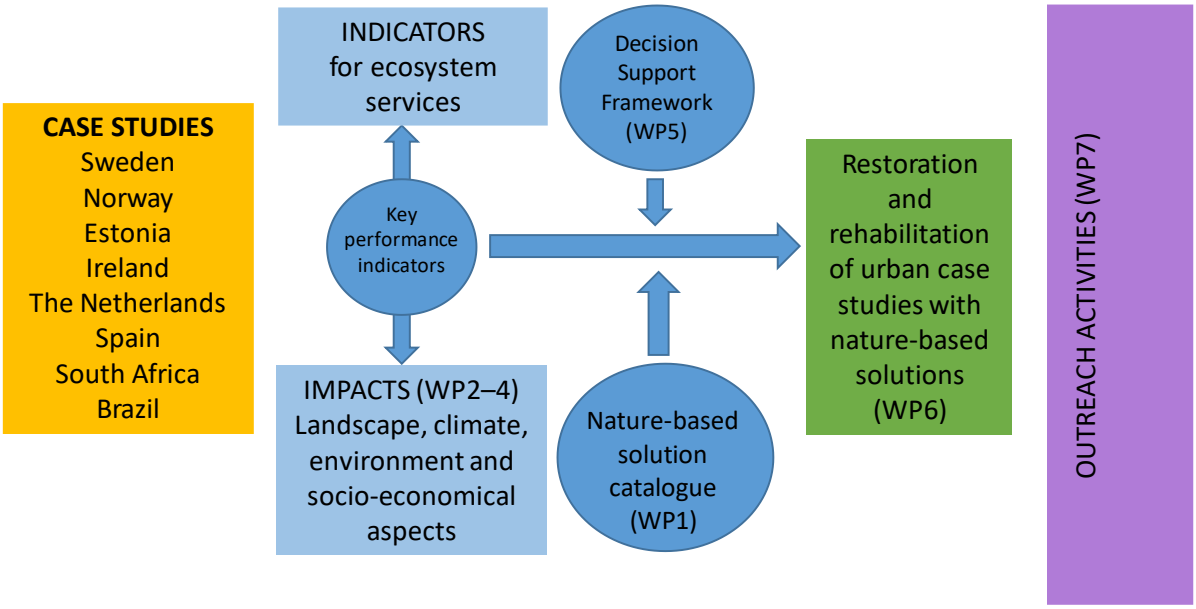


Fig. 1. Work package (WP) outline

WP4. Legal and institutional arrangements to sustain NBS for social inclusion to support ***Themes 2.1, 2.2 and 2.4*** (led by UIT; supported by all partners, except WUR and TYPSA for theme 2.1). The main task is to identify up-to-date ***indicators*** for the evaluation of the societal benefits of NBS particularly in socio-economic challenging neighbourhoods. Indicators will mainly be concerned with the planning stage and may include community acceptance and increased amenity as a surrogate measure of increased community well-being.

A large-scale review of existing knowledge about ***legal guarantee, institutional arrangement, human perception in ecosystem restoration and rehabilitation*** concerning NBS, their success and failure, from a viewpoint of policy development, governance and sociology will be assessed. Methods will be developed to evaluate how fair and equitable benefits from urban waters are shared between cities and peri-urban areas, between rich and poor, between development and protection and among water-related sectors and how these could be sustained.

A legal framework, institutional arrangements and sociological analyses of ***fair and equitable allocation of benefits and responsibilities*** of urban restoration projects as well as their procedural aspects will be developed. Specific attention to NBS as sustainability innovations will be paid to. RainSolutions will build societal capacity to increase the shared responsibility among people.

WP5. Integrated framework development to support ***Theme 3*** benefitting particularly ***Themes 1.1 and 1.2*** (led by UIT; supported by all partners, except WUR). This WP will focus on the development of the integrated framework for NBS assessment. ***The framework will contain a toolbox type repository of tools, methods, technologies and standards/guidelines*** developed in WP2-5. The aim is to customise all this to ***support urban planners, consultants and other stakeholders/end-users in making decisions*** concerning the planning and design of NBS at various scales. The central part of the framework (open access) will be a decision support type tool that will enable selection of optional intervention strategies by using multiple criteria based on wide-ranging benefits and costs identified in WP2-5.

[2] Voskamp et al. (2016). Space-time information analysis for resource-conscious urban planning and design: A stakeholder based identification of urban metabolism data gaps. Resour. Conserv. Recy., 128:516-525.

The selection of optimal solutions will be based on the ***multi-criteria decision analysis*** type methodology such as ***analytical hierarchy process*** and ***compromise programming*** thus supporting different types of stakeholder preferences. The tool will also provide support for modelling multiple scenarios of different possible futures and will enable identifying the robust and resilient solutions for the prevention of further degradation, rehabilitation and maintenance of urban and peri-urban ecosystems and the related ecological coherence and integrity of cities.

WP6. Framework application to selected case studies to support all selected themes (led by case study leaders (see section 2.1.7) but VESI takes the overall responsibility)**.** This WP assesses the potential of NBS implementation for restoration and rehabilitation of urban ecosystems. This will be done by using the framework developed in WP6. The WP lead will develop a testing protocol to ensure that similar information will be collected from all case sites.

WP7. Dissemination, stakeholder engagement and communication to support all selected themes (led by ULUND; supported all partners). This WP deals with ***dissemination, awareness raising and outreach activities*** including participatory approaches from all stakeholders and education of citizens about the benefits of nature for their social, economic and cultural well-being.

WP8. Project management and coordination to support all selected themes (led by ULUND). ULUND, UIT, WUR and DDNI form a ***Project Coordination Group***, which will have collective responsibility concerning strategic issues of the consortium including work package definition and distribution, budget and task allocations, cooperation and communication within and outside the consortium as well as project output and deliverables.

1.5. Originality and innovative aspects of the research (ambition)

RainSolutions will develop new technological solutions for restoration and rehabilitation of urban water resources. There is a ***missing knowledge link between NBS benefits, sustainable water resources management and global change***.[3] In this regard, information collected from real NBS already in place and from experimental research-oriented installations at the laboratory scale is limited and rather incomplete.[4]

The new approaches to be developed as part of RainSolutions will be integrated into a framework, which can be described as a ***computer-based interactive human-computer system*** used by decision-makers, utilising data, concepts and models, solving problems with varying degrees of structure, and finally focusing on the overall impact rather than efficiency in decision-making. The framework comprising new technologies and innovative solutions as well as governance, policy and business models will be designed to ***interactively support*** the planning and design phases of an organisation's decision-making process concerning NBS system development.

The decision-making tool will be supported by ***key system design criteria and related performance indicators***. Indicators based on parameters such as water level change, runoff, soil moisture content, temperature, as well as parameters to describe social phenomena/modifications and biodiversity will be used to build the tool. Indicators to describe the regulating ***ecosystem services***[5] such as climate regulation and water management will be identified.

