



EUROPEAN COMMISSION
Executive Agency for Small and Medium-sized Enterprises
(EASME)
Director



GRANT AGREEMENT

NUMBER — 689450 — AquaNES

This **Agreement** ('the Agreement') is **between** the following parties:

on the one part,

the Executive Agency for Small and Medium-sized Enterprises (EASME) ('the Agency'), under the power delegated by the European Commission ('the Commission')¹,

represented for the purposes of signature of this Agreement by Head of Unit - B2, Executive Agency for Small and Medium-sized Enterprises (EASME), OPERATIONS, H2020 Environment & Resources, Arnoldas MILUKAS,

and

on the other part,

1. 'the coordinator':

FACHHOCHSCHULE NORDWESTSCHWEIZ (FHNW), 632073, established in BAHNHOFSTRASSE 6, WINDISCH 5210, Switzerland, CHE116216865MWST, as '*beneficiary not receiving EU funding*' (see Article 9), represented for the purposes of signing the Agreement by Director of School of Life Sciences, Falko SCHLOTTIG

and the following other beneficiaries, if they sign their 'Accession Form' (see Annex 3 and Article 56):

2. **AKUT UMWELTSCHUTZ INGENIEURE BURKARD UND PARTNER (AKUT) DE5**, PR281, established in WATTSTRASSE 10, BERLIN 13355, Germany, DE227840440,

3. **AUTARCON GMBH (AUT) GMBH**, HRB15086, established in FRANZ ULRICH STRASSE 18 F, KASSEL 34117, Germany, DE268625098,

4. **BioDetection Systems B.V. (BDS) BV**, 34149400, established in Science Park 406, Amsterdam 1098 XH, Netherlands, NL809623626B01,

5. **HYDROBUSINESS BV (HYBU) BV**, 09110398, established in MINERVUM 7181, BREDA 4817ZN, Netherlands, NL820404603B01,

6. **IMAGEAU SAS (imaGeau) SAS**, 504316597, established in AVENUE DE L'EUROPE CAP ALPHA 9, CLAPIERS 34830, France, FR63504316597,

7. **GEO-HYD (GEOHYD) SAS**, 419713904, established in 101 RUE JACQUES CHARLES, OLIVET 45160, France, FR50419713904,

8. **MicroLAN (MicroLAN) BV**, 18071474, established in BIESBOSWEG 2, WAALWIJK 5145 PZ, Netherlands, NL812421784B01,

9. **X-FLOW BV (XFLOW) BV**, 06050907, established in MARSSTEDEN 50, ENSCHEDE 7547 TC, Netherlands, NL006541483B01,

¹ Text in *italics* shows the options of the Model Grant Agreement that are applicable to this Agreement.

10. **VERTECH GROUP (VTG) SARL**, 539865303, established in 11 RUE DEFLY, NICE 06000, France, FR16539865303,
11. **WADIS LTD (WADIS) LTD**, 514445964, established in 3 GOLDA MEIR STREET, NESS ZIONA 7403648, Israel, IL514445964,
12. **WATSTECH LIMITED (WatStech) LTD**, 05404280, established in GLAISHER DRIVE, WOLVERHAMPTON SCIENCE PARK, GLAISH IVE, WOLVERHAMPTON WV10 9RU, United Kingdom, GB857631106,
13. **XYLEM SERVICES GMBH (XYLEM) GMBH**, HRB 13463, established in BOSCHSTRASSE 4-14, HERFORD 32051, Germany, DE815414961,
14. **FOVAROSI VIZMUVEK ZARTKORUEN MUKODORESZVENYTARSASAG (BUWW) RT**, 0110042451, established in VACI UT 23-27, BUDAPEST 1134, Hungary, HU10898824,
15. **BERLINER WASSERBETRIEBE (BWB)**, HRA 30951, established in NEUE JUDENSTRASSE 1, BERLIN 10179, Germany, DE29/033/03352,
16. **DIMOTIKI EPICHIRISI YDREVSIS APOCHETEFISIS DIMOY THIRAS NOMOU KYKLADON (DEYAT)**, 1060, established in THIRA N. KYKLADON, FIRA 84700, Greece, EL997877933,
17. **DIMOS ANTIPAROU (MUOA)**, not applicable, established in ANTIPAROS - CYCLADES, ANTIPAROS 84007, Greece, EL999247040,
18. **DREWAG NETZ GMBH (DREWAG) GMBH**, HRB24980, established in ROSENSTRASSE 32, DRESDEN 01067, Germany, DE258395586,
19. **ERFTVERBAND (EV) DE9**, N/A, established in AM ERFTVERBAND 6, BERGHEIM 50126, Germany, DE228801678,
20. **IWB INDUSTRIELLE WERKE BASEL (IWB)**, CHE108955038, established in MARGARETHENSTRASSE 40, BASEL 4002, Switzerland, CHE108955038MWST, as 'beneficiary not receiving EU funding' (see Article 9),
21. **MEKOROT WATER COMPANY LIMITED (MEK) LTD**, 557652310, established in LINCOLN STREET 9, TEL AVIV 61201, Israel, IL557652310,
22. **UNIwersytet im. Adama Mickiewicza w Poznaniu (AMU)**, 000001293, established in ul. Henryka Wieniawskiego 1, POZNAN 61712, Poland, PL7770006350,
23. **BUREAU DE RECHERCHES GEOLOGIQUES ET MINIERES (BRGM)**, 582056149, established in Quai Andre Citroen - Tour Mirabeau 39-43, PARIS 75739, France, FR67582056149,
24. **CRANFIELD UNIVERSITY (UCRAN)**, RC000151, established in College Road, CRANFIELD - BEDFORDSHIRE MK43 0AL, United Kingdom, GB491358622,
25. **Hochschule fuer Technik und Wirtschaft Dresden (HTWD)**, established in Friedrich-List-Platz 1, Dresden D-01069, Germany, DE188729062,
26. **EOTVOS JOZSEF FOISKOLA (EJC)**, 881532001, established in SZEGEDI UT 2, BAJA 6500, Hungary, HU15308988,
27. **KWB KOMPENTENTZZENTRUM WASSER BERLIN GEMEINNUTZIGE GMBH (KWB) GEM GMBH**, HRB84461, established in CICEROSTRASSE 24, BERLIN 10709, Germany, DE221139990,
28. **KWR WATER B.V. (KWR) BV**, 27279653, established in GRONINGENHAVEN 7, NIEUWEGEIN 3433 PE, Netherlands, NL814938474B01,
29. **NATIONAL TECHNICAL UNIVERSITY OF ATHENS - NTUA (NTUA)**, established in HEROON POLYTECHNIUO 9 ZOGRAPHOU CAMPUS, ATHINA 15780, Greece, EL099793475,

30. Uttarakhand Jal Sansthan (UJS), 2083, established in Jal Bhawan, Nehru Colony, B-Block, Dehradun 248001, India, as 'beneficiary not receiving EU funding' (see Article 9),

Unless otherwise specified, references to 'beneficiary' or 'beneficiaries' include the coordinator.

The parties referred to above have agreed to enter into the Agreement under the terms and conditions below.

By signing the Agreement or the Accession Form, the beneficiaries accept the grant and agree to implement it under their own responsibility and in accordance with the Agreement, with all the obligations and conditions it sets out.

The Agreement is composed of:

Terms and Conditions

- | | |
|---------|---|
| Annex 1 | Description of the action |
| Annex 2 | Estimated budget for the action |
| Annex 3 | Accession Forms |
| Annex 4 | Model for the financial statements |
| Annex 5 | Model for the certificate on the financial statements |
| Annex 6 | Model for the certificate on the methodology |

TERMS AND CONDITIONS

TABLE OF CONTENTS

CHAPTER 1 GENERAL.....	12
ARTICLE 1 — SUBJECT OF THE AGREEMENT.....	12
CHAPTER 2 ACTION.....	12
ARTICLE 2 — ACTION TO BE IMPLEMENTED.....	12
ARTICLE 3 — DURATION AND STARTING DATE OF THE ACTION.....	12
ARTICLE 4 — ESTIMATED BUDGET AND BUDGET TRANSFERS.....	12
4.1 Estimated budget.....	12
4.2 Budget transfers.....	12
CHAPTER 3 GRANT.....	12
ARTICLE 5 — GRANT AMOUNT, FORM OF GRANT, REIMBURSEMENT RATES AND FORMS OF COSTS.....	12
5.1 Maximum grant amount.....	12
5.2 Form of grant, reimbursement rates and forms of costs.....	13
5.3 Final grant amount — Calculation.....	13
5.4 Revised final grant amount — Calculation.....	15
ARTICLE 6 — ELIGIBLE AND INELIGIBLE COSTS.....	15
6.1 General conditions for costs to be eligible.....	15
6.2 Specific conditions for direct costs to be eligible.....	16
6.3 Conditions for costs of linked third parties to be eligible.....	22
6.4 Conditions for in-kind contributions provided by third parties free of charge to be eligible.....	22
6.5 Ineligible costs.....	22
6.6 Consequences of declaration of ineligible costs.....	23
CHAPTER 4 RIGHTS AND OBLIGATIONS OF THE PARTIES.....	23
SECTION 1 RIGHTS AND OBLIGATIONS RELATED TO IMPLEMENTING THE ACTION.....	23
ARTICLE 7 — GENERAL OBLIGATION TO PROPERLY IMPLEMENT THE ACTION.....	23
7.1 General obligation to properly implement the action.....	23
7.2 Consequences of non-compliance.....	23
ARTICLE 8 — RESOURCES TO IMPLEMENT THE ACTION — THIRD PARTIES INVOLVED IN THE ACTION.....	23

ARTICLE 9 — IMPLEMENTATION OF ACTION TASKS BY BENEFICIARIES NOT RECEIVING EU FUNDING.....	24
9.1 Rules for the implementation of action tasks by beneficiaries not receiving EU funding.....	24
9.2 Consequences of non-compliance.....	24
ARTICLE 10 — PURCHASE OF GOODS, WORKS OR SERVICES.....	24
10.1 Rules for purchasing goods, works or services.....	24
10.2 Consequences of non-compliance.....	25
ARTICLE 11 — USE OF IN-KIND CONTRIBUTIONS PROVIDED BY THIRD PARTIES AGAINST PAYMENT.....	25
11.1 Rules for the use of in-kind contributions against payment.....	25
11.2 Consequences of non-compliance.....	25
ARTICLE 12 — USE OF IN-KIND CONTRIBUTIONS PROVIDED BY THIRD PARTIES FREE OF CHARGE.....	26
12.1 Rules for the use of in-kind contributions free of charge.....	26
12.2 Consequences of non-compliance.....	26
ARTICLE 13 — IMPLEMENTATION OF ACTION TASKS BY SUBCONTRACTORS.....	26
13.1 Rules for subcontracting action tasks.....	26
13.2 Consequences of non-compliance.....	27
ARTICLE 14 — IMPLEMENTATION OF ACTION TASKS BY LINKED THIRD PARTIES.....	27
ARTICLE 15 — FINANCIAL SUPPORT TO THIRD PARTIES.....	27
15.1 Rules for providing financial support to third parties.....	27
15.2 Financial support in the form of prizes.....	27
15.3 Consequences of non-compliance.....	27
ARTICLE 16 — PROVISION OF TRANS-NATIONAL OR VIRTUAL ACCESS TO RESEARCH INFRASTRUCTURE.....	27
16.1 Rules for providing trans-national access to research infrastructure.....	27
16.2 Rules for providing virtual access to research infrastructure.....	27
16.3 Consequences of non-compliance.....	28
SECTION 2 RIGHTS AND OBLIGATIONS RELATED TO THE GRANT ADMINISTRATION.....	28
ARTICLE 17 – GENERAL OBLIGATION TO INFORM.....	28
17.1 General obligation to provide information upon request.....	28
17.2 Obligation to keep information up to date and to inform about events and circumstances likely to affect the Agreement.....	28
17.3 Consequences of non-compliance.....	28
ARTICLE 18 — KEEPING RECORDS — SUPPORTING DOCUMENTATION.....	28
18.1 Obligation to keep records and other supporting documentation.....	28
18.2 Consequences of non-compliance.....	30

ARTICLE 19 — SUBMISSION OF DELIVERABLES.....	30
19.1 Obligation to submit deliverables.....	30
19.2 Consequences of non-compliance.....	30
ARTICLE 20 — REPORTING — PAYMENT REQUESTS.....	30
20.1 Obligation to submit reports.....	30
20.2 Reporting periods.....	30
20.3 Periodic reports — Requests for interim payments.....	30
20.4 Final report — Request for payment of the balance.....	32
20.5 Information on cumulative expenditure incurred.....	32
20.6 Currency for financial statements and conversion into euro.....	32
20.7 Language of reports.....	33
20.8 Consequences of non-compliance — Suspension of the payment deadline — Termination.....	33
ARTICLE 21 — PAYMENTS AND PAYMENT ARRANGEMENTS.....	33
21.1 Payments to be made.....	33
21.2 Pre-financing payment — Amount — Amount retained for the Guarantee Fund.....	33
21.3 Interim payments — Amount — Calculation.....	34
21.4 Payment of the balance — Amount — Calculation — Release of the amount retained for the Guarantee Fund.....	34
21.5 Notification of amounts due.....	35
21.6 Currency for payments.....	35
21.7 Payments to the coordinator — Distribution to the beneficiaries.....	35
21.8 Bank account for payments.....	36
21.9 Costs of payment transfers.....	36
21.10 Date of payment.....	36
21.11 Consequences of non-compliance.....	36
ARTICLE 22 — CHECKS, REVIEWS, AUDITS AND INVESTIGATIONS — EXTENSION OF FINDINGS.....	37
22.1 Checks, reviews and audits by the <i>Agency and the Commission</i>	37
22.2 Investigations by the European Anti-Fraud Office (OLAF).....	39
22.3 Checks and audits by the European Court of Auditors (ECA).....	39
22.4 Checks, reviews, audits and investigations for international organisations.....	39
22.5 Consequences of findings in checks, reviews, audits and investigations —Extension of findings.....	39
22.6 Consequences of non-compliance.....	41
ARTICLE 23 — EVALUATION OF THE IMPACT OF THE ACTION.....	41
23.1 Right to evaluate the impact of the action.....	41

23.2 Consequences of non-compliance.....	41
SECTION 3 RIGHTS AND OBLIGATIONS RELATED TO BACKGROUND AND RESULTS.....	41
SUBSECTION 1 GENERAL.....	42
ARTICLE 23a — MANAGEMENT OF INTELLECTUAL PROPERTY.....	42
23a.1 Obligation to take measures to implement the Commission Recommendation on the management of intellectual property in knowledge transfer activities.....	42
23a.2 Consequences of non-compliance.....	42
SUBSECTION 2 RIGHTS AND OBLIGATIONS RELATED TO BACKGROUND.....	42
ARTICLE 24 — AGREEMENT ON BACKGROUND.....	42
24.1 Agreement on background.....	42
24.2 Consequences of non-compliance.....	42
ARTICLE 25 — ACCESS RIGHTS TO BACKGROUND.....	43
25.1 Exercise of access rights — Waiving of access rights — No sub-licensing.....	43
25.2 Access rights for other beneficiaries, for implementing their own tasks under the action.....	43
25.3 Access rights for other beneficiaries, for exploiting their own results.....	43
25.4 Access rights for affiliated entities.....	43
25.5 Access rights for third parties.....	44
25.6 Consequences of non-compliance.....	44
SUBSECTION 3 RIGHTS AND OBLIGATIONS RELATED TO RESULTS.....	44
ARTICLE 26 — OWNERSHIP OF RESULTS.....	44
26.1 Ownership by the beneficiary that generates the results.....	44
26.2 Joint ownership by several beneficiaries.....	44
26.3 Rights of third parties (including personnel).....	45
26.4 <i>Agency</i> ownership, to protect results.....	45
26.5 Consequences of non-compliance.....	46
ARTICLE 27 — PROTECTION OF RESULTS — VISIBILITY OF EU FUNDING.....	46
27.1 Obligation to protect the results.....	46
27.2 <i>Agency</i> ownership, to protect the results.....	47
27.3 Information on EU funding.....	47
27.4 Consequences of non-compliance.....	47
ARTICLE 28 — EXPLOITATION OF RESULTS.....	47
28.1 Obligation to exploit the results.....	47
28.2 Results that could contribute to European or international standards — Information on EU funding.....	47
28.3 Consequences of non-compliance.....	48

ARTICLE 29 — DISSEMINATION OF RESULTS — OPEN ACCESS — VISIBILITY OF EU FUNDING.....	48
29.1 Obligation to disseminate results.....	48
29.2 Open access to scientific publications.....	48
29.3 Open access to research data.....	49
29.4 Information on EU funding — Obligation and right to use the EU emblem.....	49
29.5 Disclaimer excluding <i>Agency</i> responsibility.....	49
29.6 Consequences of non-compliance.....	49
ARTICLE 30 — TRANSFER AND LICENSING OF RESULTS.....	50
30.1 Transfer of ownership.....	50
30.2 Granting licenses.....	50
30.3 <i>Agency</i> right to object to transfers or licensing.....	50
30.4 Consequences of non-compliance.....	50
ARTICLE 31 — ACCESS RIGHTS TO RESULTS.....	51
31.1 Exercise of access rights — Waiving of access rights — No sub-licensing.....	51
31.2 Access rights for other beneficiaries, for implementing their own tasks under the action.....	51
31.3 Access rights for other beneficiaries, for exploiting their own results.....	51
31.4 Access rights of affiliated entities.....	51
31.5 Access rights for the EU institutions, bodies, offices or agencies and EU Member States.....	51
31.6 Access rights for third parties.....	51
31.7 Consequences of non-compliance.....	51
SECTION 4 OTHER RIGHTS AND OBLIGATIONS.....	52
ARTICLE 32 — RECRUITMENT AND WORKING CONDITIONS FOR RESEARCHERS.....	52
32.1 Obligation to take measures to implement the European Charter for Researchers and Code of Conduct for the Recruitment of Researchers.....	52
32.2 Consequences of non-compliance.....	52
ARTICLE 33 — GENDER EQUALITY.....	52
33.1 Obligation to aim for gender equality.....	52
33.2 Consequences of non-compliance.....	52
ARTICLE 34 — ETHICS.....	52
34.1 Obligation to comply with ethical principles.....	52
34.2 Activities raising ethical issues.....	53
34.3 Activities involving human embryos or human embryonic stem cells.....	53
34.4 Consequences of non-compliance.....	54

ARTICLE 35 — CONFLICT OF INTERESTS.....	54
35.1 Obligation to avoid a conflict of interests.....	54
35.2 Consequences of non-compliance.....	54
ARTICLE 36 — CONFIDENTIALITY.....	54
36.1 General obligation to maintain confidentiality.....	54
36.2 Consequences of non-compliance.....	55
ARTICLE 37 — SECURITY-RELATED OBLIGATIONS.....	55
37.1 Results with a security recommendation.....	55
37.2 Classified results.....	55
37.3 Activities involving dual-use goods or dangerous materials and substances.....	56
37.4 Consequences of non-compliance.....	56
ARTICLE 38 — PROMOTING THE ACTION — VISIBILITY OF EU FUNDING.....	56
38.1 Communication activities by beneficiaries.....	56
38.2 Communication activities by the <i>Agency</i>	57
38.3 Consequences of non-compliance.....	58
ARTICLE 39 — PROCESSING OF PERSONAL DATA.....	58
39.1 Processing of personal data by the <i>Agency and the Commission</i>	58
39.2 Processing of personal data by the beneficiaries.....	58
39.3 Consequences of non-compliance.....	59
ARTICLE 40 — ASSIGNMENTS OF CLAIMS FOR PAYMENT AGAINST THE <i>AGENCY</i>	59
CHAPTER 5 DIVISION OF BENEFICIARIES’ ROLES AND RESPONSIBILITIES	59
ARTICLE 41 — DIVISION OF BENEFICIARIES’ ROLES AND RESPONSIBILITIES	59
41.1 Roles and responsibilities towards the <i>Agency</i>	59
41.2 Internal division of roles and responsibilities.....	59
41.3 Internal arrangements between beneficiaries — Consortium agreement.....	60
41.4 Relationship with complementary beneficiaries — Collaboration agreement.....	61
41.5 Relationship with partners of a joint action — Coordination agreement.....	61
CHAPTER 6 REJECTION OF COSTS — REDUCTION OF THE GRANT — RECOVERY — PENALTIES — DAMAGES — SUSPENSION — TERMINATION — FORCE MAJEURE.....	61
SECTION 1 REJECTION OF COSTS — REDUCTION OF THE GRANT — RECOVERY — PENALTIES.....	61
ARTICLE 42 — REJECTION OF INELIGIBLE COSTS.....	61
42.1 Conditions.....	61
42.2 Ineligible costs to be rejected — Calculation — Procedure.....	61
42.3 Effects.....	61

ARTICLE 43 — REDUCTION OF THE GRANT.....	62
43.1 Conditions.....	62
43.2 Amount to be reduced — Calculation — Procedure.....	62
43.3 Effects.....	62
ARTICLE 44 — RECOVERY OF UNDUE AMOUNTS.....	63
44.1 Amount to be recovered — Calculation — Procedure.....	63
ARTICLE 45 — ADMINISTRATIVE AND FINANCIAL PENALTIES.....	66
45.1 Conditions.....	66
45.2 Duration — Amount of penalty — Calculation.....	67
45.3 Procedure.....	67
SECTION 2 LIABILITY FOR DAMAGES.....	68
ARTICLE 46 — LIABILITY FOR DAMAGES.....	68
46.1 Liability of the <i>Agency</i>	68
46.2 Liability of the beneficiaries.....	68
SECTION 3 SUSPENSION AND TERMINATION.....	69
ARTICLE 47 — SUSPENSION OF PAYMENT DEADLINE.....	69
47.1 Conditions.....	69
47.2 Procedure.....	69
ARTICLE 48 — SUSPENSION OF PAYMENTS.....	70
48.1 Conditions.....	70
48.2 Procedure.....	70
ARTICLE 49 — SUSPENSION OF THE ACTION IMPLEMENTATION.....	71
49.1 Suspension of the action implementation, by the beneficiaries.....	71
49.2 Suspension of the action implementation, by the <i>Agency</i>	71
ARTICLE 50 — TERMINATION OF THE AGREEMENT OR OF THE PARTICIPATION OF ONE OR MORE BENEFICIARIES.....	72
50.1 Termination of the Agreement by the beneficiaries.....	72
50.2 Termination of the participation of one or more beneficiaries, by the beneficiaries.....	73
50.3 Termination of the Agreement or the participation of one or more beneficiaries, by the <i>Agency</i> ... 75	
SECTION 4 FORCE MAJEURE.....	79
ARTICLE 51 — FORCE MAJEURE.....	79
CHAPTER 7 FINAL PROVISIONS.....	80
ARTICLE 52 — COMMUNICATIONS BETWEEN THE PARTIES.....	80
52.1 Form and means of communication.....	80
52.2 Date of communication.....	80

52.3 Addresses for communication.....	80
ARTICLE 53 — INTERPRETATION OF THE AGREEMENT.....	81
53.1 Precedence of the Terms and Conditions over the Annexes.....	81
53.2 Privileges and immunities.....	81
ARTICLE 54 — CALCULATION OF PERIODS, DATES AND DEADLINES.....	81
ARTICLE 55 — AMENDMENTS TO THE AGREEMENT.....	81
55.1 Conditions.....	81
55.2 Procedure.....	81
ARTICLE 56 — ACCESSION TO THE AGREEMENT.....	82
56.1 Accession of the beneficiaries mentioned in the Preamble.....	82
56.2 Addition of new beneficiaries.....	82
ARTICLE 57 — APPLICABLE LAW AND SETTLEMENT OF DISPUTES.....	83
57.1 Applicable law.....	83
57.2 Dispute settlement.....	83
ARTICLE 58 — ENTRY INTO FORCE OF THE AGREEMENT.....	84

CHAPTER 1 GENERAL

ARTICLE 1 — SUBJECT OF THE AGREEMENT

This Agreement sets out the rights and obligations and the terms and conditions applicable to the grant awarded to the beneficiaries for implementing the action set out in Chapter 2.

CHAPTER 2 ACTION

ARTICLE 2 — ACTION TO BE IMPLEMENTED

The grant is awarded for the action entitled '*Demonstrating synergies in combined natural and engineered processes for water treatment systems — AquaNES*' ('action'), as described in Annex 1.

ARTICLE 3 — DURATION AND STARTING DATE OF THE ACTION

The duration of the action will be **36 months** as of *1 June 2016* ('starting date of the action').

ARTICLE 4 — ESTIMATED BUDGET AND BUDGET TRANSFERS

4.1 Estimated budget

The '**estimated budget**' for the action is set out in Annex 2.

It contains the estimated eligible costs and the forms of costs, broken down by beneficiary and budget category (see Articles 5, 6). *It also contains the estimated costs of the beneficiaries not receiving EU funding (see Article 9).*

4.2 Budget transfers

The estimated budget breakdown indicated in Annex 2 may be adjusted by transfers of amounts between beneficiaries or between budget categories (or both). This does not require an amendment according to Article 55, if the action is implemented as described in Annex 1.

However, the beneficiaries may not add costs relating to subcontracts not provided for in Annex 1, unless such additional subcontracts are approved by an amendment or in accordance with Article 13.

CHAPTER 3 GRANT

ARTICLE 5 — GRANT AMOUNT, FORM OF GRANT, REIMBURSEMENT RATES AND FORMS OF COSTS

5.1 Maximum grant amount

The '**maximum grant amount**' is **EUR 7,837,292.22** (seven million eight hundred and thirty seven thousand two hundred and ninety two EURO and twenty two eurocents).

5.2 Form of grant, reimbursement rates and forms of costs

The grant reimburses **100% of the eligible costs of the beneficiaries that are non-profit legal entities and 70% of the eligible costs of the beneficiaries that are profit legal entities** (see Article 6) (**‘reimbursement of eligible costs grant’**) (see Annex 2).

The estimated eligible costs of the action are EUR **10,740,011.88** (ten million seven hundred and forty thousand eleven EURO and eighty eight eurocents).

Eligible costs (see Article 6) must be declared under the following forms (**‘forms of costs’**):

(a) for **direct personnel costs**:

- as actually incurred costs (**‘actual costs’**) or
- on the basis of an amount per unit calculated by the beneficiary in accordance with its usual cost accounting practices (**‘unit costs’**).

Personnel **costs for SME owners or beneficiaries that are natural persons** not receiving a salary (see Article 6.2, Points A.4 and A.5) must be declared on the basis of the amount per unit set out in Annex 2 (**unit costs**);

(b) for **direct costs for subcontracting**: as actually incurred costs (**actual costs**);

(c) for **direct costs of providing financial support to third parties**: *not applicable*;

(d) for **other direct costs**: as actually incurred costs (**actual costs**);

(e) for **indirect costs**: on the basis of a flat-rate applied as set out in Article 6.2, Point E (**‘flat-rate costs’**);

(f) *specific cost category(ies): not applicable.*

5.3 Final grant amount — Calculation

The **‘final grant amount’** depends on the actual extent to which the action is implemented in accordance with the Agreement’s terms and conditions.

This amount is calculated by the *Agency* — when the payment of the balance is made (see Article 21.4) — in the following steps:

Step 1 – Application of the reimbursement rates to the eligible costs

Step 2 – Limit to the maximum grant amount

Step 3 – Reduction due to the no-profit rule

Step 4 – Reduction due to improper implementation or breach of other obligations

5.3.1 Step 1 — Application of the reimbursement rates to the eligible costs

The reimbursement rate(s) (see Article 5.2) are applied to the eligible costs (actual costs, unit costs and flat-rate costs; see Article 6) declared by the beneficiaries (see Article 20) and approved by the *Agency* (see Article 21).

5.3.2 Step 2 — Limit to the maximum grant amount

If the amount obtained following Step 1 is higher than the maximum grant amount set out in Article 5.1, it will be limited to the latter.

5.3.3 Step 3 — Reduction due to the no-profit rule

The grant must not produce a profit.

‘**Profit**’ means the surplus of the amount obtained following Steps 1 and 2 plus the action’s total receipts, over the action’s total eligible costs.

The ‘**action’s total eligible costs**’ are the consolidated total eligible costs approved by the *Agency*.

The ‘**action’s total receipts**’ are the consolidated total receipts generated during its duration (see Article 3).

The following are considered **receipts**:

- (a) income generated by the action; if the income is generated from selling equipment or other assets purchased under the Agreement, the receipt is up to the amount declared as eligible under the Agreement;
- (b) financial contributions given by third parties to the beneficiary specifically to be used for the action, and
- (c) in-kind contributions provided by third parties free of charge and specifically to be used for the action, if they have been declared as eligible costs.

The following are however not considered receipts:

- (a) income generated by exploiting the action’s results (see Article 28);
- (b) financial contributions by third parties, if they may be used to cover costs other than the eligible costs (see Article 6);
- (c) financial contributions by third parties with no obligation to repay any amount unused at the end of the period set out in Article 3.

If there is a profit, it will be deducted from the amount obtained following Steps 1 and 2.

5.3.4 Step 4 — Reduction due to improper implementation or breach of other obligations — Reduced grant amount — Calculation

If the grant is reduced (see Article 43), the *Agency* will calculate the reduced grant amount by deducting the amount of the reduction (calculated in proportion to the improper implementation of

the action or to the seriousness of the breach of obligations in accordance with Article 43.2) from the maximum grant amount set out in Article 5.1.

The final grant amount will be the lower of the following two:

- the amount obtained following Steps 1 to 3 or
- the reduced grant amount following Step 4.

5.4 Revised final grant amount — Calculation

If — after the payment of the balance (in particular, after checks, reviews, audits or investigations; see Article 22) — the *Agency* rejects costs (see Article 42) or reduces the grant (see Article 43), it will calculate the ‘**revised final grant amount**’ for the beneficiary concerned by the findings.

This amount is calculated by the *Agency* on the basis of the findings, as follows:

- in case of **rejection of costs**: by applying the reimbursement rate to the revised eligible costs approved by the *Agency* for the beneficiary concerned;
- in case of **reduction of the grant**: by calculating the concerned beneficiary’s share in the grant amount reduced in proportion to its improper implementation of the action or to the seriousness of its breach of obligations (see Article 43.2).

In case of **rejection of costs and reduction of the grant**, the revised final grant amount for the beneficiary concerned will be the lower of the two amounts above.

ARTICLE 6 — ELIGIBLE AND INELIGIBLE COSTS

6.1 General conditions for costs to be eligible

‘**Eligible costs**’ are costs that meet the following criteria:

(a) for **actual costs**:

- (i) they must be actually incurred by the beneficiary;
- (ii) they must be incurred in the period set out in Article 3, with the exception of costs relating to the submission of the periodic report for the last reporting period and the final report (see Article 20);
- (iii) they must be indicated in the estimated budget set out in Annex 2;
- (iv) they must be incurred in connection with the action as described in Annex 1 and necessary for its implementation;
- (v) they must be identifiable and verifiable, in particular recorded in the beneficiary’s accounts in accordance with the accounting standards applicable in the country where the beneficiary is established and with the beneficiary’s usual cost accounting practices;
- (vi) they must comply with the applicable national law on taxes, labour and social security, and

(vii) they must be reasonable, justified and must comply with the principle of sound financial management, in particular regarding economy and efficiency;

(b) for **unit costs**:

(i) they must be calculated as follows:

{amounts per unit set out in Annex 2 or calculated by the beneficiary in accordance with its usual cost accounting practices (see Article 6.2, Point A)

multiplied by

the number of actual units};

(ii) the number of actual units must comply with the following conditions:

- the units must be actually used or produced in the period set out in Article 3;
- the units must be necessary for implementing the action or produced by it, and
- the number of units must be identifiable and verifiable, in particular supported by records and documentation (see Article 18);

(c) for **flat-rate costs**:

(i) they must be calculated by applying the flat-rate set out in Annex 2, and

(ii) the costs (actual costs or unit costs) to which the flat-rate is applied must comply with the conditions for eligibility set out in this Article.

6.2 Specific conditions for costs to be eligible

Costs are eligible if they comply with the general conditions (see above) and the specific conditions set out below for each of the following budget categories:

- A. direct personnel costs;
- B. direct costs of subcontracting;
- C. *not applicable*;
- D. other direct costs;
- E. indirect costs;
- F. *not applicable*.

‘Direct costs’ are costs that are directly linked to the action implementation and can therefore be attributed to it directly. They must not include any indirect costs (see Point E below).

‘Indirect costs’ are costs that are not directly linked to the action implementation and therefore cannot be attributed directly to it.

A. Direct personnel costs

Types of eligible personnel costs

A.1 **Personnel costs** are eligible, if they are related to personnel working for the beneficiary under an employment contract (or equivalent appointing act) and assigned to the action (**‘costs for employees (or equivalent)’**). They must be limited to salaries (including during parental leave), social security contributions, taxes and other costs included in the **remuneration**, if they arise from national law or the employment contract (or equivalent appointing act).

Beneficiaries that are non-profit legal entities² may also declare as personnel costs **additional remuneration** for personnel assigned to the action (including payments on the basis of supplementary contracts regardless of their nature), if:

- (a) it is part of the beneficiary’s usual remuneration practices and is paid in a consistent manner whenever the same kind of work or expertise is required;
- (b) the criteria used to calculate the supplementary payments are objective and generally applied by the beneficiary, regardless of the source of funding used.

Additional remuneration for personnel assigned to the action is eligible up to the following amount:

- (a) if the person works full time and exclusively on the action during the full year: up to EUR 8 000;
- (b) if the person works exclusively on the action but not full-time or not for the full year: up to the corresponding pro-rata amount of EUR 8 000, or
- (c) if the person does not work exclusively on the action: up to a pro-rata amount calculated as follows:
 - {{EUR 8 000
 - divided by
 - the number of annual productive hours (see below)},
 - multiplied by
 - the number of hours that the person has worked on the action during the year}.

A.2 The **costs for natural persons working under a direct contract** with the beneficiary other than an employment contract are eligible personnel costs, if:

- (a) the person works under the beneficiary’s instructions and, unless otherwise agreed with the beneficiary, on the beneficiary’s premises;

² For the definition, see Article 2.1(14) of the Rules for Participation Regulation No 1290/2013: **‘non-profit legal entity’** means a legal entity which by its legal form is non-profit-making or which has a legal or statutory obligation not to distribute profits to its shareholders or individual members.

(b) the result of the work carried out belongs to the beneficiary, and

(c) the costs are not significantly different from those for personnel performing similar tasks under an employment contract with the beneficiary.

A.3 The **costs of personnel seconded by a third party against payment** are eligible personnel costs, if the conditions in Article 11.1 are met.

A.4 **Costs of owners** of beneficiaries that are small and medium-sized enterprises (**'SME owners'**) who are working on the action and who do not receive a salary are eligible personnel costs, if they correspond to the amount per unit set out in Annex 2 multiplied by the number of actual hours worked on the action.

A.5 **Costs of 'beneficiaries that are natural persons'** not receiving a salary are eligible personnel costs, if they correspond to the amount per unit set out in Annex 2 multiplied by the number of actual hours worked on the action.

Calculation

Personnel costs must be calculated by the beneficiaries as follows:

{hourly rate

multiplied by

the number of actual hours worked on the action},

plus

for non-profit legal entities: additional remuneration to personnel assigned to the action under the conditions set out above (Point A.1)}.

The number of actual hours declared for a person must be identifiable and verifiable (see Article 18).

The total number of hours declared in EU or Euratom grants, for a person for a year, cannot be higher than the annual productive hours used for the calculations of the hourly rate. Therefore, the maximum number of hours that can be declared for the grant is:

{the number of annual productive hours for the year (see below)

minus

total number of hours declared by the beneficiary for that person in that year for other EU or Euratom grants}.

The **'hourly rate'** is one of the following:

(a) for personnel costs declared as **actual costs**: the hourly rate is the amount calculated as follows:

{actual annual personnel costs (excluding additional remuneration) for the person

divided by

number of annual productive hours}.

The beneficiaries must use the annual personnel costs and the number of annual productive hours for each financial year covered by the reporting period. If a financial year is not closed at the end of the reporting period, the beneficiaries must use the hourly rate of the last closed financial year available.

For the ‘number of annual productive hours’, the beneficiaries may choose one of the following:

- (i) ‘fixed number of hours’: 1 720 hours for persons working full time (or corresponding pro-rata for persons not working full time);
- (ii) ‘individual annual productive hours’: the total number of hours worked by the person in the year for the beneficiary, calculated as follows:

{annual workable hours of the person (according to the employment contract, applicable collective labour agreement or national law)

plus

overtime worked

minus

absences (such as sick leave and special leave)}.

‘Annual workable hours’ means the period during which the personnel must be working, at the employer’s disposal and carrying out his/her activity or duties under the employment contract, applicable collective labour agreement or national working time legislation.

If the contract (or applicable collective labour agreement or national working time legislation) does not allow to determine the annual workable hours, this option cannot be used;

- (iii) ‘standard annual productive hours’: the ‘standard number of annual hours’ generally applied by the beneficiary for its personnel in accordance with its usual cost accounting practices. This number must be at least 90% of the ‘standard annual workable hours’.

If there is no applicable reference for the standard annual workable hours, this option cannot be used.

For all options, the actual time spent on **parental leave** by a person assigned to the action may be deducted from the number of annual productive hours;

- (b) for personnel costs declared on the basis of **unit costs**: the hourly rate is one of the following:
 - (i) for SME owners or beneficiaries that are natural persons: the hourly rate set out in Annex 2 (see Points A.4 and A.5 above), or
 - (ii) for personnel costs declared on the basis of the beneficiary’s usual cost accounting practices: the hourly rate calculated by the beneficiary in accordance with its usual cost accounting practices, if:

- the cost accounting practices used are applied in a consistent manner, based on objective criteria, regardless of the source of funding;
- the hourly rate is calculated using the actual personnel costs recorded in the beneficiary's accounts, excluding any ineligible cost or costs included in other budget categories.

The actual personnel costs may be adjusted by the beneficiary on the basis of budgeted or estimated elements. Those elements must be relevant for calculating the personnel costs, reasonable and correspond to objective and verifiable information;

and

- the hourly rate is calculated using the number of annual productive hours (see above).

B. Direct costs of subcontracting (including related duties, taxes and charges such as non-deductible value added tax (VAT) paid by the beneficiary) are eligible if the conditions in Article 13.1.1 are met.

C. Direct costs of providing financial support to third parties *not applicable.*

D. Other direct costs

D.1 Travel costs and related subsistence allowances (including related duties, taxes and charges such as non-deductible value added tax (VAT) paid by the beneficiary) are eligible if they are in line with the beneficiary's usual practices on travel.

D.2 *The depreciation costs of equipment, infrastructure or other assets (new or second-hand) as recorded in the beneficiary's accounts are eligible, if they were purchased in accordance with Article 10.1.1 and written off in accordance with international accounting standards and the beneficiary's usual accounting practices.*

The costs of renting or leasing equipment, infrastructure or other assets (including related duties, taxes and charges such as non-deductible value added tax (VAT) paid by the beneficiary) are also eligible, if they do not exceed the depreciation costs of similar equipment, infrastructure or assets and do not include any financing fees.

*The costs of equipment, infrastructure or other assets **contributed in-kind against payment** are eligible, if they do not exceed the depreciation costs of similar equipment, infrastructure or assets, do not include any financing fees and if the conditions in Article 11.1 are met.*

The only portion of the costs that will be taken into account is that which corresponds to the duration of the action and rate of actual use for the purposes of the action.

D.3 Costs of other goods and services (including related duties, taxes and charges such as non-deductible value added tax (VAT) paid by the beneficiary) are eligible, if they are:

- (a) purchased specifically for the action and in accordance with Article 10.1.1 or

(b) contributed in kind against payment and in accordance with Article 11.1.

Such goods and services include, for instance, consumables and supplies, dissemination (including open access), protection of results, certificates on the financial statements (if they are required by the Agreement), certificates on the methodology, translations and publications.

D.4 Capitalised and operating costs of ‘large research infrastructure’³ directly used for the action are eligible, if:

- (a) *the value of the large research infrastructure represents at least 75% of the total fixed assets (at historical value in its last closed balance sheet before the date of the signature of the Agreement or as determined on the basis of the rental and leasing costs of the research infrastructure⁴);*
- (b) *the beneficiary’s methodology for declaring the costs for large research infrastructure has been positively assessed by the Commission (‘**ex-ante assessment**’);*
- (c) *the beneficiary declares as direct eligible costs only the portion which corresponds to the duration of the action and the rate of actual use for the purposes of the action, and*
- (d) *they comply with the conditions as further detailed in the annotations to the H2020 grant agreements.*

E. Indirect costs

Indirect costs are eligible if they are declared on the basis of the flat-rate of 25% of the eligible direct costs (see Article 5.2 and Points A to D above), from which are excluded:

- (a) costs of subcontracting and
- (b) costs of in-kind contributions provided by third parties which are not used on the beneficiary’s premises;
- (c) *not applicable;*
- (d) *not applicable.*

³ ‘**Large research infrastructure**’ means research infrastructure of a total value of at least EUR 20 million, for a beneficiary, calculated as the sum of historical asset values of each individual research infrastructure of that beneficiary, as they appear in its last closed balance sheet before the date of the signature of the Agreement or as determined on the basis of the rental and leasing costs of the research infrastructure.

⁴ For the definition, see Article 2(6) of Regulation (EU) No 1291/2013 of the European Parliament and of the Council of 11 December 2013 establishing Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020) (OJ L 347, 20.12.2013 p.104)-(**‘Horizon 2020 Framework Programme Regulation No 1291/2013’**): ‘**Research infrastructure**’ are facilities, resources and services that are used by the research communities to conduct research and foster innovation in their fields. Where relevant, they may be used beyond research, e.g. for education or public services. They include: major scientific equipment (or sets of instruments); knowledge-based resources such as collections, archives or scientific data; e-infrastructures such as data and computing systems and communication networks; and any other infrastructure of a unique nature essential to achieve excellence in research and innovation. Such infrastructures may be ‘single-sited’, ‘virtual’ or ‘distributed’.

Beneficiaries receiving an operating grant⁵ financed by the EU or Euratom budget cannot declare indirect costs for the period covered by the operating grant.

F. Specific cost category(ies)

Not applicable

6.3 Conditions for costs of linked third parties to be eligible

not applicable

6.4 Conditions for in-kind contributions provided by third parties free of charge to be eligible

In-kind contributions provided free of charge are eligible direct costs (for the beneficiary), if the costs incurred by the third party fulfil — *mutatis mutandis* — the general and specific conditions for eligibility set out in this Article (Article 6.1 and 6.2) and Article 12.1.

6.5 Ineligible costs

‘**Ineligible costs**’ are:

(a) costs that do not comply with the conditions set out above (Article 6.1 to 6.4), in particular:

- (i) costs related to return on capital;
- (ii) debt and debt service charges;
- (iii) provisions for future losses or debts;
- (iv) interest owed;
- (v) doubtful debts;
- (vi) currency exchange losses;
- (vii) bank costs charged by the beneficiary’s bank for transfers from the *Agency*;
- (viii) excessive or reckless expenditure;
- (ix) deductible VAT;
- (x) costs incurred during suspension of the implementation of the action (see Article 49);

(b) costs declared under another EU or Euratom grant (including grants awarded by a Member State and financed by the EU or Euratom budget and grants awarded by bodies other than the

⁵ For the definition, see Article 121(1)(b) of Regulation (EU, Euratom) No 966/2012 of the European Parliament and of the Council of 25 October 2012 on the financial rules applicable to the general budget of the Union and repealing Council Regulation (EC, Euratom) No 1605/2002 (OJ L 218, 26.10.2012, p.1) (‘**Financial Regulation No 966/2012**’): ‘**operating grant**’ means direct financial contribution, by way of donation, from the budget in order to finance the functioning of a body which pursues an aim of general EU interest or has an objective forming part of and supporting an EU policy.

Agency for the purpose of implementing the EU or Euratom budget); in particular, indirect costs if the beneficiary is already receiving an operating grant financed by the EU or Euratom budget in the same period.

6.6 Consequences of declaration of ineligible costs

Declared costs that are ineligible will be rejected (see Article 42).

This may also lead to any of the other measures described in Chapter 6.

CHAPTER 4 RIGHTS AND OBLIGATIONS OF THE PARTIES

SECTION 1 RIGHTS AND OBLIGATIONS RELATED TO IMPLEMENTING THE ACTION

ARTICLE 7 — GENERAL OBLIGATION TO PROPERLY IMPLEMENT THE ACTION

7.1 General obligation to properly implement the action

The beneficiaries must implement the action as described in Annex 1 and in compliance with the provisions of the Agreement and all legal obligations under applicable EU, international and national law.

7.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 8 — RESOURCES TO IMPLEMENT THE ACTION — THIRD PARTIES INVOLVED IN THE ACTION

The beneficiaries must have the appropriate resources to implement the action.

If it is necessary to implement the action, the beneficiaries may:

- purchase goods, works and services (see Article 10);
- use in-kind contributions provided by third parties against payment (see Article 11);
- use in-kind contributions provided by third parties free of charge (see Article 12);
- call upon subcontractors to implement action tasks described in Annex 1 (see Article 13);
- call upon linked third parties to implement action tasks described in Annex 1 (see Article 14).

In these cases, the beneficiaries retain sole responsibility towards the *Agency* and the other beneficiaries for implementing the action.

ARTICLE 9 — IMPLEMENTATION OF ACTION TASKS BY BENEFICIARIES NOT RECEIVING EU FUNDING

9.1 Rules for the implementation of action tasks by beneficiaries not receiving EU funding

Beneficiaries not receiving EU funding must implement the action tasks attributed to them in Annex 1 according to Article 7.1.

Their costs are estimated in Annex 2 but:

- *will not be reimbursed and*
- *will not be taken into account for the calculation of the grant (see Articles 5.2, 5.3 and 5.4, and 21).*

Chapter 3, Articles 10 to 15, 18.1.2, 20.3(b), 20.4(b), 20.6, 21, 23a, 26.4, 27.2, 28.1, 28.2, 30.3, 31.5, 40, 42, 43, 44, 47 and 48 do not apply to UJS, IWB.

They will not be subject to financial checks, reviews and audits under Article 22.

Chapter 3, Articles 10 to 15, 18.1.2, 20.6, 23a, 26.4, 27.2, 28.1, 28.2, 30.3, 31.5 and 40 do not apply to FHNW.

The beneficiary will not be subject to financial checks, reviews and audits under Article 22 for its own costs.

Beneficiaries not receiving EU funding may provide in-kind contributions to another beneficiary. In this case, they will be considered as a third party for the purpose of Articles 11 and 12.

9.2 Consequences of non-compliance

If a beneficiary not receiving EU funding breaches any of its obligations under this Article, its participation of the Agreement may be terminated (see Article 50).

Such breaches may also lead to any of the other measures described in Chapter 6 that are applicable to it.

ARTICLE 10 — PURCHASE OF GOODS, WORKS OR SERVICES

10.1 Rules for purchasing goods, works or services

10.1.1 If necessary to implement the action, the beneficiaries may purchase goods, works or services.

The beneficiaries must make such purchases ensuring the best value for money or, if appropriate, the lowest price. In doing so, they must avoid any conflict of interests (see Article 35).

The beneficiaries must ensure that *the Agency*, the Commission, the European Court of Auditors (ECA) and the European Anti-Fraud Office (OLAF) can exercise their rights under Articles 22 and 23 also towards their contractors.

10.1.2 Beneficiaries that are ‘contracting authorities’ within the meaning of Directive 2004/18/EC⁶ or ‘contracting entities’ within the meaning of Directive 2004/17/EC⁷ must comply with the applicable national law on public procurement.

10.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under Article 10.1.1, the costs related to the contract concerned will be ineligible (see Article 6) and will be rejected (see Article 42).

If a beneficiary breaches any of its obligations under Article 10.1.2, the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 11 — USE OF IN-KIND CONTRIBUTIONS PROVIDED BY THIRD PARTIES AGAINST PAYMENT

11.1 Rules for the use of in-kind contributions against payment

If necessary to implement the action, the beneficiaries may use in-kind contributions provided by third parties against payment.

The beneficiaries may declare costs related to the payment of in-kind contributions as eligible (see Article 6.1 and 6.2), up to the third parties’ costs for the seconded persons, contributed equipment, infrastructure or other assets or other contributed goods and services.

The third parties and their contributions must be set out in Annex 1. The *Agency* may however approve in-kind contributions not set out in Annex 1 without amendment (see Article 55), if:

- they are specifically justified in the periodic technical report and
- their use does not entail changes to the Agreement which would call into question the decision awarding the grant or breach the principle of equal treatment of applicants.

The beneficiaries must ensure that *the Agency*, the Commission, the European Court of Auditors (ECA) and the European Anti-Fraud Office (OLAF) can exercise their rights under Articles 22 and 23 also towards the third parties.

11.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the costs related to the payment of the in-kind contribution will be ineligible (see Article 6) and will be rejected (see Article 42).

Such breaches may also lead to any of the other measures described in Chapter 6.

⁶ Directive 2004/18/EC of the European Parliament and of the Council of 31 March 2004 on the coordination of procedures for the award of public work contracts, public supply contracts and public service contracts (OJ L 134, 30.04.2004, p. 114).

⁷ Directive 2004/17/EC of the European Parliament and of the Council of 31 March 2004 coordinating the procurement procedures of entities operating in the water, energy, transport and postal services sectors (OJ L 134, 30.04.2004, p. 1).

ARTICLE 12 — USE OF IN-KIND CONTRIBUTIONS PROVIDED BY THIRD PARTIES FREE OF CHARGE

12.1 Rules for the use of in-kind contributions free of charge

If necessary to implement the action, the beneficiaries may use in-kind contributions provided by third parties free of charge.

The beneficiaries may declare costs incurred by the third parties for the seconded persons, contributed equipment, infrastructure or other assets or other contributed goods and services as eligible in accordance with Article 6.4.

The third parties and their contributions must be set out in Annex 1. The *Agency* may however approve in-kind contributions not set out in Annex 1 without amendment (see Article 55), if:

- they are specifically justified in the periodic technical report and
- their use does not entail changes to the Agreement which would call into question the decision awarding the grant or breach the principle of equal treatment of applicants.

The beneficiaries must ensure that *the Agency*, the Commission, the European Court of Auditors (ECA) and the European Anti-Fraud Office (OLAF) can exercise their rights under Articles 22 and 23 also towards the third parties.

12.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the costs incurred by the third parties related to the in-kind contribution will be ineligible (see Article 6) and will be rejected (see Article 42).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 13 — IMPLEMENTATION OF ACTION TASKS BY SUBCONTRACTORS

13.1 Rules for subcontracting action tasks

13.1.1 If necessary to implement the action, the beneficiaries may award subcontracts covering the implementation of certain action tasks described in Annex 1.

Subcontracting may cover only a limited part of the action.

The beneficiaries must award the subcontracts ensuring the best value for money or, if appropriate, the lowest price. In doing so, they must avoid any conflict of interests (see Article 35).

The tasks to be implemented and the estimated cost for each subcontract must be set out in Annex 1 and the total estimated costs of subcontracting per beneficiary must be set out in Annex 2. The *Agency* may however approve subcontracts not set out in Annex 1 and 2 without amendment (see Article 55), if:

- they are specifically justified in the periodic technical report and
- they do not entail changes to the Agreement which would call into question the decision awarding the grant or breach the principle of equal treatment of applicants.

The beneficiaries must ensure that *the Agency*, the Commission, the European Court of Auditors (ECA) and the European Anti-Fraud Office (OLAF) can exercise their rights under Articles 22 and 23 also towards their subcontractors.

13.1.2 The beneficiaries must ensure that their obligations under Articles 35, 36, 38 and 46 also apply to the subcontractors.

Beneficiaries that are ‘contracting authorities’ within the meaning of Directive 2004/18/EC or ‘contracting entities’ within the meaning of Directive 2004/17/EC must comply with the applicable national law on public procurement.

13.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under Article 13.1.1, the costs related to the subcontract concerned will be ineligible (see Article 6) and will be rejected (see Article 42).

If a beneficiary breaches any of its obligations under Article 13.1.2, the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 14 — IMPLEMENTATION OF ACTION TASKS BY LINKED THIRD PARTIES

Not applicable

ARTICLE 15 — FINANCIAL SUPPORT TO THIRD PARTIES

15.1 Rules for providing financial support to third parties

Not applicable

15.2 Financial support in the form of prizes

Not applicable

15.3 Consequences of non-compliance

Not applicable

ARTICLE 16 — PROVISION OF TRANS-NATIONAL OR VIRTUAL ACCESS TO RESEARCH INFRASTRUCTURE

16.1 Rules for providing trans-national access to research infrastructure

Not applicable

16.2 Rules for providing virtual access to research infrastructure

Not applicable

16.3 Consequences of non-compliance

Not applicable

SECTION 2 RIGHTS AND OBLIGATIONS RELATED TO THE GRANT ADMINISTRATION

ARTICLE 17 — GENERAL OBLIGATION TO INFORM

17.1 General obligation to provide information upon request

The beneficiaries must provide — during implementation of the action or afterwards and in accordance with Article 41.2 — any information requested in order to verify eligibility of the costs, proper implementation of the action and compliance with any other obligation under the Agreement.

17.2 Obligation to keep information up to date and to inform about events and circumstances likely to affect the Agreement

Each beneficiary must keep information stored in the 'Beneficiary Register' (via the electronic exchange system; see Article 52) up to date, in particular, its name, address, legal representatives, legal form and organisation type.

Each beneficiary must immediately inform the coordinator — which must immediately inform the *Agency* and the other beneficiaries — of any of the following:

- (a) **events** which are likely to affect significantly or delay the implementation of the action or the EU's financial interests, in particular:
 - (i) changes in its legal, financial, technical, organisational or ownership situation
- (b) **circumstances** affecting:
 - (i) the decision to award the grant or
 - (ii) compliance with requirements under the Agreement.

17.3 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 18 — KEEPING RECORDS — SUPPORTING DOCUMENTATION

18.1 Obligation to keep records and other supporting documentation

The beneficiaries must — for a period of *five* years after the payment of the balance — keep records and other supporting documentation in order to prove the proper implementation of the action and the costs they declare as eligible.

They must make them available upon request (see Article 17) or in the context of checks, reviews, audits or investigations (see Article 22).

If there are on-going checks, reviews, audits, investigations, litigation or other pursuits of claims under the Agreement (including the extension of findings; see Articles 22), the beneficiaries must keep the records and other supporting documentation until the end of these procedures.

The beneficiaries must keep the original documents. Digital and digitalised documents are considered originals if they are authorised by the applicable national law. The *Agency* may accept non-original documents if it considers that they offer a comparable level of assurance.

18.1.1 Records and other supporting documentation on the scientific and technical implementation

The beneficiaries must keep records and other supporting documentation on scientific and technical implementation of the action in line with the accepted standards in the respective field.

18.1.2 Records and other documentation to support the costs declared

The beneficiaries must keep the records and documentation supporting the costs declared, in particular the following:

- (a) for **actual costs**: adequate records and other supporting documentation to prove the costs declared, such as contracts, subcontracts, invoices and accounting records. In addition, the beneficiaries' usual cost accounting practices and internal control procedures must enable direct reconciliation between the amounts declared, the amounts recorded in their accounts and the amounts stated in the supporting documentation;
- (b) for **unit costs**: adequate records and other supporting documentation to prove the number of units declared. Beneficiaries do not need to identify the actual eligible costs covered or to keep or provide supporting documentation (such as accounting statements) to prove the amount per unit.

In addition, for **direct personnel costs declared as unit costs calculated in accordance with the beneficiary's usual cost accounting practices**, the beneficiaries must keep adequate records and documentation to prove that the cost accounting practices used comply with the conditions set out in Article 6.2, Point A.

The beneficiaries may submit to the Commission, for approval, a certificate (drawn up in accordance with Annex 6) stating that their usual cost accounting practices comply with these conditions (**'certificate on the methodology'**). If the certificate is approved, costs declared in line with this methodology will not be challenged subsequently, unless the beneficiaries have concealed information for the purpose of the approval.

- (c) for **flat-rate costs**: adequate records and other supporting documentation to prove the eligibility of the costs to which the flat-rate is applied. The beneficiaries do not need to identify the costs covered or provide supporting documentation (such as accounting statements) to prove the amount declared at a flat-rate.

In addition, for **personnel costs** (declared as actual costs or on the basis of unit costs), the beneficiaries must keep **time records** for the number of hours declared. The time records must be in writing and

approved by the persons working on the action and their supervisors, at least monthly. In the absence of reliable time records of the hours worked on the action, the *Agency* may accept alternative evidence supporting the number of hours declared, if it considers that it offers an adequate level of assurance.

As an exception, for **persons working exclusively on the action**, there is no need to keep time records, if the beneficiary signs a **declaration** confirming that the persons concerned have worked exclusively on the action.

18.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, costs insufficiently substantiated will be ineligible (see Article 6) and will be rejected (see Article 42), and the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 19 — SUBMISSION OF DELIVERABLES

19.1 Obligation to submit deliverables

The coordinator must submit the ‘**deliverables**’ identified in Annex 1, in accordance with the timing and conditions set out in it.

19.2 Consequences of non-compliance

If the coordinator breaches any of its obligations under this Article, the *Agency* may apply any of the measures described in Chapter 6.

ARTICLE 20 — REPORTING — PAYMENT REQUESTS

20.1 Obligation to submit reports

The coordinator must submit to the *Agency* (see Article 52) the technical and financial reports set out in this Article. These reports include requests for payment and must be drawn up using the forms and templates provided in the electronic exchange system (see Article 52).

20.2 Reporting periods

The action is divided into the following ‘**reporting periods**’:

- RP1: from month 1 to month 18
- RP2: *from month 19 to month 36*

20.3 Periodic reports — Requests for interim payments

The coordinator must submit a periodic report within 60 days following the end of each reporting period.

The **periodic report** must include the following:

(a) a ‘**periodic technical report**’ containing:

- (i) an **explanation of the work carried out** by the beneficiaries;

- (ii) an **overview of the progress** towards the objectives of the action, including milestones and deliverables identified in Annex 1.

This report must include explanations justifying the differences between work expected to be carried out in accordance with Annex 1 and that actually carried out.

The report must also detail the exploitation and dissemination of the results and — if required in Annex 1 — an updated '**plan for the exploitation and dissemination of the results**';

- (iii) a **summary** for publication by the *Agency*;

- (iv) the answers to the '**questionnaire**', covering issues related to the action implementation and the economic and societal impact, notably in the context of the Horizon 2020 key performance indicators and the Horizon 2020 monitoring requirements;

- (b) a '**periodic financial report**' containing:

- (i) an '**individual financial statement**' (see Annex 4) from each beneficiary, for the reporting period concerned.

The individual financial statement must detail the eligible costs (actual costs, unit costs and flat-rate costs; see Article 6) for each budget category (see Annex 2).

The beneficiaries must declare all eligible costs, even if — for actual costs, unit costs and flat-rate costs — they exceed the amounts indicated in the estimated budget (see Annex 2). Amounts which are not declared in the individual financial statement will not be taken into account by the *Agency*.

If an individual financial statement is not submitted for a reporting period, it may be included in the periodic financial report for the next reporting period.

The individual financial statements of the last reporting period must also detail the **receipts of the action** (see Article 5.3.3).

Each beneficiary must **certify** that:

- the information provided is full, reliable and true;
- the costs declared are eligible (see Article 6);
- the costs can be substantiated by adequate records and supporting documentation (see Article 18) that will be produced upon request (see Article 17) or in the context of checks, reviews, audits and investigations (see Article 22), and
- for the last reporting period: that all the receipts have been declared (see Article 5.3.3);

- (ii) an **explanation of the use of resources** and the information on subcontracting (see Article 13) and in-kind contributions provided by third parties (see Articles 11 and 12) from each beneficiary, for the reporting period concerned;
- (iii) *not applicable*;
- (iv) a '**periodic summary financial statement**' (see Annex 4), created automatically by the electronic exchange system, consolidating the individual financial statements for the reporting period concerned and including — except for the last reporting period — the **request for interim payment**.

20.4 Final report — Request for payment of the balance

In addition to the periodic report for the last reporting period, the coordinator must submit the final report within 60 days following the end of the last reporting period.

The **final report** must include the following:

- (a) a '**final technical report**' with a **summary** for publication containing:
 - (i) an overview of the results and their exploitation and dissemination;
 - (ii) the conclusions on the action, and
 - (iii) the socio-economic impact of the action;
- (b) a '**final financial report**' containing:
 - (i) a '**final summary financial statement**' (see Annex 4), created automatically by the electronic exchange system, consolidating the individual financial statements for all reporting periods and including the **request for payment of the balance** and
 - (ii) a '**certificate on the financial statements**' (drawn up in accordance with Annex 5) for each beneficiary, if it requests a total contribution of EUR 325 000 or more, as reimbursement of actual costs and unit costs calculated on the basis of its usual cost accounting practices (see Article 5.2 and Article 6.2, Point A).

20.5 Information on cumulative expenditure incurred

Not applicable

20.6 Currency for financial statements and conversion into euro

Financial statements must be drafted in euro.

Beneficiaries with accounting established in a currency other than the euro must convert the costs recorded in their accounts into euro, at the average of the daily exchange rates published in the C series of the *Official Journal of the European Union*, calculated over the corresponding reporting period.

If no daily euro exchange rate is published in the *Official Journal of the European Union* for the currency in question, they must be converted at the average of the monthly accounting rates published on the Commission's website, calculated over the corresponding reporting period.

Beneficiaries with accounting established in euro must convert costs incurred in another currency into euro according to their usual accounting practices.

20.7 Language of reports

All reports (technical and financial reports, including financial statements) must be submitted in the language of the Agreement.

20.8 Consequences of non-compliance — Suspension of the payment deadline — Termination

If the reports submitted do not comply with this Article, the *Agency* may suspend the payment deadline (see Article 47) and apply any of the other measures described in Chapter 6.

If the coordinator breaches its obligation to submit the reports and if it fails to comply with this obligation within 30 days following a written reminder sent by the *Agency*, the Agreement may be terminated (see Article 50).

ARTICLE 21 — PAYMENTS AND PAYMENT ARRANGEMENTS

21.1 Payments to be made

The following payments will be made to the coordinator:

- one **pre-financing payment**;
- one or more **interim payments**, on the basis of the request(s) for interim payment (see Article 20), and
- one **payment of the balance**, on the basis of the request for payment of the balance (see Article 20).

21.2 Pre-financing payment — Amount — Amount retained for the Guarantee Fund

The aim of the pre-financing is to provide the beneficiaries with a float.

It remains the property of the *EU* until the payment of the balance.

The amount of the pre-financing payment will be EUR **5,094,239.94** (five million ninety four thousand two hundred and thirty nine EURO and ninety four eurocents).

The *Agency* will — except if Article 48 applies — make the pre-financing payment to the coordinator within 30 days either from the entry into force of the Agreement (see Article 58) or from 10 days before the starting date of the action (see Article 3), whichever is the latest.

An amount of EUR **391,864.61** (three hundred and ninety one thousand eight hundred and sixty four EURO and sixty one eurocents), corresponding to 5% of the maximum grant amount (see Article 5.1), is retained by the *Agency* from the pre-financing payment and transferred into the '**Guarantee Fund**'.

21.3 Interim payments — Amount — Calculation

Interim payments reimburse the eligible costs incurred for the implementation of the action during the corresponding reporting periods.

The *Agency* will pay to the coordinator the amount due as interim payment within 90 days from receiving the periodic report (see Article 20.3), except if Articles 47 or 48 apply.

Payment is subject to the approval of the periodic report. Its approval does not imply recognition of the compliance, authenticity, completeness or correctness of its content.

The **amount due as interim payment** is calculated by the *Agency* in the following steps:

Step 1 – Application of the reimbursement rates

Step 2 – Limit to 90% of the maximum grant amount

21.3.1 Step 1 — Application of the reimbursement rates

The reimbursement rate(s) (see Article 5.2) are applied to the eligible costs (actual costs, unit costs and flat-rate costs ; see Article 6) declared by the beneficiaries (see Article 20) and approved by the *Agency* (see above) for the concerned reporting period.

21.3.2 Step 2 — Limit to 90% of the maximum grant amount

The total amount of pre-financing and interim payments must not exceed 90% of the maximum grant amount set out in Article 5.1. The maximum amount for the interim payment will be calculated as follows:

{90% of the maximum grant amount (see Article 5.1)

minus

{pre-financing and previous interim payments}}.

21.4 Payment of the balance — Amount — Calculation — Release of the amount retained for the Guarantee Fund

The payment of the balance reimburses the remaining part of the eligible costs incurred by the beneficiaries for the implementation of the action.

If the total amount of earlier payments is greater than the final grant amount (see Article 5.3), the payment of the balance takes the form of a recovery (see Article 44).

If the total amount of earlier payments is lower than the final grant amount, the *Agency* will pay the balance within 90 days from receiving the final report (see Article 20.4), except if Articles 47 or 48 apply.

Payment is subject to the approval of the final report. Its approval does not imply recognition of the compliance, authenticity, completeness or correctness of its content.

The **amount due as the balance** is calculated by the *Agency* by deducting the total amount of pre-financing and interim payments (if any) already made, from the final grant amount determined in accordance with Article 5.3:

{final grant amount (see Article 5.3)}

minus

{pre-financing and interim payments (if any) made}}.

At the payment of the balance, the amount retained for the Guarantee Fund (see above) will be released and:

- if the balance is positive: the amount released will be paid in full to the coordinator together with the amount due as the balance;
- if the balance is negative (payment of the balance taking the form of recovery): it will be deducted from the amount released (see Article 44.1.2). If the resulting amount:
 - is positive, it will be paid to the coordinator
 - is negative, it will be recovered.

The amount to be paid may however be offset — without the beneficiary's consent — against any other amount owed by the beneficiary to the *Agency*, the Commission or another executive agency (under the EU or Euratom budget), up to the maximum EU contribution indicated, for that beneficiary, in the estimated budget (see Annex 2).

21.5 Notification of amounts due

When making payments, the *Agency* will formally notify to the coordinator the amount due, specifying whether it concerns an interim payment or the payment of the balance.

For the payment of the balance, the notification will also specify the final grant amount.

In the case of reduction of the grant or recovery of undue amounts, the notification will be preceded by the contradictory procedure set out in Articles 43 and 44.

21.6 Currency for payments

The *Agency* will make all payments in euro.

21.7 Payments to the coordinator — Distribution to the beneficiaries

Payments will be made to the coordinator.

Payments to the coordinator will discharge the *Agency* from its payment obligation.

The coordinator must distribute the payments between the beneficiaries without unjustified delay.

Pre-financing may however be distributed only:

- (a) if the minimum number of beneficiaries set out in the call for proposals has acceded to the Agreement (see Article 56) and
- (b) to beneficiaries that have acceded to the Agreement (see Article 56).

21.8 Bank account for payments

All payments will be made to the following bank account:

Name of bank: UBS SWITZERLAND AG
Address of branch: BADSTRASSE 12 BADEN, Switzerland
Full name of the account holder: FACHHOCHSCHULE NORDWESTSCHWEIZ AQUANES
Full account number (including bank codes):
IBAN code: CH750023223256733667J

21.9 Costs of payment transfers

The cost of the payment transfers is borne as follows:

- the *Agency* bears the cost of transfers charged by its bank;
- the beneficiary bears the cost of transfers charged by its bank;
- the party causing a repetition of a transfer bears all costs of the repeated transfer.

21.10 Date of payment

Payments by the *Agency* are considered to have been carried out on the date when they are debited to its account.

21.11 Consequences of non-compliance

21.11.1 If the *Agency* does not pay within the payment deadlines (see above), the beneficiaries are entitled to **late-payment interest** at the rate applied by the European Central Bank (ECB) for its main refinancing operations in euros ('reference rate'), plus three and a half points. The reference rate is the rate in force on the first day of the month in which the payment deadline expires, as published in the C series of the *Official Journal of the European Union*.

If the late-payment interest is lower than or equal to EUR 200, it will be paid to the coordinator only upon request submitted within two months of receiving the late payment.

Late-payment interest is not due if all beneficiaries are EU Member States (including regional and local government authorities or other public bodies acting on behalf of a Member State for the purpose of this Agreement).

Suspension of the payment deadline or payments (see Articles 47 and 48) will not be considered as late payment.

Late-payment interest covers the period running from the day following the due date for payment (see above), up to and including the date of payment.

Late-payment interest is not considered for the purposes of calculating the final grant amount.

21.11.2 If the coordinator breaches any of its obligations under this Article, the grant may be reduced (see Article 43) and the Agreement or the participation of the coordinator may be terminated (see Article 50).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 22 — CHECKS, REVIEWS, AUDITS AND INVESTIGATIONS — EXTENSION OF FINDINGS

22.1 Checks, reviews and audits by the *Agency and the Commission*

22.1.1 Right to carry out checks

The *Agency or the Commission* will — during the implementation of the action or afterwards — check the proper implementation of the action and compliance with the obligations under the Agreement, including assessing deliverables and reports.

For this purpose the *Agency or the Commission* may be assisted by external persons or bodies.

The *Agency or the Commission* may also request additional information in accordance with Article 17. The *Agency or the Commission* may request beneficiaries to provide such information to it directly.

Information provided must be accurate, precise and complete and in the format requested, including electronic format.

22.1.2 Right to carry out reviews

The *Agency or the Commission* may — during the implementation of the action or afterwards — carry out reviews on the proper implementation of the action (including assessment of deliverables and reports), compliance with the obligations under the Agreement and continued scientific or technological relevance of the action.

Reviews may be started **up to two years after the payment of the balance**. They will be formally notified to the coordinator or beneficiary concerned and will be considered to have started on the date of the formal notification.

If the review is carried out on a third party (see Articles 10 to 16), the beneficiary concerned must inform the third party.

The *Agency or the Commission* may carry out reviews directly (using its own staff) or indirectly (using external persons or bodies appointed to do so). It will inform the coordinator or beneficiary concerned of the identity of the external persons or bodies. They have the right to object to the appointment on grounds of commercial confidentiality.

The coordinator or beneficiary concerned must provide — within the deadline requested — any information and data in addition to deliverables and reports already submitted (including information on the use of resources). The *Agency or the Commission* may request beneficiaries to provide such information to it directly.

The coordinator or beneficiary concerned may be requested to participate in meetings, including with external experts.

For **on-the-spot** reviews, the beneficiaries must allow access to their sites and premises, including to external persons or bodies, and must ensure that information requested is readily available.

Information provided must be accurate, precise and complete and in the format requested, including electronic format.

On the basis of the review findings, a '**review report**' will be drawn up.

The *Agency or the Commission* will formally notify the review report to the coordinator or beneficiary concerned, which has 30 days to formally notify observations ('**contradictory review procedure**').

Reviews (including review reports) are in the language of the Agreement.

22.1.3 Right to carry out audits

The *Agency or the Commission* may — during the implementation of the action or afterwards — carry out audits on the proper implementation of the action and compliance with the obligations under the Agreement.

Audits may be started **up to two years after the payment of the balance**. They will be formally notified to the coordinator or beneficiary concerned and will be considered to have started on the date of the formal notification.

If the audit is carried out on a third party (see Articles 10 to 16), the beneficiary concerned must inform the third party.

The *Agency or the Commission* may carry out audits directly (using its own staff) or indirectly (using external persons or bodies appointed to do so). It will inform the coordinator or beneficiary concerned of the identity of the external persons or bodies. They have the right to object to the appointment on grounds of commercial confidentiality.

The coordinator or beneficiary concerned must provide — within the deadline requested — any information (including complete accounts, individual salary statements or other personal data) to verify compliance with the Agreement. The *Agency or the Commission* may request beneficiaries to provide such information to it directly.

For **on-the-spot** audits, the beneficiaries must allow access to their sites and premises, including to external persons or bodies, and must ensure that information requested is readily available.

Information provided must be accurate, precise and complete and in the format requested, including electronic format.

On the basis of the audit findings, a '**draft audit report**' will be drawn up.

The *Agency or the Commission* will formally notify the draft audit report to the coordinator or beneficiary concerned, which has 30 days to formally notify observations ('**contradictory audit procedure**'). This period may be extended by the *Agency or the Commission* in justified cases.

The '**final audit report**' will take into account observations by the coordinator or beneficiary concerned. The report will be formally notified to it.

Audits (including audit reports) are in the language of the Agreement.

The *Agency or the Commission* may also access the beneficiaries' statutory records for the periodical assessment of unit costs or flat-rate amounts.

22.2 Investigations by the European Anti-Fraud Office (OLAF)

Under Regulations No 883/2013¹⁵ and No 2185/96¹⁶ (and in accordance with their provisions and procedures), the European Anti-Fraud Office (OLAF) may — at any moment during implementation of the action or afterwards — carry out investigations, including on-the-spot checks and inspections, to establish whether there has been fraud, corruption or any other illegal activity affecting the financial interests of the EU.

22.3 Checks and audits by the European Court of Auditors (ECA)

Under Article 287 of the Treaty on the Functioning of the European Union (TFEU) and Article 161 of the Financial Regulation No 966/2012¹⁷, the European Court of Auditors (ECA) may — at any moment during implementation of the action or afterwards — carry out audits.

The ECA has the right of access for the purpose of checks and audits.

22.4 Checks, reviews, audits and investigations for international organisations

Not applicable

22.5 Consequences of findings in checks, reviews, audits and investigations — Extension of findings

22.5.1 Findings in this grant

Findings in checks, reviews, audits or investigations carried out in the context of this grant may lead to the rejection of ineligible costs (see Article 42), reduction of the grant (see Article 43), recovery of undue amounts (see Article 44) or to any of the other measures described in Chapter 6.

Rejection of costs or reduction of the grant after the payment of the balance will lead to a revised final grant amount (see Article 5.4).

Findings in checks, reviews, audits or investigations may lead to a request for amendment for the modification of Annex 1 (see Article 55).

Checks, reviews, audits or investigations that find systemic or recurrent errors, irregularities, fraud or breach of obligations may also lead to consequences in other EU or Euratom grants awarded under similar conditions (**'extension of findings from this grant to other grants'**).

¹⁵ Regulation (EU, Euratom) No 883/2013 of the European Parliament and of the Council of 11 September 2013 concerning investigations conducted by the European Anti-Fraud Office (OLAF) and repealing Regulation (EC) No 1073/1999 of the European Parliament and of the Council and Council Regulation (Euratom) No 1074/1999 (OJ L 248, 18.09.2013, p. 1).

¹⁶ Council Regulation (Euratom, EC) No 2185/1996 of 11 November 1996 concerning on-the-spot checks and inspections carried out by the Commission in order to protect the European Communities' financial interests against fraud and other irregularities (OJ L 292, 15.11.1996, p. 2).

¹⁷ Regulation (EU, Euratom) No 966/2012 of the European Parliament and of the Council of 25 October 2012 on the financial rules applicable to the general budget of the Union and repealing Council Regulation (EC, Euratom) No 1605/2002 (OJ L 298, 26.10.2012, p. 1).

Moreover, findings arising from an OLAF investigation may lead to criminal prosecution under national law.

22.5.2 Findings in other grants

The *Agency or the Commission* may extend findings from other grants to this grant ('**extension of findings from other grants to this grant**'), if:

- (a) the beneficiary concerned is found, in other EU or Euratom grants awarded under similar conditions, to have committed systemic or recurrent errors, irregularities, fraud or breach of obligations that have a material impact on this grant and
- (b) those findings are formally notified to the beneficiary concerned — together with the list of grants affected by the findings — no later than two years after the payment of the balance of this grant.

The extension of findings may lead to the rejection of costs (see Article 42), reduction of the grant (see Article 43), recovery of undue amounts (see Article 44), suspension of payments (see Article 48), suspension of the action implementation (see Article 49) or termination (see Article 50).

22.5.3 Procedure

The *Agency or the Commission* will formally notify the beneficiary concerned the systemic or recurrent errors and its intention to extend these audit findings, together with the list of grants affected.

22.5.3.1 If the findings concern **eligibility of costs**: the formal notification will include:

- (a) an invitation to submit observations on the list of grants affected by the findings;
- (b) the request to submit **revised financial statements** for all grants affected;
- (c) the **correction rate for extrapolation** established by the *Agency or the Commission* on the basis of the systemic or recurrent errors, to calculate the amounts to be rejected if the beneficiary concerned:
 - (i) considers that the submission of revised financial statements is not possible or practicable or
 - (ii) does not submit revised financial statements.

The beneficiary concerned has 90 days from receiving notification to submit observations, revised financial statements or to propose a duly substantiated **alternative correction method**. This period may be extended by the *Agency or the Commission* in justified cases.

The amounts to be rejected will be determined on the basis of the revised financial statements, subject to their approval.

If the *Agency or the Commission* does not receive any observations or revised financial statements, does not accept the observations or the proposed alternative correction method or does not approve the revised financial statements, it will formally notify the beneficiary concerned the application of the initially notified correction rate for extrapolation.

If the *Agency or the Commission* accepts the alternative correction method proposed by the beneficiary concerned, it will formally notify the application of the accepted alternative correction method.

22.5.3.2 If the findings concern **improper implementation** or a **breach of another obligation**: the formal notification will include:

- (a) an invitation to submit observations on the list of grants affected by the findings and
- (b) the flat-rate the *Agency or the Commission* intends to apply according to the principle of proportionality.

The beneficiary concerned has 90 days from receiving notification to submit observations or to propose a duly substantiated alternative flat-rate.

If the *Agency or the Commission* does not receive any observations or does not accept the observations or the proposed alternative flat-rate, it will formally notify the beneficiary concerned the application of the initially notified flat-rate.

If the *Agency or the Commission* accepts the alternative flat-rate proposed by the beneficiary concerned, it will formally notify the application of the accepted alternative flat-rate.

22.6 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, any insufficiently substantiated costs will be ineligible (see Article 6) and will be rejected (see Article 42).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 23 — EVALUATION OF THE IMPACT OF THE ACTION

23.1 Right to evaluate the impact of the action

The *Agency or the Commission* may carry out interim and final evaluations of the impact of the action measured against the objective of the *EU* programme.

Evaluations may be started during implementation of the action and up to *five* years after the payment of the balance. The evaluation is considered to start on the date of the formal notification to the coordinator or beneficiaries.

The *Agency or the Commission* may make these evaluations directly (using its own staff) or indirectly (using external bodies or persons it has authorised to do so).

The coordinator or beneficiaries must provide any information relevant to evaluate the impact of the action, including information in electronic format.

23.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the *Agency* may apply the measures described in Chapter 6.

SECTION 3 RIGHTS AND OBLIGATIONS RELATED TO BACKGROUND AND RESULTS

SUBSECTION 1 GENERAL

ARTICLE 23a — MANAGEMENT OF INTELLECTUAL PROPERTY

23a.1 Obligation to take measures to implement the Commission Recommendation on the management of intellectual property in knowledge transfer activities

Beneficiaries that are universities or other public research organisations must take measures to implement the principles set out in Points 1 and 2 of the Code of Practice annexed to the Commission Recommendation on the management of intellectual property in knowledge transfer activities¹⁸.

This does not change the obligations set out in Subsections 2 and 3 of this Section.

The beneficiaries must ensure that researchers and third parties involved in the action are aware of them.

23a.2 Consequences of non-compliance

If a beneficiary breaches its obligations under this Article, the *Agency* may apply any of the measures described in Chapter 6.

SUBSECTION 2 RIGHTS AND OBLIGATIONS RELATED TO BACKGROUND

ARTICLE 24 — AGREEMENT ON BACKGROUND

24.1 Agreement on background

The beneficiaries must identify and agree (in writing) on the background for the action (**‘agreement on background’**).

‘Background’ means any data, know-how or information — whatever its form or nature (tangible or intangible), including any rights such as intellectual property rights — that:

- (a) is held by the beneficiaries before they acceded to the Agreement, and
- (b) is needed to implement the action or exploit the results.

24.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

¹⁸ Commission Recommendation C (2008) 1329 of 10.4.2008 on the management of intellectual property in knowledge transfer activities and the Code of Practice for universities and other public research institutions attached to this recommendation.

ARTICLE 25 — ACCESS RIGHTS TO BACKGROUND

25.1 Exercise of access rights — Waiving of access rights — No sub-licensing

To exercise access rights, this must first be requested in writing (**‘request for access’**).

‘Access rights’ means rights to use results or background under the terms and conditions laid down in this Agreement.

Waivers of access rights are not valid unless in writing.

Unless agreed otherwise, access rights do not include the right to sub-license.

25.2 Access rights for other beneficiaries, for implementing their own tasks under the action

The beneficiaries must give each other access — on a royalty-free basis — to background needed to implement their own tasks under the action, unless the beneficiary that holds the background has — before acceding to the Agreement —:

- (a) informed the other beneficiaries that access to its background is subject to legal restrictions or limits, including those imposed by the rights of third parties (including personnel), or
- (b) agreed with the other beneficiaries that access would not be on a royalty-free basis.

25.3 Access rights for other beneficiaries, for exploiting their own results

The beneficiaries must give each other access — under fair and reasonable conditions — to background needed for exploiting their own results, unless the beneficiary that holds the background has — before acceding to the Agreement — informed the other beneficiaries that access to its background is subject to legal restrictions or limits, including those imposed by the rights of third parties (including personnel).

‘Fair and reasonable conditions’ means appropriate conditions, including possible financial terms or royalty-free conditions, taking into account the specific circumstances of the request for access, for example the actual or potential value of the results or background to which access is requested and/or the scope, duration or other characteristics of the exploitation envisaged.

Requests for access may be made — unless agreed otherwise — up to one year after the period set out in Article 3.

25.4 Access rights for affiliated entities

Unless otherwise agreed in the consortium agreement, access to background must also be given — under fair and reasonable conditions (see above; Article 25.3) and unless it is subject to legal restrictions or limits, including those imposed by the rights of third parties (including personnel) —

to affiliated entities¹⁹ established in an EU Member State or ‘**associated country**’²⁰, if this is needed to exploit the results generated by the beneficiaries to which they are affiliated.

Unless agreed otherwise (see above; Article 25.1), the affiliated entity concerned must make the request directly to the beneficiary that holds the background.

Requests for access may be made — unless agreed otherwise — up to one year after the period set out in Article 3.

25.5 Access rights for third parties

Not applicable

25.6 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

SUBSECTION 3 RIGHTS AND OBLIGATIONS RELATED TO RESULTS

ARTICLE 26 — OWNERSHIP OF RESULTS

26.1 Ownership by the beneficiary that generates the results

Results are owned by the beneficiary that generates them.

‘**Results**’ means any (tangible or intangible) output of the action such as data, knowledge or information — whatever its form or nature, whether it can be protected or not — that is generated in the action, as well as any rights attached to it, including intellectual property rights.

26.2 Joint ownership by several beneficiaries

Two or more beneficiaries own results jointly if:

¹⁹ For the definition, see Article 2.1(2) of the Rules for Participation Regulation No 1290/2013: ‘**affiliated entity**’ means any legal entity that is under the direct or indirect control of a participant, or under the same direct or indirect control as the participant, or that is directly or indirectly controlling a participant.

‘Control’ may take any of the following forms:

- (a) the direct or indirect holding of more than 50% of the nominal value of the issued share capital in the legal entity concerned, or of a majority of the voting rights of the shareholders or associates of that entity;
- (b) the direct or indirect holding, in fact or in law, of decision-making powers in the legal entity concerned.

However the following relationships between legal entities shall not in themselves be deemed to constitute controlling relationships:

- (a) the same public investment corporation, institutional investor or venture-capital company has a direct or indirect holding of more than 50% of the nominal value of the issued share capital or a majority of voting rights of the shareholders or associates;
- (b) the legal entities concerned are owned or supervised by the same public body.

²⁰ For the definition, see Article 2.1(3) of the Rules for Participation Regulation No 1290/2013: ‘**associated country**’ means a third country which is party to an international agreement with the Union, as identified in *Article 7 of Horizon 2020 Framework Programme Regulation No 1291/2013. Article 7 sets out the conditions for association of non-EU countries to Horizon 2020.*

- (a) they have jointly generated them and
- (b) it is not possible to:
 - (i) establish the respective contribution of each beneficiary, or
 - (ii) separate them for the purpose of applying for, obtaining or maintaining their protection (see Article 27).

The joint owners must agree (in writing) on the allocation and terms of exercise of their joint ownership (**'joint ownership agreement'**), to ensure compliance with their obligations under this Agreement.

Unless otherwise agreed in the joint ownership agreement, each joint owner may grant non-exclusive licences to third parties to exploit jointly-owned results (without any right to sub-license), if the other joint owners are given:

- (a) at least 45 days advance notice and
- (b) fair and reasonable compensation.

Once the results have been generated, joint owners may agree (in writing) to apply another regime than joint ownership (such as, for instance, transfer to a single owner (see Article 30) with access rights for the others).

26.3 Rights of third parties (including personnel)

If third parties (including personnel) may claim rights to the results, the beneficiary concerned must ensure that it complies with its obligations under the Agreement.

If a third party generates results, the beneficiary concerned must obtain all necessary rights (transfer, licences or other) from the third party, in order to be able to respect its obligations as if those results were generated by the beneficiary itself.

If obtaining the rights is impossible, the beneficiary must refrain from using the third party to generate the results.

26.4 Agency ownership, to protect results

26.4.1 *The Agency* may — with the consent of the beneficiary concerned — assume ownership of results to protect them, if a beneficiary intends — up to four years after the period set out in Article 3 — to disseminate its results without protecting them, except in any of the following cases:

- (a) the lack of protection is because protecting the results is not possible, reasonable or justified (given the circumstances);
- (b) the lack of protection is because there is a lack of potential for commercial or industrial exploitation, or
- (c) the beneficiary intends to transfer the results to another beneficiary or third party established in an EU Member State or associated country, which will protect them.

Before the results are disseminated and unless any of the cases above under Points (a), (b) or (c) applies, the beneficiary must formally notify the *Agency* and at the same time inform it of any reasons for refusing consent. The beneficiary may refuse consent only if it can show that its legitimate interests would suffer significant harm.

If the *Agency* decides to assume ownership, it will formally notify the beneficiary concerned within 45 days of receiving notification.

No dissemination relating to these results may before the end of this period or, if the *Agency* takes a positive decision, until it has taken the necessary steps to protect the results.

26.4.2 *The Agency* may — with the consent of the beneficiary concerned — assume ownership of results to protect them, if a beneficiary intends — up to four years after the period set out in Article 3 — to stop protecting them or not to seek an extension of protection, except in any of the following cases:

- (a) the protection is stopped because of a lack of potential for commercial or industrial exploitation;
- (b) an extension would not be justified given the circumstances.

A beneficiary that intends to stop protecting results or not seek an extension must — unless any of the cases above under Points (a) or (b) applies — formally notify the *Agency* at least 60 days before the protection lapses or its extension is no longer possible and at the same time inform it of any reasons for refusing consent. The beneficiary may refuse consent only if it can show that its legitimate interests would suffer significant harm.