Successful international NBS solutions will be assessed. An evaluation of the levels of technology readiness will be carried out by taking into account the profound differences among cities in partner countries concerning aspects such as diverse urban texture patterns, available space for NBS implementation, the type of ecological habitats, citizens' attitude, way-of-live and climate. The expected ***technology readiness levels*** are between 3 and 7.

1.6. Quality of transfer of knowledge for the development of the consortium partners

Various partners of the consortium will gain new knowledge from this new collaborative effort. Furthermore, they will also benefit from previous experience in projects related to the research objectives (Table 1).

1.7. Quality of the consortium and capacity to reinforce a position of leadership

Table 2 provides information on the level of experience on NBS research topics and the track record based on ongoing and recently concluded work, namely participation in projects, publications, patents and other relevant results. All partners will gain the maximum knowledge and skills from this collaborative effort, because of the unique composition of theoretical and practical international expertise in NBS.

[3] McDonale et al. (2011). Urban growth, climate change, and freshwater availability. http://www.pnas.org/content/108/15/6312.short.
[4] NYC Department of Environmental Protection (2014). New York City Green Infrastructure, 2014 Annual Report, NYC DEP Publisher, New York City, USA.
[5] Mak et al. (2017). Sustainable drainage system site assessment using urban ecosystem services. Urb. Ecosyst., 20:293–307.

Table 1. Gaining of new knowledge from RainSolutions and previous projects

Partners	Knowledge transfer pathways	
	Directly through RainSolutions	Indirectly through previous projects relevant to the objectives of RainSolutions
Lund University	Simulation of the impact of climate variability (objective (c)); development of an integrated indicator system for the evaluation of key NBS (objective (d)); test development for ecosystem services (objective (e)); creation of a design framework supported by novel methods including machine learning techniques (objective (f)).	AquaTerra (FP6) findings on catchment management communicated via Wageningen University and Research; ANA/Capes project findings on climate change communicated via the Federal University of Technology; REAGRITECH (LIFE11) outcomes on irrigation with runoff informed by Técnica y Proyectos S.A.; various integrated constructed wetland project outcomes communicated by VESI Environmental Ltd.; EU Asia-Pro Eco Project entitled Oasis-hydrosphere-desert Interaction Influencing Overall Economic development.
University of Johannesburg	Understanding of how to simulate the impact of climate variability (objective (c)); development of an new integrated indicator system for the evaluation of key NBS (objective (d)); test for ecosystem services delivered by NBS (objective (e)).	REAGRITECH (LIFE11) outcomes on irrigation with runoff informed by Técnica y Proyectos S.A.; two ongoing Swedish Formas projects on NBS and urban challenges such as flooding; EU Asia-Pro Eco Project with the title Oasis-hydrosphere-desert Interaction Influencing Overall Economic development; EU-Acqeau project FloodView.
University of Pretoria	Simulation of the impact of local and regional climate variability on NBS with relevance to South Africa (objective (c)).	ANA/Capes project findings on climate change communicated via the Federal University of Technology; EU Asia-Pro Eco Project: Oasis-hydrosphere-desert Interaction Influencing Overall Economic development; ANA project evaluating the relative role of climate and land use changes on rivers and streams (Federal University of Technology).
VESI Environmental Ltd.	Stakeholder need identification and benefit from existing experiences (objectives (a) and (b)); test for ecosystem services delivered by NBS (objective (e)).	VINNOVA project findings on NBS disseminated by Lund University; two ongoing Swedish Formas projects on NBS and urban challenges such as flooding of relevance to Ireland; EU-Acqeau project FloodView.
Federal University of Technology	Learning how to simulate of the effect of climate variability (objective (c)); contributing to the development of an integrated indicator system for the evaluation of key NBS (objective (d)); ecosystem services concept (objective (e)).	REAGRITECH (LIFE11) outcomes on irrigation with runoff informed by Técnica y Proyectos S.A.; Urban Pulse I on urban metabolism; The Street of the Future on urban water and energy infrastructure redesign; EU-Acqeau project FloodView.
Técnica y Proyectos S.A.	Stakeholder need identification and benefit from existing experiences (objectives (a) and (b)) of relevance to Spain; development of an integrated indicator system for the evaluation of key NBS (objective (d)); ecosystem services indicator development (objective (e)).	AquaTerra (FP6) findings on river management communicated via Wageningen University and Research; VINNOVA project findings on NBS disseminated by Lund University; various integrated constructed wetland project outcomes communicated by VESI Environmental Ltd.: Oasis-hydrosphere-desert Interaction Influencing Overall Economic development (EU Asia-Pro Eco Project); EU-Acqeau project FloodView.

Table 1 (cont.)

Arctic University of Norway	Widening of modelling expertise by simulation of the impact of climate variability and creating a platform on NBS (objective (c)); supporting the development of the proposed design framework benefiting from machine learning (objective (f)).	ANA/Capes project findings on the modelling of physical changes (Federal University of Technology); Urban Pulse I on urban metabolism; The Street of the Future on urban water and energy infrastructure redesign; EU-Acqeau project FloodView.
Wageningen University and Research	Directly benefiting from the simulation and validation research concerning the impact of climate variability and existing urban infrastructure on NBS planning (objective (c)); learning from and utilising the identified urban ecosystem demands; access to integrated indicator system development that can be applied to evaluate important NBS (objective (d)).	ANA/Capes project findings on climate change (Federal University of Technology); VINNOVA project findings on NBS disseminated by Lund University; two ongoing Swedish Formas projects on NBS and urban challenges such as flooding; ANA project using a hydrological model as a tool to evaluate the relative role of climate and land use changes on rivers and streams (Federal University of Technology); EU-Acqeau project FloodView.
University of Tartu	Learning from climate variability modelling with new techniques (objective (c)); directly benefitting from the development of an integrated indicator system for the evaluation of key NBS (objective (d)); ecosystem services concept development (objective (e)).	AquaTerra (FP6) findings on land-water interactions (Wageningen University and Research); VINNOVA project findings on NBS disseminated by Lund University; numerous integrated constructed wetland project outcomes (VESI Environmental Ltd.); two ongoing Swedish Formas projects on NBS and urban challenges such as flooding; EU-Acqeau project FloodView.
Danube Delta National Institute for R&D	Stakeholder and urban ecosystem needs identification (objective (a)); climate variability and change modelling (objective (c)); development of an integrated indicator system for the evaluation of NBS relevant for the Danube Delta (objective (d)); design framework creation supported by machine learning techniques (objective (f)).	AquaTerra (FP6) findings on the Danube Delta management (Wageningen University and Research); ANA/Capes project findings on catchment management (Federal University of Technology); various integrated constructed wetland project outcomes communicated by VESI Environmental Ltd.; ANA project using a hydrological model as a tool to evaluate the relative role of climate and land use changes on rivers and streams (Federal University of Technology)

Table 2. Summary of the quality and capacity of consortium partners in the field of nature-based solutions (NBS)

Partner	Existing experience	Track record in terms of previous and current projects, publications, patents, etc.
Lund University	Internationally leading research on NBS with particular reference to wetlands and sustainable drainage systems; ongoing international project participation on NBS in urban settings and NBS solutions for urban flooding.	Long history of successful EU cooperation within INTAS, INCO, ASIA Pro Eco and Horizon2020; long track record based on wetland and sustainable drainage research projects; VINNOVA project findings on NBS; two ongoing Swedish Formas projects on NBS; 400 relevant journal publications.
University of Johannesburg	Nationally leading in hydraulic engineering.	Recent track record on relevant research projects.

Table 2 (cont.)

University of Pretoria	Nationally recognised research in meteorology.	Long track record on relevant climate change projects.
VESI Environmental Ltd.	Nationally leading expertise in implementation of integrated constructed wetlands.	Long track record and designing, constructing and monitoring of integrated constructed wetlands supported by journal paper publications; flagship wetland projects with Irish Water (water utility).
Federal University of Technology	Nationally leading research on NBS as part of integrated water resources management.	Research projects concerned with decentralised wastewater treatment and water quality challenges; various ANA/Capes project findings.
Técnica y Proyectos S.A.	Nationally leading expertise in the implementation of NBS particularly in semi-dry areas.	Projects on groundwater protection and regeneration and reuse of runoff and drainage water in agricultural plots using NBS; REAGRITECH (LIFE11) outcomes on irrigation with runoff.
Arctic University of Norway	Internationally leading in simulations and modelling with tools related to NBS.	Internationally leading track record on complex modelling of processes; several multi-million Euro mega projects.
Wageningen University and Research	Internationally leading research on NBS and particularly water and soil quality management within the wider urban catchment.	Internationally leading track record of winning research funding for water and soil research related to NBS; nationally leading organisation for NBS planning and implementation in cities (Amsterdam, Almere, Utrecht, Nieuwegein, etc.).
University of Tartu	Internationally leading research on wetland ecology and hydrology.	Internationally leading track record on research grants and corresponding publications on wetland ecology research.
Danube Delta National Institute for R&D	Nationally leading research on wetlands within the Danube Delta.	Research on biodiversity, algae, aquatic monitoring, impact studies and ecological reconstruction related to the Danube Delta.

2. IMPACT

2.1. Impact of the proposal

2.1.1. Contributions to the goals of the Call

RainSolutions directly contributes to the goals of the call by (a) enabling sustainable management of water resources by developing ***new guidelines and knowledge management*** approaches; (b) promoting ***adaptive water management*** for global change; (c) supporting the ***integrative management*** by implementing natural water retention measures including groundwater recharge; (d) ***strengthening socio-economic approaches*** to water management (Fig. 2); (e) ***integrating economic and social analyses into decision-making*** processes; (f) promoting the ***reuse of water***; (g) enhancing ***new governance and knowledge management*** approaches; and (h) providing numerical tools for sustainable ***integrative water management*** (Fig. 2).

2.1.2. Added-value of the collaboration

RainSolutions provides transnational added-value to the collaboration between consortium partners by allowing the networks of each partner to interact with each other. As a result, new innovations and business opportunities based on new partnerships are being developed. Mutual learning on urban water resource management and use of NBS in cities through the case study cities will take place (Fig. 2).

2.1.3. Mid- and long-term benefits of this collaboration

RainSolutions will lead to mid- and long-term collaborative benefits. The case study areas and corresponding societies will benefit mid-term. Other areas (business development) will benefit long-term based on the lessons learned during the case study tests.

2.1.4. Plans for continued networking after the project end

The consortium plans for the continued networking and knowledge sharing after the conclusion of RainSolutions. This will be achieved by applications of the entire or parts of the consortium for new related grant applications and commercialisation of innovations developed further during the project.

2.1.5. European and International dimension of the research methodologies

RainSolutions has both European and International dimensions of the proposed research methodologies and approaches, because partners are based in ***Northern, Central, Southern and Eastern Europe, South Africa and Brazil***. It follows that the research approaches and methods are being internationally tested, benefiting from addressing various boundary conditions.

Fig. 2. Tartu case study 3: Expected impact (see support letter).

2.1.6. Added-value of the consortium to Water RDI

RainSolutions provides added-value of the consortium to the three pillars of the Water RDI Roadmap: research on NBS, human capacity development in all case studies, and deployment of innovation in selected case studies. The roadmap includes development of new NBS, participatory-based planning and testing of NBS, demonstration of new technologies, optimal positioning of innovations in the market place, and deployment of new solutions in case studies, technology know-how development and transfer.

2.1.7. Impact of the innovative solutions on business, social wellbeing and environment

RainSolutions will demonstrate impact for these case studies: Case Study 1 – ***Sustainable Drainage Systems in Malmö and Lund Region*** (led by MALMO and supported by ULUND in collaboration with Sweden Water Research, a water utility industry-association). Case Study 2 – ***Tromsø, Northern Norway*** (led by UIT). Case study 3 – ***Tartu*** (see attached letter of support)***, Estonia*** (led by UT; Fig. 2). Case Study 4 – Irish case studies such as ***Waterford*** and ***Tolka Valley Park, Dublin*** (see attached letters of support), ***Ireland*** (led by VESI). Case study 5 – Participatory planning of NBS for urban resilience in the ***Amsterdam Metropolis, The Netherlands*** (led by WUR, but not addressing themes 2.2 and 3) in collaboration with Amsterdam Institute for Advanced Metropolitan Solutions (see attached letter of support), Amsterdam Rainproof at Waternet (see attached letter of support), Amsterdam water managing company and Deltares. Case Study 6 – ***Parets del Vallés City, Spain*** (led by TYPSA in collaboration with the Catalan Water Agency to undertake pond technology-based experimental and modelling development work benefiting industry as well). Case Study 7 – ***Johannesburg and Pretoria, South Africa*** (led by UJ and supported by UP). Case Study 8 – ***Londrina, of Paraná, South Region, Brazil*** (led by UTFPA). These case studies have been selected based on different latitudes, climate conditions and urban needs. The implementation of RainSolutions will lead to ***restored and functioning sustainable water resources*** with an enhanced capacity to deliver their services. The main challenges of ***droughts and flooding*** will be mapped. The future handling of these challenges concerning ***hydrological performance, water purification, water supply, habitat improvement, enhancement of microclimate and recreational facilities*** will be improved. RainSolutions will advance ***laws and policies*** promoting cost-efficient implementation based on cost and benefit as well as driver and barrier assessments.

The above will be achieved via stakeholder engagement (addressing objectives a, b and g of this proposal), which, in turn, will ensure a ***participatory multi-stakeholder process*** that will result in ownership of solutions and visionary planning. All deployed solutions will be locally attuned to ensure that they are customised to local conditions and meet stakeholder expectations. The most promising NBS for each case study will be screened and performance indicators identified. A strength, weaknesses, opportunities and threats analysis for each city will be undertaken to

identify missing pieces in creating a truly holistic and integrated approach to improving water and climate change resilience as well as enhancing ecosystem service (objectives c–e).