If the *Agency* decides to assume ownership, it will formally notify the beneficiary concerned within 45 days of receiving notification.

26.5 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such breaches may also lead to the any of the other measures described in Chapter 6.

ARTICLE 27 — PROTECTION OF RESULTS — VISIBILITY OF EU FUNDING

27.1 Obligation to protect the results

Each beneficiary must examine the possibility of protecting its results and must adequately protect them — for an appropriate period and with appropriate territorial coverage — if:

- (a) the results can reasonably be expected to be commercially or industrially exploited and
- (b) protecting them is possible, reasonable and justified (given the circumstances).

When deciding on protection, the beneficiary must consider its own legitimate interests and the legitimate interests (especially commercial) of the other beneficiaries.

27.2 Agency ownership, to protect the results

If a beneficiary intends not to protect its results, to stop protecting them or not seek an extension of protection, *the Agency* may — under certain conditions (see Article 26.4) — assume ownership to ensure their (continued) protection.

27.3 Information on EU funding

Applications for protection of results (including patent applications) filed by or on behalf of a beneficiary must — unless the *Agency* requests or agrees otherwise or unless it is impossible — include the following:

“The project leading to this application has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 689450”.

27.4 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such a breach may also lead to any of the other measures described in Chapter 6.

ARTICLE 28 — EXPLOITATION OF RESULTS

28.1 Obligation to exploit the results

Each beneficiary must — up to four years after the period set out in Article 3 — take measures aiming to ensure ‘**exploitation**’ of its results (either directly or indirectly, in particular through transfer or licensing; see Article 30) by:

- (a) using them in further research activities (outside the action);
- (b) developing, creating or marketing a product or process;
- (c) creating and providing a service, or
- (d) using them in standardisation activities.

This does not change the security obligations in Article 37, which still apply.

28.2 Results that could contribute to European or international standards — Information on EU funding

If results are incorporated in a standard, the beneficiary concerned must — unless the *Agency* requests or agrees otherwise or unless it is impossible — ask the standardisation body to include the following statement in (information related to) the standard:

“Results incorporated in this standard received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 689450”.

28.3 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced in accordance with Article 43.

Such a breach may also lead to any of the other measures described in Chapter 6.

ARTICLE 29 — DISSEMINATION OF RESULTS — OPEN ACCESS — VISIBILITY OF EU FUNDING

29.1 Obligation to disseminate results

Unless it goes against their legitimate interests, each beneficiary must — as soon as possible — ‘**disseminate**’ its results by disclosing them to the public by appropriate means (other than those resulting from protecting or exploiting the results), including in scientific publications (in any medium).

This does not change the obligation to protect results in Article 27, the confidentiality obligations in Article 36, the security obligations in Article 37 or the obligations to protect personal data in Article 39, all of which still apply.

A beneficiary that intends to disseminate its results must give advance notice to the other beneficiaries of — unless agreed otherwise — at least 45 days, together with sufficient information on the results it will disseminate.

Any other beneficiary may object within — unless agreed otherwise — 30 days of receiving notification, if it can show that its legitimate interests in relation to the results or background would be significantly harmed. In such cases, the dissemination may not take place unless appropriate steps are taken to safeguard these legitimate interests.

If a beneficiary intends not to protect its results, it may — under certain conditions (see Article 26.4.1) — need to formally notify the *Agency* before dissemination takes place.

29.2 Open access to scientific publications

Each beneficiary must ensure open access (free of charge online access for any user) to all peer-reviewed scientific publications relating to its results.

In particular, it must:

- (a) as soon as possible and at the latest on publication, deposit a machine-readable electronic copy of the published version or final peer-reviewed manuscript accepted for publication in a repository for scientific publications;

Moreover, the beneficiary must aim to deposit at the same time the research data needed to validate the results presented in the deposited scientific publications.

- (b) ensure open access to the deposited publication — via the repository — at the latest:
 - (i) on publication, if an electronic version is available for free via the publisher, or

- (ii) within six months of publication (twelve months for publications in the social sciences and humanities) in any other case.
- (c) ensure open access — via the repository — to the bibliographic metadata that identify the deposited publication.

The bibliographic metadata must be in a standard format and must include all of the following:

- the terms “*European Union (EU)*” and “*Horizon 2020*”;
- the name of the action, acronym and grant number;
- the publication date, and length of embargo period if applicable, and
- a persistent identifier.

29.3 Open access to research data

Not applicable

29.4 Information on EU funding — Obligation and right to use the EU emblem

Unless the *Agency* requests or agrees otherwise or unless it is impossible, any dissemination of results (in any form, including electronic) must:

- (a) display the EU emblem and
- (b) include the following text:

“This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 689450”.

When displayed together with another logo, the EU emblem must have appropriate prominence.

For the purposes of their obligations under this Article, the beneficiaries may use the EU emblem without first obtaining approval from the *Agency*.

This does not however give them the right to exclusive use.

Moreover, they may not appropriate the EU emblem or any similar trademark or logo, either by registration or by any other means.

29.5 Disclaimer excluding *Agency* responsibility

Any dissemination of results must indicate that it reflects only the author's view and that the *Agency* is not responsible for any use that may be made of the information it contains.

29.6 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such a breach may also lead to any of the other measures described in Chapter 6.

ARTICLE 30 — TRANSFER AND LICENSING OF RESULTS

30.1 Transfer of ownership

Each beneficiary may transfer ownership of its results.

It must however ensure that its obligations under Articles 26.2, 26.4, 27, 28, 29, 30 and 31 also apply to the new owner and that this owner has the obligation to pass them on in any subsequent transfer.

This does not change the security obligations in Article 37, which still apply.

Unless agreed otherwise (in writing) for specifically-identified third parties or unless impossible under applicable EU and national laws on mergers and acquisitions, a beneficiary that intends to transfer ownership of results must give at least 45 days advance notice (or less if agreed in writing) to the other beneficiaries that still have (or still may request) access rights to the results. This notification must include sufficient information on the new owner to enable any beneficiary concerned to assess the effects on its access rights.

Unless agreed otherwise (in writing) for specifically-identified third parties, any other beneficiary may object within 30 days of receiving notification (or less if agreed in writing), if it can show that the transfer would adversely affect its access rights. In this case, the transfer may not take place until agreement has been reached between the beneficiaries concerned.

30.2 Granting licenses

Each beneficiary may grant licences to its results (or otherwise give the right to exploit them), if:

- (a) this does not impede the rights under Article 31 and
- (b) *not applicable*.

In addition to Points (a) and (b), exclusive licences for results may be granted only if all the other beneficiaries concerned have waived their access rights (see Article 31.1).

This does not change the dissemination obligations in Article 29 or security obligations in Article 37, which still apply.

30.3 Agency right to object to transfers or licensing

Not applicable

30.4 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such a breach may also lead to any of the other measures described in Chapter 6.

ARTICLE 31 — ACCESS RIGHTS TO RESULTS

31.1 Exercise of access rights — Waiving of access rights — No sub-licensing

The conditions set out in Article 25.1 apply.

The obligations set out in this Article do not change the security obligations in Article 37, which still apply.

31.2 Access rights for other beneficiaries, for implementing their own tasks under the action

The beneficiaries must give each other access — on a royalty-free basis — to results needed for implementing their own tasks under the action.

31.3 Access rights for other beneficiaries, for exploiting their own results

The beneficiaries must give each other — under fair and reasonable conditions (see Article 25.3) — access to results needed for exploiting their own results.

Requests for access may be made — unless agreed otherwise — up to one year after the period set out in Article 3.

31.4 Access rights of affiliated entities

Unless agreed otherwise in the consortium agreement, access to results must also be given — under fair and reasonable conditions (Article 25.3) — to affiliated entities established in an EU Member State or associated country, if this is needed for those entities to exploit the results generated by the beneficiaries to which they are affiliated.

Unless agreed otherwise (see above; Article 31.1), the affiliated entity concerned must make any such request directly to the beneficiary that owns the results.

Requests for access may be made — unless agreed otherwise — up to one year after the period set out in Article 3.

31.5 Access rights for the EU institutions, bodies, offices or agencies and EU Member States

The beneficiaries must give access to their results — on a royalty-free basis — to EU institutions, bodies, offices or agencies, for developing, implementing or monitoring EU policies or programmes.

Such access rights are limited to non-commercial and non-competitive use.

This does not change the right to use any material, document or information received from the beneficiaries for communication and publicising activities (see Article 38.2).

31.6 Access rights for third parties

Not applicable

31.7 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

SECTION 4 OTHER RIGHTS AND OBLIGATIONS

ARTICLE 32 — RECRUITMENT AND WORKING CONDITIONS FOR RESEARCHERS

32.1 Obligation to take measures to implement the European Charter for Researchers and Code of Conduct for the Recruitment of Researchers

The beneficiaries must take all measures to implement the principles set out in the Commission Recommendation on the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers²², in particular regarding:

- working conditions;
- transparent recruitment processes based on merit, and
- career development.

The beneficiaries must ensure that researchers and third parties involved in the action are aware of them.

32.2 Consequences of non-compliance

If a beneficiary breaches its obligations under this Article, the *Agency* may apply any of the measures described in Chapter 6.

ARTICLE 33 — GENDER EQUALITY

33.1 Obligation to aim for gender equality

The beneficiaries must take all measures to promote equal opportunities between men and women in the implementation of the action. They must aim, to the extent possible, for a gender balance at all levels of personnel assigned to the action, including at supervisory and managerial level.

33.2 Consequences of non-compliance

If a beneficiary breaches its obligations under this Article, the *Agency* may apply any of the measures described in Chapter 6.

ARTICLE 34 — ETHICS

34.1 Obligation to comply with ethical principles

The beneficiaries must carry out the action in compliance with:

²² Commission Recommendation 2005/251/EC of 11 March 2005 on the European Charter for Researchers and on a Code of Conduct for the Recruitment of Researchers (OJ L 75, 22.3.2005, p. 67).

- (a) ethical principles (including the highest standards of research integrity — as set out, for instance, in the European Code of Conduct for Research Integrity²³ — and including, in particular, avoiding fabrication, falsification, plagiarism or other research misconduct) and
- (b) applicable international, EU and national law.

Funding will not be granted for activities carried out outside the EU if they are prohibited in all Member States.

The beneficiaries must ensure that the activities under the action have an exclusive focus on civil applications.

The beneficiaries must ensure that the activities under the action do not:

- (a) aim at human cloning for reproductive purposes;
- (b) intend to modify the genetic heritage of human beings which could make such changes heritable (with the exception of research relating to cancer treatment of the gonads, which may be financed), or
- (c) intend to create human embryos solely for the purpose of research or for the purpose of stem cell procurement, including by means of somatic cell nuclear transfer.

34.2 Activities raising ethical issues

Activities raising ethical issues must comply with the ‘**ethics requirements**’ set out in Annex 1.

Before the beginning of an activity raising an ethical issue, the coordinator must submit (see Article 52) to the *Agency* copy of:

- (a) any ethics committee opinion required under national law and
- (b) any notification or authorisation for activities raising ethical issues required under national law.

If these documents are not in English, the coordinator must also submit an English summary of the submitted opinions, notifications and authorisations (containing, if available, the conclusions of the committee or authority concerned).

If these documents are specifically requested for the action, the request must contain an explicit reference to the action title. The coordinator must submit a declaration by each beneficiary concerned that all the submitted documents cover the action tasks.

34.3 Activities involving human embryos or human embryonic stem cells

Activities involving research on human embryos or human embryonic stem cells may be carried out only if:

²³ The European Code of Conduct for Research Integrity of ALLEA (All European Academies) and ESF (European Science Foundation) of March 2011.

http://www.esf.org/fileadmin/Public_documents/Publications/Code_Conduct_ResearchIntegrity.pdf

- they are set out in Annex 1 or
- the coordinator has obtained explicit approval (in writing) from the *Agency* (see Article 52).

34.4 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43) and the Agreement or participation of the beneficiary may be terminated (see Article 50).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 35 — CONFLICT OF INTERESTS

35.1 Obligation to avoid a conflict of interests

The beneficiaries must take all measures to prevent any situation where the impartial and objective implementation of the action is compromised for reasons involving economic interest, political or national affinity, family or emotional ties or any other shared interest (**‘conflict of interests’**).

They must formally notify to the *Agency* without delay any situation constituting or likely to lead to a conflict of interests and immediately take all the necessary steps to rectify this situation.

The *Agency* may verify that the measures taken are appropriate and may require additional measures to be taken by a specified deadline.

35.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43) and the Agreement or participation of the beneficiary may be terminated (see Article 50).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 36 — CONFIDENTIALITY

36.1 General obligation to maintain confidentiality

During implementation of the action and for four years after the period set out in Article 3, the parties must keep confidential any data, documents or other material (in any form) that is identified as confidential at the time it is disclosed (**‘confidential information’**).

If a beneficiary requests, the *Agency* may agree to keep such information confidential for an additional period beyond the initial four years.

If information has been identified as confidential only orally, it will be considered to be confidential only if this is confirmed in writing within 15 days of the oral disclosure.

Unless otherwise agreed between the parties, they may use confidential information only to implement the Agreement.

The beneficiaries may disclose confidential information to their personnel or third parties involved in the action only if they:

- (a) need to know to implement the Agreement and
- (b) are bound by an obligation of confidentiality.

This does not change the security obligations in Article 37, which still apply.

The *Agency* may disclose confidential information to its staff, other EU institutions and bodies or third parties, if:

- (a) this is necessary to implement the Agreement or safeguard the EU's financial interests and
- (b) the recipients of the information are bound by an obligation of confidentiality.

Under the conditions set out in Article 4 of the Rules for Participation Regulation No 1290/2013²⁴, the Commission must moreover make available information on the results to other EU institutions, bodies, offices or agencies as well as Member States or associated countries.

The confidentiality obligations no longer apply if:

- (a) the disclosing party agrees to release the other party;
- (b) the information was already known by the recipient or is given to him without obligation of confidentiality by a third party that was not bound by any obligation of confidentiality;
- (c) the recipient proves that the information was developed without the use of confidential information;
- (d) the information becomes generally and publicly available, without breaching any confidentiality obligation, or
- (e) the disclosure of the information is required by EU or national law.

36.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 37 — SECURITY-RELATED OBLIGATIONS

37.1 Results with a security recommendation

Not applicable

37.2 Classified results

Not applicable

²⁴ Regulation (EU) No 1290/2013 of the European Parliament and of the Council of 11 December 2013 laying down the rules for participation and dissemination in "Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020)" (OJ L 347, 20.12.2013 p.81).

37.3 Activities involving dual-use goods or dangerous materials and substances

Not applicable

37.4 Consequences of non-compliance

Not applicable

ARTICLE 38 — PROMOTING THE ACTION — VISIBILITY OF EU FUNDING

38.1 Communication activities by beneficiaries

38.1.1 Obligation to promote the action and its results

The beneficiaries must promote the action and its results, by providing targeted information to multiple audiences (including the media and the public) in a strategic and effective manner.

This does not change the dissemination obligations in Article 29, the confidentiality obligations in Article 36 or the security obligations in Article 37, all of which still apply.

Before engaging in a communication activity expected to have a major media impact, the beneficiaries must inform the *Agency* (see Article 52).

38.1.2 Information on EU funding — Obligation and right to use the EU emblem

Unless the *Agency* requests or agrees otherwise or unless it is impossible, any communication activity related to the action (including in electronic form, via social media, etc.) and any infrastructure, equipment and major results funded by the grant must:

- (a) display the EU emblem and
- (b) include the following text:

For communication activities: *“This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 689450”.*

For infrastructure, equipment and major results: *“This [infrastructure][equipment][insert type of result] is part of a project that has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 689450”.*

When displayed together with another logo, the EU emblem must have appropriate prominence.

For the purposes of their obligations under this Article, the beneficiaries may use the EU emblem without first obtaining approval from the *Agency*.

This does not, however, give them the right to exclusive use.

Moreover, they may not appropriate the EU emblem or any similar trademark or logo, either by registration or by any other means.

38.1.3 Disclaimer excluding *Agency* responsibility

Any communication activity related to the action must indicate that it reflects only the author's view and that the *Agency* is not responsible for any use that may be made of the information it contains.

38.2 Communication activities by the *Agency*

38.2.1 Right to use beneficiaries' materials, documents or information

The *Agency* may use, for its communication and publicising activities, information relating to the action, documents notably summaries for publication and public deliverables as well as any other material, such as pictures or audio-visual material that it receives from any beneficiary (including in electronic form).

This does not change the confidentiality obligations in Article 36 and the security obligations in Article 37, all of which still apply.

However, if the *Agency's* use of these materials, documents or information would risk compromising legitimate interests, the beneficiary concerned may request the *Agency* not to use it (see Article 52).

The right to use a beneficiary's materials, documents and information includes:

- (a) **use for its own purposes** (in particular, making them available to persons working for the *Agency* or any other EU institution, body, office or agency or body or institutions in EU Member States; and copying or reproducing them in whole or in part, in unlimited numbers);
- (b) **distribution to the public** (in particular, publication as hard copies and in electronic or digital format, publication on the internet, as a downloadable or non-downloadable file, broadcasting by any channel, public display or presentation, communicating through press information services, or inclusion in widely accessible databases or indexes);
- (c) **editing or redrafting** for communication and publicising activities (including shortening, summarising, inserting other elements (such as meta-data, legends, other graphic, visual, audio or text elements), extracting parts (e.g. audio or video files), dividing into parts, use in a compilation);
- (d) **translation**;
- (e) giving **access in response to individual requests** under Regulation No 1049/2001²⁵, without the right to reproduce or exploit;
- (f) **storage** in paper, electronic or other form;
- (g) **archiving**, in line with applicable document-management rules, and
- (h) the right to authorise **third parties** to act on its behalf or sub-license the modes of use set out in Points (b),(c),(d) and (f) to third parties if needed for the communication and publicising activities of the *Agency*.

²⁵ Regulation (EC) No 1049/2001 of the European Parliament and of the Council of 30 May 2001 regarding public access to European Parliament, Council and Commission documents, OJ L 145, 31.5.2001, p. 43.

If the right of use is subject to rights of a third party (including personnel of the beneficiary), the beneficiary must ensure that it complies with its obligations under this Agreement (in particular, by obtaining the necessary approval from the third parties concerned).

Where applicable (and if provided by the beneficiaries), the *Agency* will insert the following information:

“© – [year] – [name of the copyright owner]. All rights reserved. Licensed to the *Executive Agency for Small and Medium-sized Enterprises (EASME)* under conditions.”

38.3 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 39 — PROCESSING OF PERSONAL DATA

39.1 Processing of personal data by the *Agency and the Commission*

Any personal data under the Agreement will be processed by the *Agency or the Commission* under Regulation No 45/2001²⁶ and according to the ‘notifications of the processing operations’ to the Data Protection Officer (DPO) of the *Agency or the Commission* (publicly accessible in the DPO register).

Such data will be processed by the ‘**data controller**’ of the *Agency or the Commission* for the purposes of implementing, managing and monitoring the Agreement or protecting the financial interests of the EU or Euratom (including checks, reviews, audits and investigations; see Article 22).

The persons whose personal data are processed have the right to access and correct their own personal data. For this purpose, they must send any queries about the processing of their personal data to the data controller, via the contact point indicated in the ‘service specific privacy statement(s) (SSPS)’ that are published on the *Agency and the Commission* websites.

They also have the right to have recourse at any time to the European Data Protection Supervisor (EDPS).

39.2 Processing of personal data by the beneficiaries

The beneficiaries must process personal data under the Agreement in compliance with applicable EU and national law on data protection (including authorisations or notification requirements).

The beneficiaries may grant their personnel access only to data that is strictly necessary for implementing, managing and monitoring the Agreement.

The beneficiaries must inform the personnel whose personal data are collected and processed by the *Agency or the Commission*. For this purpose, they must provide them with the service specific privacy statement (SSPS) (see above), before transmitting their data to the *Agency or the Commission*.

²⁶ Regulation (EC) No 45/2001 of the European Parliament and of the Council of 18 December 2000 on the protection of individuals with regard to the processing of personal data by the Community institutions and bodies and on the free movement of such data (OJ L 8, 12.01.2001, p. 1).

39.3 Consequences of non-compliance

If a beneficiary breaches any of its obligations under Article 39.2, the *Agency* may apply any of the measures described in Chapter 6.

ARTICLE 40 — ASSIGNMENTS OF CLAIMS FOR PAYMENT AGAINST THE *AGENCY*

The beneficiaries may not assign any of their claims for payment against the *Agency* to any third party, except if approved by the *Agency* on the basis of a reasoned, written request by the coordinator (on behalf of the beneficiary concerned).

If the *Agency* has not accepted the assignment or the terms of it are not observed, the assignment will have no effect on it.

In no circumstances will an assignment release the beneficiaries from their obligations towards the *Agency*.

CHAPTER 5 DIVISION OF BENEFICIARIES' ROLES AND RESPONSIBILITIES

ARTICLE 41 — DIVISION OF BENEFICIARIES' ROLES AND RESPONSIBILITIES — RELATIONSHIP WITH COMPLEMENTARY BENEFICIARIES — RELATIONSHIP WITH PARTNERS OF A JOINT ACTION

41.1 Roles and responsibilities towards the *Agency*

The beneficiaries have full responsibility for implementing the action and complying with the Agreement.

The beneficiaries are jointly and severally liable for the **technical implementation** of the action as described in Annex 1. If a beneficiary fails to implement its part of the action, the other beneficiaries become responsible for implementing this part (without being entitled to any additional EU funding for doing so), unless the *Agency* expressly relieves them of this obligation.

The **financial responsibility** of each beneficiary is governed by Articles 44, 45 and 46.

41.2 Internal division of roles and responsibilities

The internal roles and responsibilities of the beneficiaries are divided as follows:

(a) Each **beneficiary** must:

- (i) keep information stored in the 'Beneficiary Register' (via the electronic exchange system) up to date (see Article 17);
- (ii) inform the coordinator immediately of any events or circumstances likely to affect significantly or delay the implementation of the action (see Article 17);
- (iii) submit to the coordinator in good time:

- individual financial statements for itself and, if required, certificates on the financial statements (see Article 20);
- the data needed to draw up the technical reports (see Article 20);
- ethics committee opinions and notifications or authorisations for activities raising ethical issues (see Article 34);
- any other documents or information required by the *Agency or the Commission* under the Agreement, unless the Agreement requires the beneficiary to submit this information directly to the *Agency or the Commission*.

(b) The **coordinator** must:

- (i) monitor that the action is implemented properly (see Article 7);
- (ii) act as the intermediary for all communications between the beneficiaries and the *Agency* (in particular, providing the *Agency* with the information described in Article 17), unless the Agreement specifies otherwise;
- (iii) request and review any documents or information required by the *Agency* and verify their completeness and correctness before passing them on to the *Agency*;
- (iv) submit the deliverables and reports to the *Agency* (see Articles 19 and 20);
- (v) ensure that all payments are made to the other beneficiaries without unjustified delay (see Article 21);
- (vi) inform the *Agency* of the amounts paid to each beneficiary, when required under the Agreement (see Articles 44 and 50) or requested by the *Agency*.

The coordinator may not delegate the above-mentioned tasks to any other beneficiary or subcontract them to any third party.

41.3 Internal arrangements between beneficiaries — Consortium agreement

The beneficiaries must have internal arrangements regarding their operation and co-ordination to ensure that the action is implemented properly. These internal arrangements must be set out in a written ‘consortium agreement’ between the beneficiaries, which may cover:

- *internal organisation of the consortium;*
- *management of access to the electronic exchange system;*
- *distribution of EU funding;*
- *additional rules on rights and obligations related to background and results (including whether access rights remain or not, if a beneficiary is in breach of its obligations) (see Section 3 of Chapter 4);*

- *settlement of internal disputes;*
- *liability, indemnification and confidentiality arrangements between the beneficiaries.*

The consortium agreement must not contain any provision contrary to the Agreement.

41.4 Relationship with complementary beneficiaries — Collaboration agreement

Not applicable

41.5 Relationship with partners of a joint action — Coordination agreement

Not applicable

CHAPTER 6 REJECTION OF COSTS — REDUCTION OF THE GRANT — RECOVERY — PENALTIES — DAMAGES — SUSPENSION — TERMINATION — FORCE MAJEURE

SECTION 1 REJECTION OF COSTS — REDUCTION OF THE GRANT — RECOVERY — PENALTIES

ARTICLE 42 — REJECTION OF INELIGIBLE COSTS

42.1 Conditions

42.1.1 The *Agency* will — at the time of an **interim payment**, **at the payment of the balance** or **afterwards** — reject any costs which are ineligible (see Article 6), in particular following checks, reviews, audits or investigations (see Article 22).

42.1.2 The rejection may also be based on the **extension of findings from other grants to this grant**, under the conditions set out in Article 22.5.2.

42.2 Ineligible costs to be rejected — Calculation — Procedure

Ineligible costs will be rejected in full.

If the *Agency* rejects costs **without reduction of the grant** (see Article 43) or **recovery of undue amounts** (see Article 44), it will formally notify the coordinator or beneficiary concerned the rejection of costs, the amounts and the reasons why (if applicable, together with the notification of amounts due; see Article 21.5). The coordinator or beneficiary concerned may — within 30 days of receiving notification — formally notify the *Agency* of its disagreement and the reasons why.

If the *Agency* rejects costs **with reduction of the grant** or **recovery of undue amounts**, it will formally notify the rejection in the ‘**pre-information letter**’ on reduction or recovery set out in Articles 43 and 44.

42.3 Effects

If the *Agency* rejects costs at the time of an **interim payment** or **the payment of the balance**, it will deduct them from the total eligible costs declared, for the action, in the periodic or final summary

financial statement (see Articles 20.3 and 20.4). It will then calculate the interim payment or payment of the balance as set out in Articles 21.3 or 21.4.

If the *Agency* — **after an interim payment but before the payment of the balance** — rejects costs declared in a periodic summary financial statement, it will deduct them from the total eligible costs declared, for the action, in the next periodic summary financial statement or in the final summary financial statement. It will then calculate the interim payment or payment of the balance as set out in Articles 21.3 or 21.4.

If the *Agency* rejects costs **after the payment of the balance**, it will deduct the amount rejected from the total eligible costs declared, by the beneficiary, in the final summary financial statement. It will then calculate the revised final grant amount as set out in Article 5.4.

ARTICLE 43 — REDUCTION OF THE GRANT

43.1 Conditions

43.1.1 The *Agency* may — **at the payment of the balance or afterwards** — reduce the maximum grant amount (see Article 5.1), if the action has not been implemented properly as described in Annex 1 or another obligation under the Agreement has been breached.

43.1.2 The *Agency* may also reduce the maximum grant amount on the basis of the **extension of findings from other grants to this grant**, under the conditions set out in Article 22.5.2.

43.2 Amount to be reduced — Calculation — Procedure

The amount of the reduction will be proportionate to the improper implementation of the action or to the seriousness of the breach.

Before reduction of the grant, the *Agency* will formally notify a ‘**pre-information letter**’ to the coordinator or beneficiary concerned:

- informing it of its intention to reduce the grant, the amount it intends to reduce and the reasons why and
- inviting it to submit observations within 30 days of receiving notification

If the *Agency* does not receive any observations or decides to pursue reduction despite the observations it has received, it will formally notify **confirmation** of the reduction (if applicable, together with the notification of amounts due; see Article 21).

43.3 Effects

If the *Agency* reduces the grant at the time of **the payment of the balance**, it will calculate the reduced grant amount for the action and then determine the amount due as payment of the balance (see Articles 5.3.4 and 21.4).

If the *Agency* reduces the grant **after the payment of the balance**, it will calculate the revised final grant amount for the beneficiary concerned (see Article 5.4). If the revised final grant amount for the beneficiary concerned is lower than its share of the final grant amount, the *Agency* will recover the difference (see Article 44).

ARTICLE 44 — RECOVERY OF UNDUE AMOUNTS

44.1 Amount to be recovered — Calculation — Procedure

The *Agency* will — after **termination of the participation of a beneficiary, at the payment of the balance or afterwards** — claim back any amount that was paid but is not due under the Agreement.

Each beneficiary's financial responsibility in case of recovery is limited to its own debt, except for the amount retained for the Guarantee Fund (see Article 21.4).

44.1.1 Recovery after termination of a beneficiary's participation

If recovery takes place after termination of a beneficiary's participation (including the coordinator), the *Agency* will claim back the undue amount from the beneficiary concerned, by formally notifying it a debit note (see Article 50.2 and 50.3). This note will specify the amount to be recovered, the terms and the date for payment.

If payment is not made by the date specified in the debit note, the *Agency or the Commission* will **recover** the amount:

- (a) by '**offsetting**' it — without the beneficiary's consent — against any amounts owed to the beneficiary concerned by the *Agency, the Commission* or *another* executive agency (from the EU or Euratom budget).

In exceptional circumstances, to safeguard the EU's financial interests, the *Agency* may offset before the payment date specified in the debit note;

- (b) *not applicable*;

- (c) by **taking legal action** (see Article 57) or by **adopting an enforceable decision** under Article 299 of the Treaty on the Functioning of the EU (TFEU) and Article 79(2) of the Financial regulation No 966/2012.

If payment is not made by the date specified in the debit note, the amount to be recovered (see above) will be increased by **late-payment interest** at the rate set out in Article 21.11, from the day following the payment date in the debit note, up to and including the date the *Agency or the Commission* receives full payment of the amount.

Partial payments will be first credited against expenses, charges and late-payment interest and then against the principal.

Bank charges incurred in the recovery process will be borne by the beneficiary, unless Directive 2007/64/EC²⁷ applies.

44.1.2 Recovery at payment of the balance

If the payment of the balance takes the form of a recovery (see Article 21.4), the *Agency* will formally notify a '**pre-information letter**' to the coordinator:

²⁷ Directive 2007/64/EC of the European Parliament and of the Council of 13 November 2007 on payment services in the internal market amending Directives 97/7/EC, 2002/65/EC, 2005/60/EC and 2006/48/EC and repealing Directive 97/5/EC (OJ L 319, 05.12.2007, p. 1).

- informing it of its intention to recover, the amount due as the balance and the reasons why;
- specifying that it intends to deduct the amount to be recovered from the amount retained for the Guarantee Fund;
- requesting the coordinator to submit a report on the distribution of payments to the beneficiaries within 30 days of receiving notification, and
- inviting the coordinator to submit observations within 30 days of receiving notification.

If no observations are submitted or the *Agency* decides to pursue recovery despite the observations it has received, it will **confirm recovery** (together with the notification of amounts due; see Article 21.5) and:

- pay the difference between the amount to be recovered and the amount retained for the Guarantee Fund, **if the difference is positive** or
- formally notify to the coordinator a **debit note** for the difference between the amount to be recovered and the amount retained for the Guarantee Fund, **if the difference is negative**. This note will also specify the terms and the date for payment.

If the coordinator does not repay the *Agency* by the date in the debit note and has not submitted the report on the distribution of payments: the *Agency* or the Commission will **recover** the amount set out in the debit note from the coordinator (see below).

If the coordinator does not repay the *Agency* by the date in the debit note, but has submitted the report on the distribution of payments: the *Agency* will:

- (a) identify the beneficiaries for which the amount calculated as follows is negative:

$\{ \{ \{ \text{beneficiary's costs declared in the final summary financial statement and approved by the } \}
Agency multiplied by the reimbursement rate set out in Article 5.2 for the beneficiary concerned} \}$

divided by

the EU contribution for the action calculated according to Article 5.3.1 }

multiplied by

the final grant amount (see Article 5.3) },

minus

{pre-financing and interim payments received by the beneficiary} }.

- (b) formally notify to each beneficiary identified according to point (a) a **debit note** specifying the terms and date for payment. The amount of the debit note is calculated as follows:

{ {amount calculated according to point (a) for the beneficiary concerned

divided by

the sum of the amounts calculated according to point (a) for all the beneficiaries identified according to point (a)}

multiplied by

the amount set out in the debit note formally notified to the coordinator}.

If payment is not made by the date specified in the debit note, the *Agency* will **recover** the amount:

- (a) by ‘**offsetting**’ it — without the beneficiary’s consent — against any amounts owed to the beneficiary concerned by the *Agency*, *the Commission* or *another* executive agency (from the EU or Euratom budget).

In exceptional circumstances, to safeguard the EU’s financial interests, the *Agency* may offset before the payment date specified in the debit note;

- (b) by **drawing on the Guarantee Fund**. The *Agency* or *the Commission* will formally notify the beneficiary concerned the debit note on behalf of the Guarantee Fund and recover the amount:

(i) *not applicable*;

- (ii) by **taking legal action** (see Article 57) or by **adopting an enforceable decision** under Article 299 of the Treaty on the Functioning of the EU (TFEU) and Article 79(2) of the Financial Regulation No 966/2012.

If payment is not made by the date in the debit note, the amount to be recovered (see above) will be increased by **late-payment interest** at the rate set out in Article 21.11, from the day following the payment date in the debit note, up to and including the date the *Agency* or *the Commission* receives full payment of the amount.

Partial payments will be first credited against expenses, charges and late-payment interest and then against the principal.

Bank charges incurred in the recovery process will be borne by the beneficiary, unless Directive 2007/64/EC applies.

44.1.3 Recovery of amounts after payment of the balance

If, for a beneficiary, the revised final grant amount (see Article 5.4) is lower than its share of the final grant amount, it must repay the difference to the *Agency*.

The beneficiary’s share of the final grant amount is calculated as follows:

{ {beneficiary’s costs declared in the final summary financial statement and approved by the *Agency* multiplied by the reimbursement rate set out in Article 5.2 for the beneficiary concerned}

divided by

the EU contribution for the action calculated according to Article 5.3.1 }

multiplied by

the final grant amount (see Article 5.3)}.

If the coordinator has not distributed amounts received (see Article 21.7), the *Agency* will also recover these amounts.

The *Agency* will formally notify a **pre-information letter** to the beneficiary concerned:

- informing it of its intention to recover, the due amount and the reasons why and
- inviting it to submit observations within 30 days of receiving notification.

If no observations are submitted or the *Agency* decides to pursue recovery despite the observations it has received, it will **confirm** the amount to be recovered and formally notify to the beneficiary concerned a **debit note**. This note will also specify the terms and the date for payment.

If payment is not made by the date specified in the debit note, the *Agency* will **recover** the amount:

- (a) by '**offsetting**' it — without the beneficiary's consent — against any amounts owed to the beneficiary concerned by the *Agency*, the Commission or another executive agency (from the EU or Euratom budget).

In exceptional circumstances, to safeguard the EU's financial interests, the *Agency* may offset before the payment date specified in the debit note;

- (b) by **drawing on the Guarantee Fund**. The *Agency or the Commission* will formally notify the beneficiary concerned the debit note on behalf of the Guarantee Fund and recover the amount:

(i) *not applicable*;

- (ii) by **taking legal action** (see Article 57) or by **adopting an enforceable decision** under Article 299 of the Treaty on the Functioning of the EU (TFEU) and Article 79(2) of the Financial Regulation No 966/2012.

If payment is not made by the date in the debit note, the amount to be recovered (see above) will be increased by **late-payment interest** at the rate set out in Article 21.11, from the day following the date for payment in the debit note, up to and including the date the *Agency or the Commission* receives full payment of the amount.

Partial payments will be first credited against expenses, charges and late-payment interest and then against the principal.

Bank charges incurred in the recovery process will be borne by the beneficiary, unless Directive 2007/64/EC applies.

ARTICLE 45 — ADMINISTRATIVE AND FINANCIAL PENALTIES

45.1 Conditions

Under Articles 109 and 131(4) of the Financial Regulation No 966/2012, the *Agency* may impose **administrative** and **financial penalties** if a beneficiary:

- (a) has committed substantial errors, irregularities or fraud or is in serious breach of its obligations under the Agreement or
- (b) has made false declarations about information required under the Agreement or for the submission of the proposal (or has not supplied such information).

Each beneficiary is responsible for paying the financial penalties imposed on it.

Under Article 109(3) of the Financial Regulation No 966/2012, the *Agency or the Commission* may — under certain conditions and limits — publish decisions imposing administrative or financial penalties.

45.2 Duration — Amount of penalty — Calculation

Administrative penalties exclude the beneficiary from all contracts and grants financed from the EU or Euratom budget for a maximum of five years from the date the infringement is established by the *Agency*.

If the beneficiary commits another infringement within five years of the date the first infringement is established, the *Agency* may extend the exclusion period up to 10 years.

Financial penalties will be between 2% and 10% of the maximum EU contribution indicated, for the beneficiary concerned, in the estimated budget (see Annex 2).

If the beneficiary commits another infringement within five years of the date the first infringement is established, the *Agency* may increase the rate of financial penalties to between 4% and 20%.

45.3 Procedure

Before applying a penalty, the *Agency* will formally notify the beneficiary concerned:

- informing it of its intention to impose a penalty, its duration or amount and the reasons why and
- inviting it to submit observations within 30 days.

If the *Agency* does not receive any observations or decides to impose the penalty despite of observations it has received, it will formally notify **confirmation** of the penalty to the beneficiary concerned and — in case of financial penalties — deduct the penalty from the payment of the balance or formally notify a **debit note**, specifying the amount to be recovered, the terms and the date for payment.

If payment is not made by the date specified in the debit note, the *Agency or the Commission* may **recover** the amount:

- (a) by ‘**offsetting**’ it — without the beneficiary’s consent — against any amounts owed to the beneficiary concerned by the *Agency*, the Commission or another executive agency (from the EU or Euratom budget).

In exceptional circumstances, to safeguard the EU’s financial interests, the *Agency* may offset before the payment date specified in the debit note;

(b) by **taking legal action** (see Article 57) or by **adopting an enforceable decision** under Article 299 of the Treaty on the Functioning of the EU (TFEU) and Article 79(2) of the Financial Regulation No 966/2012.

If payment is not made by the date in the debit note, the amount to be recovered (see above) will be increased by **late-payment interest** at the rate set out in Article 21.11, from the day following the payment date in the debit note, up to and including the date the *Agency or the Commission* receives full payment of the amount.

Partial payments will be first credited against expenses, charges and late-payment interest and then against the principal.

Bank charges incurred in the recovery process will be borne by the beneficiary, unless Directive 2007/64/EC applies.

SECTION 2 LIABILITY FOR DAMAGES

ARTICLE 46 — LIABILITY FOR DAMAGES

46.1 Liability of the *Agency*

The *Agency* cannot be held liable for any damage caused to the beneficiaries or to third parties as a consequence of implementing the Agreement, including for gross negligence.

The *Agency* cannot be held liable for any damage caused by any of the beneficiaries or third parties involved in the action, as a consequence of implementing the Agreement.

46.2 Liability of the beneficiaries

46.2.1 Conditions

Except in case of force majeure (see Article 51), the beneficiaries must compensate the *Agency* for any damage it sustains as a result of the implementation of the action or because the action was not implemented in full compliance with the Agreement.

Each beneficiary is responsible for paying the damages claimed from it.

46.2.2 Amount of damages - Calculation

The amount the *Agency* can claim from a beneficiary will correspond to the damage caused by that beneficiary.

46.2.3 Procedure

Before claiming damages, the *Agency* will formally notify the beneficiary concerned:

- informing it of its intention to claim damages, the amount and the reasons why and
- inviting it to submit observations within 30 days.

If the *Agency* does not receive any observations or decides to claim damages despite the observations it has received, it will formally notify **confirmation** of the claim for damages and a **debit note**, specifying the amount to be recovered, the terms and the date for payment.

If payment is not made by the date specified in the debit note, the *Agency or the Commission* may **recover** the amount:

- (a) by '**offsetting**' it — without the beneficiary's consent — against any amounts owed to the beneficiary concerned by the *Agency*, the Commission or another executive agency (from the EU or Euratom budget).

In exceptional circumstances, to safeguard the EU's financial interests, the *Agency* may offset before the payment date specified in the debit note;

- (b) by **taking legal action** (see Article 57) or by **adopting an enforceable decision** under Article 299 of the Treaty on the Functioning of the EU (TFEU) and Article 79(2) of the Financial Regulation No 966/2012.

If payment is not made by the date in the debit note, the amount to be recovered (see above) will be increased by **late-payment interest** at the rate set out in Article 21.11, from the day following the payment date in the debit note, up to and including the date the *Agency or the Commission* receives full payment of the amount.

Partial payments will be first credited against expenses, charges and late-payment interest and then against the principal.

Bank charges incurred in the recovery process will be borne by the beneficiary, unless Directive 2007/64/EC applies.

SECTION 3 SUSPENSION AND TERMINATION

ARTICLE 47 — SUSPENSION OF PAYMENT DEADLINE

47.1 Conditions

The *Agency* may — at any moment — suspend the payment deadline (see Article 21.2 to 21.4) if a request for payment (see Article 20) cannot be approved because:

- (a) it does not comply with the provisions of the Agreement (see Article 20);
- (b) the technical reports or financial reports have not been submitted or are not complete or additional information is needed, or
- (c) there is doubt about the eligibility of the costs declared in the financial statements and additional checks, reviews, audits or investigations are necessary.

47.2 Procedure

The *Agency* will formally notify the coordinator of the suspension and the reasons why.

The suspension will **take effect** the day notification is sent by the *Agency* (see Article 52).

If the conditions for suspending the payment deadline are no longer met, the suspension will be **lifted** — and the remaining period will resume.

If the suspension exceeds two months, the coordinator may request the *Agency* if the suspension will continue.

If the payment deadline has been suspended due to the non-compliance of the technical or financial reports (see Article 20) and the revised report or statement is not submitted or was submitted but is also rejected, the *Agency* may also terminate the Agreement or the participation of the beneficiary (see Article 50.3.1(l)).

ARTICLE 48 — SUSPENSION OF PAYMENTS

48.1 Conditions

The *Agency* may — at any moment — suspend, in whole or in part, the pre-financing payment and interim payments for one or more beneficiaries or the payment of the balance for all beneficiaries, if a beneficiary:

- (a) has committed or is suspected of having committed substantial errors, irregularities, fraud or serious breach of obligations in the award procedure or under this Agreement or
- (b) has committed — in other EU or Euratom grants awarded to it under similar conditions — systemic or recurrent errors, irregularities, fraud or serious breach of obligations that have a material impact on this grant (**extension of findings from other grants to this grant**; see Article 22.5.2).

48.2 Procedure

Before suspending payments, the *Agency* will formally notify the coordinator:

- informing it of its intention to suspend payments and the reasons why and
- inviting it to submit observations within 30 days of receiving notification.

If the *Agency* does not receive observations or decides to pursue the procedure despite the observations it has received, it will formally notify **confirmation** of the suspension. Otherwise, it will formally notify that the suspension procedure is not continued.

The suspension will **take effect** the day the confirmation notification is sent by the *Agency*.

If the conditions for resuming payments are met, the suspension will be **lifted**. The *Agency* will formally notify the coordinator.

During the suspension, the periodic report(s) (see Article 20.3) must not contain any individual financial statements from the beneficiary concerned. When the *Agency* resumes payments, the coordinator may include them in the next periodic report.

The beneficiaries may suspend implementation of the action (see Article 49.1) or terminate the Agreement or the participation of the beneficiary concerned (see Article 50.1 and 50.2).

ARTICLE 49 — SUSPENSION OF THE ACTION IMPLEMENTATION

49.1 Suspension of the action implementation, by the beneficiaries

49.1.1 Conditions

The beneficiaries may suspend implementation of the action or any part of it, if exceptional circumstances — in particular *force majeure* (see Article 51) — make implementation impossible or excessively difficult.

49.1.2 Procedure

The coordinator must immediately formally notify to the *Agency* the suspension (see Article 52), stating:

- the reasons why and
- the expected date of resumption.

The suspension will **take effect** the day this notification is received by the *Agency*.

Once circumstances allow for implementation to resume, the coordinator must immediately formally notify the *Agency* and request an **amendment** of the Agreement to set the date on which the action will be resumed, extend the duration of the action and make other changes necessary to adapt the action to the new situation (see Article 55) — unless the Agreement or the participation of a beneficiary has been terminated (see Article 50).

The suspension will be **lifted** with effect from the resumption date set out in the amendment. This date may be before the date on which the amendment enters into force.

Costs incurred during suspension of the action implementation are not eligible (see Article 6).

49.2 Suspension of the action implementation, by the *Agency*

49.2.1 Conditions

The *Agency* may suspend implementation of the action or any part of it:

- (a) if a beneficiary has committed or is suspected of having committed substantial errors, irregularities, fraud or serious breach of obligations in the award procedure or under this Agreement;
- (b) if a beneficiary has committed — in other EU or Euratom grants awarded to it under similar conditions — systemic or recurrent errors, irregularities, fraud or serious breach of obligations that have a material impact on this grant (**extension of findings from other grants to this grant**; see Article 22.5.2), or
- (c) if the action is suspected of having lost its scientific or technological relevance.

49.2.2 Procedure

Before suspending implementation of the action, the *Agency* will formally notify the coordinator:

- informing it of its intention to suspend the implementation and the reasons why and
- inviting it to submit observations within 30 days of receiving notification.

If the *Agency* does not receive observations or decides to pursue the procedure despite the observations it has received, it will formally notify **confirmation** of the suspension. Otherwise, it will formally notify that the procedure is not continued.

The suspension will **take effect** five days after confirmation notification is received by the coordinator (or on a later date specified in the notification).

It will be **lifted** if the conditions for resuming implementation of the action are met.

The coordinator will be formally notified of the lifting and the Agreement will be **amended** to set the date on which the action will be resumed, extend the duration of the action and make other changes necessary to adapt the action to the new situation (see Article 55) — unless the Agreement has already been terminated (see Article 50).

The suspension will be lifted with effect from the resumption date set out in the amendment. This date may be before the date on which the amendment enters into force.

Costs incurred during suspension are not eligible (see Article 6).

The beneficiaries may not claim damages due to suspension by the *Agency* (see Article 46).

Suspension of the action implementation does not affect the *Agency's* right to terminate the Agreement or participation of a beneficiary (see Article 50), reduce the grant or recover amounts unduly paid (see Articles 43 and 44).

ARTICLE 50 — TERMINATION OF THE AGREEMENT OR OF THE PARTICIPATION OF ONE OR MORE BENEFICIARIES

50.1 Termination of the Agreement by the beneficiaries

50.1.1 Conditions and procedure

The beneficiaries may terminate the Agreement.

The coordinator must formally notify termination to the *Agency* (see Article 52), stating:

- the reasons why and
- the date the termination will take effect. This date must be after the notification.

If no reasons are given or if the *Agency* considers the reasons do not justify termination, the Agreement will be considered to have been '**terminated improperly**'.

The termination will **take effect** on the day specified in the notification.

50.1.2 Effects

The coordinator must — within 60 days from when termination takes effect — submit:

- (i) a periodic report (for the open reporting period until termination; see Article 20.3) and
- (ii) the final report (see Article 20.4).

If the *Agency* does not receive the reports within the deadline (see above), only costs which are included in an approved periodic report will be taken into account.

The *Agency* will **calculate** the final grant amount (see Article 5.3) and the balance (see Article 21.4) on the basis of the reports submitted. Only costs incurred until termination are eligible (see Article 6). Costs relating to contracts due for execution only after termination are not eligible.

Improper termination may lead to a reduction of the grant (see Article 43).

After termination, the beneficiaries' obligations (in particular Articles 20, 22, 23, Section 3 of Chapter 4, 36, 37, 38 and 40) continue to apply.

50.2 Termination of the participation of one or more beneficiaries, by the beneficiaries

50.2.1 Conditions and procedure

The participation of one or more beneficiaries may be terminated by the coordinator, on request of the beneficiary concerned or on behalf of the other beneficiaries.

The coordinator must formally notify termination to the *Agency* (see Article 52) and inform the beneficiary concerned.

If the coordinator's participation is terminated without its agreement, the formal notification must be done by another beneficiary (acting on behalf of the other beneficiaries).

The notification must include:

- the reasons why;
- the opinion of the beneficiary concerned (or proof that this opinion has been requested in writing);
- the date the termination takes effect. This date must be after the notification, and
- a request for amendment (see Article 55), with a proposal for reallocation of the tasks and the estimated budget of the beneficiary concerned (see Annexes 1 and 2) and, if necessary, the addition of one or more new beneficiaries (see Article 56). If termination takes effect after the period set out in Article 3, no request for amendment must be included unless the beneficiary concerned is the coordinator. In this case, the request for amendment must propose a new coordinator.

If this information is not given or if the *Agency* considers that the reasons do not justify termination, the participation will be considered to have been **terminated improperly**.

The termination will **take effect** on the day specified in the notification.

50.2.2 Effects

The coordinator must — within 30 days from when termination takes effect — submit:

- (i) a report on the distribution of payments to the beneficiary concerned and
- (ii) if termination takes effect during the period set out in Article 3, a '**termination report**' from the beneficiary concerned, for the open reporting period until termination, containing an overview of the progress of the work, an overview of the use of resources, the individual financial statement and, if applicable, the certificate on the financial statement (see Articles 20.3 and 20.4).

The information in the termination report must also be included in the periodic report for the next reporting period (see Article 20.3).

If the request for amendment is rejected by the *Agency*, (because it calls into question the decision awarding the grant or breaches the principle of equal treatment of applicants), the Agreement may be terminated according to Article 50.3.1(c).

If the request for amendment is accepted by the *Agency*, the Agreement is **amended** to introduce the necessary changes (see Article 55).

The *Agency* will **calculate** — on the basis of the periodic reports, the termination report and the report on the distribution of payments — if the (pre-financing and interim) payments received by the beneficiary concerned exceed the beneficiary's EU contribution (calculated by applying the reimbursement rate(s) to the eligible costs declared by the beneficiary and approved by the *Agency*). Only costs incurred by the beneficiary concerned until termination takes effect are eligible (see Article 6). Costs relating to contracts due for execution only after termination are not eligible.

- If the payments received **exceed the amounts due**:
 - if termination takes effect during the period set out in Article 3 and the request for amendment is accepted, the beneficiary concerned must repay to the coordinator the amount unduly received. The *Agency* will formally notify the amount unduly received and request the beneficiary concerned to repay it to the coordinator within 30 days of receiving notification. If it does not repay the coordinator, the *Agency* will draw upon the Guarantee Fund to pay the coordinator and then notify a **debit note** on behalf of the Guarantee Fund to the beneficiary concerned (see Article 44);
 - in all other cases (in particular if termination takes effect after the period set out in Article 3), the *Agency* will formally notify a **debit note** to the beneficiary concerned. If payment is not made by the date in the debit note, the Guarantee Fund will pay to the *Agency* the amount due and the *Agency* will notify a debit note on behalf of the Guarantee Fund to the beneficiary concerned (see Article 44);
 - if the beneficiary concerned is the former coordinator, it must repay the new coordinator according to the procedure above, unless:
 - termination is after an interim payment and
 - the former coordinator has not distributed amounts received as pre-financing or interim payments (see Article 21.7).

In this case, the *Agency* will formally notify a **debit note** to the former coordinator. If payment is not made by the date in the debit note, the Guarantee Fund will pay to the *Agency*

the amount due. The *Agency* will then pay the new coordinator and notify a debit note on behalf of the Guarantee Fund to the former coordinator (see Article 44).

- If the payments received **do not exceed the amounts due**: amounts owed to the beneficiary concerned will be included in the next interim or final payment.

If the *Agency* does not receive the termination report within the deadline (see above), only costs included in an approved periodic report will be taken into account.

If the *Agency* does not receive the report on the distribution of payments within the deadline (see above), it will consider that:

- the coordinator did not distribute any payment to the beneficiary concerned and that
- the beneficiary concerned must not repay any amount to the coordinator.

Improper termination may lead to a reduction of the grant (see Article 43) or termination of the Agreement (see Article 50).

After termination, the concerned beneficiary's obligations (in particular Articles 20, 22, 23, Section 3 of Chapter 4, 36, 37, 38 and 40) continue to apply.

50.3 Termination of the Agreement or the participation of one or more beneficiaries, by the *Agency*

50.3.1 Conditions

The *Agency* may terminate the Agreement or the participation of one or more beneficiaries, if:

- (a) one or more beneficiaries do not accede to the Agreement (see Article 56);
- (b) a change to their legal, financial, technical, organisational or ownership situation is likely to substantially affect or delay the implementation of the action or calls into question the decision to award the grant;
- (c) following termination of participation for one or more beneficiaries (see above), the necessary changes to the Agreement would call into question the decision awarding the grant or breach the principle of equal treatment of applicants (see Article 55);
- (d) implementation of the action is prevented by force majeure (see Article 51) or suspended by the coordinator (see Article 49.1) and either:
 - (i) resumption is impossible, or
 - (ii) the necessary changes to the Agreement would call into question the decision awarding the grant or breach the principle of equal treatment of applicants;
- (e) a beneficiary is declared bankrupt, being wound up, having its affairs administered by the courts, has entered into an arrangement with creditors, has suspended business activities, or is subject to any other similar proceedings or procedures under national law;

- (f) a beneficiary (or a natural person who has the power to represent or take decisions on its behalf) has been found guilty of professional misconduct, proven by any means;
- (g) a beneficiary does not comply with the applicable national law on taxes and social security;
- (h) the action has lost scientific or technological relevance;
- (i) *not applicable*;
- (j) *not applicable*;
- (k) a beneficiary (or a natural person who has the power to represent or take decisions on its behalf) has committed fraud, corruption, or is involved in a criminal organisation, money laundering or any other illegal activity affecting the EU's financial interests;
- (l) a beneficiary (or a natural person who has the power to represent or take decisions on its behalf) has — in the award procedure or under the Agreement — committed:
 - (i) substantial errors, irregularities, fraud or
 - (ii) serious breach of obligations, including improper implementation of the action, submission of false information, failure to provide required information, breach of ethical principles;
- (m) a beneficiary has committed — in other EU or Euratom grants awarded to it under similar conditions — systemic or recurrent errors, irregularities, fraud or serious breach of obligations that have a material impact on this grant (**'extension of findings from other grants to this grant'**).

50.3.2 Procedure

Before terminating the Agreement or participation of one or more beneficiaries, the *Agency* will formally notify the coordinator:

- informing it of its intention to terminate and the reasons why and
- inviting it, within 30 days of receiving notification, to submit observations and — in case of Point (l.ii) above — to inform the *Agency* of the measures to ensure compliance with the obligations under the Agreement.

If the *Agency* does not receive observations or decides to pursue the procedure despite the observations it has received, it will formally notify to the coordinator **confirmation** of the termination and the date it will take effect. Otherwise, it will formally notify that the procedure is not continued.

The termination will **take effect**:

- for terminations under Points (b), (c), (e), (g), (h), (j), and (l.ii) above: on the day specified in the notification of the confirmation (see above);
- for terminations under Points (a), (d), (f), (i), (k), (l.i) and (m) above: on the day after the notification of the confirmation is received by the coordinator.

50.3.3 Effects

(a) for **termination of the Agreement**:

The coordinator must — within 60 days from when termination takes effect — submit:

- (i) a periodic report (for the last open reporting period until termination; see Article 20.3) and
- (ii) a final report (see Article 20.4).

If the Agreement is terminated for breach of the obligation to submit the reports (see Articles 20.8 and 50.3.1(l)), the coordinator may not submit any reports after termination.

If the *Agency* does not receive the reports within the deadline (see above), only costs which are included in an approved periodic report will be taken into account.

The *Agency* will **calculate** the final grant amount (see Article 5.3) and the balance (see Article 21.4) on the basis of the reports submitted. Only costs incurred until termination takes effect are eligible (see Article 6). Costs relating to contracts due for execution only after termination are not eligible.

This does not affect the *Agency's* right to reduce the grant (see Article 43) or to impose administrative and financial penalties (Article 45).

The beneficiaries may not claim damages due to termination by the *Agency* (see Article 46).

After termination, the beneficiaries' obligations (in particular Articles 20, 22, 23, Section 3 of Chapter 4, 36, 37, 38 and 40) continue to apply.

(b) for **termination of the participation of one or more beneficiaries**:

The coordinator must — within 60 days from when termination takes effect — submit:

- (i) a report on the distribution of payments to the beneficiary concerned;
- (ii) a request for amendment (see Article 55), with a proposal for reallocation of the tasks and estimated budget of the beneficiary concerned (see Annexes 1 and 2) and, if necessary, the addition of one or more new beneficiaries (see Article 56). If termination is notified after the period set out in Article 3, no request for amendment must be submitted unless the beneficiary concerned is the coordinator. In this case the request for amendment must propose a new coordinator, and
- (iii) if termination takes effect during the period set out in Article 3, a **termination report** from the beneficiary concerned, for the open reporting period until termination, containing an overview of the progress of the work, an overview of the use of resources, the individual financial statement and, if applicable, the certificate on the financial statement (see Article 20).

The information in the termination report must also be included in the periodic report for the next reporting period (see Article 20.3).

If the request for amendment is rejected by the *Agency* (because it calls into question the decision awarding the grant or breaches the principle of equal treatment of applicants), the Agreement may be terminated according to Article 50.3.1(c).

If the request for amendment is accepted by the *Agency*, the Agreement is **amended** to introduce the necessary changes (see Article 55).

The *Agency* will **calculate** — on the basis of the periodic reports, the termination report and the report on the distribution of payments — if the (pre-financing and interim) payments received by the beneficiary concerned exceed the beneficiary's EU contribution (calculated by applying the reimbursement rate(s) to the eligible costs declared by the beneficiary and approved by the *Agency*). Only costs incurred by the beneficiary concerned until termination takes effect are eligible (see Article 6). Costs relating to contracts due for execution only after termination are not eligible.

- If the payments received **exceed the amounts due**:
 - if termination takes effect during the period set out in Article 3 and the request for amendment is accepted, the beneficiary concerned must repay to the coordinator the amount unduly received. The *Agency* will formally notify the amount unduly received and request the beneficiary concerned to repay it to the coordinator within 30 days of receiving notification. If it does not repay the coordinator, the *Agency* will draw upon the Guarantee Fund to pay the coordinator and then notify a debit note on behalf of the Guarantee Fund to the beneficiary concerned (see Article 44);
 - in all other cases, in particular if termination takes effect after the period set out in Article 3, the *Agency* will formally notify a **debit note** to the beneficiary concerned. If payment is not made by the date in the debit note, the Guarantee Fund will pay to the *Agency* the amount due and the *Agency* will notify a debit note on behalf of the Guarantee Fund to the beneficiary concerned (see Article 44);
 - if the beneficiary concerned is the former coordinator, it must repay the new coordinator the amount unduly received, unless:
 - termination takes effect after an interim payment and
 - the former coordinator has not distributed amounts received as pre-financing or interim payments (see Article 21.7)

In this case, the *Agency* will formally notify a **debit note** to the former coordinator. If payment is not made by the date in the debit note, the Guarantee Fund will pay to the *Agency* the amount due. The *Agency* will then pay the new coordinator and notify a debit note on behalf of the Guarantee Fund to the former coordinator (see Article 44).

- If the payments received **do not exceed the amounts due**: amounts owed to the beneficiary concerned will be included in the next interim or final payment.

If the *Agency* does not receive the termination report within the deadline (see above), only costs included in an approved periodic report will be taken into account.

If the *Agency* does not receive the report on the distribution of payments within the deadline (see above), it will consider that:

- the coordinator did not distribute any payment to the beneficiary concerned, and that
- the beneficiary concerned must not repay any amount to the coordinator.

After termination, the concerned beneficiary's obligations (in particular Articles 20, 22, 23, Section 3 of Chapter 4, 36, 37, 38 and 40) continue to apply.

SECTION 4 FORCE MAJEURE

ARTICLE 51 — FORCE MAJEURE

'Force majeure' means any situation or event that:

- prevents either party from fulfilling their obligations under the Agreement,
- was unforeseeable, exceptional situation and beyond the parties' control,
- was not due to error or negligence on their part (or on the part of third parties involved in the action), and
- proves to be inevitable in spite of exercising all due diligence.

The following cannot be invoked as force majeure:

- any default of a service, defect in equipment or material or delays in making them available, unless they stem directly from a relevant case of force majeure,
- labour disputes or strikes, or
- financial difficulties.

Any situation constituting force majeure must be formally notified to the other party without delay, stating the nature, likely duration and foreseeable effects.

The parties must immediately take all the necessary steps to limit any damage due to force majeure and do their best to resume implementation of the action as soon as possible.

The party prevented by force majeure from fulfilling its obligations under the Agreement cannot be considered in breach of them.

CHAPTER 7 FINAL PROVISIONS

ARTICLE 52 — COMMUNICATION BETWEEN THE PARTIES

52.1 Form and means of communication

Communication under the Agreement (information, requests, submissions, ‘formal notifications’, etc.) must:

- be made in writing and
- bear the number of the Agreement.

Until the payment of the balance: all communication must be made through the electronic exchange system and using the forms and templates provided there.

After the payment of the balance: formal notifications must be made by registered post with proof of delivery (‘formal notification on paper’).

Communications in the electronic exchange system must be made by persons authorised according to the ‘Terms and Conditions of Use of the electronic exchange system’. For naming the authorised persons, each beneficiary must have designated — before the signature of this Agreement — a ‘Legal Entity Appointed Representative (LEAR)’. The role and tasks of the LEAR are stipulated in his/her appointment letter (see Terms and Conditions of Use of the electronic exchange system).

If the electronic exchange system is temporarily unavailable, instructions will be given on the *Agency and Commission* websites.

52.2 Date of communication

Communications are considered to have been made when they are sent by the sending party (i.e. on the date and time they are sent through the electronic exchange system).

Formal notifications through the **electronic** exchange system are considered to have been made when they are received by the receiving party (i.e. on the date and time of acceptance by the receiving party, as indicated by the time stamp). A formal notification that has not been accepted within 10 days after sending is considered to have been accepted.

Formal notifications **on paper** sent by **registered post** with proof of delivery (only after the payment of the balance) are considered to have been made on either:

- the delivery date registered by the postal service or
- the deadline for collection at the post office.

If the electronic exchange system is temporarily unavailable, the sending party cannot be considered in breach of its obligation to send a communication within a specified deadline.

52.3 Addresses for communication

The **electronic** exchange system must be accessed via the following URL:

<https://ec.europa.eu/research/participants/portal/desktop/en/projects/>

The *Agency* will formally notify the coordinator and beneficiaries in advance any changes to this URL.

Formal notifications on paper (only after the payment of the balance) addressed **to the Agency** must be sent to the following address:

*Executive Agency for Small and Medium-sized Enterprises (EASME)
H2020 Environment & Resources
MADO 31/027
B-1049 Brussels Belgium*

Formal notifications on paper (only after the payment of the balance) addressed **to the beneficiaries** must be sent to their legal address as specified in the 'Beneficiary Register'.

ARTICLE 53 — INTERPRETATION OF THE AGREEMENT

53.1 Precedence of the Terms and Conditions over the Annexes

The provisions in the Terms and Conditions of the Agreement take precedence over its Annexes.

Annex 2 takes precedence over Annex 1.

53.2 Privileges and immunities

Not applicable

ARTICLE 54 — CALCULATION OF PERIODS, DATES AND DEADLINES

In accordance with Regulation No 1182/71²⁸, periods expressed in days, months or years are calculated from the moment the triggering event occurs.

The day during which that event occurs is not considered as falling within the period.

ARTICLE 55 — AMENDMENTS TO THE AGREEMENT

55.1 Conditions

The Agreement may be amended, unless the amendment entails changes to the Agreement which would call into question the decision awarding the grant or breach the principle of equal treatment of applicants.

Amendments may be requested by any of the parties.

55.2 Procedure

The party requesting an amendment must submit a request for amendment signed in the electronic exchange system (see Article 52).

²⁸ Regulation (EEC, Euratom) No 1182/71 of the Council of 3 June 1971 determining the rules applicable to periods, dates and time-limits (OJ L 124, 8.6.1971, p. 1).

The coordinator submits and receives requests for amendment on behalf of the beneficiaries (see Annex 3).

If a change of coordinator is requested without its agreement, the submission must be done by another beneficiary (acting on behalf of the other beneficiaries).

The request for amendment must include:

- the reasons why;
- the appropriate supporting documents;
- for a change of coordinator without its agreement: the opinion of the coordinator (or proof that this opinion has been requested in writing).

The *Agency* may request additional information.

If the party receiving the request agrees, it must sign the amendment in the electronic exchange system within 45 days of receiving notification (or any additional information the *Agency* has requested). If it does not agree, it must formally notify its disagreement within the same deadline. The deadline may be extended, if necessary for the assessment of the request. If no notification is received within the deadline, the request is considered to have been rejected

An amendment **enters into force** on the day of the signature of the receiving party.

An amendment **takes effect** on the date agreed by the parties or, in the absence of such an agreement, on the date on which the amendment enters into force.

ARTICLE 56 — ACCESSION TO THE AGREEMENT

56.1 Accession of the beneficiaries mentioned in the Preamble

The other beneficiaries must accede to the Agreement by signing the Accession Form (see Annex 3) in the electronic exchange system (see Article 52) within 30 days after its entry into force (see Article 58).

They will assume the rights and obligations under the Agreement with effect from the date of its entry into force (see Article 58).

If a beneficiary does not accede to the Agreement within the above deadline, the coordinator must — within 30 days — request an amendment to make any changes necessary to ensure proper implementation of the action. This does not affect the *Agency's* right to terminate the Agreement (see Article 50).

56.2 Addition of new beneficiaries

In justified cases, the beneficiaries may request the addition of a new beneficiary.

For this purpose, the coordinator must submit a request for amendment in accordance with Article 55. It must include an Accession Form (see Annex 3) signed by the new beneficiary in the electronic exchange system (see Article 52).

New beneficiaries must assume the rights and obligations under the Agreement with effect from the date of their accession specified in the Accession Form (see Annex 3).

ARTICLE 57 — APPLICABLE LAW AND SETTLEMENT OF DISPUTES

57.1 Applicable law

The Agreement is governed by the applicable EU law, supplemented if necessary by the law of Belgium.

57.2 Dispute settlement

If a dispute concerning the interpretation, application or validity of the Agreement cannot be settled amicably, the General Court — or, on appeal, the Court of Justice of the European Union — has sole jurisdiction. Such actions must be brought under Article 272 of the Treaty on the Functioning of the EU (TFEU).

As an exception, if such a dispute is between the Agency and FACHHOCHSCHULE NORDWESTSCHWEIZ, WADIS LTD, IWB INDUSTRIELLE WERKE BASEL, MEKOROT WATER COMPANY LIMITED, the competent Belgian courts have sole jurisdiction.

As an exception, for the following beneficiaries:

- *Uttarakhand Jal Sansthan*

such disputes must — if they cannot be settled amicably — be referred to arbitration.

The Permanent Court of Arbitration Optional Rules for Arbitration Involving International Organisations and States in force at the date of entry into force of the Agreement will apply.

The appointing authority will be the Secretary-General of the Permanent Court of Arbitration following a written request submitted by either party.

The arbitration proceedings must take place in Brussels and the language used in the arbitral proceedings will be English.

The arbitral award will be binding on all parties and will not be subject to appeal.

If a dispute concerns administrative or financial penalties, offsetting or an enforceable decision under Article 299 TFEU (see Articles 44, 45 and 46), the beneficiaries must bring action before the General Court — or, on appeal, the Court of Justice of the European Union — under Article 263 TFEU. *Actions against enforceable decisions must be brought against the Commission (not against the Agency).*

ARTICLE 58 — ENTRY INTO FORCE OF THE AGREEMENT

The Agreement will enter into force on the day of signature by the *Agency* or the coordinator, depending on which is later.

SIGNATURES

For the coordinator

For the *Agency*



EUROPEAN COMMISSION
Executive Agency for Small and Medium-sized Enterprises
(EASME)

H2020 Environment & Resources



ANNEX 1 (part A)

Innovation action

NUMBER — 689450 — AquaNES

Table of Contents

1.1. The project summary.....	3
1.2. The list of beneficiaries.....	4
1.3. Workplan Tables - Detailed implementation.....	6
1.3.1. WT1 List of work packages.....	6
1.3.2. WT2 List of deliverables.....	7
1.3.3. WT3 Work package descriptions.....	11
Work package 1.....	11
Work package 2.....	17
Work package 3.....	23
Work package 4.....	29
Work package 5.....	34
Work package 6.....	39
Work package 7.....	45
Work package 8.....	51
Work package 9.....	54
1.3.4. WT4 List of milestones.....	56
1.3.5. WT5 Critical Implementation risks and mitigation actions.....	60
1.3.6 WT6 Summary of project effort in person-months.....	63
1.3.7. WT7 Tentative schedule of project reviews.....	65

1.1. The project summary

Project Number ¹	689450	Project Acronym ²	AquaNES
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One form per project

General information

Project title ³	Demonstrating synergies in combined natural and engineered processes for water treatment systems
Starting date ⁴	01/06/2016
Duration in months ⁵	36
Call (part) identifier ⁶	H2020-WATER-2015-two-stage
Topic	WATER-1b-2015 Demonstration/pilot activities
Fixed EC Keywords	Water technology
Free keywords	natural and engineered water treatment systems, constructed wetlands, managed aquifer recharge, bank filtration, ecosystem services, drinking water, wastewater treatment, water reuse, LCA

Abstract ⁷

The AquaNES project will catalyse innovations in water and wastewater treatment processes and management through improved combinations of natural and engineered components. Among the demonstrated solutions are natural treatment processes such as bank filtration (BF), managed aquifer recharge (MAR) and constructed wetlands (CW) plus engineered pre- and post-treatment options.

The project focuses on 13 demonstration sites in Europe, India and Israel covering a representative range of regional, climatic, and hydrogeological conditions in which different combined natural-engineered treatment systems (cNES) will be demonstrated through active collaboration of knowledge and technology providers, water utilities and end-users. Our specific objectives are

- to demonstrate the benefits of post-treatment options such as membranes, activated carbon and ozonation after bank filtration for the production of safe drinking water
- to validate the treatment and storage capacity of soil-aquifer systems in combination with oxidative pre-treatments
- to demonstrate the combination of constructed wetlands with different technical post- or pre-treatment options (ozone or bioreactor systems) as a wastewater treatment option
- to evidence reductions in operating costs and energy consumption
- to test a robust risk assessment framework for cNES
- to deliver design guidance for cNES informed by industrial or near-industrial scale experiences
- to identify and profile new market opportunities in Europe and overseas for cNES

The AquaNES project will demonstrate combined natural-engineered treatment systems as sustainable adaptations to issues such as water scarcity, excess water in cities and micro-pollutants in the water cycle. It will thus have impact across the EIP Water's thematic priorities and cross-cutting issues, particularly on 'Water reuse & recycling', 'Water and wastewater treatment', 'Water-energy nexus', 'Ecosystem services', 'Water governance', and 'DSS & monitoring'.

1.2. List of Beneficiaries

Project Number ¹	689450	Project Acronym ²	AquaNES
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List of Beneficiaries

No	Name	Short name	Country	Project entry month ⁸	Project exit month
1	FACHHOCHSCHULE NORDWESTSCHWEIZ	FHNW	Switzerland	1	36
2	AKUT UMWELTSCHUTZ INGENIEURE BURKARD UND PARTNER	AKUT	Germany	1	36
3	AUTARCON GMBH	AUT	Germany	1	36
4	BioDetection Systems B.V.	BDS	Netherlands	1	36
5	HYDROBUSINESS BV	HYBU	Netherlands	1	36
6	IMAGEAU SAS	imaGeau	France	1	36
7	GEO-HYD	GEOHYD	France	1	36
8	MicroLAN	MicroLAN	Netherlands	1	36
9	X-FLOW BV	XFLOW	Netherlands	1	36
10	VERTECH GROUP	VTG	France	1	36
11	WADIS LTD	WADIS	Israel	1	36
12	WATSTECH LIMITED	WatStech	United Kingdom	1	36
13	XYLEM SERVICES GMBH	XYLEM	Germany	1	36
14	FOVAROSI VIZMUVEK ZARTKORUEN MUKODORESZVENYTARSASAG	BUWW	Hungary	1	36
15	BERLINER WASSERBETRIEBE	BWB	Germany	1	36
16	DIMOTIKI EPICHIRISI YDREVSIS APOCHETEFSIS DIMOY THIRAS NOMOU KYKLADON	DEYAT	Greece	1	36
17	DIMOS ANTIPAROU	MUOA	Greece	1	36
18	DREWAG NETZ GMBH	DREWAG	Germany	1	36
19	ERFTVERBAND	EV	Germany	1	36
20	IWB INDUSTRIELLE WERKE BASEL	IWB	Switzerland	1	36
21	MEKOROT WATER COMPANY LIMITED	MEK	Israel	1	36
22	UNIWERSYTET IM. ADAMA MICKIEWICZA W POZNANIU	AMU	Poland	1	36
23	BUREAU DE RECHERCHES GEOLOGIQUES ET MINIERES	BRGM	France	1	36
24	CRANFIELD UNIVERSITY	UCRAN	United Kingdom	1	36

1.2. List of Beneficiaries

No	Name	Short name	Country	Project entry month ⁸	Project exit month
25	Hochschule fuer Technik und Wirtschaft Dresden	HTWD	Germany	1	36
26	EOTVOS JOZSEF FOISKOLA	EJC	Hungary	1	36
27	KWB KOMPENTENTZZENTRUM WASSER BERLIN GEMEINNUTZIGE GMBH	KWB	Germany	1	36
28	KWR WATER B.V.	KWR	Netherlands	1	36
29	NATIONAL TECHNICAL UNIVERSITY OF ATHENS - NTUA	NTUA	Greece	1	36
30	Uttarakhand Jal Sansthan	UJS	India	1	36

1.3. Workplan Tables - Detailed implementation

1.3.1. WT1 List of work packages

WP Number ⁹	WP Title	Lead beneficiary ¹⁰	Person-months ¹¹	Start month ¹²	End month ¹³
WP1	Potential of bank filtration and post-treatments in (drinking)water supply	25 - HTWD	254.00	1	34
WP2	Managed aquifer recharge & soil aquifer treatment for water storage and quality improvement	23 - BRGM	220.30	1	34
WP3	Constructed wetlands and other natural systems for improved wastewater treatment	27 - KWB	211.70	1	36
WP4	Risk Assessment and Water Quality Control	28 - KWR	96.00	1	33
WP5	Interfaces with the Environment & Society	24 - UCRAN	104.00	1	34
WP6	Decision Support and System Design	29 - NTUA	69.50	1	36
WP7	Exploitation and Dissemination	10 - VTG	100.50	1	36
WP8	Management	1 - FHNW	35.00	1	36
WP9	Ethics requirements	1 - FHNW	N/A	1	36
Total			1,091.00		

1.3.2. WT2 list of deliverables

Deliverable Number ¹⁴	Deliverable Title	WP number ⁹	Lead beneficiary	Type ¹⁵	Dissemination level ¹⁶	Due Date (in months) ¹⁷
D1.1	Database on bank filtration sites	WP1	22 - AMU	Report	Public	18
D1.2	Design of bank filtration schemes and coupled engineered solutions	WP1	3 - AUT	Report	Public	24
D1.3	Demonstration of using software tools SOMA 2 for predicting the behaviour of micropollutants and SIPHON for energy efficient siphon well operation	WP1	25 - HTWD	Other	Public	30
D1.4	Tool box for risk assessment and decision support for BF design/operation in combination with engineered post-treatment	WP1	22 - AMU	Report	Public	32
D1.5	Planning of siphon well systems	WP1	25 - HTWD	Report	Public	32
D1.6	Advantages and limitations, impact of BF design, recommendations for operators	WP1	26 - EJC	Report	Public	34
D2.1	Oxidative pre-treatment for managed aquifer recharge and soil-aquifer treatment systems	WP2	1 - FHNW	Report	Public	30
D2.2	High flow pre-treatment and infiltration system for aquifer storage and recovery with storm water runoff	WP2	28 - KWR	Report	Public	30
D2.3	Novel monitoring-modelling systems to manage qualitative and quantitative status of coastal aquifers	WP2	23 - BRGM	Report	Public	30

Deliverable Number ¹⁴	Deliverable Title	WP number ⁹	Lead beneficiary	Type ¹⁵	Dissemination level ¹⁶	Due Date (in months) ¹⁷
D2.4	SAT-MAR-specific ICT system for stakeholder use	WP2	7 - GEOHYD	Other	Public	32
D3.1	Combining constructed wetlands and engineered treatment for water reuse	WP3	27 - KWB	Report	Public	24
D3.2	Combining constructed wetlands and engineered treatment for surface water protection	WP3	24 - UCRAN	Report	Public	30
D3.3	Design recommendations for combining CW with engineered pre- or post-treatments including case studies of demonstration sites	WP3	2 - AKUT	Report	Public	34
D4.1	R packages for integrative data processing & visualisation tool	WP4	27 - KWB	Other	Public	12
D4.2	Blueprint for a water quality assessment framework for cNES	WP4	28 - KWR	Report	Public	18
D4.3	Fast monitoring systems for various contaminants in cNES	WP4	28 - KWR	Report	Public	27
D4.4	Web based interactive tools for QMRA tool and chemical water quality assessment	WP4	27 - KWB	Other	Public	30
D5.1	EU governance for cNES	WP5	24 - UCRAN	Report	Public	24
D5.2	Ecosystem services from cNES	WP5	24 - UCRAN	Report	Public	30
D5.3	LCA & LCC in combined natural and engineered treatment systems	WP5	10 - VTG	Report	Confidential, only for members of the consortium (including the Commission Services)	33
D5.4	Guidance on citizen science approaches	WP5	24 - UCRAN	Report	Public	34

Deliverable Number ¹⁴	Deliverable Title	WP number ⁹	Lead beneficiary	Type ¹⁵	Dissemination level ¹⁶	Due Date (in months) ¹⁷
D5.5	Gaming approach for stakeholder engagement	WP5	28 - KWR	Report	Public	34
D6.1	cNES Decision Framework and Knowledge Management System	WP6	29 - NTUA	Report	Confidential, only for members of the consortium (including the Commission Services)	12
D6.2	Suite of cNES Decision Support Tools (1st prototype)	WP6	29 - NTUA	Demonstrator	Confidential, only for members of the consortium (including the Commission Services)	22
D6.3	Decision Reasoning System for cNES (1st prototype)	WP6	29 - NTUA	Demonstrator	Confidential, only for members of the consortium (including the Commission Services)	28
D6.4	AquaNES Decision Support System and relevant documentation	WP6	29 - NTUA	Demonstrator	Public	34
D7.1	Project Website	WP7	1 - FHNW	Websites, patents filling, etc.	Public	3
D7.2	Exploitation Plan	WP7	10 - VTG	Report	Confidential, only for members of the consortium (including the Commission Services)	6
D7.3	Dissemination Plan & Report	WP7	1 - FHNW	Report	Public	6
D7.4	Market Analysis Report	WP7	10 - VTG	Report	Confidential, only for members of the consortium (including the Commission Services)	12
D7.5	Dissemination Events	WP7	1 - FHNW	Other	Public	36
D7.6	Marketing Report & Brochures	WP7	1 - FHNW	Report	Public	27
D8.1	Meeting minutes	WP8	1 - FHNW	Report	Confidential, only for members	2

Deliverable Number ¹⁴	Deliverable Title	WP number ⁹	Lead beneficiary	Type ¹⁵	Dissemination level ¹⁶	Due Date (in months) ¹⁷
					of the consortium (including the Commission Services)	
D9.1	EPQ - Requirement No. 3	WP9	1 - FHNW	Ethics	Confidential, only for members of the consortium (including the Commission Services)	2
D9.2	NEC - Requirement No. 4	WP9	1 - FHNW	Ethics	Confidential, only for members of the consortium (including the Commission Services)	2
D9.3	EPQ - Requirement No. 1	WP9	1 - FHNW	Ethics	Confidential, only for members of the consortium (including the Commission Services)	2

1.3.3. WT3 Work package descriptions

Work package number ⁹	WP1	Lead beneficiary ¹⁰	25 - HTWD
Work package title	Potential of bank filtration and post-treatments in (drinking)water supply		
Start month	1	End month	34

Objectives

In WP1 new technology components will be integrated and monitoring and operating regimes will be adopted to further optimise water treatment in bank filtration schemes for these new requirements. Specific goals of WP1 are to:

1. improve the confidence with which water service providers are able to specify, design, and implement combined bank filtration (BF) and engineered water treatment systems,
2. evidence how full scale combined systems can achieve reductions in operating costs of 10%-30% and in energy consumption per m3 treated of up to 50% compared to current established solely engineered solutions,
3. demonstrate the benefits of post-treatment options such as nanofiltration (NF), ultrafiltration (UF), reverse osmosis (RO), granular activated carbon (GAC), ultraviolet disinfection (UV), ozonation and electrochlorination after bank filtration for the production of safe drinking water,
4. deliver design guidance for bank filtration systems combined with engineered treatment components informed by industrial or near-industrial scale experiences and to prove the transferability of tested technical approaches across contexts and water quality challenges,
5. strengthen the leading position of European researchers and water utilities in efficient use of bank filtration worldwide and achieve a new level of market penetration in Asia.

Description of work and role of partners

WP1 - Potential of bank filtration and post-treatments in (drinking)water supply [Months: 1-34]
HTWD, AUT, XFLOW, BUWW, BWB, DREWAG, AMU, EJC, KWB, UJS
 Demonstration sites: Overview (bold = innovative product/services)
 Site 1: Berlin (DE). Operated by BWB. demonstrating RBF + Anoxic/ Suboxic NF (pilot)+ aeration + sand filtration
 Site 2: Dresden, river Elbe (DE). Operated by DREWAG, demonstrating RBF + Aeration + UF (pilot) + Activated Carbon Filtration + Disinfection (Cl2)
 Site 3: Budapest, River Danube (HU). Operated by BUWW, demonstrating RBF + RO (pilot)+ Disinfection (ClO2)+ UV
 Site 4: Poznan, River Warta, (PL). Investigated by AMU, demonstrating RBF + Aeration + Ozonation + GAC + Disinfection (ClO2)
 Site 5: Haridwar, Ganga River (IN). Operated by AUT (SME), UJS (Utility), demonstrating RBF + Disinfection (Cl2) using in-line electro-lysis (existing and pilot)

Task 1.1 Decentralized NF for anoxic to suboxic BF, Site 1 (M1-M30)
 Lead: KWB, Contributors: BWB, XFLOW
 NF can remove both sulphate and EDTA in one treatment step (Van der Bruggen et al., 2004). BF in front of the NF is a reliable measure to remove biopolymers (Gruenheid et al., 2005), a primary UF foulant, and ensures a high level of membrane filtration performance. Beyer et al. (2014) demonstrated the long-term stability of spiral wound NF of strictly anoxic groundwater, a concept which will be adapted to bank filtration and suboxic conditions. Demonstrate long-term stability of anoxic capillary NF as post-treatment for BF, operated at single wells for decentralized partial removal of selected inorganic and organic compounds; extend applicability of NF for BF/groundwater treatment from strictly anoxic to suboxic conditions and highlight benefits of BF regarding biofouling prevention of the membrane in comparison to direct surface water treatment via NF (site 1).

Subtask 1.1.1 Planning of demonstration site and production of innovative NF modules
 Lead: KWB, Contributors: BWB, XFLOW

- Design and first industrial size production of capillary NF modules with optimized removal of sulphate vs. reduced transmembrane pressure
- Design and installation of a decentralized NF-pilot scheme (< 5 m3/h) for targeted partial treatment for an/suboxic bank filtrate
- Survey of existing NF schemes for groundwater or BF treatment, analysis of available data on the selected sites (recovery ratio, pressure loss, fouling, energy demand, maintenance) to benchmark AquaNES improvement in energy and cost savings

Subtask 1.1.2 NF-performance analysis and integration of results

Lead: BWB, Contributors: XFLOW, KWB

- Evaluation of the operational requirements for suboxic bank filtrate treatment. Monitoring with special focus of sulfate, DOC, micropollutants (yet to be determined) and EDTA.
- Demonstration of long-term stability of operation with anoxic and suboxic BF as feed water
- Validation of removal capacity for selected inorganic and organic compounds, integration into centralized water distribution system and evaluation of cost/energy savings compared to mainstream centralized treatment.

Task 1.2 Centralized UF/RO to reduce breakthrough of pathogens and micropollutants after BF, Sites 2, 3, 5 (M1-M34)

Lead: HTWD, Contributors: DREWAG, BUWW, EJC, AUT

UF with coagulation achieves effective removal of pathogens (ElHadidy et al., 2013; Mueller, 2005) and TOC removal of >40 % (Kabsch-Korbuowicz, 2005). However, UF, coagulation or both in combination are not effective at removing MP, except specific compounds (Wray et al., 2014). BF in front of the UF can remove degradable micropollutants (Maeng et al., 2011) and the combination of both, UF/RO and BF can be applied as a reliable multi-barrier treatment. Demonstrate advantages and limitations of centralized oxic membrane filtration (UF, RO) in combination with BF after Fe/Mn removal. Assess UF as additional barrier to the breakthrough of pathogens and organic compounds during subsequent activated carbon filtration (sites 2, 3)

Subtask 1.2.1 Running of UF-pilot scheme at site 2

Lead: DREWAG, Contributors: HTWD

Design, installation and operation of an UF-pilot scheme (0.5-2 m³/d) at site 2, long term monitoring of selected organic and biological parameters as well as membrane performance (recovery ratio, pressure loss, fouling, energy demand, maintenance) for 24 months, estimation of removal rates and comparison of life-cycle costs and advantages of additional UF-treatment against regular reactivation of GAC (higher organic load) plus additional disinfection. Survey of existing UF schemes for groundwater or BF treatment, analysis of available data on the selected sites (recovery ratio, pressure loss, fouling, energy demand, maintenance)

Subtask 1.2.3 Running of RO-pilot scheme at site 3

Lead: BUWW, Contributors: EJC

Design, installation and operation of a RO-pilot scheme (0.3 m³/d) at site 3, event based operation and monitoring of selected biological parameters and membrane performance (recovery ratio, pressure loss, fouling, energy demand, maintenance) at the RO-pilot scheme (24 months) and estimation of removal rates (BUWW, EJC).

Subtask 1.2.3 UF membrane unit coupled with BF and the inline-electrolysis at site 5

Lead: AUT

Demonstration of an autarkic UF membrane unit coupled with BF and inline-electrolysis in India (4 m³/d). Focus will be set on long term operation of membranes by simplifying necessary maintenance and rinsing procedures. Cleaning agents e.g. can be produced electrolytically reducing substantially the demand for external chemical supply.