RainSolutions will undertake an impact quantification exercise in agreement with the impact evaluation framework to support planning of NBS.[6] Key performance indicators will be used to ***qualify and quantify the identified project impacts***. The indicators will be developed covering the restored water resources, costs and benefits of NBS, and the development phases of guidelines. They will include increased number of infrastructure projects, number of citizens aware of solutions, reduced floods and number of citizens benefitting socially from the project.

Public acceptance is likely to be high, particularly where RainSolutions has a high visibility such as regions where RainSolutions innovations will be tested. However, the potential barriers and obstacles that may limit the achievement are (a) the socio-economic and cultural differences in implementation and participation, (b) securing data from water service authorities, and (c) differences in water quality evaluation approaches and standards on drinking water and other uses in different regions and countries. RainSolutions is aware of these challenges and pays special attention to avoid lack of communication and misunderstandings, moderating and harmonizing the international cooperation. Our approaches are participatory, collaborative and engaging with users and consumers.

2.2. Expected outputs

2.2.1. Publications including books

RainSolutions will disseminate the academic project findings via ***peer-reviewed high impact journals*** such as Water, Bioresource Technology, Ecological Engineering, Environmental Modelling and Software, and Journal of Hydrology. Furthermore, key findings will be published in new chapters of the third edition of Prof. Scholz's current textbook[1] published by Elsevier (objective g).

2.2.2. Communications in meetings

RainSolutions will address the following expected impacts of the call by their case study work: ***Bring together international stakeholders in sustainable water resources actions***. Partners participating in the RainSolutions consortium ensure a high level of collaboration with national stakeholders (e.g., Swedish Water in the South of Sweden) in dissemination activities given that many cities belong already to active support networks. The project will create a NBS catalogue describing technologies and experiences. Key performance indicators are number of stakeholders involved in the networking events, number of cities attending the workshops, etc. (objective g).

2.2.3. Reports

Increase evidence concerning the benefits from restored urban water systems. RainSolutions will provide a wide range of evidence-based knowledge regarding NBS that were successful (objective b). RainSolutions will organise this knowledge using a catalogue of best practice for stakeholders. Key performance indicators: number of technologies, etc.

2.2.4. Organisation of events

Increase awareness of the benefits delivered by restored ecosystems (objective g). This will be achieved with the creation of tools (objective f) to foster the public participation in decision processes of designing and planning of NBS (e.g., Living labs, Communities of Practices, winning-twinning workshops, web-based surveys, etc.). Key performance indicators: number of identified social groups within cities engaged during the project through workshops, training and dissemination events, number of social media followers, etc.

2.2.5. Advanced training and academic achievements from an educational standpoint

RainSolutions will offer ***continuous professional development*** (CPD) courses (open to the public) on NBS linked to core project findings such as the framework and practical applications in case studies. Depending on national regulations, some members will obtain accreditation from professional bodies and universities for these CPD events. Furthermore, experiences from the project will be used in coursework and master programmes (e.g., SIDA MFS) will be initiated, which contribute both to education and data collection/research. On-going PhD students will benefit from data and experiences, and post-docs will subsequently be initiated.

[6] EKLIPSE (2017). https://ec.europa.eu/research/environment/pdf/renaturing/eklipse_report1_nbs-02022017.pdf.

2.2.6. Software applications including models

Creation of guidelines for cost-effective urban water resources restoration and ecological rehabilitation measures (objective f) such as an evidence-based geo-spatial model integrating multiple functions of NBS for supporting participatory NBS planning. RainSolutions will create a decision-support framework, etc. (objective g).

2.2.7. Prototypes, pilot plants and patents

Creation of new NBS business models supported by the framework (objective f). International cooperation between project partners will represent a bridge for market opportunities.

2.2.8. Mobility schemes

RainSolutions will give members of the participating institutions, contractors and collaborating municipalities the opportunity to benefit from funds to support their mobility for ***training and knowledge transfer*** (objective g).

2.3. Exploitation and communication activities (measures to maximise impact)

2.3.1. Communication and public engagement strategy

RainSolutions ensures that project results are disseminated and exploited via appropriate communication channels, transfer routes into other research and innovation settings and industrial commercialisation. These measures will be supported by a ***communication and public engagement strategy*** outlining guidelines on dissemination of the research results, exploitation of the findings and intellectual property rights.

2.3.2. Business and investment cases

An ***advisory board*** supported by industry associations such as Sweden Water Research will help RainSolutions in making strong ***business and investment cases for NBS*** based on the benefits from restored urban water resources with regard to clean water, urban liveability, climate change resilience, social inclusion, urban regeneration, public health and well-being. The project will increase the potential and sustainability of existing technologies for application in developing countries such as South Africa and Brazil. RainSolutions will monitor the project progress and develop a comprehensive set of indicators for measuring the impact across different beneficiaries and mechanisms, all with the aim to ensure that the project objectives are achieved and the outcomes are successfully transferred from pilot sites. The business and investment case will be based on RainSolutions delivering the societal impact across the following key categories and mechanisms knowledge, economy, people and society (see below).

2.3.3. Knowledge impact category

Knowledge benefitting ***Themes 1.1., 1.2, 2.1, 2.2, 2.4 and 3:*** RainSolutions will deliver new knowledge and related tools and guidelines for innovative planning and assessment of NBS as part of sustainable water systems. This will be achieved by conducting the proposed research and innovation work. The communication and public engagement strategy (see above) outlines knowledge management and protection including measures to provide open access to peer-reviewed scientific publications by a dedicated RainSolutions on-line platform publishing final drafts of all publications. Moreover, all relevant information will be made available to the wider community of experts from research and practice as well as the interested public and decision-makers. Targeted knowledge products will be developed for the different audiences informing them about the benefits of NBS and the proposed evidence-based framework. The RainSolutions platform will also facilitate expert knowledge exchange.

2.3.4. Economy impact category

Economy benefitting ***Themes 1.1., 1.2, 2.2 and 3*****:** RainSolutions will generate 'green' companies and jobs. By employing an effective methodology on the planning and design of NBS, and developing an associated resource database, RainSolutions will become a reference framework for future solution deployment. This will facilitate the growth of small businesses providing NBS and services, and creating new local green jobs in the process. By adopting a truly holistic and integrated approach, RainSolutions strives towards the reduction of uncertainty for potential investors in blue-green solution deployment, and contributes to standards and policies, reducing barriers. All monitoring data generated through the lifetime of the project will be shared with the public via open access annotated databases to advance research, foster innovation and to promote the research results. Only data linked to commercial products cannot be made immediately available, and embargo periods will be negotiated with the funding body.

2.3.5. People impact category

People benefitting ***Themes 1.1., 1.2, 2.1 and 2.2:*** By stimulating mutual exchange and learning, trans-national cooperation via RainSolutions will increase skills of employees. This will enable enterprises to implement innovative products, services and/or processes contributing to the respective regional smart specialisation strategies. Innovative learning systems, jointly developed at transnational level, will contribute to targeted improvement of skills; thus increasing regional competitiveness. Joint approaches on a trans-national basis will support entrepreneurship by building competences and promoting entrepreneurial mind sets and initiatives. Next to economically driven innovation, improvement of skills and entrepreneurship will contribute to advancing social innovation. Innovations will meet social needs and improve the capacities to manage challenges such as migration and brain drain. The project will also ensure the assessment of NBS that are appreciated by local inhabitants, which will increase NBS success, spreading good case study example experience through the RainSolutions dissemination strategy.

2.3.6. Society impact category

Society benefitting ***Themes 1.1., 1.2, 2.1, 2.2 and 2.4:*** By including social inclusion as an aspect of implementing NBS, the society as a whole will benefit via substantially improved quality of life and well-being due to innovative NBS used which, in turn, will help reduce the risk of flooding and droughts whilst restoring urban ecosystems and adding to the amenity value of the urban environment. The new guidelines and recommendations are expected to ultimately make its way into new policy.

2.4. Market knowledge and economic advantages/return of investment

The potential market for the new knowledge and innovative technological solutions and services for NBS in Europe and worldwide is fast and likely to increase rapidly in the future, particularly for areas where climate change and human building activities lead to greater runoff. However, the nature of this market also sees an increase in international competitors. RainSolutions will provide a considerable economic advantage for the project partners in terms of return of investment and synergies with other products and services. The tool- and technology-related activities will contribute to collaborative research, development and innovation, ***supporting particularly small enterprises developing products*** further in an international context.

3. IMPLEMENTATION

3.1. Overall coherence and effectiveness of the work plan

RainSolutions has established a coherent work plan based on eight effective work packages (WP) to which tasks and resources have been allocated in an optimal way to achieve the outlined impact. Corresponding work package descriptions are summarised in Table 3. The first four WP inform WP5, where the framework is being developed. The output of WP5 will be tested in WP 6. Table 4 highlights the associated key deliverables and milestones of the project. Moreover, Table 5 shows the project GANTT Chart indicating the timings for various actions.

Table 3. Work package (WP) descriptions.

WP	WP Title	Duration (months)	Starting Month	End Month	WP Description
WP1	Building on existing knowledge	6	1	6	Analysis of existing successful implementations of key nature-based technologies to build a common international knowledge base regarding best practice.
WP2	Improving landscape, environmental and water quality aspects of urban water resources	9	6	14	Assessment of NBS for integrated and ecologically coherent urban landscape planning, and identification of appropriate up-to-date indicators for evaluation of ecosystem services of key NBS implementations; provision of key information to WP5.
WP3	Increasing urban resilience to climate pressures	9	6	14	Assessment of the hydrologic and hydraulic aspects of NBS to enhance resilience to urban floods and droughts toward more climate proof cities; provision of key information to WP5.

Table 3 (cont.)

WP4	Legal and institutional arrangements to sustain NBS for social inclusion	9	6	14	Identification of justifiable and latest indicators for the evaluation of the societal benefits of NBS; key emphasis will be on the support for socio-economic deprived neighbourhoods; provision of key information to WP5.
WP5	Integrated framework development	13	12	24	Development of an integrated framework for NBS assessment containing a toolbox type repository; key information input from WP 1 to 4.
WP6	Framework application to selected case studies	19	15	33	Assessment of NBS for restoration and rehabilitation of representative urban case study ecosystems; application of the framework and feeding-back of information to WP5 for subsequent improvements.
WP7	Dissemination, stakeholder engagement and communication	36	1	36	Dissemination, awareness raising and outreach activities including education of citizens about the benefits of nature; focus on case study areas and regions (particularly deprived neighbourhoods)
WP8	Project management and coordination	36	1	36	Collective responsibility of the Project Coordination Group concerning strategic issues of the consortium and the day-to-day management activities.

3.2. Appropriateness of the management structure, procedures and quality management

RainSolutions will implement three tiers of management: ***project co-ordinator*** (PCO), ***project management team*** (PMT) and ***WP leaders***. The PCO is Miklas Scholz representing ULUND as the PI and UJ as a co-investigator. Miklas will be responsible for the overall coordination, planning and control of the project, the use of resources and funds in accordance with the budget and the directions given by the commission.

The ***project co-ordination team*** (PCT) will be led by Miklas Scholz who will be responsible for the consortium management and moderating the project process. Other PCT members are Prof. Ronny Berndtsson (LU, project reporting), Dr Linus Zhang (LU, financial management), Prof. Mojtaba Moatamedi (UIT, advisory board coordination), Prof. Huub Rijnaarts (WUR, industry coordination), Dr Liliana Török (DDN, case study coordination).

Table 4. Deliverables, milestones, progress monitoring, mobility scheme and risk assessment.

Work Package (W) Number	Deliverables (D)	Milestones (M)	Progress Monitoring (P)	Mobility Scheme (S)	Risk Management (R)
W1	D1. Report summarising the state-of-the-art and gaps in knowledge regarding case studies, nations and international scene.	M1. Understanding the assessment of the current state-of-the-art.	P1. W1 report draft assessment and feedback.	S1. Visits by W1 participants to assess different regional practices informing WP2 to 6.	R1. Recommendations regarding P1 to improve progress in WP2-4; measures to ensure an international review.
W2	D2. Report on environmental improvements evidenced by indices through NBS benefitting case studies and partner countries.	M2. Provision of information for framework development (WP5).	P2. W2 report draft assessment and feedback.		R2. Recommendations regarding P2 to improve progress in WP5.
W3	D3. Report and a prototype of geo-spatial model (to be delivered to WP5) on urban resilience benefitting case studies and partner countries.	M3. Provision of information for framework development (WP5).	P3. W3 report draft assessment and feedback.		R3. Recommendations regarding P3 to improve progress in WP5

Table 4 (cont.)

W4	D4. Report on NBS benefitting social inclusion, particularly in case studies located in deprived areas and partner countries.	M4. Provision of information for framework development (WP5).	P4. W4 report draft assessment and feedback.		R4. Recommendations regarding P4 to improve progress in WP5.
W5	D5. Framework provision based on input from WP1 to 4.	M5. Framework ready for case study testing.	P5. Framework draft assessment.		R5. Recommendations regarding P5 to improve progress.
W6	D6. Report on case study applications of the framework and recommendations for improvements to be undertaken in WP5 (iterative consultation process between WP).		P6. W6 report draft assessment.	S2. Visits by W6 participants to assess the framework application in different case studies.	R6. Recommendations regarding P6 to improve progress.
W7	D7. Communication and public engagement strategy plan delivery. D8. Initial public engagement consultations case study areas. D9. Final public engagement consultations case study areas. D10. Journal review paper summarising the state-of-the-art and gaps in knowledge. D11. Journal paper(s) on outcomes of W2 to W4. D12. Framework (open access) and journal paper(s) on framework. D13. Journal paper(s) on framework applications.	M6. Incorporation of public feedback into the framework.		S3. Mid-term public workshop. S4. Public conference.	R7. Recommendations on how to address feedback appropriately.
W8			P7 to P11. Key Project Coordination Group meetings.		