Task 1.3 Ensure water supply safety with BF and modern disinfection, Sites 2 - 5 (M1-M34)

Lead: AUT, Contributors: UJS, BUWW, EJC, DREWAG, HTWD, AMU

BF is a worldwide recognized natural and low cost treatment for pathogens. But field investigations have confirmed that some wells are at risk during floods such that contamination, especially by pathogens, can occur (Sandhu et al., 2015; Saph Pani, 2013). The risks identified as a result were mostly associated with the location of the BF wells and their designs resulting in direct contamination, inadequate existing flood protection measures and insufficient contingency measures. For site 5 it was shown that monsoon floods were a major contributor to the risk for human health and disability-adjusted life years (DALY's) were strongly dependent on RBF and disinfection pathogen removal capabilities (Bartak et al., 2015). Demonstrate how to ensure water supply safety with BF and modern disinfection including UV (Site 3) and on-site electrochlorination (Site 5) during extreme weather conditions such as floods and droughts. Developing a robust operation strategy to apply in-line electrolysis modules at sites where chloride concentration is <10 mg/L as observed at site 5 and often found in regions in Asia (sites 3 & 5).

Subtask 1.3.1 BF and decentralized large scale and small scale in-line electrolysis

Lead: AUT, Contributors: UJS, HTWD

Current disinfection practice at site 5 involves questionable manual NaHOCl disinfection at the well heads, which is common in India. In order to improve water safety, an existing innovative in-line electrolysis module (40 m³/d) for production of chlorine on-site for water disinfection will be tested at site 5 at a large caisson well. Also, a new in-line electrolysis module (4 m³/d) produced by the SME AUTARCON will be coupled with a so-called Koop-well system near site 5 to prove the potential for small scale RBF and disinfection for small communities; monitoring of residual chlorine.

Subtask 1.3.2 BF and disinfection using UV and/or ozone

Lead: BUWW, Contributors: EJC, AMU, DREWAG, HTWD

Long term and event based monitoring of selected water quality parameter before and after UV disinfection (sites 2 & 3). Effect of ozonation on pathogen removal after BF and before GAC will be studied at site 4.

Subtask 1.3.3 Adaption strategies to improve water safety at BF-sites

Lead: HTWD, Contributors: AUT, DREWAG, BUWW, AMU

Evaluation of existing data during extreme weather conditions, demonstrate compliance and non-compliance with regular operation, develop strategies to improve water safety (well operation, well design, well head safety, etc.) at sites in Europe as well as for future sites under different climate conditions such as in Asia or Africa. Specific methods will be tested to identify leakages at well heads, protective measures will be tested and evaluated in order to maximize well head protection, reduce surface water ingress (e.g. floods) and increase water safety.

Task 1.4 Treatment efficiency of combined natural and engineered BF systems, Sites 1-4 (M6-M34)

Lead: AMU, Contributors: DREWAG, BUWW, EJC, KWB, HTWD

Despite direct effects on source water quantity and quality, extreme weather affects BF efficacy indirectly by variations in travel time and redox conditions (Sprenger et al., 2011; Schoenheinz & Grischek, 2011; Massmann et al., 2006). Demonstrate the impact of travel time of BF and coupling with managed aquifer recharge (MAR) on the efficacy of existing BF post treatment (ozonation, activated carbon filtration, disinfection); evaluate the effectiveness of additional treatment steps (NF, UF, RO, UV, in-line disinfection) and summarize results in a software tool for prediction of the behaviour of micropollutants and other water constituents. Key performance indicators will be summarized for WP5&6.

Subtask 1.4.1 Removal of organic micropollutants with respect to travel time and redox conditions, Sites 1-5

Lead: AMU, Contributors: all others

Evaluation of removal rates for organic compounds with respect to travel time and development of well operation strategies to increase travel time. Study of existing data from the demonstration sites including travel times (1, 2, 3, 4, 5) demonstration of the current state of the art performance with respect to travel time. Create data base on BF sites and existing post-treatment in Eastern Europe. Application and adaptation of the software tool SOMA 2 based on SOMA (EU-Project TECHNEAU) to predict removal rates of micropollutants.

Subtask 1.4.2 Pilot experiments to determine BF-boundary conditions

Lead: EJC, Contributors: BUWW

Pilot scale experiments focused on crucial processes in order to determine the boundary conditions of the BF operation, including biofilm dynamics, bacterial production, nitrification/denitrification, removal of markers trace molecules, effects of environmental stressors (heat stress, dehydration stress, toxic effects), and the 3D changes of various electron donors (NH₄⁺, Fe etc.) within the active zone of the BF. Key performance indicators will be summarized for WP5&6.

Subtask 1.4.3 Evaluation of additional treatment for pathogen removal

Lead: HTWD, Contributors: AMU, BUWW, KWB

Evaluation and demonstration of the advantages of additional pathogen removal by membranes, UV and in-line electrolysis - disinfection using a quantitative risk assessment approach (QMRA) from WP4. Assessment of energy saving potential and ecosystem service when using BF as first barrier to remove pathogens.

Task 1.5 Long term BF abstraction rates and siphon wells for energy reduction, Sites 2-5 (M6-M24)

Lead: HTWD, Contributors: DREWAG, EJC, AMU, KWB, BWB, BUWW, UJS

Demonstration of an evaluation tool for prediction of riverbed clogging and required long term abstraction rates. Validation of a design tool for siphon systems to achieve a “renaissance” of siphon systems in BF using modern armatures and monitoring equipment to reduce pumping energy costs by >50%.

Subtask 1.5.1 Management of riverbed clogging

Lead: BUWW, Contributors: EJC, AMU, DREWAG, HTWD

Comparison of riverbed clogging studies from demonstration sites 2-4, maximum infiltration rates during flood and drought periods, demonstration of operational procedures to manage floods and droughts: declogging of riverbeds - dredging of the Warta River bottom, water abstraction during droughts in order to avoid unwanted water quality changes.

Subtask 1.5.2 Energy efficiency of different well types and siphon well design tool

Lead: HTWD, Contributors: DREWAG, BUWW, AMU, EJC, UJS

Assessment of the energy efficiency and life cycle costs of different well types (single operated with pumps vs. siphon wells vs. horizontal collector wells) and develop measures for energy management (sites 2-5). Demonstration of new constructive elements for novel siphon systems (replacement and new design) including recent developments in vacuum technology, testing of commercially available technical equipment for trenchless vacuum leak survey and measures for siphon rehabilitation; Developing a planning guideline for the design of siphon wells. Key performance indicators will be summarized for WP5&6.

Task 1.6 Interfaces with WP5 and WP6, Sites 1-5 (M3-M34)

Lead: HTWD, Contributors: BWB, KWB, DREWAG, EJC, AMU, BUWW, AUT, XFLOW, UJS

This task will ensure that data from WP2 will effectively feed into the activities of WP4 (Water quality assessment framework), WP5 (namely the LCA and ecosystem services assessments) and WP6 (namely AquaNES DSS and knowledge repository). Among the data derived from demonstration activities will be

- water quality parameters
- energy use
- chemicals use
- land use and
- flow data

This will involve liaising with partners on WP5 and WP6 in order to establish the scope of WP5 assessments and WP6 decision support, to define data needed for WP5&6 and to establish templates for data collation.

Participation per Partner

Partner number and short name	WP1 effort
3 - AUT	25.00
9 - XFLOW	18.00
14 - BUWW	38.00
15 - BWB	29.00
18 - DREWAG	14.00
22 - AMU	36.00
25 - HTWD	32.00
26 - EJC	29.00
27 - KWB	24.00
30 - UJS	9.00
Total	254.00

List of deliverables

Deliverable Number ¹⁴	Deliverable Title	Lead beneficiary	Type ¹⁵	Dissemination level ¹⁶	Due Date (in months) ¹⁷
D1.1	Database on bank filtration sites	22 - AMU	Report	Public	18
D1.2	Design of bank filtration schemes and coupled engineered solutions	3 - AUT	Report	Public	24
D1.3	Demonstration of using software tools SOMA 2 for predicting the behaviour of micropollutants and SIPHON for energy efficient	25 - HTWD	Other	Public	30

List of deliverables

Deliverable Number ¹⁴	Deliverable Title	Lead beneficiary	Type ¹⁵	Dissemination level ¹⁶	Due Date (in months) ¹⁷
	siphon well operation				
D1.4	Tool box for risk assessment and decision support for BF design/ operation in combination with engineered post-treatment	22 - AMU	Report	Public	32
D1.5	Planning of siphon well systems	25 - HTWD	Report	Public	32
D1.6	Advantages and limitations, impact of BF design, recommendations for operators	26 - EJC	Report	Public	34

Description of deliverables

D1.1 : Database on bank filtration sites [18]

An existing, limited database on BF sites in Europe will be completed with a special focus on BF sites in south-east Europe. The database will contain mainly geohydraulic site parameters, contact addresses, references and description of existing post-treatment

D1.2 : Design of bank filtration schemes and coupled engineered solutions [24]

Marketing Report: The marketing report will focus on regional needs in Europe, Asia and Africa and market options for combined systems with special focus on cost savings. It will highlight favourite design practices and adaption strategies for the combination of BF with engineered solutions in order to secure water supply under extreme weather conditions.

D1.3 : Demonstration of using software tools SOMA 2 for predicting the behaviour of micropollutants and SIPHON for energy efficient siphon well operation [30]

Improved/adapted software tools SOMA 2 for predicting the behaviour of micropollutants and SIPHON for energy efficient siphon well operation will be validated at demo sites. Results from monitoring programs, pilot testing, pumping tests and energy consumption measurements will be combined and used to test the application limits/ advantages of the software tools

D1.4 : Tool box for risk assessment and decision support for BF design/operation in combination with engineered post-treatment [32]

Technical REport: The report will present a validation of how existing tools can be applied for risk assessment and decision support for BF design/operation in combination with engineered post-treatment (all sites). Required qualification/training for using such tools will be evaluated.

D1.5 : Planning of siphon well systems [32]

Technical Report: A guideline for planning, construction and technical equipment of siphon well systems will be prepared. Users of the guideline will be engineers, consultancies, water companies.

D1.6 : Advantages and limitations, impact of BF design, recommendations for operators [34]

Technical Report: Information from demonstration sites and literature data on advantages, limitations, design and operation of BF schemes will be analysed to draw conclusions for managers, decision makers and operators. Key outputs are transferable numbers on attenuation rates for relevant pollutants in relation to the Water Framework

Directive and on technical problems related to redox conditions. The report includes BF + Membrane filtration (Task 1.1+1.2); BF + Disinfection (Task 1.3+1.4); Energy efficient operation (Task 1.5)

Schedule of relevant Milestones

Milestone number ¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS1	Set-up for all pilot/ demonstration sites completed	1 - FHNW	9	Site description, technical specification and operational procedure documented. HTWD, BRGM and KWB are supporting the collection of info within WP1, WP2 and WP3
MS2	Qualitative and first quantitative information for WP4-6 shared	23 - BRGM	12	Data exchanged & transferred according to procedures. Concerns all partners in WP1-4, to be coordinated by HTWD for WP1, BRGM for WP2, KWB for WP3, KWR for WP4.
MS3	First integrated data sets from pilot / demonstration sites available for WP5&6	25 - HTWD	24	Comprehensive data set from demonstration sites in WP1-4 at hand and exchanged. Input per Work Package to be coordinated by relevant WP Leaders (WP1-4), i.e. shared Lead for this milestone
MS10	Monitoring parameter inventory from demonstration sites	28 - KWR	10	List available, structured data base for parameters relevant for cNES to be compiled by KWR
MS27	Project internal data exchange procedures defined	7 - GEOHYD	10	Formats defined, decision on potential system made

Work package number ⁹	WP2	Lead beneficiary ¹⁰	23 - BRGM
Work package title	Managed aquifer recharge & soil aquifer treatment for water storage and quality improvement		
Start month	1	End month	34

Objectives

Demonstrate the effectiveness and validate the long-term feasibility of combined natural and engineered (cNES) treatment technologies for Soil Aquifer Treatment (SAT) and Managed Aquifer Recharge (MAR) sites for various hydro-climatic and regional contexts and a broad range of source waters (surface water, storm water, waste water) treated for drinking water purposes or water reuse. Specific goals of WP2 are to:

- Demonstrate the impact of oxidative pre-treatment steps to SAT on bulk organics, micropollutants and microbiological quality at pilot plant scale (Lange Erlen site)
- Test the combination of alternating ozonation-biofiltration-oxidation with short SAT to improve reduction of organic matter, micropollutants and pathogens for indirect potable reuse at demonstration scale (Shafdan site)
- Test and optimise a mobile high-rate filtration system combined to MAR for temporary storage of storm water at demonstrator scale (Waddinxveen site)
- Demonstrate the efficiency of combined secondary wastewater treatment + reed bed filtration with SAT/MAR on groundwater quality and quantity at aquifer scale through novel subsurface monitoring, data management and modelling including advanced chemical and isotopic analysis (Agon Coutainville site)
- Assess the overall long-term performance of combined engineered-MAR/SAT solutions for operational implementation, assisted by advanced monitoring and modelling (ICT) for system control and optimisation

Description of work and role of partners

WP2 - Managed aquifer recharge & soil aquifer treatment for water storage and quality improvement
 [Months: 1-34]
BRGM, FHNW, HYBU, imaGeau, GEOHYD, MicroLAN, WADIS, XYLEM, IWB, MEK, KWR
 Four MAR-SAT sites have been selected in Switzerland, Israel, Netherlands, and France for the demonstration of cNES treatment. These long established recharge sites exhibit operational features common to many schemes so that the demonstrated synergies of high technology with MAR/SAT will be representative and widely applicable.

Task 2.1 Oxidative pre-treatment of pre-filtered surface water prior to forest soil infiltration - Lange Erlen site (M 1-30)
 Lead: FHNW, contributors: IWB, XYLEM
 The Lange Erlen site (Site 6) produces drinking water for the city of Basel (CH) from the river Rhine (surface water abstraction). The treatment train encompasses screening, filtration and subsequent soil infiltration. After re-abstraction the water is treated by granular activated carbon and UV-disinfection. A pilot plant (reactor and column set-ups) will be operated to demonstrate the effectiveness of UV+H2O2 pre-treatment before infiltration, especially with respect to micropollutant removal and its effects on biodegradation and sorption processes (see scheme below).

Subtask 2.1.1 Oxidation processes for pre-filtered water from river Rhine and river Wiese
 Lead: XYLEM, contributors: IWB
 The demonstration site consists of a pilot plant capable of operating advanced oxidation processes including H2O2 dosing and UV activation to foster radical formation by Xylem. It will be set-up and put into operation, with subsequent column passages, to treat pre-filtered surface water both from the river Rhine and the nearby river Wiese, which is an alternative source water but has a lower water quality. The setup of the pilot plant and the columns will be finalized by M5 followed by a test- and conditioning period in M5-M6.

Subtask 2.1.2 Column set-ups
 Lead: FHNW, contributors: IWB
 To model the infiltration conditions, several columns will be set up with (1) disturbed soil samples from the infiltration area and (2) biological activated carbon with better controllable flow conditions. There will be reference columns fed with pre-treated water without oxidation and columns fed with the oxidized feed. All columns will be fed in the wet-dry cycles as encountered in the full scale system and will have several sampling ports at different points. Tracer experiments will be conducted to characterise the mass transfer in the column. The column material properties will be characterised before and after the experiment (e.g. particle size distribution, organic content, mineral composition and microbial composition). The column experiments are supposed to run in parallel for 12 months on each feed water (Rhine/Wiese).

A comprehensive characterisation of the feed and product water is foreseen, in terms of bulk organics (DOC fractionation by LC-OCD) and micropollutants (LC-MS/MS, transformation products will be measured for some target compounds) as well as microbiological parameters (indicators and flow cytometry). The treatment influence of H₂O₂ and UV dose will be tested in pre-experiments (M1-M5) for different feed water conditions (e.g. turbidity).

Subtask 2.1.3 Processes evaluation

Lead: FHNW, Contributors: XYLEM, IWB

The treatment performance of the demonstrated system will be compared to the existing infiltration plus adsorption system particularly with respect to organic removal. Recommendations will be derived on how the natural treatment system can be intensified by appropriate oxidative pre-treatment. Transferability to other managed aquifer recharge sites will be considered.

Task 2.2 Optimised advanced oxidation processes as pre-treatment for soil-aquifer treatment Indirect Potable Reuse (InPR) Shafdan site (M1-30)

Lead: MEK, Contributors: WADIS, XYLEM

The Shafdan demonstration site (Site 7) is located near Tel Aviv. Treated wastewater is infiltrated into an aquifer, which is re-abstracted for agricultural irrigation. Various comprehensive pre-treatment options have been tested previously to remove nutrients, micropollutants and increase the redox potential control for removal. The Shafdan pilot will demonstrate effectiveness of different combinations of ozonation-biofiltration-oxidation steps with short Soil Aquifer Treatment (sSAT) to improve the biodegradability and reduction of DOC, micropollutants and pathogens to satisfy Israeli and EU drinking water criteria for Indirect Potable Reuse (InPR). Different treatment trains (recirculated ozonation-sSAT, ozonation-BAC-UF, electric pulse (WADIS) – BAC-UF or sSAT) will be assessed. This demonstration site will validate the technical feasibility of two main innovative engineered pre-treatment processes combined with natural treatment system (sSAT) at a large scale:

- An optimization of the ozonation yield with recirculation of ozonated streams from the Xylem ozonator to biological treatment steps for organic matter, microorganisms and MPs removal
- A chemical-free treatment alternative with Wadis electropulse oxidation for organic matter, micro organisms and MPs removal.

Work is performed on an existing pilot plant which will be refurbished according to needs. The planned demonstration steps are as follows:

Subtask 2.2.1 Refurbishing and adopting existing pilot plant

Lead: MEK, Contributors: WADIS, Xylem

The existing pilot will be upgraded to accommodate the ozonated return stream. The biofilter height also will be doubled to cope with increasing ammonia concentrations in the secondary effluents. Additional monitoring equipment will be installed in the upper short SAT layer to allow for process control and evaluation, including on-line instrumentation by XYLEM (UV, DOC, DO., ...). The BAC-ceramic UF (0.3-0.5 m³/hr) system will be installed. An electric pulse oxidation system (WADIS) will be installed, for high performance for organic matter, microorganisms and MPs removal based on high electric voltage discharge into pre-treated secondary effluent. An analysis and monitoring program related to WP4 will be prepared including chemical analysis (trace organics and disinfection by-products like bromate and NDMA analysis) and microbial analysis (coliform, crypto, giardia and viruses log removal criteria for drinking water).

Subtask 2.2.2 Running of the pilot with sSAT

Lead: MEK, Contributors: WADIS, Xylem

This will be done in 3 steps: 1. Biofilter-ozonation (with return stream)-sSAT for 11 months (first operation year), 2. sSAT cleaning for 3 months, only combined to biofilter. 3. Biofilter- EP WADIS (with return stream) - sSAT testing for 11 months in the second year.

Subtask 2.2.3 Running of the pilot with BAC-UF

Lead: MEK, Contributors: WADIS, Xylem

For comparison with the cNES system, the first operation year 0.3-0.5 m³/hr of the biofilter-recirculated ozonation will be combined with biologically activated carbon (BAC) and ceramic UF for 11 months. The second year of operation, for half year, 0.3-0.5 m³/hr of Electropulse (EP WADIS)) treated water will be combined with BAC-UF in parallel to the EP WADIS-sSAT for comparison. Another half year secondary effluents without biofilter pretreatment will be ozonated and sent to the BAC –UF to see the effect of the biofilter to the BAC-UF process. The first half of the third year secondary effluents without any oxidative treatment will be sent to the BAC-UF for comparison to the effects of biofiltration-ozonation or biofiltration-Ep to the BAC-UF polishing process.

Subtask 2.2.4 Treatment train performances analysis

Lead: MEK

For each treatment train, chemical, microbial, MPs analyses will be conducted at numerous sampling points along the system. The results will be analysed in order to assess the quality performance and the economic feasibility for each of the trains in accordance with WP4 and WP5 with a planned collaboration with the Israeli Health Ministry

Task 2.3 High rate (in)filtration and Aquifer storage and recovery (ASR) for flood prevention and additional water supply, Waddinxveen site M1 - M30

Lead: KWR, Contributors: HYBU

The Waddinxveen site (Site 8) is a polder located app.10-15 km NE of Rotterdam. It will be used to demonstrate an innovative technology for enhanced subsurface storage of storm water for later withdrawal and use. The technology is based on high rate water treatment and subsurface infiltration.

Subtask 2.3.1 Deliver a prototype of a high flow pre-treatment and infiltration system for storm water runoff

Lead: KWR, Contributors: HYBU

The prototype of a high flow water treatment facility connected to a high flow infiltration system will feature the following unique properties: (1) can handle high rate flows and (2) is capable to handle a range of water qualities from various sources such as surface water and storm runoff from greenhouses and commercial buildings (3) is effective in removing pollutants and suspended material in order to prevent clogging of injection wells by particles and contamination of groundwater. The filter will be based on the fuzzy filter concept of compressible filter media made of fibrous spheres, enabling adaptable pore sizes and flows. The filter media can be adapted to the contaminants to be removed.

Subtask 2.3.2 Demonstrate the high flow pre-treatment and infiltration prototype

Lead: KWR, Contributors: HYBU

The prototype system will be demonstrated at Waddinxveen for various water types (roofwater, surface water, treated flushwater greenhouses). A fuzzy filter will be tested as one of the pre-treatment options next to combinations of proven treatment steps. The minimal water quality standards will be established as well as maximum capacities for “ephemeral” injection wells during short periods of high rate filtration to prevent well clogging and maintaining well integrity. To assess water quality regarding the presence of bacterial contamination, the BACTcontrol, an online automated instrument for the detection of microbiological activity in water will be used.

Subtask 2.3.3 Develop and demonstrate an operational remote control system

Lead: KWR, Contributors: HYBU

Develop and demonstrate a remote control system for Monitoring and operational decision support of the high flow pre-treatment and infiltration system. The remote control system will be based on now-casts of fresh groundwater supplies, water demand and meteorological predictions. A main task is the selection of appropriate proxy parameters for well clogging including trigger values for intervention.

Task 2.4 Advanced monitoring-modeling interface for optimised MAR/SAT system design & operation, Agon-Countainville site (M1-M32)

Lead: BRGM, contributors: IMAGEAU, GEOHYD, microLAN).

The Site 9 of Agon-Countainville uses secondary effluent after red bed and sand dune filtration for golf course irrigation in a coastal area. The underlying aquifer is prone to salinization. This task will demonstrate how innovative water quality monitoring and modelling linked to data management and communication, facilitates an optimised management of cNES sites and their future implementation.

Subtask 2.4.1. Online monitoring to constrain saline intrusion into coastal aquifers

Lead: IMAGEAU, Contributors: BRGM

The Subsurface Monitoring Device (SMD) is an in-situ and autonomous remote-controlled downhole monitoring device designed to record and transmit calibrated and validated physical and chemical pore water data (resistivity, gamma ray, sonic, T°C, pressure...). Drilling operation will be implemented on site in order to set up vertically several sensors. Results will be used to constrain the geological structure, water flow and geochemistry of the reactive transport model. Online continuous data access will be integrated in the ICT system to provide insights to remediation of saline intrusion through SAT/MAR

Subtask 2.4.2. Validate water quality improvement at demonstrator scale (BRGM, MicroLAN)

Lead: BRGM, Contributors: microLAN

Based on non-target screening data obtained by LC-Q-TOF, a shortlist of pertinent MPs will be monitored by target analysis, together with geochemical and using the BACTcontrol (linked to WP4) microbial parameters, needed for reactive modelling (subtask 2.4.3), throughout the treatment train and in the aquifer. As a complement to the BACTcontrol system. Virus and pathogens sampling will be performed for laboratory analysis in order to ensure the required log removal. This will allow calculating elimination rates, contaminant transfer.

Results will be integrated in the reactive transport model. The monitoring methodology will also comprise innovative environmental isotope tracing providing information on progress and spatial extension of storage, and mixing processes during storage-retrieval, thus constraining boundary conditions, as control parameters for the geochemical models.

Subtask 2.4.3. Innovative reactive transport modelling products for water quality management in SAT/MAR system

Lead: BRGM, Contributors: GEOHYD

Based on a conceptual soil-unsaturated zone-aquifer model, the performance of a combined thermo-kinetic hydrodynamic reactive transport approach will be demonstrated, based on up-to date thermodynamic data. It will be shown that this model is able to predict the geochemical processes that may lead to long term decrease of system performances and test system optimisation options. It will also be used to specifically simulate elimination of pathogens and organic pollutants in the reed bed pre-treatment.

Subtask 2.4.4. SAT/MAR-specific ICT system and system performance optimisation

Lead: GEOHYD, Contributors: BRGM

The design and implementation of a SAT/MAR-specific ICT system will ensure the knowledge integration.. ICT tool will integrate the collected data from online monitoring systems (SMD task 2.4.1, BACTcontrol task 2.4.2) and laboratory analysis as well as the reactive transport model (task 2.4.3). The off-the-shelf software will be validated with data from the Agon-Coutainville site. The evaluation of system optimisation options will be simulated for scenarios of pre-treatment train modulation, SAT/MAR efficiency, inflow quality changes and constraints such as groundwater quality standards, and climatic conditions. This tool will facilitate the implementation and operation of SAT-MAR based cNES systems as an input to WP6.

Task 2.5: Interface with work packages 4, 5 & 6 (M3-M30)

Lead: BRGM, Contributors: all WP2 partners

This task will ensure that data from WP2 will effectively feed into the activities of WP4 (Water quality assessment framework), WP5 (namely the LCA and ecosystem services assessments) and WP6 (namely AquaNES DSS and knowledge repository). Among the data derived from demonstration activities will be

- water quality parameters
- energy use
- chemicals use
- land use and
- flow data

This will involve liaising with partners on WP5 and WP6 in order to establish the scope of WP5 assessments and WP6 decision support, to define data needed for WP5&6 and to establish templates for data collation.

Participation per Partner

Partner number and short name	WP2 effort
1 - FHNW	18.00
5 - HYBU	9.00
6 - imaGeau	12.50
7 - GEOHYD	30.00
8 - MicroLAN	2.00
11 - WADIS	16.00
13 - XYLEM	23.00
20 - IWB	10.00
21 - MEK	45.80
23 - BRGM	42.00
28 - KWR	12.00
Total	220.30

List of deliverables

Deliverable Number ¹⁴	Deliverable Title	Lead beneficiary	Type ¹⁵	Dissemination level ¹⁶	Due Date (in months) ¹⁷
D2.1	Oxidative pre-treatment for managed aquifer recharge and soil-aquifer treatment systems	1 - FHNW	Report	Public	30
D2.2	High flow pre-treatment and infiltration system for aquifer storage and recovery with storm water runoff	28 - KWR	Report	Public	30
D2.3	Novel monitoring-modelling systems to manage qualitative and quantitative status of coastal aquifers	23 - BRGM	Report	Public	30
D2.4	SAT-MAR-specific ICT system for stakeholder use	7 - GEOHYD	Other	Public	32

Description of deliverables

D2.1 : Oxidative pre-treatment for managed aquifer recharge and soil-aquifer treatment systems [30]
 Integration, synthesis and recommendations from demonstration sites applying combinations of oxidative and biological treatments. Report covering performance and design aspects derived from Task 2.1 (Lange Erlen site) and Task 2.2 (Shafdan site). Two part report with responsibilities at FHNW and MEK alike

D2.2 : High flow pre-treatment and infiltration system for aquifer storage and recovery with storm water runoff [30]
 Report on design, applicability and performance of high flow pre-treatment and infiltration system for storm water runoff including its remote control system as elaborated in Task 2.3. (Waddinxveen demonstration site)

D2.3 : Novel monitoring-modelling systems to manage qualitative and quantitative status of coastal aquifers [30]
 Integration, synthesis and recommendations from demonstration site 8 applying a combination of monitoring and modelling tools for optimised SAT/MAR system. Characterisation of performance in dependence of environmental and other parameters (climatic constraints, waste water quality & flux, golf water supply,...). (Task 2.4)

D2.4 : SAT-MAR-specific ICT system for stakeholder use [32]
 SICT tools as an innovative water quality monitoring and modelling linked to data management and communication, for optimised management of cNES sites and their future implementation. Stand-alone software derived from Task 2.4.4 and to handed over to AquaNES DSS.

Schedule of relevant Milestones

Milestone number ¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS1	Set-up for all pilot/demonstration sites completed	1 - FHNW	9	Site description, technical specification and operational procedure

Schedule of relevant Milestones

Milestone number ¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
				documented. HTWD, BRGM and KWB are supporting the collection of info within WP1, WP2 and WP3
MS2	Qualitative and first quantitative information for WP4-6 shared	23 - BRGM	12	Data exchanged & transferred according to procedures. Concerns all partners in WP1-4, to be coordinated by HTWD for WP1, BRGM for WP2, KWB for WP3, KWR for WP4.
MS3	First integrated data sets from pilot / demonstration sites available for WP5&6	25 - HTWD	24	Comprehensive data set from demonstration sites in WP1-4 at hand and exchanged. Input per Work Package to be coordinated by relevant WP Leaders (WP1-4), i.e. shared Lead for this milestone
MS10	Monitoring parameter inventory from demonstration sites	28 - KWR	10	List available, structured data base for parameters relevant for cNES to be compiled by KWR
MS27	Project internal data exchange procedures defined	7 - GEOHYD	10	Formats defined, decision on potential system made

Work package number ⁹	WP3	Lead beneficiary ¹⁰	27 - KWB
Work package title	Constructed wetlands and other natural systems for improved wastewater treatment		
Start month	1	End month	36

Objectives

Demonstrate the combination of constructed wetlands (CW) and other natural treatment systems with different technical post- or pre-treatment options such as ozonation, bioreactor systems or disinfection in pilot and full scale sizes in different European climates (UK, Germany, Greece) for innovative and resource-efficient treatment of wastewater and combined sewer overflows. Specific goals of WP3 are to:

- Demonstrate the impact of CW as low energy post-treatment for ozonation of WWTP effluent, especially regarding removal of micropollutants and microbiological contamination at pilot plant scale (Germany)
- Demonstrate the flexible use of CW for combined CSO treatment and WWTP polishing at full scale targeting the reduction of nutrients, heavy metals, micropollutants and pathogens (Germany)
- Demonstrate the application of CW as pre-treatment for disinfection targeting water reuse applications for treatment of primary effluent at full scale (Greece)
- Demonstrate the use of cNES for nutrient removal and surface water protection at small WWTP (UK)

Establish design and marketing recommendations for combining constructed wetlands with engineered systems

Description of work and role of partners

WP3 - Constructed wetlands and other natural systems for improved wastewater treatment [Months: 1-36]
KWB, AKUT, WatStech, XYLEM, BWB, DEYAT, MUOA, EV, UCRAN, NTUA

The operation, monitoring and data analysis of 6 different innovative system combinations at 4 demonstrations sites are the core tasks and activities in WP3.

Task 3.1 Constructed wetlands as post-treatment after ozonation (M1-M24)
 Lead: KWB, Contributors: AKUT, BWB, XYLEM

The combination of an ozonation (engineered system) with two different constructed wetlands (natural treatment system) for further polishing of secondary effluent will be realized at pilot scale and operated at the WWTP Schönerlinde north of Berlin, Germany. The pilot systems will be operated for 18 months under controlled conditions making use of adapted plants transferred from a tertiary treatment wetland. This will reduce commissioning time and provide real conditions from the beginning.

The main treatment goals in this combined system are:

- the removal of micropollutants,
- the improved removal of pathogens and antibiotic resistance genes (chemical and physical barrier)

Field of application is further polishing of secondary effluent especially at WWTP below 100.000 PE (person equivalents) with downstream demands, e.g. when indirect potable reuse through bank filtration (removal of micropollutants necessary), reduction of micropollutant levels in surface water (e.g. Diclofenac) to comply with potential environmental quality standards –or compliance with Bathing Water Directive (removal of pathogens) is anticipated.

Subtask 3.1.1 Construction and demonstration of system performance (ozonation + CW) (M1-M24)
 Lead: KWB, Contributor: AKUT, BWB, XYLEM

Construction, test and long-term operation of the combined system will be accomplished. A monitoring strategy will be developed and implemented in line with the objectives and treatment goals described above and contemplated in WP4.

Subtask 3.1.2: Comparison of CW type (M12-M24)
 Lead: KWB, Contributor: AKUT

Two types of wetlands will be constructed in parallel (subsurface and surface flow wetland) to determine the best system combination. They will be evaluated with regards to treatment performance and operation robustness. The results will be compared to other post-treatment options such as dual media filtration in respect of cost and energy demand. Results will feed into design recommendations developed in task 3.5.

Subtask 3.1.3: Closed-loop control of ozonation based on online monitoring (M1-M24)
 Lead: KWB, Contributor: XYLEM

Effective control of the energy-intensive ozonation unit is necessary to optimize treatment efficiency and minimize energy demand. In this subtask the operational control of the ozonation unit via online monitoring (UVA254nm) will be implemented as innovative control of the required ozone dose for efficient operation.

Task 3.2 Retention soil filters for flexible treatment of WWTP effluent and combined sewer overflows (M1-M30)

Lead: EV

The objective of this task is to demonstrate at full scale a retention soil filter (RSF+WWTP) system with an innovative flow and treatment management for the reduction of nutrients, heavy metals, micropollutants and pathogens in different conditions:

- Dry weather flow: alternative tertiary treatment step to polish WWTP effluent
- Heavy storm events: treatment of combined sewer overflows (CSO)

Subtask 3.2.1 Full scale flexible flow system for combined treatment of CSO and WWTP effluent (M1-M30)

Lead: EV

A full scale retention soil filter system (RSF+WWTP, size: 4500 m²) for flexible treatment of WWTP effluent or water from CSOs will be constructed at WWTP Rheinbach in Germany and operated under field conditions for 2 years. The key innovation is the flexible use of the constructed wetland as CW for combined sewer overflow often suffering from long periods without any water flow. The innovative combination of systems for CSO treatment with WWTP effluent polishing will reduce chemical and micro-biological contamination of the receiving river used for bank filtration (drinking water production) and recreational purposes. Removal capacities of the following parameters will be monitored: sum parameters such as biological/chemical oxygen demand, nutrients, heavy metals, pharmaceutical compounds, X-ray contrast media, biocides, pesticides, disinfection products, flame retardants, endocrine disrupting compounds and microbial indicators (intestinal enterococci, Escherichia coli).

Subtask 3.2.2 Pilot systems targeting innovative substrate additions for wetland (M1-M30)

Lead: EV

In addition to the full scale system, pilot systems for testing of innovative substrate additions (e.g. GAC, Biochar, CaCO₃) will be operated in columns to improve the design of other full scale RSF for optimized removal of targeted pollutants. Results will feed into design recommendations of task 3.5.

Subtask 3.2.3 Feasibility studies

Lead: EV

The transferability of RSF+WWTP will be tested. The Erftverband is operating 28 RSF, most of them used as RSF CSO. These existing RSF CSO within the Erft river catchment (the Erftverbands area of activity) will be examined for their possible usability as RSF+WWTP. Effects on water quality through the extended treatment and costs will be estimated.

Task 3.3 Constructed wetlands as pre-treatment for disinfection targeting water reuse applications (M1-M24)

Lead: NTUA, Contributor: DEYAT, MUOA

In this task innovative pre- and post-treatment options for constructed wetland systems at full scale will be demonstrated for treatment of raw wastewater. At two sites in Greece characterized by significant seasonal variations of hydraulic and pollution loads the combination of natural and engineered treatment for water reuse will be implemented in 2015. Within this task partners will:

- demonstrate the feasibility of including CW in the treatment train to obtain water for irrigation of public spaces in small municipalities,
- demonstrate that high human health standards can be achieved even at remote WWTP by relying not only on a technical system but also on a robust natural treatment (results will especially feed into task 4.1 of WP4 regarding the Water Safety Plan approach for cNES),
- intensively assess the water quality data and operational cost of the first 2-3 years of operation to derive recommendations for the local operator and also for potential operators at other sites (together with WP4).

Field of application is wastewater treatment at smaller communities with need for subsequent use of effluent for irrigation of agriculture, public spaces (e.g. in the proximity of the WWTP) or use for industrial purposes, as the combination of constructed wetlands with disinfection improves significantly the quality of treated effluents.

Subtask 3.3.1: Full scale demonstration of disinfection performance after constructed wetlands as secondary treatment (Antiparos) (M1-M24)

Lead: NTUA, Contributor: MUOA

The application of a CW system (2-stage subsurface wetland system followed by stabilization pond) for secondary treatment with subsequent disinfection (chlorination) will be demonstrated at full scale.

Subtask 3.3.2: Full scale demonstration of solar photo-catalysis and ultrafiltration as pre- and post-treatment for CW (Thirasia) (M1-M24)

Lead: NTUA, Contributor: DEYAT

At the second Greek site (Thirasia), solar heterogeneous photo-catalysis with TiO₂ as catalyst is currently (2015) implemented for the first time in full scale as innovative pre-treatment for constructed wetlands. In addition, the constructed wetland serves as pre-treatment for an ultrafiltration unit to minimize membrane fouling. Specific aims of this subtask are:

- to validate the positive impact of solar photo-catalysis as pre-treatment for CW at full scale,
- to demonstrate the operational stability of ultrafiltration after CW treatment
- to show the reliability of the overall system

Task 3.4 Natural systems for P-removal at small WWTP in rural areas (M1-M24)

Lead: UCRAN, Contributor: WatStech

The main objective of this task is to demonstrate the removal of phosphorus to low levels in the effluent of oxidation ditch based WWTP by two innovative natural post-treatment options. At the demonstration site located in Packington northeast of Birmingham (UK), an existing sewage treatment plant (32,000 p.e.) based on oxidation ditches will be combined with two separate natural treatment systems operated at demonstration scale. Both systems will receive the effluent from the oxidation ditches as inflow for further improvement of water quality, in particular for the removal of phosphorus to very low levels (< 0.3 mg/L) and hazardous chemicals (metals, micropollutants) in order to limit the discharge to the river Mease, an ecologically sensitive area.

The work will not only focus on the ability of these technologies to remove phosphorus to very low levels but also on the potential added value of the technologies such as biomass production with potential for energy generation and P recovery. The field of application for this combination is advanced wastewater treatment at small WWTP, when sensitive water bodies require low nutrient concentrations.

Subtask 3.4.1 Reactive media CW for P-removal (M1-M24)

Lead: UCRAN, Contributor: WatStech

The first natural system consists of a reactive media reed bed for advanced P removal from the WWTP effluent. The constructed wetlands (100 m²) will be operated with steel slag as reactive media. Beside demonstration of effective P-removal, the potential for phosphorus recovery from the reed bed system will also be investigated with possible precipitate collection or regeneration of the reactive media.

Subtask 3.4.2 Immobilised microalgae photo-bioreactor for P and N removal (M1-M24)

Lead: UCRAN, Contributor: WatStech

In parallel, a microalgae photobioreactor (4 m³) with immobilized algae (entrapped in alginate beads) will be demonstrated in pilot scale for advanced removal of both N and P. Additional benefits of the algae system to be investigated are methane production from anaerobic digestion of the algal biomass recovered (energy production) and potential recovery of nutrients.

Task 3.5 Establish design and marketing recommendations (M18-M36)

Lead: AKUT, Contributors: EV, KWB, UCRAN, XYLEM, NTUA

Within this task the results of task 3.1-3.4. will be combined to derive design recommendations for combining constructed wetlands with engineered systems. The different goals of the treatment (e.g. surface water protection or water reuse), size factors (urban vs. rural) and local climate (UK vs. Greece) will be included to facilitate the implementation of the combined approach by consulting and engineering companies.

A main issue will be the evaluation of results with respect to application in practice. Operators need to understand advantages as well as costs of innovative technologies. Operation and maintenance, availability of raw materials and available building technologies will influence operators' choice. All useful combinations and variations will be listed and sorted by treatment goals and range of performance for target and general treatment parameters. If applicable, restrictions by technologies or countries will be defined.

A strategy for introducing these new innovative technology combinations with respect to private and public structure within the water and wastewater sector in the participating countries will be outlined and elaborated under WP7 activities.

Task 3.6 Interface with work packages 4, 5 & 6 (M3-M30)

Lead: KWB, Contributors: all WP3 partners

This task will ensure that data from WP3 will effectively feed into the activities of WP4 (Water quality assessment framework), WP5 (namely the LCA and ecosystem services assessments) and WP6 (namely AquaNES DSS and knowledge repository). Among the data derived from demonstration activities will be

- water quality parameters
- energy use
- chemicals use
- land use and

- flow data

This will involve liaising with partners on WP5 and WP6 in order to establish the scope of WP5 assessments and WP6 decision support, to define data needed for WP5&6 and to establish templates for data collation.

Participation per Partner

Partner number and short name	WP3 effort
2 - AKUT	21.00
12 - WatStech	18.00
13 - XYLEM	6.00
15 - BWB	29.00
16 - DEYAT	20.00
17 - MUOA	17.50
19 - EV	45.20
24 - UCRAN	25.00
27 - KWB	24.00
29 - NTUA	6.00
Total	211.70

List of deliverables

Deliverable Number ¹⁴	Deliverable Title	Lead beneficiary	Type ¹⁵	Dissemination level ¹⁶	Due Date (in months) ¹⁷
D3.1	Combining constructed wetlands and engineered treatment for water reuse	27 - KWB	Report	Public	24
D3.2	Combining constructed wetlands and engineered treatment for surface water protection	24 - UCRAN	Report	Public	30
D3.3	Design recommendations for combining CW with engineered pre- or post-treatments including case studies of demonstration sites	2 - AKUT	Report	Public	34

Description of deliverables

D3.1 : Combining constructed wetlands and engineered treatment for water reuse [24]

The demonstration activities are summarized and the benefits of the combined treatment especially in regard to the reduction of human health risks are highlighted. Key output will be a comprehensive comparison of water reuse related water quality data with national water reuse legislations (e.g. Greece, Italy, Spain) to evaluate the marketability of the approach in different EU member states.

D3.2 : Combining constructed wetlands and engineered treatment for surface water protection [30]

The demonstration activities in the field of surface water protection (Sites: Task 3.1, 3.2, 3.4) are summarized and the benefits of the combined treatment are highlighted. Key outputs are transferable numbers on e.g. load reduction of nutrients or pharmaceuticals into surface water bodies in relation to the Water Framework Directive.

D3.3 : Design recommendations for combining CW with engineered pre- or post-treatments including case studies of demonstration sites [34]

Technical report: The recommendations combine the results from AquaNES with existing guidelines for constructed wetlands and summarize also the design data of the studied sites. The aim of the report is to facilitate the market replication of the combined solutions by giving detailed information on its design and benefits.

Schedule of relevant Milestones

Milestone number ¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS1	Set-up for all pilot/ demonstration sites completed	1 - FHNW	9	Site description, technical specification and operational procedure documented. HTWD, BRGM and KWB are supporting the collection of info within WP1, WP2 and WP3
MS2	Qualitative and first quantitative information for WP4-6 shared	23 - BRGM	12	Data exchanged & transferred according to procedures. Concerns all partners in WP1-4, to be coordinated by HTWD for WP1, BRGM for WP2, KWB for WP3, KWR for WP4.
MS3	First integrated data sets from pilot / demonstration sites available for WP5&6	25 - HTWD	24	Comprehensive data set from demonstration sites in WP1-4 at hand and exchanged. Input per Work Package to be coordinated by relevant WP Leaders (WP1-4), i.e. shared Lead for this milestone
MS4	Construction of wetland and installation/test of ozonation system completed	27 - KWB	4	System ready for operation
MS5	Monitoring completed at site 12	27 - KWB	20	Demo phase and monitoring program successfully completed

Schedule of relevant Milestones

Milestone number ¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS6	Evaluation of RSF +WWTP	19 - EV	12	Evaluation of operational processes of monitoring completed
MS7	Feasibility studies	19 - EV	20	Investigations on technical implementation in river basins (Erft catchment) completed
MS8	First year of operation completed in site 10 and data transfer to WP4	29 - NTUA	12	KWR received all required data from local operator
MS9	Evaluation of energy recovery from algal biomass completed	24 - UCRAN	12	Anaerobic digestion trials in relation to site 13 completed
MS10	Monitoring parameter inventory from demonstration sites	28 - KWR	10	List available, structured data base for parameters relevant for cNES to be compiled by KWR
MS26	Start-up of the test units at Site 13	24 - UCRAN	1	Systems ready for operation
MS27	Project internal data exchange procedures defined	7 - GEOHYD	10	Formats defined, decision on potential system made

Work package number ⁹	WP4	Lead beneficiary ¹⁰	28 - KWR
Work package title	Risk Assessment and Water Quality Control		
Start month	1	End month	33

Objectives

The treatment efficiency of combined natural and engineered processes (cNES) requires a tailored monitoring strategy that integrates microbial and chemical water quality parameters. Such a monitoring strategy includes a proper monitoring set-up, definition of risk based thresholds of monitored parameters, robust and sensitive monitoring systems, easy to use data processing and visualization as well as integrated (automated) data interpretation of parameters of multiple monitoring tools. WP4 will design and demonstrate an efficient quantitative water quality assessment framework for cNES that is easy to use and allows integration of innovative monitoring approaches. Modules will be designed using a set of monitoring systems for a variety of emerging water quality issues such as fecal contamination, antibiotic resistance genes and biological effects of complex mixtures of chemicals. The effectiveness of cNES to remove the monitored biological and chemical contamination will be demonstrated.

Specific goals of WP4 are to:

- Design a water quality assessment framework for cNES
- Implement innovative monitoring modules to demonstrate cNES treatment efficacy:
 - o An innovative sensor to monitor fecal contamination
 - o An innovative monitoring system to assess antibiotic resistance genes
 - o Quantitative CALUX bioassays to monitor endocrine disrupting/toxic compounds
- Demonstrate data-processing and -visualization techniques and integrate results of multiple monitoring tools in an open access software based water quality reporting tool
- Demonstrate its use in selected demonstration sites from WP1-3 and derive an interactive water quality assessment tool to be embedded in the decision support platform in WP6.

Description of work and role of partners

WP4 - Risk Assessment and Water Quality Control [Months: 1-33]

KWR, BDS, MicroLAN, WADIS, BWB, MEK, KWB, NTUA

The water quality assessment framework and the monitoring systems will be implemented and demonstrated at selected sites with two major functions. (1) Illustrating the added value for water quality assessment and (2) demonstrating treatment efficiency and robustness of cNES technologies for these essential water quality parameters. Thereby, the work package will both facilitate the exploitability of the tools demonstrated within the work package and that of the monitored cNES, by proving the efficacy and robustness.

The water quality assessment framework to be developed in AquaNES combines conventional and new monitoring systems and relates the outcomes to trigger values thereby using advanced data handling tools. The framework will be tailored to the type of water use and is to support operators of water reuse and production systems. Also the framework will feed improvements of existing treatment schemes.

WP4 is defined in four tasks.

Task 4.1 Design and validate a water quality assessment framework (M1-M18)

Lead: KWR, Contributor: KWB.

The aim of this task is to design, implement and validate a water quality assessment framework, thereby ensuring comparability and consistency of data produced from the different pilot sites. All water quality parameter needed for the risk assessment and overall technology assessment in WP5&6) are made available in a comparable way (water quality parameter, monitoring methods, sample type). The approach will be to

- Validate a water quality assessment framework (based on the WHO Water Safety Plan approach) for cNES.
- Coordinate the compilation of required data on water quality for risk assessment, LCA and AquaNES DSS for each site together with WP1-3 (linked to Task “Interface with WP5&6” in WP1-3)
- Validate tailored monitoring strategies by defining cNES site specific requirements for monitoring parameters, monitoring frequency, required sensitivity and risk based thresholds for water quality monitoring.
- Tailor and test it at demonstration sites

Task 4.2 Implementation of three innovative monitoring tools (M4-M24)

Lead: KWR, Contributors: microLAN, BWB, BDS.

Adding to the commonly applied monitoring systems, this task demonstrates three innovative monitoring systems for cNES relevant parameters and enabling fast interventions. They address (1) fecal (microbial) contamination, being the major human health threat, (2) antimicrobial resistance development that is considered an increasingly serious human health threat by the WHO and (3) effects of complex mixtures of micro pollutants (e.g. endocrine disruption) that affect organisms in the environment and thereby threaten functionality of aqueous ecosystems. The tools enable (1) faster detection of fecal contamination by detecting *E. coli* and Coliform bacteria (2) quantitative detection of antibiotic resistance genes and (3) quantitative detection of biological effects induced by chemicals present in a sample. All three tools are ready to use, but need adaptation to be applied in the cNES treatment trains, e.g. the online microbial monitoring tool was not yet used to assess ozonation of WWTP effluent which may require an adapted maintenance protocol.

Proper water quality monitoring requires an array of sensitive and selective monitoring tools to cover relevant parameters. An enhancement of the monitoring response with respect to presence of fecal contamination (Ryzinska-Paier et al., 2014) and the detection of antibiotic resistance genes (Hoekstra and Hornstra, 2015) and the detection and characterization of yet (unknown) endocrine disrupting compounds (Brand et al., 2013; van Der Linden et al., 2008) is called for. Three innovative monitoring tools addressing these issues are implemented, validated and demonstrated at selected demonstration sites.

Subtask 4.2.1 Fast detection of *E. coli* (faecal contamination) by photometric on-line measurement

Lead: microLAN, Contributor: KWR

This subtask is to demonstrate and validate the BACTcontrol™ system, which is an automated online instrument for the detection of microbiological (enzymatic) activity in water. This system can monitor microbial activity, and notice changes (events) within a time frame of 4-6 hours. Registration of an event can initiate in depth microbiological analysis in the laboratory, which makes this sensor complementary to off-line cultivation methods. Three activities are planned:

- Demonstrate application in bank filtration (BF with WP1) combined with pre- and post-treatment techniques (membrane filtration, activated carbon filtration, ozonation) at the Elbe (Germany) and, Ganga River (India)
- Demonstrate application in MAR/SAT in the Waddinxveen demonstration site (Task 2.3)
- Demonstrate application of constructed wetlands (CW WP3) with pre- and post-treatment techniques (ozonation) and validation of the performance of the closed-loop control of ozonation. The selected demonstration site is WWTP Schonerlinde north of Berlin, Germany.

Obtained data from analyses will feed into Task 4.3.

Subtask 4.2.2 Implement DNA-based techniques for detection of antibiotic resistance genes along cNES treatment trains

Lead: KWR, Contributor: BWB

Within this task the demonstration site WWTP Schonerlinde north of Berlin (Task 3.1) are screened for DNA fragments of resistance genes. Three activities are planned:

- Develop a list of relevant antibiotic resistance genes for the demonstration sites
- Develop and apply a monitoring programme for the antibiotic resistance genes
- Assess removal performance of antibiotic resistance genes by cNES at the selected demonstration sites
- Comparison of ARG removal during CSO treatment with removal rates for WWTP effluent polishing

Obtained data from analyses will feed into Task 4.3.

Subtask 4.2.3 Implement CALUX assays to monitor a broad set of biological effects along cNES treatment

Lead: BDS, Contributor: KWR

This task validates CALUX assays at cNES sites. CALUX assays are sensitive cell based bioassays that enable the detection of mixtures of biological active compounds in environmental samples (van Der Linden et al., 2008). These whole effluent bioassays enable an effect based water quality monitoring thereby providing valuable information for both technology assessment and valorization. Furthermore, risk based thresholds enable implementation of these techniques in the WFD and other legislative frameworks.

The following activities are planned.

- Based on the initial screening a selection will be made of the most informative assays for operational analysis of cNES efficiency. A range of CALUX assays are known to be relevant for water quality monitoring (as shown in the FP7 DEMEAU project), such as for certain disinfection byproducts.
- Validate selected CALUX assays at two cNES sites in each of the demo WP's (WP1-3) including as a priority the sites with AOP
- Assess removal performance of the toxic compounds as measured by the CALUX assays at the selected demonstration sites.

Obtained data from analyses will feed into Task 4.3.

Task 4.3 Data processing and data visualization techniques and an integrative water quality reporting tool based on open access software "R" (M12-M24)

Lead: KWB, Contributors: KWR, NTUA.

The output of (on-line) monitoring technologies is often difficult to interpret and also inconvenient to handle as the output formats of different devices (in one water treatment scheme) can vary strongly. Furthermore, frequent reporting and documentation of the treatment performance via (on-line) monitoring can be time consuming for the personnel and requires advanced software solutions. An alternative to commercial (and often expensive) software solutions are tools which are based on the open software R. The free software approach allows any R programmer to produce customized tools for each individual end-user (Gibert et al., 2015; Sonnenberg et al., 2014).

Subtask 4.3.1: Adaptation of “R” software package to selected cNES sites (M1-12)

Lead: KWB, Contributors: KWR, NTUA

Software package already developed at KWB and KWR will be adapted to the needs of cNES technologies and the targeted treatment goal. Sites will be selected as part of Task 4.1. to identify sites with the highest need for integrative data reporting.

Subtask 4.3.2: Demonstration of “R” tools:(M12-18)

Lead: KWB, Contributor: KWR, NTUA

The aim is to demonstrate the benefit of 3-4 exemplary data analysis tools that ease an integrative assessment of the different monitoring devices and integration with water quality data obtained from analysis in the laboratory for a selected demo-site. The applied tools will:

- Increase the reliability and reproducibility of handling large amounts of data by reducing the likeliness in human error in complex systems and by increasing the transparency of the data processing.
- Promote the use of customized R tools for different end-user such as utilities, consultants and other research teams.

Task 4.4 Implementation and validation of an interactive water quality assessment tool (M19-M33)

Lead: KWB, Contributors: KWR, microLAN, NTUA, MEK, WADIS

Probabilistic and/or stochastic approaches become more and more frequent for the assessment of water treatment and water quality (Rieckermann et al., 2011; Smeets, 2008) which both require in depth knowledge in computation and programming. The aim of this task is to reduce the hurdle to use such state-of-the-art assessment approaches by making them available in a web-based user-friendly form.

Subtask 4.4.1 Quantitative microbial risk assessment tool

Lead: KWB, Contributor: microLAN, NTUA

Quantitative microbial risk assessment (QMRA) becomes more and more widespread in the water sector (e.g. the drinking water directive in the Netherlands), increasing the need of consultants, utilities and consumer protection association to perform or to verify risk calculations as part of the overall risk management process. The main features and activities related to this tool will be:

- a first stage risk assessment of a given treatment train
- an interactive user interface, which allows to change the QMRA settings according to the local conditions
- an automated reporting tool, which states the likeliness to fulfil or exceed the required tolerable risk level e.g. according to the WHO standards for water reuse
- the implementation and validation of the tool for 1-2 bank filtration sites (see task 1.4.4) and 1-2 MAR site (see task 2.4.4) by the local partner
- Implementation in the AquaNES DSS (WP6)

Subtask 4.4.2 Chemical water quality assessment tool

Lead: KWB, Contributor: MEK, WADIS, NTUA

•Construction of a decision tree for possibly applicable technologies based on local occurrence of chemical pollutants. This decision tree will give information on the general applicability of selected technologies

- Construction of a database on removal efficiencies of various techniques for a broad range of pollutants and an overview on current guidance values and toxicological evidence.
- Implementation of the decision tree and database in the AquaNES DSS (WP6).

Participation per Partner

Partner number and short name	WP4 effort
4 - BDS	21.00
8 - MicroLAN	14.00

Partner number and short name	WP4 effort
11 - WADIS	2.00
15 - BWB	15.00
21 - MEK	3.00
27 - KWB	13.00
28 - KWR	20.00
29 - NTUA	8.00
Total	96.00

List of deliverables

Deliverable Number ¹⁴	Deliverable Title	Lead beneficiary	Type ¹⁵	Dissemination level ¹⁶	Due Date (in months) ¹⁷
D4.1	R packages for integrative data processing & visualisation tool	27 - KWB	Other	Public	12
D4.2	Blueprint for a water quality assessment framework for cNES	28 - KWR	Report	Public	18
D4.3	Fast monitoring systems for various contaminants in cNES	28 - KWR	Report	Public	27
D4.4	Web based interactive tools for QMRA tool and chemical water quality assessment	27 - KWB	Other	Public	30

Description of deliverables

D4.1 : R packages for integrative data processing & visualisation tool [12]

The developed R packages for data processing and visualisation will be transferred to the site operator together with a short comprehensive manual to enable the use and future adaption of the tools

D4.2 : Blueprint for a water quality assessment framework for cNES [18]

Report on the design and validation of water quality assessment frameworks for demonstration sites of WP1 -3, having regard to Water Safety Plan approaches

D4.3 : Fast monitoring systems for various contaminants in cNES [27]

Report and application manual for demonstrated and validated innovative monitoring systems for E. coli, endocrine disruptors/toxic compounds and antibiotic resistance genes

D4.4 : Web based interactive tools for QMRA tool and chemical water quality assessment [30]

A web based QMRA application will be launched which allows the assessment of various treatment trains regarding the compliance with WHO health targets (subtask 4.4.1). Further this deliverable provides a decision tree to select a

treatment train based on chemical water quality and application (subtask 4.4.2). Both parts ready to be integrated into the AquaNES DSS

Schedule of relevant Milestones

Milestone number ¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS2	Qualitative and first quantitative information for WP4-6 shared	23 - BRGM	12	Data exchanged & transferred according to procedures. Concerns all partners in WP1-4, to be coordinated by HTWD for WP1, BRGM for WP2, KWB for WP3, KWR for WP4.
MS3	First integrated data sets from pilot / demonstration sites available for WP5&6	25 - HTWD	24	Comprehensive data set from demonstration sites in WP1-4 at hand and exchanged. Input per Work Package to be coordinated by relevant WP Leaders (WP1-4), i.e. shared Lead for this milestone
MS10	Monitoring parameter inventory from demonstration sites	28 - KWR	10	List available, structured data base for parameters relevant for cNES to be compiled by KWR
MS11	Implement innovative monitoring tools at selected demonstration sites	28 - KWR	12	Systems up and running
MS12	Implementation of risk assessment tools in AquaNES DSS of WP6	27 - KWB	30	Tool online available
MS27	Project internal data exchange procedures defined	7 - GEOHYD	10	Formats defined, decision on potential system made

Work package number ⁹	WP5	Lead beneficiary ¹⁰	24 - UCRAN
Work package title	Interfaces with the Environment & Society		
Start month	1	End month	34

Objectives

Robust cases for investment in combined natural and engineered treatment systems will not only need to address treatment performance and financial criteria but also be able to demonstrate that such systems offer environmental benefits, can be appropriately and effectively regulated, and will meet with citizen approval.

The central ambition of WP5 is therefore to better understand the ways in which considerations such as environmental impacts, ecosystem service contributions, policy and governance arrangements, and socio-economic perspectives influence the desirability and feasibility of combined natural and engineered water services. Working closely with demonstration sites, WP5 will explore the dynamics between these considerations and scheme design. The goal is to develop more credible pathways to market opportunities for combined treatment systems, by helping system owners and operators to mitigate environmental impacts, assess costs, navigate regulatory compliance, and build trust and confidence in their wider communities.

The specific objectives are to:

- Characterise and evaluate the environmental impacts of combined systems throughout their life cycles, as well as the ecosystem services derived from their operation
- Identify potential gaps, barriers and leverage points in regulatory frameworks, both at national and EU level, that facilitate or hinder the advancement of combined systems
- Evaluate the social impacts of, and public receptivity towards, combined system, and identify new mechanisms to support effective citizen engagement

The outcomes from WP5 will help facilitate innovation in combined systems by providing new ways for system managers to understand and address impacts on the environment and society. Outcomes will also inform emerging regulation and policy at both national and European levels (e.g. realization of the Blueprint, maturing a European strategy on water scarcity and droughts) to make them more supportive of combined systems.

Description of work and role of partners

WP5 - Interfaces with the Environment & Society [Months: 1-34]
 UCRAN, FHNW, VTG, DREWAG, MEK, BRGM, HTWD, KWR, NTUA
 Task 5.1 Characterising environmental interfaces (M1-34)
 Lead: UCRAN, Contributors VTG, NTUA, FHNW

Subtask 5.1.1 – Environmental Life Cycle Assessment – M1-M34
 Lead: VTG, Contributors: NTUA, FHNW

Life cycle assessment (LCA) is a methodology that enables the systematic evaluation of the impacts from a product or system throughout all stages of its life cycle, from ‘cradle to grave’. LCA will involve the definition of scope and goal (scope definition), the development of relevant inventory inputs and outputs of the system (inventory analysis), the assessment of their potential impacts (impact assessment) and the interpretation of the results within the context of proposed targets (interpretation). For this subtask AquaNES will focus on three demonstration sites, using LCA to comprehensively characterise their environmental impacts (E-LCA). LCA will be carried out taking into account the guidelines of ISO 14040/14044 on product life cycle assessment. The analysis will draw on existing data from the demo sites, as well as outputs from WPs 1 - 3. One demo site from each of the initial three WPs will be selected for this task, and the selection will be based on the availability and suitability of relevant data as well as their technical (or techno-economical) performance. The outcome from this task will be the development of a life cycle assessment approach that is specifically tailored for cNES, which will be applied to three demo sites. The assessment approach will be made available (as part of D5.3) as a decision support mechanism to be fed into WP 6.

Subtask 5.1.2 Ecosystem services analysis – M6-M30:
 Lead: UCRAN, Contributor: KWR

This subtask will identify and characterise the ecosystem services (ES) associated with combined systems. The analyses for this subtask will focus principally on the current operation of combined systems, rather than the whole life cycle of the project (as in 5.1.1). As a starting point for the analysis, we will draw from the outputs of the DESSIN project and their ecosystem services framework and tool box. This will involve working closely with three demonstration sites.

These will be different sites to those included in 5.1.1 in order to minimise the burden on individual sites and maximise the learning opportunities for the WP as a whole. ES approaches involve characterising and valuing the flow of services from given sites, including provisioning services (e.g. supply of water and other natural resources); regulating services (e.g. hydrologic functions, climate change mitigation); supporting services (e.g. habitats, nutrient cycles) and cultural services (e.g. amenity benefits, recreational uses). Data inputs for the ES analysis will build on outputs from WPs 1 - 3, along with some additional data collection (see Task 5.4). Data sharing opportunities between 5.1.1 and 5.1.2 will be maximised, in order to optimise learning and ensure an efficient spread of resources. The outcome from this task will be the development of an ecosystem services evaluation approach that is specifically tailored for cNES, which will be applied to three demo sites. The evaluation approach will be made available (D5.2) as a decision support mechanism to be fed into WP 6.

Task 5.2 Characterising policy and governance interfaces (M6-36)

Lead: UCRAN, Contributors: BRGM, KWR, MEK

Subtask 5.2.1 – Enablers and barriers for demonstration sites – M6-M18:

Lead: UCRAN, Contributor: BRGM

This subtask will involve working with a range of existing combined systems (including but not limited to the demonstration sites) to identify any enablers for and/or barriers to the development of combined systems in relevant policy and regulatory frameworks, with a focus on the national level. The work will cover a variety of systems exhibiting a range of combinations of ‘hard’ and ‘soft’ treatment systems. The data will be drawn from existing published sources as well as from interviews with key informants (e.g. scheme operators, regulators). The analysis will look to identify common issues between types of schemes and/or between countries, in order to synthesise a set of key regulatory considerations for combined systems. Insights will be considered when investigating the market potential in WP7 (link to PEST analysis used there).

Subtask 5.2.2 Mapping governance systems and identifying leverage points – M10-M22:

Lead: UCRAN, Contributor: BRGM

Using systems mapping and visualisation software, this subtask will map and analyse the overlapping governance domains and jurisdictions at EU level that apply to combined systems. The analysis will identify gaps, positive and negative feedback loops, and potential leverage points to create more supportive frameworks.

Subtask 5.2.3 Governance frameworks for selected cNES M18-M36:

Lead: UCRAN, Contributor: MEK

Drawing on the findings from 5.2.1 and 5.2.2, this subtask will use test cases to identify and develop governance frameworks to better support combined systems. One will be the fast infiltration and flood protection system in NL (Site 9), examined in WP 2 (Task 2.3). The fast ASR-system will be privately owned and operated but will generate private and public benefits such as prevention of flooding. The governance framework will outline responsibilities, operational schemes and financial regimes for the public-private partnership. Further the case of the Shafdan site (Site 7) aspiring for indirect potable reuse will be investigated. The site owner will work with the Israel’s Health Ministry (Environmental Health Department) regarding the cNES processes deployed at the site. This work will explore options for governing indirect potable reuse and help establish appropriate and robust water quality criteria

Task 5.3 – Characterising socio-economic interfaces (M1-34)

Lead: UCRAN, Contributors: VTG, NTUA, FHNW, KWR

Subtask 5.3.1 Life Cycle Cost Analysis (M1-M34)

Lead: VTG, Contributor: NTUA, FHNW

Life cycle cost analysis (LCC) will be conducted in parallel to the LCA. This involves assessing the cost of the whole chain for the selected demo sites. As a result, a complete analysis of Life Cycle Costs (LCC) will also be addressed which will be intimately linked to the E-LCA (Subtask 5.1.1). LCC will be developed in two basic steps: cost identification and an economic feasibility study. LCC will present a similar structure as in parallel conducted on LCA (in terms of functional unit and approach). The results of this analysis will make it possible to compare the proposed technologies with currently used techniques, from an economical point of view, and to determine the overall reduction of investment (CAPEX) and operating costs (OPEX) that will be achieved, identifying the cost-effectiveness of the technologies. As with 5.1.1, the assessment approach will be made available (as part of D5.3) as a decision support mechanism to be fed into WP 6.

Subtask 5.3.2 Social Life Cycle Assessment (M1-M34)

Lead: VTG, Contributor: NTUA, UCRAN

In conjunction with 5.1.1 (and using the same demonstration sites) this subtask will apply LCA to the evaluation of social impacts of combined systems throughout their life cycles, and compare these to the impacts of engineered systems. This analysis will focus particularly on socio-economic impacts on the organisations (and their employees) involved

throughout the project life cycle, including within the operational supply chain. Impacts on users and/or the wider public will also be considered (in conjunction with subtask 5.3.3). The impact analysis will include an initial evaluation of social and socio-economic impacts according to different impact categories and the interpretation of the results obtained. The impact categories evaluated will include: human rights; working conditions; health and safety; cultural heritage; governance; socio-economic repercussions. As with 5.1.1, the assessment approach will be made available (as part of D5.3) as a decision support mechanism to be fed into WP 6.

Subtask 5.3.3 Public receptivity – M10-M24:

Lead: UCRAN

This subtask will involve primary data collection (through large-scale surveys) in multiple countries. Sample populations will include the sites’ users / customers, as well as the wider public. The analysis will develop a detailed understanding of how citizens understand, value and trust combined systems, compared to engineered systems. We will maximise the synergies between data collection activities and data sharing between 5.3.2, 5.3.1 and 5.1.2 (for cultural ecosystem services) in order to optimise learning and ensure efficient use of resources.

Subtask 5.3.4 Citizen science – M18-M34:

Lead: KWR, Contributor: UCRAN

Based on the review of monitoring activities undertaken in WP 4, this subtask will assess whether and how a citizen science initiative might effectively support the monitoring and control activities for any of the demo sites. It will also identify what the value of such an initiative might be, both in terms of monitoring effectiveness and improved citizen engagement. A pilot CS initiative will be developed for one demonstration site as a test case.

Subtask 5.3.4 Gaming for citizen & stakeholder engagement (M18-M34)

Lead: KWR, Contributor: UCRAN

Drawing on the findings from 5.3.2, this subtask will develop a gamified modelling approach to support citizen and stakeholder engagement with combined systems. The game approach will be developed and implemented with one demo site –the Waddinxveen (Rotterdam area) site – as the test case. The game will be played with groups of stakeholders to extract their opinions on governance mechanisms, financing schemes and technical set up for combined systems. Outcomes will be fed back into decision-making processes for the owners / operators of combined systems. The subtask will also develop a skeleton framework and guidelines for gaming at other sites in AquaNES and beyond.

Task 5.4 Interfaces with other WPs (M1-36)

Lead: UCRAN, Contributors: NTUA, VTG

Subtask 5.4.1 Data interface with WPs 1, 2 and 3 (M1-M18)

Lead: UCRAN, Contributors: NTUA, VTG

This subtask will involve liaising with partners and WP leaders from WPs 1-3, in order to ensure that data from those WPs can effectively feed into the activities of WP 5 (principally the life cycle assessments and ecosystem services assessments). We will establish the scope of WP 5 assessments, select appropriate exemplar sites from WPs 1-3 (where needed), and establish templates for data collation.

Subtask 5.4.2 Interface with the DS Platform – M19-M36:

Lead: UCRAN; Contributor: NTUA

This subtask will facilitate the interface between the outputs from WP5 and the development of the decision support platform in WP6.

Participation per Partner

Partner number and short name	WP5 effort
1 - FHNW	7.00
10 - VTG	38.00
18 - DREWAG	1.00
21 - MEK	1.00
23 - BRGM	3.00
24 - UCRAN	30.00
25 - HTWD	2.00

Partner number and short name	WP5 effort
28 - KWR	8.00
29 - NTUA	14.00
Total	104.00

List of deliverables

Deliverable Number ¹⁴	Deliverable Title	Lead beneficiary	Type ¹⁵	Dissemination level ¹⁶	Due Date (in months) ¹⁷
D5.1	EU governance for cNES	24 - UCRAN	Report	Public	24
D5.2	Ecosystem services from cNES	24 - UCRAN	Report	Public	30
D5.3	LCA & LCC in combined natural and engineered treatment systems	10 - VTG	Report	Confidential, only for members of the consortium (including the Commission Services)	33
D5.4	Guidance on citizen science approaches	24 - UCRAN	Report	Public	34
D5.5	Gaming approach for stakeholder engagement	28 - KWR	Report	Public	34

Description of deliverables

D5.1 : EU governance for cNES [24]

Map of EU governance systems and analysis of leverage points

D5.2 : Ecosystem services from cNES [30]

Full report on the ecosystem services analysis from demonstration sites

D5.3 : LCA & LCC in combined natural and engineered treatment systems [33]

Full report on the LCA and LCC analysis from the demonstration sites. Evaluation of technical achievements according to environmental and costs key performance indicators and room for optimization. Life Cycle Costing (LCC) studies will evaluate CAPEX and OPEX.

D5.4 : Guidance on citizen science approaches [34]

Guidance document on the potential value of citizen science approaches for cNES and tools / approaches for implementation

D5.5 : Gaming approach for stakeholder engagement [34]

Guidance document on the potential value of gaming approaches to promote stakeholder engagement with cNES and approach for implementation

Schedule of relevant Milestones

Milestone number ¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS13	Boundary conditions defined, and templates for data collation for LCA, LCC and ES from WPs 1-3 developed	10 - VTG	8	Development of templates for data collation from WPs 1-3. Templates agreed with partners and distributed
MS14	Framework for pilot citizen science initiative	24 - UCRAN	24	Description uploaded to project intranet
MS28	Approach / methodology for Ecosystem Services analysis	24 - UCRAN	12	Description of methodology available
MS29	Intermediate version of LCA/LCC report to be shared with other WPs / interface with AquaNES DSS	10 - VTG	15	Report available
MS30	Second intermediate version of LCA/ LCC report to be shared with other WPs, interface with AquaNES DSS	10 - VTG	24	Report available

Work package number ⁹	WP6	Lead beneficiary ¹⁰	29 - NTUA
Work package title	Decision Support and System Design		
Start month	1	End month	36

Objectives

Objectives
 The goal of WP6 is to integrate existing and new methodologies, tools and knowledge into a fully-fledged and validated platform, providing a unified environment (AquaNES DSS) for supporting strategic and as operational decisions in cNES. The AquaNES DSS will target the needs of different end-users (water utilities, water and regional authorities, enterprises, technology providers, water managers, system operators, environmental agencies, academic institution and citizens) and will provide support in all decision making stages (system selection and design, system assessment, system operation and monitoring, market penetration and system replication).
 The following objectives are set:

- Improve the confidence with which service providers are able to specify, design and implement cNESs.
- Facilitate market penetration of cNES solutions.
- Maximize replication potential of AquaNES innovations.

WP6 will integrate previously fragmented approaches in decision frameworks, in modelling and in decision support tools. It will create a homogeneous and consistent decision support environment following a holistic approach to water and wastewater management, covering all water cycle aspects (hydrological, economic, environmental, social and market). Communication interfaces between tools, based on open ICT standards, will be provided, and gaps in the decision making chain will be addressed through further development. Data, tools and methods will follow the EU open access policy, thus promoting their market penetration.

Description of work and role of partners

WP6 - Decision Support and System Design [Months: 1-36]
 NTUA, FHNW, GEOHYD, VTG, DEYAT, MEK, AMU, HTWD, KWR
 WP6 will deliver:

- A Decision Framework encompassing all levels of cNES management, from adoption/selection and design to system uptake and operation management.
- A Suite of Tools to support all the stages in the Key Performance Indicators’ (KPIs) estimation.
- A Knowledge Repository (KR) for all AquaNES results and knowledge.
- An intelligent knowledge-driven Reasoning System, which will use the information stored in the KR to suggest Decision Support Roadmaps, providing information on DSS tools and procedures for meeting user questions and objectives (e.g. system design and technology to meet specific environmental standards and risk assessment).
- A Decision Support Platform (DSP) providing the foundation for integrating the suite of DSS tools as well as communication channels for interaction and information exchange among DSS tools

The approach will build on already prototyped models and methodologies, and the components will be exploited, tested and validated in AquaNES demonstration sites. Each tool will be able to function independently, providing specific decision support services, and, finally, all tools will be integrated in a platform, enabling their seamless operation through proper communication protocols and data sharing. Where required, additional minor tool development will be implemented, to tackle specific aspects not addressed within the existing tools.

The KR will integrate data and knowledge from the AquaNES demonstration sites concerning innovative technologies and their parameters, system specifications, configuration options, technical-environmental-economic and social indicators, monitoring and assessment variables and results, information on policy and regulatory frameworks, involved actors and market conditions. Knowledge integration will expand beyond the geographical focus of the project, including legislation, good design practices and success stories from other sites.

A vertical integration approach will be followed, where methodologies, tools and data will be integrated into the decision platform in different stages. Each integration stage will be marked by a relevant milestone (see list of milestones) and supported by relevant training sessions, organised in WP7.

Task 6.1: AquaNES Decision Framework and Knowledge Management System Design (M1–M10)
 Lead: NTUA; Contributors: HTWD, GEOHYD, FHNW
 The Task will develop the overall framework of the AquaNES DSS, including the analysis of the DSS tools as well as the design of the KR and the integration platform, releasing the first conceptual prototype of the DSS.

Subtask 6.1.1: End-Users Analysis and Tools Specifications (M1–M6)

Lead: NTUA; Contributors: HTWD, GEOHYD, FHNW

This subtask will perform an analysis of the information and decision support needs of the main end-users, for different design/operation stages, to identify critical variables/parameters, key performance/ assessment criteria and indicators and user-interface/knowledge requirements. This analysis will be primarily based on data and end-user consultation processes among consortium partners and at the AquaNES demonstration sites; the process will also be informed by one small-scale workshop and targeted semi-structured interviews with technology providers and end-users. A detailed analysis of the functionalities, data requirements and outputs of the tools will also be performed, and overlaps among the services provided by the tools and potential gaps will be identified.

Subtask 6.1.2: Outline for DSS Development (M4–M8)

Lead: NTUA; Contributors: HTWD, GEOHYD, FHNW

This subtask will elaborate an outline for the development of the AquaNES DSS, delineating the mission, goals and objectives, rules, entities, relations, available options and choices, overall model and specifications for the linking of the different tools. Based on the outcomes of the ‘suppliers and users’ consultation process, the outline will also describe a limited application cases of the DSS, to illustrate the decision framework and to be served as an initial database for the reasoning system (Task 6.3).

Subtask 6.1.3: Knowledge Repository Design (M6–M10)

Lead: NTUA; Contributors: HTWD, GEOHYD, FHNW

This subtask will develop a first release of the KR, aiming at providing structured information and data placeholder, which will enable the collection and retrieval of evidence, data and information from the AquaNES demonstration sites.

Task 6.2: Integration of Decision Support Tools for the Uptake, Design, Assessment and Operation of cNES (M8–M22)

Lead: NTUA; Contributors: KWR, GEOHYD, FHNW, VTG

Task 6.2 will adapt, extend and integrate into the decision support platform existing tools or tools developed in other WPs, to support the strategic and operational decisions of the framework developed in Task 6.1.

Subtask 6.2.1: Process Selection and Configuration Design (M8–M15)

Lead: NTUA; Contributors: GEOHYD, FHNW

This subtask will extend and integrate existing tools to support the selection of technically feasible alternative system configurations (treatment trains), in order to meet specific water quality standards. Design objectives that will be used for developing and selecting feasible configurations will include a list of performance targets for the effective removal of key pollutants and contaminants. Expert knowledge expressed as heuristics will be used to account for non-technical and non-quantitative factors/constraints influencing the design process (such as regulations, policies and legislation). Spatial constraints (e.g. land use restrictions) and geomorphological features (e.g. soil characteristics, topology) will be taken into account by integrating GIS features. Each component of the proposed systems will be appropriately modelled in WP1-3, and the sub-models will be linked, to be able to technically analyse the behaviour of the configuration in a systemic and holistic way.

Subtask 6.2.2: Performance and Risk Analysis (M13–M16)

Lead: NTUA; Contributors: KWR

This subtask will integrate tools developed and validated in WP4, aiming at assessing the design as well as the operational risk of cNES.

Subtask 6.2.3: Environmental and Socio-Economic Impact Assessment (M15–M19)

Lead: NTUA; Contributors: GEOHYD

This subtask will integrate tools, used and validated in WP5, aiming at assessing the environmental impacts and benefits of the proposed configurations, using life cycle analysis and ecosystem service valuation concepts and assessing wider socio-economic implications. A life-cycle approach will be used to address the environmental (e-LCA), social aspects (s-LCA) and economic (LCCA) aspects. Additionally, the subtask will adapt tools for quantifying key Ecosystem Services and the relevant KPIs.

Subtask 6.2.4: Economic Viability, Market Analysis and Technology Uptake (M17–M22)

Lead: NTUA; Contributors: VTG

This subtask will adapt and link existing tools demonstrated in WP1-5 as well as methodologies and tools applied in WP7 (involving PEST and Porter’s Forces analyses), for assessing the economic viability of cNES configurations, performing a market analysis and supporting the uptake of cNES solutions.

A list of tools to be integrated into the platform is presented in the following table:

Name of the tool; WP to be used/ developed; Holder/ Partner; Description

- Micropollutant Predictor; WP1; AMU; Predicting the fate and behaviour of micropollutants and other water constituents

- Riverbed Clogging; WP1; HTWD; Predicting and evaluating riverbed clogging and required long term abstraction rates
- Siphon Systems; WP1; HTWD; Designer of siphon systems, achieving a “renaissance” of siphon systems
- Performance assessment software; WP2; GEOHYD; Assess the performance of innovative water quality monitoring and modelling technology
- QMRA; WP4; KWB; Web-based human health risk assessment tool via quantitative microbial risk assessment (QMRA)
- Data processing tool; WP4; KWB; Reporting water quality based on data processing and data visualization techniques
- Environmental Life Cycle Assessment; WP5; VTG; Assessing the environmental impacts following a life cycle approach
- Social Life Cycle Assessment; WP5; VTG; Assessing the social impacts following a lifecycle approach
- Life Cycle Cost Assessment; WP5; VTG; Assessing the life cycle cost of a cNES configuration
- Ecosystem Services; WP5; UCRAN; Quantifying key Ecosystem Services
- Market Analysis; WP7; VTG; Identify potential barriers for technology uptake and aiding water governance

Task 6.3: Knowledge Exploitation and Decision Support Reasoning System (M19–M28)

Lead: NTUA; Contributors: FHNW

This task aims at integrating existing methodologies to allow the exploitation of the knowledge stored in the KR. The objective is to combine the knowledge stored in the KR with the decision framework developed in Task 6.1 and the tools integrated in Tasks 6.2 and 6.3, to provide intelligent decision support to different end-users. Based on the analysis performed in Task 6.1 concerning the end-user decision support needs, an extensive list of queries answered by the KS will be designed and implemented.

An intelligent decision support reasoning system will also be developed, intended to guide the end-user and achieving specific goals. The system will propose decision making roadmaps, entailing DSS application pathways along the overall decision framework, and will recommends specific DSS tools in each stage, to help meet the end-users goals. The methodology will be based on a case base inference engine to generate decision/guidance roadmaps from the knowledge provided by the KR. The system will use the experience collected from the demonstration sites and other cNES applications to provide solutions to similar problems. Gathered experience will be stored in a database of Cases, where a Case will be composed by a set of features as well as the complete Roadmap to its solution. The features will establish a basis for expressing/translating end-user goals and will permit the system to identify and retrieve similar Case information/knowledge from the database. The system will be dynamic, by adapting previous solutions to the new situation, evaluating the suggested roadmaps and revising them in light of the evaluation. Revised cases will be retained in the database for future use, providing a continuous revision of the KR with problems that the system has learned to solve.

Task 6.4: Implementation, Validation and Final Integration of the AquaNES DSS (M13–M36)

Lead: NTUA; Contributors: HTWD, GEOHYD, FHNW, DEYAT, MEK, AMU

Task 6.4 will be horizontal, running from the completion of Task 6.1 and until the end of the project. It will consistently and continuously develop the infrastructure for implementing the services of the AquaNES DSS, integrating knowledge into the KR and testing/validating the AquaNES DSS, ensure that it conforms to user needs, is supportive to decision-making requirements, and is well validated against the demonstration sites of the project.

This Task will also encompass the continuous collection, and integration within the KR, of the information collected from the AquaNES demonstration sites as well as from sources outside the project. Inputs from the WP1, WP2 and WP3 will be fully integrated. Proper front-end and back-end layers to the KR will be implemented and integrated into the platform, allowing administrators to manage the information and users to exploit the knowledge stored in the KR. The final release of the AquaNES DSS, following extensive validation at the level of demonstration sites, will integrate all application tools, permitting their operation through proper communication protocols and data sharing. It will allow the end users to search the KR, investigate the potential application of solutions and their impact in application cases in Europe and other areas, perform comparative assessments of alternative cNES applications, visualise outcomes and receiving decision making roadmaps toward their goals.

To ensure that all consortium partners and local coordinators will apply the AquaNES DSS consistently, training sessions will be organized starting from the first release of the DSS prototype and at each vertical integration step.

Participation per Partner

Partner number and short name	WP6 effort
1 - FHNW	4.00

Partner number and short name	WP6 effort
7 - GEOHYD	15.00
10 - VTG	1.00
16 - DEYAT	3.50
21 - MEK	1.00
22 - AMU	2.00
25 - HTWD	3.00
28 - KWR	1.00
29 - NTUA	39.00
Total	69.50

List of deliverables

Deliverable Number ¹⁴	Deliverable Title	Lead beneficiary	Type ¹⁵	Dissemination level ¹⁶	Due Date (in months) ¹⁷
D6.1	cNES Decision Framework and Knowledge Management System	29 - NTUA	Report	Confidential, only for members of the consortium (including the Commission Services)	12
D6.2	Suite of cNES Decision Support Tools (1st prototype)	29 - NTUA	Demonstrator	Confidential, only for members of the consortium (including the Commission Services)	22
D6.3	Decision Reasoning System for cNES (1st prototype)	29 - NTUA	Demonstrator	Confidential, only for members of the consortium (including the Commission Services)	28
D6.4	AquaNES Decision Support System and relevant documentation	29 - NTUA	Demonstrator	Public	34

Description of deliverables

D6.1 : cNES Decision Framework and Knowledge Management System [12]

Results from the end-user analysis will be summarized and conclusions will be drawn towards the requirements and restrictions for cNES tools and decision support. Concise cNES tool specifications will be compiled, with emphasis to interfacing and function within an integrated decision support environment. The goals, procedures and overall design of the DSS platform will follow, complemented with representative cases of DSS use. A plan for the development of AquaNES DSS Platform will also be included. Finally, the entire cNES knowledge domain will be described and structured, on the basis of both the requirements resulting from the DSS Platform specifications and the analysis of

available data and information. The design of a cNES Knowledge Management System and its underlying Database (Knowledge Repository) will be described.

D6.2 : Suite of cNES Decision Support Tools (1st prototype) [22]

All cNES Tools developed in WP1 to WP5 will be finalized, interfaced, integrated as a Suite of DSS tools and tested in a common operating environment, producing the AquaNES Decision Support Platform (DSP) for the Uptake, Design, Assessment and Operation of cNES. AquaNES Tools that have not been yet finalized by their respective tasks, will be added in preliminary versions and their final versions will be delivered in D6.4 in order to ensure the full integration of all tools in their final version into the Suite. Additional, already available tools will be adapted and added to the Platform, closing functionality and communication gaps, according to the specifications outlined in D6.1. The resulting AquaNES Decision Support Platform will be delivered in 1st prototype, together with examples of use, description of the work done in Task 6.2 and a preliminary documentation of the software.

D6.3 : Decision Reasoning System for cNES (1st prototype) [28]

A prototype version of the knowledge-driven Decision Reasoning System (DRS) will be delivered, with a linked database of cases of decision pathways. The software will provide users with complete roadmaps to solutions for their specific problems, utilising knowledge stored in the Knowledge Repository (KR). The DRS will include an extensive set of queries to the KR, covering all user/use requirements. A report of the development work, the overall methodology, description of inference engine algorithms, description of KR queries, examples of use (problems solved) and relevant documentation, will also be delivered.

D6.4 : AquaNES Decision Support System and relevant documentation [34]

The AquaNES DSS final version will be delivered, including final versions of tools developed by WP1 to WP5, the Decision Reasoning System (DRS), the Knowledge Management sub-system and any other component, as well as complete documentation on all the above. The Knowledge Repository will be fully populated with data & knowledge collected or generated by all AquaNES tasks and demonstration and it will be fully functional both as i) a component of the DRS for producing problem-solving Roadmaps to the available knowledge, as well as ii) a stand-alone DSS component to be exploited by end-users. Complementary to the DSS documentation provided, training and presentation material will also be delivered, as well as detailed recommendations for further development.

Schedule of relevant Milestones

Milestone number ¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS12	Implementation of risk assessment tools in AquaNES DSS of WP6	27 - KWB	30	Tool online available
MS15	First Integration: First conceptual prototype of the AquaNES DSS	29 - NTUA	10	Detailed mapping and analysis of the system and end-user requirements, the specifications for the decision framework and the suite of tools as well as the design of the KR.
MS16	Second Integration: Adaptation and the linking of tools and population of KR with information relating to system design and risk analysis	29 - NTUA	14	Embedded tools for system design and risk analysis. Training session for demonstration site users and WP4, 5 and 7 partners.
MS17	Third integration: Adaptation and	29 - NTUA	22	Embedded tools for environmental and

Schedule of relevant Milestones

Milestone number ¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
	linking of tools and population of KR with information relating to system assessment and market analysis.			socio-economic impact assessment, and market analysis. Training session.
MS18	Fourth Integration: Integration of decision reasoning system.	29 - NTUA	28	Developed decision reasoning system. Training session.
MS19	Final Integration: Final release of the AquaNES DSS and its wide dissemination beyond the consortium.	29 - NTUA	34	Completely validated tools, the fully-populated KR and the front-ends to the KR and the decision support reasoning system.