The PMT and communications platform is comprised of team leaders from each organization who will delegate tasks and deliverables between members. The ***PMT oversees the management and overall project progress*** and facilitates its review, monitoring and quality control. For example, it defines the quality control procedures to ensure that all project outputs (including reports, key journal and conference papers, presentations, promotional material) are fit-for-purpose, and conform to the project's house style.

The ***WP leaders are responsible for the technical co-ordination and quality of work*** within their WP, and will ensure activities within the WP proceed according to the project work plan. The WP leaders are also responsible for the production of the relevant deliverables and may delegate parts of this responsibility to other WP participants. The management within individual organizations is responsible for provision of assigned deliverables.

The scientific and stakeholder ***Advisory Board*** is comprised by authority representatives and scientific experts to overview the scientific activities of the project and will act as a constant review panel expressing its opinions on NBS decisions, reports and any issues on demand by the project coordinator. The advisory board will be formally appointed by the PMT and will formally meet at least once per annum over the course of the project as well as being invited to PMT meetings (Table 5). The WP and management of RainSolutions will be supported by an advisory board directing the work to ensure concrete outputs of real value.

Table 5. Project GANTT Chart showing the timings of activities.

Month/ Description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Work Package 1	W1	W1	W1	W1	W1	W1																														
Work Package 2						W2	W2	W2	W2	W2	W2	W2	W2	W2																						
Work Package 3						W3	W3	W3	W3	W3	W3	W3	W3	W3																						
Work Package 4						W4	W4	W4	W4	W4	W4	W4	W4	W4																						
Work Package 5												W5	W5	W5	W5	W5	W5	W5	W5	W5	W5	W5	W5	W5												
Work Package 6															W6	W6	W6	W6	W6	W6	W6	W6	W6	W6	W6	W6	W6	W6	W6	W6	W6	W6	W6			
Work Package 7	W7	W7	W7	W7	W7	W7	W7	W7	W7	W7	W7	W7	W7	W7	W7	W7	W7	W7	W7	W7	W7	W7	W7	W7	W7	W7	W7	W7	W7	W7	W7	W7	W7	W7	W7	W7
Work Package 8	W8	W8	W8	W8	W8	W8	W8	W8	W8	W8	W8	W8	W8	W8	W8	W8	W8	W8	W8	W8	W8	W8	W8	W8	W8	W8	W8	W8	W8	W8	W8	W8	W8	W8	W8	W8
Deliverable			D7		D1		D10			D8			D2/3/4		D11								D5		D12		D9				D6		D13		
Milestone						M1								M2/3/4										M5					M6						
Progress Monitoring				P1				P7		P2/3/4						P8			P5					P9			P6					P10			P11
Mobility Schemes			S.1															S4							S2								S4		
Risk Management					R1						R2/3/4										R5								R6				R7			
PMT meetings	1									2										3								4						5		
AB meetings		1													2											3										

W, work package; D, deliverable; M, milestone; S, mobility scheme; R, risk management; PMT, project management team; AB, advisory board.

The ***financial management strategy*** is based on the approach that each partner will have its own budget based upon the support from relevant funders, as the financial support is granted at national level. Each partner will carry its own costs including expenses for travelling, meetings and exchange visits. Direct costs for field investigations will be covered by the country partner where the site is located. Some partners will sub-contract specific work to collaborating institutions such as MALMO (city) and CSDI (small company). The decision-making is milestone-driven.

The WP structure is guided by ***milestones***. The ***decision-making structure*** has been designed with the aim to facilitate the partnership cooperation between equal partners located in various countries. The appointed WP leader is responsible for the daily operation of each WP. To keep the WP together, the PMT overlooks the work and prioritizes key tasks. Any issues that cannot be resolved by the work package leader, will be discussed within the PMT and solutions will be identified. The PCO will chair the PMT meetings and report to the secretariat.

RainSolutions has ***procedures and tools*** in place for ***communication and progress monitoring.*** At least three annual group (physical) meetings and monthly progress reporting (Skype video conference). Internet resources, a water portal and the project website will be used to monthly update on progress and dissemination of findings. Both advisory board and PMT have the key responsivity to monitor the project progress.

3.3. Risk management

The consortium will adopt a clear ***strategy for risk management and progress measurement***. The most critical risks identified by the consortium are: (a) Lack of cooperation with and obtaining feedback from stakeholders due to ***insufficient knowledge transfer*** to the water sector because of resistance to change; (b) ***Resistance to change*** by parts of the society and public institutions; they may prefer to maintain obsolete but well-known technologies instead of innovations; and (3) The ***level of expertise*** of technicians and operators from public administrations and water companies might be inadequate to fully understand the correct selection procedures and implementation of innovative technologies. The proposed RainSolutions framework will deal with these challenges making sure that customers know the benefits of the proposed innovative solutions early on and those practitioners, technicians and operators will be made aware of their mechanisms, technologies, performance and impacts.

RainSolutions will manage risk by (a) encouraging an active involvement of the ***advisory board*** and the ***water industry*** (e.g., Sweden Water Research); (b) developing a ***risk register*** together with the technical group after the kick-off meeting for efficient management of major risks in the project by dedicating it to knowledge transfer support and stakeholder engagement; and (c) ***specifying risks*** associated with the work of each partner will be identified and their effect on the project will be evaluated. The technical risk register will be regularly up-dated, depending on the progress of work. If a serious risk is eminent, threatening to jeopardize the completion of a specific activity or work package (or even the whole project), appropriate follow-up meetings will be held to discuss and mitigate the risk.

Appropriate actions to deal with any major conflicts and challenges arising within the consortium concerning the implementation of the project or other matters related to the project itself will be addressed: (a) The parties will try to resolve the conflict between them in a ***friendly, informal and professional manner***; (b) If this attempt fails, the challenges will be discussed during the first scheduled consortium meeting, or if the issue is urgent, an ad hoc meeting will be convened by the project coordinator at the request of at least two partners; (c) The issue will be examined at a consortium meeting and the project coordinator will try to resolve it by reaching a consensus; and (4) If a consensus cannot be reached, decisions will be reached by majority vote, which will take place according to the rules specified in the consortium agreement.

If the problem cannot be resolved through vote or in a case where one of the parties is not in the position to accept the vote, the Commission's advice will be sought to resolve the conflict. Risks will be regularly monitored, assessed, prioritized and mitigated through periodical risk evaluations. Risk assessment and action report sections will be part of the periodical management reports (Table 5).

3.4. Potential and commitment of the consortium to realise the project

As described within the quality of the consortium partners, collaborative arrangements and capacity of the consortium to reinforce a position of leadership sections, RainSolutions integrated team has the high potential and solid commitment to successfully realise the project by close cooperation. Success is likely due to the ***long and proven track record*** of key members of the consortium, which is evident by their academic and industrial performance.