Work package number ⁹	WP7	Lead beneficiary ¹⁰	10 - VTG
Work package title	Exploitation and Dissemination		
Start month	1	End month	36

Objectives

The main objective of WP7 is to carry out exploitation and dissemination activities for the AquaNES innovations, as outlined in Section 2.2, to support and accelerate their market uptake. Specific objectives are:

- To perform a comprehensive market analysis to gather data on market needs, identify the full range of potential customer segments as well as opportunities and threats for the positioning of the innovation on the market.
- To develop and adapt business models for commercial innovations to strategically manage their marketability beyond the duration of the project
- To develop a final exploitation plan for each exploitable result in order to outline the project main results, minimize exploitation risks and to determine the exploitation activities for each of the results.
- To implement a dissemination plan of the project results towards potentially interested parties across stakeholders including policy makers, industry groups, geographical markets and the academic community

Description of work and role of partners

WP7 - Exploitation and Dissemination [Months: 1-36]
VTG, FHNW, AKUT, AUT, BDS, HYBU, imaGeau, GEOHYD, MicroLAN, XFLOW, WADIS, WatStech, XYLEM, BUWW, BWB, DEYAT, DREWAG, EV, MEK, AMU, BRGM, HTWD, KWB, KWR, NTUA, UJS
 Task 7.1 Exploitation Plans for AquaNES innovations (M1-M36)
 Lead: VTG, Contributors: AKUT, AUT, BDS, HYBU, IMAGEAU, GEOHYD, microLAN, XFLOW, VTG, WADIS, WatStech, XYLEM, EV, MEK

Exploitation plans for AquaNES innovations will be developed during the project’s lifetime. The elaboration of the exploitation plans will be an iterative and continuous process which will be handled in the ‘innovation exploitation teams (IET) as outlined in Part B Section 2.2 and supervised by an Exploitation and Dissemination Committee (E&DC). The E&DC will be formed at the beginning of the project (M1) from IET members, the Dissemination Manager and the Exploitation Manager (see Part B Section 3.2 for more details)

The draft Exploitation Plans will be detailed for each innovative technology and approach during the project contemplating major parameters and routes for exploitation and market uptake. Aspect to be considered are:

- List and description of project innovative results
- Business idea and business models development
- General environment analysis: PEST analysis.
- Specific environment analysis: SWOT analysis
- Operation, Organization, Financial and Marketing plan
- Exploitation risk analysis

The long-term sustainability of the water quality assessment framework and other tools derived from AquaNES demonstration will be guaranteed and various options will be investigated, such as the incorporation of the assessment framework into the Knowledge Management Platform Watershare (www.watershare.eu) where appropriate.

Subtask 7.1.1 Market analysis (M1-M12)
 Lead: VTG, Contributors: FHNW, XYLEM, XFLOW, AUT, MEK BUWW

A water market analysis (drinking water, wastewater and water reuse) will be carried out during the first year of the project. Thereby water sector needs, current practice and trends for future developments in and outside Europe (as described in Part B section 2.2) are investigated, as well as market structure, agents and world and market information. This will be performed with two approaches: a) general market and b) specific market.

The general market study will include a PEST analysis to characterise the Political, Economic, Socio-Cultural, and Technological factors and changes to better understand the overall conditions in target markets. Moreover, a market Porter’s analysis will be performed for AquaNES innovative exploitable results and objective markets to determine the level of competition expected and support business model development.

To evaluate the specific market environment a SWOT analysis (strengths, weaknesses, opportunities and threats) will be performed. It will identify the internal and external factors that are favourable and unfavourable for commercial exploitation.

Markets continuous monitoring will be applied to detect new trends and possibilities, which will allow the consortium to react to the market changes and adapt the projects' outcomes accordingly to upgrade the deployment of the studied water treatment technologies and business models. Towards the end of the project (M32), the states of development achieved (proof of principle/proof of concept/prototype etc) of the studied AquaNES technology innovations will be compared to the progress of any competing technologies.

Subtask 7.1.2 Business models and financial impacts (M3-M18)

Lead: VTG, Contributors: AKUT, AUT, BDS, HYBU, IMAGEAU, GEOHYD, microLAN, XFLOW, VTG, WADIS, Watstech, XYLEM, EV, MEK

A business model of each of the commercially exploitable innovations will be elaborated using CANVAS methodology adapted to the relevant target markets as identified in task 7.1.1.

Given the importance of the financial aspects, value finance will be studied beyond the business model definition, and will be approached as follows:

- Investment Profitability Analysis: to assess the sustainability of business, profitability is calculated through a spreadsheet approach. Economic parameters will be used (Net Present Value, Internal Rate of Return).
- Sensitivity analysis: Many of the financial parameters in a business model are difficult to estimate. Consequently, this analysis will identify the future steps which may strengthen or threaten the business case. Such events may influence evaluations or even the structure of the value model itself.
- Cash flow analysis to reach first sales and break even for such results: Financial needs to reach first sales, and to reach breakeven over the life cycle of the key results will be evaluated. We will particularly elaborate the potential for return on invest and estimate the cost-effectiveness of the technologies to enable their commercialization

Boston Consulting Group (BCG) matrix will be used to assess the commercial potential of the technologies. Based on this outcome we will

- draw innovative products portfolio strategy which will help the consortium and partners commercializing several products to prioritize when allocating resources.
- shortlist technologies for the ETV Pilot programme

Subtask 7.1.3 IPR and Exploitation Risk Management (M1-M36)

Lead: VTG, Contributors: E&DC, IET

The overall IPR strategy of the project will ensure that partners are free to benefit from their complementarities and are able to fully exploit their market position. The assessment of knowledge generated in the project (Foreground IP) concerning definition of IPR, patentability and optimal IPR protection options, and commercialization potential shall all be covered here. Any disputes over IPRs shall be settled according to the rules laid out in the Consortium Agreement, which will assign this responsibility to the Steering Committee. Solutions are being prepared in mutual discussions within the E&DC Meetings.

Exploitation risk management aims at setting identifying risk management strategies taking into account the internal and external factors which may prevent the successful exploitation of the AquaNES innovations. This task follows two steps: the identification of exploitation risks and the assessment of these exploitation risks along two dimensions (probability of occurrence and potential impact). This risk mapping will be reviewed and updated at each E&DC Meeting. The risk management provisions will form a part of the Exploitation Plan.

Task 7.2 Dissemination Plan (M1-M36)

Lead: FHNW, Contributors: all partners, especially E&DC

This task will be coordinated by the Dissemination Manager. Jointly with the E&DC they will be responsible for developing the communication strategy and for drafting and implementation of the Dissemination Plan.

Key messages of the project on a number of points (technology, efficiency, environmental and economic impact) will be defined. The main messages will be developed taking into account the different target groups identified. The messages must be suitable to promote the AquaNES project and its outcomes, making the case for European added value of R&D cooperation, understandable and relevant to the target audience.

All planned and performed dissemination activities will be compiled and described in this document. It complements the Exploitation Plan as it details (marketing) actions for specific AquaNES innovations.

- identify target groups, stakeholders for interaction and outline routes of communication / communication channels
- provide a tentative planning of dissemination event
- facilitate the organisation of dissemination actions by a calendar function.

Task 7.3. Project website, online media and print (M1-M36)

Lead: FHNW, Contributor: all WP7 partners

The visibility of the project and accessibility of its output will be promoted by various activities. Project specific dissemination material will be elaborated

- Design of project identity (logo, layouts)

- Dedicated website, including information on all aspects of the project
 - Active participation in social networks communities targeting a more general public (citizens and youngsters) via Facebook, Twitter, YouTube (for VNRs).
 - Project flyer and factsheets,
 - Marketing and information brochures of validated AquaNES innovations for customers and policy
- Material will be produced in English and in local languages where appropriate. In these cases, consortium partners will support translation and proper societal perception adaptation.

Task 7.4 Outreach to markets, industry and stakeholders (M3-M36)

Subtask 7.4.1 Events and training (M3-36)

Lead: FHNW Contributors: AUT, AKUT, VTG, BUWW, BWB, DREWAG, DEYAT, MEK, AMU, BRGM, HTWD, KWB, KWR, NTUA UJS,

This task will facilitate the timely exchange with relevant end-users and their associations, scheme planners and decision makers on public and dedicated project events (exhibitions, fairs, conferences, workshops).

AquaNES will host dedicated sessions and workshops on selected cNES innovations on the following events and occasions (non-exhaustive list):

Event; Topic, Format, target audience; Lead; Promoted innovation

- Wasser Berlin; (March 28-31, 2017); exhibition, visualization/model for cNES at trade fair; KWB / BWB; All AquaNES innovations
- International Water Week, Amsterdam (2017, 2019); Conference/fair; KWR; Monitoring devices WP4
- WATEC Israel (2017); Exhibition, Workshop with Health authorities; MEK / WADIS; AOP-MAR/SAT for indirect potable reuse
- Water Innovation Europe (Annually); Conference/fair; KWR; All AquaNES innovations
- IWA Specialist Conference on Wetland Systems for Water Pollution Control (2016, Poland or 2018, tbd); Scientific exchange; KWB and WP3 partners; Various CW based treatment trains
- AQUATECH India, Delhi (2017, 2019); Exhibition stall at trade fair and presentation; AUT, HTWD, UJS, ; WP1
- 3rd KWB Wasserwerkstatt “Next generation constructed wetlands – combining CW with engineered solutions” (ca 80-100 participants from local water sector) date tbd;
- End-user oriented workshop; KWB; O3 + CW,RSF WP3
- Masterplan “Bank filtration” in India – Activities 2016-2018; Cooperation with Indo-German Science & Technology Centre in Chennai; training courses in India to promote European monitoring equipment and disinfection modules; HTWD, AUT, UJS, other Indian institutions; WP1
- Webinar and/or presentation at exhibitions ; Designing cNES with the AquaNES DSS, training
- Water planners, engineering consultants; NTUA; WP6 AquaNES DSS
- International training and consultancy; formation of group of bank filtration experts to get Europe leading in the field of BF and subsequent water treatment, installation of a contact point via website bankfiltration.com; HTWD; WP1

Subtask 7.4.2 Link to EiP Water Action Groups, WssTP and related projects (M3-36)

Lead: KWR, Contributors: AKUT, AUT, BDS BUWW, MEK, KWB, KWR

We will ensure awareness of tested solutions through dissemination activities and interaction and collaboration with related EIP Water Action Groups and WssTP working Groups

EIP-W Action Groups include

- AG128 Managed Aquifer Recharge Strategies and Actions
- AG100 RTWQM – Real Time Water Quality Monitoring
- AG228 NatureWat - Nature-based technologies for innovation in water management

WssTP Working Groups include those of Ecosystem Services, Emerging pollutants and urban water pollution, Green infrastructure, TechWatch (promoting innovative technologies), Water & ICT and Water-Energy-Food-Biodiversity nexus. This includes active involvement in their activities and shaping of work programmes. AquaNES partners are represented in almost all these groups which facilitates the dissemination.

Participation per Partner

Partner number and short name	WP7 effort
1 - FHNW	8.00
2 - AKUT	3.00
3 - AUT	3.00

Partner number and short name	WP7 effort
4 - BDS	2.00
5 - HYBU	2.00
6 - imaGeau	2.00
7 - GEOHYD	5.00
8 - MicroLAN	4.00
9 - XFLOW	2.00
10 - VTG	36.00
11 - WADIS	1.00
12 - WatStech	2.00
13 - XYLEM	2.50
14 - BUWW	4.00
15 - BWB	3.00
16 - DEYAT	1.00
18 - DREWAG	1.00
19 - EV	2.00
21 - MEK	2.00
22 - AMU	1.00
23 - BRGM	2.00
25 - HTWD	4.00
27 - KWB	1.00
28 - KWR	1.00
29 - NTUA	5.00
30 - UJS	1.00
Total	100.50

List of deliverables

Deliverable Number ¹⁴	Deliverable Title	Lead beneficiary	Type ¹⁵	Dissemination level ¹⁶	Due Date (in months) ¹⁷
D7.1	Project Website	1 - FHNW	Websites, patents filing, etc.	Public	3
D7.2	Exploitation Plan	10 - VTG	Report	Confidential, only for members of the consortium (including the Commission Services)	6
D7.3	Dissemination Plan & Report	1 - FHNW	Report	Public	6

List of deliverables

Deliverable Number ¹⁴	Deliverable Title	Lead beneficiary	Type ¹⁵	Dissemination level ¹⁶	Due Date (in months) ¹⁷
D7.4	Market Analysis Report	10 - VTG	Report	Confidential, only for members of the consortium (including the Commission Services)	12
D7.5	Dissemination Events	1 - FHNW	Other	Public	36
D7.6	Marketing Report & Brochures	1 - FHNW	Report	Public	27

Description of deliverables

D7.1 : Project Website [3]
public project website

D7.2 : Exploitation Plan [6]
Exploitation Plan (including Business Models, addressing IPR & Exploitation Risk Management as well as project follow-up) to be updated periodically M 6, M 18, M 30 and M36

D7.3 : Dissemination Plan & Report [6]
Dissemination Plan & Report to be updated periodically about planned and performed dissemination activities, M6, M18, M30 and M36

D7.4 : Market Analysis Report [12]
Study of the attractiveness and the dynamics of a water market for AquaNES cNES solutions. • PESTLE analysis to characterise the Political, Economic, Socio-Cultural, and Technological factors. • Porter’s 5 forces analysis to determine the level of competition expected and support business model development. and • SWOT analysis (strengths, weaknesses, opportunities and threats)

D7.5 : Dissemination Events [36]
3 dedicated dissemination events (e.g. Workshops, Training) M36 (between M24-M36)

D7.6 : Marketing Report & Brochures [27]
Marketing Report/ Brochures for selected innovations

Schedule of relevant Milestones

Milestone number ¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS20	Stakeholder database established	1 - FHNW	6	Database available
MS21	Business model canvas for of each exploitable result drafted	10 - VTG	12	Canvas created and presented to E&DC
MS22	Exploitation Plan update & Risk Management Strategy	10 - VTG	32	Exploitation Plans updated / internal workshop held

Schedule of relevant Milestones

Milestone number ¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS23	Innovations selected for ETV	10 - VTG	34	Assessment matrix for selection completed and adopted by E&DC
MS25	E&DC composed	10 - VTG	1	Kick off meeting minutes and list of members of the Exploitation and Dissemination Committee

Work package number ⁹	WP8	Lead beneficiary ¹⁰	1 - FHNW
Work package title	Management		
Start month	1	End month	36

Objectives

- manage the project implementation within contractual rules and deadlines
- assure project success by project monitoring and steering
- facilitate communication with the European Commission
- guarantee a smooth flow of information and efficient decision making processes within the consortium
- control the financial expenditures of project partners
- organize regular project meetings

Description of work and role of partners

WP8 - Management [Months: 1-36]
FHNW, VTG, BRGM, UCRAN, HTWD, KWB, KWR, NTUA
Task 8.1 Project steering and decision making (M1-M36)
 Decision making competence within the consortium is assigned to different project entities. The Steering Committee (SC) will represent the highest level of decision making in the consortium. The steering Committee consists of one person per partner with the authority of making decisions on behalf of their institution. The tasks of the Steering Committee are:

- to define the overall project strategy
- to handle contractual matters (Grant Agreement amendments, extension of the consortium, termination of participants)
- to agree on the principles for resource allocation (consortium budget and payment schedules)
- to agree an intellectual property right related strategy

In order to enable decision making in such a large consortium, the SC will vote on major decisions by simple majority of the quorum. The details will be fixed in the Consortium Agreement
 Decisions related to the implementation of work, and the assessment of work progress are made by the Project Management Board (see Task 8.3). It will propose adjustment and means of remediation in case of deviation from the work plan or occurrence of any of the risks and contingencies identified in WT5 (List of critical implementation risks and mitigation actions). The PMB will also discuss and prepare decisions for all issues requiring a vote of the Steering Committee. In that respect the PMB will be responsible for preparation of conflict solving interventions. It will make its decision on simple majority.

Task 8.2 Project Coordination (M1-M36)
 Lead: FHNW
 The project coordination and management will be accomplished by the entities described under Part B, Section 3.2. The Coordinating Team at FHNW will

- Act as link to the European Commission in all matters related to the Grant and dissemination
- Establish and maintain an effective and efficient management and coordination structure
- Keep track of administration of financial matters, i.e. manage the financial contribution from the EC and ensure a proper distribution to the partners.
- Prepare, chair and report on project meetings
- Coordinate and facilitate good collaboration among the project partners
- Timely submission of reports, deliverables, cost statements etc. to the EC
- Contribute, upon invitation by EASME, to common information and dissemination activities and attend workshops and other events, in order to facilitate the exchange of information to increase synergies between and the visibility of H2020 projects, to increase the uptake of innovations and to facilitate policy feedback and priority setting activities to maximize their impact.

Task 8.3 Implementation of Work & Progress Monitoring (M1-M36)
 Lead: FHNW, Contributors: HTWD, BRGM, KWB, KWR, UCRAN, NTUA, VTG
 Jointly the WP leaders constitute the Project Management Board (PMB). This project entity will meet twice a year and on bi-monthly web conferences

- to monitor work progress

- to review of timely execution of tasks, quality control and validation of the project deliverables and rescheduling of tasks when necessary
 - to assess the fulfilment of tasks and deliverables;
- to promote the integration of results and facilitate the interfaces between work package.

For these various tasks a responsible persons will be appointed among the members of the PMB to act as Data Quality Invigilator, Risk Reviewer, etc.

The PMB members are responsible

- to run and supervise action list of their respective work packages
- inform the Coordinator in case of delay in the performance of the work packages or in case of breach of responsibilities of any beneficiary
- analyse and document a presumed breach of responsibilities of a beneficiary and preparing a proposal of remedies to the Steering Committee

Task 8.4 Contractual Reporting (M1-M36)

Lead: FHNW, Contributors: HTWD, BRGM, KWB, KWR, UCRAN, NTUA, VTG

The task will involve the preparation and communication of reports on the project implementation and progress to the European Commission services. It includes also the reporting on the use of resources (financial reporting). In this reporting, the Project Coordinator will be supported by the Project Management Board, who will collate the relevant information from their work package partners.

Task 8.5 Risk Management

The risk of failing to achieve the project objectives and deliverables will be managed by a close monitoring of the work progress facilitated by regular reporting obligations. These extend to

- bi-monthly status reports of the WP Leader within the PMB meetings
- bi-annual risk assessment reports by the WP Leaders about the work package
- bi-annual activity reports of all partners in preparation for the project meetings

If major deviations are recognised the PMB will investigate the reasons and decide on countermeasures and request remediation within defined periods (see Task 8.2).

Participation per Partner

Partner number and short name	WP8 effort
1 - FHNW	18.00
10 - VTG	2.00
23 - BRGM	3.00
24 - UCRAN	2.00
25 - HTWD	3.00
27 - KWB	3.00
28 - KWR	2.00
29 - NTUA	2.00
Total	35.00

List of deliverables

Deliverable Number ¹⁴	Deliverable Title	Lead beneficiary	Type ¹⁵	Dissemination level ¹⁶	Due Date (in months) ¹⁷
D8.1	Meeting minutes	1 - FHNW	Report	Confidential, only for members of the consortium (including the	2

List of deliverables

Deliverable Number ¹⁴	Deliverable Title	Lead beneficiary	Type ¹⁵	Dissemination level ¹⁶	Due Date (in months) ¹⁷
				Commission Services)	

Description of deliverables

D8.1 : Meeting minutes [2]
 Minutes of bi-annual consortium meetings M2, M7, M13, M19, M25, M31, M36

Schedule of relevant Milestones

Milestone number ¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS24	Kick-off meeting	1 - FHNW	1	Kick-meeting being held

Work package number ⁹	WP9	Lead beneficiary ¹⁰	1 - FHNW
Work package title	Ethics requirements		
Start month	1	End month	36

Objectives

The objective is to ensure compliance with the 'ethics requirements' set out in this work package.

Description of work and role of partners

WP9 - Ethics requirements [Months: 1-36]
FHNW
 This work package sets out the 'ethics requirements' that the project must comply with.

List of deliverables

Deliverable Number ¹⁴	Deliverable Title	Lead beneficiary	Type ¹⁵	Dissemination level ¹⁶	Due Date (in months) ¹⁷
D9.1	EPQ - Requirement No. 3	1 - FHNW	Ethics	Confidential, only for members of the consortium (including the Commission Services)	2
D9.2	NEC - Requirement No. 4	1 - FHNW	Ethics	Confidential, only for members of the consortium (including the Commission Services)	2
D9.3	EPQ - Requirement No. 1	1 - FHNW	Ethics	Confidential, only for members of the consortium (including the Commission Services)	2

Description of deliverables

The 'ethics requirements' that the project must comply with are included as deliverables in this work package.

D9.1 : EPQ - Requirement No. 3 [2]
 The applicant must provide further information about the possible harm to the environment caused by the research and state the measures that will be taken to mitigate the risks.

D9.2 : NEC - Requirement No. 4 [2]
 Detailed information must be provided to confirm that fair benefit-sharing arrangements with stakeholders from low and/or lower-middle income countries are ensured during the project.

D9.3 : EPQ - Requirement No. 1 [2]
 The applicant must ensure that appropriate health and safety procedures conforming to relevant local/national guidelines/legislation are followed for staff involved in this project.

Schedule of relevant Milestones

Milestone number ¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
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1.3.4. WT4 List of milestones

Milestone number ¹⁸	Milestone title	WP number ⁹	Lead beneficiary	Due Date (in months) ¹⁷	Means of verification
MS1	Set-up for all pilot/demonstration sites completed	WP1, WP2, WP3	1 - FHNW	9	Site description, technical specification and operational procedure documented. HTWD, BRGM and KWB are supporting the collection of info within WP1, WP2 and WP3
MS2	Qualitative and first quantitative information for WP4-6 shared	WP1, WP2, WP3, WP4	23 - BRGM	12	Data exchanged & transferred according to procedures. Concerns all partners in WP1-4, to be coordinated by HTWD for WP1, BRGM for WP2, KWB for WP3, KWR for WP4.
MS3	First integrated data sets from pilot / demonstration sites available for WP5&6	WP1, WP2, WP3, WP4	25 - HTWD	24	Comprehensive data set from demonstration sites in WP1-4 at hand and exchanged. Input per Work Package to be coordinated by relevant WP Leaders (WP1-4), i.e. shared Lead for this milestone
MS4	Construction of wetland and installation/test of ozonation system completed	WP3	27 - KWB	4	System ready for operation
MS5	Monitoring completed at site 12	WP3	27 - KWB	20	Demo phase and monitoring program successfully completed
MS6	Evaluation of RSF +WWTP	WP3	19 - EV	12	Evaluation of operational processes of monitoring completed
MS7	Feasibility studies	WP3	19 - EV	20	Investigations on technical implementation in river basins (Erft catchment) completed
MS8	First year of operation completed in site 10 and data transfer to WP4	WP3	29 - NTUA	12	KWR received all required data from local operator
MS9	Evaluation of energy recovery from algal biomass completed	WP3	24 - UCRAN	12	Anaerobic digestion trials in relation to site 13 completed

Milestone number ¹⁸	Milestone title	WP number ⁹	Lead beneficiary	Due Date (in months) ¹⁷	Means of verification
MS10	Monitoring parameter inventory from demonstration sites	WP1, WP2, WP3, WP4	28 - KWR	10	List available, structured data base for parameters relevant for cNES to be compiled by KWR
MS11	Implement innovative monitoring tools at selected demonstration sites	WP4	28 - KWR	12	Systems up and running
MS12	Implementation of risk assessment tools in AquaNES DSS of WP6	WP4, WP6	27 - KWB	30	Tool online available
MS13	Boundary conditions defined, and templates for data collation for LCA, LCC and ES from WPs 1-3 developed	WP5	10 - VTG	8	Development of templates for data collation from WPs 1-3. Templates agreed with partners and distributed
MS14	Framework for pilot citizen science initiative	WP5	24 - UCRAN	24	Description uploaded to project intranet
MS15	First Integration: First conceptual prototype of the AquaNES DSS	WP6	29 - NTUA	10	Detailed mapping and analysis of the system and end-user requirements, the specifications for the decision framework and the suite of tools as well as the design of the KR.
MS16	Second Integration: Adaptation and the linking of tools and population of KR with information relating to system design and risk analysis	WP6	29 - NTUA	14	Embedded tools for system design and risk analysis. Training session for demonstration site users and WP4, 5 and 7 partners.
MS17	Third integration: Adaptation and linking of tools and population of KR with information relating to system assessment and market analysis.	WP6	29 - NTUA	22	Embedded tools for environmental and socio-economic impact assessment, and market analysis. Training session.

Milestone number ¹⁸	Milestone title	WP number ⁹	Lead beneficiary	Due Date (in months) ¹⁷	Means of verification
MS18	Fourth Integration: Integration of decision reasoning system.	WP6	29 - NTUA	28	Developed decision reasoning system. Training session.
MS19	Final Integration: Final release of the AquaNES DSS and its wide dissemination beyond the consortium.	WP6	29 - NTUA	34	Completely validated tools, the fully-populated KR and the front-ends to the KR and the decision support reasoning system.
MS20	Stakeholder database established	WP7	1 - FHNW	6	Database available
MS21	Business model canvas for of each exploitable result drafted	WP7	10 - VTG	12	Canvas created and presented to E&DC
MS22	Exploitation Plan update & Risk Management Strategy	WP7	10 - VTG	32	Exploitation Plans updated / internal workshop held
MS23	Innovations selected for ETV	WP7	10 - VTG	34	Assessment matrix for selection completed and adopted by E&DC
MS24	Kick-off meeting	WP8	1 - FHNW	1	Kick-meeting being held
MS25	E&DC composed	WP7	10 - VTG	1	Kick off meeting minutes and list of members of the Exploitation and Dissemination Committee
MS26	Start-up of the test units at Site 13	WP3	24 - UCRAN	1	Systems ready for operation
MS27	Project internal data exchange procedures defined	WP1, WP2, WP3, WP4	7 - GEOHYD	10	Formats defined, decision on potential system made
MS28	Approach / methodology for Ecosystem Services analysis	WP5	24 - UCRAN	12	Description of methodology available
MS29	Intermediate version of LCA/ LCC report to be shared with other WPs / interface with AquaNES DSS	WP5	10 - VTG	15	Report available
MS30	Second intermediate	WP5	10 - VTG	24	Report available

Milestone number ¹⁸	Milestone title	WP number ⁹	Lead beneficiary	Due Date (in months) ¹⁷	Means of verification
	version of LCA/ LCC report to be shared with other WPs, interface with AquaNES DSS				

1.3.5. WT5 Critical Implementation risks and mitigation actions

Risk number	Description of risk	WP Number	Proposed risk-mitigation measures
R1	NF clogging with Fe/Mn (operational risk) D1.6 in WP1	WP1	Fe/Mn removal before NF
R2	Extreme Elbe/Danube/Ganga River flow conditions with subsequent risk of flooding/ damage of pilot sites	WP1	Flood proof installation, in extreme events decommission or dismantling of pilot site
R3	High oxidant dose might be required to achieve better degradability of specific pollutants in sub-surface	WP2	Ideal combination of UV and oxidant dose has to be verified, suitability for up-scaling will be assessed
R4	Difficulties to be expected for pretreatment and infiltration of surface water with higher TSS,	WP2	Alternative for stormwater is the sand filtration (but is less compact, higher volumes needed). Adapt the water treatment by adding for example adsorbents to the Fuzzy filter (eg. activated coal), for the removing pollutants.
R5	Online monitoring implementation delay Delay of data acquisition	WP2	Establish a stringent schedule for operation concerning monitoring tools installation and sampling campaigns in close collaboration with IMAGEAU, SAUR to prevent delays
R6	Difficulties in close interactions with end-users	WP2	Anticipate the need of end-user for a user-friendly interface of the system by organizing early consultation meeting in the project
R7	Ozonation imposed health and safety risk during operation also at pilot scale. Without adequate preplanning the H&S department of BWB might causing delays in the project.	WP3	Xylem, KWB and BWB need to implement a H&S management which follows the local legislation before first operation of the pilot.
R8	Technical problems of engineered system parts (e.g. disinfection, membrane system) at demonstration sites in Greece not solved in time as	WP3	Close cooperation between Greek partners (especially DEYAT and MUOA) and company that has built the whole treatment systems at both sites to quickly solve

Risk number	Description of risk	WP Number	Proposed risk-mitigation measures
	the operator (first year only) is not an AquaNES partner WP3 D3.1: Combining constructed wetlands and engineered treatment for water reuse (M24)		problems and to prevent delays. If delays cannot be prevented, sampling period will be shortened while increasing sampling frequency.
R9	Design recommendations might be perceived as too site specific for broader market application Results of demonstration sites delayed WP3 D3.3: Technical Report - Design recommendations for combining constructed wetlands with engineered pre- or post-treatments including case studies of demonstration sites	WP3	Include also results from literature (other study sites with constructed wetlands) in evaluation to ensure broad applicability See risk mitigation measures for D3.1 and 3.2 (above)
R10	Tools do not fit with the infrastructure or operations of the selected site. Fast delivery of samples is required to achieve reliable antibiotic resistant gene analyses WP4 D4.3	WP4	Choose other (from the many) AquaNes sites for implementation Select suitable delivery service and prepare each sampling carefully. In case delivery turn out to difficult, onsite pre-treatment of samples is needed.
R11	WP4 data processing: Needs and expectations of end-user does not match with the implemented solution For QMRA tool: Implemented QMRA tool might fail due to low trust of users and authorities in the approach WP4 D4.4	WP4	Discuss early in project the expectation of potential end-users and also be transparent of about the limitation of an open software a) organize review of the tool by at least two internationally known QMRA experts (Proposal: G.Medema + B. Stanford); b) ensure an transparent documentation of the assumptions made for the QMRA
R12	Lack of data available from demonstration sites to sufficiently complete the required analyses WP5 D5.2 and D 5.3	WP5	We have built in a number of tasks across the work packages that are specifically dedicated to facilitating the interfaces between WPs 1-3 and WP 5. These tasks will help ensure the approach to analysis is built around the kind of data that the sites can realistically provide.

Risk number	Description of risk	WP Number	Proposed risk-mitigation measures
R13	Communication between tools developed in AquaNES and integrated in DS platform is inconsistent or unreliable. WP6 D6.2 cNES Decision Support Tools (first prototype), D6.4 AquaNES DSS final version and documentation	WP6	Provide analytical definition of decision support framework and specifications of tools early in the project (T6.1 and D6.1) combined with workshop with tool developers. Reliable open standards will be exploited to provide a common data interchange format.
R14	The validation of tools and/or and the DSS in the demonstration site fails. WP6 D6.4 AquaNES DSS final version and documentation	WP6	Risk will be minimized by complementarity of partners and scheduling tasks for updating/calibration.

1.3.6. WT6 Summary of project effort in person-months

	WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	WP9	Total Person/Months per Participant
1 - FHNW	0	18	0	0	7	4	8	18		55
2 - AKUT	0	0	21	0	0	0	3	0		24
3 - AUT	25	0	0	0	0	0	3	0		28
4 - BDS	0	0	0	21	0	0	2	0		23
5 - HYBU	0	9	0	0	0	0	2	0		11
6 - imaGeau	0	12.50	0	0	0	0	2	0		14.50
7 - GEOHYD	0	30	0	0	0	15	5	0		50
8 - MicroLAN	0	2	0	14	0	0	4	0		20
9 - XFLOW	18	0	0	0	0	0	2	0		20
10 - VTG	0	0	0	0	38	1	36	2		77
11 - WADIS	0	16	0	2	0	0	1	0		19
12 - WatStech	0	0	18	0	0	0	2	0		20
13 - XYLEM	0	23	6	0	0	0	2.50	0		31.50
14 - BUWW	38	0	0	0	0	0	4	0		42
15 - BWB	29	0	29	15	0	0	3	0		76
16 - DEYAT	0	0	20	0	0	3.50	1	0		24.50
17 - MUOA	0	0	17.50	0	0	0	0	0		17.50
18 - DREWAG	14	0	0	0	1	0	1	0		16
19 - EV	0	0	45.20	0	0	0	2	0		47.20
20 - IWB	0	10	0	0	0	0	0	0		10
21 - MEK	0	45.80	0	3	1	1	2	0		52.80
22 - AMU	36	0	0	0	0	2	1	0		39
23 - BRGM	0	42	0	0	3	0	2	3		50

	WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	WP9	Total Person/Months per Participant
24 - UCRAN	0	0	25	0	30	0	0	2		57
25 - HTWD	32	0	0	0	2	3	4	3		44
26 - EJC	29	0	0	0	0	0	0	0		29
27 - KWB	24	0	24	13	0	0	1	3		65
28 - KWR	0	12	0	20	8	1	1	2		44
29 - NTUA	0	0	6	8	14	39	5	2		74
30 - UJS	9	0	0	0	0	0	1	0		10
Total Person/Months	254	220.30	211.70	96	104	69.50	100.50	35		1091

1.3.7. WT7 Tentative schedule of project reviews

Review number ¹⁹	Tentative timing	Planned venue of review	Comments, if any
RV1	21	Europe	Brussels/Demonstration site
RV2	36	Europe	Brussels/Demonstration site

1. Project number

The project number has been assigned by the Commission as the unique identifier for your project. It cannot be changed. The project number **should appear on each page of the grant agreement preparation documents (part A and part B)** to prevent errors during its handling.

2. Project acronym

Use the project acronym as given in the submitted proposal. It can generally not be changed. The same acronym **should appear on each page of the grant agreement preparation documents (part A and part B)** to prevent errors during its handling.

3. Project title

Use the title (preferably no longer than 200 characters) as indicated in the submitted proposal. Minor corrections are possible if agreed during the preparation of the grant agreement.

4. Starting date

Unless a specific (fixed) starting date is duly justified and agreed upon during the preparation of the Grant Agreement, the project will start on the first day of the month following the entry into force of the Grant Agreement (NB : entry into force = signature by the Commission). Please note that if a fixed starting date is used, you will be required to provide a written justification.

5. Duration

Insert the duration of the project in full months.

6. Call (part) identifier

The Call (part) identifier is the reference number given in the call or part of the call you were addressing, as indicated in the publication of the call in the Official Journal of the European Union. You have to use the identifier given by the Commission in the letter inviting to prepare the grant agreement.

7. Abstract

8. Project Entry Month

The month at which the participant joined the consortium, month 1 marking the start date of the project, and all other start dates being relative to this start date.

9. Work Package number

Work package number: WP1, WP2, WP3, ..., WPn

10. Lead beneficiary

This must be one of the beneficiaries in the grant (not a third party) - Number of the beneficiary leading the work in this work package

11. Person-months per work package

The total number of person-months allocated to each work package.

12. Start month

Relative start date for the work in the specific work packages, month 1 marking the start date of the project, and all other start dates being relative to this start date.

13. End month

Relative end date, month 1 marking the start date of the project, and all end dates being relative to this start date.

14. Deliverable number

Deliverable numbers: D1 - Dn

15. Type

Please indicate the type of the deliverable using one of the following codes:

- R Document, report
- DEM Demonstrator, pilot, prototype
- DEC Websites, patent filings, videos, etc.
- OTHER
- ETHICS Ethics requirement

16. Dissemination level

Please indicate the dissemination level using one of the following codes:

PU Public
CO Confidential, only for members of the consortium (including the Commission Services)
EU-RES Classified Information: RESTREINT UE (Commission Decision 2005/444/EC)
EU-CON Classified Information: CONFIDENTIEL UE (Commission Decision 2005/444/EC)
EU-SEC Classified Information: SECRET UE (Commission Decision 2005/444/EC)

17. Delivery date for Deliverable

Month in which the deliverables will be available, month 1 marking the start date of the project, and all delivery dates being relative to this start date.

18. Milestone number

Milestone number: MS1, MS2, ..., MSn

19. Review number

Review number: RV1, RV2, ..., RVn

20. Installation Number

Number progressively the installations of a same infrastructure. An installation is a part of an infrastructure that could be used independently from the rest.

21. Installation country

Code of the country where the installation is located or IO if the access provider (the beneficiary or linked third party) is an international organization, an ERIC or a similar legal entity.

22. Type of access

VA if virtual access,
TA-uc if trans-national access with access costs declared on the basis of unit cost,
TA-ac if trans-national access with access costs declared as actual costs, and
TA-cb if trans-national access with access costs declared as a combination of actual costs and costs on the basis of unit cost.

23. Access costs

Cost of the access provided under the project. For virtual access fill only the second column. For trans-national access fill one of the two columns or both according to the way access costs are declared. Trans-national access costs on the basis of unit cost will result from the unit cost by the quantity of access to be provided.

History of changes

Version	Changes	By	on
V1	Changes addressing the comments in the Evaluation Summary Report	RH	13.01.16
V2	Minor revision of the estimated budget for the action and clarifications on pilots' innovative aspects	RH	23.02.16
V5	<p>Last specification on budgets</p> <ul style="list-style-type: none"> • shift from subcontracting to Other Goods & Services (imageau) • changes in amount of some subcontracts (MEK), • reallocation of funds for project meetings (from BRGM, AMU, XYLEM to KWB, KWR, VTG, BUWW, NTUA) <p>Updated GANTT chart</p> <p>Tentative meeting schedule added</p> <p>Remaining comments addressed (pilot sites, overall structure of the work plan)</p>	RH	15.03.16 18.03.16
V6	Table 1 edits, correction of pagebreaks	RH	29.03.16

Part B

Table of Contents

PART B	1
1 EXCELLENCE	2
1.1 Objectives	2
1.2 Relation to the work programme	3
1.3 Concept and approach	5
1.3.1 Overall approach and methodology.....	6
1.4 Ambition	13
1.4.1 Advances beyond the state-of-the-art	13
1.4.2 Innovation potential.....	17
2 IMPACT	19
2.1 Expected impacts.....	19
2.1.1 Wide and fast deployment of sustainable innovative solutions in the water management sector and contribution to the implementation of the EIP ‘Water’	19
2.1.2 Market penetration and demonstration, long-term application and sustained use by various end-users.....	20
2.1.3 Creation of new market opportunities both inside and outside Europe	20
2.1.4 Increased resource efficiency and environmental performance of the water sector.....	22
2.1.5 Significant reduction in (fresh) water use	22
2.1.6 More than 50% reduction of energy demand in water supply, treatment and transportation	22
2.1.7 Support to the implementation and evaluation of technology verification schemes, including the EU Environmental Technology Verification Pilot (ETV) programme.	23
2.1.8 Other environmental and socially important impacts: Responsible innovation.....	23
2.1.9 Barriers and obstacles setting expected impacts at risk.....	23
2.2 Measures to maximise impacts.....	24
2.2.1 Exploitation	24
2.2.2 IPR and Knowledge Management	31
2.2.3 Dissemination and communication	32
3 IMPLEMENTATION	34
3.1 Work plan- Work packages, deliverables and milestones	34
3.1.1 Overall structure of the work plan	34
3.1.2 Timing of the different work packages and their components (Gantt Chart).....	35
3.2 Management structure and procedures.....	37
3.3 Consortium as a whole	39
3.4 Resources to be committed.....	42
4 MEMBERS OF THE CONSORTIUM	49
4.1 Participants	49
4.2 Third parties involved in the project	109
5 ETHICS AND SECURITY	110
5.1 Ethics.....	110
5.2 Security.....	110

1 Excellence

1.1 Objectives

Europe's water service providers are under increasing pressure to deliver improved and affordable water services to a growing population whilst reducing the amount of energy used, lowering the environmental impact of their activities and coping with climate change (EC, 2013a, EA, 2012). These challenges have prompted water sector professionals to revisit the potential role of catchment landscape features such as river banks, aquifers and wetlands in providing treatment potential and storage capacity.

Whilst the role of ecosystems (natural water bodies) in providing water services has long been acknowledged (EC, 2013), heightened interest in integrated water resources management has provoked closer assessment of the benefits of combined natural and engineered treatment systems - cNES (GWP & INBO, 2009). There is now a pervasive recognition that 'Investing in integrated water management strategies that combine engineered solutions with *'natural infrastructure'* can reduce costs, enhance services, and provide a suite of co-benefits for communities and the environment' (WRI, 2013). These developments, combined with contemporary debates around the potential social and economic value of Green Infrastructure (The Nature Conservancy, 2013) have challenged the research community to develop more accurate understandings of how such combined natural and engineered systems can best be designed and operated so as to deliver safe, reliable water services.

Natural water bodies are already being exploited as low energy treatment options which, although often associated with longer residence times, provide welcome flexibility for water service providers aiming for more cost-effective processes with lower environmental impact (energy & chemical demand, CO₂ footprint). Research on the fundamental processes and performance of natural treatment systems has advanced rapidly in recent years (see, for example, Dillon et al., 2008, Maeng et al., 2010; García et al., 2010;). These advances provide the underpinning knowledge required to enable scale up and demonstration of suitable combinations of natural and engineered water treatment process steps in practice.

More broadly, the widespread adoption of such treatment systems by utilities and communities is still hampered by several sources of uncertainty, particularly in terms of the distribution of responsibilities, risks, and rewards amongst stakeholders. As the water passes back and forth across the interfaces between public, private, and shared environments, so the regulatory, financial and contractual arrangements which guarantee service levels become complicated and contentious. We argue that the consequential lack of robust risk management and governance arrangements (critical if investors are to be constructively engaged) is crippling both the confident design and widespread implementation of combined natural and engineered treatment systems.

The AquaNES project will have demonstrable impact across the EIP Water's thematic priorities and cross-cutting themes with particular emphasis on 'Water reuse and recycling', 'Water and wastewater treatment', 'Water-energy nexus', 'Ecosystem services', 'Water governance', and 'Decision support systems and monitoring'. It will catalyse innovation in the European water sector, accelerate the implementation of more sustainable water management systems, and improve Europe's ability to deliver sustainable water services for its communities, industry, agriculture, and the environment. In demonstrating the impacts and benefits of combined natural and engineered water treatment trains we will promote more sustainable adaptations to issues such as water scarcity, excess water in cities and micropollutants in the water cycle as well as make a number of substantive contributions to Europe's transition to a Green Economy.

The AquaNES consortium will deliver on the following **specific objectives**. We will:

- improve the confidence with which water service providers are able to **specify, design, and implement** combined natural and engineered water treatment systems (cNES),
- advance the technology readiness levels of a range of innovative cNES technologies from typically 5/6 to 7/8
- evidence how full scale combined natural and engineered treatment systems can **achieve reductions** in operating costs of 10%-30% and in energy consumption per m³ treated of up to 50% compared to current established solely engineered solutions,
- test a robust **risk assessment framework** which is sensitive to the variety of phenomena and processes exhibited by combined natural and engineered treatment processes,
- deliver **design guidance** for combined natural and engineered treatment components and systems informed by industrial or near-industrial scale experiences,
- evidence the relative **environmental impact** of cNES compared to fully engineered conventional solutions,
- demonstrate the benefits of post-treatment options such as nanofiltration, activated carbon, ozonation and electrochlorination after **bank filtration** for the production of safe drinking water,
- validate the full exploitation of the treatment and storage capacity of **soil-aquifers systems** in combination with conventional or oxidative pre-treatments in both drinking water production and water reuse,

- demonstrate the combination of **constructed wetlands** and other natural treatment systems with different technical post- or pre-treatment options such as ozonation or bioreactor systems as a wastewater treatment option,
- replace chemically assisted **phosphorous removal** in wastewater treatment by natural treatment components with energy and nutrients recovery potential,
- aid **water governance** by addressing the unclear responsibilities of the various stakeholders in order to alleviate barriers for the widespread implementation of such systems throughout Europe,
- provide **decision support** by delivering a sound basis for water managers and governments for proper process assessment and selection,
- **prove the transferability** of tested technical approaches across contexts and water quality challenges,
- **deliver new market opportunities** in Europe and overseas for innovative cNES.

1.2 Relation to the work programme

The AquaNES proposal responds to the call Water1B for *Bridging the gap: from innovative water solutions to market replication* by demonstrating combined natural and engineered water treatment systems as viable concepts to address the EIP for Water priorities on water & wastewater treatment, water reuse & recycling as well as flood & drought risk management. Our creative solutions will be implemented in real environments and at industrial scale to demonstrate their long-term viability. Their globally positive environmental impact will be demonstrated by life cycle analysis. AquaNES addresses the pre-commercialisation challenges and the residual risk linked to scale-up. It tackles these challenges from both technical and non-technical perspectives, applying new concepts in water governance and providing decision support systems to facilitate consideration and uptake of these combined technologies in water management decisions.

The design and implementation of combined natural and engineered water treatment systems which make best use of the relative strengths of both environmental and engineered processes presents a multifaceted set of challenges for water service providers. Whilst the call text rightly points out that innovative solutions ‘often do not reach the market due to pre-commercialisation challenges and the residual risk linked to scaling-up.’ it is important to remember that such scale-up risks do not only relate to technical and operational issues. The transition from one-off or demonstrator schemes to an established solution also presents challenges for regulation, calls for greater attention to be paid to environmental impact and ecosystem services, and demands a more nuanced understanding of how communities might respond to new solutions. A comprehensive list of our responses to the challenges set out in the work programme is compiled below.

Challenges and scope of call “H2020-WATER-1-2015”	How AquaNES will address the challenge
Lack of real scale demonstration of their long-term viability.	AquaNES is founded on 13 full- or pilot scale and demonstration sites. These demonstrations will be the first references in an operational environment of the proposed technology combinations and last around two years.
Pre-commercialisation challenges and the residual risk linked to scaling-up.	Those challenges will be answered by the full- and demonstration scale in AquaNES. They will act as “first movers” and therefore will greatly reduce the residual risk associated with implementation of innovative technologies
Accelerate the commercialisation of eco-innovative water solutions with a view to stimulating sustainable economic growth, business and job creation in the water sector.	AquaNES will accelerate the opening of a new market: the market of cost-effective solutions for treatment of (waste)water targeting the synergies of technical and natural treatment systems. This will contribute to the development of the green economy in Europe, stimulating sustainable economic growth, business and job creation in the water sector.
Focus on the cross cutting priorities identified in the EIP on water, while addressing the thematic priorities.	AquaNES has a strong focus on the EIP water cross cutting themes, in particular the set up and demonstration of governance regimes and risk management frameworks (including decision support and monitoring) for the cNES demosites as these are main barriers for the implementation of innovative cNES. In addition AquaNES fully addresses the EIP water thematic priorities “Water and wastewater treatment”, “Water reuse and recycling” and “Role of ecosystem services in the provision of water related services”, as well as “flood & drought risk management” with particular relevance to the following actions: “reducing energy consumption related to wastewater treatment”, “improved water quality to increase water reuse potential” and “innovative concepts for alternative water treatment.” They are also suited for “regions that currently lack of appropriate sewer systems and treatment and sanitation facilities, by applying smart

Challenges and scope of call "H2020-WATER-1-2015"	How AquaNES will address the challenge
	<i>technologies and decentralized systems with a focus on alternative water sources</i> .
First application and market replication of near-market water solutions.	Technologies proposed in AquaNES are mature for commercialisation and need a first full-scale application before market replication.
Aim to help process industries ensuring efficient management of resources (e.g. raw materials and energy).	AquaNES' contribution to an efficient management of resources in the water sector will primarily focus on reduced energy consumption by combining engineered solutions with low-energy natural treatment systems. In addition, the potential of energy recovery through biomass harvesting will be assessed (e.g. Microalgal photobioreactor in WP3) and the use of solar energy will be fostered (solar driven disinfection WP 1, photocatalysis WP3).
Exploiting untapped potential of ICT by developing and deploying advanced ICT solutions for water resources management	AquaNES will deliver a framework for water quality assessment at combined natural and engineered water production sites, with specific emphasis on transparent and reproducible data-handling and data-analysis techniques (ICT) and user-friendly reporting tools.
Complex issues should be addressed with innovative, creative solutions with a globally positive environmental impact demonstrated by lifecycle analysis.	All technology lines in AquaNES will be assessed by methods such as environmental impact and life cycle assessment. The scope and intensity of environmental impacts resulting from the use of combined systems will be characterised and a comparative analysis related to benchmark systems such as fully engineered alternatives will be delivered. We will also describe and quantify ecosystem service benefits from of cNES utilisation.
Social, institutional, economic and governance aspects ensuring a more rapid uptake of solutions; aspects affecting market deployment and uptake, such as, standardisation and regulatory issues, market assessment and business plan.	The results of the project will be widely disseminated via scientific and end-user conferences and workshops. Key results will be used to support the business plans of the involved companies and to influence design standards and good design practice documents where appropriate, such as guidelines. On regulation we will identify areas of policy and regulation which constrain or hamper progress in the utilisation of combined systems, identify the gaps and tensions between those governance domains and jurisdictions which would have to work together to effectively regulate cNES.
Include the participation of SMEs, as far as possible.	The consortium has been built around a coalition of SMEs who all play active roles in AquaNES. Eight SMEs will participate (> 30% of budget) , bringing in specific competencies in a critical aspect of technical innovation. Project outputs support capacity building and business / market development.

1.3 Concept and approach

AquaNES pursues the concept of integrating nature-based elements into solutions for water management challenges. ‘These solutions are inspired and supported by nature, while maintaining and enhancing natural capital. They are sustainable measures that simultaneously meet environmental and socio-economic objectives (EC, 2014). We will focus on soil aquifer treatment coupled to managed aquifer recharge (MAR/SAT), constructed wetlands (CW) and bank filtration (BF) and their combinations with engineered pre- or post-treatments as illustrated in Figure 1.

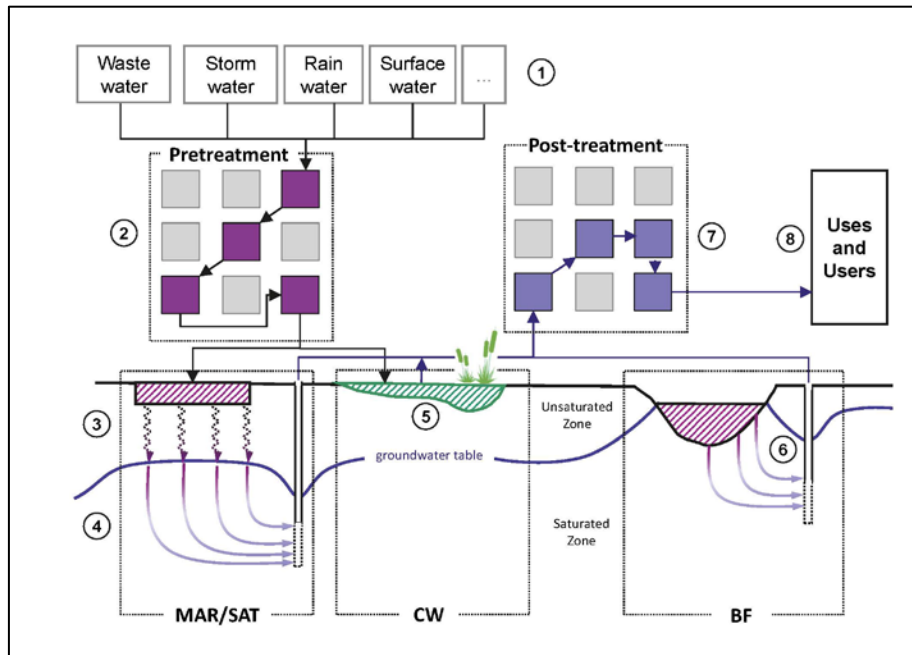


Figure 1 AquaNES project scope (MAR/SAT=managed aquifer recharge / soil aquifer treatment, CW= constructed wetland, BF=river bank filtration. (1) variety of water types to be treated, (2) matrix of pre-treatment options, (3)-(6) ecosystem services (3) of the unsaturated soil zone, (4) of the aquifer, with a combined physical, geochemical and microbiological cleaning potential, (5) of constructed wetlands, (6) of the river bank and associated alluvial aquifer, (7) matrix of post-treatment options, (8) uses and related water quality targets

Our approach is to demonstrate the synergistic benefits of combined natural and engineered components in delivering water services; benefits that go beyond the mere addition of the processes, e.g. better pollutant removal or lower energy demand. The demonstration site activities will evidence the technical and economic feasibility of the chosen treatment trains, assess their long-term performance, and specifically demonstrate how the the purification capacity of natural treatment systems can be enhanced, e.g. through pre-oxidation for better biodegradation, compound adsorption and subsequent biodegradation. AquaNES assembles a balanced consortium of leading European players with representation along the value chain: (i) scientific partners as knowledge providers for evaluation and optimization, (ii) SMEs and industries providing design, engineering and/or manufacturing of equipment, and (iii) water utilities who are responsible for scheme implementation. The consortium contains leading edge competencies across the science, engineering and humanities professions with many partners having extensive experience of European level collaboration.

AquaNES will enhance the development stage of combined natural and engineered water treatment processes from pilot / demonstration to market replication. Each demonstration treatment scheme incorporates one TRL >7 component and one TRL >5 component. The combined applications will achieve TRL7-8 with systems demonstrated in operational environments (see Table 3). AquaNES draws on a number of **past and ongoing research activities** coordinated or supported by consortium partners. Process performance and substance fate modelling approaches derived in the RECLAIM Water and TECHNEAU projects will be further refined and deployed for assessing cNES. Our work on governance and ecosystem services is guided by amongst others the MAR authorization protocol elaborated in DEMEAU and an overarching assessment framework developed in the DESSINS project and approaches from TRUST. Activities and exploitation ambitions for India are complementing work of the projects SaphPani, Water4India and SWINGS. During its lifetime AquaNES will continuously exchange with and inform the work of several EIP Water Action Groups, namely AG128: MAR Solutions, AG100: RTWQM – Real Time Water Quality Monitoring and AG228 NatureWat on Nature-based technologies for innovation in water management.

1.3.1 Overall approach and methodology

The methodological focus is on demonstrating the feasibility and value of cNES process combinations at pilot to full-scale. The sites involved cover a range of geographical, climatic, and source water availability contexts. They are located in densely populated areas with semi-closed water cycles as well as in more rural areas and regions with seasonal population variations due to tourism. Site activities will run for an extended period of one to two years and generate recommendations on best practice for water utilities and technology providers. Figure 6 in section 3.1.1 illustrates the overall structure of the project. The project is comprised of eight workpackages as follows. All sites mentioned are summarised in Table 1.

WP1. Potential of bank filtration and post-treatments in (drinking)water supply

Bank filtration (BF) schemes for the production of drinking water are increasingly challenged by new constituents of concern such as organic micropollutants (MP) and pathogens in the source water and hydrological flow variations due to weather extremes.

Objective: In WP1 new technology components will be integrated and monitoring and operating regimes will be adopted to further optimise water treatment in bank filtration schemes for these new requirements.

Approach: Demonstration actions in four sites in Europe and one in India will be carried out in cooperation between water utilities, research institutions and SME, covering a wide range of source water qualities in order:

- to demonstrate the long-term stability of **anoxic capillary nanofiltration** operated at single wells for partial removal of selected compounds, extension of applicability of nanofiltration for bank filtrate/groundwater treatment from strictly anoxic to suboxic conditions and to highlight benefit of BF regarding biofouling prevention of the membrane in comparison to direct surface water treatment via nanofiltration (Site 1),
- to demonstrate the advantages and limitations of membrane filtration (nanofiltration, ultrafiltration, reverse osmosis) in combination with BF, to assess ultrafiltration (UF) as additional barrier to the breakthrough of pathogens and organic compounds during subsequent activated carbon filtration (Sites 1, 2, 3),
- to demonstrate how to ensure water supply safety with BF and modern disinfection including UV and on-site electrochlorination during extreme weather conditions such as floods and droughts (Sites 3 and 5),
- to demonstrate the impact of travel time of bank filtrate and coupling with MAR on the efficacy of existing treatment (ozonation, activated carbon filtration, disinfection) and additional treatment steps (membranes, UV) and to summarize results in a software tool for prediction of the behaviour of micropollutants and other water constituents (Sites 2, 3 and 4),
- to prepare a design tool for siphon systems to achieve a “renaissance” of siphon systems in BF using modern armatures and monitoring equipment to reduce pumping energy costs by >50% (Sites 2 and 3).

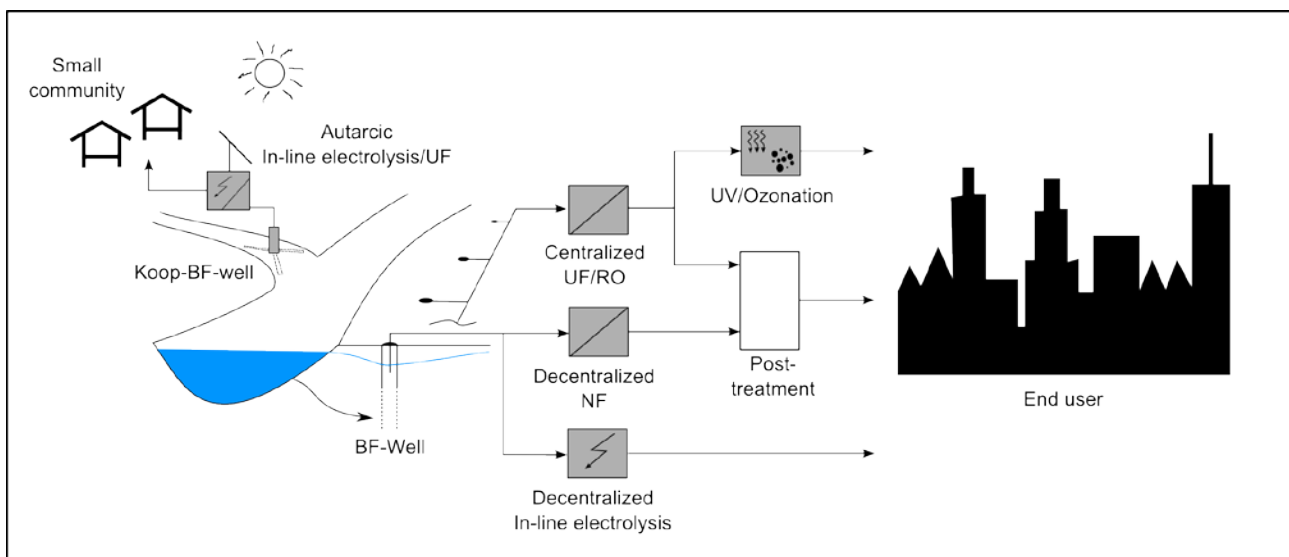


Figure 2 Overview of demonstrated combinations of BF and engineered post-treatment technologies

WP2. Managed aquifer recharge/soil aquifer treatment for storage and quality improvement

Managed groundwater recharge is an inherent component of many water supply schemes. It provides both water treatment and storage capacity.

Objectives: WP2 will assess the effectiveness and long-term feasibility of natural and engineered treatment combinations for SAT and MAR sites in various hydro-climatic and regional contexts. The activities encompass a broad range of source waters (surface water, storm water, wastewater) treated for drinking water purposes or water reuse.

Approach: progress will be brought about in four demonstration sites:

- Agon-Countainville (Site 8): effluent treatment by a reed bed followed by dune filtration for water reuse. The complexity of MAR-SAT systems needs innovative monitoring strategies and process modelling to be able to assess their efficiency under varying conditions. Special attention will be paid to the fate and transport of micropollutants in groundwater using reactive transport modelling tools, continuous and dynamic medium to long-term monitoring of the quality and quantity of water resources, and online access to groundwater data. We will develop ICT solutions as input to a decision support system (WP6).
- The Shafdan MAR/SAT system (Site 7) is a long-established scheme for the use of treated wastewater for agricultural irrigation. In previous pilot studies, the effect of an oxidation/ ozonation step prior to infiltration was investigated. Indirect Potable Reuse is now envisaged. Novel technologies will be combined with MAR/SAT including high voltage pulsed electric discharge in the liquid leading to advanced oxidation process (AOP) of organic pollutants.
- The Lange Erlen site (Site 6) produces drinking water for the city of Basel (CH) from the river Rhine (surface water abstraction). The treatment train encompasses screening, filtration and subsequent soil infiltration. After re-abstraction the water is treated by granular activated carbon and UV-disinfection. A pilot plant (reactor and soil column) will be operated to demonstrate the effectiveness of UV+H₂O₂ pre-treatment before infiltration with respect to micropollutants removal especially and how it affects the biodegradation and sorption processes in the soil.
- A pilot in Waddinxveen (NL) will be utilised to demonstrate subsurface storage of storm water for later withdrawal and use. The pilot includes innovative pretreatment (a.o. fuzzy filters) and infiltration technologies to enable high infiltration flow rates. This approach has additional value to traditional solutions to deal with flooding events leading to turbidity peaks.

WP2 will be in close interaction with WP5, 6 and 7 in order to help technology providers to implement facilities, fulfil the end-users needs and supply the planners with innovative and connected decision support tools

WP3. Constructed wetlands and other natural systems for improved wastewater treatment

Objectives: In work package 3, the combination of constructed wetlands and other natural treatment systems with different technical post- or pre-treatment options such as ozonation, bioreactor systems or disinfection will be demonstrated in pilot and full scale sizes in different European climates (UK, Germany, Greece).

Approach: Six different innovative system combinations treating wastewater as well as polishing of wastewater treatment plant effluent were chosen to demonstrate long-term viability of these eco-innovative water solutions and facilitate market uptake. In particular, demonstration sites will include:

- constructed wetlands with ozonation as pre-treatment for removal of micropollutants, pathogens and antibiotic resistance genes in WWTP effluent as well as biodegradation of transformation products generated by ozonation (Site 12),
- retention soil filters (with biochar and/or GAC layer) for combined treatment of WWTP effluent and combined sewer overflows (CSO) for nutrient, heavy metal, micropollutant & pathogen removal for surface water protection (Site 11),
- solar catalytic photo-oxidation as pre-treatment of constructed wetlands treating primary effluent followed by ultrafiltration for urban water reuse and potentially aquifer recharge (Site 10),
- disinfection as post-treatment of constructed wetlands treating primary effluent for irrigation of public spaces (Site 10)
- reactive media reed beds as post-treatment of oxidation ditches for advanced P removal in WWTP effluent to comply with strict P-consent for surface water quality (Site 13),
- microalgal photobioreactor with immobilized algae as post-treatment for advanced removal of N and P from WWTP effluent with potential for energy/nutrient recovery (Site 13).

WP4. Risk assessment and water quality control

Objectives: WP 4 will develop and test a water quality assessment framework for the cNES demonstrated in WP1-WP3. It aims at providing guidance to tailor monitoring strategies specific for such schemes.

Approach: The innovative concept of WP4 is to develop a more integrated chemical and microbiological monitoring approach for water quality making use of automated data analysis to inform risk assessment workflows. The monitoring will comprise important water quality parameters such as e.g. pathogens, antibiotic resistance genes,

organic substances or heavy metals. For ensuring maximum reproducibility the data transfer, analysis and visualisation will be automatized using the open source programming. This approach allows event (e.g. in case of outliers) or demand based reports and optimizing the monitoring strategy (e.g. measurement frequency). Risk assessment is a powerful tool to optimize water quality monitoring strategies and serves as basis for operational decision-support for the various demonstration sites.

The water quality assessment framework will be tested, implemented and demonstrated at selected demo sites. The framework will be tailored to the specific water quality risks of the sites in terms of type and frequency of critical parameters to be monitored as well as related monitoring systems and trigger values above which actions should be considered. Data processing and data visualization techniques will be developed and applied at the sites to support decision making.

The water quality assessment framework to be developed in AquaNES combines conventional and new monitoring systems and relates the outcomes to trigger values thereby using advanced data handling tools. The framework will be tailored to the type of water use and is to support operators of water reuse and production systems. The potential of the water quality assessment framework can also be exploited by improving existing treatment schemes.

In detail we will

- Assess the efficiency of the different treatment technologies (WP1-WP3) through water quality monitoring (by e.g. well established generic online sensor technology for parameters such as pH, EC, TOC, nutrients, etc.,
- Implement innovative monitoring systems for antibiotic-resistance, bioassays for toxic compounds and online detection of microbial parameters,
- Develop data-processing and -visualisation techniques such as an automated routine for water quality report generation based on data analysis,
- Develop and program an automated water quality reporting tool, critically combining the data from chemical and microbiological parameters,
- Derive an interactive quantitative risk assessment tool based on open software R.

To keep the water quality assessment framework alive after completion of the project, it will be incorporated in the recently launched Knowledge Management Platform Watershare (www.watershare.eu). This platform is to sustain outcomes of water research and to facilitate their implementation in real life.

WP5. Interfaces with the Environment & Society

Objective: The central ambition of WP5 is to better understand the ways in which considerations such as environmental impact, ecosystem services contribution, regulation, and consumer perspectives influence the desirability and feasibility of combined natural and engineered water services.

Approach: Working closely with demonstration sites (WPs 1-3), WP5 outcomes will provide input to policy (e.g. realization of the Blueprint for Water, maturing a European strategy on water scarcity and droughts) and shape practice. The following activities also help to ensure that the AquaNES consortium can extend the relevance and value of its findings beyond the demonstration sites.

The project addresses public receptivity through sub-task 5.3.3 where we seek a detailed understanding of how citizens respond to combined engineered / natural treatment systems. Large scale surveys in several member states using stratified sampling will be used to expose public understanding of the systems' function and operation as well as identifying how the public values their contribution to water services. Analysis of survey responses will enable us to both characterise significant differences between attitudes in different member states and deliver a profile of pan European receptivity. Ultimately, deliverables will characterise public trust in combined systems so as to inform communication and learning initiatives.

We also assess the potential for citizen science contributions to support the monitoring and control activities at the AquaNES demo sites through sub-task 5.3.4. This activity focuses on the practicalities and reliability of data and information collection as well as how such involvement can catalyse improved citizen engagement with the schemes. A pilot Citizen Science initiative will be developed for one demonstration site as a test case. This will involve roll out of a 'live' demonstration of volunteer citizens utilising mobile phone apps to provide scheme monitoring data. An Action Research methodology will be used to evaluate the success of this initiative leading to targeted recommendations on the design and management of citizen science operations

On environmental interfaces we will:

- characterise the scope and intensity of potential environmental impacts resulting from the use of combined systems and describe the relative environmental impact of combined systems as contrasted with fully engi-

neered alternatives. The environmental aspects will be addressed by implementing the standard Environmental Life Cycle Analysis (E-LCA) methodology while a Social Life Cycle Assessment (S-LCA) will be applied to address socio-economic aspects.

- describe and quantify the ecosystem service benefits of combined systems and characterise the sensitivity of these ecosystem service benefits in the face of climate change and varying hydrological flows.

On regulatory interfaces we will:

- identify areas of policy and regulation which constrain or hamper progress in the utilisation of combined systems
- identify the gaps and tensions between those governance domains and jurisdictions which would have to work together to effectively regulate combined natural and engineered systems
- develop and field test a set of regulatory principles and mechanisms for combined systems.

On consumer interfaces we will:

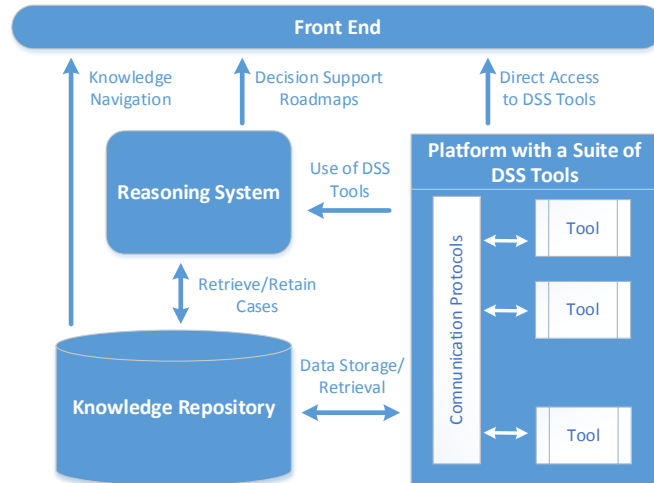
- generate a detailed understanding of how consumers and citizens understand, value, and trust engineered, natural, and combined treatment processes
- determine the extent to which Citizen Science may be used in support of the combined system monitoring and control.

WP6. Decision support and system design

Designing and operating water treatment plants involves complex decision making, due to of trade-offs between technical, economic, environmental, and social factors (Roda et al., 1999; Hamouda et al., 2009).

Objectives: WP6 will integrate existing and new modelling, monitoring data management and decision support tools and knowledge into a platform, providing a unified environment (AquaNES DSS) for supporting strategic and operational decisions in cNES.

Approach: With a view to contributing to the sustained use of the AquaNES DSS by various end-users of different levels and types of expertise, the DSS will aim at encapsulating and making all useful knowledge collected or developed by AquaNES easily available.



A. The AquaNES DSS will provide a unified environment for strategic and operational decisions by offering support in all decision making stages of cNES applications (system selection and design, system assessment, system operation and monitoring, market penetration and system replication). The AquaNES DSS will provide a platform for integrating a suite of modelling and decision support tools (DSS Tools), enabling their seamless operation through proper communication protocols (based on open ICT standards), providing smooth data sharing/exchange and a common interface. The suite of DSS Tools will bundle already prototyped models and methodologies.

B. The AquaNES DSS will be built around a Knowledge Repository (KR), incorporating data and information on successful applications, technologies, experience, and market conditions. The KR will also integrate knowledge from outside the project, including legislation, good design practices and success stories. All AquaNES data and knowledge will be integrated, categorized, indexed and inter-related in the KR, forming an extensive cNES knowledge network. Knowledge integration will expand beyond the geographical focus of the project including information and storylines from other locations. The KR will provide all data and other information necessary for making decisions at all stages. The structure of knowledge in the KR and the network of relations within it will reflect that objective. The KR knowledge and data will be organized into thematic areas and thematic clusters with-

in these areas. In addition, a meta-knowledge area will encompass all knowledge and greatly facilitate both its retrieval and the use of the DSS suite of tools. The KR meta-knowledge will be used to dynamically provide to end-users roadmaps to the KR information content and decision support using the tools.

C. The AquaNES DSS will allow end-users to perform complex operation sequences without special training, by providing Decision Support Roadmaps through an intelligent knowledge-driven Reasoning System (RS). This will exploit past experience gained from the demonstration sites as well as successful cNES application Cases outside the project, to address specific questions/objectives of the users. Application cases of the decision framework, using the DSS tools, will be stored in the KR to provide roadmaps for knowledge and decision support. A dynamic RS will be based on this information, guiding end-users (through the KR front-end) towards specific goals. The RS will be able to answer specific questions such as: which system design and technology can meet specific environmental standards, how to perform a market analysis, what is the risk of implementing a specific solution. The answers will have the form of a Roadmap suggesting the exact path to reaching a goal. This would include the tools/methods to be used, the procedure of use (steps/ action list, data, parameters, decisions to be taken, etc.) as well as explanations and references on these. The RS will be based on a case-based inference engine to generate decision/guidance roadmaps exploiting the knowledge provided by the KR. Case based reasoning is a well-established intelligent methodology that has been successfully applied for supporting decisions in many water management (Anzaldi et al.), engineering (Yang), medical (Pla et al.) and other fields (Amailef and Lu) of decision making. The main features will be:

- Gathered experience is stored in a database of Cases, combining case-specific patterns of attribute ranges with complete Roadmaps to their solution.
- Stored patterns establish a basis for expressing/translating end-user situations/conditions and goals.
- The system identifies and retrieve relevant knowledge and roadmaps from the KR.
- Suggested roadmaps are adapted to new situations, evaluated and revised.

Revised cases are retained for future use, enabling the continuous revision of the KR with problems that the system has learned to solve. Thus the RS, being dependent on the KR informational content and rules stored in the KR, will be fully configurable, adaptable and capable of evolution.

D. A Front-End will also be developed, allowing end-users to query/navigate the information stored in the KR, ask specific questions and receive decision roadmaps, follow complex qualitative and quantitative procedures for decision making, and obtain direct access to modelling and decision tools.

WP7. Exploitation and dissemination

Objectives: WP7 will provide the mechanisms to exploit AquaNES innovations and prepare their market uptake.

Approach: The activities will include dissemination of results and exchange with target groups as well as support in pre-commercialization and up-scaling laid down in the Exploitation Plan. Market search and analysis as well as appropriated IPR management will prepare the development of business plans for our products. In particular we will

- establish exploitation plans for all technology lines by identifying their unique selling propositions based on results from technology testing and socio-economic assessment.
- develop financing models and funding schemes having regard to the analyses of costs and investment barriers as performed in the project.

In terms of dissemination the visibility of the project and accessibility of its output will be promoted by

- a dedicated website, including information on all aspects of the project and interactive elements
- timely exchange with relevant end-users and their associations, scheme planners and decision makers on public and dedicated project events (exhibitions, fairs, conferences, workshops), e.g. formation of group of bank filtration experts to get Europe leading in the field of BF and subsequent water treatment.
- prominently placing the AquaNES DSS on selection and operation of cNES in the watershare® suite of tools

WP8. Management

The project will be implemented and coordinated by an experienced team at FHNW adhering to best management practice. Staff involved also brings in technical expertise in the project topic having coordinated previously the FP5, FP6 and FP7 projects: AQUAREC, RECLAIM WATER and SaphPani.

The **technical scope, application purposes and relation to the EIP thematic priorities** of the combined natural and engineered treatment processes at the demonstration sites are summarised in Table 1.

Table 1 Technical scope, application purposes and relation to the EIP thematic priorities of AquaNES demonstration sites (AOP=advanced oxidation processes, CAS=conventional activated sludge process, CSO=combined sewer overflow, DW=drinking water, GAC=granular activated carbon, MP=micropollutant removal, PAT=pathogen removal, SFW=surface water, STW=stormwater, TWW=treated wastewater, WW=raw wastewater)

No.	Natural & engineered components, natural components in colour, engineered ones in grey		WP	Case study site / Country		Source water	State of the existing installations		AquaNES Pilot installation: Size of demo activity / treated flow		Water reuse and recycling	Water and WW treatment incl. recovery of resources	Water and energy integration	Flood and drought risk management	Role of ecosystem services	
																Description
1	Bank filtration	Nanofiltration on single well level	1	Water works Berlin	DE	SFW	Full scale bank filtration system for drinking water production	80'000 m ³ /d 55 wells	Single well nanofiltration demonstration	For partial flow treatment 5 m ³ /h (2 parallel lines to compare membrane types)		DW MP	✓			
2	Bank filtration	Ultrafiltration		Dresden	DE	SFW	Full scale bank filtration system for drinking water production	3'000 m ³ /d	UF pilot plant	0.5-2 m ³ /h		DW MP PAT	✓	✓		
3	Bank filtration	Dense membrane / UV disinfection		Budapest	HU	SFW	full scale bank filtration system for drinking water production for post-treatment (UV, ozone) + 3 BF wells for non-potable water supply at Baja on the premises of the EJC for post-treatment options (RO, UV, ozone)	2500 m ³ /h, 150 m ³ /h.	new RO-equipment, UV and ozonation accessory at the Baja site with partner EJC	0.3 m ³ /h		DW MP PAT		✓	✓	
4	Bank filtration / MAR	Ozone / Activated Carbon		Poznan	PL	SFW	Full scale bank filtration system for drinking water production Full scale post-treatment options (AC, Ozone)	2500 m ³ /h	No new piloting Full-scale demonstration at existing installation	2500 m ³ /h		DW MP PAT		✓	✓	
5	Bank filtration	On-site electrochlorination		Haridwar, Ganga River	IN	SFW	Full scale bank filtration system for drinking water production	2550 m ³ /h	In-line electrolysis unit	0.5-10 m ³ /h		DW PAT	✓		✓	
6	AOP / Ozone	MAR soil infiltration	2	Basel, Lange Erlen	CH	SFW	Full scale drinking water production by soil infiltration	100'000 m ³ /d	AOP / H2O2 pilot plant as pretreatment before soil infiltration Soil column testing	1-3 m ³ /h		DW MP			✓	
7	AOP	Biofilter		Shafdan	IL	TWW	Full-scale municipal WWTP with Infiltration basins for SAT Part of pilot plant (ozonator, mechanical pretreatment)	15'500 m ³ /h	Enlarged biofilter and ozonation pilot with recycled ozonated stream	10 m ³ /h biofilter 5 m ³ /h (SAT)	✓	DW MP	✓			
	AOP/O ₃	Bio GAC							Ceramic UF	sSAT	Electric pulse oxidation on pre-treatment with recirculation	1.5 m ³ /h	✓	DW MP	✓	
								BioGAC filter or activate clay and ceramic UF or MF	0.5- 1 m ³ /h	✓	DW MP	✓				

No.	Natural & engineered components, natural components in colour, engineered ones in grey			WP	Case study site / Country		Source water	State of the existing installations		AquaNES Pilot installation: Size of demo activity / treated flow		Water reuse and recycling	Water and WW treatment incl. recovery of resources	Water and energy integration	Flood and drought risk management	Role of ecosystem services
	Description	Size/capacity	Description		Size/capacity											
8	CAS	SAT dune infiltration		2	Agon-Coutainville	FR	TWW	Full-scale municipal wwtp with dune infiltration	280 m³/h	No new piloting Full-scale demonstration at existing installation	280 m³/h	✓	MP PAT			
9	High flow pretreatment and infiltration system	Aquifer storage & recovery			Wadinxveen	NL	STW	No existing installation	N/A	Prefiltration plant based on FuzzyFilter or comparable technology	35-200 m³/h	✓			✓	✓
10	Prim. treatment Photocat. oxid	CW	Ultra-filtration	3	Thirasia Island	GR	WW	Recently constructed municipal WWTP (including all listed elements)	Peak instantaneous flow: 16 m³/h	No new piloting Full-scale demonstration at existing installation	16 m³/h	✓	WW PAT	✓	✓	✓
	Prim. treatment	CW	Stabilisation ponds & Disinfection		Antiparos Island	GR	WW	Recently constructed municipal WWTP (including all listed elements)	Peak instantaneous flow: 71 m³/h	No new piloting Full-scale demonstration at existing installation	71 m³/h	✓	WW PAT		✓	✓
11	CAS	Retention Soil Filter modified with GAC		Ertverband	DE	TWW / CSO	Full-scale municipal WWTP (Rheinbach)	240 m³/h	Retention soil filter	240 m³/h		WW MP PAT				✓
12	CAS	O ₃	CW	Berlin	DE	TWW	Full-scale municipal WWTP(Schönerlinde) Full scale wetland	WWTP: 4'375 m³/h Wetland: 250 m³/h	Ozonation pilot followed by Constructed wetland	Ozone: max.. 12 m³/h Constructed wetland: 1-4 m³/h		MP PAT				
13	Oxidation ditches	Algal photo-bioreactor		Packington	UK	WW	Full-scale municipal WWTP	194 m³/h	Algal photo-bioreactor	0.2-2 m³/h		WW	✓			
	Oxidation ditches	Reactive media reed beds		Packington	UK	WW	Full-scale municipal WWTP	194 m³/h	Reactive media reed bed	1-5 m³/h		WW	✓			

Out of 13 demonstration sites the installation and operation of only 3 requires additional permits (see list below). The partners are aware of the required procedure which will be started in due time. In each of the Work packages concerned a first milestone marks the achievement of an operational pilot which includes all mandatory permits.

For the other demonstration sites, some of them are either existing (full-scale) demonstrator where all authorisations are at hand (Site 4, Site 8, Site 10, Site 11, Site 13) or where due to the limited extend of piloting (capacity, spatial) no authorization is required (Site 2, Site 3, Site 5, Site 6) and where a written information of the authorities is sufficient (Site 12).

List of sites requiring new permits

Site 1:

Two options for the NF implementation are currently reviewed regarding pro/cons:

- At an existing well or the construction of a new well with is not yet feeding in the drinking water supply system to avoid safety issue with the produced drinking water
- Both options will require a temporary permit to place the NF pilot (Pentair) within a drinking water protection zone

The permission process at BWB will be started even before the project start to discuss any special needs regarding the environmental safety design with the water authority and the supplier (Pentair) directly at the start of the project. The final request for permission will be submitted to the water authority until months 3 of the project:

- If a separate well is constructed a permission for construction from the water authority is needed. This is a standard procedure often conducted by BWB.

Site 7:

- does not require additional permits by the water authorities,
- yet the installation of the containerized pilot plant, especially the preparation of the cement foundation need a construction permit from the Ministry of Interior

Site 9:

- Permit from the Dutch water Board is needed for soil infiltration of storm water. This is a standard procedure and will be requested once the GA is signed and the design of the pilot is further progressed.

1.4 Ambition

1.4.1 Advances beyond the state-of-the-art

Whilst many natural treatment components have proven their effectiveness in water treatment over recent decades (Kazner et al., 2012) their capacity may become limited due to space restrictions (e.g. size of CW and infiltration basins) or negatively impacted by flow variations during floods and droughts (bank filtration). In the AquaNES project we will demonstrate how engineered pre- and post-treatment components help to improve performance and increase resilience.

Bank filtration (BF) at lakes and rivers has been used in Europe for more than 140 years, primarily for removal of pathogens. Later, the systems have been completed by conventional aeration, filtration for Fe/Mn removal and often activated carbon to improve drinking water quality (Hiscock & Grischek, 2002). Many schemes are not any more adequate to remove pathogens (viruses, protozoa) and emerging micropollutants, especially during extreme events such as floods and droughts and need to be adapted accordingly (Maeng et al., 2010; Sandhu et al., 2015). To date, membrane technology is implemented in flow sheets for drinking water production from surface water only in specific cases in Europe (established plants include Mery sur Oise, Dinslaken, Roetgen). Its introduction as an additional barrier will result in higher safety and optimal use of other treatment steps such as activated carbon filtration and disinfection. As many water utilities are forced to improve their water safety systems, demonstration of operating new treatment combinations and tools for optimal design will offer a wide market in Europe (Beyer et al., 2014;). First time decentralized treatment at single wells will be tested using a new type of capillary membrane, produced based on a ‘Layer by Layer’ technique as developed in the FP7 projects Nametech and LbLBRANE and demonstrating two inline electrochlorination modules at different scale. Such systems could prevent closure of existing sites affected by specific pollutants and

set new standards in chemical consumption, operational ease and maintenance cost (Schmidt, 2012; Sandhu et al., 2015). For water safety plan development and implementation at BF schemes during floods and droughts, customised well operation procedures, innovative adaption strategies and technical measures will be applied and qualified to be market ready at the end of the project.

Siphon well systems are flood proof, independently operating and do not require permanent power supply. As compared to a series of single-operated wells with submersible pumps, which are commonly used in water supply, they reduce energy costs and CO₂-emissions by >50 %. Their design is complex and such systems were constructed in the early 1900 mainly by experience, which has been lost to date (Ray et al., 2011). Based on still operating siphon well examples at site 2, 3 and 4, recommendations for the rehabilitation of such systems as well as a software tool for the design of new siphon wells will be validated and demonstrated.

Managed aquifer recharge schemes play a vital role in drinking water supplies (Grützmacher et al., 2013). The technology has also gained increasing attention as water reuse application (Lazarova et al., 2011, Kazner et al., 2012). In both cases appropriate pre-treatment of the infiltration water is necessary to enhance system performance and efficiency, to remove critical contaminants (pathogens, ammonia, trace metals...) from the source water, to ensure the long-term system performance and to meet regulatory demands. Methods that are commonly used for pre-treatment for MAR are sedimentation, different forms of assisted filtration and disinfection to avoid clogging of the system (Van der Hoek et al., 2000; Balke & Zhu, 2008; Dillon et al., 2009). In the view of micropollutants, pathogens and antibiotic-resistant bacteria and genes (Pal et al., 2010) new approaches are required to reduce associated risks. Specifically new target uses, as indirect potable use, will come with high regulatory standards so that optimised approaches are required to reduce associated risks and allow wider implementation for MAR systems in the EU regulatory framework. Within AquaNES we will thus better eliminate or retain these constituents with appropriate engineered pre-treatment, such as advanced oxidation Zucker *et al.*, 2015. The use of subsoil natural systems (soil and aquifer) for water treatment also requires a stringent monitoring and modelling to detect and foresee any adverse effects and risks for the concerned water bodies (e.g. contaminant flow beyond the confined injection-pumping perimeter). In AquaNES, advanced monitoring and data management techniques will assure surveillance of the water bodies used for SAT/MAR. Improved monitoring and reactive transport and fate modelling of these constituents extending previous work (Pettenati, 2012, Thiéry, 2010) will be used for improved operation and design in large-scale applications.

Constructed wetlands (CW) and other natural treatment systems can be a cost-efficient and easily operated alternative or additional to technical systems for treatment of wastewater, combined sewer overflows, surface water, or polishing of WWTP effluent (Kadlec & Wallace, 2009, Vymazal, J. 2005) with additional ecological and social benefits (e.g. treatment systems as habitats, potential recreational use), thus providing additional ecosystem services compared to pure technical systems. However, the performance of natural treatment systems is limited by several factors. As microbiological degradation processes are reduced at low temperatures, treatment performance for biodegradable compounds depends on the local climate and seasonal variations, especially low temperatures in winter (Kadlec & Reddy, 2001). In addition, not all relevant compounds can be removed in natural treatment systems, especially compounds with low biodegradability and low adsorption such as certain micropollutants (Li et al., 2014). Finally, removal requires sufficient retention times usually in the order of several days that result in large system sizes.

The combination of natural treatment systems with technical treatment systems can overcome these disadvantages and even provide additional benefits regarding the treatment efficiency by combining the removal mechanisms of both system types (Liu et al. 2015). For example, ozonation as pre-treatment for constructed wetlands is able to oxidize a number of compounds recalcitrant to removal in wetlands, e.g. carbamazepine (Hollender et al., 2009). Transformation products generated during the ozonation process are often more easily biodegradable (Hübner et al., 2015) and can then be further eliminated in subsequent natural treatment systems such as constructed wetlands. Furthermore, sizes of the wetland system could be reduced due to the treatment capabilities of the complementary technical system. An innovative example is the application of solar photocatalysis (Ibhadon & Fitzpatrick 2013, Araña et al. 2008) as pre-treatment for constructed wetlands to significantly reduce land requirements and costs of CWs (Antoniadis et al. 2010: size reduction of CW by ~50% through combination with solar photocatalytic oxidation).

Finally, pathogenic bacteria present in effluents are of increasing concern, especially in case of reuse applications. A recent study on agricultural reuse of effluents from constructed wetlands treating wastewater in South Europe concluded that constructed wetlands were found to have problems meeting required levels of microbial contamination (Stevo & Maurozio 2015). In addition, the presence of antibiotic-resistant bacteria and resistance genes after conventional wastewater treatment and associated risks came into focus in recent years. For example, it could be shown that antibiotic resistance genes are present in chlorinated effluent of a conventional wastewater treatment plant (Al-Jassim et al.