4. DESCRIPTION OF THE PARTICIPATING RESEARCHERS

Table 6 shows a list of major achievements and proven track records of team members.

Table 6. List of major achievements and proven track records of the personnel involved in RainSolutions.

Partner Number	Research Team Members	General Description
Coordinator	Dr Linus Zhang, Associate Professor in Water Resources Engineering, Lund University (ULUND)	Project leader of several EU projects on water management (e.g., FloodView); considerable experiences in low impact developments, rainwater harvesting solutions and using marginal waters in urban and peri-urban areas; 39 journal paper publications (runoff predictions and integrated water resources management)
	Prof. Ronny Berndtsson, Professor in Water Resources Engineering, ULUND	Coordinator of the National Strategic Research Area "Middle East in the Contemporary World (MECW)" that includes Metropolitan Middle East with NBS as an active water problem solver at Lund University (annual budget 1.3 mill US$); Swedish coordinator of Horizon 2020 project FASTER (Farmers' adaptation sustainability in Tunisia through excellence in research); project leader of various Swedish research projects of direct relevance to RainSolutions; Google H-index of 40.
	Dr Tim Delshammar (S), Landscape Architect, City of Malmö	Formerly an academic at the Swedish Agricultural University; participant in the European Green Surge project (greensurge.eu). Now urban planner at the city of Malmö; contributions to the 'Urban Green Infrastructure Planning Guide for Practitioners' and the 'Cloudburst Plan for Malmö'; access to case study (Malmö) information including socio-economic data.
	Dr Johanna Alkan Olsson, Assistant Professor, ULUND	Environmental social scientist with ecology background; long experience in integrated water management and participatory management of natural resources (water and land) both in developed and developing countries; very good knowledge of the implementation process of NBS from a governance (law policy, institutions) perspective; experience concerning challenges of the use of NBS in socially deprived neighbourhoods.
Partner 1	Dr Stephen Nyende-Byakika, Senior Lecturer in Hydraulic Engineering, University of Johannesburg (UJ)	Five recent journal paper publications (water quality, hydraulic modelling, open channel flow, water distribution within pipes and modelling); project engineering background in consultancy.
	Dr Maria Ferentinou, Head of Department of Civil Engineering Science, UJ	Three recent grants; 10 recent journal paper publications (ground engineering, classification and indicator systems and artificial neural networks).
Partner 3	Dr Caolan Harrington, Senior Scientist, VESI Environmental Ltd. (VESI)	PhD in civil engineering (water) from The University of Edinburgh; design, installation and management of integrated constructed wetland systems across Ireland.
	Ms. Aila Harrington, Director, VESI	Designed, constructed and commissioned 100s of integrated constructed wetlands treating various wastewater types in Ireland; main contractor for Irish Water, municipalities and industries.

Table 6 (cont.)

Partner 4	Dr Marcos Jeronimo Goroski Rambalducci, Professor in Economics and Economics of the Environment, UTFPA	Coordinator of the Applied Economics Research Group; project leader for continued economic research at local and regional level; leading experience in techniques of economic valuation of environmental resources; determination of the value of direct use of an environmental resource; product price performance.
Partner 5	Santiago Sahuquillo, Project Manager of water treatment and innovation projects, TYPSA	Twenty-four years of experience in industrial and urban water treatment; management of water treatment installation constructions; start-up of installations; maintenance and control of water treatment plants for industrial and municipal customers; management of research, development and innovation projects.
	Àngel Barrero, Water Engineering Department Leader, TYPSA	More than 16 years of professional career; hydraulics, hydrometrics, dam engineering, coastal engineering; development and innovation projects; international experience in Brazil, Bolivia and Saudi Arabia; technical coordination of different projects.
	Miguel Ángel Gago, Project Manager of urban drainage and river hydraulics, TYPSA	More than 23 years of professional career; hydraulic engineering; urban drainage; river hydraulics; construction; operation of storm water tanks and storm ponds; lectures at various conferences and seminars on urban drainage, flood risk; provided workshops on water landscape management at the School of Architecture.
Partner 6	Dr Linmei Nie (S), Director, CSDI	Sustainable development and innovation of technologies; research and innovation projects; 30-years of commercial expertise.
	Dr. Tong Chang, Engineer, CSDI	SINTEF and NTNU project in eco-hydrology and eco-hydraulics; ecoregion classification; riparian assessment; aquatic habitat simulation; hydropower balancing need analysis.
	Dr. Pingju Li, Engineer, CSDI	Fluid dynamics; DAQ/analysis/model building of unsteady flow; 3D modelling; FEM analysis; big data management, analysis.
Partner 7	Dr Nora Sutton, Assistant Professor, ETE-WUR	Urban soil and water remediation; resource quality and risk in assessments circular economy; currently supervising six PhD projects on water technologies and micro-pollutant treatment and two PhD projects on urban water management; Urban Pulse II (WUR + AMS) on “Participatory-based, resource oriented urban planning for food, water and energy in the city of Amsterdam”; Funqy Water (WUR + Deltares) on “Functional, quality-sensitive planning of non-potable water reuse in cities for mitigating climate change and improving resource efficiency”; applied urban hydraulic engineering; 17 recent journal articles.
	Dr Wei-Shan Chen, Post-doctoral Researcher, WUR	Redesign the urban water infrastructure and its future transition for the application of resource-recovering waste(water) technologies in cities; two PhD projects on urban resource management: 1) DeCent: Decentralising and decoupling resource recovery at multiple temporal and urban spatial scales and 2) CURESOIL: redesign urban organic waste management chain for soil fertility and food security; part-time research fellow at AMS, working together with the Municipality of Almere, Floriade 2022 and the AMS Institute on the project “The Street of the Future”; working on project “ReStore” addressing the life cycle impact of different organic waste processing biotechnologies in Amsterdam.

Table 6 (cont.)

Partner 8	Prof. Jaak Jaagus, Professor in Climatology, University of Tartu (UT)	Climatology covering also manifestations of global climate warming, water regime changes, long-term climatic changes and creation of climate change scenarios up to the end of the 21st century; three current research projects; 11 key journal publications since 2015.
	Dr Kuno Kasak, Post-doc at the University of California, Berkeley with link to UT	Ten recent journal paper publications; Baltic American Freedom Foundation Award to become a Research Scholar at University of California (Biosphere-atmosphere interactions and feedbacks with climate change and land-use using eddy covariance flux measurements), Berkeley; Six relevant international research expeditions; PhD in Environmental Technology (Greenhouse gas emissions and water treatment efficiency in subsurface flow filters using various substrates) from the University of Tartu.
	Dr Mait Sepp, Research Fellow, UT	Research fellow at the University of Tartu; currently work on four ongoing research projects; ten journal papers since 2015; PhD on Influence of Atmospheric Circulation on Environmental Variables in Estonia; research in synoptic climatology including changes in general atmospheric circulation, cyclone activity and impact of climate change on different environmental variables.
Partner 9	Dr Zsolt Török, Senior Researcher, Danube Delta National Institute for R&D	Editor-in-Chief of Scientific Annals of the Danube Delta Institute and PETARDIA; biodiversity conservation; ecology of species of conservative interest; stock-assessment in aquatic natural resources; environmental impact assessments; led the inventory of Romanian wetlands; establishment of the Natura 2000 network in Romania; international projects on wetlands of international importance (Ramsar Small Fund); provision of the scientific background for the management plan of the Macin Mountains National Park (LIFE-Nature program).