2015). In this context the combination of constructed wetlands with disinfection technologies as well as the utilization of removal mechanisms for bacteria in constructed wetlands (Scheurer et al. 2015, Kadlec & Wallace, 2009) as post-treatment of technical systems are innovative approaches tackled within AquaNES through combination of natural and engineered systems to promote reuse of treated wastewater in arid regions.

Safety and compliance checking of drinking water supply systems is moving from substance based monitoring to **risk assessment** and risk management (RA/RM) approaches tailored to the context of the supply system (e.g. WHO Water Safety Plans, EC Stakeholder Forum on Revision Drinking Water Directive, 26 May 2015, Brussels). Nevertheless quantitative microbial risk assessment can also be a hurdle, as experts might not be available within especially smaller water utilities (WHO/UBA/IWA, 2014) and as quantitative microbial risk assessment (QMRA) is sometimes perceived as too complicated. AquaNES will develop operational RiskAssessment / Risk Management protocols and monitoring tools which are beyond what is currently available and which enable to implement the RA/RM trend. One key feature shall be an easy-to-use online tool for QMRA which AquaNES will launch. The tool shall serve operators a guided instrument for QMRA without the need for own programming work.

Statistical analyses from full scale drinking water plants showed, that grab sampling of e.g. microbial parameter might not fulfil the data requirements needed e.g. to prove > 4 log removal during disinfection as the data density is too low. Increased monitoring frequency of microbial parameters using online tools thus can increase the safety of water production (Smeets, 2008). Therefore improvement of real-time monitoring based on core water quality parameters and new monitoring technologies is envisaged within AquaNES in order to cost-effectively provide relevant information for the operations of cNES and to increase the data density for process performance validation. Nowadays, new monitoring technology is coming to the market that is ready for implementation, e.g. online sensors for microbial parameters, sensitive cell based bioassays for whole effluent assessment and detection of antimicrobial resistance genes.

A bottleneck for the implementation of (online) monitoring is how to deal with large amounts of data and how to extract relevant information from this data. One key approach is automated handling of data, which a) does not change the raw data and b) for which the calculation and data transformation is documented in a reproducible and transparent manner (Sonnenberg et al., 2013)(QQ). The use of the free software R for data handling and documentation data processing will be demonstrated within AquaNES.

Another bottleneck for the implementation of cNES is proper illustration of the robustness of the technique. The proposed innovative monitoring tools can show the robustness of the techniques. New methodologies for looking into data are being investigated (Che & Liu, 2014). Therefore, the project aspires to use data-aggregation and analysis techniques for the efficient unravelling of useful information from monitoring data.

[WP5] With regards to market uptake of cNES, AquaNES will expose those systems to a level of critical scrutiny and, for the first time, undertake a systematic comparative analysis of their environmental, regulatory, economic and social dimensions. WP5 will use well established methodologies (e.g. life cycle assessment, ecosystem services) and apply them in novel ways to develop a holistic understanding of the impacts from cNES and their potential pathways to market. We will also apply highly innovative mechanisms for public and stakeholder engagement through gamification and citizen science initiatives. Both are the subject of growing interest for their potential to enhance community awareness and buy-in around environmental decision making processes (e.g. Conrad & Hilchey, 2011, Tolmie et al. 2014), but both have yet to be significantly explored in the context of treatment technology. The configurational and contextual variety of combined treatment systems makes the identification of generic principles and conclusions a particular challenge. However, the work undertaken within WP5 will allow professionals working in the water sector to make decisions on combined natural and engineered treatment systems with greater confidence.

[WP6] The main challenge when designing/operating a water or wastewater treatment plant is to decide on the suitable configuration among a large number of potential unit process combinations (Patil et.al, 2014; Hamouda, 2011). Currently, most approaches focus on satisfying water quality constraints, regardless of other parameters including socio-economic and environmental sustainability (Joksimovic, 2008; Hamouda et. al., 2009). The AquaNES DSS, to be developed in the context of WP6, will allow the design and analysis of water and wastewater treatment configurations, embedding natural water treatment processes. It will widen the scope to a more holistic approach, which will cover not only the hydrological but also the ecological and socio-economic aspects. WP6 will also address the currently fragmented approach in decision making. It will provide a concrete decision framework, covering all decision making stages. The AquaNES DSS will also provide a platform for integrating a suite of modelling and decision support tools (DSS Tools), enabling their seamless operation through proper communication protocols, providing smooth data sharing/exchange and a common interface. An innovative knowledge-driven Reasoning System, based on a case-based inference engine (Anzaldi et al., 2014; Yang, 2014), will also be developed, allowing end-users to easily perform

complex operation sequences with no special training. The exploitation of the information embedded in the Knowledge Repository will enable industries, SMEs, water utilities/authorities to use and knowledge on CNES technologies, enhancing networking in the market and among professionals. This will also ensure the marketability of the products beyond the duration of the project.

Table 2 Progress beyond state of previous projects (that influenced / drove AquaNES innovations)

Project Full name, acronym, GA / funding no.	Product / output / tool used in AquaNES and progress cp. to previous	WP, site where it will be applied	AquaNES partner involved
LbLBRANE	Modification of UF membranes by layer-by-layer technology Progress to be achieved in AquaNES: Demonstration in full-scale	WP1, BF, single well NF, Berlin	XFLOW
Joint German-Israeli cooperation program funded by the German BMBF and MOST	Hybrid process of biofiltration of secondary effluent followed by ozonation and short soil aquifer treatment for water reuse Progress to be achieved in AquaNES:	WP2, recirculated ozonated stream, Shafdan site	XYLEM, MEK
ASKURIS/IST4R (local funding, German BMBF and ERDF)	Comparison of different filters for post-treatment after ozonation (sand filter, biological activated carbon)	Used in WP3 as benchmark for constructed wetland	BWB, KWB, AKUT
	First short term application of closed-loop control for ozonation (target: trace organics)	WP3: improvement of reactivity + long-term validation for disinfection and trace organic removal	KWB, BWB, microLAN
Demeau	European MAR catalogue	WP7, catalogue will be used for market transfer	KWB, FHNW
Demoware (FP7 – GA No.619040)	Microbial risk assessment for water reuse	WP4, implement and demonstrate online tool for risk assessment	KWB, KWR
ELAN (German BMBF)	treatment performance of different constructed wetlands for effluent polishing (without ozonation)	Use of performance data for design of CW in AquaNES and as benchmark of cNES technologies	AKUT, BWB, KWB
Reclaim Water	Isotope tracing methods to characterise MAR	Agon-Coutainville/FR	BRGM
EcoWater FP7, GA No 282882,	EcoWater Toolbox SEAT modelling tool EVAT modelling tool EcoWater Technology Inventory	WP1, WP2, WP3	NTUA
Coroado, FP7, GA No 283025,	POSEIDON tool	WP1, WP2, WP3	FHNW
AquaStress , FP6, GA 511231-2	AquaDT tool	WP1, WP2, WP3	NTUA
GERF RBF in Arid Regions (German-Egyptian Research Fund)	Assessment strategies, indicator parameters to study the effect of extreme droughts on BF	WP1	HTWD
Saph Pani	Flood-proofing of BF sites; on-site enrichment of micropollutants in India for water analysis	WP1	HTWD, UJS
	Network for marketing	WP7	AUT

1.4.2 Innovation potential

Innovations derived in AquaNES cover new, improved technology combinations and configurations as well as predictive modelling and DSS tools. Moreover, the use of advanced monitoring tools to confirm required performance and aid operation as well as new operational set-ups and use in contexts will be demonstrated. A concise overview of the innovations and associated exploitation teams are listed in Table 3.

Table 3 Innovative products developed in AquaNES (technologies, design and operational support): * TRL of the demonstrated technology at the beginning and end of the project

Products & services already on the market / State of the Art	Innovated product / service demonstrated through AquaNES	TRL start vs end*	Exploitation team in AquaNES & ambition
BF in combination with aeration, sand filtration and AC filtration	BF combined with membrane technologies – ultrafiltration and dense membrane processes to remove organic micropollutants and pathogens	6 → 7	WP1: EJC, DREWAG, HTWD, AMU; setting new standard for BF-membrane filtration in Europe
BF and conventional disinfection using Cl ₂ and Cl ₂ O	Market ready coupling of BF with small and large scale on-site electrochlorination modules for disinfection; optimized usage of Cl ₂ + UV and ozonation for disinfection	6 → 8	WP1: HTWD, AUT; BUWW, EJC; Indian associated partners; opening significant market in Asia
Closure of BF schemes during floods or operation with higher chlorine dosage	Innovative concepts for well operation & protection during floods and droughts, DSS	5 → 7	WP1: BUWW, HTWD, new quality/scope of prediction+DSS tools
Centralized treatment of all bank filtrate in waterworks	Decentralized targeted partial treatment, new type of optimised nanofiltration membrane for an-/suboxic bank filtrate	5 → 7	WP1: KWB, BWB, XFLOW - first application, new module, development of market
Novel siphon well systems	Design tool for siphon systems	6 → 8	WP1: HTWD, DREWAG
Infiltration basins with limited infiltration capacity and prone to clogging	High velocity infiltration of excess urban run-off; Innovative application of fuzzy filters enabling fast subsurface storage of storm water and reuse	6 → 8	WP2: KWR, HYBU; demonstration and worldwide roll-out
AOPs as final treatment step (e.g. Waternet in NL)	Enhanced bio-degradation of organic compounds during soil passage by pre-oxidation with AOPs addressing refractory compounds	5 → 6	WP2: FHNW, IWB, XYLEM - first application, development of market
Advanced oxidation processes based on UV/H ₂ O ₂ or ozone	Chemical free and less energy demanding electric pulse oxidation process to decrease residual DOC and micropollutants	6 → 7	WP2: MEK, WADIS - Demonstrate effectiveness, prepare for market
Energy intensive double membrane processes for indirect potable reuse	Membrane-free, less energy demanding indirect potable reuse scheme. Recirculation of ozonated water for enhanced DOC removal	6 → 7	WP2: MEK, XYLEM - Demonstrate groundbreaking technology
CW for treatment of wastewater for small communities (Vyzmal, 2005)	Combination of CW treatment with photocatalytic oxidation and membrane filtration: solar photocatalysis as pre-treatment to significantly reduce land requirements and cost of CWs, subsurface CWs as pre-treatment for ultrafiltration (UF) to significantly reduce membrane fouling	5 → 7	WP3: NTUA, DEYAT, AUT microLAN Demonstrate novel process configuration, roll-out small communities
CW for treatment of wastewater for small communities (Vyzmal, 2005)	Validation of technical and economic viability of the treatment systems under seasonal variations of hydraulic and pollution loads.	5 → 7	WP3: NTUA, DEYAT – Knowledge base for scheme design

Products & services already on the market / State of the Art	Innovated product / service demonstrated through AquaNES	TRL start vs end*	Exploitation team in AquaNES & ambition
CW (retention soil filters - RSF) for single treatment of CSO (Scheurer et al., 2015)	Evolve from stand-by / occasionally used infrastructure to polishing of WWTP effluent during dry weather flow in one system focussing on additional removal of pathogens by the CW and of micropollutants through amending the system with e.g. granular activated carbon layer	6 → 7	WP3: EV, AKUT, Establish worldwide 1st full-scale reference of RSF application. Demonstrate removal capacity & benefits for the receiving water
CW alone for polishing of WWTP effluent (Llorens et al, 2009)	CW with ozonation pre-treatment (with operational control of ozonation unit via online monitoring) for advanced removal of micropollutants, degradation of transformation products generated by ozonation, improved removal of antibiotic resistance genes and pathogens by combining treatment steps	5 → 7	WP3: KWB, BWB, XYLEM, AKUT Demonstrate upgrade options for large number of established CW to enhance performance
Biological nutrient removal plant in combination with coagulant dosing for phosphorus (P) removal	Combination of oxidation ditch based WWTP and microalgal photo-bioreactor for nutrient removal of both P & N to very low levels (< 0.3 mg/L). Immobilisation of microalgae in alginate beads for cost-effective harvesting of the algal biomass and option for energy recovery from anaerobic digestion	5 → 7	WP3: UCRAN, WatStech Provide low cost and low energy options for wastewater polishing with opportunities for nutrient recovery
Conventional biological treatment plant in combination with coagulant dosing for P removal	Combination of oxidation ditch based WWTP and low energy, chemical free CW with steel slag as reactive media for phosphorus removal to low levels (< 0.3 mg/L)	6 → 7	WP3: UCRAN, WatStech Demonstrate value of waste material use in wastewater treatment.
Current monitoring acc. to legal requirements often lacks knowledge about specific risk determining aspects	Development of a more integrated chemical and microbiological water quality monitoring approach for cNES to inform adapted risk assessment & management.	5 → 7	WP4: KWR, KWB Demonstrate methodology with end-users, roll-out in the water sector
Indicator organisms and cultivation technique based microbial monitoring	Improved on-line microbiological monitoring techniques with short analysis time; screening techniques based on (meta)genomics; microbial community fingerprinting; antibiotic resistance genes	4/5 → 6	WP4: KWR, microLAN, KWB, BWB Demonstrate methodology with end-users, roll-out in the water sector
Classical, punctual monitoring procedures with no connected data analysis support system	Operate SAT and recharge scheme constraining saline intrusion with SMD (Subsurface Monitoring Device). Real time, calibrated and dynamic monitoring system to enhance groundwater quality for water reuse.	7 → 8	WP2: Imageau/BRGM Demonstrate MAR/SAT performance through dynamic monitoring of water resources quality and availability
Suite of independent modelling programmes to depict processes in individual treatment train components.	ICT solutions for water managers, via a connected decision support system, for efficient monitoring and management of hybrid systems including SAT-MAR connecting surface treatment processes to groundwater quality evolution.	5 → 7	WP2/6: BRGM, Geohyd, Market introduction of integrated modelling tools for end-users to manage schemes in compliance with groundwater quality targets
Individual tools to assess and depict system performance	Decision support system for cNES, improved and validated tools, based on their application in the demonstration sites and on their integration into a versatile DSS (GIS components compliant with provisions & standards of the INSPIRE directive)	5 → 6	WP2/6: NTUA, Geohyd, BRGM, AMU, HTWD Demonstrating usability and benefits by end-users

Products & services already on the market / State of the Art	Innovated product / service demonstrated through AquaNES	TRL start vs end*	Exploitation team in AquaNES & ambition
Software solutions tending to out-date, low flexibility and higher workload for user	Automatized data analysis and risk assessment workflows based on open source software enables flexible tailor fit solutions	5 → 7	WP4/6:KWB, KWR Demonstrate methodology with end-users, roll-out in the water sector

2 Impact

2.1 Expected impacts

2.1.1 Wide and fast deployment of sustainable innovative solutions in the water management sector and contribution to the implementation of the EIP ‘Water’

The water sector does not readily implement innovative technologies and processes in the absence of a systematic evaluation of their industrial scale operation. To support the goals of the European Innovation Partnership on Water AquaNES will:

- deliver a series of comprehensively field-tested combined natural and engineered water treatment trains,
- demonstrate their technical and environmental performance including comparisons to benchmark technologies with respect to treatment effectiveness, energy demand and cost. In doing so it will offer water sector professionals greater confidence in making decisions on the design, implementation and management of combined treatment systems,
- increase the Technology Readiness Level of several process combinations, typically from 5/6 to 7/8 (table 3),
- provide the contextual information and tools that water managers and authorities require to preference innovative combined natural and engineered water treatment solutions.

These outputs will be shaped by the active involvement of the water sector and will form the cornerstone of further market penetration. Rapid deployment of these innovative solutions within two to three years of demonstration in the AquaNES project will be supported by market analysis and an exploitation and dissemination strategy (see Section 2.2). We will ensure awareness of tested solutions through dissemination activities and close collaboration with related EIP **Action Groups** (e.g. AG128 Managed Aquifer Recharge Strategies and Actions, AG100 RTWQM – Real Time Water Quality Monitoring and AG228 NatureWat - Nature-based technologies for innovation in water management) of which AquaNES partners are members.

We will **foster the uptake of solutions** by addressing two of the **cross-cutting priorities of the EIP ‘Water** (‘Water governance’, and ‘Decision support systems and monitoring’). Specifically, the outcomes from WP5 will allow the deployment of combined systems to be more ambitiously specified within an appropriate environmental, regulatory, and societal context. Further support is provided in WP6 by (a) supporting a holistic approach to the design, operation and assessment of natural and engineered water systems and (b) providing improved and direct access to information and resources for such systems. It is also relevant to the thematic priorities on (a) ‘flood and drought risk management’, through the integration of relevant risks for the development of appropriate operational strategies, and (b) ‘ecosystem services’ by providing tools to develop preliminary assessments of how the AquaNES systems contribute to sustaining and further enhancing ecosystem services.

These actions will **increase the full-scale implementation chances of combined systems significantly** and deliver a competitive advantage for both the solution providers and end-users in the water sector. Market chances will also be generated for the export business through demonstration outside Europe (e.g. in Israel and India).

As many of the demonstrated solutions could support a range of process industries in their efforts to cope with water challenges, market potential across these sectors will be explored. Through dissemination and exploitation activities we will illustrate how industry can increase sustainability. This will be complemented by increasing awareness on water value and social conscience on sensible use of this resource - in support of SPIRE PPP ambitions on sustainable water management and resource efficiency as described in the **SPIRE PPP roadmap** and Key Action 1.3: Optimal and integrated (re) use of water. An explicit ambition of AquaNES is to improve our understanding of how **consumers understand, value, and trust different forms of treatment processes**. In doing so, we will be informing the rich debate

around the social and economic value of water. Outputs from WP5 on these issues will play an important role in shaping future attitudes and behaviours.

2.1.2 Market penetration and demonstration, long-term application and sustained use by various end-users

The AquaNES activities are tailored to stimulate long-term application of successful and sustainable innovative solutions. We carry out extended on-site demonstration of large scale cNES with comprehensive testing and definition of operational procedures and limits, performance, environmental sustainability, etc. This will feed into water quality control and risk management frameworks to assure systems safety and regulatory requirements fulfilment based on the WHO Water Safety Plan concept.

cNES are to become **competitive with more traditional solutions**. WP5 will deliver evidence and guidance to ensure that the full value of combined treatment systems is taken into account when such assessments are being made. WP6 will provide, through the developed decision support platform, the opportunity to **maximise the replication potential** of the AquaNES innovations, and help to identify relevant economic incentives and strategies for accelerated uptake. It will also enable e.g. planners and end-users less familiar with natural treatment systems to perform an initial assessment of the feasibility and hence include those options in the further stages of planning if deemed appropriate (e.g. initial design, detailed design). To ensure effective market penetration and demonstration WP7 will develop detailed exploitation plans for each tested technology, product or service and follow bespoke dissemination strategies among which will be three specialised conferences/workshops organised at international level (e.g. during water fair Wasser-Berlin 2017) on BF, MAR and CW to achieve better market penetration.

2.1.3 Creation of new market opportunities both inside and outside Europe

The management of aging water and wastewater treatment assets poses additional challenges to countries in Europe or the United States (WssTP, 2010; US EPA 2014). These **challenges require innovative technologies and represent market opportunities** in a number of areas as reflected in current estimates of the growing global water market for water-related equipment and operations reaching \$696 billion (CAPEX and OPEX) in 2018 (GWI, 2014). We identify clear growth potential in a number of fields and technology market segments such as NF membranes, smart water sensors or software, and advanced oxidation processes combined with natural treatment components:

Extending existing markets: Replacement and upgrading of infrastructure to comply with new requirements will be one of the major opportunities: Natural treatment technologies are already practiced **in Europe** to a great extent, i.e., around **270 MAR sites** out of which 145 (54%) are induced bank filtration (BF) facilities followed by infiltration ponds & basins (23%) and well, shaft and borehole recharge systems (16%). More than half of all these sites are located in Germany and the Netherlands. MAR systems play an important role in the European water supply and especially induced bank filtration produces large water quantity. 60% of Berlin's drinking water (120 million m³/year) is based on MAR (Site No. 1). Similarly, 60% of Basel's drinking water (16 million m³/year) derives from MAR through Soil infiltration (Site No. 6). Along the rivers Rhine and Danube bank filtrate serves > 20 Mio. people. In Hungary, for example, MAR sites contribute to approximately 60 % of the public water supply, in Slovakia to about 55%. In France and the Netherlands drinking water supply is fed up to 50 % by BF and 16% dune filtration respectively (Grützmaier et al., 2013; Hannappel et al., 2014). The combination of those already proven natural components with engineered options allows **addressing several key challenges** such as enhanced **removal of persistent compounds**, coping with water quality and water quantity changes as well as limited space availability. Combining strengths of both technology classes and mitigating their weaknesses through smart combination will create new market opportunities for involved solution providers. *Based on the assumption that every second water utility using BF in Europe needs to improve the treatment process within the next 10 years and an additional treatment step (e.g. membrane filtration) would cost 1 to 10 million Euro depending on the waterworks capacity, we estimate the required invest to at least >50 million Euro per year.* **Constructed wetlands** with horizontal sub-surface flow as viable alternative treatment for wastewater with small sources of pollution (organics and suspended solids) are used **throughout the world**. Over 50,000 horizontal subsurface flow constructed wetlands are in operation Germany, ca. 1,000 in Austria, ca. 800 in the UK, ca. 300 in Italy, around 160 in the Czech Republic and 120 in Poland or Portugal. In North America around 8,000 horizontal subsurface flow constructed wetlands are estimated (Vymazal, 2005). Combinations with engineered elements to increase removal efficiencies and reduce land requirements are essential to preserve the advantages of this low-cost, low-energy and ecosystem services providing treatment solution. This understanding is reflected e.g. in Israel where 5-15 Mt/d combined sewer wetlands with integrated technical solutions for water re-use are part of actual tenders. In Greece (Site No.10) and other Mediterranean regions with remote areas such as islands with limited natural water resources and high tourist driven seasonal demand, constructed wetlands have considerable potential in terms of water reuse and re-

cycling for various purposes. *Assuming that 25% of 100 remote sites in Greece will select constructed wetlands with integrated engineered elements for wastewater treatment (ca. 2 million Euro per system), around 50 million Euro could be generated.*

Provide low-cost, low energy solutions to new markets: Through our demonstration sites in Hungary and Poland (Demonstration sites No. 3 and 4) we will directly **reach out into the eastern European water sector**, where a strong need for improvement of water treatment is recognised. Further investments are also necessary to achieve conformity with EU wastewater legislation e.g. compliance with UWWTD targets are still below 40% for Estonia, Poland, Bulgaria, Romania and Slovenia (EC, 2013c). A recent study has estimated implementation cost of 12 billion EUR for achieving this and 230 million EUR for providing wastewater services to smaller agglomerations, for Poland only (SGE, 2013).

Since, recent water reuse projects such as the IWVA scheme at Torreele/Belgium and Singapore's NEWater programme have demonstrated that the reuse of treated **wastewater for** high-value urban applications such as **indirect potable reuse** is an efficient means for the local adaptation and mitigation to climate change and the diminishing water resources (GWI, 2010; WssTP, 2010), additional market shares are expected in this sector. The 'current gold standard' for direct and indirect potable reuse uses energy intensive and costly UF & RO processes yet the combination of ozone / AOP oxidation with natural soil treatment can reduce OPEX and CAPEX by more than 50% and thus is an attractive alternative to membrane based processes for reusing water (Site No. 7). *According to GWI (2010), UF Membranes for drinking water applications have an estimated market value of 330 million USD in 2016, Xylem therefore estimates up to 30 million EUR additional turn-over within the next 6-7 years due to the introduction of an alternative indirect potable reuse scheme.*

Outside Europe the implementation of cNES poses an even greater potential, specifically in achieving the post-2015 Sustainable development Goals (i.e., 'Goal 6: Ensure availability and sustainable management of water and sanitation for all' and protection and restoration of ecosystem services of aquatic and terrestrial ecosystems as per Goals 15 and 16') in developing and emerging countries such as India where one of the demonstration sites is placed. Asia will be one focus of exploitation activities. For example, on-site production of disinfectants by electrochlorination will be studied at different scales at a site in India, where a *market of several million EUR is expected for the SME (AUT) involved*. Overall the international market in Asia, America and Africa has a huge potential for low-cost and medium-cost treatment systems. Growth rates of the municipal water market in Southern Asia is larger than 5% per annum and just in China to where some of the demonstrated technologies can be exported both the municipal water and wastewater market is expected to reach 20 billion USD each in 2015 (GWI, 2014).

The development of new market opportunities will also be directly fostered through the integration of results from the innovation demonstration in the AquaNES **Decision Support System**. The **knowledge base** and the attached modules will allow users (mainly water managers, planners and authorities) to investigate the potential application of solutions and their impact in application cases in Europe and other areas.

Reach technology market segments: For the each of the innovative products and services demonstrated within AquaNES it is expected that commercialisation can be achieved soon after project completion with deployment at full scale within two to three years. The **expected number of installations** or applications will range from several initial sites for very specific technologies (e.g. electric pulse technology) with great potential for broader uptakes internationally in the medium term to rapid market uptake for other solutions (such as *for ozone pre-treatment equipment and control is estimated at > 4 million € through 5 years*).

- *microLAN*: Expected increase in sales of BACTcontrol™ system from 800,000 € in 2015 to 2 million € in 2018.
- *BDS*: The size of water monitoring market in 2020 is forecasted at 1.6 billion (EPEC, 2011), additional turn-overs of 2-5 million € are expected, depending on implementation in regulatory framework and standardisation.
- *imaGEAU*: In Europe, soil and groundwater monitoring and remediation technologies are estimated to rise up to 2.7 billion € in 2020 (EPEC, 2011), imaGEAU expects sales of the Subsurface Monitoring Device (SMD) of > 10 million EUR until 2018.
- *EV*: Assuming that 10% of 38'000 combined sewer outflows (CSO) need to be refurbished in Germany, the size of potential market is 3'800 CSOs which could be upgraded with Retention soil filters (RSF_{WWTP+}). During AquaNES, 5 RSF_{WWTP+} installations per year are expected (costs of filter: 2 million €) generating an *additional turn-over of 50 million € until 2018*.

2.1.4 Increased resource efficiency and environmental performance of the water sector

The environmental assessment of technological interventions to be pursued in the demonstration sites will evidence the optimised use of resources and the reduced ecological footprint of the combined treatment technologies. Savings are anticipated not only with respect to energy but also material intensity and chemical requirements. Water utilities will be expected to improve their **performance indicator** for "Materials, chemicals and other consumable costs". The exploitation teams at the demonstration sites are composed of water utilities (e.g. BUWW, BWB, EV, DEYAT, DREWAG, IWB), SMEs (e.g. AUT, AKUT, HYBU, WatStech, microLAN, WADIS) as well as industry (XYLEM, XFLOW) and research organisations. These intensive collaborations will facilitate early agreement and tuning of needs and expectations, thereby hastening execution of both the demonstration activities and subsequent exploitation initiatives. That way we achieve synergies between public water authorities, water utilities, various economic actors and sectors, major companies and industries, SMEs and research organisations.

2.1.5 Significant reduction in (fresh) water use

Several of the demonstrated AquaNES solutions help to better manage regional or local water cycles by efficiently and safely augmenting groundwater or incorporating water reuse into the water supply portfolio. In consequence, this will **lower the demand for freshwater abstraction from conventional sources** particularly through water solutions which can provide high quality water for various uses, e.g. irrigation but also indirect potable reuse. Examples are system combinations aiming at e.g. irrigation at the Greek and French sites (Sites no. 10, 11 & 8) and indirect potable reuse in Israel (Site no.7).

AquaNES will particularly support the ongoing policy initiative started under the Blueprint for Water to promote the development of water reuse in Europe and achieve more uniform criteria for different water reuse applications, e.g. in agriculture. Demonstration results from AquaNES will feed into the process of establishing typical performance criteria, monitoring methods and design approaches which can be beneficial for the overall water reuse development in Europe.

2.1.6 More than 50% reduction of energy demand in water supply, treatment and transportation

The European Benchmarking Co-operation (2014) published the international benchmark for water and wastewater using data of 2013 from 48 water and wastewater utilities from 17 different countries. The median electricity consumption for drinking water was 0.46 kWh/m³ per m³ water produced - including abstraction, pumping and treatment. The energy consumption for wastewater treatment is fairly distributed between 23 and 43 kWh/p.e., with a median score of 30 kWh/p.e. served. Another set of general estimates of energy intensity in European water supply gives a range of 0.5–4 kWh/m³ for surface water, 1–6 kWh/m³ for recycled water, and 4–8 kWh/m³ for desalination (WssTP, 2011). AquaNES aspires to identify and **demonstrate significantly less energy intensive process components and combinations** for a variety of applications. The project AquaNES will contribute to reducing the overall energy demand of water sector by

- Demonstrating natural treatment systems such as constructed wetlands or soil retention filters as low energy alternatives compared to purely technical systems. In combination, energy demand could be lowered by ca. 20-50% (WP3).
- Proposing operational schemes which allow the coupling of treated water flows to variations in delivered solar power. Ideally during day-time full supply by solar power shall be possible, resulting in >50 % reduction of primary energy demand (WP3).
- Some of the demonstration sites will validate the performance of technological options which can e.g. replace energy intensive double membrane systems for indirect potable reuse which are state of the art and consume around 1.2-1.6 kWh/m³. With the combination of oxidation, biofiltration and soil-aquifer treatment this energy consumption can be potentially lowered to around 0.6 kWh/m³, even with additional safety disinfection in the reclaimed product water (WP2).
- The design support tool for siphon systems for BF schemes could prevent the currently frequent closure of such systems and catalyse a “renaissance” of siphon applications which could, in turn, be operated with sophisticated vacuum and control devices to reduce the energy consumption for water abstraction via wells by >50% (WP1).

2.1.7 Support to the implementation and evaluation of technology verification schemes, including the EU Environmental Technology Verification Pilot (ETV) programme.

AquaNES will support the EU Environmental Technology Verification Pilot programme in so far as the requirements for ETV verification will be included in the planning of the demonstration phase. As an output of our demonstration we will formulate claims on the performance and environmental benefits of the tested technologies and thereby prepare for 'independent and credible evidence of its advantages' (ETV, 2013). Application to actual verification may be considered in the exploitation plans of selected technologies. We will foresee a budget for co-fund ETV programme participation for two selected technologies from the AquaNES portfolio.

2.1.8 Other environmental and socially important impacts: Responsible innovation

Greening of water infrastructure, i.e. the integration of natural or semi-natural systems in overall water treatment and supply systems, is becoming increasingly recognized as an opportunity for addressing complex challenges of water management (UNEP, 2014) and as means to halt ecosystem degradation and biodiversity loss, i.e., Target 2 of EU Biodiversity Strategy to 2020 (2011): '*By 2020, ecosystems and their services are maintained and enhanced by establishing Green infrastructure and restoring at least 15% of degraded ecosystems*'. AquaNES will demonstrate cost-effective, long-term ecosystem-based water treatment and supply infrastructures which support ecosystems' integrity and thereby maintain the stream of valuable goods and services (e.g. water purification through soil infiltration or biodegradation of pollutants) to all members of society. This commitment to responsible innovation underpins our project's ambition and execution. **AquaNES will deliver processes, products, and services which drive both social and environmental benefit.** We believe that such a strategy anchors the innovation process in common European values (Sutcliffe, 2011) such as sustainable development, balanced economic growth, social progress, a high level of protection and improvement of the quality of the environment, and the promotion of scientific and technological advances. We will achieve these ambitions through a number of mechanisms including; (i) embedded continuing stakeholder involvement in our workplan to ensure that considerations of the public good are reflected in our actions and outputs, (ii) regular reviews of risks and opportunities allow us to prioritise formal assessment of the social, ethical and environmental impacts of the solutions being developed, (iii) robust oversight mechanisms which support us to anticipate and problems and opportunities and adapt and respond quickly to changing knowledge and circumstances, and (iv) promotion of openness and transparency along the innovation process.

2.1.9 Barriers and obstacles setting expected impacts at risk

Realising the expected impacts from the project will depend on a number of factors internal and external to the AquaNES. The successful demonstration and exploitation is essential, namely achieving the expected robust treatment performances in the full and pilot scale tests with the envisaged benefits in terms of limited energy and chemical demand as well as low maintenance requirements. Moreover, the AquaNES innovations have to go beyond the technical progress and reach out to the market through fulfilling requirements by end-users. This will challenge the AquaNES partners to interact successfully with stakeholders inside and outside the project. Market pull will depend on a number of external factors such as regulatory frameworks in Europe and beyond, e.g. the further development of a more harmonised framework for water reuse in Europe as currently envisaged by European Commission activities (DG Env and JRC) and availability of financial resources to invest in a more climate change resilient water infrastructure under the current economic constraints in most European countries. AquaNES will actively address the full range of challenges, potential barriers and obstacles to the more wide-spread implementation of cNES through integrating technical, human health and environmental aspects with socio-economic dimensions and advances of business options fitting to both market needs and profiles of the companies involved in AquaNES. In summary, AquaNES fully embodies the necessary innovation activities to address the existing uncertainties stakeholders face in fully exploiting the huge potential of combined natural and engineered water and wastewater treatment systems delivering high quality water for different purposes

2.2 Measures to maximise impacts

To achieve an improved confidence in the design and operation of combined natural and engineered systems and foster successful market-uptake of AquaNES innovative technologies, products and services, different exploitation (Section 2.2.1) and dissemination (Section 2.2.2) activities and measures will be taken during and after the project period. AquaNES innovation activities (particularly demonstration & validation in WPs 1-4 and exploitation in WP7) form essential elements in the pathway to deliver innovative products and services to market. The valuation of ecosystem services (WP5) and a suite of decision support tools (WP6) will form a solid basis to disseminate knowledge and learning on cNES more widely and promote their further implementation (WP7), strengthening and stimulating the market for the exploitable results (Figure 3). Different elements of the AquaNES innovation activities such as the exploitation and dissemination pathway are illustrated in the coming sections.

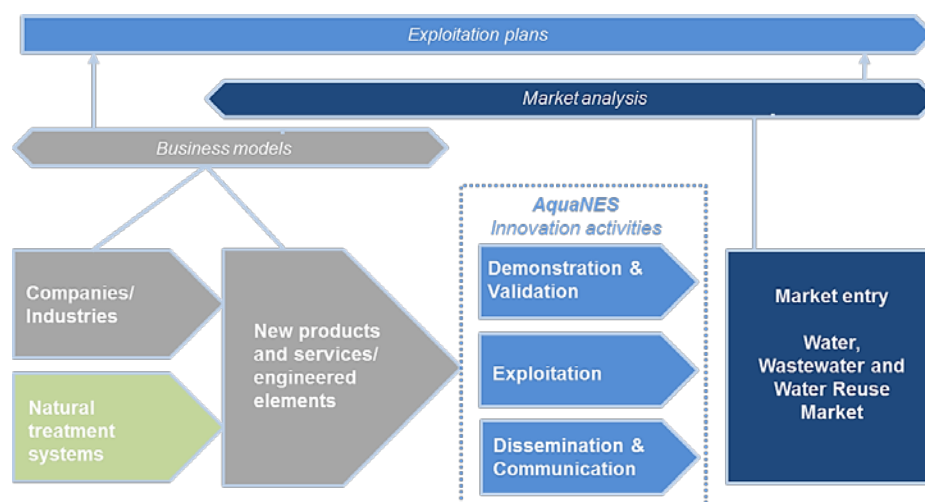


Figure 3 Innovation activities of AquaNES project

2.2.1 Exploitation

The AquaNES exploitation strategy aims to achieve **market-uptake** of promising combined natural and engineered treatment technologies, products and services **within 2 – 3 years** after the end of the project. AquaNES comprises a variety of exploitable innovations ranging from (waste)water treatment and monitoring technologies to services such as software tools for decision-support and new approaches and methodologies (Table 3) and involves commercial partners and industries who will profit from successful demonstration and validation of their products in different demonstration sites (Table 4).

Table 4 AquaNES commercial partners and products

Sector:	Commercial partner/ industry	Product	Demonstration site
pre- & post treatment technology providers	XFLOW	Capillary NF membrane (capNF)	WP1: Site No. 1
	AUT	Inline electrolysis system (SuMeWa System)	WP1: Site No. 5
	WADIS	Electrical Pulse Oxidation Process (EPOP)	WP2: Site No. 7
	XYLEM	Diverse advanced oxidation processes (divAOP)	WP2: Site No. 6/ 7 WP3: Site No. 12
	HYBU	High velocity infiltration filter (Fuzzy Filter)	WP2: Site No. 9
	EV	Retention Soil Filter (RSF _{WWTP+})	WP3: Site No. 11
	Watstech	Microalgal bioreactor (AlgaeBead)	WP3: Site No. 13
Monitoring technology/ devices provider	microLAN	Online microbiological monitoring technique (BACTcontrol)	WP1: Site No. 2 or No. 5; WP2: Site No. 9; WP3: Site No. 12
	BDS	Bioassays for screening toxicological effects (CALUX [®] assays)	Two sites each in WP1, WP2 and WP3. Priority to sites with AOP (No. 4, 6, 7, 10, 12)
	imaGEAU	Subsurface Monitoring Device (SMD)	WP2: Site No. 8

Sector:	Commercial partner/ industry	Product	Demonstration site
Software service providers	Geohyd	Modelling software for management of hybrid WWTP/SAT systems (WWTP/SAT modelling)	WP2: Site No. 8
Design and consultancy service providers	AKUT	Design and engineering of (waste)water treatment solutions, Consultancy (ecological engineering)	WP3: Site No. 10

AquaNES innovations are aimed at different target markets in the water sector (drinking water, wastewater, water reuse) and diverse key areas of application. Distinct exploitation routes and commercialization roadmaps will need to be created and individual strategies (i.e., goals and measures) formulated and implemented based on consideration of companies’ resources and an assessment of the internal and external environment the company or industry competes in. For each AquaNES innovation tailored exploitation plans, addressing aforementioned aspects, will be specified and deepened in WP7 by the AquaNES consortium forming Innovation Exploitation Teams. These are composed of AquaNES commercial partners supported by other project entities as outlined in section 3.2 ‘Management structure and procedures’. Key components of exploitation plans are market analysis and business model development forming the basis of strategy formulation and implementation.

Macro- and microenvironment analysis and assessment of the market potential for exploitable products/services

We will characterize relevant markets and market segments for different geographical regions as well as different types of application: water and wastewater sector, water reuse markets. The analyses will provide a picture of the **market size** (i.e. number of customers) and **economic opportunities** (i.e. sales revenues for existing products) and identify opportunities resulting from technology synergies and complementarities.

In WP7, we will specifically analyze the companies’ macro- and microenvironment to come up with comprehensive understandings of how the company or industry can compete in existing settings. We will

- conduct country specific **PESTLE-analyses** (political, economic, social, technological, legal and environmental factors) to assess opportunities and threats deriving from the external macro-environment and to understand market development and opportunities (Fahey & Narayanan, 1986);
- apply the **Porter 5 forces analysis** to understand the level of market competitiveness which is manifested by five forces in the company’s microenvironment (i.e., threat of substitute products or services, threat of established rivals, threat of new entrants, the bargaining power of suppliers and the bargaining power of customers) that determine the profitability of a business (Porter, 1980);
- and conduct **SWOT-analyses** to evaluate company/innovation internal strengths and weaknesses against external opportunities and threats to recognize their competitive advantages.

AquaNES exploitation teams will periodically review current and future water market trends to estimate evolving opportunities and threats for the product’s positioning on the market and to ensure that exploitation strategies are well informed.

Generate business models for AquaNES innovations:

We will utilize the business model canvas approach (Osterwalder & Pigneur, 2010) to describe a set of core strategic aspects related to our companies’ businesses, which derive from the understanding of companies’ environmental analyses, i.e., which values (social, economic, environmental) the company creates with its product (**‘value propositions’**), how they maintain their relationships with target customers (**‘customer relationships’**), which **channels** they rely on to deliver ‘created values’ to their customer segments. Moreover, business model canvas describes **company internal structures, infrastructure and resources**. The visual representations of our partner companies, their resources and how they do business will provide a shared language and lead to candid understanding and constructive conversations within the innovation exploitation teams when creating exploitation plans and exploring possibilities for future development on the basis of analyzed market trends, threats and opportunities.

The Canvas in Figure 4 summarizes the business models of our commercial partners/industries and their products (listed in Table 4) structured into the nine Canvas Business Model categories. During the project period we will elaborate **individual Business Model Canvas for all AquaNES companies**.

Tailoring exploitation plans for each AquaNES innovation:

Drawing on both, the market analysis and business models, a series of strategic actions for commercialization will be formulated and implemented taking into account the companies’ resources (e.g., partners, infrastructure, organizational structures) and competitive advantages. **Expected financial impacts will be quantified.** Exemplarily, Table 5 to Table 7 demonstrate ‘draft exploitation plans’ of AquaNES innovations for which we estimate to have considerable economic impacts. These include elements from a preliminary market analysis (e.g. trends, geographical market, size, customer segments and competitors), companies’ business models (e.g. organizations key activities, value propositions/competitive advantages of innovative product), financial projections and a series of strategic actions formulated (Commercialization roadmap/Dissemination & communication actions) which will promote a successful market entry. Draft exploitation plans for all the innovations will be prepared which form the basis for further elaborating and individual tailoring.

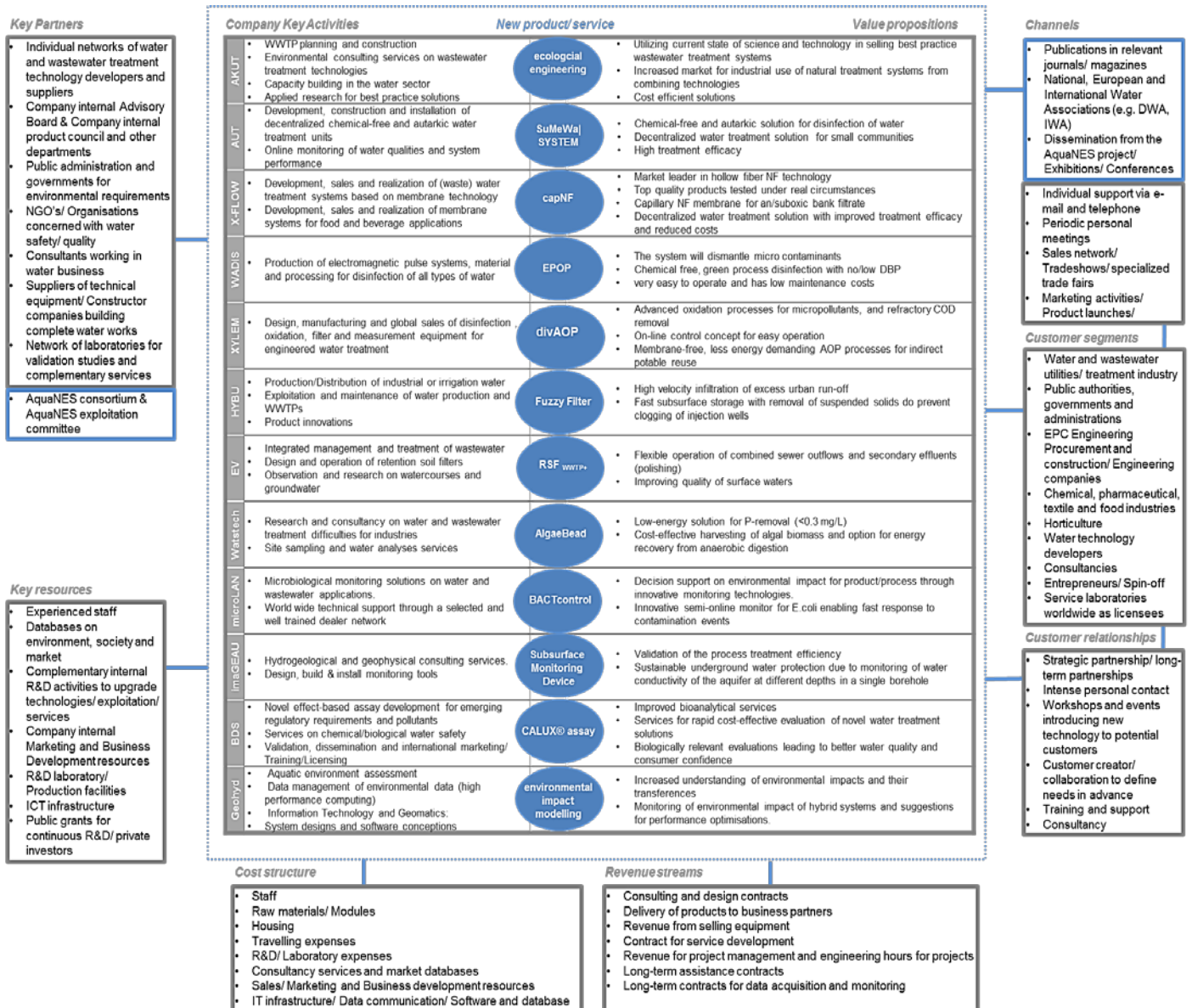


Figure 4 Summarized business model canvas of AquaNES commercial partners. *Explanation:* A range of company internal categories (i.e. key resources, cost structure and key partners) form the basis to create and deliver value ('value propositions') to different customer segments and thereby generate a profit (revenue stream) from a 'new product/service'.

Table 5 Draft exploitation plans for capillary NF membrane in combination with BF (WP1)

WP/ innovation name	WP 1/ NF-WellCare
Key exploitable results	<p>New type of optimised capillary nanofiltration (NF) membrane as pre-treatment for an-/ suboxic bank filtration</p> <p><u>Treatment targets:</u> Biologically active bank filtration in combination with membrane filtration provide excellent product quality also with respect micropollutants and undesired inorganic constituents</p> <p><u>Development stage:</u> The relatively open capillary hollow fibre NF (HFNF) type HFW1000 is commercially available and applied in treating surface water for drinking water production. The experiences with the development and production of the HFW1000 is the basis for a more tight and optimised HFNF for BF and applications</p> <p><u>Differences from competing product (Value propositions):</u> hollow fibre NF (HFNF) has fewer tendencies for fouling than spiral wound NF (SWNF) and furthermore can be cleaned using chlorine. Applications that were not viable up till now, become economical viable.</p>
Innovation and Exploitation Team	<p>KWB, BWB, Pentair. Pentair (X-Flow) has gained exploit experiences from the FP7 LbLBRANE project to develop and produce the HFW1000 HFNF membrane on commercial scale. The HFW1000 is sold for full scale drinking water plants at the moment. It is expected that the optimised HFNF membrane in this project will be available for commercial applications before the end of the AquaNES project.</p>
Expected key areas of application & customer segments	<p>Commercial application in drinking water sector as decentralized water treatment solution with improved treatment efficiency and reduced costs. Industrial applications for optimized water reuse and further reduction of the water footprint.</p>
Market	<p><u>Trend/driver:</u> Stricter requirements for product quality and consumer perception, emerging international markets</p> <p>Market: EU, US, East Asia Pacific</p> <p>Size: Global market of NF was 400 million \$ (360 million Euro) (Frost & Sullivan, 2010). Newest figures estimate a NF market share of \$445.1 million in 2019 with five-year compound growth rate of 15% (GWI, 2014). Membranes for water and wastewater treatment represent the largest share of the market (\$338 million in 2019) primarily driven by sales of NF membranes for water softening, desalination, and wastewater treatment.</p> <p><u>Main competitors and competitive advantage:</u> X-Flow (Netherlands), GE Water (USA), Siemens (Germany), Asahi Kasei (Japan), Hyflux (Singapore) and Kubota (Japan) are top producers of membrane filtration technologies (92% of market share in 2010). X-Flow's HFW1000 is an innovative, chlorine-tolerant NF module widely used in the production of process and potable water. . The tighter NF-membrane developed in this research will also be of interest for industrial applications. Its much smaller tendency for fouling in combination with its high chemical resistance opens possibilities for applications that were not economical viable up till now. HFNF is a one-step solution and therefore favourable compared to other technologies such as SWNF which requires pre-treatment including coagulant dosing and sludge processing. In remote areas and in situations where no continuous attendance of operators is available, HFNF is often the only robust option. The expected market share for the tighter NF-membrane comprises a yearly turnover of 6-7 million € within five years.</p>
Financial projections	<p>The project will speed up the market introduction of the existing NF membrane. Beside this 1 or 2 new membrane types shall move to the market. Expected additional turnover till 2020 will be 10 Mio €. After 2020 a yearly turn over around 6-7 million € is expected. The payback of the tighter membrane development is expected in the second year after its introduction in the market during the project.</p>
Dissemination and Communication actions	<ul style="list-style-type: none"> • Collaboration with local water supplier/works • Specialized trade fares (e.g. IFAT, Aquatech, Wasser Berlin)
Commercialisation roadmap/ exploitation routes	<ul style="list-style-type: none"> • Demonstrate performance and cost effectiveness in pilot trials. Use results for paper publication • Establish benchmark NF site to current practice. • Obtain the required certifications for drinking water applications. • Process optimisation for full scale applications. • Direct commercialisation and production
Risk assessment	<p>Low risk since market ready NF membrane is used, sustainable permeat flux levels and cleaning protocols need to be confirmed ,</p>
IPR management	<p>NF-membrane licensed by Pentair</p>

Table 6 Draft exploitation plan for inline electrolysis in combination with BF (WP1)

WP/ innovation name	WP 1/ SuMeWa BF
Key exploitable results	<p><u>Description:</u> Market-ready coupling of BF with small and large scale on-site electro-chlorination (inline electrolysis) modules for disinfection</p> <p><u>Treatment targets:</u> Oxidation and disinfection</p> <p><u>Development stage:</u> System Adaption and demonstration</p> <p><u>Differences from competing product (Value propositions):</u> Autarkic and robust system, high reliability, flexibility and monitoring options. Decentralized water treatment solution, improved treatment efficacy</p>
Innovation and Exploitation Team	<p>AUT, UJS, HTWD, EJC: UJS is a water utility with excellent performance in India and received various awards for improving drinking water supply by innovative solutions; AUT has many international projects for groundwater disinfection and will expand to couple BF and its systems</p>
Expected key areas of application & customer segments	<p>Commercial application in drinking water sector. Thousands of small villages in remote areas with difficulties in ensuring storage of chemicals for disinfection, access for maintenance staff. Also application for removal of arsenic possible (on-going other project). Large scale application at wells with high production rates affected by flooding and emergency relief.</p>
Market	<p>Decentralized off grid drinking water supply:</p> <p><u>Trend/driver- Legislation:</u> Drinking water regulations and sustainable development goals tend to more stringent guideline values for organic micro pollutants and pathogens in Europe. Given standards are not met in most developing regions. Worldwide nearly 700 million people have no access to improved water sources. 79 % of such live in rural areas (WHO, 2015). The number of people without access to water, that meets the given guidelines is expected to be by far higher.</p> <p>Progressive water safety improvement</p> <p>Most recent improvements of water supply in rural areas has been achieved by drilling new wells or the supply of water by tankers. However, no reliable decentralized technology for water treatment in these regions is available. Thus people have to drink unsafe or buy bottled water. Thus there is a stringent need and demand for decentralized, reliable, small scale and easy-to-maintain water treatment solutions that meet the drinking water regulations. BF substantially reduces treatment requirements to achieve drinking water quality and thus costs and maintenance efforts. After BF generally only residual disinfection is required as treatment step in order to achieve drinking water quality. Only in special incidents further treatment is required. The coupling of BF with on-site electro-chlorination poses an optimal treatment combination for off grid drinking water supply. Electro-chlorination is energetically highly efficient and can be run solely on solar PV basis, and thus completely independent on existing infrastructures.</p> <p>Market:</p> <p>Asia, Africa, South America</p> <p>The planned development of SuMeWa BF units is expected to establish a new reliable and robust drinking water treatment alternative for remote developing regions.</p> <p><u>Size:</u> Currently, SuMeWa units can supply up to 500 people with safe water where each person would have 20 L/d of drinking water available. In combination with BF it is expected that the capacity can be doubled without additional component costs. Assuming 500 million people, that are living in remote areas close to open water bodies and that are consuming water that does not meet the quality criteria leads to a theoretical potential market of 500.000 SuMeWa BF units worldwide.</p> <p>Next to Asia AUTARCON plans to expand its sales also to Africa and South America where perennial rivers can be used. Currently, AUTARCON systems are only applied for deep wells in Africa which requires complex and costly pre-treatment.</p> <p>Main competitors and competitive advantage:</p> <p>Chinese companies offering low-cost water filtration units coupled with chemical disinfection. Even Reverse Osmosis Systems have become affordable. However, due to technical complexity their application in remote developing off grid regions is not possible. Advantage of SuMeWa BF is robustness and autarkic operation using photovoltaic modules. Transport, storage and dosing of chemicals will never be required reducing sources of failure of common systems.</p> <p>Europe:</p>

	<p>In Europe and other developed areas the application of SuMeWa technology has the following focus: Protection from legionella in water facilities In Europe the market for decentralized protection from legionella in water distribution and supply facilities is increasing. Wastewater Reuse in Mediterranean region: The interest in the reuse of treated wastewater is constantly growing. Driving factors are increased demand and reduced availability of water. The SuMeWa technology has the capacity to disinfect treated grey- and wastewaters that permit their reuse in agriculture (irrigation), industrial (Cooling), and inter-urban as well domestic applications (cleaning, park irrigation and toilet flushing) and thus directly substituting fresh water resources.</p>																																																									
<p>Financial projections</p>	<p>The Asian market is especially price sensitive and generally takes more time to achieve satisfying sales. AUTARCON plans to sell 20 units in Asia by the end of 2020. Significant increase is expected after 5 years of successful technology demonstration, based on needs for improving water supply and disinfection stated by Indian government. Between 2020 and 2025 sales are expected to reach 100 units per year with an annual turnover of one million Euro alone in Asia. AUTARCON plans to hire new employees in the field of engineering and production. Currently, all components are manufactured in Germany and further reduction of costs is urgently necessary. With further standardization some components can be outsourced and substantial cost reductions are expected. The planned investment costs for one unit are expected to be in the range between 10.000 and 15.000 € per unit. For a brief economic evaluation, the investment, operation and maintenance cost for one unit are given in the table below.</p> <table border="1"> <thead> <tr> <th>Cost</th> <th>Euro</th> <th>INR</th> </tr> </thead> <tbody> <tr> <td>SuMeWa BF (target costs)</td> <td>12.500 €</td> <td>900.000 INR</td> </tr> <tr> <td>Batteries</td> <td>1.000 €</td> <td>72.000 INR</td> </tr> <tr> <td>Solar Panels</td> <td>1.500 €</td> <td>108.000 INR</td> </tr> <tr> <td>Infrastructure/Pipes/Pump/Well etc.</td> <td>2.500 €</td> <td>180.000 INR</td> </tr> <tr> <td>Amount</td> <td>17.500 €</td> <td>1.260.000 INR</td> </tr> <tr> <td>Tax</td> <td>1.225 €</td> <td>88.200 INR</td> </tr> <tr> <td>Sum</td> <td>18.725 €</td> <td>1.348.200 INR</td> </tr> <tr> <td colspan="3">Annual running costs</td> </tr> <tr> <td>Maintenance / Operation</td> <td>100 €</td> <td>7.200 INR</td> </tr> <tr> <td>Spare parts (mainly batteries)</td> <td>700 €</td> <td>50.400 INR</td> </tr> <tr> <td>Annual costs [€/a]</td> <td>3.225 €</td> <td>232.198 INR</td> </tr> <tr> <td colspan="3">Production capacity</td> </tr> <tr> <td>Daily produced quantity of water [L/d]*</td> <td>20.000 L/d</td> <td>20.000 L/d</td> </tr> <tr> <td>Yearly produced quantity of water [L/a]</td> <td>7.300.000 L/a</td> <td>7.300.000 L/a</td> </tr> <tr> <td>Price per liter of water [€/L]</td> <td>0,0004 € /L</td> <td>0,032 INR/L</td> </tr> <tr> <td>Price per liter of water [€cent/L]</td> <td>0,044 € cent/</td> <td>3,18 Païse</td> </tr> <tr> <td>Price per 20 L jerrycan</td> <td>0,009 €</td> <td>0,64 INR</td> </tr> <tr> <td>Price per m³ of water [€/m³]</td> <td>0,44 €/m³</td> <td>31,81 INR/m</td> </tr> </tbody> </table> <p>Based on AUTARCON data, an interest rate of 5 % and a amortization period 10 years * estimated values</p> <p>These numbers show that the drinking water costs per capita (20 L/day*cap) is less than on 1 Eurocent per day. If cost for water treatment is passed on to the consumers a large variety of investment mechanisms can be considered (e.g. public private partnerships) facilitating implementation and speeding up sales.</p>	Cost	Euro	INR	SuMeWa BF (target costs)	12.500 €	900.000 INR	Batteries	1.000 €	72.000 INR	Solar Panels	1.500 €	108.000 INR	Infrastructure/Pipes/Pump/Well etc.	2.500 €	180.000 INR	Amount	17.500 €	1.260.000 INR	Tax	1.225 €	88.200 INR	Sum	18.725 €	1.348.200 INR	Annual running costs			Maintenance / Operation	100 €	7.200 INR	Spare parts (mainly batteries)	700 €	50.400 INR	Annual costs [€/a]	3.225 €	232.198 INR	Production capacity			Daily produced quantity of water [L/d]*	20.000 L/d	20.000 L/d	Yearly produced quantity of water [L/a]	7.300.000 L/a	7.300.000 L/a	Price per liter of water [€/L]	0,0004 € /L	0,032 INR/L	Price per liter of water [€cent/L]	0,044 € cent/	3,18 Païse	Price per 20 L jerrycan	0,009 €	0,64 INR	Price per m³ of water [€/m³]	0,44 €/m³	31,81 INR/m
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<p>Dissemination and Communication actions</p>	<ul style="list-style-type: none"> • Training courses in India to promote European monitoring equipment and dis-infection modules • Collaboration with local water supplier/works via UJS • Specialized trade fares (AQUATECH India 2017, 2019) • Workshops at IIT Roorkee and UJS office Dehradun 																																																									
<p>Commercialisation roadmap/ exploitation routes</p>	<ul style="list-style-type: none"> • Demonstration of on-site chlorine production performance, pathogen removal capabilities and robust and cost effective operation with low maintenance, which is especially important for small-scale application in remote areas in Asia. • Benchmark to current practise. • Demonstrate benefits during extreme events such as floods. 																																																									

	<ul style="list-style-type: none"> • Preparing maintenance and operation handbook with symbols and translation into Hindi. • Use results of demonstration actions for discussions on potential implementation of combined SuMeWa BF into production • Direct commercialisation and production of SuMeWa System
Risk assessment	None, if market ready on-site electro-chlorination modules will be used for application, low demonstration risk if UF and electro-chlorination are combined into one module by AUT and power supply is not reliable at pilot site to demonstrate continuous operation performance.
IPR management	SuMeWa is licensed by AUT. IPR for combined system will be regulated in cooperation contract

Table 7 Draft exploitation plan for advanced oxidation processes in combination with MAR/SAT as an indirect potable reuse scheme (WP2)

WP/ innovation name	WP 2/ AOP+SAT for InPR
Key exploitable results	<p><u>Description:</u> Membrane-free, less energy demanding indirect potable reuse scheme on the basis of advanced oxidation processes (Ozonation/ recirculated ozonation/ UV+H₂O₂) as pre-treatment in MAR/SAT.</p> <p><u>Treatment targets:</u> DOC, micropollutants, pathogens up to Israeli and EU drinking water standards for Indirect Potable Reuse (InPR).</p> <p><u>Development stage:</u> Single treatment processes are well known. The development goal is to combine and integrate these in an overall process train, to understand the synergistic effects and get a more value added process.</p> <p><u>Differences from competing product (Value propositions):</u> The use of the natural barrier downstream the AOP process instead of technical filter solutions (such as UF/RO) should allow for a lower energy demand of the full process, higher process stability due to better hydraulic buffering and longer retention times at even higher elimination rates for pollutants than achieved with technical filtration.</p>
Innovation and Exploitation Team	MEK (Water utility) has a good international reputation for obtaining tenders and implements easy solutions for water production, supply and reuse; XYLEM: Leading manufacturer of non-chemical treatment of water, heavily engaged in the designing of AOP treatment concepts.
Expected key areas of application & customer segments	Commercial application in water-scarce countries with the need to further reuse the effluents of municipal wastewater plants. <u>Customer segments:</u> wastewater treatment facilities, water supply facilities, consultants in water business, contractors in water business, solution provider companies in targeted markets
Market	<p><u>Trend/Driver:</u> Climate change, scarcity of water resources</p> <p><u>Market:</u> Water scarce and water stressed countries like South Europe (Portugal, Spain, South France, South Italy, Greece), Middle and Far East countries, Australia, South America, South USA, Africa</p> <p><u>Size:</u> Global markets for wastewater recycling and reuse are expected to increase from \$9.5 billion in 2012 to \$23.4 billion in 2017, reflecting a five-year CAGR of 19.7% (GWI, 2014). Looking at different regions Asia/ Australia have the highest portion followed by US then Middle East and Europe.</p> <p><u>Main competitors and competitive advantage:</u> The current "gold standard" for DPR and InPR uses energy intensive and costly UF & RO processes. The combination of Ozone / AOP oxidation with natural soil treatment can reduce OPEX and CAPEX by more than 50% and thus is an attractive alternative to membrane based processes for reusing water. Also it saves brine production, being a much "greener" process (less CO₂ footprint and no brine).</p>
Financial projections	<p>30 Mio € through 5 years is expected minimum. The generated revenue will increase during each year and sum up after 5 years with 30M Euro. As these are typically projects with a longer lead time (tender phase) we assume to have 0 revenue in the first year – then starting revenue in the second year – and increased revenue in years 3 – 4 – 5 . With these estimations we believe that we can get the return of our investment (money we spend in the AquaNES project) in the third year. So our estimated ROI < 3 years.</p> <p>The expected turn-over is a more conservative figure taking into account that we are focusing on only a part of the global wastewater reuse market and we expect a certain time delay in acceptance of new solutions and a slower start up curve for sales. The overall global market potential is bigger.</p>
Dissemination and Communica-	<ul style="list-style-type: none"> • Workshop/training and conferences: Promote scheme of InPR at WATEC Israel (2017) among health authorities; IWA Specialist Conference on Wetland Systems for Water Pollution Control (2016, Poland or 2018, tbd) • Design and marketing recommendations for combining constructed wetlands with engineered systems

tion actions	<ul style="list-style-type: none"> • Use results of demonstration activities for paper publication
Commercialisation roadmap/ exploitation routes	<ul style="list-style-type: none"> • Successful demonstration of the combined technical and natural process is a mandatory enabler to achieve acceptance of water authorities and market the solution to new drinking water treatment export markets still utilizing chlorine based oxidation. • Demonstration of treatment results and benchmarking of achieved water qualities and treatment costs to current state IPR and DPR schemes. • Proof of acceptance by end-users. • Possible implementation into production
Risk assessment	Ozonation can impose health and safety risks during operation (low-medium risks). Health and Safety management which follows local legislation has to be implemented.
IPR management	Ozone + UV units are licensed by Xylem. IPR for combined system will be regulated in cooperation contract.

2.2.2 IPR and Knowledge Management

The AquaNES Intellectual Property Right (IPR) and Knowledge Management strategy will be defined in the Consortium Agreement (CA), which will follow the DESCA Horizon2020 model and will be signed by the partners prior to signing the grant agreement. The CA will set down the basic rules covering the sharing of information and ideas, the rights of each partner for exploiting their intellectual property, the ownership of know-how and the rules for access to IPRs generated during the project. Most AquaNES innovation results involve commercially exploitable technologies, products or services suitable for direct commercialisation or potential implementation on the market (Figure 5). AquaNES CA respects the individual commercial interests of the project partners and their intellectual property rights on all pre-existing items that are used during the project period. All related matter to IPR will pass through an IPR advisor which checks patentable contents of innovations and supports partners in protecting their innovations by providing information and contacts to responsible authorities (see section 3.2 ‘Management structure and procedures’). Aligned with the CA is a commitment of the partners to provide open access to all peer-reviewed scientific publications of demonstration and validation results of cNES under a ‘green’ open access or ‘gold’ open access scheme. Before any dissemination activity (publication, presentation) the AquaNES Dissemination manager ensures that the intended dissemination of innovation results will not jeopardize the potential protection of generated IP (e.g., patent, product design). A detailed dissemination plan, including peer-reviewed publications, will be agreed upon during the first months and constantly updated during project execution.

WP6 will set up a knowledge depository as an AquaNES internal platform integrating several developed tools and approaches which are being tested in WP1-WP5 and test results ultimately feed-back into the Decisions Support System (DSS) for different stakeholders (i.e., engineering consultants, planning departments of water utilities). Some of the tools included in the DSS are subject to IP and not freely available (e.g., ICT modelling software of Geohyd). Efforts are undertaken to guarantee a free-of-charge access and use of the DSS by developing and implementing free-ware, light versions of the programmes and tools with restricted access.

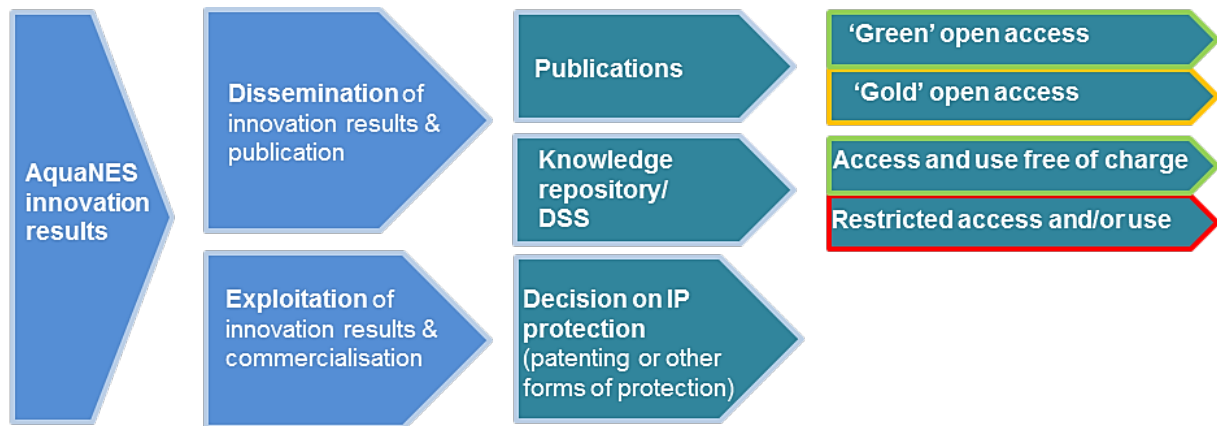


Figure 5 AquaNES IPR and Knowledge Management

Data management:

As noted above, one of our project objectives is improve the confidence with which water service providers are able to specify, design, and implement combined natural and engineered water treatment systems. The project's success is therefore contingent on the precision and accuracy of data collected through field trials etc. We will be generating new datasets and developing new insights from existing data sources. A key challenge is therefore to ensure the impartiality and accuracy of any data collected as data can become biased towards an individual or organisation's objectives and secondary data may be misinterpreted if it was collected for a different purpose. To mitigate these weaknesses we will triangulate between sources where possible, and look for result confirmation across different data / information sources. So as to hard-wire data quality management into the project's day-to-day activities we will appoint a senior member of the Project Management Board (PMB) to act as a Data Quality Invigilator with a remit to maintain a watching brief on data quality and data management issues. In addition, data quality and management will be a standing agenda item at meetings of the PMB.

The AquaNES consortium wishes to opt out of the open research data pilot. Data and information acquired during demonstration/testing will be used for dedicated exploitation of the technologies/innovations. It will key in identifying the unique advantages of our approaches and major asset in the AquaNES DSS.

2.2.3 Dissemination and communication

Whilst our technical activities will be demonstrating the benefits and feasibility of various technology lines in cNES including the tools to monitor them, our dissemination efforts will ensure that these approaches are more widely recognised, understood, and positively perceived. Our dissemination and communication activities support the exploitation ambitions of the partners and have been designed to engage, inform, and interact. Insights gained during the market analysis and business model generation will help to shape the dissemination strategy. Based on these findings we will actively address what was identified as barriers or risks to exploitation and will

- communicate with relevant stakeholders and user groups in dedicated workshops (e.g. EiP Water events)
- enhance the credibility of demonstrated benefits by scientific publications (journal papers and conferences)
- train engineering consultants and planning departments of water utilities in the use of the DSP and other AquaNES tools
- target technology markets (fairs & exhibitions)
- address national/regional markets (fairs & exhibitions with local support of AquaNES partner WATEC Israel, WasserBerlin (KWB))
- showcase demonstration sites as good practice and successful implementation examples in regional workshops (GR, IL)
- Organize training courses in India to promote European monitoring equipment and disinfection modules

Precise activities will be described in the Plan for Dissemination and Exploitation and are exemplified in the WP7 description

It is assumed that barriers are not only or not necessarily technical. An explicit ambition of AquaNES activities is to improve our understanding of how **consumers understand, value, and trust different forms of treatment processes**. In doing so, we will be informing the rich debate around the social and economic value of water. Outputs from WP5 on these issues will be targeted at relevant scientific and practitioner communities.

Our dissemination and communication activities will be adjusted and anchored to ongoing environmental debates and related events, such as public consultations and workshops (water framework directive implementation, discussion on CSO, circular economy). **Communication measures** will be chosen carefully for individual target groups and defined purposes. Overall we will make use of

- classical online and social media (website, webinars)
- print (project flyer, technology/marketing brochures)
- audio (video)
- face-to-face events (training workshops, conferences, exhibitions/fairs)

An overview of major tools, their application and purpose are listed in Table 8.

Table 8 Initial list of target groups and communication purpose and measures

	Target group, audience	User needs (selection) Relevant topics	Potential dissemination event Communication tool measure
Commercial	Industrial Engineering, Procurement and Construction (EPC)	Information about achievable quality levels and related limitations of combined natural and engineered water treatment systems (cNES)	Publications at conferences and industry events
	Water treatment equipment manufacturers	Information about technology availability and quality Proven application cases of cNES	Presentation at industry events, and at WWT's (Annual Water Industry Technology Innovation Conference)
	Water utilities and municipalities	Economic, environmental and legal feasibility of the solutions, Promotion of the AquaNES DSS and individual tools	Dedicated Training Workshops
Policy making, Environment	Policy makers: European Commission; Local Authorities & National regulatory entities Regional Public Bodies (to be defined)	Guidance on effective policy options. Insights into technical feasibilities. Awareness regarding policy conflicts from a technical perspective	Policy briefs, involvement in relevant stakeholder consultations
Investment	Investors: Angel Investors; Peer-To-Peer; Lending; Venture Capitalists; Banks	Profitability of the investment. Feasibility of the system: legal and economic.	Commercial brochures and specific presentations and B2B meetings
Setting standards	(National) Water Associations / Technical Associations (DWA, DVGW)	Feedback on standards implementation	Exchange of specific information in events, B2B meetings
Skills & educational training	End-users, engineering consultants	Familiarisation with technical performance and specifics Support placing the technology/approach in the market	Provide / develop Training modules as part of customer relationship
Social	General Public	Concerns about general health, safety and environmental issues. Limited understanding about home water treatment systems.	Website (downloads, video) Social media Open-door days
Research	Scientific peer-group; Applied researchers; industrial R&D Dept.	Advanced beyond the state of the art and technology establishment and performance.	Scientific conferences
	Consortia from other funded projects	Create synergies and promote the impact of the project.	Joint events: conferences, seminars,

3 Implementation

3.1 Work plan- Work packages

3.1.1 Overall structure of the work plan

The project distinguishes three levels of activities to which the individual work packages are assigned (see Figure 6):

1. Demonstration of individual AquaNES innovations in the demonstration sites as shown in Table 1.
2. Innovative technology assessment considering both process performance and water quality aspects as well as interfaces with the environment and the society (e.g. ecosystem service valuation). Output from work at these levels will inform the
3. Technology exploitation: this encompasses the development of business models and plans for individual innovations but also integrates results and knowledge gained in the other work packages for decision support in scheme planning and assessment..

The technical demonstration of cNES will be addressed by three work packages, one for each type of natural treatment systems, bank filtration (WP1), MAR/SAT (WP2), constructed wetlands (WP3). cNES feasibility for full-scale implementation will be judged principally on the ability of the system to achieve throughput and quality targets. A dedicated work package (WP4) will address the framework of monitoring and modelling of water quality under varying conditions of use as well as user-friendly approaches to handle large data sets. The risks associated with failures to meet target specifications for a specific use will be evaluated as well. Furthermore, potential obstacles to market introduction situated at the interface of technology and society will be investigated in WP5, in particular regulatory constraints, economic competitiveness and consumer acceptance. Elements from WP4 and 5, and, indirectly, from WP1-3 will feed a suite of knowledge repository and decision support tools developed by WP6, allowing for the design of combined natural and engineered systems adapted to specific uses under specific local constraints. Such a tool is expected to greatly facilitate technological exploitation of combined natural and engineered systems addressed in WP7. Dissemination and communication to the broader stakeholder community will be handled by WP7. Project management including the project steering bodies will be implemented in WP8.

The work packages will produce a number of deliverables which form also the basis for exploitation and dissemination.

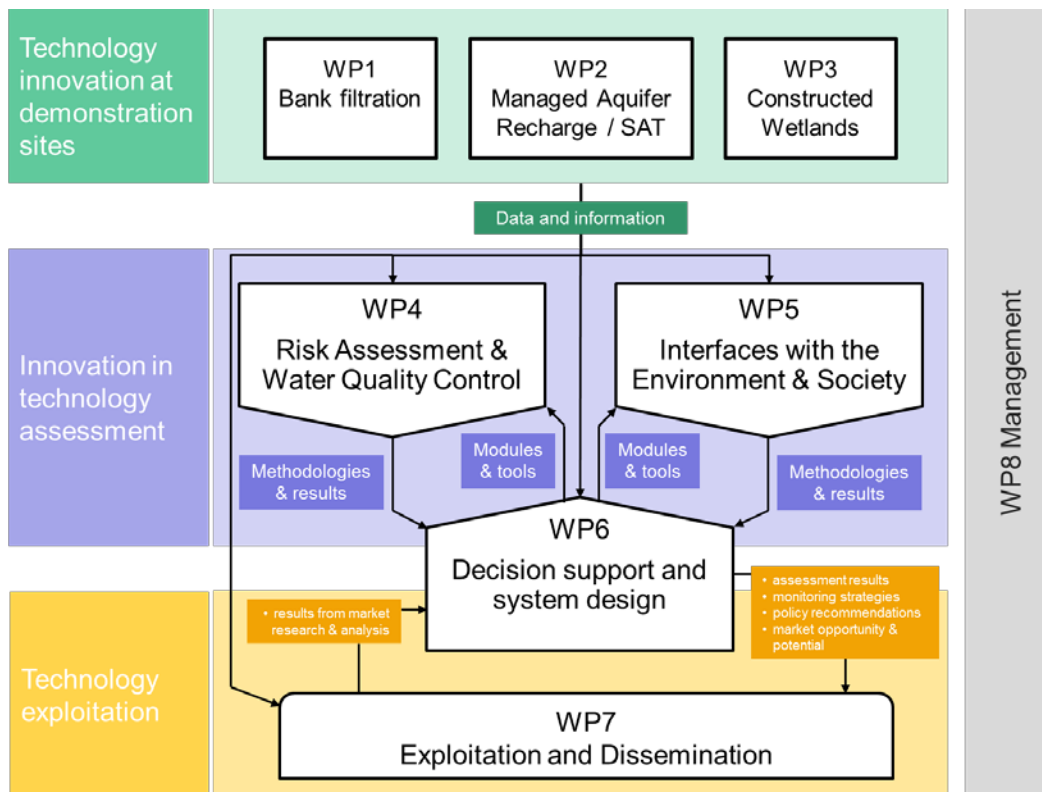
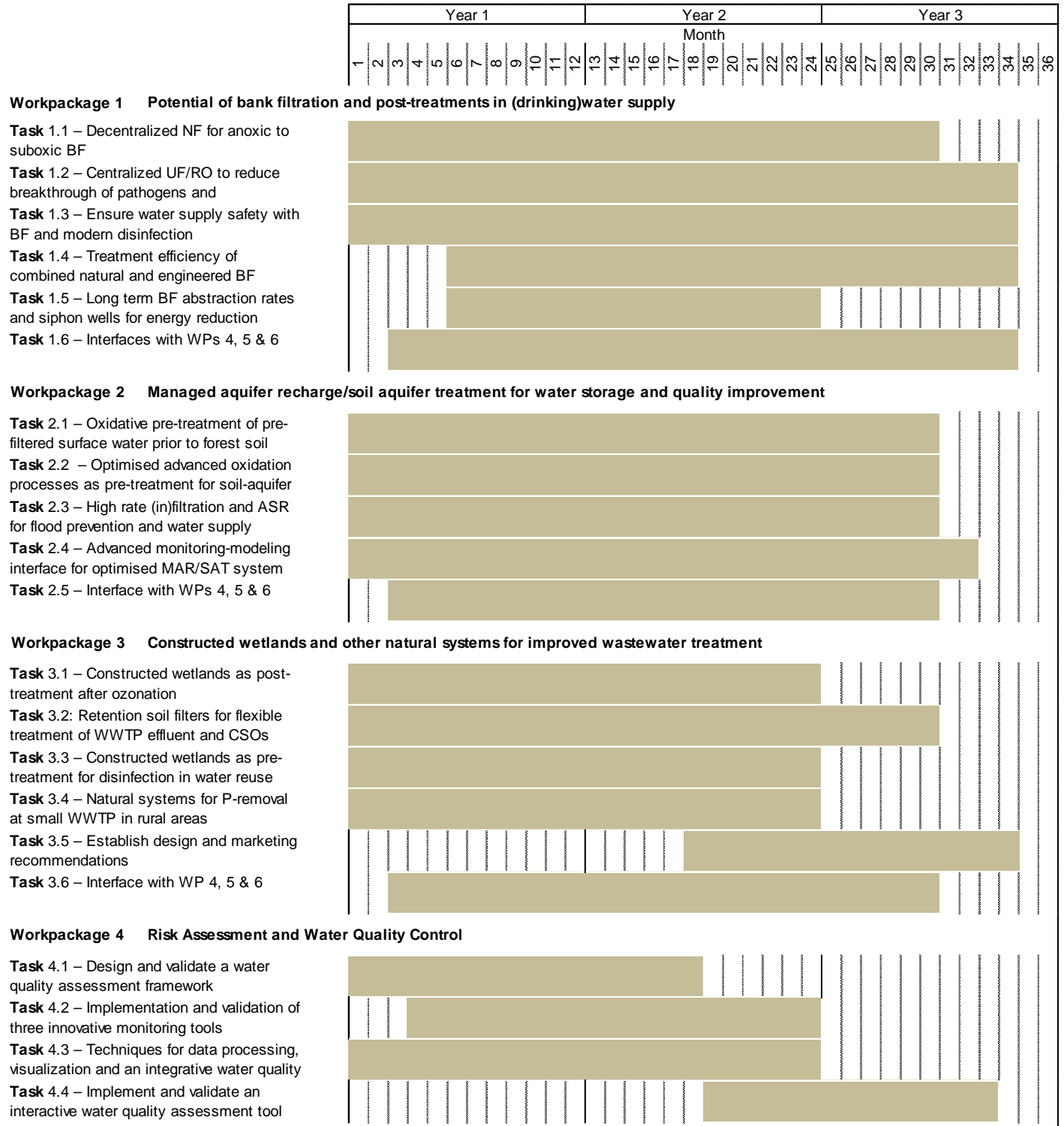


Figure 6 AquaNES project structure

3.1.2 Timing of the different work packages and their components (Gantt Chart)

Overall a three-year duration is foreseen for the project, which will allow a sufficiently long demonstration period in the demonstration sites (WP1-3) and a comprehensive assessment as well as an integration of data into a decision support structure allowing transfer of results. Exploitation and dissemination of results will be continuously supported and intensified towards the conclusion of the project. The timing of the different work packages and the included tasks in given in the GANTT chart below.



	Year 1												Year 2												Year 3											
	Month																																			
	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
Workpackage 5 Interfaces with the Environment & Society																																				
Task 5.1 – Characterising environmental interfaces																																				
Task 5.2 – Characterising policy and governance interfaces																																				
Task 5.3 – Characterising socio-economic interfaces																																				
Task 5.4 – Interfaces with other WPs																																				
Workpackage 6 Decision Support and System Design																																				
Task 6.1 – AquaNES Decision Framework and Knowledge Management System																																				
Task 6.2 – Integration of Decision Support Tools for the Uptake, Design, Assessment																																				
Task 6.3 – Knowledge Exploitation and Decision Support Reasoning System																																				
Task 6.4 – Implementation, Validation and Final Integration of the AquaNES DSS																																				
Workpackage 7 Exploitation and Dissemination																																				
Task 7.1 – Exploitation Plans for AquaNES innovations																																				
Task 7.2 – Dissemination Plan																																				
Task 7.3 – Project website, online media and print																																				
Task 7.4 – Outreach to markets, industry and stakeholders																																				
Workpackage 8 Management																																				
Task 8.1 – Project steering and decision making																																				
Task 8.2 – Project Coordination																																				
Task 8.3 – Implementation of Work & Progress Monitoring																																				
Task 8.4 – Contractual Reporting																																				
Task 8.5 – Risk Management																																				

3.2 Management structure and procedures

The AquaNES consortium comprises 30 partners and will be implemented in 13 demonstration sites in which numerous innovative processes and tools are being demonstrated or validated. The management structure is equally addressing the challenge to implement the planned work and demonstrate the innovation, as well as to create impact from these activities. These tasks will be brought about by the Project Management Board and an **Exploitation & Dissemination Committee**.

Innovation management will be facilitated by the scope and design of the Exploitation Strategy as described in Section 2.2 and WP7. Based on our technical demonstration activities in WP1-4 we will be able to characterise the improved products and their new fields of application. We will carry out a dedicated market analysis and observation of trends in the policy area. The Exploitation Plan and Dissemination Plan will identify and perform the required actions and interventions with stakeholders and end-users of the AquaNES innovations.

The project management structure as shown in Figure 7 is derived from best practices established in the management of Framework Projects and reflects both the specific needs of an Innovation Action and the large partnership. The coordinating team at FHNW (coordinator, project manager, project assistant) has more than 12 years of experience of managing large European projects (4 in FP6, 4 in FP7) in the area of water and environmental technology with a legacy of successful implementation and delivery of sound project outputs and has developed the management concept accordingly.

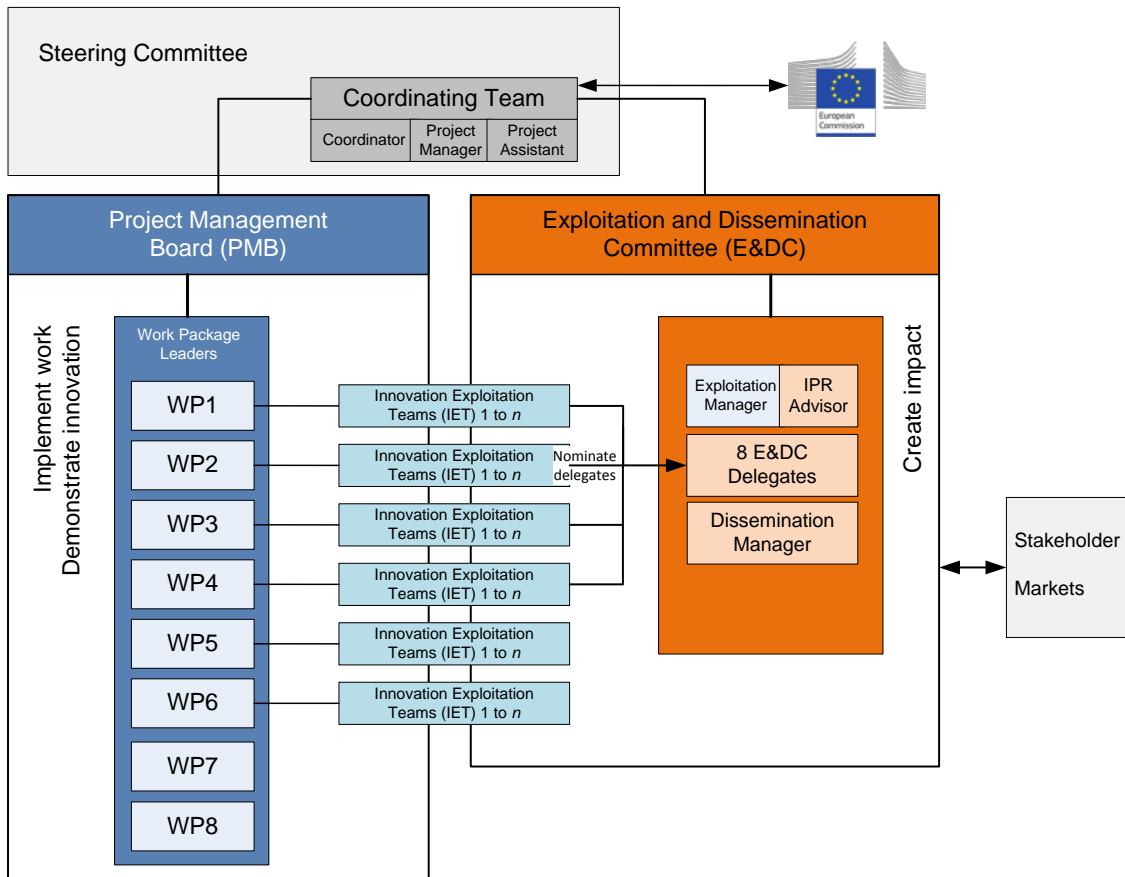


Figure 7 AquaNES project management structure

The composition and responsibilities of the different entities are explained below. Details on the rights and obligations and working procedures will be defined in the Consortium Agreement

Project Coordinating Team

The AquaNES project will be coordinated by the University of Applied Sciences and Arts Northwestern Switzerland. The project team has extensive project leading experience in FP5, FP6 and FP7. The Team will be responsible for all administrative and financial project work, communication within the consortium and towards the European Commission as also described in WP8.

Steering Committee (SC)

The steering Committee is the highest level decision taking entity in the consortium. It consists of one person per partner with the authority of making decisions on behalf of their institution. The tasks of the Steering Committee are:

- to define the overall project strategy
- to handle contractual matters (Grant Agreement amendments, extension of the consortium, termination of participants)
- to agree on the principles for resource allocation (consortium budget and payment schedules)
- to agree an intellectual property right related strategy

In order to facilitate decision making in such a large consortium, the SC will vote on major decisions by simple majority of the quorum. The details will be fixed in the Consortium Agreement

Project Management Board (PMB)

The PMB consists of the Work Package leader and is chaired by the Coordinator. It monitors the overall work progress based on milestones and deliverables, oversees the work within the work packages and facilitates relevant interfaces between the WPs. It will propose adjustment and means of remediation in case of deviation from the work plan or occurrence of any of the risks and contingencies identified in WT5 (List of critical implementation risks and mitigation actions). The PMB will also discuss and prepare decisions for all issues requiring a vote of the Steering Committee. In that respect the PMB will be responsible for preparation of conflict solving interventions. It will make decision by simple majority of the votes.

The PMB will meet regularly (bi-monthly) in web-conferences or at other project meetings to closely observe and exchange on the project implementation. Among the agenda items will be the risk register review, equality & diversity issues, appointing specific roles such as quality control (Data Quality Invigilator) or report editing and other item raised by the members.

Exploitation & Dissemination Committee (E&DC)

The Exploitation & Dissemination Committee will prepare for up-take of results and market entry of the demonstrated innovations. It will draft, develop and implement the Exploitation Plan. An IPR advisor will support partners in protecting their innovation where needed. He will inform the partners of knowledge protection issues, check patentable content of innovations and direct them to relevant national and international entities. The E&DC will consist of:

- Exploitation Manager (acting as chair of the ED&C and as IPR Advisor, staff of VTG)
- 8 ED&C delegates which are nominated by the different innovation exploitation teams of the demonstration sites. From each of the Work Packages 1 to 4, commercial partners, utilities and research partners will be delegated.
- the Dissemination Manager

For the exploitation part the E&DC will review the business plans, advice on marketing actions and shortlist technologies to be transferred to the ETV

For the dissemination part the E&DC will identify and coordinate suitable dissemination events and activities (participation in exhibitions, schedule training measures). The Dissemination Manager (Rita Hochstrat, FHNW) will be in charge of updating the Dissemination Plan.

In addition we will appoint a Gender Officer to inform about and promote gender aspects in the project and exploitation phase.

Meeting schedule

Bi-annually consortium meetings will be scheduled. In order to keep travel efforts low these events will host various side meetings allowing for

- in depth exchange of progress in the technical Work Packages (Work Package partners, 1 day)
- develop and agree on Exploitation and Dissemination issues (E&DC Meeting 0.25 day)
- share project development (Plenary Meeting, 0.5 day)
- review work progress (PMB meeting, 0.25 day)
- decide on issues requiring the vote of the Steering Committee (Steering committee, 0.1 day)

All partners have been allocated resources for participation in their respective budgets in the work packages they are mostly involved in.

The consortium will convene according to this tentative schedule:

Meeting	Frequency	Participants, type of meeting, location
Kick-off meeting	1	All partners
Full consortium meeting (incl. Steering Committee -SC meeting)	2 per year (2-3 days)	All partners Month, tentative hosting organisation and city M1- Kick-off - FHNW, Basel M6 - NTUA, Athens M12- KWR ,Nieuwegein M18 - mid-term Brussels M24 - BUWW, Budapest M30 - VTG, Nice M36 - KWB/BWB, Berlin
Exploitation & Dissemination Committee (E&DC) Meeting	2 per year	E&DC members, web conferences / during full consortium meetings
Work Package Meeting Innovation Exploitation Teams meeting	2 + 1 additional per year if need be	Work Package participants, IET (back-to-back meeting of several WPs)
PMB Meeting	6 per year	WP Leaders, web conferences and/or physical meetings during other events

3.3 Consortium as a whole

AquaNES consortium comprises high level academic partners and research institutes (9), SMEs (9) and industries (3) and (waste)water utilities (9) from eight different European countries and India, which are well balanced along a ‘technology innovation’ value chain (Figure 8). The roles and contributions of the different consortium entities are clearly defined and complementary: Our SME’s and industries provide existing pre- or post-treatment technologies, monitoring devices or software tools (see Table 3 and Table 4) which are integrated by water utilities in existing treatment schemes to demonstrate and validate the treatment efficacy of the combined system. The close collaboration with partnering water utilities will speed-up the deployment of successfully operating combined treatment processes. The integration and combination of natural and engineered elements is supported by water treatment designers/planners and knowledge providers which share their extensive experience in natural water systems and treatment methods in Europa, Asia and Africa. Given the big number of consortium partners and innovations, the demonstrated and validated AquaNES technologies, products and services are promoted in smaller ‘innovation exploitation teams’ which are collective partnerships of SME’s/industries reinforced by knowledge providing entities and/or water utilities. The innovation exploitation teams are further guided by a dedicated Exploitation & Dissemination Committee (E&DC) led by VTG with support of FHNW and the work package leaders. The E&DC further applies a targeted dissemination and communication strategy as outlined in Section 2.2, promoting combined natural and engineered systems in and outside Europe to achieve investments from diverse end users (e.g. water utilities, governmental water/environment authorities) and commercial success of SME’s treatment technologies, monitoring devices or software tools.

No additional partners are foreseen in the project. The AquaNES consortium will closely interact and collaborate with related WssTP Working groups and relevant EIP Action Groups of which AquaNES partners are members to ensure the awareness of the tested solutions. Individual partners hold close contacts or memberships in national technical organisation which will facilitate the constructive dialogue towards wider acceptance of this type of schemes.

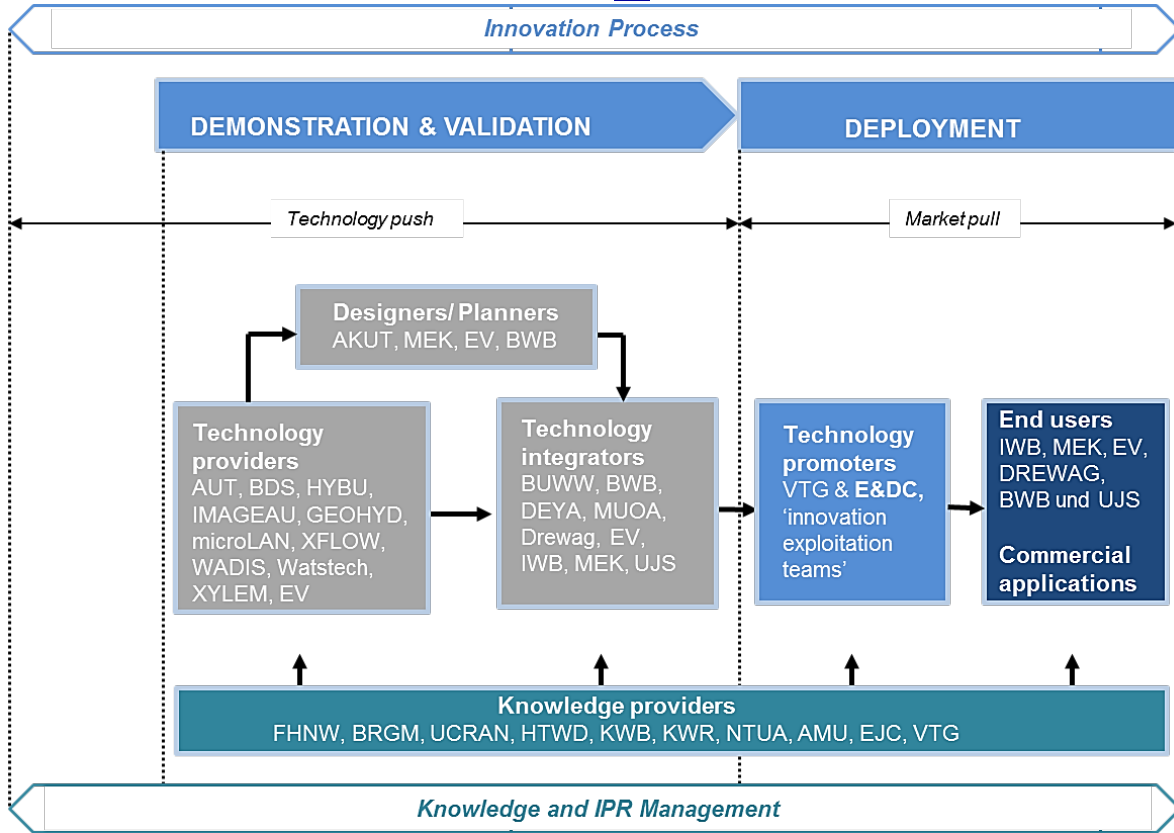


Figure 8 AquaNES consortium involved entities along technology development, demonstration and deployment value chain

There are partner from two third countries involved: Switzerland and India. The coordinating partner FHNW is from Switzerland and has both a large track record in leading European projects on natural and engineered water treatment systems (e.g. coordination of FP projects MINOTAURUS, Saph Pani and Actiwate). Switzerland has also an outstanding experience in utilising natural treatment components for water supply (e.g. the Lange Erlen scheme in Basel operated by consortium partner IWB, which is a unique scheme utilising forest soil for infiltration). The participation of an Indian partner is justified by the outstanding role of the Indian water market and builds on the close collaborations already developed during the successful Saph Pani project.

The consortium will comprise approx. 100 persons of staff of which 22% are women. Two of the work packages (WP2 & WP5) are led by female researchers. This comparatively low number is due to the fact that water and wastewater sector is a field with generally low female involvement. In order to strengthen the female participation in the project, women will be encouraged to apply for the new positions to be generated in the project.

Table 9 Role of partners (U= water utility, R=Research partner, S=SME, I=Industry, E=Engineering, T=Technology provider)

short name	Type*	Main role(s)	demonstration site
FHNW (CH)	R	Project coordinator and leader of WP8, dissemination manager (WP7) Performance assessment of pilot system in Basel CH (WP2)	WP2: Site No. 6
AKUT (DE)	S, E	Design, construction and maintenance of pilot system in Greece (WP3); Design and marketing recommendations for cNES in WP3/WP7	WP3: Site No. 10
AUT (DE)	S, T	Implementation and evaluating of solar-driven treatment unit (SuMeWa System) for disinfection in India (WP1)	WP1: Site No. 5
BDS (NL)	S, T	Implementation of bioassays (CALUX® assays) in demonstration sites of WP1-3 (two sides per WP). Development of tailored monitoring programmes.	Sites with AOP No. 4; 6; 7; 10; 12
HYBU (NL)	S, T, E	Designing, implementing and optimizing full scale system of high velocity infiltration filter (Fuzzy Filter) in Rotterdam NL (WP1).	WP2: Site No. 9
IMAGEAU (FR)	S, T	Design, build and install three Subsurface Monitoring Devices (SMD) for electrical conductivity monitoring in France (WP2)	WP2: Site No. 8
GEOHYD	I, T	Design and implementation of an ICT System for WP2; acquisition of data	WP2: Site No. 8

short name	Type*	Main role(s)	demonstration site
(FR)		from SMD and integration into centralized knowledge platform(WP6)	
microLAN (NL)	S, T	Monitoring microbiological contamination with BACTcontrol device in WP1-3. Tailoring monitoring strategies for cNES.	different sites in WP1-3
XFLOW (NL)	I, T	Operation and performance evaluation of two NF-pilot plants testing capillary NF membrane after bank filtration in Berlin DE (WP1).	WP1: Site No. 1
VTG (FR)	S	WP7 leader, Exploitation Manager and IPR Advisor, Environmental assessment (E-LCA, LCC, S-LCA) of cNES	-all sites-
WADIS (IL)	S, T	Demonstration of electric pulse oxidation system in WP2	WP2: Site No. 7
Watstech (UK)	S, T	Operation of pilot plants for P-Removal in Packington UK (WP3)	WP3: Site No. 13
XYLEM (DE)	I, T	Design and implementation of AOP pilot systems in IL and CH (WP2) and evaluation of results; Operation and evaluation of ozonation unit (WP3)	WP2: Site No. 6/7 WP3: Site No. 12
BUWW (HU)	U	Design, installation and operation of a RO-pilot scheme in Budapest HU (WP1). Demonstration of BF operation in combination with usage of Cl ₂	WP1: Site No. 3
BWB (DE)	U	Operation and regular monitoring of one demonstration site in WP1 and WP3 each (both in DE). Conducting of water quality analyses in WP3.	WP1: Site No. 1 WP3: Site No. 12
DEYAT & MUOA (GR)	U	Operation and maintenance of WWTP in Greece (WP3). Collection and data assessment of different demonstrated treatment technologies	WP3: Site No. 10
Drewag (DE)	U	Operation and maintenance of UF-pilot scheme in Dresden DE (WP1), coordination of testing methods, provision of performance and energy data	WP1: Site No. 2
EV (DE)	U, T	Operation, monitoring and evaluation of one demonstration site in DE (WP3). Implementation and assessment of new Retention Soil Filter (RSF _{WWTP+})	WP3: Site No. 11
IWB (CH)	U	Owner of demonstration site in Basel CH. Operation of pilot plant in WP2. Analytics of transformation products	WP2: Site No. 6
MEK (IL)	U	Operator and owner of demonstration site in Shafdan IL (WP2). Piloting and performance tests. Testing of water quality assessment framework (WP4)	WP2: Site No. 7
AMU (PL)	R	Operation and monitoring of demonstration site in Poznan PL (WP1). Assessment of travel times' impact on pollutant and pathogen removal	WP1: Site No.4
BRGM (FR)	R	Leader of WP 2. Validation of monitoring and process modelling at site in France (WP2). Characterization of policy and governance interface (WP5).	WP2: Site No. 8
UCRAN (UK)	R	Leader of WP5. Environmental, social and policy implications of cNES (will feed in WP7). Assessment of P-removal in Packington UK (WP3).	WP3: Site No. 13
HTWD (DE)	R	Leader of WP1. Site responsibility for site in Dresden DE (WP1). Contribution to assessment of site in India. Application of software tools(WP5/WP6).	WP1: Site No. 2 (Site No. 5)
EJC (HU)	R	Performance assessment of site in Budapest HU (WP1)	WP1: Site No. 3
KWB (DE)	R	Leader of WP3. Data interpretation, demonstration on effluent polishing effect of CWs. Pilot operation of site in Berlin DE (WP3). Demonstration on partial treatment of bank filtration and nanofiltration in Berlin DE (WP1). Application of software tools, providing data for (WP5/WP6).	WP3: Site No. 12; WP1: Site No. 1
KWR (NL)	R	Leader of WP4. Development of monitoring and risk assessment framework, coordination of monitoring in WP1-3. Operation and results evaluation of site in Rotterdam (WP2). Gaming tool for WP5.	WP2: Site No. 9
NTUA (GR)	R	Leader of WP6. Knowledge repository, AquaNES DSS. Coordination of Greek sites (WP3), Contribution in development of data processing and water quality reporting tool (WP4), LCA, LCC and S-LCA of cNES (WP5)	WP3: Site No. 10
UJS (IN)	U	Demonstration, operation and monitoring of site in Haridwar IN (WP1)	WP1: Site No. 5

3.4 Resources to be committed

The AquaNES consortium will dedicate considerable financial and human resources to the project as summarised in the Part A of this DoA and Figure 9 below. The major staff effort is allocated to technical work in the demonstration sites (in total around 60 %) and another 25 % for assessment with respect to water quality and environment and society as well as the elaboration of the AquaNES DSS. Activities in relation to Exploitation and Dissemination are to make up 10 % of the man-months. With respect to dissemination, this comprises only the efforts for the dedicated AquaNES specific actions and events mentioned in the WP7 description.

Management accounts for only 3 % of the person-months and is limited to the coordinator and work package leaders for their project management and WP management as described in WP8. In general, all partners have been allocated resources for reporting contributions and project meeting attendance within their budgets of the work packages they are most active in.

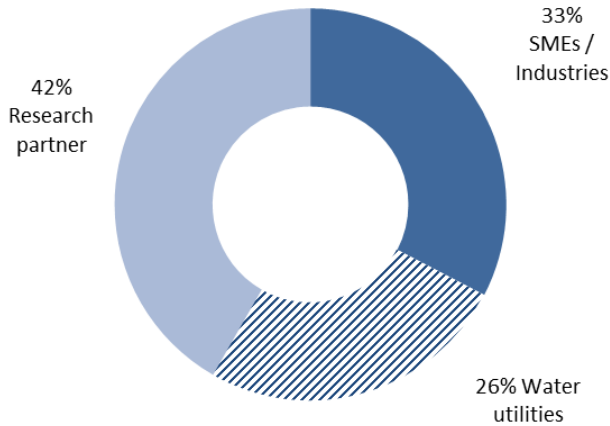


Figure 9 Distribution of requested EU funding among types of AquaNES partners

The activities are expected to incur about 10.7 million EUR of which 60 % is for personnel, but also expenditures for equipment and installation for our demonstration pilots and for consumables and analytical work are budgeted. Travel will be a relatively small budget.

SMEs, industry and water utilities will receive almost 60% of the requested funding. Research partners will support the innovation actions with 40 % of the total funding request (Figure 9).

Funding for participants FHNW and IWB from Switzerland, currently an Industrialized Third Country, will be provided directly by the Swiss Government through a national funding scheme specifically set up for participants in Horizon2020 projects. In H2020, 166 funding request to SERI with a total volume of 100 million CHF have been granted. The Indian partner will assure its small budget from national funding sources as well.

The allocation of resources per partner and activities in the individual work packages will be detailed during the first month of the project in order to facilitate project monitoring with respect to use of resources.

Table 10 'Other direct cost' items (travel, equipment, other goods and services Table 3.4b:)

2	AKUT	Cost(€)	Justification												
	Travel	7'400	Project consortium & technical meetings, dissemination events												
	Equipment	46'960	Assembly and delivery of containerised constructed wetland for demonstration at Berlin site no. 12 comprising: Containment, general equipment, piping , control system, machines, energy equipment												
	Other goods and services	4'800	Transportation of goods, safety inspections/certificates, conference fees												
	Total	59'160													
3	AUT	Cost(€)	Justification												
	Travel	22'600	Autarcon will be equipping and assessing the demonstration site in India for on-site electrolysis. 15'800 EUR for travel and stays in India (site selection, installation, follow-up and participation in technical fair. Site evaluation visit India (1 trip, 1 week) 1'500 EUR Installation (1 trip, 3 weeks) 3'500 EUR System checking and optimizing (3 trips ,2 weeks each: 3 x 2800 EUR = 8'400 EUR Marketing in Asia 1 trip, 2 persons 2'400 EUR, Rest for consortium and technical meetings												
	Equipment	3'000	Laboratory equipment for water quality monitoring in the field												
	Other goods and services	55'900	Technical components to be installed at site 5 in India for inline electrolysis demonstration.2 solardriven AO units (one reference unit in Kassel), Protection frame for system modularized for solar equipment and filtration, Solar energy supply (PV, Batteries, Charge controller), Pre-Filtration System (Zeolith based), UF Filtration modules for integration into system setting including control module 3 x, Data transfer unit, Substitute AO Cells 2 x, Tanks, Pipes, Fittings, Reagents for field test kits), transport of pilot plant, onsite plumber work to connect the decentral / inline electrolysis plant at household level. (53'000 EUR) Translations and publications Conference fees, fair exposition stand												
	Total	81'500													
4	BDS	Cost(€)	Justification												
	Travel	7'700	Project consortium and technical meetings, conferences												
	Equipment	-													
	Other goods and services	30'000	laboratory consumables for advanced ecotoxicological test (cell culture, media, extraction) 20'000 EUR sampling material (cartridges, vials) 2'800 EUR, approx. 10 sampling campaigns at each of 6 sites, 120 EUR per shipment: 7'200 EUR												
	Total	37'700													
5	HYBU	Cost(€)	Justification												
	Travel	4'200	Project consortium and technical meetings, site visits												
	Equipment	40'000	Tailored, flexible mobile pre-treatment system for processing infiltration water (housing of the mobile infiltration, treatment and monitoring unit and its connections/piping to the local infrastructure)												
			<table border="1"> <thead> <tr> <th>Capacity</th> <th>Eligible cost (EUR)</th> <th>Total cost (EUR)</th> <th>Depreciation period (months)</th> <th>Period of use (months)</th> <th>% used in the project</th> </tr> </thead> <tbody> <tr> <td></td> <td>40'000</td> <td>40'000</td> <td>24</td> <td>24</td> <td>100</td> </tr> </tbody> </table>	Capacity	Eligible cost (EUR)	Total cost (EUR)	Depreciation period (months)	Period of use (months)	% used in the project		40'000	40'000	24	24	100
Capacity	Eligible cost (EUR)	Total cost (EUR)	Depreciation period (months)	Period of use (months)	% used in the project										
	40'000	40'000	24	24	100										
	Other goods and services	-													
	Total	44'200													

6 IMAGEAU Cost (€) 6							
Travel	8'900	Project consortium and technical meetings, site visits					
Equipment	-						
Other goods and services	31'723	Auxillary parts for measuring set-up: 3 electric arrays with remote control and high resolution monitoring (SMD), preparation of site for equipment installation (electrical works)					
Total	40'623						
8 microLAN Cost (€) Justification							
Travel	26'400	microLAN will install its detection systems at 3 demonstration sites incurring travel for commissioning and maintenance. Further attendance to project and technical meetings, as well as conferences and dissemination events					
Equipment	21'600	Manufacturing of three BactControl systems for three demonstration sites including parts and cables, electronics, reaction chamber, pumps, valves, tubing, electrical cabinet, sampling devices.					
		Capacity	Eligible cost (EUR)	Total cost (EUR)	Depreciation period (months)	Period of use (months)	% used in the project
		NA	21'600	32'400	36	24	100
Other goods and services	46'500	Reagents, parts and accessories needed to operate the devices: Consumables and supplies, ecoli/coliform/entero reagents, cleaning solutions (21'500 EUR), various pumps and filters for site specific water applications (17'500 EUR), Conference fees (7'500 EUR)					
Total	94'500						
9 XFLOW Cost (€) Justification							
Travel	14'860	travelling from Enschede to Berlin for commissioning, site support, various project (consortium) meetings					
Equipment	220'000	Technical upgrading of two pilot plants for testing NF-membranes on site in Berlin Schönerlinde (no. 1) Assembly, technical upgrading and installation of two pilot plants for testing nanofiltration (NF)-membranes on site in Berlin; modification for crossflow NF-operation: high pressure pumps, piping in general, electrical cabinet, software, monitoring equipment					
		Capacity	Eligible cost (EUR)	Total cost (EUR)	Depreciation period (months)	Period of use (months)	% used in the project
		5 m ³ /h	220'000	220'000	24	24	100
Other goods and services	35'800	2 membrane modules (20'000 EUR) materials and chemicals for process optimization and membrane modification for improved operation (10'000) and sulphate removal (5'800)					
Total	270'660						
11 WADIS Cost (€) Justification							
Travel	6'500	Consortium and technical meetings					
Equipment	57'453	Electropulse oxidation system components High Voltage Rotating Switch, resistors, modules capacitors, control system, electro discharge chamber, electrode automatic feeding system pumps and pi-ping, body and housing					
Other goods and services	13'800	consumables for all pilot period for O & M of the system for 2 years operation of the pilot in the BAC -UF and SAT mode					
Total	77'753						
13 XYLEM Cost (€) Justification							
Travel	39'100	Technical meetings for pilot installation, start up and support at 3 sites (nos. 6, 7 and 12) located in Israel (5 visits,2 persons) Switzerland and Germany (ca. 6 trips), Consortium meetings					

Equipment	73'667	Durable Pilot equipment for 2 sites Israel (site no. 7): upgrade of existing ozone system (measurements, gas feedback loop, reaction system), on-line sensor equipment for ozone + biofilter system control (UV-VIS IQ Sensor Net, Ammonia, DO), on-line sensor equipment for SAT control (47'667 EUR) Switzerland (site no. 6); complete UV-AOP pilot system (26'000 EUR)					
		Capacity	Eligible cost (EUR)	Total cost (EUR)	Depreciation period (months)	Period of use (months)	% used in the project
		5 m ³ /h	47'667	110'000	60	26	100
		1-3 m ³ /h	26'000	60'000	60	26	100
Other goods and services	60'000	XYLEM equips and maintains ozonation or other advanced oxidation process technologies in 3 demonstration sites (Israel, Switzerland, Germany). For those a number of project specific piping, valves, fittings, pumps, reaction system, gas preparation, safety devices are required					
Total	172'767						
14 BUWW	Cost (€)	Justification					
Travel	14'500	project consortium and technical meetings, conferences					
Equipment	40'000	Dense membranes (RO) Pilot plant installation at Budapest (site no. 3),					
		Capacity	Eligible cost (EUR)	Total cost (EUR)	Depreciation period (months)	Period of use (months)	% used in the project
		0.3 m ³ /h	40'000	60'000	36	24	100
Other goods and services	10'100	chemicals, mechanical parts, replaceable elements during operational phase, conference fees (2 x), hosting of 1 consortium meeting					
Total	64'600						
15 BWB	Cost (€)	Justification					
Travel	12'200	Besides consortium and kick-off meetings, 3 technical meetings per WP (1/3/4) are planned, 3 conferences					
Equipment	-						
Other goods and services	80'000	Construction material to setup demo sites and connect pilot plants of the project partners to BWB infrastructure; piping, connection to power supply and automatization/ connection, smaller safety equipment parts Laboratory consumables for chemical and microbiological analyses (solvents, HPLC equipment (columns etc.), filter cartridges, solid phase extraction cartridges, standards, sample flasks, chemicals, disposable tubes, reaction tubes, specifically designed DNA primers, pipettes etc. conference fees (approx. 1.000 € each for IWA conferences); open access fees 1.500 € for publication of results; CFS is needed					
Total	92'200						
18 DREWAG	Cost (€)	Justification					
Travel	18'100	project consortium and technical meetings, conferences, demo site visits					
Equipment	64'000	Ultrafiltration pilot plant installation at BF site 2 in Dresden (tanks. pumps, modules)					
		Capacity	Eligible cost (EUR)	Total cost (EUR)	Depreciation period (months)	Period of use (months)	% used in the project
		m ³ /h	64'000	96'000	36	24	100
Other goods and services	9'671	chemicals, mechanical parts, replacable elements for the pilot plant in site 2; conference fees (2 x)					
Total	91'771						

19 EV	Cost (€)	Justification																																																
Travel	11'300	Regular project meetings are important for a successful project. Since the project consortium is international, travel costs are hence higher.																																																
Equipment	48'000	monitoring equipment, automatic sampler and sensor for full-scale demonstration site. 11: <ul style="list-style-type: none"> • Sampling system and equipment • Measuring sensors • Measurement and control technique <table border="1"> <thead> <tr> <th>Capacity</th> <th>Eligible cost (EUR)</th> <th>Total cost (EUR)</th> <th>Depreciation period (months)</th> <th>Period of use (months)</th> <th>% used in the project</th> </tr> </thead> <tbody> <tr> <td>240 m³/h</td> <td>33'500</td> <td>67'000</td> <td>60</td> <td>30</td> <td>100</td> </tr> <tr> <td></td> <td>8'500</td> <td>17'000</td> <td>60</td> <td>30</td> <td>100</td> </tr> <tr> <td></td> <td>6'000</td> <td>12'000</td> <td>60</td> <td>30</td> <td>100</td> </tr> </tbody> </table>	Capacity	Eligible cost (EUR)	Total cost (EUR)	Depreciation period (months)	Period of use (months)	% used in the project	240 m ³ /h	33'500	67'000	60	30	100		8'500	17'000	60	30	100		6'000	12'000	60	30	100																								
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Other goods and services	47'900	Costs for analytics, Conference fees Consumables for chemical analytics - bulk organics, heavy metals, micropollutants (sample containers, HPLC columns, GC columns, SPE cartridges, standards, helium, technical nitrogen, solvents, reagents, replacement parts GC and HPLC) 39'000 EUR, conference fees, translation, CFS																																																
Total	107'200																																																	
20 IWB	Cost (€)	Justification																																																
Travel	8'900	Project meeting attendance,																																																
Equipment	4'500	Pre-filtration unit																																																
Other goods and services	60'000	Material and chemicals, labwork, analytics (micropollutants - transformation products), Columns, pre-filtration unit, piping, samplers																																																
Total	73'400																																																	
21 MEK	Cost (€)	Justification																																																
Travel	15'800	Consortium and technical meetings																																																
Equipment	91'932	Upgrading existing pilot installation (biofilter, ozonator, BAC), costs are composed of depreciation of existing components and that of those newly added, all components for a set-up to treat 5 m ³ /h <table border="1"> <thead> <tr> <th>Capacity</th> <th>Eligible cost (EUR)</th> <th>Total cost (EUR)</th> <th>Depreciation period (months)</th> <th>Period of use (months)</th> <th>% used in the project</th> </tr> </thead> <tbody> <tr> <td>Existing part of the pilot plant</td> <td>32'882</td> <td>92'500</td> <td>60-84</td> <td>27</td> <td>100</td> </tr> <tr> <td>Ozonator (built in 2012)</td> <td>10'000</td> <td>35'000</td> <td>84</td> <td>24</td> <td>100%</td> </tr> <tr> <td>Dug Well and 3 observation wells connection and electrical system</td> <td>7'500</td> <td>50'000</td> <td>180</td> <td>27</td> <td>100%</td> </tr> <tr> <td>Expansion of Bio Filter</td> <td>11'250</td> <td>25'000</td> <td>60</td> <td>27</td> <td>100%</td> </tr> <tr> <td>Mixing Reservoir</td> <td>4'500</td> <td>10'000</td> <td>60</td> <td>27</td> <td>100%</td> </tr> <tr> <td>Ceramic UF membrane</td> <td>12'000</td> <td>30'000</td> <td>60</td> <td>24</td> <td>100%</td> </tr> <tr> <td>BAC Filter</td> <td>13'800</td> <td>34'500</td> <td>60</td> <td>24</td> <td>100%</td> </tr> </tbody> </table>	Capacity	Eligible cost (EUR)	Total cost (EUR)	Depreciation period (months)	Period of use (months)	% used in the project	Existing part of the pilot plant	32'882	92'500	60-84	27	100	Ozonator (built in 2012)	10'000	35'000	84	24	100%	Dug Well and 3 observation wells connection and electrical system	7'500	50'000	180	27	100%	Expansion of Bio Filter	11'250	25'000	60	27	100%	Mixing Reservoir	4'500	10'000	60	27	100%	Ceramic UF membrane	12'000	30'000	60	24	100%	BAC Filter	13'800	34'500	60	24	100%
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Other goods and services	55'900	Consumables for pilot operation (flocclants, hydrogenperoxide dosing, cleaning chemicals for membrane and tanks such as NaOCl, NaOH, HCl), spare parts, piping electroinstallation and connection services and chemical and microbial analytical programme (labware, test kits, media, solvents), CFS																																																
Total	163'632																																																	

22	AMU	Cost (€)	Justification				
Travel	23'900	cost of travel including consortium and technical meetings as well as frequent travel for field work in sample sites of Mosina water capture (site no. 4) and other sites in Poland to extend the database (4'500 EUR), conference attendance (5'600 EUR)					
Equipment	12'438	Specialised equipment and hardware for data gathering and processing: computer for groundwater transport modelling, field lap-top for field work at site no. 4 multifunction meter for measuring physico-chemical parameters in the field pump set for groundwater sampling from piezometers in the field (Grundfos MP1), sensors/data loggers for water level, temperature					
		Capacity	Eligible cost (EUR)	Total cost (EUR)	Depreciation period (months)	Period of use (months)	% used in the project
		computer	1'610	1'610	36	36	100
		field lap-top	1'413	1'590	36	32	100
		rent of multifunction meter	3'381	3'381	36	36	100
		rent of pump set	1'500	1'500	36	36	100
		sensors/data loggers	4'533	5'100	36	32	100
Other goods and services	20'400	Reagents, certified materials for ICP-MS and HPLC-MS water analysis Materials for field work (pH, Eh, O2 and conductivity probes, protective clothes, etc.), Computer software licences (groundwater transport, GIS), Conference fees					
Total	56'738						
24	UCRAN	Cost (€)	Justification				
Travel	30'340	cost of travel including consortium and technical meetings as well as field work in demonstration site Packington					
Equipment	-						
Other goods and services	27'000	Test kits, consumables and chemicals for lab work, CFS					
Total	57'340						
25	HTWD	Cost (€)	Justification				
Travel	37'640	Attendance consortium and technical meetings 18'440 EUR, field work in demonstration sites 2, 4, & 5, 9'600 EUR, trip to India for exploitation. 2'400 EUR Conferences (IAH, IWA, DVGW, India) (excluding fees) 7'200 EUR					
Equipment	28'000	monitoring equipment for pilot plant installation at BF site 2, (flowmeter, turbidity meter, pressure transducer), Bank filtrate sampling equipment, on-site parameter determination, Data loggers for water level, temperature, conductivity, energy					
		Capacity	Eligible cost (EUR)	Total cost (EUR)	Depreciation period (months)	Period of use (months)	% used in the project
		Pilot plant monitoring equipment	14'000	21'000	36	24	100%
		Sampling equipment	4'667	14'000	36	24	50%
		Data loggers	9'333	14'000	36	24	100%
Other goods and services	44'227	Consumables for water sampling (filters, bottles, preservation chemicals), pathogen filtration/enrichment in the field, chemical and microbiological analyses (columns, chemicals, IDEXX trays ..) - 22'000 EUR, Consumables for monitoring water levels, EC, temp. (accu, connectors, cable), Marketing in Asia (fair participation) - 9'000 EUR Conference fees, open access fees, translation - 10'000 EUR, CFS					
Total	109'867						

26	EJC	Cost (€)	Justification
Travel	14'000	Attendance consortium and technical meetings as well as field work in demonstration sites, conference	
Equipment	-		
Other goods and services	15'200	Consumables and materials for water sampling and analyses , conference fees	
Total	29'200		
27	KWB	Cost (€)	Justification
Travel	11'500	Attendance consortium and technical meetings as well as field work in demonstration sites, conference	
Equipment	40'000	Online sensors, remote control, alarm system, ozone unit for sites no. 1 and no.12	
		Capacity / Equip. type	Eligible cost (EUR)
		Total cost (EUR)	Depreciation period (months)
		Period of use (months)	% used in the project
		Remote control and safety installations	10'000
		10'000	20'000
		36	18
		100%	
		Operational sensors (flow, water level)	5'000
		10'000	36
		18	100%
		Ozone unit	15'000
		60'000	72
		18	100%
Other goods and services	28'365	Chemicals for membrane cleaning - 5'065 EUR Lab material (bottle, filters, wipes, HSE equipment etc) - 10'000 EUR Lab material (bottle, filters) + onsite analyses - 10'000 EUR 2 conferences 500 € fee each (1'000 EUR), hosting of 1 consortium meeting (1'300 EUR) CFS (1'000 EUR)	
Total	79'865		
28	KWR	Cost (€)	Justification
Travel	11'900	Attendance consortium and technical meetings as well as field work in demonstration sites, conference	
Equipment	54'000	flexible mobile water pre-treatment facility, Analysis of resistance genes, Equipment for on-site water quality measurements and investment in mobile treatment, infiltration and monitoring equipment including high flow filtration units (fuzzy filter) at site 9. depreciation Analysis of chemicals high resolution mass spectrometry to support monitoring Q-PCR equipment for antibiotic resistance gene identification LTQ-Orbitrap machine	
		Capacity / Equip. type	Eligible cost (EUR)
		Total cost (EUR)	Depreciation period (months)
		Period of use (months)	% used in the project
		Sensor equipment	2'000
		5'000	60
		24	100%
		Mobile pretreatment	40'000
		40'000	24
		24	100%
		Q-PCR equipment	2'000
		20'000	120
		24	50%
		LTQ-Orbitrap machine	10'000
		500'000	120
		24	10%
Other goods and services	10'800	Field and lab consumables, hosting of 1 consortium meeting CFS is required	
Total	76'700		

4 Members of the consortium

4.1 Participants

University of Applied Sciences and Arts Northwestern Switzerland (FHNW)	50
Akut Umweltschutz Ingenieure Burkard und Partner (AKUT)	53
AUTARCON GmbH (AUT)	55
BioDetection Systems B.V. (BDS)	57
HydroBusiness (HYBU)	59
imaGeau (IMAGEAU)	60
Geo-Hyd (GEOHYD)	62
microLAN BV (microLAN)	64
X-Flow B.V. (XFLOW)	66
Vertech Group (VTG)	68
Wadis Ltd.	70
WatStech Ltd.	72
Xylem Services GmbH (XYLEM)	74
Budapest Waterworks plc., Hungary (BUWW)	76
Berliner Wasserbetriebe (BWB)	78
Municipal Authority for Water Supply and Sanitation Thiras (DEYAT)	80
Municipality of Antiparos (MUOA)	82
DREWAG Netz GmbH (DREWAG)	83
Erftverband (EV)	85
Industrielle Werke Basel (IWB)	87
Mekorot (MEK)	89
Adam Mickiewicz University in Poznań	91
French Geological Survey (BRGM)	93
Cranfield University (UCRAN)	95
Dresden University of Applied Sciences (HTWD)	97
Eötvös József College (EJC)	99
Kompetenzzentrum Wasser Berlin gGmbH (KWB)	101
KWR Water B.V. (KWR)	103
National Technical University of Athens	105
Uttarakhand Jal Sansthan (UJS) – Uttarakhand State Water Supply & Sewerage Organisation, India	107

1	University of Applied Sciences and Arts Northwestern Switzerland (FHNW)	 University of Applied Sciences and Arts Northwestern Switzerland School of Life Sciences
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General description:

The School of Life Sciences (HLS) of the University of Applied Sciences and Arts Northwestern Switzerland (FHNW) is located in the centre of the tri-national Basel area (Switzerland – France – Germany). The four institutes of the HLS are Pharma Technology, Medical and Analytical Technologies, Chemistry and Bioanalytics and Eco-preneurship (IEC). Circa 200 scientists at HLS work currently on about 240 projects. The research and development activities of HLS encompasses a wide range of projects ranging from the development of new products and devices as well as the optimisation of production processes in terms of material and energy saving up to life cycle and risk assessment of some of these products.

The core activities of the Institute for Eco-preneurship (IEC) at the FHNW include Environmental Technologies, Environmental Biotechnology and Sustainable Resources Management. It possesses lab facilities such as pilot-scale lab, trace analysis lab and radioisotope lab, which are all equipped with cutting-edge devices.

IEC holds close contacts to relevant water authorities, water equipment providers, end-users in the region such as municipal water and wastewater utilities which allows for on-site pilot-testing. The institute covers the whole life cycle of technologies from proof of concept and assessment over implementation to monitoring and evaluation. Water frameworks and conclusive indicator systems play a crucial role in our daily work of assessments and evaluations in water management and technologies. The institute has extensive experience in leading and collaborating in large international research projects (e.g., AQUAREC, RECLAIM Water, Saph Pani, Water4India, COROADO) and feasibility studies in developing countries in the water sector and adopted technologies.

Main tasks in the project:

- **WP2:** Performance assessment of Lange Erlen site, AOP pilot plant and soil column experiments, chemical analysis of micropollutants based on the long-lasting collaboration with the utility IWB.
- **WP5:** LCA on selected cNES
- **WP6:** contribution to AquaNES DSS development
- **WP7:** Dissemination Manager
- **WP8:** Management: Project Coordinator. Project implementation by an experienced team at FHNW adhering to best management practice. Staff involved also brings in technical expertise in the project topic having coordinated the FP5, FP6 and FP7 projects: AQUAREC, RECLAIM WATER and Saph Pani.

Principal research personnel to be involved:

Name/ Profile/ Project responsibility	Gender
<p>Prof. Thomas Wintgens</p> <p>Chemical Engineer (PhD) and expert in water technologies. Leader of the Environmental Technology group at IEC with research focus on membrane, adsorption and advanced oxidation processes. Vast experience in EU project coordination in FP5, FP6 and FP7 programs: AQUAREC, RECLAIM WATER and Saph Pani. He is the AquaNES Project Coordinator.</p>	M
<p>Rita Hochstrat</p> <p>Research Associate at IEC with diploma in biology and environmental sciences background (MTechn). Acquainted with a broad spectrum of challenges in water management, specifically water reuse. Technical Secretary of Working Group Water Reuse at EurEau for the last 6 years. Profound project management experience in various EU research projects (MBR-TRAIN - FP6-MOBILITY-EST, Ref. 021050; MINOTAURUS - FP7-KBBE; GA no. 265946, Kill•Spill FP7-KBBE GA no.312139). She will be acting as AquaNES Project Manager</p>	F
<p>Julia Plattner</p> <p>Holds a master by research in environmental engineering and acts as research assistant at IEC. Practical experience in pilot-plant and lab-based research work related to micropollutant removal (adsorption, membrane technologies) in drinking water and wastewater. Previously she was involved in Saph</p>	F

<p>Pani where she was both carrying out field work and assisting in the administrative coordination. In AquaNES she will be carrying out the project related experiments, analytical work and oversee the pilot plant.</p>	
<p>Dr. Armin Zenker</p> <p>Armin studied biology in Salzburg (Austria) and Hohenheim (Germany) focussing on aquatic toxicology. Since 2006 he is working as post-doc at FHNW heading the environmental analysis laboratory at the IEC. He is experienced in the analysis of organic contaminants in drinking water, surface water, wastewater and sludge and will be responsible for the analysis of micropollutant in the Lange Erlen site (site 6).</p>	M
<p>Dr. Fredy Dinkel</p> <p>Holds a master in theoretical physics ETH Zürich and a PhD in polymer physics. About 25 years partner in environmental consultancy (Carbotech AG). Consultant in the field of environment and sustainable development, director for the department environmental consultancy: Life Cycle Assessment and mass flow analysis for cleaner production and environmental management. He is a senior expert in LCA performed more than hundreds LCA studies for industries and national and international organizations. Vast experience as lecturer (also at FHNW). Will be responsible for WP5 activities on LCA.</p>	M

Relevant publications:

1. Wintgens T., Nättorp A., Elango L. and Asolekar S. R. (2015). Natural Water Treatment Systems for Safe and Sustainable Water Supply in the Indian Context: Saph Pani. IWA Publishing, London.
2. Excel-Tool for the evaluation and selection of water reuse options presented in the EU-FP7 project CORO-ADO. Project deliverable D4.2: Development and application of a web-based geographical tool for WR&R technologies, accessible under: http://www.corado-project.eu/?page_id=20
3. Kazner C., Wintgens T. and Dillon P. (2012) (Eds.). Water Reclamation Technologies for Safe Managed Aquifer Recharge. IWA Publishing, 460 pp.
4. Löwenberg J., A. Zenker, M. Baggenstos, G. Koch, C. Kazner, T. Wintgens (2014). Comparison of two PAC/UF processes for the removal of micropollutants from wastewater treatment plant effluent: process performance and removal efficiency. Water research 56: 26-36.
5. Dinkel F, Kägi T, Hochstrat R, Wintgens T (2015) LCA of advanced wastewater treatment to remove micro pollutants. Life Cycle Management Conference 2015, 30 August - 2 September 2015, Bordeaux, France

Relevant previous projects or activities:

1. **Saph Pani** (EU project, FP7 GA no. 282911): Saph Pani addressed the improvement of natural water treatment systems such as river bank filtration (RBF), managed aquifer recharge (MAR) and wetlands in India. The project aimed at enhancing water resources and water supply particularly in water stressed urban and peri-urban areas in different part of the sub-continent.
2. **COROADO** (EU project, FP7 GA no. 283025): In order to be able to maximize the benefits from reuse and recycling technologies projects, COROADO both developed new and adapted existing concepts and operational frameworks. A web-based toolbox for reuse and recycling technologies and integrated water resources management was created in for the Latin American context, taking into account long-lasting changes, and at the same time addressing environmental and ecosystem integrity.
3. **DEMOWARE** (EU project, FP7 GA no. 619040) aims at increasing Europe's ability to profit from the resource security and economic benefits of water reuse schemes without compromising human health and environmental integrity. The programme aims to enhance the availability and reliability of innovative water reuse solutions, and to create a unified professional identity for the European Water Reuse sector.
4. **RECLAIM WATER** (EU project, FP6 contract no. 018309): developed hazard mitigation technologies for water reclamation providing safe and cost effective routes for managed aquifer recharge. The work assessed different treatment applications in terms of behaviour of key microbial and chemical contaminants. The project integrated technological water reclamation solutions with natural attenuation processes occurring in the subsurface to achieve upgraded water quality assessed on the basis of key contaminants.
5. **TAPES** (Transnational Action Program on Emerging Substances; INTERREG IVB 2012 – 2015. Project on technologies for the removal of micro-pollutants in water production and wastewater treatment, aiming at knowledge development and transfer in and between water companies, managers of wastewater treatment

plants, national and local government, and interested public.

Infrastructure/ technical equipment:

- LC QqQ MS, LC ESI-Ion trap and GC-(ED)-MS for analysis of micropollutants
- LC-OCD equipment for analysis of organic carbon fractions

2 Akut Umweltschutz Ingenieure Burkard und Partner (AKUT)



General description:

AKUT is a small independent German SME working in all fields of ecological engineering, consulting, applied research and capacity building. It has special expertise in wastewater treatment with constructed wetlands, low energy consuming aerobic and anaerobic water treatment, renewable energy systems, ecological river engineering and water management. AKUT has more than 20 years of experience in planning and development of constructed wetlands for many applications. AKUT is founding member of the Global Wetland Technology Association (www.globalwettech.com), a worldwide acting group for establishing high quality wetlands all over the world. AKUT has participated in numerous national and international research and developing projects. The last EU research project (SLASORB, grant agreement RFSP-CT-2009-00028) was dealing with the use of industrial by-products such as steel slags in combination with natural and engineered wastewater treatment systems. AKUT is working in national and international specialist groups on constructed wetlands including the German DWA (German Association for Water, Wastewater and Waste) standards task group.

Main tasks in the project:

- **WP 3:** Design, construction and maintenance of the pilot system for natural wastewater treatment in combination with ozone treatment during the time of demonstration and experiments, final removal of the container system. This task has been executed in many R+D projects by AKUT.
- **WP 3:** Establishing design and marketing recommendations for combined systems. The scientific data from experiments and demonstration sites will be evaluated with the background of practical engineering. Several guidelines in Germany (DWA, DIN) and abroad have been written with substantial contributions from AKUT.
- **WP 7:** Developing a marketing strategy for innovative products such as combined NES in participating countries. AKUT has special experience in international cooperation for capacity building in the public and private water sector.

Principal research personnel to be involved:

Name/ Profile/ Project responsibility	Gender
<p>Prof. Jens Nowak</p> <p>Water Engineering and Management (PhD). Chair for Water Management at the University of Applied Sciences Potsdam, Department of Civil Engineering. Since 2011 consultant and managing partner of AKUT in the field of wastewater treatment and energy efficiency; 2007-2011 technical and financial manager of wastewater utilities AZV Reichenbacher Land; 1995-2007 expert on wastewater disposal concepts, combined water treatment concepts, management of WWTP monitoring as state officer at EPA Plauen /State Council Chemnitz, Saxony. His expertise includes consultancies for wastewater associations, municipalities and public authorities in Germany, Czech Republic, Romania, Albania and Russia. Nowak is chairman of German Water Association (DWA) specialist group on wastewater treatment in rural areas (FA-KA 10) and leading the German task group for new standards in wastewater treatment with constructed wetlands (A-262). Nowak will be responsible for NES design recommendations and marketing strategies derived from demonstration sites (WP 3/7).</p>	M
<p>Heribert Rustige</p> <p>Environmental Engineer (Dipl.-Ing., TU Berlin) founder and managing partner of AKUT. Responsible for R+D projects. Specialist in natural wastewater treatment and water engineering. German coordinator of IWA specialist group on constructed wetlands and member of IÖV and DWA task groups. Rustige has expertise as project manager for design, construction and optimization of numerous treatment wetlands in Germany, France, Spain, Portugal and China for more than 25 years. Rustige will manage design, construction and maintenance of the Berlin demonstration site (WP 3).</p>	M

Relevant publications:

1. Rühmland S., Barjenbruch M., Rustige H., Heinzmann B. and Dünnbier U. (2008). Comparison of Seven Constructed Wetlands and Ponds for Advanced Wastewater Treatment, 11th International Conference on Wetland Systems for Water Pollution Control, Institute of Environment Management and Plant Sciences, Vikram University, Ujjain, India.
2. Rustige H. and Platzer C. (2001). Nutrient removal in subsurface flow constructed wetlands for application in sensitive regions, *Wat. Sci. Tech.*, 44(11-12), 149-155.
3. Rustige H. and Nolde, E. (2007). Nitrogen elimination from landfill leachates using an extra carbon source in subsurface flow constructed wetlands, *Wat. Sci. Tech.*, 56(3), 125–133.
4. Rustige H. (2012). Dephosphorisation of wastewater by fixed bed reactors using steel slags (in German language). *Entphosphorung von Abwässern im Festbett auf Basis von Elektroofen- und Konverterschlacke, Schlacken aus der Metallurgie, Band 2*, TK Verlag, ISBN 978-3-935317-86-6
5. Nowak J. and Rustige H. (2012). Combined sewage treatment with constructed wetlands, *DWA Regenerassertage 1.-13. Juni 2012*, Schönefeld, Berlin, Germany.

Relevant previous projects or activities

1. **Changshu**: A 5 ha system as **combined tertiary treatment wetland** for industrial water re-use (4.000 t/d) including subsurface and surface flow wetlands combined with technical units for precipitation of phosphorus and for external carbon dosing. Design and supervision of construction and operation. Jiangsu, China (2009-2017). AKUT in cooperation with German Ecological Engineering Society.
2. **SLASORB** (EU grant agreement RFSP-CT-2009-00028): AKUT designed, installed and operated a container system as fixed bed reactors for utilizing steel slags at the demonstration site in Kappe, Brandenburg, Germany. The leading university was École des Mines de Nantes. Industrial partners were Arcelor Mittal and Epur Nature.
3. **Design recommendations** on constructed wetlands for the rural areas of **Kaliningrad**, adapting German DWA standards, Russia, Nowak J. (Umweltbundesamt, 2015)
4. **Catalogue of Berlin water sector**: References, products and needs of Berlin water sector comprising more than 100 institutions from Berlin (SenWirt Berlin, 2014).
5. Proyecto de agua, saneamiento y manejo del recurso hídrico para **Piura**. Componente **fortalecimiento institucional**, comunicación y sensibilización pública (Peru, GIZ 2015-2017) Institutional strengthening of water utilities with respect to technology, economy, organization and public awareness. AKUT is supporting the building of capacities within *EPS Grau*, a large water and wastewater service provider for 750,000 inhabitants, in cooperation with SEECON GmbH, Basel.

Infrastructure/ technical equipment

Office in Berlin with all necessary hard- and software as well as a technical laboratory for common water, sludge and soil analyses for WWTP operation. A team of several engineers and technical assistants is available for construction and supervision of the demonstration site.

3 AUTARCON GmbH (AUT)



General description:

AUTARCON is specialized in the development, construction and installation of decentralized water treatment units that can be run without the external supply of energy and chemicals as well as on online monitoring of water qualities and system treatment performance. The company was founded in 2010 as Spin-off from Kassel University and has implemented its technology in 10 countries since then.

The core component of the SuMeWa|SYSTEM called technology is an inline electrolytic (AO) unit to disinfect drinking or treated wastewater for a pathogen free and safe water supply. Drinking water disinfection units are installed worldwide with a current focus on Africa (Egypt and Tanzania). Units for the disinfection of treated wastewater are currently being implemented in India.

AUTARCON is conducting on-going research to develop water treatment products, which allow a stronger market penetration by offering adapted modularized treatment solutions. That way AUTARCON is able to react to locally existing water quality challenges and can offer unique cost and energetically efficient systems for e.g., the removal of turbidity, pathogens, hardness, arsenic, iron and manganese from source water.

The SME has extensive experience in collaborating in international research projects (e.g., SWINGS, UFC12, So-lArEx) and has proven to be a reliable partner especially when it comes to in-field experience. AUTARCON currently employs six people, mostly engineers.

Main tasks in the project:

- **WP 1:** AUTARCON will implement test and evaluate a solar driven treatment unit that is especially developed for pumping and disinfecting bank filtrate. Before its safe disinfection by inline electrolytic chlorine production from natural salt content of the water it can also be pre-filtered. Water quality and system performance will be online monitored and made available through a SCADA System. Integration of UF membranes into treatment setting with automated backwash and system cleaning.
- **WP 7** Market studies, exploitation & dissemination: development of an adapted water treatment product for operation in developing regions, focus on on-site disinfection using electrolysis exhibition in India

Principal research personnel to be involved:

Name/ Profile/ Project responsibility	Gender
<p>Philipp Otter M.Sc. in Environmental Engineering and M.Sc. in Renewable Energies and Energy Efficiencies. He has conducted pilot plant research for adapted drinking water and wastewater treatment technologies in India, Tanzania, Cameroon, Egypt, Costa Rica and Brazil. Since 2010, Philipp Otter coordinates national and international water research projects for AUTARCON, such as SWINGS, UFC1₂ and SolArEx and has acquired in depth experience in accomplishing research projects under different challenging environments. Philipp will be coordinating the AUT activities in India (piloting and dissemination)</p>	M
<p>Alexander Goldmaier Dipl.-Ing. in electrical engineering. He developed the concept and the control unit for water disinfection based on anodic oxidation including solar-pv, pump, and water quality sensors during a research cooperation with Federal University of Ceará, Brazil. He conducted several field-tests in North-East Brazil between 2004 and 2007 and implemented a solar driven treatment system to supply drinking water in Gambia, Egypt, and Ghana. He is Co-founder and CEO of AUTARCON GmbH. Technical support and data assessment of piloting</p>	M
<p>Florian Benz Dipl.-Ing. in electrical engineering. He developed and implemented the online monitoring unit for the remote control of SuMeWa SYSTEM simplifying maintenance and monitoring of water quality</p>	M

parameters. He is Co-founder and CEO of AUTARCON GmbH and focuses on renewable off grid energy supply. Responsible for pilot assemblage and field work.

Relevant publications:

1. Otter P., and Goldmaier A. (2014). Solar- und Wassertechnik ermöglichen neue Lösungsansätze für die Trinkwasserproblematik in Entwicklungsländern,'Solar and water technology enabling solutions to drinking water challenges in developing countries'. *Deutsche Lebensmittel Rundschau*, **110**(2), 54-59, ISSN 0012-0413.
2. Otter P. and Mishra V. (2013). Water Disinfection for Remote Areas of Developing Regions – An Innovative and Sustainable Approach using Solar Technology and Anodic Oxidation, Presentation at *1st IFAWET*, December 2013, New Delhi, India.
3. SuMeWa|SYSTEM online monitoring tool for mobile phones and computer used for water quality and system performance monitoring

Relevant previous projects or activities:

Autarcon features extensive experience in piloting their technologies in developing countries in collaboration with governmental institutions and local organisations

1. **SWINGS**, "Safeguarding Water Resources in India with Green and Sustainable Technologies" (FP7 GA no. 308502) seeks to integrated and optimized solutions for wastewater reuse in different areas of India.
2. **UFCl2**, Pure Water for Challenging Conditions. The project is developing an innovative and integrated solution for drinking water purification in off grid regions with poor source water qualities. The overall objective is to provide a system of low maintenance need and extremely low operational cost. The fully solar driven and containerized solution will join the strengths of ultrafiltration and anodic oxidation technology to supply reliably safe water (funded by German Federal Ministry of Education and Research (BMBF))
3. **SolarEx**: Solar Driven Arsenic Removal. The aim of this project is to develop an innovative technology in order to secure the drinking water supply in arsenic contaminated rural developing regions. In this project an innovative solar driven treatment system shall be developed being capable in quickly oxidizing arsenic species by means of anodic oxidation and removing them via adsorption and physical filtration. The focus will be set on the operability of such a technical solution in challenging of grid developing regions (funded by German Federal Ministry of Education and Research (BMBF))

Infrastructure/ technical equipment:

- Laboratory and workshops for prototype testing, pilot unit development and commissioning
- Basic water quality analysis equipment

4	BioDetection Systems B.V. (BDS)	
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General description:

BioDetection Systems (BDS) (30 staff, based in the Netherlands) is an SME established in 2001 that develops, markets and applies bio-based detection methods for a wide range of applications. A main focus is on safety assessment and quality control of food, water and the environment. BDS' methods, like the CALUX® methods, are used as alternatives to chemical analytical methods and as animal alternatives. They are successfully applied in more cost effective, sustainable and ethically less controversial screening programs either as stand-alone, in a high throughput mode, or in smart combinations with more conventional technologies. Analyses carried out in its service department are strictly confidential and performed under ISO17025 and GMP+ certified conditions. BDS offers its technologies and services world-wide through a network of laboratories and agents.

BDS is a frequent partner/coordinator of national-, and EU funded projects on water safety (e.g. TECHNEAU, DEMEAU), and various projects that have contributed to the development and validation of its platform technology for various applications (e.g., ReProTect, ChemScreen, NewGeneris). National projects like Genes4water and BE-Basic contributed to the further development of comprehensive screening platforms for water quality monitoring. BDS actively participates in validation and international ring study exercises for its technologies via (inter)national organisations, including ECVAM, OECD, DIN committees, etc.

Main tasks in the project:

- **WP4:** Implementation of a range of bioassays in demonstration sites. Adaptation of monitoring technologies to needs of combined natural engineered treatment systems. Development of tailored monitoring programmes. In that frame BDS interact with other WPs (particularly WP6) for data exchange and –interpretation,
- **WP7:** BDS will participate in the exploitation plan development for its bioassays and dissemination activities (exhibit at fairs, contribute on conferences)

Principal research personnel to be involved:

Name/ Profile / Project responsibility	Gender
<p>Dr Bart van der Burg</p> <p>Dr Bart van der Burg is the Director of Innovation of BDS and has ample experience in developing rapid and quantitative bioassays for various applications, including water quality monitoring as a main one. He has been coordinator and section leader of various EU- and other large scale collaborative research projects and has ample experience in valorization and open innovation. He will coordinate BDS contributions in AquaNES and actively drive the product development.</p>	M
<p>Dr Barbara van Vugt-Lussenburg</p> <p>Dr Barbara van Vugt-Lussenburg has a background in chemistry and biology, expert in automated cell-based screening, and risk analysis taking pharmacokinetics into account. Responsible for sample preparation and toxicity assessment</p>	F
<p>Dr Bart Pieterse</p> <p>Dr Bart Pieterse has a background in genomics, bioinformatics and data integration. He will be responsible for data management and their integration into the KR of AquaNES DSS (WP6)</p>	M
<p>Dr Harrie Besselink</p> <p>Dr Harrie Besselink is a toxicologist, with expertise in water quality monitoring and validation. Responsible for sample preparation and toxicity assessment</p>	M

Relevant publications:

1. Van der Linden S., Heringa M. B., Man H. Y., Sonneveld E., Puijker L., Brouwer A. and Van der Burg, B. (2008). Detection of multiple hormonal activities in waste water effluents and surface water, using a panel of

- steroid receptor CALUX bioassays, *Environmental Science and Technology*, **42**, 5814-5820.
2. Schriks M., van der Linden S. C., Stoks P. G. M., van der Burg B., Puijker L., de Voogt P. and Heringa M. B. (2013). Occurrence of glucocorticogenic activity in various surface waters in The Netherlands. *Chemosphere*, 93(2), 450-454.
 3. Van der Burg B., Van der Linden S. C., Man H. Y., Winter R., Jonker L., Van Vugt-Lussenburg B. and Brouwer A. (2013). A panel of quantitative CALUX® reporter gene assays for reliable high throughput toxicity screening of chemicals and complex mixtures. In: High throughput screening methods in toxicity testing, Steinberg P. (ed.), John Wiley and Sons, Inc. New York. ISBN 9781118065631, pp. 519-532.
 4. Van der Linden S. C., von Bergh A., Van Vugt-Lussenburg B., Jonker L., Brouwer A., Teunis M., Krul C. and Van der Burg B. (2014). Development of a panel of high throughput reporter gene assays to detect genotoxicity and oxidative stress, *Mutation Res.*, 760, 23-32.
 5. Escher B. I., Allinson M., Altenburger R., Bain P., Balaguer P., Busch W., Crago J., Humpage A., Denslow N. D., Dopp E., Hilscherova K., Kumar A., Grimaldi M., Jayasinghe B. S., Jarosova B., Jia A., Makarov S., Maruya K. A., Medvedev A., Mehinto A. C., Mendez J. E., Poulsen A., Prochazka E., Richard J., Schifferli A., Schlenk D., Scholz S., Shiraishi F., Snyder S., Su G., Tang Y., Van der Burg B., Van der Linden S., Werner I., Westerheide S. D., Wong C. K., Yang M., Yeung B. H. Y., Zhang X. and Leusch F. (2014). Benchmarking organic micropollutants in wastewater, recycled water and drinking water with in vitro bioassays. *Environ Sci Technol*, **48**, 1940–1956.

Relevant previous projects or activities:

1. **TECHNEAU** (EU project, FP6) Integrated project to develop technologies for universal access to safe water.
2. **DEMEAU** (EU project, FP7, GA no. 308339) promotes the uptake of knowledge, prototypes and practices from previous EU research enabling the water cycle sector to face emerging pollutants and thus securing water and waste water services and public health. The project exploits four groups of promising technologies from previous EU research: Managed Aquifer Recharge (MAR), hybrid ceramic membrane filtration, hybrid advanced oxidation processes, bioassays. BDS coordinates the work on selection and validation of bioassays for water quality assessment.
3. **BE-Basic** (National project: www.be-basic.org) develops high throughput genomics-based monitoring tools for waste- surface- and drinking water

Infrastructure/ technical equipment:

BDS is able to routinely process samples for toxic/ecotoxicological effects in its facilities:

- Modern facilities specialized in qualitative effect-based bioassay measurements
- Fully equipped R&D and Service facilities with GMP+ and ISO17025 accreditation
- High throughput automated cell-based screening facility
- qPCR, next generation sequencing, and basic chemical analytics

5	HydroBusiness (HYBU)	
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General description:
 HydroBusiness is a company in the Dutch water sector and a part of the water company Brabant Water. Hydro-Business designs, builds, finances and operates plants for the production of industrial water or wastewater treatment. At the moment HydroBusiness is a national player with the ambition to start with international projects in 2 years. To date, HydroBusiness has participated in several pilot studies and the implementation of full scale plants.

- Main tasks in the project:**
- **WP 2:** technology provider to Waddinxveen demonstration site, i.e. Fuzzy Filter use for on the treatment and underground storage of storm water. Designing, implementing and optimizing a full-scale system
 - **WP7:** exploitation of the high velocity infiltration innovation (fairs, exhibitions; tentative training)

Principal research personnel to be involved:

Name/ Profile/ Project responsibility	Gender
Dipl. Ing. Joost Smetsers	M
Joost is working for HYBU since 2009 as account manager and project engineer. He completed Food and Environment studies at the HAS University of Applied Sciences (Germany). In previous positions he worked as wastewater engineer for the Dutch government. He will be supervising the technical activities in the Waddinxveen site.	
Mr. Toine Van Aard.	M
Toine is working for HYBU since 2012 as manager exploitation. He is responsible for the exploitation of all the HYBU-plants. He will be supervising all the operational activities in the Waddinxveen site and exploit the technology in WP7	

- Relevant publications:**
- No publications available

- Relevant previous projects or activities**
- Various national projects on water treatment and distribution in the Netherlands, primarily for the food industry:
1. Designing irrigation water project Glaspapel (ongoing)
 2. Operating irrigation water project Kievitsakkers (ongoing)
 3. Design, finance and operate waste water treatment plant for the food company Vion (ongoing)
 4. Design, finance and operate ground water treatment plant for the food company Sensus (ongoing)
 5. Operating a storm water collection system (ongoing)

- Infrastructure/ technical equipment:**
- Fast filtration
 - Redundancy
 - Remote control

6 imaGeau (IMAGEAU)



General description:

imaGeau was founded in 2008 as a spin-off from the national research laboratory in Geophysics (CNRS Montpellier Geophysic laboratory part of Montpellier University). It has strong expertise in both Geophysics and Hydrogeology.

imaGeau provides a unique tool to understand/monitor groundwater resources. imaGeau's patented Subsurface Monitoring Device (SMD) is autonomous in energy and is installed in a 2" borehole where it automatically and continuously monitors the fluid conductivity in the soil pores up to an aquifer depth of 300m.

The SMD delivers online graphic representations with a high spatial and time resolution of the stratification and dynamic of the aquifer and indicates the evolution of potential pollution (e.g., by seawater, leakage, etc.). SMD provides relevant information about the water quality in aquifers and can be applied for quality monitoring in Managed Aquifer Recharge.

imaGeau has installed SMD networks in France, Spain, the Netherlands, Israel and Jordan and works with local governments and water agencies, research institutes (e.g., Deltares, BRGM, CNRS) and industries (e.g. SAUR, VEOLIA, SOLVAY). imaGeau puts a strong emphasis on R&D and has been participating in a number of EU funded collaborative research programmes such as MUSTANG, PANACEA or TRUST.

Main tasks in the project:

- **WP 2:** monitoring and visualisation of effects of aquifer recharge with reclaimed water in the Agon-Coutainville demonstration site. Validation of the tool for saline intrusion management in artificial groundwater replenishment scheme. imaGeau will design, build and install three SMDs to monitor the electrical conductivity of poral fluid in the aquifers.
- **WP 7:** develop business model for the SMD application in water reuse contexts

Principal research personnel to be involved:

Name/ Profile/ Project responsibility	Gender
<p>Matthieu Baisset</p> <p>Hydrogeologist engineer graduated from ENSG (French National Geological Engineering School). He started his career in French Guyana at the BRGM where he was scientific manager of groundwater management projects. He has now joined imaGeau in charge of data interpretation. He will be coordinating the technical-scientific contributions of imaGeau to the AquaNES project.</p>	<p>M</p>
<p>Dr Jean-Philippe Bellot</p> <p>PhD in Environmental Hydrogeology from Montpellier University (2001). He started his career at BRGM then continued in academic research for his PhD and lately managed the hydrogeological department of HGM (an environmental consulting company). He will be the AquaNES project manager Back-up at imaGeau.</p>	<p>M</p>
<p>Olivier Depraz</p> <p>Graduated from the Bordeaux Business School in 1988 and holder of an MBA from the London Business School (1995). Twenty years' experience as sales adviser then marketing manager of multinational IT companies.</p> <p>He is a founding partner of imaGeau and heads the Sales and Marketing department. He will be managing the imaGeau contributions to the AquaNES project. He will be looking after the commercialisation of the application.</p>	<p>M</p>

Relevant publications:

1. Bellot J-P. and Neyens D. (2014). Continuous monitoring of in-situ electrical resistivity : imaGeau case studies

and potential applications. *Réunion Sciences de la Terre – RST2014* (24th Earth science meeting), October 27-31, University of Pau, Pau, France.

2. Bellot J-P., Neyens D., Jauzein V. and Nauleau F. (2014). New downhole real time and near field hydrogeophysical observatory of groundwater quality: salt water intrusion and wastewater infiltration. *Colloque GEOFCAN*, November 13-14, Faculté des Sciences d'Orsay, Paris, France.
3. Bellot J-P., Lemaire B. and Alouran S. (2015). Real time and in-situ monitoring of groundwater conductivity for long-time management : the Azraq wellfield, Jordan. 42nd IAH Congress AQUA2015- Hydrogeology: back to the future!, September 13-18, Rome, Italy.

Relevant previous projects or activities

IMAGEAU has tested subsurface monitoring devices in various subsoil storage contexts

1. **Mustang** (EU FP7-ENERGY-2008-1): High resolution **monitoring** with Subsurface Monitoring Device - A multiple space and time scale approach for the quantification of deep saline formations for CO₂ storage.
2. **Panacea** (EU FP7-ENERGY-2011-1 GA No. 282900): **Monitoring** (With SMD) and predicting the long-term behaviour of CO₂ injected in deep geological formations
3. **Trust** (EU FP7-ENERGY-2012-1 GA no. 309067) : High resolution **monitoring**, real time visualization and reliable modelling of highly controlled, intermediate and up-scalable size pilot injection tests of underground storage of CO₂.
4. **Grain d'sel** (French Project ANR): New approaches and innovative sensors for knowledge and monitoring of coastal aquifers. Application to saltwater intrusion **monitoring** in the sedimentary basin of Roussillon (France).

Infrastructure/ technical equipment:

All necessary devices for equipping demonstration sites with the relevant monitoring system are at hand

- Subsurface Monitoring Device (design and build)
- Data acquisition box
- Wireless Communication
- Data processing infrastructure (Webserver and Database)

7 Geo-Hyd (GEOHYD)



General description:

Geo-Hyd is a consultancy firm providing services in computing & Information System applied to Integrated Water Resource Management. It has about thirty collaborators, including scientists in agronomy, geology, computer science and GIS. In January 2013, Geo-Hyd became a full subsidiary of Antea Group. Currently Geo-Hyd is part of Innovation and Development Division of Antea Group (DID).

Geo-Hyd provides services and expertise in 4 domains:

- Aquatic environments expertise: water body quality assessment (physical and chemical quality of water, physical condition of the watercourse, status of biological communities);
- Data management: Data integration management, analysis and valorization of environmental data (special skill in High Performance Computing - HPC);
- Information Technology and Geomatics: needs analysis, Information System design and software conception, GIS & Relational Database Management System (RDBMS), remote sensing;
- Integrated water resources management (IWRM): public policy, master plan, river, basin and hydrological modeling.

Geo-Hyd invests significant R & D efforts on developing GIS systems and operational monitored tools for assessing fate of pollution in soil and water bodies. It has a strong R&D strategy based on several collaborations with academic partners (Agence National de la Recherche, French Ministry of Industry, European Union) such as the COQUEIRAL, SAMCO, FlocOn Bio and FRAME projects.

Main tasks in the project:

- **WP 2:** Implement a Centralized Knowledge Platform (CKP) in order to ensure the interoperability and the knowledge capitalization of WP2, design and implementation of an ICT System for WP2, data management and dissemination strategy via WP6 and WP7.
- **WP2:** Interface site data acquisition (imaGeau) and modelling/processing techniques (BRGM) into an off-the-shelf software dedicated to Agon-Coutainville demonstration site.
- **WP 2/6:** Develop SAT/MAR-specific system performance optimisation tool based on real-scale demonstration results.
- **WP 6:** Integrate WP2 ICT system and SAT/MAR efficiency assessment tool output into general Decision Support Platform of AquaNES (WP6).
- **WP 7:** Stakeholder/training workshop on ‘Surface treatment-SAT/MAR’ system efficiency assessment tool for different end-uses (irrigation, indirect potable reuse)

Principal research personnel to be involved:

Name/ Profile/ Project responsibility	Gender
<p>Dominique TAFANI:</p> <p>In the company since 2010 as project manager in water, energy and waste activities. Engineer of French “Grandes Ecoles” in water, forest and rural engineering, Dominique has a good experience in groundwater management from modelling of groundwater flows and pollutants fate to resource exploitation and protection. He has besides skills in program development, data management and analysis (statistics and geostatistics, etc.). <i>He will be acting as Geo-Hyd manager in AquaNES Project.</i></p>	<p>M</p>
<p>Loïc THOMAS:</p> <p>In the company since 2001 as data IT and engineering information systems unit manager. Programmer analyst by training, Loïc Thomas is led to design and implement specialized computer tools in management, processing and analysis of environmental data. <i>In AquaNES project, he will work on implementation of the Centralized Knowledge Platform for WP2 and on IT development of</i></p>	<p>M</p>

<i>the SAT/MAR ICT system.</i>	
<p>Axel AUROUET :</p> <p>In the company since 2004 with initial training in water resources management, Axel Aurouet also developed a dual expertise in the field of information systems, GIS, hydrological and hydrochemical modeling. He speaks regularly with water agencies on valuation issues, pressures-impacts assessment and regarding integrated water resource management planning issues <i>In AquaNES project, he will work particularly on SAT/MAR efficiency assessment tool and its integration into AquaNES Decision Support Platform.</i></p>	M
<p>Dr. Hervé NOEL:</p> <p>In the company since 2004 as Research and Development project manager, Hervé Noël is. Doctor of Sedimentary Geology. He has a good experience in multi-scale diagnostics on transfer of dissolved and particle elements from urban and rural catchment areas to ground and surface waters. <i>In AquaNES Project, He will be coordinating the scientific contributions of Geo-Hyd.</i></p>	M
<p>Relevant publications:</p> <ol style="list-style-type: none"> 1. Dedewanou M., S. Binet, JI. Rouet, Y. Coquet, A. Bruand and <u>H. Noel</u> (2015). Groundwater vulnerability and risk 1 mapping based on Residence Time Distributions: Spatial analysis for the estimation of lumped parameters. <i>Water Resources Management</i> (in press). 2. Pierre D., <u>Aurouet A.</u>, Essayan V., Eberscheweiller Ch., Vuathier J.R., Armand C., Barrat J.M., Dodo A. and Baba Sy L. (2015). Integrated Water Resources Management of the Iullemeden-Taoudeni/Tanezrouft Aquifer Systems along with the Niger River. <i>25th Annual International Conference on Soil, Water, Energy and Air</i>, March 23 -26, 2015, San Diego, California. 3. Chasles A., Dedewanou M., Minc D., <u>Noel H.</u>, Oppeneau E. and Talva R. (2015). Evaluer le transfert des produits phytosanitaires entre zones d'application et eaux souterraines. Application "Phyto'Scope" au Val d'Orléans, <i>Techniques Sciences & Méthodes</i>, 110(1/2), 39-52. 4. <u>Tafani D.</u>, <u>Noel H.</u>, Suire P., Dedewanou M. and Thierion Ch. (2014). Prise en compte de la Zone Non Saturée (ZNS) dans l'évaluation des transferts de polluants de surface dans les eaux souterraines pour l'aide à la décision - "Innover dans les services publics locaux de l'environnement". <i>93ème Congrès de l'ASTEE</i> , June 3 -6, Orléans, France. 5. Bordeau F., Binet S., Peyraube N., <u>Noel H.</u>, Dedewanou M., Hertout A., Thauvin M., Coquet Y., Pierre D. and <u>Tafani D.</u> (2014). Dynamique des transferts d'eau et de nitrate d'origine agricole, des sols vers le captage S1 de la Saussaye (Chartes Métropole). Développement et application de l'outil DARCI: Distribution Analysis of Residence Times - "Innover dans les services publics locaux de l'environnement". <i>93ème Congrès de l'ASTEE</i> , June 3 -6, Orléans, France. 	
<p>Relevant previous projects or activities:</p> <p>Geo-Hyd has already developed operational tools for subsoil pollution assessment that will be used for SAT/MAR ICT system implementation in AquaNES Project</p> <ol style="list-style-type: none"> 1. Integrated Water Resource management for Iullemeden and Taoudeni / Tanezrouft aquifer – Observatoire du Sahara et du sahel – Remote sensing, Spatial recharge modeling and IWRM Strategy definition. 2. Urban community of Orléans and Chartres (French community) - DARCI Tools (Distribution Analysis of Residence Times). Simplified GIS model of agricultural contaminants transfers from soil to drinking water catchment area. 3. Many french territorial collectivity and French Water Agency - Axionne solution - Water bodies ecological status assessment with Axionne solution. 4. Nuclear facility - S-Eau-S is a friendly user interface to manipulate numerical groundwater models. The user can describe geolocalized pollution sources and pumping stations through a map interface, launch the model computation, and display the time-animated evolution of the pollution plume. 	
<p>Infrastructure/ technical equipment:</p> <p>For the processing of large data sets and modeling trains, Geo-Hyd may use its HPC cluster consisting of 80 processing cores and 512 graphics compute cores.</p>	

8	microLAN BV (microLAN)	
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General description:

microLAN, based in Waalwijk, the Netherlands, is a company specialized in early warning systems for water quality monitoring based on light measurements. microLAN has developed a range of fully automated online monitoring devices for guarding the quality of drinking, surface and process waters. microLAN supplies three complementary systems that detect algae, bacteria and chemical pollutions. microLAN's online monitors instantly response to a change in water quality, giving an alarm signal to indicate a possible water pollution. The advantage of microLAN's monitoring is that the water intake is guarded permanently, avoiding the need for a high frequent collection of water samples and lab analyses. A possible pollution is detected within minutes, allowing the operator to take appropriate actions immediately.

The newly developed BACTcontrol detects the presence of bacteria - including *E.coli* and coliforms – in the water. The online monitoring is based on an enzymatic reaction performed by the bacteria that makes the degradation product visible for fluorescence detection. References of BACTcontrol users include water supply companies, environmental laboratories and operators of bathing facilities in Austria, Germany, Switzerland, the Netherlands, Denmark, Finland and Spain.

The company conducts research and development through collaborations with customers and specialized research organizations focusing on new technologies and oriented to market demand. Its current products, which include the iTOXcontrol monitor and the ALGcontrol for monitoring algae species and bio-toxins, enable microLAN to provide quick, sensitive, environmentally-friendly and cost effective monitoring solutions.

- Main tasks in the project:**
- **WP4:** tailor monitoring strategies for cNES based on data from site monitoring in WP1, 2 and 3. Support to QMRA task.
 - **WP7:** develop exploitation strategy for the BACTcontrol. Inform the dialogue with authorities with respect to standardisation and certification of the device. Contribution to dissemination in Workshops

Principal research personnel to be involved:

Name/ Profile/ Project responsibility	Gender
<p>Joep Appels:</p> <p>has a degree in analytical chemistry (HBO-A) and a degree in marketing (NIMA-B). He has 30+ years of experience in the field of (on-line) water and environmental analysis and worked for several major US instrument companies including Thermo Instruments and New Brunswick Scientific. He will coordinate the work within this project for microLAN and attend meetings</p>	M
<p>Jaap van den Dries:</p> <p>Has a bachelor degree (Avans University) and works with the company since 2009. He will be responsible for all technical developments and supports the installations, trainings and testing at local facilities.</p>	M

Relevant publications:

1. Appels J., Kuster E. and van den Broeke J. (2007). Combination of an on-line biomonitor using light emitting bacteria and a UV spectrophotometer probe for homeland security and drinking water safety. In: Kamerman G. W., Steinvall O. K., Keith L. Lewis, Krapels K. A., Carrano J. C. and Zukauskas A. (eds.), *Proceedings of the SPIE 6739, Electro-Optical Remote Sensing, Detection, and Photonic Technologies and Their Applications*, 6739E, Florence, Italy. doi:10.1117/12.748031
2. Appels J. and van Tuijn J. (2012). iTOXcontrol Safeguards Intake Romanian Drinking Water, *Everything About Water magazine*, 31-32.
3. Appels J. and Kokkali V. (2013). On-line SPE-TOX monitoring: the end of lab toxicity testing, *Rapid Methods Europe (RME) Conference*, January 21, Noordwijkerhout, The Netherlands.

Further, microLAN contributed with instrumentation to the research described in:

4. Ryzinska-Paier G., Lendenfeld T., Correa K., Stadler P., Blaschke A.P., Mach R.L., Stadler H., Kirschner A.K. and Farnleitner A.H (2014). A sensitive and robust method for automated on-line monitoring of enzymatic activities in water and water resources, *Water Science and Technology*, **69**(6),1349-1358.

Relevant previous projects or activities:

1. **AQUAVALENS** (EU FP7, 2014 – 2018 GA no. 311846): AQUAVALENS will be developing technologies to better control water supplies with respect to health safety. The microLAN device is being tested for suitable application in drinking water production and water for the food processing industry.

Infrastructure/ technical equipment:

- BACTcontrol device: an online automated instrument for the detection of microbiological activity in water.
- workshop facilities for maintenance of systems

9	X-Flow B.V. (XFLOW)	X-FLOW
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General description:

X-Flow is part of Pentair’s Flow and Filtration Solutions business and produces and supplies a wide range of standard membranes and modules for filtration and purification processes in different industries, like water, waste water and beverage.

Therefore, advanced membranes are our business. We help equipment manufacturers, engineering and construction contractors to exceed expectations with membranes that make the difference, even in the most challenging tasks and conditions. Focused on practical and economic progress, we develop filtration technology with the lowest total cost of ownership and the highest efficiency.

One of the newest developments is a capillary nanofiltration membrane. X-Flow nanofiltration membranes are characterized by a low operating pressure and chlorine resistant PES membrane material. The membranes find their main applications in the removal of humic substances and other dissolved organic matter. And it also removes synthetic chemical compounds such as dyes.

Main tasks in the project:

- **WP 1:** Preparation and operation of two NF-pilot plants for testing NF-membranes after bank filtration (BF) on Berlin demonstration site (no. 1) to demonstrate long-term stability of capillary nanofiltration. Evaluation of the results and tuning/developing NF-membranes for partial removal of selected compounds and the extension of applicability of nanofiltration for bank filtrate/groundwater treatment from strictly anoxic to suboxic conditions.
- **WP7:** scientific and commercial exploitation of demonstration results (exhibitions, workshops)

Principal research personnel to be involved:

Name/ Profile/ Project responsibility	Gender
<p>Leo Vredenburgt</p> <p>Leo Vredenburgt is researcher in the Advanced Filtration (AF) R&D group of Pentair X-Flow. He is specialized in the process development of especially capillary nanofiltration membranes. He coordinates the AquaNES project inside the organization of X-Flow B.V and attends the project meetings and different bilateral meetings to fulfil the expectations of the project including dissemination of results and exchange with target groups as well as support in pre-commercialization and up-scaling.</p>	M
<p>Jens Potreck</p> <p>Jens Potreck is R&D Manager X-Flow and is head of the AF R&D group. He supports Leo Vredenburgt in the project lead due to his experience in EU funded projects.</p>	M
<p>Radek Oborny</p> <p>Radek Oborny is an R&D technologist in the AF R&D group inside X-Flow. He is a specialist in the layer by layer (LbL) technology and he will transfer the generated knowledge inside the consortium into the production steps of our company.</p>	M
<p>Wika Wiratha</p> <p>W. Wiratha is an R&D technologist in the AF R&D group inside X-Flow. She will transfer the generated knowledge inside the consortium into the production steps of our company.</p>	F
<p>Michael Rojas</p> <p>Michael Rojas is project manager in the AF R&D group inside X-Flow and supports Leo Vredenburgt in all project management and commercialization related subjects.</p>	M
<p>Tom Spanjer</p> <p>Tom Spanjer is senior technologist in the AF R&D group inside X-Flow. He is specialized in the process</p>	M

<p>development of capillary ultra- and nanofiltration membranes. He supports the pilot research with data processing and interpretation, troubleshooting and process optimization. Furthermore he will support Henry Hamberg with the upgrading of the pilots.</p>	
<p>Henry Hamberg</p> <p>Henry Hamberg is a technician in the AF R&D group inside X-Flow and well experienced in the construction, modification and operation of pilot plants. He will have the practical lead during the upgrading and commissioning of the pilots.</p>	<p>M</p>
<p>Relevant publications:</p> <ol style="list-style-type: none"> 1. Keucken, A., Spanjer, T., Ericsson, P., Persson, K.M., Köhler, S. (2014). Evaluation of Color Removal Package (CRP) for drinking water based on novel hollow fiber nanofiltration, The 9th Nordic Drinking water Conference, 2014. 2. De Grooth J., <u>Oborny R.</u>, <u>Potreck J.</u>, Nijmeier K. and De Vos W. M. (2015). The Role of Ionic Strength and Odd-Even Effects on the Properties of Polyelectrolyte Multilayer Nanofiltration Membranes. <i>Journal of Membrane Science</i>, 475, 311-319. 3. Heidfors, I., Vredembregt, L.,H.J., Homes, A., Van Es, B. (2015). Pilot testing with hollow fiber nano filtration membranes for removal of NOM from surface water in Sweden. NOM 6, IWA Specialist Conference on Natural Organic Matter in Water, Malmö, Sweden 7–10 September 2015 	
<p>Relevant previous projects or activities:</p> <ol style="list-style-type: none"> 1. LbLBRANE (FP7 GA no. 281047): Regenerable active polyelectrolyte nanofiltration membranes for water reuse and metal-acid recovery. XFLOW developed a modified membrane module with specific retention and filtration behaviour which will be demonstrated in full-scale application in AquaNES. 2. SurFunCell (FP7 GA no. 214653): Surface functionalization of cellulose matrices using cellulose embedded nano-particles. 	
<p>Infrastructure/ technical equipment:</p> <p>XFLOW possesses facilities to test, characterise and modify its membrane products</p> <ul style="list-style-type: none"> • Well-equipped laboratory with all relevant membrane analysis methods as: SEM/EDX, ICPE, DSC, GPC, TOC, UV-Vis, Rheometer, several retention and permeability measurement units. • Small scale up to pilot scale process testing on real and synthetic waters. • Pilot and laboratory membrane spinning lines. • Module production and development equipment. • Coating equipment from laboratory to large production module size. 	

10 Vertech Group (VTG)



General description:

VERTECH GROUP (VTG) is a French research intensive SME with business focus on High-Tech Environmental Consultancy, International R&D Consultancy and Market Research and business development. VTG aims to create value by supporting and advising private and public organizations in various sectors (e.g. recycling, energy and waste treatment), and regions (e.g. Europe, Latin America) to get from research to market. VTG is member of the French Life Cycle Assessment Platform (Avnir)

VTG capabilities include:

- Sustainability Assessments of processes and strategies
- Analysis of ecological footprint
- Life Cycle Assessment and Life Cost Cycling of innovative processes and products Environmental Technology Verification
- Socio-economic impacts of innovative products by Social Life Cycle Assessment
- Techno-economic, environmental, social and legal analysis and risk assessment
- Business models and business plans definitions
- Exploitation of R&D results and exploitation plans
- Dissemination activities

The staff of Vertech Group has over 10 years of experience on international cooperation, coordinating projects and WPs. Vertech Group is member of the French Life Cycle Assessment Platform (Avnir). The company is based in Nice, in the French EcoValley, that is the first example of a real sustainable urban environment. VTG is also present in Spain and has expansion plans to other markets besides Europe (e.g South America).