S, subcontracted by the corresponding partner

5. CAPACITY OF THE CONSORTIUM ORGANISATIONS

Table 7 shows a description of the profile, commitment and capability of each of the participating organisations.

Table 7. Description of each of the participating organisations in this consortium.

Partner	Categories	General Description
Coordinator (Lund University)	Role and main responsibilities in the project	Project coordinator; moderation of the project progress and coordination of advisory board meetings; composing of progress reports as well as mid-term and final reports; contact to Water JPI; Work package (WP) 7 and WP8 leaders; supporting all WP; case study 1 lead; communication and knowledge dissemination of consortium findings.
	Key research facilities, infrastructure, equipment	Turnover of about EUR 800 million, of which two thirds is in research; comprehensive water, soil and chemical laboratories; four large climate chambers simulating climate change in peatlands, constructed wetlands and corresponding receiving watercourses; fieldwork site provision in collaboration with Malmö and Lund.
	Relevant publications and/or research/innovation products	Founded in 1666, the university is ranked as one of the top 100 research-led universities in the world; three highly relevant text books and more than 200 journal paper publications within the research team alone.
Partner 1 (University of Johannesburg)	Role and main responsibilities in the project	Supporting WP1, 2 and 4 to 7; case study 7 lead; hydraulic and geotechnical support; contribution to landscape, environmental and water quality research related to case studies; assessment of legal and institutional arrangements to sustain NBS for social inclusion (particularly informal settlements); integrated framework testing in case study areas.
	Key research facilities, infrastructure, equipment	Hydraulic laboratory facilities and access to demonstration case studies.
	Relevant publications and/or research/innovation products	Mainly publications in hydraulics and water resources engineering/management.
Partner 2 (University of Pretoria)	Role and main responsibilities in the project	Supporting WP1 and 3 to 7; meteorology including climate change research (temporal and spatial analysis); urban resilience to climate pressure studies; integrated framework testing.
	Key research facilities, infrastructure, equipment	Hydrology facilities and equipment; access to case studies.
	Relevant publications and/or research/innovation products	Leading publications in meteorology; most accomplished South African researcher in seasonal climate forecasting; physical and empirical prediction models for hydrological catchments.
Partner 3 (VESI Environmental Ltd.)	Role and main responsibilities in the project	WP6 leader (overall case study coordination); supporting WP1, 2 and 4 to 7; case study 4 lead; small commercial enterprise with access to wetland databases; integrated framework testing.
	Key research facilities, infrastructure, equipment	Access to 100s of field sites and wetland-related construction and monitoring equipment.
	Relevant publications and/or research/innovation products	Both academic and popular science publications; inventors of the integrated constructed wetland technology.

Table 7 (cont.)

Partner 4 (Federal University of Technology, Londrina, Brazil)	Role and main responsibilities in the project	Supporting WP1 and 4 to 7; case study 8 lead; integrated water resources management in tropical climate; assessment of legal and institutional arrangements to sustain NBS for social inclusion (deprived neighbourhoods); integrated framework testing in case study 8
	Key research facilities, infrastructure, equipment	Extreme Atmospheric Events Laboratory including a computational cluster; software suitable for water resources applications (e.g., ArcGis and SWAT); ancillary database (e.g., rainfall, streamflow and land use).
	Relevant publications and/or research/innovation products	Nationally leading publications on integrated water resources management research studies and climate change; 20 years of experience in developing the local computational facility.
Partner 5 (Técnica y Proyectos S.A.)	Role and main responsibilities in the project	Supporting WP1 and 4; case study 6 lead; knowledge exchange between academia and industry; assessment of legal and institutional arrangements; framework testing the study area.
	Key research facilities, infrastructure, equipment	Large consultancy company with access to 100s of case studies and field equipment; wide network of collaborating partners in industry.
	Relevant publications and/or research/innovation products	Plenty of technical consultancy reports and popular science articles.
Partner 6 (Arctic University of Norway)	Role and main responsibilities in the project	Advisory board coordination; WP4 and WP5 leaders; supporting WP1 and 3 to 8; case study 2 lead; taking the lead in modelling and simulation; urban resilience to climate pressures studies; integrated framework development and testing in case study areas.
	Key research facilities, infrastructure, equipment	Environmental and water laboratory and field site access; parallel supercomputers for complex and demanding modelling requirements including simultaneous engineering; computer facilities in collaboration with the University of Manchester, UK.
	Relevant publications and/or research/innovation products	Internationally leading papers on relevant modelling work in various subject disciplines; Finite Element Analysis (Taylors & Francis); editor of The International Journal of Multiphysics.
Partner 7 (Wageningen University and Research)	Role and main responsibilities in the project	Industrial partner coordination; WP 3 leader; supporting WP1, 2 and 4 to 7; case study 5 lead; integrated water resources management and decision-support framework development and research; water quality control research leader; contribution to landscape, environmental and water quality research related to consortium case studies; urban resilience to climate pressures studies; assessment of legal and institutional arrangements to sustain NBS for social inclusion; integrated framework testing in case study areas such as Amsterdam.
	Key research facilities, infrastructure, equipment	Access to well-equipped water and environmental laboratory facilities and key case studies including large fieldwork sites.
	Relevant publications and/or research/innovation products	Internationally leading publications on integrated water resources management and decision-support frameworks; water technology innovations.

Table 7 (cont.)

Partner 8 (University of Tartu)	Role and main responsibilities in the project	WP1 leader; Supporting WP1, 4, 5 and 7; case study 3 lead; also lead on NBS ecology; undertaking of a critical literature review on existing knowledge and practices; assessment of legal and institutional arrangements to sustain NBS for social inclusion.
	Key research facilities, infrastructure, equipment	Access to environmental laboratory facilities and fieldwork sites.
	Relevant publications and/or research/innovation products	Internationally leading research publications on wetlands, ecology and hydrology.
Partner 9 (Danube Delta National Institute for R&D)	Role and main responsibilities in the project	WP2 leader; supporting WP1, 4, 5 and 7; lead on landscape, environmental (particularly water ecology) and water quality research; assessment of legal and institutional arrangements to sustain NBS for social inclusion.
	Key research facilities, infrastructure, equipment	Water and environmental laboratory facility and case study access.
	Relevant publications and/or research/innovation products	Nationally leading publications related to the Danube Delta.