Main tasks in the project:

- **WP 7:** Leader of WP7 - Exploitation and dissemination'. Responsible for exploitation strategy including market studies and business models generation, and support of dissemination of results. Designated Exploitation Manager and IPR Advisor
- **WP 5:** Environmental assessment of cNES technologies by Environmental Life Cycle Assessment (E-LCA); study of the cost of the system by performing a lifecycle costing (LCC); evaluate socio-economic impacts with Social Life Cycle Assessment S-LCA

Principal research personnel to be involved:

Name/ Profile/ Project responsibility	Gender
<p>Dr Paola Castrillo</p> <p>Paola Castrillo has a Science and Materials Engineering PhD from Carlos III he University of Madrid. From 2004 to the present she has been active in the preparation, management, coordination and / or development of several European R & D projects in the areas of sustainability and revalorization of urban and agricultural wastes/residues (i.e. FFW-FP7, NOSHAN-FP7, GRAIL-FP7, CLOSEWEEE-H2020, INNOBITE-FP7, TECNOCAI- CENIT, etc.). Her research interests include sustainable revalorization of urban wastes, energy and resources efficiency, sustainability and manufacturing processes efficiency assessments. She is the Technical Coordinator of the FFW (FP7) and CLOSEWEEE (H2020) projects. Currently working as Commercial Manager for Vertech Group. Support on LCA, LCC and social LCA development.</p>	F
<p>Dr Erasmo Cadena</p> <p>Erasmo Cadena has a PhD in Environmental Science from Universitat Autònoma de Barcelona (UAB). He holds a Msc in Enviromental Engineering. Postdoctoral Researcher at University of Cambridge-UK and Universitat Politècnica de Catalunya (UPC), BarcelonaTech. He has experience in international re-</p>	M

<p>search initiatives and his research interests include technical, environmental and economic analysis of new processes and high-performance. products, life cycle assessment, life cycle costs analysis. Erasmo will be performing the various LCA, LCC tasks in WP5.</p>	
<p>Eléonore Chabbey</p> <p>Eléonore Chabbey is BSc in Business & Management from the University of Nice Sophia Antipolis, Msc1 and Msc2 in Economy Management of Small-Medium-Enterprises. Currently Mrs. Chabbey is in charge of business development within the company, her activities include market research and analysis, business modelling and market uptake strategies. She will be working on the market analysis and Business Model CANVAS tasks.</p>	F
<p>Antonio Barona</p> <p>Antonio Barona is the responsible of the overall R&D, Innovation & Business strategy of the company. He holds a Bs in Civil Engineering, M.Sc. on Materials and Innovation, M.Sc. in Project Management. Mr. Barona has more than 10 years of experience in the coordination of international research. He is member of several international academic, business and research platforms dealing with Environmental and Energy Technologies for a Sustainable Future. In terms of international research cooperation, he has not only actively participated in several project proposals but has led the project Coordination of the FP7 projects: EE-QUARRY & S4EeB. He will be performing the management of the project and WP7, assessing on strategic planning and support on LCA and LCC.</p>	M
<p>Relevant publications:</p> <ol style="list-style-type: none"> 1. Garfí M., <u>Cadena E.</u>, Pérez I. and Ferrer I. (2014). Technical, economic and environmental assessment household biogas digesters for rural communities. <i>Renewable Energy</i>, 62, 313–318. 2. Adesanya V., <u>Cadena E.</u>, Scott S. and Smith, A. (2014). Life cycle assessment on algae biodiesel production using a hybrid cultivation system. <i>Bioresource Technology</i>, 163, 343-355. 3. Colón J., <u>Cadena E.</u>, Sánchez A., Artola A. and Font X. (2012). Environmental impacts of installations of biological treatment of municipal organic wastes. <i>Ingeniería Química</i>, 44, 62–67. 4. Colón J., <u>Cadena E.</u>, Pognani M., Maulini C., Barrena R., Sánchez A., Font X. And Artola A. (2013). Toward the implementation of new regional biowaste management plans: Environmental assessment of different waste management scenarios in Catalonia. <i>Resources, Conservation and Recycling</i>. Volume 95, February 2015, Pages 143–155 	
<p>Relevant previous projects or activities:</p> <ol style="list-style-type: none"> 1. EU FP7 WATER4INDIA - Smart, cost-effective solutions for water treatment and monitoring in small communities in India. A Decision support system integration tool. 11 partners. www.water4india.eu. The project develops solutions for producing drinking water, technologies for treatment of wastewater, monitoring technologies of treated waste water and a Decision Support System (DSS) integration tool aiming to large scale deployment of technologies in cost effective manner. 2. EU FP7 INNOBITE - Transforming urban and agricultural residues into high performance biomaterials for green construction. 9 partners. www.innobite.eu. The project analysis of the cost effectiveness and environmental credentials of the products/processes developed and of new possible business lines and new business models. 3. H2020 CloseWEEE - Integrated solutions for pre-processing electronic equipment, closing the loop of post-consumer high-grade plastics, and advanced recovery of critical raw materials including antimony and graphite. 12 partners. www.closeweee.eu. 	
<p>Infrastructure/ technical equipment:</p> <ul style="list-style-type: none"> • software SimaPro® 8 (PRé Consultants) and Ecoinvent v.3 databases (Swiss Center for Life-Cycle Inventories, 2010). Analytical tools in accordance with ISO 14040 & 14044 standards (ISO 14042, 2000). 	



11 Wadis Ltd.

General description:

Wadis Ltd. is a private start-up company, located in Ness Ziona, Science Park, Israel. Founded in 2010, by Oren Gafri, a leading expert in electromagnetic pulse systems and material and processing and Riki Gafri, who has 25 years of management experience in the high-tech and clean-tech industry. The company has 7 employees, comprised of scientists, mechanical, electrical and environmental engineers.

Wadis is the first company to have developed and patented a commercially viable, industrial-scale process that applies an electrical pulse discharge technology (“EPDT”) for the disinfection of all types of water. This technology has many advantages over the conventional existing disinfection technologies as being more environmental friendly process (no /low disinfection byproducts formation) while effectively disinfecting

Main tasks in the project:

- **WP 2:** WADIS will demonstrate the electric pulse oxidation system as an alternative to ozonation at the Shafdan study site (IL). The process will be tested as a pre-oxidation system for bioactive carbon filter and UF ceramic filter and also in combination with short soil aquifer treatment.
- **WP4:** test case support to Risk Assessment tool
- **WP7:** participation in the exploitation plan development for its EPDT.

Principal research personnel to be involved:

Name/ Profile/ Project responsibility	Gender
<p>Riki Gafri, CEO</p> <p>Riki Gafri is a software engineer and a business manager (MBA), She has 25 years of management experience in the high-tech and clean-tech industries, having served as CFO, CHR as well as a director in several companies. Riki will manage the project, coordinate between Wadis team, Mekorot and Shafdan people, take care of the project budget, be responsible for the purchase orders, see that work meets the predefined time table</p>	F
<p>Amit Izhar, R&D manager</p> <p>Amit serves as Wadis R&D manager since 2010. Before that he served as freelance advisor to Avkad in the fields of automated stock and commodity trading "robots" and design of noise emission metering. Prior to that, and for 10 years, he served as application engineer in Pulsar Welding, where he was involved in developing magnetic burst-energy systems (replacing explosives in welding, forming, excavation, etc.) Amit is the senior engineer of the project, he will be responsible of the design, build and run of the system. He will also be responsible for the system maintenance and he will supervise the work in the field.</p>	M
<p>Dr. Haim Cikurel</p> <p>In-house consultant and coordinator of the Shafdan demonstration site. He has 43 years of experience in different fields of research, operation and engineering in the Chemical Process Industries and in Environmental Engineering. He has been involved with Mekorot and other Israeli companies in all EU – Framework programmes (4th, 5th, 6th and 7th) since 1998 with different projects in effluent reuse, water and wastewater treatment (e.g., Catchwater, Aquarec, Techneau, Reclaim, Switch, MINOTAURUS, Water4India, Demoware). Supervising on-site activities in Shafdan. Contribution to technology performance validation.</p>	M

Relevant patents: System and method for treatment of liquid – the Wadis system

Country	App. No.	Our Ref.	Filed	Patent No./	Grant Date/	Status/Next action

Israel	210808	2059034	23/01/2011			Examination in progress; Acceptance/Next office action received: Jul 29, 2015
Patent Cooperation Treaty	PCT/IL2012/050013	2137727	19/01/2012			National Phase entered & case finished
China	201280006215.3	2234932	19/01/2012	CN 103328390A	25/09/2013	Examination in progress; Office Action due: Jul 19, 2015
European Patent Office	12707387.2	2234942	19/01/2012	2665684	27/11/2013	Examination in progress; Acceptance/Next office action received: Jan 13, 2016
India	1382/MUMNP/2013	2234959	19/01/2012			Examination requested; Expected date for 1st Official Action: Dec 11, 2015
United States of America	13/980,734	2234970	19/01/2012	US-2013-0299351	14/11/2013	Examination in progress; Office Action due: Jul 17, 2015

Relevant previous projects or activities:

1. Running system in Kfar Sabba WWTP (waste water treatment plant), treating tertiary water (instead of UV). Disinfection results achieved were very good : a 4-5 log reduction.

Infrastructure/ technical equipment:

The Wadis System consists of three main parts:

- **Power Generator** - contains solid-state capacitors for accumulating and condensing electrical energy, and multi-vacuum switches that discharge this energy to the coil in a few microseconds. It produces electrical pulses according to predefined amount and power. The pulses move through sophisticated high voltage cables to the EDC. The generator provides high energy efficiency in switching; due to an innovative use of switches and cables the switches are durable to the recurrent discharges. **2)**
- **Electrode Discharge Chamber (EDC Reactor)** - The reactor is where the liquids flow through and undergo the electro-discharge disinfection process. It is connected by flanges to the liquid flow tubular system. Here, the pulses move to unique electrodes that are dumped in the waste water. It is a tube which includes new, innovative electrodes. The unique characteristics of electrode cells - their structure, their number and their arrangement in the tube enable high voltage pulses coming from the Pulse Current Generator (PCG) to be discharged. They enable high performance while using a low consumption of energy.
- **Control unit** – this unit incorporates an operator console and contains the operating system software to control the energy input and output (intensity and time). The software also gives a complete real time diagnostics of the system functioning.

12 WatStech Ltd.



General description:

WatStech was originally a spin-off company from the University of Wolverhampton and was first formed as a research group in 2000. In 2005, WatStech Ltd. was created which in 2008 became an independent company. WatStech Ltd. is a research and consultancy company providing technical support to the Water Industry for over 10 years, with a focus on applied research and problem solving for treatment difficulties faced by the water industry. WatStech Ltd. has expertise in water and wastewater treatment with practical experience in full-scale, pilot-scale and lab-scale treatment processes. WatStech Ltd. has fully equipped laboratories for process testing and development of specialist analytical techniques. The trademarked analysis service called RapStech® was developed specifically for the water industry, to determine granular activated carbon (GAC) regeneration time scales to meet drinking water standards.

WatStech Ltd. is a framework supplier for “Wastewater Sampling & Specialist Analysis” to Severn Trent Water Ltd. from 2010-15. It provides regular site sampling and analysis services for many wastewater sites throughout the Severn Trent region and assists in the feasibility studies for full-scale plant design for the Asset Management Programme 5 (AMP5) and beyond. WatStech is a key member of the team for operating & monitoring pilot plants that are using novel technologies for the treatment of wastewaters within the West Midlands. WatStech Ltd. also works with other industry sectors; including food & drinks manufacturing, pharmaceutical products and metal processing such as the Galvanising industry.

WatStech has a team of qualified and technical experts with over 30 years of experience in water and wastewater including feasibility and project scoping studies, pilot-scale and full-scale evaluations, project management as well as research & development activities.

Main tasks in the project:

- **WP3:** operation of pilot plants for phosphorous removal at demonstration site (No. 13) Packington
- **WP7** exploitation plan development for innovative, low energy enhanced P-removal technologies

Principal research personnel to be involved:

Name/ Profile/ Project responsibility	Gender
<p>Dr. Kalminder “Kally” Kaur Qualifications: BSc in Biological Sciences, PhD in Chemical Engineering & Biology using Ozone as a Biocide, at the University of Birmingham, UK. Kally Kaur is an expert in the fields of operational science and engineering of water treatment technologies with 25 years of experience. She is the managing Director of WatStech Ltd., employing up to 5 staff members and with a total turnover in the last 8 years of approx. £1.7 million. Previously, Kally was the Founder and Leader of the Research Group ‘WatStech’ within the School of Applied Sciences at the University of Wolverhampton for 5 years. Prior to academia, Kally Kaur was an employee of Severn Trent Water for 11 years, directly involved in the research of new processes, commissioning major treatment plants including ozone and GAC plants, assessing design and operation of a wide range of water treatment assets. She will be supervising the AquaNES activities at the demonstration site and coordinating WatStech contribution within WP7.</p>	<p>F</p>
<p>John Churchley Qualifications: BSc. Chemistry (Leeds University, UK) and member of CIWEM (Chartered Institution of Water & Environmental Management), as well as past-Chairman of East Midlands Branch of CIWEM. John Churchley, recently retired from Severn Trent Water (2010) with over 34 years of experience working within the water industry, specifically at Severn Trent Water utility in wastewater treatment. Since, joining WatStech Ltd. in 2010, he has continued to provide expert advice to Severn Trent Water and was directly involved in two UKWIR projects WW17 “Dangerous Substances and Priority Hazardous/Priority Substances” and “Catalytic Oxidation of Pharmaceutical Compounds in Wastewater Effluents”. He is principal author or co-author on a number of published papers amounting to over 25 in total. Topics have included chemical dosing, dyewaste colour removal, tip leachate treatment, phosphorus removal, ASP optimisation, heavy metal removal, struvite formation and occurrence and removal of endocrine disrupting chemicals. He will be involved in dissemination and exploitation</p>	<p>M</p>

<p>tasks, networking and marketing activities.</p>	
<p>Lovina Kulkarni Qualifications: BSc. Eng. Chemical & Environmental Engineering, University of Mauritius. MSc Environmental Technology, University of Wolverhampton UK. Lovina Kulkarni has worked at WatStech Ltd. for 9 years, since completing her MSc at the University of Wolverhampton. She has provided technical expertise and research development skills in her role as Process Technologist, with excellent interpersonal skills and ability to work under pressure to meet deadlines while maintaining the quality of work. Lovina Kulkarni has acquired 9 years of experience of operating pilot scale and full-scale plants for water/wastewater treatment on client's premises, as well as analysis in the laboratory environment. Lovina Kulkarni has developed skills for environmental problem solving, as well as managing projects with responsibilities for completion of technical reports, managing budgets for laboratory consumables and equipment. Responsible for pilot plant operation and technology assessment within WP3.</p>	<p>F</p>
<p>Relevant publications:</p> <ol style="list-style-type: none"> 1. Baynes, A., Green, C., Nicol, E., Beresford, N., Kanda, R., Henshaw, A., Churchley, J., Jobling, S. (2012). Additional Treatment of Wastewater Reduces Endocrine Disruption in Wild Fish-A Comparative Study of Tertiary and Advanced Treatments. Environmental Science & Technology. 46. 10: 5565-5573 2. Pitt S., Hale, C., Kaur, K., Vale, P., & Wilson, R., (2008). Evaluation of suitable design configurations for Enhanced Biological Phosphorus Removal (EBPR) at Minworth WwTW. Second European Water & Wastewater Management Conference, 29-30th Sept. 2008 at Millennium Point, Birmingham, UK. 3. Kaur K., Pitt, S., Porter, M., & Wetherill, A., (2008). Assessing the Service Life of Field-Spent GAC using Rapid Small Scale Column Tests (RSSCTs - RapStech® service). Second European Water & Wastewater Management Conference, 29-30th Sept. 2008 at Millennium Point, Birmingham, UK. 4. Ifelebuegu, AO., Lester, JN., Churchley, J., Cartmell, E (2006). Removal of an endocrine disrupting chemical (17 alpha-ethinyloestradiol) from wastewater effluent by activated carbon adsorption: Effects of activated carbon type and competitive adsorption. Environmental Technology. 27. 12: 1343-1349. 5. Kaur, K., Churchley, J., Kandhola, N (2005). Development of an electrochemical oxidation process for the treatment of landfill leachates. Water and Environment Journal. 19. 4: 384-393. 	
<p>Relevant previous projects or activities:</p> <p>WatStech brings in experience in technology piloting and collaboration with water utilities;</p> <ol style="list-style-type: none"> 1. WatStech have operated, maintained and sampled <u>pilot Enhanced Biological Phosphate Removal (EBPR) wastewater plants</u> based at 4 wastewater sites within Severn Trent Water region, for durations of between 3 to 18 months. Compilation of results, production of detailed reports and regular client liaison has formed the basis of the work completed. <p>WatStech has also been involved with specific Chemical Investigations Programme (CIP) as follows;</p> <ol style="list-style-type: none"> 2. UKWIR project WW17 Dangerous Substances and Priority Hazardous/Priority Substances: WatStech's remit was to provide the technical, process expertise for the consortium for C2 Investigations to Assess Treatment Options for Chemicals and specifically for C3 Investigations to Assess Advanced Treatment Options. WatStech has worked for Severn Trent Water Ltd. as part of this consortium and was operating 3 pilot plants at Hallam Fields, with associated project management, design of experiments, data analysis and provision of technical reports. 3. UKWIR project WW17: Catalytic Oxidation of Pharmaceutical Compounds in Wastewater Effluents 2012: WatStech provided technical expertise, staff and laboratory facilities to the project 	
<p>Infrastructure/ technical equipment:</p> <p>WatStech Ltd. has two fully equipped laboratories to provide analytical services with practical applied research facilities for laboratory scale testing of wastewaters and can be utilised as part of this project.</p>	



13 Xylem Services GmbH (XYLEM)

General description:

Xylem Services GmbH with its ozone oxidation and UV disinfection brand Wedeco is a leading manufacturer of non-chemical treatment of water with more than 250,000 installations worldwide. Xylem offers environmentally friendly, healthy and residue-free forward-looking technologies such as ultraviolet systems and ozone systems. Maximum customer benefit is provided by a comprehensive combination of standardized systems and engineered solutions for treatment of potable water, process water, municipal and industrial wastewater. Xylem is also heavily engaged in the field of Advanced Oxidation Processes (AOP) by designing improved AOP concepts.

In Xylem's R&D department lab-, bench scale and technical scale pilot tests and modelling of ozone and UV systems are conducted to develop market-ready products and applications together with the product management department which focuses on cost calculations and Life-Cycle Assessments. Xylem also has an engineering department where ozone, UV and AOP systems are designed, customized and engineered as well as a manufacturing department which retro-fits and builds new equipment and is responsible for the installation and start-up of AOP systems.

Xylem Services GmbH participated in several pilot studies and the implementation of full scale plants around the globe for the treatment of drinking water sources and wastewater reuse research and full-scale projects with ozone or UV based advanced oxidation processes.

Main tasks in the project:

- **WP 2:** Xylem will design and establish AOP pilot systems at the Shafdan demonstration site (water reuse) and the Lange Erlen demonstration site (drinking water production). Xylem will further evaluate the results and assess the suitability of AOP processes in combination with MAR/SAT for indirect potable reuse of treated wastewater; feed expertise into AquaNES DSS
- **WP3:** Xylem will provide, assess and exploit the ozonation + control unit in combination with CW as post-treatment at WWTP Schönerlinde, Berlin, Germany (demonstration site No. 12)
- **WP7:** contribution to exploitation and dissemination (exhibition, fairs, workshops).

Principal research personnel to be involved:

Name/ Profile/ Project responsibility	Gender
<p>Dr. Achim Ried</p> <p>Dr. Achim Ried is in the company since 1993 as Chief Engineer of the Research and Development Department. He has a PhD in Chemistry from the Universities of Göttingen and Marburg, Germany. Dr. Achim Ried is member of the International Board of Ozone Association, secretary of IWA Specialized Group AOP, chairman of ozone working group within FIGAWA ("Firmen im Gas- und Wasserfach") as well as member of the AOP working group DWA. He has participated in EU FP5 Poseidon, EU FP7 Innovatec, EU FP7 Aquafit4use and EU FP7 Limpid. He will be supervising the XYLEM activities in AquaNES Project and</p>	<p>M</p>
<p>Harald Stapel</p> <p>Harald Stapel is in the company since 1998. He is the Manager of Industrial & Process Sales. He has a degree in environmental engineering at the Universities of Applied Sciences Höxter, Germany. Harald Stapel has been involved in the EU FP7 Aquafit4use project. He will be the Coordinator of XYLEM tasks in the AquaNES Project, overseeing pilot installation and commissioning and optimization.</p>	<p>M</p>
<p>Arne Wieland</p> <p>Arne Wieland joined Xylem in 2004 as Application and Process Engineer in the Research and Development Department. He has a degree in environmental and process engineering at University of Applied Sciences Osnabrueck, Germany. He participated in EU FP7 Innovatec and the EU FP6 Neptun projects. Arne Wieland will be Project Manager for the XYLEM activities in the AquaNES Project, responsible for pilot installation and performance assessment.</p>	<p>M</p>

Relevant publications:

1. Scheideler J., Lekkerkerker-Teunissen K., Knol T., Ried A., Verberk J. and van Dijk H. (2011). Combination of O₃ / H₂O₂ and UV for multiple barrier micropollutant treatment and bromate formation control – an economic attractive option. *Water Practice and Technology*, 6(4), doi:10.2166/wpt.2011.0063
2. Lekkerkerker-Teunissen, J. Scheideler, A.H. Knol, A. Ried, J.Q.J.C. Verberk, J.C. van Dijk (2011). Combined O₃/H₂O₂ and UV for multiple barrier OMP treatment and bromate formation control – One year pilot plant research. IOA World Conference, Paris, 23-27 May 2011
3. Krüger J., A. Ried, K. Teunissen, A.H. Knol, and D. Csalovszki (2009). Advanced Oxidation Process – Effective and Technical Suitable for Micropollutant Removal in Contaminated Water Sources. IOA Conference Boston, 3-6 May 2009

Relevant previous projects or activities:

Xylem has provided oxidative treatment processes for testing in various RTD projects.

1. **POSEIDON** (EU project, FP5 project reference. EVK1-CT-2000-00047): POSEIDON focused on the assessment and improvement of technologies for the removal of pharmaceuticals and ingredients of personal care products (PPCPs) in wastewater and drinking water facilities to prevent the contamination of receiving waters, groundwater and drinking water by planned and unplanned indirect potable water reuse of treated urban wastewater.
2. **INNOWATECH** (EU project, FP6 GA no. 36882): The main objective of the project was to investigate, assess and enhance the potentiality of promising technological options for the treatment of industrial wastewater with the specific aim to provide tailor-made solutions to end-users for a wide range of wastewaters. Such solutions are essentially based on the optimised integration of the investigated options and on technological improvements with respect to treatment system components, operation and control.
3. **AquaFit4Use** (EU project, FP7 GA no. 211534): AquaFit4Use aimed at making industries more independent of the supply of fresh drinking water for their production processes. Secondly, an important step forward was being taken within the project in obtaining water qualities that are tailored to suit product and process demands and quality standards, in other words “water fit-for-use”.
4. **LIMPID** (EU project, FP7 GA no. 310177): LIMPID aims at generating new knowledge on photocatalytic materials and processes in order to develop novel depollution treatments with enhanced efficiency and applicability. The main goal of LIMPID is to develop materials and technologies based on the synergic combination of different types of nanoparticles into a polymer host to generate innovative nanocomposites which can be actively applied to the catalytic degradation of pollutants and bacteria, both in air or in aqueous solution.
5. **TransRisk** (Federal Institute for Hydrology, funding code 02WRS1275A): The project focused on transformation products that are generated through the oxidative treatment of water containing micropollutants. The resulting risk was assessed and different technologies were tested to minimize the formation of transformation products and to enhance the degradation of micropollutants.

Infrastructure/ technical equipment:

- Xylems R&D and manufacturing site for Ozone, UV and AOP products in Herford, Germany produces with 260 employees all equipment and auxiliaries for the global ozone, UV and AOP market.
- Xylems application R&D lab provides Ozone, UV and AOP feasibility testing capabilities.
- The Xylem pilot engineering team designs, builds and trains operators or operates pilot system all over the world to investigate new processes and client specific tasks.



14 Budapest Waterworks plc., Hungary (BUWW)

General description:

The 147-year-old company provides water to the population of Budapest and the surrounding settlements. Budapest Waterworks is in charge of water production from 740 wells with bank filtration along the Danube River, the maintenance and repairing of their 5,200 km long distribution network, and serves 2 million clients at the end of the 250,000 service connections whose aggregated maximum daily demand is 581,000 m³. The number of employees is 1,750. Through the implementation of active leakage control activity, district-metered areas and other measurements and processes during the last years, the company managed to decrease the Non-Revenue Water (NRW) rate below 16%.

Through a wide network of partner universities, industrial partners and SMEs a continuous participation in R+D+I projects is ensured. The water supply network, the laboratories and other premises of the company serve mainly as test and pilot fields for these activities.

Budapest Waterworks research and development activities focus on supply network management, pressure management, loss management / NRW-reduction and mobile water treatment. Relevant employees are regularly taking part in conferences, seminars and trainings.

Main tasks in the project:

- **WP1.** Demonstration of bank filtration operation, optimized usage of Cl₂ and other technologies. Coupling of bank filtration and UV and RO in cooperation with EJC. Innovative concepts for well operation & protection during floods and droughts.
- **WP7.** Dissemination and exploitation

Principal research personnel to be involved:

Name/ Profile/ Project responsibility	Gender
<p>Ing. László Debreczeny, head of water production department</p> <p>Educated water supply and electrical engineer, professional in water and sewage treatment, with experience in water extraction, water treatment and network operation. Participated in several R&D projects in water loss management, pump analytics, life cycle analysis of water production equipment. Participates in trainee programmes and is active in professional association. Responsible in AquaNES for dissemination and exploitation of site results into the Hungarian Water Utility Association and Danube River Basin water sector.</p>	M
<p>Ing. Balázs László, water technology engineer</p> <p>Experienced environmental and IT engineer, chemist, with experience in water base management, surface water quality, water treatment and water quality assurance. Worked in the field of R&D at the Budapest Technical University and the research department of the Hungarian Academy of Sciences. Responsible for running of RO-pilot scheme at site 3</p>	M
<p>Ing. Till Gábor, senior consultant</p> <p>Engineer with strong managerial knowledge, experienced in the field of water supply, building services and energetics. Special technical fields in pumping, renewable energy, industrial processes and managing projects, multinational teams. Technical advice and support in knowledge dissemination.</p>	

Relevant publications:

1. Davidesz J. and Debreczeny L. (2009). Long term sustainability of river bank filtration aquifers regarding availability and capacities, Hungarian Water Utility Conference
2. Davidesz J., Dorko J., Molnár Z. and Szolgay Zs. (2008). Water Production By Bank-filtration With Mini Ranney Wells, IWA World Water Congress and Exhibition in Vienna
3. Grandguillaume J.J., Pusztai A., Paillé J. S., Jano T., Molnar Z. and Davidesz J. (2008). Microbiological Water Quality of a Massive Riverbank Filtration System on the Danube River, IWA World Water Congress and Exhibition in Vienna, 7-12 September 2008

4. Dorkó J., Davidesz J., Molnár Z. and Debreczeny L. (2007). Investigations at the Northern water base of Budapest Waterworks, Hungarian Water Utility Conference
5. Fenyvesi N., László I., Davidesz J. and Molnár Z. (2009). Preparing for shallow water periods, Operation management at the Southern water base of Budapest Waterworks, Hungarian Water Utility Conference

Relevant previous projects or activities

Budapest Waterworks actively initiates and takes part in internal and external research and development projects with

1. operation of riverbank filtration among extreme weather conditions (flood and drought operation),
2. modelling and investigation of the sustainability and efficiency of the natural riverbank filtration,
3. research and development of renovation at mini Ranney wells (in co-operation with Duna-Kút Ltd.)

Infrastructure/ technical equipment

Budapest Waterworks operates a

- large and complex water extraction, treatment and distribution network: 740 wells, 5,200 km distribution pipe-work, 67 reservoirs and serves 2 million inhabitants.
- activities certified according to ISO9001, ISO14001 and ISO22000 standards. Operations are monitored and controlled by a widespread IT infrastructure.
- accredited and certified laboratory.



15 Berliner Wasserbetriebe (BWB)

General description:

Berliner Wasserbetriebe (BWB), as a public utility is responsible for drinking water supply and wastewater disposal for the 3.5 million inhabitants of Berlin and is therefore Europe’s largest integrated water utility. BWB and its predecessor organisations have been responsible for urban water supply and sanitation in Berlin for 150 years. The turn over per year is about 250 million € in infrastructure and new technologies.

BWB has a department of R&D with an annual budget of 2.5 Mio € on research. BWB is currently involved as partner or coordinator in 35 projects funded by national and international programmes.

Research activity is structured along the water cycle; including water and wastewater treatment, network modelling, hydraulic engineering and new technologies. Results from R&D are presented in the national Committee for Certification and on international conferences.

Main tasks in the project:

- **WP 1:** One of the demonstration sites (No. 1) will be operated at BWB wells (water protection area) where bank-filtration in combination with anoxic capillary nanofiltration at single wells will be assessed for their advantages and limitations. BWB will operate and regularly monitor the demonstration site, coordinates and communicates with authorities and end users.
- **WP 3:** Demonstration site No. 12 will be constructed and operated at BWB WWTP Schonerlinde to demonstrate long-term viability of constructed wetlands with ozonation as pre-treatment. BWB will operate the demonstration scheme and coordinates with regular treatment scheme at the WWTP and communicates with authorities (e.g. regarding discharge permits) and end-users.
- **WP 4:** BWB will conduct chemical and microbiological analyses of trace organic chemicals, pathogens as well as antibiotic resistance genes at WWTP Schonerlinde.

Principal research personnel to be involved:

Name/ Profile/ Project responsibility	Gender
<p>Dipl.-Ing. Regina Gnriss</p> <p>Regina Gnriss graduated in 1991 from TU Berlin as a civil engineer specialising in water and wastewater technologies. She has been working for the Berliner Wasserbetriebe since 1991 in the department “Laboratory” and since 1994 in the department “Wastewater operation”. She was project manager since 1995 for various projects such as wastewater treatment with carbon dosing, optimisation of aeration systems, membrane-filtration and membrane bioreactors. Since 2007 she is director of the R&D department within the Berliner Wasserbetriebe with a specialised project management certificate. She is a member of the management board of specialised DWA-working groups, e.g. advanced wastewater treatment and Modelling. She is the author and co-author of over 60 journal and conference publications and one patent. Supervisor and coordinator of BWB activities in AquaNES</p>	F
<p>Dr.-Ing. Alexander Sperlich</p> <p>Alexander Sperlich is environmental engineer (PhD), specializing in water and wastewater technologies. After joining Berliner Wasserbetriebe in 2010, he has been responsible for a number of research projects on removal of organic micropollutants during advanced wastewater treatment as well as drinking water treatment, tertiary filtration as advanced wastewater treatment, bank filtration, etc. Responsible for pilot operation and coordination of analytical work on the demonstration sites.</p>	M

Relevant publications:

1. Jekel M., Dott W., Bergmann A., Dünnbier U., Gnriss R., Haist-Gulde B., Hamscher G., Letzel M., Licha T., Lyko S., Miehe U., Sacher F., Scheurer M., Schmidt C. K., Reemtsma T. and Ruhl A. S. (2015). Selection of organic process and source indicator substances for the anthropogenically influenced water cycle. *Chemosphere*, **125**, 155-167.

2. Altmann J., Sperlich A. and Jekel M. (2015). Integrating organic micropollutant removal into tertiary filtration: Combining PAC adsorption with advanced phosphorus removal. *Water Research*, **84**, 58-65.
3. Jekel M., Ruhl A. S., Meinel F., Zietzschmann F., Lima S. P., Baur, N., Wenzel M., Gnirss R., Sperlich A., Dünnbier U., Böckelmann U., Hummelt D., Van Baar P., Wode F., Petersohn D., Grummt T., Eckhardt A., Schulz W., Heermann A., Reemtsma T., Seiwert B., Schlittenbauer L., Lesjean B., Miehe U., Remy C., Stapf M. and Mutz D. (2013). Anthropogenic organic micro-pollutants and pathogens in the urban water cycle: Assessment, barriers and risk communication (ASKURIS). *Environmental Sciences Europe*, **25**(20), doi:10.1186/2190-4715-25-20
4. Sperlich A., Warschke D., Wegmann C., Ernst M. and Jekel M. (2010). Treatment of membrane concentrates: Phosphate removal and reduction of scaling potential. *Water Science and Technology*, **61**(2), 301-306.
5. Sperlich A., Zheng X., Ernst M. and Jekel M. (2008). An integrated wastewater reuse concept combining natural reclamation techniques, membrane filtration and metal oxide adsorption. *Water Science and Technology*, **57**(6), 909-914.

Relevant previous projects or activities

BWB participated in a number of including pilot facilities at their wastewater treatment and water production sites

1. **ASKURIS** (2011-2015, national funding BMBF): A project about the risk posed by anthropogenic micropollutants and multiresistant bacteria in the urban water cycle. BWB developed and validated innovative analytical methods and effect-based assessment approaches.
2. EU FP 7 PREPARED: Preparing water utilities for the effects of climate change (2010-2014). Berlin was pilot city in the project
3. **NASRI** (2002-2006, BWB): Natural and artificial systems for recharge and infiltration. Inhouse project in cooperation with KWB. The interdisciplinary project focused on microorganisms and trace organic substances present in surface waters. It looked into the behaviour and removal of pharmaceutical residues during bank filtration (BWB water capture sites in Berlin).

Infrastructure/ technical equipment

- WWTP
- Drinking water wells
- fully equipped, accredited water laboratory (microbiological and chemical parameter, including micropollutants - HPLC MS/MS)

16 Municipal Authority for Water Supply and Sanitation Thiras (DEYAT)



General description:

DEYA Thiras is the Municipal Company for the provision of water supply and sewage treatment and disposal of Thira (Santorini and Thirasia Islands, Greece) and was founded in May 2011, after the merging of two local water companies. It is responsible for the planning, construction, management, operation and maintenance of the water supply system (desalination plants and pumping wells), irrigation, drainage, and the wastewater collection networks and treatment plants for the islands of Thira (Santorini) and Thirasia.

DEYA Thiras is a local authority with great impact on the island population’s quality of life. Since its foundation, it has undertaken and implemented numerous national and EU-funded infrastructure projects, including expansion of the water supply (network length of more than 6,500 meters) and sewerage networks, six desalination units of 4,000 m³/d, and one wastewater treatment plant (WWTP) in Thirasia island. These projects boosted the tourism sector and enhanced the local economy, while at the same time improving the standards of living in the island by protecting public health and ensuring environmental protection.

DEYA Thiras employs 60 personnel of different affiliations and is managed by an 11 member Board of Directors, which sets the goals for the development policy of the company.

Main tasks in the project:

- **WP 3:** DEYA Thiras is in charge of the operation and maintenance of the WWTP of Thirasia island (demonstration site no. 10) which is under construction and to be completed in December 2015. They will collect and assess data of the demonstrated treatment technologies: solar heterogeneous photocatalysis, constructed wetlands, ultrafiltration membranes, and disinfection. Performance monitoring throughout the duration of the project under different seasonal and hydraulic conditions.

Principal research personnel to be involved:

Name/ Profile/ Project responsibility	Gender
<p>Nikolaos Mainas</p> <p>Nikolaos Mainas is the General Director of DEYA Thiras. He is a mechanical engineer and has more than 10 years of experience in coordinating and delivering water supply and sewerage infrastructure projects.</p>	M
<p>Stamatis Avlonitis</p> <p>Stamatis Avlonitis is the Head of DEYA’s department in the area of Oia and Thirasia. He holds an MSc. in Chemical Engineering and a PhD in Mechanical Engineering with more than 20 years of experience and participation in water supply and sanitation utilities and relevant projects.</p>	M

Relevant publications:

Not applicable

Relevant previous projects or activities:

Vast experience in construction, operation and maintenance projects in the Greek water and wastewater sector will facilitate smooth operation and assessment of the AquaNES cNES sites in the Greek islands:

1. Previous construction, operation and maintenance projects in the water and wastewater sector
2. sewerage network in the villages of Imerovigli, Perissa, Emporio, Oia of Santorini Island and in Thirasia island.
3. Construction, operation and maintenance of the water supply network in the villages of Fira, Imerovigli, Pyrgos, Oia.
4. Studies, installation and operation of six desalination units:
5. One unit in Akrotiri village of Santorini island (capacity: 2,000 m³/day);
6. Two units in Fira village of Santorini island (capacity: 2,000 m³/day);

7. One unit in Thirasia island (capacity: 140 m³/day; in operation since 2012);
8. One unit in Oia village of Santorini island (capacity: 500 m³/day; in operation since 2012);
9. One unit for serving the settlements of Mesa Gonia and Ag. Paraskeui in Thira (capacity: 5,000 m³/day, to be constructed).

Infrastructure/ technical equipment:

- The DEYA owns the facilities of the WWTP in Thirasia and the technical equipment related to the collection, treatment, disposal and use of wastewater and sludge. It also owns a chemical laboratory, located inside the WWTP, for quality monitoring of the treated effluent.
- Use of telemetry systems for the remote monitoring and handling of sewage pumping stations, water pumping stations, and reservoirs.

17 Municipality of Antiparos (MUOA)



General description:

The Municipality of Antiparos was founded in 2010 (under the Greek administrative reform “Kallikratis”), and is a public entity responsible for the administration of the island of Antiparos (1,196 permanent inhabitants; census 2011). Among other things, it is in charge of the provision of water supply and sewerage services on the island, and is also responsible for the planning, construction, management, operation and maintenance of the main infrastructure projects that take place in Antiparos (e.g. water supply and sewerage networks, desalination unit).

The Municipality of Antiparos is a local authority with great impact on the island population’s quality of life, as it has undertaken projects which boosted the tourism sector and enhanced the local economy, while at the same time improving the standards of living in the island by safeguarding public health and environmental protection. One of the most valuable infrastructure projects, recently completed, is the wastewater treatment plant (WWTP). Before the construction of the plant, the domestic wastewater of the island was disposed into septic tanks, causing contamination of groundwater and the marine environment, and generation of unpleasant odors. Municipality of Antiparos is managed by a 13 member Board of Directors, which sets goals and shapes the development policy of the island.

Main tasks in the project:

- **WP 3:** in charge of the operation and maintenance of the WWTP of the island (treatment technologies: constructed wetlands and disinfection), **provision of** data and measurements related to the operation of the plant (site 10)

Principal research personnel to be involved:

Name/ Profile/ Project responsibility	Gender
<p>Dr. Sotiris Skourtis</p> <p>Dr. Sotiris Skourtis is president of the Municipal Council. He is a General Practitioner of medicine and has worked as a doctor in Antiparos island for more than nine years. He is the president of the local committee of the Hellenic Society for the Protection of the Environment and Cultural Heritage (2006-present), a founding member of the cultural association “Antiparos En Plo”, and has participated in a variety of cultural and environmental actions and projects.</p>	<p>M</p>
<p>Artemios Triantafillos</p> <p>Artemios Triantafillos is the Municipal Councillor. He is currently the president of the Municipal Committee of tourism development and promotion and has more than 10 years of experience in administrative bodies, organizations and projects concerning the development of the local community and economy.</p>	<p>M</p>

Relevant publications:

- not applicable

Relevant previous projects or activities:

1. Construction, operation and maintenance of the 5 pumping stations which supply the island, and the two storage tanks with capacity of 1,300 m³
2. Installation, operation and maintenance of the desalination unit which is expected to serve the potable needs of the island (capacity: 400 m³/day)
3. Restoration of the old area of uncontrolled waste disposal located in Profitis Ilias area (total waste volume: 13,000 m³).

Infrastructure/ technical equipment:

The Municipality of Antiparos owns the facilities of the WWTP, and the technical equipment related to the collection, treatment, disposal and use of wastewater and sludge.

18	DREWAG Netz GmbH (DREWAG)	
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General description:

The enterprise was founded in 2007 as network company by the DREWAG Stadtwerke GmbH, which is a community owned enterprise that holds 100 % of the shares. DREWAG NETZ serves more than 300.000 customers with drinking water, electricity, natural gas and district heating. It is responsible for operation, maintenance, monitoring, design, network construction and acquisition of facilities for the network.

The water supply sector consists of four water works (including demonstration site 2) and a 2.500 km long drinking water distribution network including 28 water storage reservoirs and 25 pumping stations for pressure control. A total average of 140.000 m³ is sourced daily from both the Elbe River as riverbank filtrate and from nearby surface water reservoirs via direct abstraction.

One of the main corporate objectives is reliable, efficient and environmentally friendly water and energy supply. In order to ensure and improve its objectives, the DREWAG NETZ supports and integrates innovative energy concepts and strategies to increase customer satisfaction and the sustainable increase of its overall energy efficiency.

- Main tasks in the project:**
- **WP1:** Facilitation and operation of an UF-pilot scheme at demonstration site 2. Coordination of testing methods and concepts to maximize well head protection. Provision of data to evaluate removal of organic compounds.. Facilitation of energy measurements at different vertical well types. Demonstrate rehabilitation strategies and novel constructive elements for siphon well systems in collaboration with HTWD.
 - **WP5:** Integrating data for life cycle assessments and ecosystem services assessments

Principal research personal to be involved:

Name	Profile/ Project responsibility	Gender
Dipl.-Ing. Rüdiger Opitz	Head of the department “distribution network” and responsible for the strategic planning and management of water supply, quality and treatment facilities. His is the coordinator for the activities undertaken at demonstration site 2.	M
Dipl.-Ing. Alexander Auer	Water technology engineer of the department for innovation and development strategies. His role is the assessment and evaluation of existing and alternative treatment technologies for process optimization, risk management, implementation of new technologies and life cycle assessment.	M

Relevant publications:

Several internal reports and contributions to DVGW and water companies newsletters (in German)

- Relevant previous projects or activities**
1. **Risk assessment of the infiltration of untreated river water (2011-12)** Assessment and evaluation of infiltration basin clogging and water quality changes during flooding and infiltration of untreated river water in collaboration with HWTd
 2. **Riverbed clogging (2013-2015)** Industry research project in collaboration with HWTd to re-investigate riverbed clogging and re-estimate sustainable abstraction rates after the Elbe River water quality has improved significantly over the last 20 years.
 3. **Infiltration basin clogging (2014)** Industry research project in collaboration with HWTd to investigate long term MAR infiltration rates and effect of pre-treatment options on clogging rates.

Infrastructure/ technical equipment

DREWAG NETZ operates, among others, two over 100-year-old RBF-waterworks facilities with a total capacity of 100,000 m³/d. One of them is site 2, which has a capacity of 72.000 m³/d and abstracts riverbank filtrate and artificially

augmented groundwater along the Elbe River from a total number of 136 wells, of which 108 wells are connected to a siphon pipe. The remainder are single-operated wells equipped with submersible pumps. Well drawdown, energy consumption and abstraction rates can be measured at various locations at different groundwater levels and operation regimes.

Electricity, space and different source water qualities along the water treatment train are available to facilitate the UF-pilot scheme. The pilot site is equipped with a large existing network of groundwater level and quality observation wells that can be used for additional monitoring purposes.

There is also a large existing database containing water quantity and quality (organic, trace and inorganic substances) information for both water works. The quality of water is continuously monitored by the own accredited and certified laboratory.

19 Erftverband (EV)



General description:

The Erftverband was established as a water management association for the Erft River region in North Rhine-Westphalia (NRW) in 1958. The association is currently composed of 264 members in the region, including cities, municipalities, regional districts and commercial enterprises. As one of eleven water management associations in NRW, the Erftverband performs integrated water management services. The association’s activity area comprises 4,216 km² with approximately 2,600,000 inhabitants. Erftverband provides wastewater treatment for around 0.7 million inhabitants and about 0.2 industrial inhabitant equivalents of the operational region and has an installed treatment capacity of 1.1 million inhabitant equivalents.

The Erftverband plans, builds and operates groundwater measurement facilities, sewage treatment plants, storm water and flood water overflow tanks and is responsible for rivers in the Erft area. The Erftverband conducts business in the following fields:

- Wastewater treatment including residual management
- Observation and research on watercourses and groundwater
- Regulation and maintenance flowing watercourses

The Erftverband has extensive expertise in the operation of retention soil filters (RSF) for combined sewer overflow and separate sewer outlets. Starting in 1998 with the implementation of the first RSF, the Erftverband is currently operating 28 conventional RSF.

Besides water management activities, the Erftverband is also involved in research projects. Since 1991 the working group water quality management has been involved in 12 national and international projects either as project leader or project partner. Through these research activities profound knowledge on water quality, emission sources and measures to reduce pollution loads has been gained.

Main tasks in the project:

- **WP 3:** The Erftverband is operating, monitoring and evaluating one of the demonstration sites in WP3 (demonstration site no. 11). Based upon the broad knowledge and experience in operating RSF, the Erftverband is going to implement a new, innovative RSF_{WWTP+}. The efficiency of this RSF_{WWTP+} and the effects on water quality will be observed. The transferability to general application cases will be shown. Extensive cooperation, knowledge and data exchange with **WP4, WP5**
- **WP7** exploitation of RSTFlex technology and dissemination within at workshops and conferences.

Principal research personnel to be involved:

Name/ Profile/ Project responsibility	Gender
<p>Dr. rer nat. Ekkehard Christoffels</p> <p>Ekkehard Christoffels is environmental researcher (PhD) and head of the water quality working group within the river basin management department. He is expert in river basin management, emission balancing, water quality modelling and retention soil filters. He works at the Erftverband since 1982. Ekkehard Christoffels is project leader of several national research projects and involved in international research projects. He is member of several DWA (German Association for Water Economy, Waste Water and Waste) working groups: Central committee “Water Bodies and Soil”; Expert committee “Ecology and Management of River Basins”; Chairman of expert committee “Emissions and Impacts in Rivers”; Spokesman of working group “Numerical Simulation in Water Quality Management”; Central committee “Hydrology and Water Management”; Chairman of expert committee “Qualitative Hydrology”; Spokesman of working group “Monitoring of Water Quality”; Coordination group “Emerging substances in the hydrological cycle”.</p> <p>Supervisor and coordinator of EV activities. Responsible for dissemination activities and technology exploitation.</p>	<p>M</p>

<p>Dipl. Geocol. Andrea F. Brunsch</p> <p>Andrea F. Brunsch is research assistant at the river basin management department since 2011. She is involved in two international and one national research projects. She is an external PhD candidate at Wageningen University, NL. Her field of research is "Emission balancing of anthropogenic micropollutants, removal of micropollutants through retention soil filters". She will in charge of the operation and performance assessment of demonstration site.</p>	<p>F</p>
<p>Dipl. Ing. Jens Wunderlich-Pfeiffer</p> <p>Jens Wunderlich-Pfeiffer is research assistant at the river basin management department since 2010. He is involved in two international and one national research projects. His field of expertise is emission modelling. In AquaNES he will provide the interface to WP5 for environmental assessment of the combined system.</p>	<p>M</p>

Relevant publications:

1. Christoffels E., Mertens F. M., Kistemann T. and Schreiber C. (2014). Retention of pharmaceutical residues and microorganisms at the Altendorf retention soil filter. *Water Science & Technology*, **70**(9), 1503–1509.
2. Christoffels, E. (2008): Monitoring und Modellanwendung – Entwicklung eines Immissionsinventars am Beispiel der Erft (Monitoring and Modelling – Development of an Immission Inventory with the Example of the Erft River). Erftverband, Bergheim, Germany.
3. Poster: Brunsch A. F., Christoffels E., Beyerle L., Krump R., Ter Laak T., 3, Rijnaarts H. (2015): Retention soil filter (RSF) for reducing micropollutants at wastewater treatment plant outlets. Environmental Technology for Impact Conference, 29.-30.04.2015, Wageningen, NL.

Relevant previous projects or activities:

1. **TAPES** - Transnational Action Program on Emerging Substances (Interreg IVb 2012 – 2015). Project on technologies for the removal of micro-pollutants in water production and wastewater treatment, aiming at knowledge development and transfer in and between water companies, managers of wastewater treatment plants, national and local government, and interested public. Erftverband successfully tested the RSF_{WWTP} approach in small pilot scale.
2. **RESMO** – Reduction of anthropogenic micropollutants and hygienically relevant microorganisms in watercourses with the example of the Erft river. (funded by the Ministry for Climate Protection, Environment, Agriculture, Conservation and Consumer Protection of North Rhine-Westphalia. 2013 – 2015). Project in cooperation with Bonn University, Institute for Hygiene and Public Health with Erftverband as project leader. Investigations on micropollutant and pathogen emissions from different pathways; develop methods to reduce emissions. Time integrated monitoring of Kaster RSF_{CSO}.
3. **M³** - Application of integrative Modelling and Monitoring approaches for river basin Management evaluation (funded by the European Commission – Life +). 2009 – 2012. Project on monitoring techniques, water quality and emission modelling and water management at three river catchments. Erftverband implemented micropollutant monitoring at wastewater treatment plants and water courses and developed an emission model for emission balancing.
4. **SWIST IV** – Evaluation of measures to reduce physical, chemical and microbiological loads in rivers with the Example of the Swist River (funded by the Ministry for Climate Protection, Environment, Agriculture, Conservation and Consumer Protection of North Rhine-Westphalia. 2008 – 2012). Project in cooperation with Bonn University, Institute for Hygiene and Public Health with Erftverband as project leader. Amongst other findings, Altendorf RSF_{CSO} was monitored for pathogen, nutrient, heavy metal and micropollutant removal.

Infrastructure/ technical equipment:

Operation of demonstration site and analytical work can be carried out independently

- small pilot set-up of RSF
- Automatic sampling systems for event specific time proportional sampling
- HPLC MS/MS for micropollutant analytics
- GC MS/MS for micropollutant analytics
- A-YES Test for determination of 17-β Ethinylestradiol equivalents



20 Industrielle Werke Basel (IWB)

General description:

IWB is the company for energy, water and telecommunication services in Basel (Switzerland) and the surrounding region; it demonstrates commitment, expertise and reliability. IWB is a leading provider of renewable energy and energy efficiency. The company is heading for a fully renewable supply that allows an efficient, environmentally friendly and economic use of energy. The company supplies its customers with 100% renewable electricity, renewable district heating, drinking water and biogas natural gas. Its customer base includes more than 250,000 customers, small and medium-sized enterprises and industry and administration. It owns and manages all the necessary facilities for the distribution, storage and quality control of its services.

IWB produces drinking water for 210'000 inhabitants in two water works, supplying around 26 million m³ per year. A great share is produced in the Lange Erlen site (Site 6) from surface water of the river Rhine. The treatment train encompasses screening, filtration and subsequent soil infiltration. After reabstraction the water is treated by granular activated carbon and UV-disinfection.

IWB controls the water quality in its own accredited water quality lab, with 15 person staff (chemists and lab assistants). IWB features long-year experiences in various pilot plant operations at their full-scale facilities

Main tasks in the project:

- **WP2.** Owner of the Lange Erlen site. Demonstration of oxidative pre-treatment of pre-filtered surface water prior to forest soil infiltration. Operation of pilot plant and analytics of transformation products

Principal research personnel to be involved:

Name/ Profile/ Project responsibility	Gender
<p>Pascal Temmler, Dipl.-Ing.(FH) In the company since 2011 as Head of Operation Drinking Water Plant. Degree in Environmental Technology at the University of Applied Sciences Jena (Germany). Responsible, coordination and contact person of the project. Responsible for pilot plant operation.</p>	<p>M</p>
<p>Richard Wülser, Dipl. Chem. (FH) In the company for 28 years as Head of Water Laboratory and Head of Quality Assurance in the department of drinking water production. Leads the analytical laboratory and surveillance of production and supplying processes. Member of the professional bodies "Quality and Treatment" (Swiss Gas and Water Association, SVGW) and different scientific committees (International Association of Water Works in the Rhine Basin, IAWR and AWBR). In the project responsible for analytical work on water and quality assessments.</p>	<p>M</p>
<p>Fabienne Eugster, Master of Science (University) Scientific Employee of IWB Water Laboratory (analysis of organic micropollutants). Master of Science (MSc) in Environmental Geoscience, Subject area Physical and Chemical Processes of the Environment (University of Lausanne). Master Thesis (2013): „Water and mine waste of former mining sites on eastern Elba (Italy): characterisation and assessment evaluation”. Responsible for sample preparation and analytical works like validation processes.</p>	<p>F</p>
<p>Thomas Meier, Dipl. Ing. (FH) 25 years in water treatment companies. Since 2010 head of Drinking Water Production IWB and since 2011 CEO of Hardwasser AG, drinking water supplier for IWB and communities in the state of Basel-Landschaft. Member of the “head commission water” at the SVGW (Swiss Gas and Water Association). Member of the board at the Association of Water Works in the Rhine Basin, IAWR and AWBR). Supervision of and advice to project activities. Dissemination of result in the Swiss water sector.</p>	<p>M</p>

Relevant publications:

1. Meier T, (2014): Herausforderung der Trinkwassergewinnung aus Flussfiltraten. (*Challenges for drinking water production from bank filtrates*) In: Wasserversorgung und Uferfiltration - ein System unter Druck? Tagungsband Eawag - das Wasserforschungsinstitut des ETH-Bereichs vom 09.09.2014: 26-29.
2. Temmler P, Haist-Gulde B (2014): Aktivkohle für das Wasserwerk. (Activated Carbon for Water Works): Aqua & Gas, Nr. 9: 17-22.
3. Wülser R, Eggers J, Hamsch B, (2012): Desinfektion mit UV statt mit Chlordioxid, Aqua & Gas 3/2012: 46-53
4. Storck FR, Schmidt CK, Wülser R, & Brauch H-J, (2012): Effects of boundary conditions on the cleaning efficiency of riverbank filtration and artificial groundwater recharge systems regarding bulk parameters and trace pollutants. *Water Science & Technology* 66(1): 138–144.
5. Helbing J, Kaiser H-P, Wülser R, (2015): Mikroverunreinigungen in Rheinwasser, FOWA-Projekt: Abbau mit Ozon und Ozon/Wasserperoxid. Aqua & Gas 4/2015:
6. Storck F, Schütz K, Wülser R, Nagel P, Alewell Ch, (2014): Künstliche Grundwasseranreicherung für die Trinkwassergewinnung, Untersuchungen zur Nachhaltigkeit der Reinigungsleistung bei der Bodenpassage am Standort "Lange Erlen" (Basel). *Regio Basiliensis* Nr. 55/3: 115-125

Relevant previous projects or activities:

1. **TAPES** (Transnational Action Program on Emerging Substances; INTERREG IVB 2012 – 2015. Project on technologies for the removal of micro-pollutants in water production and wastewater treatment. IWB operated a pilot plant to compare different granular activated carbon with respect to micro-pollutant elimination
2. **WV BL 21** (Water production and supply in the state of Basel-Landschaft in the 21 century). The project includes 5 different parts. Part 1; Quality of spring water in the upper part of the state. Part 2; drinkingwater production near rivers (riverbank filtration) and the problem of revitalisation. Part 3; groundwater situation in the Hardwald (the location where Hardwasser AG use the groundwater). Part 4; possibilities of different processes in water treatment by using the groundwater in the Hardwald. Part 5; Discussion of different structures of waterproductions and suppliers in the state

Infrastructure/ technical equipment:

- Testing laboratory for analyses of ground water, spring water, surface water and treated drinking water in accordance with the Standard ISO/IEC 17025. The scope of accreditation is defined in the Official Directory of the Accredited Testing Laboratories.
- Analytical equipment and techniques:
 - Gaschromatography (GC) with mass selective detector (MS)
 - SPE and SPME automatic systems
 - High resolution MS-Spectrometry (Orbitrap technique)
 - High performance liquid chromatography (HPLC) with photodiode array dedector,
 - fluorescence dedector
 - Ion chromatography (IC) with conductivity detector
 - Spectroscopic techniques: Ultra-violet spectroscopy, Visible spectroscopy, Infrared spectroscopy
 - Electrochemical analysis: Potentiometry, Conductometry, Amperometry, Voltametry, Physical analysis, Thermometry, Nephelometry
- Microbiological analysis
 - Quantitative determination of hygiene relevant germs by plate count or membran filtration method
 - Quantitative determination of hygiene relevant germs by enzymatic methods
 - Quantitative determination of chemical and microbiological parameters with luminescence measurement
 - Quantitative determination and characterisation of cells with flow cytometry

21 Mekorot (MEK)



General description:

Mekorot, Israel's National Water Company is a public utility founded in 1937. Mekorot is one of the world's most advanced water companies, a leader in water resources management, desalination, wastewater treatment and effluent reuse, rain enhancement, water quality, water security and water project engineering. Mekorot's uniqueness as a water utility lies in its unparalleled experience, know-how, technologies and innovative processes for the management, operation and treatment of all types of water resources, whether surface water, underground water, brackish water, seawater or effluents. Mekorot is active in the global market through its subsidiary company - Mekorot Development and Enterprise. Mekorot's revenue is about 1 billion USD in a year with 250 million USD invested in development of water infrastructure. The company is rated AAA with 2,200 employees.

In Europe and the Middle East, Mekorot was among the first to investigate and implement large-scale wastewater reuse systems like Soil Aquifer Treatment after conventional secondary treatment in Israel which has the world's highest water reclamation rate to date. Mekorot supplies 80% of the water in Israel (about 1.5 billion m³/year) to approximately 5,000 intermediary water providers including municipalities, regional associations, agricultural settlements and industrial consumers. In addition, the company treats 40% of Israel's wastewater in eight water purification plants and with its nine wastewater reclamation plants it enables a 70% reuse of treated effluents for agriculture purposes.

Main tasks in the project:

- **WP2:** owner and operator of the Shafdan demonstration site (Site 7) . Responsible for piloting and performance assessment
- **WP 4** – Contribution to the development and testing of the water quality assessment framework for the demonstrated processes (especially for the AOP-SAT processes) and also for the derivation of an interactive quantitative risk assessment tool.
- **WP 5/6** – Contribution to understanding how the different stake holders will accept the InPR concept in Israel after proof of process in the pilot (WP5) and contribution in validation and final integration activities of AquaNES DSS (WP6)
- **WP7:** contribution to exploitation of AOP-SAT combination as treatment option for indirect potable reuse. MEK will organise a relevant workshop at the fair WATEC in Israel and establish interfaces with the Health Ministry.

Principal research personnel to be involved:

Name/ Profile/ Project responsibility	Gender
<p>Avi Aharoni (M.Sc) is director of wastewater treatment and effluent reuse department, in water quality division in Mekorot since 2012. During the last decade the department participated in a long list of EU research projects (see below), bilateral German researches (BMBF - MOST) and national research projects. Supervisor of MEK AquaNES technical activities, main contact with authorities, in charge of conference preparation, commercialization.</p>	M
<p>Lilah Strasler (M.Sc) In Mekorot company since 2010 as water quality engineer in the Water Quality Department. Degree in Biology and Environmental studies at the Tel Aviv University. Works in the field of treated wastewater quality and reuse. Investigated "The effect of treated wastewater quality on UV disinfection at the Shafdan WWTP". Pilot responsible and report preparation</p>	F
<p>Dr. Anat Lakretz-Mashiah Process Engineer at Mekorot's Desalination and Special Projects Division. Lakretz-Mashiah holds a B.Sc. (Biotechnology Engineering) degree from the Ben-Gurion University, an M.Sc. and a Ph.D. (Environmental Engineering, Biofouling control in water by UV and AOP processes) degree from the Tel-Aviv University. Researcher for the pilot and report preparation</p>	F

<p>Dr. Shai Era Head of the Water Quality Division, Mekorot. The Division is responsible for all aspects of drinking water and wastewater and effluent reuse for quality, treatment standards. Dr. Ezra has a Ph.D (Summa Cum Laude) from the department of Geological and Environmental Sciences at Ben Gurion University. Risk assessment and decision making for pilot results</p>	<p>M</p>
<p>Dr. Haim Cikurel In-house consultant and coordinator of the project has 43 years of experience in different fields of research, operation and engineering in the Chemical Process Industries and in Environmental Engineering. He has been involved with Mekorot and other Israeli companies in EU projects since 1998 with different projects in effluent reuse, water and wastewater treatment (Catchwater, Aquarec, Techneau, Reclaim, Switch, Minotaurus, Water4India, Demoware). Adviser, pilot design, help for contact with authorities, conference preparation, commercialization</p>	<p>M</p>

Relevant publications:

1. Zucker I., Mamane H., Cikurel H., Jekel M., Hübner U., Avisar D., (2015) "A Hybrid Process of Biofiltration of Secondary Effluent followed by Ozonation and Short Soil Aquifer Treatment for Water Reuse"; Water Research <http://dx.doi.org/10.1016/j.watres.2015.07.034>
2. Cikurel H., Guttman J., Aharoni A., (2012), "Managed aquifer recharge for agricultural reuse in Shafdan, Israel" Chapter 6 In: Water Reclamation Technologies for Safe Managed Aquifer Recharge, Kazner C., Wintgens T. and Dillon P. (eds.), pp. 460. ISBN: 9781843393443.
3. Kloppmann W., Aharoni A., Cikurel H., Dillon P., Gaus I., Guttman J., Kraitzer T., Kremer S., Masciopinto C., Miotlinski K., Pavelic P., Pettenati M. and Picot-Colbeaux G. (2012). "Use of groundwater models for prediction and optimisation of the behaviour of MAR sites". Chapter 18 In: Water Reclamation Technologies for Safe Managed Aquifer Recharge, Kazner C., Wintgens T. and Dillon P. (eds.), pp. 460. ISBN: 9781843393443.
4. Aharoni A., Guttman J., Sharma S., Cikurel H., (2011), "Guidelines for design operation and maintenance of SAT (and hybrid SAT) systems". EU SWITCH D 3.2 Safe water reuse report.
5. Gaus I, Cikurel, H., Picot G., Aharoni A., Guttman Y., Azaroual M., Kloppmann W. (2007), "Alternative SAT treatment of secondary effluents using a combination of UF and short term SAT for increasing infiltration rates at the Shafdan site (Israel)" International Groundwater Recharge Conference ISMAR 6, Phoenix, Arizona, Oct. 28-Nov. 2

Relevant previous projects or activities

Mekorot has been involved in a number of research focused on the Shafdan MAR site

1. **RECLAIM WATER** (EU project, FP6 contract no. 018309): At the Shafdan site, the project assessed different treatment applications in terms of behaviour of key microbial and chemical contaminants and fate during soil passage.
2. **DEMOWARE** (EU project, FP7 GA no. 619040) aims at increasing Europe's ability to profit from the resource security and economic benefits of water reuse schemes without compromising human health and environmental integrity. The programme has two central ambitions (i) to enhance the availability and reliability of innovative water reuse solutions, and (ii) to create a unified professional identity for the European Water Reuse sector.
3. **SWITCH** (EU project, FP 6 contract no. 018530. (2006-2011). "Sustainable Water Management Improves Tomorrow's Cities Health" Mekorot was involved in the "Natural Treatment Systems Research Theme" and Safe Water Reuse.
4. Evaluation and Enhancing Ground Water Effluent Recharge Technology, (2010-2013). A **BMBF-MOST** (German-Israeli research fund) project. The purpose of the common project with TU Berlin, Tel-Aviv Univ, and Mekorot was to use at a pilot scale level ozonation and ozone based advanced oxidation technology (AOP), H₂O₂/O₃ as a complementary (to short SAT) source-treatment solution for: Degradation and removal of micropollutants. Prevention of manganese solubilization in the SAT system. Improvement of the infiltration rates for the SAT.

Infrastructure/ technical equipment

- existing pilot facility for oxidative pre-treatment before soil-aquifer treatment to be refurbished and reconfigured in AquaNES.
- analytical lab for standard parameters / currently establishing capacity for micro-pollutants analytics

22 Adam Mickiewicz University in Poznań



General description:

Adam Mickiewicz University in Poznan (AMU) is one of the best and most prestigious Universities in Poland. The Department of Hydrogeology and Water Protection (Institute of Geology, Faculty of Geographical and Geological Sciences, AMU) works on applied hydrogeology. Studies focus on water management and protection of groundwater resources, bank filtration and artificial recharge projects in western Poland and Poznań agglomeration area. The Department participates in EU and international research projects depending groundwater management of the rural landscape and metals in drinking water.

Main tasks in the project:

- **WP 1:** Responsibility for the site demonstration in Poland (Mosina Water Capture) and assessment of impact of travel times on removal of pollutants and pathogens

Principal research personnel to be involved:

Name/ Profile/ Project responsibility	Gender
<p>Prof. Dr hab. Józef Górski</p> <p>Prof. Dr hab. Józef Górski is a hydrogeologist and director of the Institute of Geology at AMU. He is Head of the Department of Hydrogeology and Water Protection and leader of many national projects focusing on groundwater management and protection, bank filtration and artificial recharge of groundwater. He is involved in the European Project ESSEM COST Action 637. In charge of Task 1.4 Treatment efficiency of combined natural and engineered BF systems.</p>	M
<p>Prof. Dr hab. Krzysztof Dragon</p> <p>Prof. Dr hab. Krzysztof Dragon is expert in hydrogeology, especially in hydrogeochemistry with a focus on groundwater chemistry changes due to human activity. He is project manager of several grants funded by Ministry of Science and Higher Education and National Science Centre Poland. He is author of several publications in the field of hydrogeology and environmental protection. Responsible for data acquisition and assessment, support in Task 1.4 Treatment efficiency of combined natural and engineered BF systems</p>	M

Relevant publications:

1. Górski J. (2011). Quality of Riverbank Filtrated Water on the Base of Poznan City (Poland) Waterworks Experiences. Chapter 16 in: *Riverbank Filtration for Water Security in Desert Countries*. Ray C. and Shamrukh M. (eds.), Springer Netherlands, pp 269-279. doi:10.1007/978-94-007-0026-0_16
2. Górski J., and Siepak M. (2014). Assessment of metal concentrations in tap-water – from source to the tap: a case study from Szczecin, Poland. *Geologos* **20**(1), 25-33.
3. Górski et al. (2013) Best Practice Guide on the Control of Iron and Manganese in Water Supply. Postawa, A., Hayes, C. (eds.) IWA Publishing.
4. Górski J. and Przybyłek J. (2005). Quality of bank filtrated water in different wells locations. In: IAH-BGR-2006-“Interaction between groundwater and surface water”, Int. Association of Hydrogeologists, German and Polish National Chapter, Berlin – Spandau, Germany.
5. Dragon K. and Górski J. (2009). Identification of hydrogeochemical zones in postglacial buried valley aquifer (Wielkopolska Buried Valley aquifer, Poland). *Environmental Geology*, **58**(4), 859-866.

Relevant previous projects or activities:

1. **COST ACTION 637** Metals and related substances in drinking water (European Cooperation in the Field of Scientific and Technical research): Collaboration in the field of metals (especially lead) in drinking water at consumers in Poland. 2006-2010.
2. **Environmental Management of the Rural Landscape in Central and Eastern Europe**. Project coordinated by CORNELL University, USA. Collaboration in the field of “Evaluation of groundwater resources for the use in wa-

- ter supplies in Wyskoc River Watershead (Poland). 2000-2002
3. Migration of micropollutants in water flowing from Warta River to the Mosina bank filtration water capture (BF). Detailed two years research in the field of water quality including macro and micro chemical components, bacteria and plankton organisms. 1996-1998.
 4. Groundwater treatment in the aquifer-iron and manganese removal. Project applied on Wroniawy groundwater capture (capacity of 300 m³/hour) in Poland. Method implemented in 1989. Successful exploitation till today under supervision of Institute of Geology (AMU).
 5. Project of new artificial recharge water capture (**MAR**) for the **Bydgoszcz City (Poland)**. Capacity of 3,125 m³/h. 2008-2011.

Infrastructure/ technical equipment:

- Analytical instruments for organic micropollutant detection: High performance liquid chromatography with inductively coupled plasma mass spectrometry (HPLC-ICP-MS)
- Metal and major anion/cation analysis: Ion chromatography (IC), Inductively coupled plasma mass spectrometry (ICP-MS), Atomic absorption spectrometry with flame atomisation (F-AAS), Graphite furnace atomic absorption spectrometry (GF-AAS)
- Sediment analysis: MARSXpress - Microwave Reaction System

23 French Geological Survey (BRGM)



General description:

Bureau de Recherches Géologiques et Minières (BRGM) is a public institute acting as the French Geological Survey. BRGM's research activities gather a large variety of competences in geosciences, environmental monitoring, resources (water, mineral resources), material sciences, microbiology, experimental approaches and modelling. BRGM is acknowledged within France as a leading authority on Water Management and Survey, Soil Protection, Local Point Pollution and Environmental Monitoring (on groundwater resources, soil, industrial sites).

BRGM develops advanced modelling tools addressing reactive transport of organic and inorganic pollutants including microbial processes. BRGM is member of the French Committee of Experts of Prioritization and part of AQUAREF reference laboratory. It has a broad range of analytical facilities for organic and inorganic micropollutants, passive sampling, isotope fingerprinting, microbiology and molecular biology. BRGM is involved in several large-scale monitoring programs on emerging pollutants. BRGM coordinates several European Research Projects on groundwater pollution (Footprint, Pegase, Bridge, Boromed) and is/was partner of other projects such as Water JPI FRAME, Saph Pani, Reclaimwater, Safir, Norman and Aquaterra.

Main tasks in the project:

- **WP 2:** Leader of WP2. Validation of innovative monitoring strategies and process modelling for assessing efficient effluent treatment by a reed bed followed by dune filtration at Agon-Coutainville in collaboration with IMAGEAU and GEOHYD.
- **WP 5:** BRGM will be involved with UCRAN in the characterization of policy and governance interfaces.
- **WP 6:** BRGM will provide process specifications for the development of ICT solutions via a connected decision support system.
- **WP8:** member of the Project Management Team

Principal research personnel to be involved:

Name/ Profile/ Project responsibility	Gender
<p>Dr. Marie Pettenati</p> <p>Marie Pettenati is a hydrogeologist and geochemist. She is a specialist for conceptualizing reactive transport models of organic and inorganic pollutants in the vadose zone-aquifer continuum, with a particular focus on active management of water resources. She has expertise on equilibrium studies of natural aquifers, transfer studies of inorganic pollutants in soils, hydro-geochemical and thermo-kinetic modelling of water-rock interactions under consideration of biogeochemical processes. Marie Pettenati is WP2 leader.</p>	F
<p>Dr. Géraldine Picot-Colbeaux</p> <p>Géraldine Picot-Colbeaux holds a PhD in unsaturated/saturated environments hydrogeology. She is a specialist for conceptualizing flow and reactive transport models of inorganic pollutants and emergents in the aquifer, focusing particularly on active management of water resources, polluted soils and geological storage of CO₂.</p>	F
<p>Dr. Wolfram Kloppmann</p> <p>Dr. W. Kloppmann hydrogeologist and isotopes geochemist. He has coordinated and participated in several EU projects (FP5, FP6) on geogenic contaminants (BOREMED), Managed Aquifer Recharge (RECLAIMWATER) and reuse of wastewater (SAFIR). Leading work on isotope analysis in WP2.</p>	M

Relevant publications:

1. Pettenati M., Picot-Colbeaux G., Thiéry D., Boisson A., Alazard M., Perrin J., Dewandel B., Maréchal J. C., Ahmed S. and Kloppmann W. (2014). Water quality evolution during managed aquifer recharge (MAR) in Indian crystalline basement aquifers: reactive transport modeling in the critical zone. *Procedia Earth and Planetary Sci-*

ence, **10**, 82 – 87. doi:10.1016/j.proeps.2014.08.016

2. Pettenati M., Croiset N., Casanova J., Azaroual M., Besnard K. and Rampnoux N. (2012). Optimisation of waste water treatments through combined geomaterials and natural soil filter: modelling tools. *Journal of Water Reuse and Desalination*, **2**(4), 185–193.
3. Kloppmann W., Aharoni A., Chikurel H., Dillon P., Gaus I., Guttman J., Kraitzer T., Kremer S., Masciopinto C., Miotlinski K., Pavelic P., Pettenati M. and Picot-Colbeaux G. (2012). Use of groundwater models for prediction and optimisation of the behaviour of MAR sites. Chapter 18 In: *Water Reclamation Technologies for Safe Managed Aquifer Recharge*, Kazner C., Wintgens T. and Dillon P. (eds.), pp. 460. ISBN: 9781843393443.
4. Kloppmann W., Chikurel H., Picot-Colbeaux G., Pettenati M., Guttman.Y., Aharoni.A., Guerrot C., Millot R., Gaus.I. and Wintgens.T. (2009). B and Li isotopes as intrinsic tracers for injection tests in aquifer storage and recovery systems. *Applied Geochemistry*, **24**(7), 1214-1223.
5. Kloppmann W., Van Houtte E., Gaus I., Picot-Colbeaux G., Vandenbohede A., Lebbe L., Guerrot C., Millot R. and Wintgens T. (2008). Monitoring reverse osmosis treated wastewater recharge into a coastal aquifer by environmental isotopes (B, Li, O, H), *Environmental Science and Technology*, **42**(23), 8759-8765.

Relevant previous projects or activities:

1. **FRAME** (EU Water JPI project): The aim of FRAME is to develop an overall evaluation procedure enabling a comprehensive assessment of efficient and cost-effective indirect potable reuse measures to minimize the risks associated with emerging chemicals and microbial contaminants, while closing local and regional water cycles.
2. **Saph Pani** (EU project, FP7 GA no. 282911): Saph Pani addressed the improvement of natural water treatment systems such as river bank filtration, managed aquifer recharge and wetlands in India building on a combination of local and international expertise. The project aimed at enhancing water resources and water supply particularly in water stressed urban and peri-urban areas in different parts of the sub-continent.
3. **SAFIR** (EU project FP6, FOOD-CT-2005-023168): In order to ensure a sustainable use of our water resources and at the same time the production of high quality and safe vegetable crops the strategic objective of SAFIR was to develop irrigation management and water saving technologies for the production of high quality and safe vegetable crops using low quality water resources.
4. **RECLAIM WATER** (EU project FP6, no.018309): The strategic objective of the project was to develop hazard mitigation technologies for water reclamation providing safe and cost effective routes for managed aquifer recharge. The work assessed different treatment applications in terms of behaviour of key microbial and chemical contaminants.

Infrastructure/ technical equipment:

Data acquisition for transport modelling work will be facilitate by appropriate analytical equipment

- ICP/MS, for analytics
- Non-target screening for micropollutants data using LC-Q-TOF
- Neptune MC-ICP-MS for isotopes analysis

24 Cranfield University (UCRAN)



General description:

Cranfield University is an exclusively post-graduate, international centre of excellence in research and teaching in strategic areas of science, technology and management. The university is distinctive in undertaking near or full industrial scale evaluations of new science and technology. Cranfield combines the academic rigour and long term perspective of a university with the commercial and business focus of industry. It is a world leader in defence and natural resource management, including the management of water quality. Our research income, measured as a percentage of our turnover, puts us as one of the top five research intensive universities in the UK alongside Oxford, Cambridge, and London’s Imperial College. The Cranfield Water Science Institute (CWSI) is both nationally and internationally recognised for its work on water and wastewater treatment, the human dimensions of water management, process science, technology development, water policy analysis, decision support, infrastructure management, governance and policy. CWSI also coordinates the STREAM Engineering Doctorate Centre (www.stream-idc.net) which currently includes several projects on combined natural and engineered treatment systems. Our research draws on a range of specialized laboratories as well as near-industrial scale pilot testing facilities. CWSI maintains close working relationships with the UK’s water and wastewater service providers, including strategic research partnership agreements with Yorkshire Water and Severn Trent Water. The institute also has extensive experience on large international research projects (e.g., AQUAREC, RECLAIM Water, TRUST, Water4India, DEMOWARE)

Main tasks in the project:

- **WP3** – Constructed wetlands and other natural systems for improved wastewater treatment: Cranfield staff will work closely with WatsTech, with additional support from Severn Trent Water, to assess P removal through natural treatment systems, a reactive media reed bed and an immobilised algae photo-bioreactor, using the Packington test site near Birmingham, UK.
- **WP5:** Interfaces with environment and society: Cranfield will lead this work package, which examines the environmental, social and policy implications of combined natural and engineered treatment systems, in order to better understand their pathways to commercialisation. Staff on this task has expertise in the regulation and governance of water and wastewater services, public perceptions, and ecosystem services assessments.
- **WP8:** member of the Project Management Team

Principal research personnel to be involved:

Name/ Profile/ Project responsibility	Gender
Cranfield's contribution to the AquaNES project will be led by Dr Heather Smith , who is an Academic Fellow in Water Governance. Her expertise covers policy and regulation for water and wastewater services across Europe, and how they enable and/or constrain the development and application of innovative technologies. It also covers public perceptions of water and wastewater services, and the relationship between those services and customer behaviour. Recent relevant activities have included important work on governance and public perceptions of water reuse schemes across Europe, including the development of advice for public outreach and engagement around such schemes. She will lead WP 5.	F
Dr Ronald Corstanje is a Senior Lecturer in Environmental Informatics. He works in the realm of Environmental Informatics (EI), in which he focuses on developing the modelling tools (statistical or quasi-mechanistic) which can assemble, manipulate and communicate meaningful outcomes from large environmental datasets, particularly the understanding and evaluation of ecosystem services (ESS). He will lead the ESS assessment work in WP 5.	M
Miss Joanna Zawadzka is a Research Assistant in Pedometrics. She has a strong interest in spatial data analysis in the context of the environmental mapping and modelling. She uses various GIS, remote sensing, and statistical methods to extract, analyse, and interpret data on natural environment, including for ecosystem goods and services assessments. She will support the ESS assessment work in WP 5.	F
Dr Marc Pidou is a Lecturer in Resource Recovery. His current research activities are focused on the development and optimisation of technologies (chemical, physical and biological) for phosphorus removal and recovery from wastewater effluents and for the treatment of trade wastes. He will lead Cran-	M

field's contribution to WP 3. Dr Pidou has extensive experience on EC funded projects with contributions in the EUROMBRA, MBR-TRAIN and INNOWATECH projects.

Post-doctoral research associate – A PDRA with relevant skills in wastewater treatment and nutrient recovery will be hired to support Cranfield's contribution to WP 3..

Relevant publications:

1. Smith, H.M., Rutter, P and Jeffrey, P. (2015) Public perceptions of recycled water: a survey of visitors to the London 2012 Olympic Park. *Journal of Water Reuse and Desalination* 5(2) 189-195.
2. Goodwin, D., Raffin, M., Jeffrey, P. & Smith H.M. (2015, in press) Applying the water safety plan to water reuse: towards a conceptual risk management framework. *Environmental Science: Water Research and Technology*.
3. Whitton, R., Santinelli, M., Pidou, M., Ometto, F., Henderson, R., Roddick, R., Villa, R. and Jefferson, B. (2015) Tertiary nutrient removal from wastewater by immobilised microalgae: Impact of N:P ratio and hydraulic retention time (HRT). *Water Research*, Submitted.
4. Pidou, M., Whitton, R., Santinelli, M., Muhammad, A., Soares, A., Villa, R. and Jefferson, B (2015) Novel technologies for low phosphorus discharge consents and resource recovery. 3rd Water Research Conference, 11-14th January, Shenzhen, China.
5. Chiverton A, Hannaford J, Holman I, Corstanje R, Prudhomme C, Bloomfield J & Hess TM (2015) Which catchment characteristics control the temporal dependence structure of daily river flows?, *Hydrological Processes*, 29(6) 1353-1369.

Relevant previous projects or activities:

1. **DEMOWARE** (EU project, FP7 GA no. 619040) aims at increasing Europe's ability to profit from the resource security and economic benefits of water reuse schemes without compromising human health and environmental integrity. The programme has two central ambitions (i) to enhance the availability and reliability of innovative water reuse solutions, and (ii) to create a unified professional identity for the European Water Reuse sector.
2. **TRUST** (EU project, FP7 no. 265122) provided research-driven innovations in governance, modelling concepts, technologies and novel approaches to integrated water, energy, and infrastructure asset management. TRUST outcomes will be incorporated into planning guidelines and decision support tools for urban water services, will be subject to life-cycle assessment and be shaped by regulatory considerations as well as potential environmental, economic and social impacts.
3. **INNOWATECH** (EU project, FP6 no. 036882) provided tailor-made solutions to end-users for the treatment of industrial wastewaters through the development and demonstration of promising novel technological options applicable to a wide range of wastewaters.
4. **Fragments, Functions, Flows & Urban Ecosystem Services** (NERC) is part of the wider Biodiversity and Ecosystem Services project (BESS) and examines the scaling of biodiversity and ecosystem services in urban ecosystems. The project is premised on the view that, in order to understand how ecosystem services are provided, we need to understand what determines the *functions* of individual *fragments* of green space, and how these are linked together by *flows* of materials, organisms, and people

Infrastructure/ technical equipment:

- The demonstration units to be tested as part of the contribution to WP 3 are installed on the Severn Trent Water owned Packington sewage works. The systems studied include a 100 m² reactive media reed bed (1-5 m³/h) and a unique immobilised algae photo-bioreactor (4 m³; 0.2-2 m³/h). The test site is fitted with dosing units to control nutrients levels in the feed water to be treated and online monitoring on the effluents.
- Cranfield University owns state-of-the-art laboratories that have extensive analytical services. Specifically, analytical equipment such as ICP-MS and LC-MS will be used for the metals and hazardous chemicals analyses. Also a dedicated fermentation laboratory will be used for the algal biomass anaerobic digestion trials

25 Dresden University of Applied Sciences (HTWD)

General description:

The HTWD was founded in 1992 and is the successor of the former University for Transport and Communications "Friedrich List" which was founded in 1966. Today it is with 180 professors and over 5,000 students the second largest university of the regional capital of Saxony. It has 8 faculties covering fields in science, engineering and economics. The HTWD has partnerships with more than 100 universities worldwide.

The Division of Water Sciences belongs to the Faculty of Civil Engineering & Architecture and has a long history in applied research and strong collaboration links to regional water utilities and water engineering consultancies. Dresden is a historic and scientific centre for riverbank filtration, having 3 waterworks along the River Elbe. Research has been focused on bank filtration for >20 years, resulting in many regional and international activities, networks, site-dependent projects, workshops, education and promotion. In 2010, HTWD founded a "Cooperation Centre for Riverbank Filtration" in Haridwar, India. Marketing activities in cooperation with SME and large companies resulted in the involvement of European companies in India, Russia and Egypt. New research foci are energy efficiency in water supply and coupling advanced water treatment technologies with bankfiltration to meet future demands for save drinking water.

Main tasks in the project:

- WP1. Work package coordinator; Responsible for site 2, focus on energy efficiency and ecosystem service of BF and especially siphon systems; contribution to assessment of site 5 in India based on long-term collaboration with UJS and AUT; application of software tools (SOMA 2, QMRA) for site assessment and providing data for WP 5 & 6.
- WP5: Life-cycle assessment of BF system, focus on site 2
- WP6: Decision support system for BF scheme design
- WP7. Dissemination, supporting AUT on Asian market for BF coupled with on-site disinfection using electrolysis
- **WP8:** member of the Project Management Team

Principal research personnel to be involved:

Name	Profile/ Project responsibility	Gender
Prof. Dr.-Ing. Thomas Grischek	Groundwater Engineer (PhD) and expert in water abstraction and supply. Head of the Division of Water Sciences at HTWD with research focus on bankfiltration, subsurface groundwater treatment and energy efficiency in water supply. Experience in EU project coordination and participation: SQUAREC, RECLAIM WATER and Saph Pani. He is the coordinator of WP 1 Bankfiltration.	M
Dipl.-Ing. Rico Bartak	Young Research Associate at HTWD with water engineering and groundwater flow modeling background. He has been a key worker in bankfiltration projects in Germany, Egypt, Thailand and India. Experience in EU research projects (Saph Pani, BF in Egypt). He will be responsible for work at the BF pilot site in Dresden, for developing energy efficiency assessment and optimization tools and integrating results from other BF pilot sites.	M
Dr. Ulrike Feistel	Hydrologist and surface flow modelling expert, experienced researcher and project manager. She managed the WP "Innovation in education and research" in the EDUWAT project with Syria, organised workshops and marketing activities with SMEs in Germany, Vietnam and Costa Rica. She will be involved in marketing and dissemination activities.	F

Relevant publications:

1. Bartak, R., Page, D., Sandhu, C., Grischek, T., Saini, B., Mehrotra, I., Jain, C.K., Ghosh, N.C. (2015) Application of risk-based assessment and management to riverbank filtration sites in India. *J. Water and Health* 13(1), 174-189.
2. Bartak, R., Grischek, T., Ghodeif, K.O., Wahaab, R.A. (2015) Shortcomings of the RBF pilot site in Dishna, Egypt. *J. Hydrol. Eng.* 20(9), 05014033.
3. Grischek, T., Schoenheinz, D., Eckert, P., Ray, C. (2012) Sustainability of river bank filtration – examples from Germany. In: Maloszewski, P., Witczak, S., Malina, G. (eds.) *Groundwater quality sustainability. Selected papers on hydrogeology 17*, Taylor & Francis, London, UK, 213-227.
4. Ray, C., Jaspers, J., Grischek, T. (2011) Bank filtration as natural filtration. In: Ray, C., Jain, R. (eds.) *Drinking water treatment*. Springer, Dordrecht, 93-158.
5. Schoenheinz, D., Grischek, T. (2011) Behavior of dissolved organic carbon during bank filtration under extreme climate conditions. In: Ray, C., Shamrukh, M. (eds.) *Riverbank filtration for water security in desert countries*. Springer Science+Business Media B.V., 51-67.

Relevant previous projects or activities

1. **Saph Pani** (EU project, FP7 GA no. 282911): Saph Pani addressed the improvement of natural water treatment systems such as river bank filtration (RBF), managed aquifer recharge (MAR) and wetlands in India building on a combination of local and international expertise. The project aimed at enhancing water resources and water supply particularly in water stressed urban and peri-urban areas in different part of the sub-continent.
2. **SOLAREX** (BMBF, no. 02WQ1333B, 2014-2016): Combining inline-electrolysis for drinking water disinfection and removal of arsenic with a filter unit regenerated by produced chlorine. Market studies in India and Costa Rica to sell treatment units using solar energy for small communities.
3. **EDUWAT** (EU TEMPUS SMHES project, no. 511251) aimed at developing curricula in water science education in Syria, project was kept alive despite war in Syria, final report submitted in summer 2015 will form a basis for adaptation of water engineering education in Syria to European system and for reconstruction of education system and infrastructure in Syria.
4. **GEF** (BMBF, GERF, no. EGY 10/052): Bank filtration for water supply in an arid climate; workshops & site assessments in Egypt, a feasibility study on bank filtration along the River Nile and canals; assessment of water quality (trace organics, metals) and further treatment requirements.
5. **SDWSU** (DAAD “A new passage to India”, no. 57125632): Exchange program 2010-2015 for PhD and undergraduate students to work on “Sustainable Drinking Water Supply in Uttarakhand, India”, including collaboration with industry, water companies and projects on bank filtration.

Infrastructure/ technical equipment

- Fieldwork equipment (various water level and discharge meters, data loggers, groundwater sampling equipment, well inspection cameras, on-site water quality parameter measurement devices, electrical current meters)
- Water quality analysis (IC, ICP, UV, IDEXX)

26 Eötvös József College (EJC)



General description:

The Eötvös József College at Baja, Hungary (EJC) is located in the southern region of the country near to the Serbian and Croatian borders. Currently, about 20 scientists work at EJC. The research and development activities of EJC include a spectrum of drinking water treatment and wastewater treatment technologies. The priority activities in the field of R+D include the development of innovative technologies for arsenic removal and in addition to this iron, manganese and ammonium reduction in drinking water. Cooperation with international partners, particularly in the South-eastern European countries has long-ranging tradition, including cross-boundary projects such as the ARSENICPLATFORM with the University of Novi Sad (HUSRB/1002/121/075).

The EJC has laboratory facilities of >1,000 m² containing a wide range of pilot-scale treatment units, such as UV disinfection, chlorination, various adsorbers, RO, NF, MF, FO and anaerobic membrane equipment, sand filters and flocculators, etc. The Water Technology Basis has its own bank filtered drinking water wells that can be connected to any of the additional treatment facilities.

Main tasks in the project:

- **WP 1:** Piloting: Assessment the performance of bank filtration systems under various critical hydrological scenarios (i.e., floods, droughts, redox), performance assessment of Budapest site, water chemistry analysis and collaboration with BUWW

Principal research personnel to be involved:

Name/ Profile/ Project responsibility	Gender
<p>Dr. Erno Fleit, PhD. Biologist (PhD) and expert in water and wastewater treatment technologies. Professor of the Institute of Water Supply and Environmental Engineering at EJC. Research focus on environmental monitoring, risk assessment, biological hazards and membrane processes.</p>	M
<p>Zoltan Melicz, PhD. Professor of the Institute of Water Supply and Environmental Engineering at EJC. Civil engineer, focussing on water treatment technologies, particularly on membrane processes.</p>	M

Relevant publications:

1. Gulyás P., Fleit E., Melicz Z. and Bognár F. (2015): Biológiai szennyvíztisztító berendezések mikroszkópos vizsgálati módszertana. Főiskolai jegyzet. Eötvös József Főiskolai Kiadó. Budapest-Baja. ISBN 978 615 5429 16 3. pp. 303. (Microscopic diagnostic system for activated sludge – in Hungarian)
2. Fetter É., Sándor D. and Fleit E. (2010). Implementation of a monitoring system on the ecological effects of anthropogenic interventions on the Danube morphology for the Gemenc-Béda-Karapanca floodplain. *Pollack Periodica: An International Journal for Engineering and Information Sciences*, **5**(1), 151-162.
3. Sándor D. B., Zajzon G. and Fleit E. (2012). Investigation of simultaneous nitrification and denitrification process using biofilm formed on intelligent hydrogel microcarriers. *6th IWA International Conference for Young Water Professionals*, 1-10. ISBN:978-963-87507-8-5
4. Fleit E., Melicz Z., Sándor D., Zrínyi M., Filipcsei G., László K., Dékány I. and Király Z. (2008). IASON – Intelligent Activated Sludge Operated by Nanotechnology – Hydrogel Microcarriers in Wastewater Treatment. *Progress in Colloid and Polymer Science*, **135**. 209-217.

Relevant previous projects or activities:

1. **ARSENICPLATFORM** (EU IPA project): The EJC and the University of Novi Sad conducted research and dissemination activities on removal of arsenic and ammonium from drinking water to meet EU standards in the region.

Infrastructure/ technical equipment:

- over 1,000 m² water technology centre. Pilot scale and laboratory scale equipment including reverse osmosis, microfiltration, ultra- and nanofiltration units, forward osmosis and anaerobic membrane facilities. Available disinfection methods advanced UV, chlorination units, sand filters, etc.
- EJC owned and operated bank filtered drinking water bases on the bank of the Danube
- Fully capable water chemistry laboratory for traditional water pollutants and heavy metals, complemented with microscopic facilities. GPS linked field equipment for on-site analyses (Eh, pH, DO, etc.).

27	Kompetenzzentrum Wasser Berlin gGmbH (KWB)	
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General description:

The Berlin Centre of Competence for Water (Kompetenzzentrum Wasser Berlin gGmbH, KWB), is an international non-profit research center on urban water systems. The main mission consists of the planning and the execution of R&D projects, and the dissemination of project results together with the organization of conventions and symposia. The KWB has a staff of 30 full-time persons, who are active in projects mainly related to water resource management and innovative water and wastewater treatment technologies. Since its creation in 2001, KWB initiated and conducted several studies related to leading edge technologies for wastewater treatment resulting in more than 200 publications (journals and conferences). During this time, KWB gained extensive experiences in management and realization of pilot scale studies and monitoring programmes.

KWB is specialized in the management of research projects and is certified since 2010 under Quality Management System according to DIN EN ISO 9001:2008 that guarantees professional project management procedures and the maximum quality level of all our activities. KWB has also extensive experience with European projects: in the past years. KWB participated in the FP6 and FP7 projects MBR-TRAIN (#MEST-CT-2005-021050), TECHNEAU (#018320), PREPARED (#244232), and SAPH-PANI (#282911). KWB currently coordinates the H2020-project POWERSTEP (#641661), and in the past coordinated the EU-LIFE project ENREM (LIFE04 ENV/DE/000058) and the FP6 project AMEDEUS (#018328). KWB is corporate member of the International Water Association (IWA), and the Water Supply and Sanitation Technology Platform (WssTP).

- Main tasks in the project:**
- **WP 3:** Lead of WP3 activities, demonstration activity on effluent polishing with ozonation + constructed wetland treatment, pilot operation, sampling, data interpretation
 - **WP 1:** Demonstration activity on partial treatment (bank filtration + nanofiltration), pilot operation, sampling, data interpretation
 - **WP 4:** Demonstration of feasibility of open software solution for the water sector, implementation of risk management tool
 - **WP8:** member of the Project Management Team

Principal research personnel to be involved:

Name/ Profile/ Project responsibility	Gender
<p>Dr Ulf Mieke</p> <p>Dr Ulf Mieke is Head of the department on advanced wastewater engineering. He was/is the KWB internal coordinator of several projects focussing on tertiary treatment and water reuse: Demoware, ASKURIS, IST4R (see below). He is member of the working group on oxidation in the German Society for Water Chemistry. He will manage the overall activities of KWB within AquaNES.</p>	M
<p>Dr Daniel Wicke</p> <p>Dr Daniel Wicke is Environmental Engineer (PhD) and project manager at KWB with background in urban waters, micropollutants and eco-engineered systems. Currently he coordinates the project OGRE (EFRE co-funding) on micropollutants in urban stormwater. Daniel Wicke is (Co)-Author of > 25 papers and conference manuscripts. He is member of the working groups on ecosystem services, green infrastructure and emerging compounds in the Water Supply and Sanitation Technology Platform (WssTP). He will be leader of WP3 and coordinate the site activities of KWB.</p>	M
<p>NN (M/W): project engineer for pilot operation</p>	M/F
<p>Wolfgang Seis</p> <p>Wolfgang Seis brings in specialisation on environmental biotechnology, water and environmental chemistry and analytics and water supply systems. He is expert in risk assessment and in programming in open software R. He will be responsible for the utilisation and adaptation of these approaches in WP4. He is currently working especially in DEMOWARE on QMRA for water reuse.</p>	M

Kristine Oppermann

Kristine Oppermann is professional book-keeper. She performed book-keeping and supervised financing reporting and audits of FP6 project AMEDEUS, FP7 project P-REX and LIFE Projects ENREM and SCST. She will be the project financial officer at KWB.

F

Relevant publications:

1. Stapf M., Miehe U., Wiedemann B. and Jekel M. (2014). Comparison between different filter systems as a post treatment after tertiary ozonation. The 5th International Slow Sand and Alternative Biological Filtration Conference, June 19-21, Nagoya, Japan.
2. Seis W., Remy C. and Ackermann R. (2013). Microbial Risk Assessment of the Water Reuse Scheme in Braunschweig based on WHO guidelines. International conference ReWater Braunschweig, November 2- 3, Braunschweig, Germany.
3. Wicke D. (2013). Eco-engineered systems for removal of micropollutants from WWTP effluents – existing knowledge. Report, project deliverable of KWB project EcoTreat, accessible under <http://www.kompetenzwasser.de/ECOTREAT.559.0.html>

Relevant previous projects or activities:

1. **Saph Pani** (EU project, FP7 GA no. 282911): Saph Pani addressed the improvement of natural water treatment systems such as river bank filtration (RBF), managed aquifer recharge (MAR) and wetlands in India building on a combination of local and international expertise. The project aimed at enhancing water resources and water supply particularly in water stressed urban and peri-urban areas in different parts of the sub-continent.
2. **DEMOWARE** (EU project, FP7 GA no. 619040) aims at increasing Europe’s ability to profit from the resource security and economic benefits of water reuse schemes without compromising human health and environmental integrity. The programme has two central ambitions (i) to enhance the availability and reliability of innovative water reuse solutions, and (ii) to create a unified professional identity for the European Water Reuse sector.
3. **ASKURIS** – (German Federal Ministry of Education and Research (BMBF)), within the project KWB assessed the efficiency of oxidation processes for the removal of trace organic compounds and performed comparative LCA studies to evaluate the tested technologies.
4. **IST4R** – (local funding + EFRE co-funding), the integration of ozonation or powdered activated carbon in tertiary treatment for phosphorus removal is assessed in pilot studies and as well via LCA. KWB successfully developed the first running closed-loop control for ozonation targeting trace organic removal.

Infrastructure/ technical equipment:

- Ozonation pilot unit acquired after former project IST4R (original prize for pilot ~300.000 €) for use in site Schönerlinde (no. 12)

28 KWR Water B.V. (KWR)



General description:

KWR (170 staff, based in the Netherlands) is a publicly owned research institute for the (urban) water cycle (www.kwrwater.nl). Building on 40 years of experience in the Dutch water sector, KWR has evolved into a prominent player in the European water research and innovation arena. We develop and unlock knowledge about the water cycle from water systems, technologies and water quality to governance. Our objective is to provide the water sector with the means to identify and effectively meet the challenges of our time: from climate change to the increasing amount of contaminants, and the growing pressure to use space intensively and for multiple purposes.

KWR has ample experience in European research and innovation projects, many of them as coordinator such as WE-KNOW, MICRORISK, TECHNEAU, PREPARED, DEMEAU and SUBSOL. KWR is founding member of the European Water Platform WssTP (www.wsstp.eu), member of both the High Level Steering Group and Task Force of the EIP-Water and chair of ARC (a collaborative platform of leading applied water research institutes). Other EU-funded research projects that KWR is or has been involved in, are SCENES, MICRORISK, LEGIONELLOSIS, CPDW, TOXIC. SOCOPSE, TESTNET, ARTDEMO, TRUST, TAPES, Water4India, SmartWater4Europe, DEMOWARE, SOLUTIONS and DESSIN.

Main tasks in the project:

- **WP 4** WP lead, development of innovative tools, monitoring framework and risk assessment
- **WP 2** responsible for Waddinxveen demonstration site (no.9) Guidance and interpretation of results, Validate a Monitoring and Decision Support System to optimize water supply for greenhouses
- **WP 5** Gaming tool for engaging the general public, Governance framework recommendation for the Waddinxveen site
- **WP 7** Dissemination & communication, link to WssTP and EIP Action Groups
- **WP8:** member of the Project Management Team

Principal research personnel to be involved:

Name/ Profile / Project responsibility	Gender
<p>Dr Thomas ter Laak</p> <p>Dr Thomas ter Laak is an experienced researcher in environmental chemistry. His research focus is on occurrence of emerging substances in the urban water cycle, specifically, in drinking water sources and drinking water. He will be leading WP4</p>	M
<p>Dr Kirsten Baken</p> <p>Dr Kirsten Baken is an experienced researcher in toxicology and an expert in human health effects of environmental contaminants. She has experience in the field of human health risk assessment, innovative testing strategies and refinement of risk assessment tools. She will contribute to the water quality assessment framework in WP4</p>	F
<p>Dr Luc Hornstra</p> <p>Dr Luc Hornstra is an experienced microbiologist. His research aims at the fate and behaviour of microorganisms in natural and engineered environmental systems. Additionally, he has experience in monitoring antibiotic resistance genes in environmental samples. He will contribute to the innovative monitoring systems in WP4</p>	M
<p>Dr Marcel Paalman</p> <p>Dr Marcel Paalman is a geochemist, as a senior advisor and scientist he connects policy and research issues and develops water management strategies with a scientifically sound basis and societal benefits. He will be responsible for activities at the Waddinxveen site.</p>	M
<p>Dr Theo van den Hoven</p>	M

<p>Dr Theo van den Hoven is manager international research and has >30 years of experience with research, valorisation and governance issues in water and waste water services. Theo is Vice-President of WssTP and member of the EIP-W Task Force. His role is to contribute to the governance framework of the Waddinxveen site in WP5 (task 5.2.3) and the dissemination actions in WP 7 (task 7.3)</p>	
<p>Dr Christos Makropoulos</p> <p>Dr Christos Makropoulos is the Chief Information Officer of KWR an Assistant Professor at the School of Civil Engineering of the National Technical University of Athens. Dr Makropoulos is an expert in hydroinformatic tools and methods for water management with an emphasis on water systems optimisation. His work focuses on risk analysis, uncertainty quantification, multi-objective evolutionary optimization, decision support and long-term policy scenario development. He will contribute to the interactive quantitative risk assessment tool in WP3 (task 4.4) and the gaming tool in WP 5 (task 5.3.4)</p>	<p>M</p>
<p>Relevant publications:</p> <ol style="list-style-type: none"> 1. Baken K. and Kools S. (2014). Innovative testing strategies and their relevance for evaluating chemical drinking water quality. Nieuwegein: KWR. No. BTO 2014.009. 2. Van Loon A., Jalink M. and Paalman M. (2013). Potentials of groundwater storage management in the dry Stipfelberg forests. <i>Landschap</i>, 30(4), 181-189. 3. Hoekstra J. and Hornstra L. (2015). The presence of antibiotic resistance genes in Dutch surface water and drinking water treatment plants (Confidential report, available upon request) 4. Kossieris, P., A. Panayiotakis, K. Tzouka, P. Gerakopoulou, E. Rozos, C. Makropoulos (2014). An eLearning Approach for Improving Household Water Efficiency, <i>Procedia Engineering</i>, Volume 89, Pages 1113-1119, ISSN 1877-7058, http://dx.doi.org/10.1016/j.proeng.2014.11.232 5. Koutiva I. and C. Makropoulos (2012) Linking tools for social simulation and urban water network modelling for supporting an adaptive approach of urban water resources management, 6th International Congress on Environmental Modelling and Software - iEMSs 2012, 1-5 July 2012, Leipzig Germany 	
<p>Relevant previous projects or activities:</p> <ol style="list-style-type: none"> 1. DEMEAU (EU project, FP7 GA no. 308339) develops and implements knowledge, prototypes and practices enabling the water cycle sector to face emerging pollutants. Feeds into water quality assessment framework and systems in WP4 2. DEMOWARE (EU project, FP7 GA no. 619040) aims at increasing Europe's ability to profit from the resource security and economic benefits of water reuse schemes without compromising human health and environmental integrity. The programme has two central ambitions (i) to enhance the availability and reliability of innovative water reuse solutions, and (ii) to create a unified professional identity for the European Water Reuse sector. pollutants. Feeds into water quality assessment framework and systems in WP4 3. SOLUTIONS (EU project, FP7 GA no. 603437) aims to link occurrence of chemicals with the ecological status of waters, to identify major chemical stressors, and to produce consistent solutions for the large number of legacy, present and future chemicals posing a risk to European water resources with respect to ecosystems and human health. pollutants. Feeds into water quality assessment framework and systems in WP4 4. DESSIN (EU project, H2020 GA no 619039) addresses the Ecosystems Services concept to boost innovative solutions in the water sector. This novel approach adds socio-economic and environmental aspects to the traditional technological assessment of innovations. This project feeds into WP5 (task 5.1.2) 	
<p>Infrastructure/ technical equipment:</p> <ul style="list-style-type: none"> • Not relevant 	

29 National Technical University of Athens



General description:

The National Technical University of Athens (NTUA) is one of the oldest and most prestigious Academic Institutes in Greece, with a long experience in education, training and technological research and development. The Environmental and Energy Management Research Unit (EEMRU, <http://environ.chemeng.ntua.gr>) is an educational and research unit of the School of Chemical Engineering, with extensive research experience, particularly in regions of the Mediterranean. The EEMRU has coordinated or participated in several EU international research projects (including FP7 WatERP, EcoWater, DROUGHT-R&SPI, COROADO, SWITCH, WASSERMed, XEROCHORE, FP6 AquaStress, INECO, OPEN-GAIN, Nostrum-DSS, FP5 WaterStrategyMan, ARID Cluster etc.), and has produced numerous publications in scientific journals and conferences.

Within the framework of past and on-going research projects, the EEMRU has developed models and tools to support decision making in water management:

- The EcoWater web toolbox, which can be used to perform life-cycle and value chain analysis for water systems (developed within the framework of the FP7 ECOWATER project).
- The WSM DSS, a water demand modeling tool that provides the framework for examining the applicability of dominant and shifting paradigm options in terms of effectiveness, environmental and economic impacts under different scenarios of water availability and demand (developed within the framework of the FP5 WaterStrategyMan project).
- The OPEN-GAIN DSS, a tool that supports the design and implementation of a hybrid power system (co-generation of electrical power from renewable energy sources and water from desalination) and enables the assessment of economic, environmental and social performance for alternative configurations (developed within the framework of the FP6 OPEN-GAIN project).
- A GIS-Based tool for assessing climate change impacts on the tourism sector. The tool enables the analysis of the anticipated changes in tourism fluxes, water demand from the tourism sector and income generation. Also, the losses of coastal areas due to sea level rise are examined (developed within the framework of the FP7 WASSERMed project).
- The AquaDT tool, a web-based Multi-Criteria Decision Analysis (MCDA) application, which supports stakeholders in participatory complex decision making processes (developed within the FP6 AquaStress Integrated Project).

The EEMRU is also responsible for courses covering a wide spectrum of subjects at both the undergraduate and post-graduate level, which are supported through specifically tailor-made web material.

Main tasks in the project:

- **WP 6:** work package lead, development of decision support platform
- **WP 3:** coordination of Greek demonstration sites
- **WP4:** Contribution on development of data processing and integrative water quality reporting tool based on open access software “R”.
- **WP5:** Contribution in the development of an LCA approach tailored for cNES, application of LCC analysis determine cost-effectiveness of cNES and S-LCA evaluating social and socio-economic impacts of cNES. Outputs from WP5 will support the development of AquaNEs DSS interface and platform in WP6.
- **WP 7:** (regional) stakeholder workshop on cNES/CW based solutions in remote / rural areas
- NTUA will in addition contribute to all other WPs, in an effort to receive and provide input regarding WP6 (DSS) implementation.
- **WP8:** member of the Project Management Team

Principal research personnel to be involved:

Name/ Profile/ Project responsibility	Gender
Prof. Dionysis Assimacopoulos	M
He is the EEMRU Coordinator, and a full Professor at the School of Chemical Engineering of NTUA.	

He has participated in more than 20 research projects at the national and European/International level as coordinator or partner. He will lead WP6 and coordinate the participation of the NTUA in AquaNES.

Dr. George Arampatzis

M

He is a senior researcher in the EEMRU, and a member of the teaching staff of the School of Chemical Engineering. His expertise is on modelling and optimization of systems and processes, on the development and implementation of computational techniques and on the design and development of decision support systems. He will be in charge of the AquaNES DSS development, testing and validation in WP6.

Dr. Eleni Kampragou

F

She holds a degree in Environmental Engineering and a Ph.D. in Water Resources Management, and has participated in 10 EU-funded projects undertaken by the EEMRU over the past 10 years. She will be in charge of the coordination of the Greek demonstration sites in WP3.

Relevant publications:

1. Assimacopoulos D., Dimova G., Ribarova I. and Stanchev P. (2014). A first iteration of an Eco-efficiency Assessment of Sofia's Urban Water System. *Procedia Engineering*, **70**, 1411-1420.
2. Levidow L., Lindgaard-Jorgensen P, Nilsson A, Skenhall S. A. and Assimacopoulos D. (2014). Eco-efficiency improvements in industrial water-service systems: Assessing options with stakeholders. *Water Science and Technology*, **69**(10), 2113-2121.
3. Ribarova I., Assimacopoulos D., Jeffrey P., Daniell K., Inman D., Vamvakeridou-Lyroudia L., Melin T., Kalinkov P., Ferrand N. and Tarnaki K. (2011). Research-supported participatory planning for water stress mitigation. *Journal of Environmental Planning and Management*, **54**, 1-18.
4. Arampatzis G., Angelis-Dimakis A., Blind M. and Assimacopoulos D.(2014). An online suite of tools to support the systemic eco-efficiency assessment in water use systems. *17th European Roundtable on Sustainable Consumption and Protection, Research – Experience – Development*, October 10, Portoroz, Slovenia.
5. Karka P., Lekkas D.F., Grigoropoulou H. and Assimacopoulos D. (2010). Conceptual modelling and data based techniques to understand urban water use and wastewater production. *Journal of Environmental Science and Engineering (USA)*, **9**(4), 573-587.

Relevant previous projects or activities:

NTUA has gained experience and proven expertise in modelling tools through various projects

1. “**Ecowater**: Development of eco-efficiency meso-level indicators for technology assessment (Ecowater)”, financed by the European Commission, DG Research, 7th Framework Programme, Theme: ENV.2011.3.1.9-2, Collaborative Project, 282882, 2011-2014.
2. “Water availability and Security in Southern Europe and the Mediterranean (**WASSERMed**)”, financed by the European Commission, DG Research, 7th Framework Programme, Theme 6: Environment (including Climate Change), Collaborative Project, 244255, 2010-2012.
3. “Institutional and Economic Instruments for Sustainable Water Management in the Mediterranean Region (**INECO**)”, financed by the European Commission. DG Research, 6th Framework Programme, INCO-CT-2006-517673, 2006-09.
4. “Mitigation of Water Stress through new approaches to Integrating Management, Technical Economic and Institutional Instruments (**AquaStress Integrated Project**)”, financed by the European Commission. DG Research, 6th Framework Programme, Priority 1.1.6.3 “Global Change and Ecosystems”, 511231, 2005-08.
5. “Improving Competitiveness of SMEs through IT-based Environmental Business Planning (**SMITE**)” financed by the European Commission, DG AIDCO, MEDA Programme, B7-4100/2000/2165-072P421. 2002 – 2005.

30 Uttarakhand Jal Sansthan (UJS) – Uttarakhand State Water Supply & Sewerage Organisation, India



General description:

The Uttarakhand State Water Supply & Sewerage Organisation – Uttarakhand Jal Sansthan (UJS) is an autonomous body of the Uttarakhand state government (> 4,250 employees). It currently operates and maintains 63 urban and 5,355 rural water supply schemes to provide wholesome water for approximately its 9 million population. Its main functions are: (1) to plan, promote, execute & operate efficient water supply schemes, (2) where feasible, to plan, promote, execute & operate sewage treatment and disposal schemes, treatment of industrial effluents, (3) to manage all of UJS’s affairs so as to provide the people of the area within its jurisdiction with wholesome water and where feasible, with efficient sewerage service, (4) to take such measures, as may be necessary, to ensure water supply in times of any emergency.

UJS operates and maintains bank filtration (BF/RBF) schemes for the provision of drinking water to urban and rural areas at presently more than 7 locations in the state, notable amongst them is the AquaNES site in Haridwar. UJS is experienced in research cooperation with AQUANES partners (HTWD) with whom they have been assessing existing BF schemes and constructed 5 new BF schemes. They recently participated in the EU Saph Pani project. In recent years they have been involved in a number of network and research projects on RBF. Consequently, UJS created the dedicated Riverbank Filtration Cell and its employees are regularly taking part in conferences, seminars and trainings on BF and post-treatment.

Main tasks in the project:

- **WP1:** Demonstration of bank filtration operation in Haridwar, coupling of bank filtration and inline-electrolysis in cooperation with AUTARCON. Innovative concepts for well operation & protection during floods and droughts. Assessment of advantages of siphon systems.
- **WP7:** Dissemination and exploitation of small systems combining BF and inline-electrolysis.

Principal research personal to be involved:

Name	Profile/ Project responsibility	Gender
Ing. P. C. Kimothi, General Manager – Technical, Research and Materials	Educated civil engineer with >35 years professional experience in planning, execution, operation and monitoring of water extraction, treatment, distribution and network operation projects in Uttarakhand. >10 years experience in research and construction of BF systems in hill regions. Participated in several Indo-German and Indo-EU R&D projects on BF since 2005, water loss management, energy efficiency of pumps. Member of the Indian Water Works Association (IWWA).	M
Ing. S. K. Sharma, Superintending Engineer, Dehradun	Educated civil engineer with >38 years professional experience in planning, maintenance & operation of water extraction, treatment, distribution and network operation projects in Uttarakhand. >8 years experience in research and construction of BF systems in hill regions. Participated in several Indo-German and Indo-EU R&D projects on BF since 2007, water loss management, energy efficiency of pumps. Member of the Indian Water Works Association.	M
Ing. D. K. Singh, Superintending Engineer, Haridwar	Educated civil engineer with >30 years professional experience in planning, maintenance & operation of water extraction, treatment, distribution and network operation projects in Uttarakhand. >4 years experience as engineer-in-charge for RBF scheme in Haridwar.	M

Relevant publications:

1. Sandhu, C., Grischek, T., Ronghang, M., Mehrotra, I., Kumar, P., Ghosh, N.C., Rao, Y.R.S., Chakraborty, B., Patwal, P.S., **Kimothi, P.C.** (2015) Overview of bank filtration in India and the need for flood-proof RBF systems. In: Wintgens, T., Nätörp, A., Lakshmanan, E., Asolekar, S.R. (eds.) Saph Pani – Enhancement of natural

water systems and treatment methods for safe and sustainable water supply in India. IWA Publishing, London, UK (*in press*).

2. Essl, L., Starkl, M., **Kimothi, P.C.**, Sandhu, C., Grischek, T. (2014) Riverbank filtration and managed aquifer recharge as alternative water supply technologies for India: strengths – weaknesses – opportunities – threats analysis. *Wat. Sci. Technol.: Water Supply* 14(4), 690-697.
3. **Kimothi, P.C.**, Dimri, D.D., Adlakha, L.K., Kumar, S., Rawat, O.P., Patwal, P.S., Grischek, T., Sandhu, C., Ebermann, J., Ruppert, M., Dobhal, R., Ronghang, M., Kumar, P., Mehrotra, I., Uniyal, H.P. (2012) Development of Riverbank Filtration in Uttarakhand. *J. Indian Water Works Association, Special issue on RBF*, 13-18.
4. Ronghang, M., Kumar, P., Mehrotra, I., **Kimothi, P.C.**, Adlakha, L.K., Sandhu, C., Grischek, T., Voltz, T.J. (2012) Application of Riverbank Filtration for year-round Drinking Water Production in a small town in the hills of Uttarakhand. *J. IWWA, Special Issue on RBF*, 19-24.
5. Key members of UJS team for achieving National Urban Water Awards in India for UJS in 2008 for Uttaranchal Koop-well for small-scale decentralised RBF water supply and in 2009 for development of RBF in Uttarakhand and in 2010 for attaining demonstration-site status for RBF in Haridwar from Managed Aquifer Recharge Commission of the International Assoc. of Hydrogeologists.

Relevant previous projects or activities

1. **ADB Project (2014-2018)** Flood-protection, capacity enhancement and redevelopment of drinking water supply infrastructure including RBF systems for 9 towns affected by June 2013 flood in Uttarakhand
2. **Saph Pani** (EU project, FP7 GA no. 282911, 2011-2014): Responsible for data collection, management and operation of 3 out of 4 BF case study sites in project.
3. **Development of RBF in Hill-Regions for Sustainable Water Supply in Uttarakhand** (DST/WTI/2k9/149, 2010-2013): Site-selection, construction and monitoring of 5 new RBF schemes in Uttarakhand. Project funded by Water Technology Initiative of Department of Science & Technology, Government of India.
4. **RBFN** (BMBF project, no. IND 08/156, 2008-2011) main Indian industry member of Indo-German Riverbank Filtration Network (RBFN) project. Together with HTWD, responsible for achieving demonstration-site status for RBF site in Haridwar.
5. **CCRBF** (since 2008): UJS is founding and principal industry-member of the Cooperation Centre for Riverbank Filtration (CCRBF), Dehradun (registered under Societies Registration Act of India). The CCRBF is a resource centre on RBF in general and specifically for India. It provides technical support to national projects related to RBF systems, establishes international linkages for collaborative research, develops human resources in the field of RBF & strengthens the cooperation between water supply companies and universities.

Infrastructure/ technical equipment

UJS operates a large RBF water abstraction system in Haridwar along the Ganga River and Upper Ganga Canal comprising 22 RBF wells having a mean daily total abstraction of ~61,400 m³. The system is recognised as a demonstration site by IAH's MAR-NET. There is a large database of water quality data. Different operation schemes and water qualities are available for pilot facilities.

4.2 Third parties involved in the project

The project will only make use of the third parties as detailed in Table 11. Beneficiaries will not work with Linked Third Parties.

Table 11 Subcontracts to be awarded within the project

			Does the participant plan to subcontract certain tasks (please note that core tasks of the project should not be sub-contracted)
2	AKUT	15'000	Site construction work to prepare for installation of constructed wetland, Site 12 Schönerlinde
10	VTG	60'000	1-2 subcontracts (30'000 EUR each). This amount is reserved for any potential Environmental Technology Verification procedure of up to 2 AquaNES technologies. Whether and for which technologies exactly this amount will be used will be decided based on the project activities outcome (as foreseen in Task 7.1.2). Once decided which technologies, the amount will be reallocated to the relevant participant's budget. This activity can only be carried out by qualified third parties called "Verification Bodies" which are not represented in the consortium.
11	WADIS	19'200	1 subcontract on chemical and microbiological analysis during optimization period of pilot on electropulse oxidation a Site 7 (WP2, Task 2.2.2-2.2.4) for the assessment of the effect of this oxidative treatment on organic micropollutant removal Specialised analytical expertise not available in the consortium at more competitive conditions
15	BWB	135'500	setup pilot, connect to infrastructure (WP1, WP3) external laboratory analytics (trace organics, AR gene sequencing, AR gene detection) (WP4) Dissemination material (model or video) (WP7)
18	Drewag	50'000	1 subcontract on planning, design, operation and maintenance of the ultrafiltration pilot plant in Site 2 in relation to Task 1.2.1) Neither DREWAG nor HTWD do have the technical expertise to run this pilot. All other potentially capable partners are located too far away and it would be more costly to involve them
21	MEK	62'024	2 subcontracts for <ul style="list-style-type: none"> • microbiological analysis and spiking (viruses, coliphages, giardia) 15'524 EUR and • organic micropollutant analysis (46'500 EUR) during operation of Site 7 (WP2 Task 2.2, WP4) which aims at indirect potable reuse. The fate of pathogens is thus to be monitored. Specialised analytical expertise not available in the consortium
22	AMU	40'500	2 subcontracts 1 supporting in water sampling, water analyses, (32'500 EUR) 2 external laboratory for chemical analyses of specific parameters (e.g. micropollutants) (8'000 EUR) at Site 4, Poznan (WP1)
23	BRGM	8'000	1 subcontract for virus and pathogens analysis in reclaimed water for golfcourse irrigation Site 8, (WP2, Task 2.4.2 & 2.5). French legislation on water reuse requires a minimum removal effectiveness for coliphages which has to be proven in the demonstration site. Specialised analytical expertise not available in the consortium
25	HTWD	17'000	1 subcontract for pathogen analysis in Site 2 (viruses and viral indicators) in relation to Tasks 1.2.1 and 1.4.3 to assess ultrafiltration effectiveness and to contribute to WP4 QMRA tool Specialised analytical expertise not available in the consortium

5 ETHICS AND SECURITY

5.1 Ethics

The Ethics Summary Report identified Environmental issues and third countries involvement as aspects to be addressed. :

Ethics Requirements:

pre-grant – Ethics Requirement 2:

The applicant must confirm that the ethical standards and guidelines of Horizon2020 will be rigorously applied, regardless of the country in which the research is carried out.

The applicant confirms that the ethical standards and guidelines of Horizon2020 will be rigorously applied, regardless of the country in which the research is carried out

Ethics Requirement 4

Detailed information must be provided to confirm that fair benefit-sharing arrangements with stakeholders from low and/or lower-middle income countries are ensured during the project.

The activities in India are performed in close collaboration with the local utility and under support of a research institute in the area. Knowledge gained will be scientifically exploited in joint publications. Further the utility will acquaint the operational know-how which makes them potentially independent from external support in running such systems. The Indian partner will be partner in the exploitation team of the technology. More detailed information on the benefit-sharing arrangements with this partner will be submitted in Month 2 of the project.

Ethics Requirement 3

The applicant must provide further information about the possible harm to the environment caused by the research and state the measures that will be taken to mitigate the risks.

All our demonstration facilities have permission of competent authorities as far as required. The interventions in most sites are comparably minor in terms of flow and thus of expectedly limited impact on the water environment. More detailed information related to this Ethics Requirement will be submitted in Month 2 of the project.

Ethics Requirement 1

The applicant must ensure that appropriate health and safety procedures conforming to relevant local/national guidelines/legislation are followed for staff involved in this project.

All demonstration plant set-up are equipped with the legally mandatory protection devices as for (where applicable) electrical installation, EX-protection, ozone destruction etc.. More detailed information related to this Ethics Requirement will be submitted in Month 2 of the project.

5.2 Security

not applicable

The project will not involve:

- Activities or results raising security issues:
- EU classified information as background or results:

ESTIMATED BUDGET FOR THE ACTION (page 1 of 3)

Estimated eligible ¹ costs (per budget category)									EU contribution			Additional information				
A. Direct personnel costs		B. Direct costs of subcontracting	[C. Direct costs of fin. support]	D. Other direct costs	E. Indirect costs ²	Total costs	Reimbursement rate %	Maximum EU contribution ³	Maximum grant amount ⁴	Information for indirect costs	Information for auditors	Other information:				
A.1 Employees (or equivalent) A.2 Natural persons under direct contract A.3 Seconded persons [A.6 Personnel for providing access to research infrastructure]		A.4 SME owners without salary A.5 Beneficiaries that are natural persons without salary		D.1 Travel D.2 Equipment D.3 Other goods and services D.4 Costs of large research infrastructure						Estimated costs of in-kind contributions not used on premises	Declaration of costs under Point D.4	Estimated costs of beneficiaries/ linked third parties not receiving EU funding				
Form of costs ⁶	Actual	Unit ⁷	Unit ⁸	Actual	Actual	Actual	Flat-rate ⁹									
	(a)	Total (b)	No hours	Total (c)	(d)	(e)	(f)	(g)=0,25x ((a)+(b)+ (c)+(f) +[(h1)+(h2)]- (m))	(i)= (a)+(b)+(c)+ (d)+(e)+(f)+ (g)+(h1)+(h2)+(h3)	(j)	(k)	(l)	(m)	Yes/No		
1. FHNW ¹³								726437.50								726437.50
2. AKUT	38336.30	0.00	1720	55263.60	15000.00	0.00	59160.00	38189.98	205949.88	70.00	144164.92	144164.92	0.00	No		
3. AUT	138600.00	0.00	0	0.00	0.00	0.00	81500.00	55025.00	275125.00	70.00	192587.50	192587.50	0.00	No		
4. BDS	147200.00	0.00	0	0.00	0.00	0.00	37700.00	46225.00	231125.00	70.00	161787.50	161787.50	0.00	No		
5. HYBU	77000.00	0.00	0	0.00	0.00	0.00	44200.00	30300.00	151500.00	70.00	106050.00	106050.00	0.00	No		
6. imaGeau	76125.00	0.00	0	0.00	0.00	0.00	40623.00	29187.00	145935.00	70.00	102154.50	102154.50	0.00	No		
7. GEOHYD	255955.00	0.00	0	0.00	0.00	0.00	16800.00	68188.75	340943.75	70.00	238660.63	238660.63	0.00	No		
8. MicroLAN	78000.00	0.00	0	0.00	0.00	0.00	94500.00	43125.00	215625.00	70.00	150937.50	150937.50	0.00	No		
9. XFLOW	150378.00	0.00	0	0.00	0.00	0.00	270660.00	105259.50	526297.50	70.00	368408.25	368408.25	0.00	No		
10. VTG	443805.00	0.00	504	18194.40	60000.00	0.00	18800.00	120199.85	660999.25	70.00	462699.48	462699.48	0.00	No		
11. WADIS	95000.00	0.00	0	0.00	19200.00	0.00	77753.00	43188.25	235141.25	70.00	164598.88	164598.88	0.00	No		
12. WatStech	160000.00	0.00	0	0.00	0.00	0.00	22700.00	45675.00	228375.00	70.00	159862.50	159862.50	0.00	No		
13. XYLEM	176400.00	0.00	0	0.00	0.00	0.00	172767.00	87291.75	436458.75	70.00	305521.13	305521.13	0.00	No		
14. BUWW	172200.00	0.00	0	0.00	0.00	0.00	64600.00	59200.00	296000.00	70.00	207200.00	207200.00	0.00	No		
15. BWB	410400.00	0.00	0	0.00	135500.00	0.00	92200.00	125650.00	763750.00	70.00	534625.00	534625.00	0.00	No		
16. DEYAT	46550.00	0.00	0	0.00	0.00	0.00	4900.00	12862.50	64312.50	70.00	45018.75	45018.75	0.00	No		
17. MUOA	33250.00	0.00	0	0.00	0.00	0.00	2765.00	9003.75	45018.75	100.00	45018.75	45018.75	0.00	No		
18. DREWAG	96800.00	0.00	0	0.00	50000.00	0.00	91771.00	47142.75	285713.75	70.00	199999.63	199999.63	0.00	No		
19. EV	287920.00	0.00	0	0.00	0.00	0.00	107200.00	98780.00	493900.00	100.00	493900.00	493900.00	0.00	No		
20. IWB ¹³									209875.00							209875.00
21. MEK	343200.00	0.00	0	0.00	62024.00	0.00	163632.00	126708.00	695564.00	70.00	486894.80	486894.80	0.00	No		
22. AMU	76662.00	0.00	0	0.00	40500.00	0.00	56738.00	33350.00	207250.00	100.00	207250.00	207250.00	0.00	No		
23. BRGM	0.00	355000.00	0	0.00	8000.00	0.00	52950.00	101987.50	517937.50	100.00	517937.50	517937.50	0.00	No		
24. UCRAN	307800.00	0.00	0	0.00	0.00	0.00	57340.00	91285.00	456425.00	100.00	456425.00	456425.00	0.00	No		
25. HTWD	259600.00	0.00	0	0.00	17000.00	0.00	109867.00	92366.75	478833.75	100.00	478833.75	478833.75	0.00	No		
26. EJC	72500.00	0.00	0	0.00	0.00	0.00	29200.00	25425.00	127125.00	100.00	127125.00	127125.00	0.00	No		
27. KWB	360750.00	0.00	0	0.00	0.00	0.00	79865.00	110153.75	550768.75	100.00	550768.75	550768.75	0.00	No		
28. KWR	440000.00	0.00	0	0.00	0.00	0.00	76700.00	129175.00	645875.00	70.00	452112.50	452112.50	0.00	No		
29. NTUA	351500.00	0.00	0	0.00	0.00	0.00	29900.00	95350.00	476750.00	100.00	476750.00	476750.00	0.00	No		

ESTIMATED BUDGET FOR THE ACTION (page 2 of 3)

Estimated eligible ¹ costs (per budget category)								EU contribution			Additional information		
A. Direct personnel costs		B. Direct costs of subcontracting	[C. Direct costs of fin. support]	D. Other direct costs	E. Indirect costs ²	Total costs	Reimbursement rate %	Maximum EU contribution ³	Maximum grant amount ⁴	Information for indirect costs	Information for auditors	Other information:	
A.1 Employees (or equivalent) A.2 Natural persons under direct contract A.3 Seconded persons [A.6 Personnel for providing access to research infrastructure]		A.4 SME owners without salary A.5 Beneficiaries that are natural persons without salary		D.1 Travel D.2 Equipment D.3 Other goods and services D.4 Costs of large research infrastructure						Estimated costs of in-kind contributions not used on premises	Declaration of costs under Point D.4	Estimated costs of beneficiaries/ linked third parties not receiving EU funding	
Form of costs ⁶	Actual	Unit ⁷	Unit ⁸	Actual	Actual	Actual	Flat-rate ⁹						
	(a)	Total (b)	No hours Total (c)	(d)	(e)	(f)	(g)=0,25x ((a)+(b)+ (c)+(f) +[(h1)+(h2)]- (m))	(i)= (a)+(b)+(c)+ (d)+(e)+(f)+ (g)+(h1)+(h2)+(h3)	(j)	(k)	(l)	(m)	Yes/No
30. UJS ¹³							45000.00						45000.00
Total consortium	5202431.30	874750.00	73458.00	407224.00	0.00	2115591.00	2066557.58	10740011.88		7837292.22	7837292.22	0.00	981312.50

ESTIMATED BUDGET FOR THE ACTION (page 3 of 3)

- (1) See Article 6 for the eligibility conditions
- (2) The indirect costs covered by the operating grant (received under any EU or Euratom funding programme; see Article 6.5.(b)) are ineligible under the GA. Therefore, a beneficiary that receives an operating grant during the action's duration cannot declare indirect costs for the year(s)/reporting period(s) covered by the operating grant (see Article 6.2.E).
- (3) This is the theoretical amount of EU contribution that the system calculates automatically (by multiplying all the budgeted costs by the reimbursement rate). This theoretical amount is capped by the 'maximum grant amount' (that the Commission/Agency decided to grant for the action) (see Article 5.1).
- (4) The 'maximum grant amount' is the maximum grant amount decided by the Commission/Agency. It normally corresponds to the requested grant, but may be lower.
- (5) Depending on its type, this specific cost category will or will not cover indirect costs. Specific unit costs that include indirect costs are: costs for energy efficiency measures in buildings, access costs for providing trans-national access to research infrastructure and costs for clinical studies.
- (6) See Article 5 for the forms of costs
- (7) Unit : hours worked on the action; costs per unit (hourly rate) : calculated according to beneficiary's usual accounting practice
- (8) See Annex 2a 'Additional information on the estimated budget' for the details (costs per hour (hourly rate)).
- (9) Flat rate : 25% of eligible direct costs, from which are excluded: direct costs of subcontracting, costs of in-kind contributions not used on premises, direct costs of financial support, and unit costs declared under budget category F if they include indirect costs
- (10) See Annex 2a 'Additional information on the estimated budget' for the details (units, costs per unit).
- (11) See Annex 2a 'Additional information on the estimated budget' for the details (units, costs per unit, estimated number of units, etc)
- (12) Only specific unit costs that do not include indirect costs
- (13) See Article 9 for beneficiaries not receiving EU funding
- (14) Only for linked third parties that receive EU funding

ANNEX 2a

ADDITIONAL INFORMATION ON THE ESTIMATED BUDGET

Costs for an SME owner not receiving a salary

Units: hours worked on the action

Amount per unit ('hourly rate')*:

- **Beneficiary 2 AKUT: EUR 32.13**

* Amount calculated as follows:

{4 650/ 143 hours}

multiplied by

{country-specific correction coefficient of the country where the beneficiary is established}

Country correction coefficient: **98.8%**

- **Beneficiary 10 VTG: EUR 36.10**

* Amount calculated as follows:

{4 650/ 143 hours}

multiplied by

{country-specific correction coefficient of the country where the beneficiary is established}

Country correction coefficient: **111%**

Estimated number of units: see Annex 2

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

AKUT UMWELTSCHUTZ INGENIEURE BURKARD UND PARTNER (AKUT) DE5, PR281, established in WATTSTRASSE 10, BERLIN 13355, Germany, DE227840440 ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become *beneficiary* No ('2')

in Grant Agreement No 689450 ('the Agreement')

between FACHHOCHSCHULE NORDWESTSCHWEIZ **and** *the Executive Agency for Small and Medium-sized Enterprises (EASME) ('the Agency'), under the power delegated by the European Commission ('the Commission'),*

for the action entitled 'Demonstrating synergies in combined natural and engineered processes for water treatment systems (AquaNES)'.
'

and mandates

the *coordinator* to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

AUTARCON GMBH (AUT) GMBH, HRB15086, established in FRANZ ULRICH STRASSE 18 F, KASSEL 34117, Germany, DE268625098 ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become *beneficiary* No ('3')

in Grant Agreement No 689450 ('the Agreement')

between FACHHOCHSCHULE NORDWESTSCHWEIZ **and** *the Executive Agency for Small and Medium-sized Enterprises (EASME) ('the Agency'), under the power delegated by the European Commission ('the Commission'),*

for the action entitled 'Demonstrating synergies in combined natural and engineered processes for water treatment systems (AquaNES)'.
'

and mandates

the *coordinator* to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

BioDetection Systems B.V. (BDS) BV, 34149400, established in Science Park 406, Amsterdam 1098 XH , Netherlands, NL809623626B01 ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become *beneficiary* No ('4')

in Grant Agreement No 689450 ('the Agreement')

between FACHHOCHSCHULE NORDWESTSCHWEIZ **and** *the Executive Agency for Small and Medium-sized Enterprises (EASME) ('the Agency'), under the power delegated by the European Commission ('the Commission'),*

for the action entitled 'Demonstrating synergies in combined natural and engineered processes for water treatment systems (AquaNES)'.
'

and mandates

the *coordinator* to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

HYDROBUSINESS BV (HYBU) BV, 09110398, established in MINERVUM 7181, BREDA 4817ZN, Netherlands, NL820404603B01 ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become *beneficiary* No ('5')

in Grant Agreement No 689450 ('the Agreement')

between FACHHOCHSCHULE NORDWESTSCHWEIZ **and** *the Executive Agency for Small and Medium-sized Enterprises (EASME) ('the Agency'), under the power delegated by the European Commission ('the Commission'),*

for the action entitled 'Demonstrating synergies in combined natural and engineered processes for water treatment systems (AquaNES)'.
'

and mandates

the *coordinator* to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

IMAGEAU SAS (imaGeau) SAS, 504316597, established in AVENUE DE L'EUROPE CAP ALPHA 9, CLAPIERS 34830, France, FR63504316597 ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become *beneficiary* No ('6')

in Grant Agreement No 689450 ('the Agreement')

between FACHHOCHSCHULE NORDWESTSCHWEIZ **and** *the Executive Agency for Small and Medium-sized Enterprises (EASME) ('the Agency'), under the power delegated by the European Commission ('the Commission'),*

for the action entitled 'Demonstrating synergies in combined natural and engineered processes for water treatment systems (AquaNES)'.
'

and mandates

the *coordinator* to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

GEO-HYD (GEOHYD) SAS, 419713904, established in 101 RUE JACQUES CHARLES, OLIVET 45160, France, FR50419713904 ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become *beneficiary* No ('7')

in Grant Agreement No 689450 ('the Agreement')

between FACHHOCHSCHULE NORDWESTSCHWEIZ and *the Executive Agency for Small and Medium-sized Enterprises (EASME) ('the Agency')*, under the power delegated by the European Commission ('the Commission'),

for the action entitled 'Demonstrating synergies in combined natural and engineered processes for water treatment systems (AquaNES)'.

and mandates

the *coordinator* to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

MicroLAN (MicroLAN) BV, 18071474, established in BIESBOSWEG 2, WAALWIJK 5145 PZ, Netherlands, NL812421784B01 ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become *beneficiary* No ('8')

in Grant Agreement No 689450 ('the Agreement')

between FACHHOCHSCHULE NORDWESTSCHWEIZ **and** *the Executive Agency for Small and Medium-sized Enterprises (EASME) ('the Agency'), under the power delegated by the European Commission ('the Commission'),*

for the action entitled 'Demonstrating synergies in combined natural and engineered processes for water treatment systems (AquaNES)'.
'

and mandates

the *coordinator* to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

X-FLOW BV (XFLOW) BV, 06050907, established in MARSSTEDEN 50, ENSCHEDE 7547 TC, Netherlands, NL006541483B01 ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become *beneficiary* No ('9')

in Grant Agreement No 689450 ('the Agreement')

between FACHHOCHSCHULE NORDWESTSCHWEIZ **and** *the Executive Agency for Small and Medium-sized Enterprises (EASME) ('the Agency'), under the power delegated by the European Commission ('the Commission'),*

for the action entitled 'Demonstrating synergies in combined natural and engineered processes for water treatment systems (AquaNES)'.
'

and mandates

the *coordinator* to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

VERTECH GROUP (VTG) SARL, 539865303, established in 11 RUE DEFLEY, NICE 06000, France, FR16539865303 ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become *beneficiary* No ('10')

in Grant Agreement No 689450 ('the Agreement')

between FACHHOCHSCHULE NORDWESTSCHWEIZ **and** *the Executive Agency for Small and Medium-sized Enterprises (EASME) ('the Agency'), under the power delegated by the European Commission ('the Commission'),*

for the action entitled 'Demonstrating synergies in combined natural and engineered processes for water treatment systems (AquaNES)'.
'

and mandates

the *coordinator* to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

WADIS LTD (WADIS) LTD, 514445964, established in 3 GOLDA MEIR STREET, NESS ZIONA 7403648, Israel, IL514445964 ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become *beneficiary* No ('11')

in Grant Agreement No 689450 ('the Agreement')

between FACHHOCHSCHULE NORDWESTSCHWEIZ **and** *the Executive Agency for Small and Medium-sized Enterprises (EASME) ('the Agency'), under the power delegated by the European Commission ('the Commission'),*

for the action entitled 'Demonstrating synergies in combined natural and engineered processes for water treatment systems (AquaNES)'.
'

and mandates

the *coordinator* to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

WATSTECH LIMITED (WatStech) LTD, 05404280, established in GLAISHER DRIVE, WOLVERHAMPTON SCIENCE PARK, GLAISH IVE, WOLVERHAMPTON WV10 9RU, United Kingdom, GB857631106 ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become *beneficiary* No ('12')

in Grant Agreement No 689450 ('the Agreement')

between FACHHOCHSCHULE NORDWESTSCHWEIZ and the Executive Agency for Small and Medium-sized Enterprises (EASME) ('the Agency'), under the power delegated by the European Commission ('the Commission'),

for the action entitled 'Demonstrating synergies in combined natural and engineered processes for water treatment systems (AquaNES)'.

and mandates

the *coordinator* to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

XYLEM SERVICES GMBH (XYLEM) GMBH, HRB 13463, established in BOSCHSTRASSE 4-14, HERFORD 32051, Germany, DE815414961 ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become *beneficiary* No ('13')

in Grant Agreement No 689450 ('the Agreement')

between FACHHOCHSCHULE NORDWESTSCHWEIZ **and** *the Executive Agency for Small and Medium-sized Enterprises (EASME) ('the Agency'), under the power delegated by the European Commission ('the Commission'),*

for the action entitled 'Demonstrating synergies in combined natural and engineered processes for water treatment systems (AquaNES)'.
'

and mandates

the *coordinator* to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

FOVAROSI VIZMUVEK ZARTKORUEN MUKODORESZVENYTARSASAG (BUWW) RT, 0110042451, established in VACI UT 23-27, BUDAPEST 1134, Hungary, HU10898824 ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become *beneficiary* No ('14')

in Grant Agreement No 689450 ('the Agreement')

between FACHHOCHSCHULE NORDWESTSCHWEIZ **and** *the Executive Agency for Small and Medium-sized Enterprises (EASME) ('the Agency'), under the power delegated by the European Commission ('the Commission'),*

for the action entitled 'Demonstrating synergies in combined natural and engineered processes for water treatment systems (AquaNES)'.
'

and mandates

the *coordinator* to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

BERLINER WASSERBETRIEBE (BWB), HRA 30951, established in NEUE JUDENSTRASSE 1, BERLIN 10179, Germany, DE29/033/03352 ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become *beneficiary* No ('15')

in Grant Agreement No 689450 ('the Agreement')

between FACHHOCHSCHULE NORDWESTSCHWEIZ **and** *the Executive Agency for Small and Medium-sized Enterprises (EASME) ('the Agency'), under the power delegated by the European Commission ('the Commission'),*

for the action entitled 'Demonstrating synergies in combined natural and engineered processes for water treatment systems (AquaNES)'.
'

and mandates

the *coordinator* to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

DIMOTIKI EPICHIRISI YDREVSIS APOCHETEFISIS DIMOY THIRAS NOMOU KYKLADON (DEYAT), 1060, established in THIRA N. KYKLADON, FIRA 84700, Greece, EL997877933 ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become *beneficiary* No ('16')

in Grant Agreement No 689450 ('the Agreement')

between FACHHOCHSCHULE NORDWESTSCHWEIZ and the Executive Agency for Small and Medium-sized Enterprises (EASME) ('the Agency'), under the power delegated by the European Commission ('the Commission'),

for the action entitled 'Demonstrating synergies in combined natural and engineered processes for water treatment systems (AquaNES)'.

and mandates

the *coordinator* to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

DIMOS ANTIPAROU (MUOA), not applicable, established in ANTIPAROS - CYCLADES, ANTIPAROS 84007, Greece, EL999247040 ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become *beneficiary* No ('17')

in Grant Agreement No 689450 ('the Agreement')

between FACHHOCHSCHULE NORDWESTSCHWEIZ **and** *the Executive Agency for Small and Medium-sized Enterprises (EASME) ('the Agency'), under the power delegated by the European Commission ('the Commission'),*

for the action entitled 'Demonstrating synergies in combined natural and engineered processes for water treatment systems (AquaNES)'.
'

and mandates

the *coordinator* to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

DREWAG NETZ GMBH (DREWAG) GMBH, HRB24980, established in ROSENSTRASSE 32, DRESDEN 01067, Germany, DE258395586 ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become *beneficiary* No ('18')

in Grant Agreement No 689450 ('the Agreement')

between FACHHOCHSCHULE NORDWESTSCHWEIZ and *the Executive Agency for Small and Medium-sized Enterprises (EASME)* ('the Agency'), under the power delegated by the European Commission ('the Commission'),

for the action entitled 'Demonstrating synergies in combined natural and engineered processes for water treatment systems (AquaNES)'.

and mandates

the *coordinator* to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

ERFTVERBAND (EV) DE9, N/A, established in AM ERFTVERBAND 6, BERGHEIM 50126, Germany, DE228801678 ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become *beneficiary* No ('19')

in Grant Agreement No 689450 ('the Agreement')

between FACHHOCHSCHULE NORDWESTSCHWEIZ **and** *the Executive Agency for Small and Medium-sized Enterprises (EASME) ('the Agency'), under the power delegated by the European Commission ('the Commission'),*

for the action entitled 'Demonstrating synergies in combined natural and engineered processes for water treatment systems (AquaNES)'.
'

and mandates

the *coordinator* to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

IWB INDUSTRIELLE WERKE BASEL (IWB), CHE108955038, established in MARGARETHENSTRASSE 40, BASEL 4002, Switzerland, CHE108955038MWST ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become *beneficiary* No ('20')

in Grant Agreement No 689450 ('the Agreement')

between FACHHOCHSCHULE NORDWESTSCHWEIZ **and** *the Executive Agency for Small and Medium-sized Enterprises (EASME) ('the Agency'), under the power delegated by the European Commission ('the Commission'),*

for the action entitled 'Demonstrating synergies in combined natural and engineered processes for water treatment systems (AquaNES)'.
'

and mandates

the *coordinator* to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

MEKOROT WATER COMPANY LIMITED (MEK) LTD, 557652310, established in LINCOLN STREET 9, TEL AVIV 61201, Israel, IL557652310 ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become *beneficiary* No ('21')

in Grant Agreement No 689450 ('the Agreement')

between FACHHOCHSCHULE NORDWESTSCHWEIZ **and** *the Executive Agency for Small and Medium-sized Enterprises (EASME) ('the Agency'), under the power delegated by the European Commission ('the Commission'),*

for the action entitled 'Demonstrating synergies in combined natural and engineered processes for water treatment systems (AquaNES)'.
'

and mandates

the *coordinator* to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

UNIWERSYTET IM. ADAMA MICKIEWICZA W POZNANIU (AMU), 000001293, established in ul. Henryka Wieniawskiego 1, POZNAN 61712, Poland, PL7770006350 ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become *beneficiary* No ('22')

in Grant Agreement No 689450 ('the Agreement')

between FACHHOCHSCHULE NORDWESTSCHWEIZ **and** *the Executive Agency for Small and Medium-sized Enterprises (EASME) ('the Agency'), under the power delegated by the European Commission ('the Commission'),*

for the action entitled 'Demonstrating synergies in combined natural and engineered processes for water treatment systems (AquaNES)'.
'

and mandates

the *coordinator* to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

BUREAU DE RECHERCHES GEOLOGIQUES ET MINIERES (BRGM), 582056149, established in Quai Andre Citroen - Tour Mirabeau 39-43, PARIS 75739, France, FR67582056149 ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become *beneficiary* No ('23')

in Grant Agreement No 689450 ('the Agreement')

between FACHHOCHSCHULE NORDWESTSCHWEIZ **and** *the Executive Agency for Small and Medium-sized Enterprises (EASME) ('the Agency'), under the power delegated by the European Commission ('the Commission'),*

for the action entitled 'Demonstrating synergies in combined natural and engineered processes for water treatment systems (AquaNES)'.
'

and mandates

the *coordinator* to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

CRANFIELD UNIVERSITY (UCRAN), RC000151, established in College Road, CRANFIELD - BEDFORDSHIRE MK43 0AL, United Kingdom, GB491358622 ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become *beneficiary* No ('24')

in Grant Agreement No 689450 ('the Agreement')

between FACHHOCHSCHULE NORDWESTSCHWEIZ **and** *the Executive Agency for Small and Medium-sized Enterprises (EASME) ('the Agency'), under the power delegated by the European Commission ('the Commission'),*

for the action entitled 'Demonstrating synergies in combined natural and engineered processes for water treatment systems (AquaNES)'.
'

and mandates

the *coordinator* to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

Hochschule fuer Technik und Wirtschaft Dresden (HTWD), established in Friedrich-List-Platz 1, Dresden D-01069, Germany, DE188729062 ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become *beneficiary* No ('25')

in Grant Agreement No 689450 ('the Agreement')

between FACHHOCHSCHULE NORDWESTSCHWEIZ **and** *the Executive Agency for Small and Medium-sized Enterprises (EASME) ('the Agency'), under the power delegated by the European Commission ('the Commission'),*

for the action entitled 'Demonstrating synergies in combined natural and engineered processes for water treatment systems (AquaNES)'.
'

and mandates

the *coordinator* to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

EOTVOS JOZSEF FOISKOLA (EJC), 881532001, established in SZEGEDI UT 2, BAJA 6500, Hungary, HU15308988 ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become *beneficiary* No ('26')

in Grant Agreement No 689450 ('the Agreement')

between FACHHOCHSCHULE NORDWESTSCHWEIZ **and** *the Executive Agency for Small and Medium-sized Enterprises (EASME) ('the Agency'), under the power delegated by the European Commission ('the Commission'),*

for the action entitled 'Demonstrating synergies in combined natural and engineered processes for water treatment systems (AquaNES)'.
'

and mandates

the *coordinator* to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

KWB KOMPONENTENZENTRUM WASSER BERLIN GEMEINNUTZIGE GMBH (KWB)
GEM GMBH, HRB84461, established in CICEROSTRASSE 24, BERLIN 10709, Germany,
DE221139990 ('the beneficiary'), represented for the purpose of signing this Accession Form by the
undersigned,

hereby agrees

to become *beneficiary* No ('27')

in Grant Agreement No 689450 ('the Agreement')

between FACHHOCHSCHULE NORDWESTSCHWEIZ **and** *the Executive Agency for Small and
Medium-sized Enterprises (EASME) ('the Agency'), under the power delegated by the European
Commission ('the Commission'),*

for the action entitled 'Demonstrating synergies in combined natural and engineered processes for
water treatment systems (AquaNES)'.
'

and mandates

the *coordinator* to submit and sign in its name and on its behalf any **amendments** to the Agreement,
in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant
in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

KWR WATER B.V. (KWR) BV, 27279653, established in GRONINGENHAVEN 7, NIEUWEGEIN 3433 PE, Netherlands, NL814938474B01 ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become *beneficiary* No ('28')

in Grant Agreement No 689450 ('the Agreement')

between FACHHOCHSCHULE NORDWESTSCHWEIZ **and** *the Executive Agency for Small and Medium-sized Enterprises (EASME) ('the Agency'), under the power delegated by the European Commission ('the Commission'),*

for the action entitled 'Demonstrating synergies in combined natural and engineered processes for water treatment systems (AquaNES)'.
'

and mandates

the *coordinator* to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

NATIONAL TECHNICAL UNIVERSITY OF ATHENS - NTUA (NTUA), established in HEROON POLYTECHNIOU 9 ZOGRAPHOU CAMPUS, ATHINA 15780, Greece, EL099793475 ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become *beneficiary* No ('29')

in Grant Agreement No 689450 ('the Agreement')

between FACHHOCHSCHULE NORDWESTSCHWEIZ **and** *the Executive Agency for Small and Medium-sized Enterprises (EASME) ('the Agency'), under the power delegated by the European Commission ('the Commission'),*

for the action entitled 'Demonstrating synergies in combined natural and engineered processes for water treatment systems (AquaNES)'.
'

and mandates

the *coordinator* to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

Uttarakhand Jal Sansthan (UJS), 2083, established in Jal Bhawan, Nehru Colony, B-Block, Dehradun 248001, India ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become *beneficiary* No ('30')

in Grant Agreement No 689450 ('the Agreement')

between FACHHOCHSCHULE NORDWESTSCHWEIZ **and** *the Executive Agency for Small and Medium-sized Enterprises (EASME) ('the Agency'), under the power delegated by the European Commission ('the Commission'),*

for the action entitled 'Demonstrating synergies in combined natural and engineered processes for water treatment systems (AquaNES)'.
'

and mandates

the *coordinator* to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

🖨 print format A4 landscape

MODEL ANNEX 4 FOR H2020 GENERAL MGA — MULTI

FINANCIAL STATEMENT FOR [BENEFICIARY [name]/ LINKED THIRD PARTY [name]] FOR REPORTING PERIOD [reporting period]

Eligible ¹ costs (per budget category)													Receipts		EU contribution			Additional information	
A. Direct personnel costs				B. Direct costs of subcontracting	[C. Direct costs of fin. support]	D. Other direct costs		E. Indirect costs ²		[F. Costs of ...]		Total costs	Receipts	Reimbursement rate %	Maximum EU contribution ³	Requested EU contribution	Information for indirect costs :		
A.1 Employees (or equivalent)		A.4 SME owners without salary				D.1 Travel	[D.4 Costs of large research infrastructure]		[F.1 Costs of ...]				Receipts of the action, to be reported in the last reporting period, according to Article 5.3.3				Costs of in-kind contributions not used on premises		
A.2 Natural persons under direct contract		A.5 Beneficiaries that are natural persons without salary				D.2 Equipment													
A.3 Seconded persons [A.6 Personnel for providing access to research infrastructure]						D.3 Other goods and services													
Form of costs ⁴		Actual	Unit	Unit		Actual	Actual	Actual	Actual	Flat-rate ⁵	Unit	Unit							
										25%									
		a	Total b	No hours	Total c	d	[e]	f	[g]	h=0,25 x (a+b+c+f+[g] + [i1] ⁶ + [i2] ⁶ - o)	No units	Total [i1]	Total [i2]	j = a+b+c+d+[e] + f + [g] + h + [i1] + [i2]	k	l	m	n	o
[short name beneficiary/linked third party]																			

The beneficiary/linked third party hereby confirms that:
 The information provided is complete, reliable and true.
 The costs declared are eligible (see Article 6).
 The costs can be substantiated by adequate records and supporting documentation that will be produced upon request or in the context of checks, reviews, audits and investigations (see Articles 17, 18 and 22).
 For the last reporting period: that all the receipts have been declared (see Article 5.3.3).

📌 Please declare all eligible costs, even if they exceed the amounts indicated in the estimated budget (see Annex 2). Only amounts that were declared in your individual financial statements can be taken into account lateron, in order to replace other costs that are found to be ineligible.

¹ See Article 6 for the eligibility conditions

² The indirect costs claimed must be free of any amounts covered by an operating grant (received under any EU or Euratom funding programme; see Article 6.2.E). If you have received an operating grant during this reporting period, you cannot claim any indirect costs.

³ This is the *theoretical* amount of EU contribution that the system calculates automatically (by multiplying the reimbursement rate by the total costs declared). The amount you request (in the column 'requested EU contribution') may have to be less (e.g. if you and the other beneficiaries are above budget, if the 90% limit (see Article 21) is reached, etc).

⁴ See Article 5 for the form of costs

⁵ Flat rate : 25% of eligible direct costs, from which are excluded: direct costs of subcontracting, costs of in-kind contributions not used on premises, direct costs of financial support, and unit costs declared under budget category F if they include indirect costs (see Article 6.2.E)

⁶ Only specific unit costs that do not include indirect costs

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

ANNEX 5

MODEL FOR THE CERTIFICATE ON THE FINANCIAL STATEMENTS

- For options [*in italics in square brackets*]: choose the applicable option. Options not chosen should be deleted.
- For fields in [grey in square brackets]: enter the appropriate data

TABLE OF CONTENTS

TERMS OF REFERENCE FOR AN INDEPENDENT REPORT OF FACTUAL FINDINGS ON COSTS DECLARED UNDER A GRANT AGREEMENT FINANCED UNDER THE HORIZON 2020 RESEARCH FRAMEWORK PROGRAMME..... 2

INDEPENDENT REPORT OF FACTUAL FINDINGS ON COSTS DECLARED UNDER A GRANT AGREEMENT FINANCED UNDER THE HORIZON 2020 RESEARCH FRAMEWORK PROGRAMME 7

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

Terms of Reference for an Independent Report of Factual Findings on costs declared under a Grant Agreement financed under the Horizon 2020 Research and Innovation Framework Programme

This document sets out the **‘Terms of Reference (ToR)’** under which

[OPTION 1: [insert name of the beneficiary] (*‘the Beneficiary’*)] [OPTION 2: [insert name of the linked third party] (*‘the Linked Third Party’*), third party linked to the Beneficiary [insert name of the beneficiary] (*‘the Beneficiary’*)]

agrees to engage

[insert legal name of the auditor] (*‘the Auditor’*)

to produce an independent report of factual findings (*‘the Report’*) concerning the Financial Statement(s)¹ drawn up by the [Beneficiary] [Linked Third Party] for the Horizon 2020 grant agreement [insert number of the grant agreement, title of the action, acronym and duration from/to] (*‘the Agreement’*), and

to issue a Certificate on the Financial Statements’ (*‘CFS’*) referred to in Article 20.4 of the Agreement based on the compulsory reporting template stipulated by the Commission.

The Agreement has been concluded under the Horizon 2020 Research and Innovation Framework Programme (H2020) between the Beneficiary and [OPTION 1: *the European Union, represented by the European Commission (‘the Commission’)*][OPTION 2: *the European Atomic Energy Community (Euratom,) represented by the European Commission (‘the Commission’)*][OPTION 3: *the [Research Executive Agency (REA)] [European Research Council Executive Agency (ERCEA)] [Innovation and Networks Executive Agency (INEA)] [Executive Agency for Small and Medium-sized Enterprises (EASME)] (‘the Agency’), under the powers delegated by the European Commission (‘the Commission’).*]

¹ By which costs under the Agreement are declared (see template ‘Model Financial Statements’ in Annex 4 to the Grant Agreement).

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

The *[Commission]* *[Agency]* is mentioned as a signatory of the Agreement with the Beneficiary only. The *[European Union]**[Euratom]**[Agency]* is not a party to this engagement.

1.1 Subject of the engagement

The coordinator must submit to the *[Commission]**[Agency]* the final report within 60 days following the end of the last reporting period which should include, amongst other documents, a CFS for each beneficiary and for each linked third party that requests a total contribution of EUR 325 000 or more, as reimbursement of actual costs and unit costs calculated on the basis of its usual cost accounting practices (see Article 20.4 of the Agreement). The CFS must cover all reporting periods of the beneficiary or linked third party indicated above.

The Beneficiary must submit to the coordinator the CFS for itself and for its linked third party(ies), if the CFS must be included in the final report according to Article 20.4 of the Agreement..

The CFS is composed of two separate documents:

- The Terms of Reference ('the ToR') to be signed by the *[Beneficiary]* *[Linked Third Party]* and the Auditor;
- The Auditor's Independent Report of Factual Findings ('the Report') to be issued on the Auditor's letterhead, dated, stamped and signed by the Auditor (or the competent public officer) which includes the agreed-upon procedures ('the Procedures') to be performed by the Auditor, and the standard factual findings ('the Findings') to be confirmed by the Auditor.

If the CFS must be included in the final report according to Article 20.4 of the Agreement, the request for payment of the balance relating to the Agreement cannot be made without the CFS. However, the payment for reimbursement of costs covered by the CFS does not preclude the *[Commission]*,*[Agency]*, the European Anti-Fraud Office and the European Court of Auditors from carrying out checks, reviews, audits and investigations in accordance with Article 22 of the Agreement.

1.2 Responsibilities

The *[Beneficiary]* *[Linked Third Party]*:

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

- must draw up the Financial Statement(s) for the action financed by the Agreement in compliance with the obligations under the Agreement. The Financial Statement(s) must be drawn up according to the *[Beneficiary's] [Linked Third Party's]* accounting and book-keeping system and the underlying accounts and records;
- must send the Financial Statement(s) to the Auditor;
- is responsible and liable for the accuracy of the Financial Statement(s);
- is responsible for the completeness and accuracy of the information provided to enable the Auditor to carry out the Procedures. It must provide the Auditor with a written representation letter supporting these statements. The written representation letter must state the period covered by the statements and must be dated;
- accepts that the Auditor cannot carry out the Procedures unless it is given full access to the *[Beneficiary's] [Linked Third Party's]* staff and accounting as well as any other relevant records and documentation.

The Auditor:

- *[Option 1 by default: is qualified to carry out statutory audits of accounting documents in accordance with Directive 2006/43/EC of the European Parliament and of the Council of 17 May 2006 on statutory audits of annual accounts and consolidated accounts, amending Council Directives 78/660/EEC and 83/349/EEC and repealing Council Directive 84/253/EEC or similar national regulations].*
- *[Option 2 if the Beneficiary or Linked Third Party has an independent Public Officer: is a competent and independent Public Officer for which the relevant national authorities have established the legal capacity to audit the Beneficiary].*
- *[Option 3 if the Beneficiary or Linked Third Party is an international organisation: is an [internal] [external] auditor in accordance with the internal financial regulations and procedures of the international organisation].*

The Auditor:

- must be independent from the Beneficiary *[and the Linked Third Party]*, in particular, it must not have been involved in preparing the *[Beneficiary's] [Linked Third Party's]* Financial Statement(s);
- must plan work so that the Procedures may be carried out and the Findings may be assessed;
- must adhere to the Procedures laid down and the compulsory report format;
- must carry out the engagement in accordance with this ToR;
- must document matters which are important to support the Report;
- must base its Report on the evidence gathered;
- must submit the Report to the *[Beneficiary] [Linked Third Party]*.

The Commission sets out the Procedures to be carried out by the Auditor. The Auditor is not responsible for their suitability or pertinence. As this engagement is not an assurance engagement, the Auditor does not provide an audit opinion or a statement of assurance.

1.3 Applicable Standards

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

The Auditor must comply with these Terms of Reference and with²:

- the International Standard on Related Services ('ISRS') 4400 *Engagements to perform Agreed-upon Procedures regarding Financial Information* as issued by the International Auditing and Assurance Standards Board (IAASB);
- the *Code of Ethics for Professional Accountants* issued by the International Ethics Standards Board for Accountants (IESBA). Although ISRS 4400 states that independence is not a requirement for engagements to carry out agreed-upon procedures, the [Commission][Agency] requires that the Auditor also complies with the Code's independence requirements.

The Auditor's Report must state that there is no conflict of interests in establishing this Report between the Auditor and the Beneficiary [and the Linked Third Party], and must specify - if the service is invoiced - the total fee paid to the Auditor for providing the Report.

1.4 Reporting

The Report must be written in the language of the Agreement (see Article 20.7).

Under Article 22 of the Agreement, the [Commission] [Agency], the European Anti-Fraud Office and the Court of Auditors have the right to audit any work that is carried out under the action and for which costs are declared from [the European Union] [Euratom] budget. This includes work related to this engagement. The Auditor must provide access to all working papers (e.g. recalculation of hourly rates, verification of the time declared for the action) related to this assignment if the [Commission] [Agency], the European Anti-Fraud Office or the European Court of Auditors requests them.

1.5 Timing

The Report must be provided by [dd Month yyyy].

² Supreme Audit Institutions applying INTOSAI-standards may carry out the Procedures according to the corresponding International Standards of Supreme Audit Institutions and code of ethics issued by INTOSAI instead of the International Standard on Related Services ('ISRS') 4400 and the Code of Ethics for Professional Accountants issued by the IAASB and the IESBA.

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

1.6 Other terms

[The [Beneficiary] [Linked Third Party] and the Auditor can use this section to agree other specific terms, such as the Auditor’s fees, liability, applicable law, etc. Those specific terms must not contradict the terms specified above.]

[legal name of the Auditor]	[legal name of the [Beneficiary][Linked Third Party]]
[name & function of authorised representative]	[name & function of authorised representative]
[dd Month yyyy]	[dd Month yyyy]
Signature of the Auditor	Signature of the [Beneficiary][Linked Third Party]

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

Independent Report of Factual Findings on costs declared under Horizon 2020 Research and Innovation Framework Programme

(To be printed on the Auditor's letterhead)

To

[name of contact person(s)], [Position]

[*Beneficiary's*] [*Linked Third Party's* name]

[Address]

[dd Month yyyy]

Dear [Name of contact person(s)],

As agreed under the terms of reference dated [dd Month yyyy]

with [OPTION 1: *insert name of the beneficiary*] ('the Beneficiary') [OPTION 2: *insert name of the linked third party*] ('the Linked Third Party'), third party linked to the Beneficiary [*insert name of the beneficiary*] ('the Beneficiary'),

we

[name of the auditor] ('the Auditor'),

established at

[full address/city/state/province/country],

represented by

[name and function of an authorised representative],

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

have carried out the procedures agreed with you regarding the costs declared in the Financial Statement(s)³ of the [Beneficiary] [Linked Third Party] concerning the grant agreement

[insert grant agreement reference: number, title of the action and acronym] ('the Agreement'),

with a total cost declared of

[total amount] EUR,

and a total of actual costs and 'direct personnel costs declared as unit costs calculated in accordance with the [Beneficiary's] [Linked Third Party's] usual cost accounting practices' declared of

[sum of total actual costs and total direct personnel costs declared as unit costs calculated in accordance with the [Beneficiary's] [Linked Third Party's] usual cost accounting practices] EUR

and **hereby provide our Independent Report of Factual Findings ('the Report')** using the compulsory report format agreed with you.

The Report

Our engagement was carried out in accordance with the terms of reference ('the ToR') appended to this Report. The Report includes the agreed-upon procedures ('the Procedures') carried out and the standard factual findings ('the Findings') examined.

The Procedures were carried out solely to assist the [Commission] [Agency] in evaluating whether the [Beneficiary's] [Linked Third Party's] costs in the accompanying Financial Statement(s) were declared in accordance with the Agreement. The [Commission] [Agency] draws its own conclusions from the Report and any additional information it may require.

³ By which the Beneficiary declares costs under the Agreement (see template 'Model Financial Statement' in Annex 4 to the Agreement).

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

The scope of the Procedures was defined by the Commission. Therefore, the Auditor is not responsible for their suitability or pertinence. Since the Procedures carried out constitute neither an audit nor a review made in accordance with International Standards on Auditing or International Standards on Review Engagements, the Auditor does not give a statement of assurance on the Financial Statements.

Had the Auditor carried out additional procedures or an audit of the *[Beneficiary's]* *[Linked Third Party's]* Financial Statements in accordance with International Standards on Auditing or International Standards on Review Engagements, other matters might have come to its attention and would have been included in the Report.

Not applicable Findings

We examined the Financial Statement(s) stated above and considered the following Findings not applicable:

Explanation (to be removed from the Report):

If a Finding was not applicable, it must be marked as 'N.A.' ('Not applicable') in the corresponding row on the right-hand column of the table and means that the Finding did not have to be corroborated by the Auditor and the related Procedure(s) did not have to be carried out.

The reasons of the non-application of a certain Finding must be obvious i.e.

- i) if no cost was declared under a certain category then the related Finding(s) and Procedure(s) are not applicable;*
- ii) if the condition set to apply certain Procedure(s) are not met the related Finding(s) and those Procedure(s) are not applicable. For instance, for 'beneficiaries with accounts established in a currency other than euro' the Procedure and Finding related to 'beneficiaries with accounts established in euro' are not applicable. Similarly, if no additional remuneration is paid, the related Finding(s) and Procedure(s) for additional remuneration are not applicable.*

List here all Findings considered not applicable for the present engagement and explain the reasons of the non-applicability.

....

Exceptions

Apart from the exceptions listed below, the *[Beneficiary]* *[Linked Third Party]* provided the Auditor all the documentation and accounting information needed by the Auditor to carry out the requested Procedures and evaluate the Findings.

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

Explanation (to be removed from the Report):

- If the Auditor was not able to successfully complete a procedure requested, it must be marked as 'E' ('Exception') in the corresponding row on the right-hand column of the table. The reason such as the inability to reconcile key information or the unavailability of data that prevents the Auditor from carrying out the Procedure must be indicated below.
- If the Auditor cannot corroborate a standard finding after having carried out the corresponding procedure, it must also be marked as 'E' ('Exception') and, where possible, the reasons why the Finding was not fulfilled and its possible impact must be explained here below.

List here any exceptions and add any information on the cause and possible consequences of each exception, if known. If the exception is quantifiable, include the corresponding amount.

....

Example (to be removed from the Report):

1. The Beneficiary was unable to substantiate the Finding number 1 on ... because
2. Finding number 30 was not fulfilled because the methodology used by the Beneficiary to calculate unit costs was different from the one approved by the Commission. The differences were as follows: ...
3. After carrying out the agreed procedures to confirm the Finding number 31, the Auditor found a difference of _____ EUR. The difference can be explained by ...

Further Remarks

In addition to reporting on the results of the specific procedures carried out, the Auditor would like to make the following general remarks:

Example (to be removed from the Report):

1. Regarding Finding number 8 the conditions for additional remuneration were considered as fulfilled because ...
2. In order to be able to confirm the Finding number 15 we carried out the following additional procedures:

Use of this Report

This Report may be used only for the purpose described in the above objective. It was prepared solely for the confidential use of the [Beneficiary] [Linked Third Party] and the [Commission] [Agency], and only to be submitted to the [Commission] [Agency] in connection with the requirements set out in Article 20.4 of the Agreement. The Report may not be used by the [Beneficiary] [Linked Third Party] or by the [Commission] [Agency] for any other purpose, nor may it

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

be distributed to any other parties. The [Commission] [Agency] may only disclose the Report to authorised parties, in particular to the European Anti-Fraud Office (OLAF) and the European Court of Auditors.

This Report relates only to the Financial Statement(s) submitted to the [Commission] [Agency] by the [Beneficiary] [Linked Third Party] for the Agreement. Therefore, it does not extend to any other of the [Beneficiary's] [Linked Third Party's] Financial Statement(s).

There was no conflict of interest⁴ between the Auditor and the Beneficiary [and Linked Third Party] in establishing this Report. The total fee paid to the Auditor for providing the Report was EUR [] (including EUR [] of deductible VAT).

We look forward to discussing our Report with you and would be pleased to provide any further information or assistance.

[legal name of the Auditor]

[name and function of an authorised representative]

[dd Month yyyy]

Signature of the Auditor

⁴ A conflict of interest arises when the Auditor's objectivity to establish the certificate is compromised in fact or in appearance when the Auditor for instance:

- was involved in the preparation of the Financial Statements;
- stands to benefit directly should the certificate be accepted;
- has a close relationship with any person representing the beneficiary;
- is a director, trustee or partner of the beneficiary; or
- is in any other situation that compromises his or her independence or ability to establish the certificate impartially.

Agreed-upon procedures to be performed and standard factual findings to be confirmed by the Auditor

The European Commission reserves the right to i) provide the auditor with additional guidance regarding the procedures to be followed or the facts to be ascertained and the way in which to present them (this may include sample coverage and findings) or to ii) change the procedures, by notifying the Beneficiary in writing. The procedures carried out by the auditor to confirm the standard factual finding are listed in the table below.

If this certificate relates to a Linked Third Party, any reference here below to 'the Beneficiary' is to be considered as a reference to 'the Linked Third Party'.

The 'result' column has three different options: 'C', 'E' and 'N.A.':

- 'C' stands for 'confirmed' and means that the auditor can confirm the 'standard factual finding' and, therefore, there is no exception to be reported.
- 'E' stands for 'exception' and means that the Auditor carried out the procedures but cannot confirm the 'standard factual finding', or that the Auditor was not able to carry out a specific procedure (e.g. because it was impossible to reconcile key information or data were unavailable),
- 'N.A.' stands for 'not applicable' and means that the Finding did not have to be examined by the Auditor and the related Procedure(s) did not have to be carried out. The reasons of the non-application of a certain Finding must be obvious i.e. i) if no cost was declared under a certain category then the related Finding(s) and Procedure(s) are not applicable; ii) if the condition set to apply certain Procedure(s) are not met then the related Finding(s) and Procedure(s) are not applicable. For instance, for 'beneficiaries with accounts established in a currency other than the euro' the Procedure related to 'beneficiaries with accounts established in euro' is not applicable. Similarly, if no additional remuneration is paid, the related Finding(s) and Procedure(s) for additional remuneration are not applicable.

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
A	ACTUAL PERSONNEL COSTS AND UNIT COSTS CALCULATED BY THE BENEFICIARY IN ACCORDANCE WITH ITS USUAL COST ACCOUNTING PRACTICE		

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	<p>The Auditor draws a sample of persons whose costs were declared in the Financial Statement(s) to carry out the procedures indicated in the consecutive points of this section A.</p> <p><i>(The sample should be selected randomly so that it is representative. Full coverage is required if there are fewer than 10 people (including employees, natural persons working under a direct contract and personnel seconded by a third party), otherwise the sample should have a minimum of 10 people, or 10% of the total, whichever number is the highest)</i></p> <p>The Auditor sampled [] people out of the total of [] people.</p>		
A.1	<p>PERSONNEL COSTS</p> <p><u>For the persons included in the sample and working under an employment contract or equivalent act (general procedures for individual actual personnel costs and personnel costs declared as unit costs)</u></p> <p>To confirm standard factual findings 1-5 listed in the next column, the Auditor reviewed following information/documents provided by the Beneficiary:</p> <ul style="list-style-type: none"> ○ a list of the persons included in the sample indicating the period(s) during which they worked for the action, their position (classification or category) and type of contract; ○ the payslips of the employees included in the sample; ○ reconciliation of the personnel costs declared in the Financial Statement(s) with the accounting system (project accounting and general ledger) and payroll system; ○ information concerning the employment status and employment conditions of personnel included in the sample, in particular their employment contracts or equivalent; 	<p>1) The employees were i) directly hired by the Beneficiary in accordance with its national legislation, ii) under the Beneficiary's sole technical supervision and responsibility and iii) remunerated in accordance with the Beneficiary's usual practices.</p> <p>2) Personnel costs were recorded in the Beneficiary's accounts/payroll system.</p> <p>3) Costs were adequately supported and reconciled with the accounts and payroll</p>	

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	<ul style="list-style-type: none"> ○ the Beneficiary’s usual policy regarding payroll matters (e.g. salary policy, overtime policy, variable pay); ○ applicable national law on taxes, labour and social security and ○ any other document that supports the personnel costs declared. <p>The Auditor also verified the eligibility of all components of the retribution (see Article 6 GA) and recalculated the personnel costs for employees included in the sample.</p>	<p>records.</p> <p>4) Personnel costs did not contain any ineligible elements.</p> <p>5) There were no discrepancies between the personnel costs charged to the action and the costs recalculated by the Auditor.</p>	
	<p><i>Further procedures if ‘additional remuneration’ is paid</i></p> <p>To confirm standard factual findings 6-9 listed in the next column, the Auditor:</p> <ul style="list-style-type: none"> ○ reviewed relevant documents provided by the Beneficiary (legal form, legal/statutory obligations, the Beneficiary’s usual policy on additional remuneration, criteria used for its calculation...); ○ recalculated the amount of additional remuneration eligible for the action based on the supporting documents received (full-time or part-time work, exclusive or non-exclusive dedication to the action, etc.) to arrive at the applicable FTE/year and pro-rata rate (see data collected in the course of carrying out the procedures under A.2 ‘Productive hours’ and A.4 ‘Time recording system’). 	<p>6) The Beneficiary paying “additional remuneration” was a non-profit legal entity.</p> <p>7) The amount of additional remuneration paid corresponded to the Beneficiary’s usual remuneration practices and was consistently paid whenever the same kind of work or expertise was required.</p>	

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	<p><i>IF ANY PART OF THE REMUNERATION PAID TO THE EMPLOYEE IS NOT MANDATORY ACCORDING TO THE NATIONAL LAW OR THE EMPLOYMENT CONTRACT ("ADDITIONAL REMUNERATION") AND IS ELIGIBLE UNDER THE PROVISIONS OF ARTICLE 6.2.A.1, THIS CAN BE CHARGED AS ELIGIBLE COST TO THE ACTION UP TO THE FOLLOWING AMOUNT:</i></p> <p><i>(A) IF THE PERSON WORKS FULL TIME AND EXCLUSIVELY ON THE ACTION DURING THE FULL YEAR: UP TO EUR 8 000/YEAR;</i></p> <p><i>(B) IF THE PERSON WORKS EXCLUSIVELY ON THE ACTION BUT NOT FULL-TIME OR NOT FOR THE FULL YEAR: UP TO THE CORRESPONDING PRO-RATA AMOUNT OF EUR 8 000, OR</i></p> <p><i>(C) IF THE PERSON DOES NOT WORK EXCLUSIVELY ON THE ACTION: UP TO A PRO-RATA AMOUNT CALCULATED IN ACCORDANCE TO ARTICLE 6.2.A.1.</i></p>	<p>8) The criteria used to calculate the additional remuneration were objective and generally applied by the Beneficiary regardless of the source of funding used.</p>	
		<p>9) The amount of additional remuneration included in the personnel costs charged to the action was capped at EUR 8,000 per FTE/year (up to the equivalent pro-rata amount if the person did not work on the action full-time during the year or did not work exclusively on the action).</p>	
	<p><i>Additional procedures in case "unit costs calculated by the Beneficiary in accordance with its usual cost accounting practices" is applied:</i></p> <p>Apart from carrying out the procedures indicated above to confirm standard factual findings 1-5 and, if applicable, also 6-9, the Auditor carried out following procedures to confirm standard factual findings 10-13 listed in the next column:</p>	<p>10) The personnel costs included in the Financial Statement were calculated in accordance with the Beneficiary's usual cost accounting practice. This methodology was consistently used in all H2020 actions.</p>	

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	<ul style="list-style-type: none"> ○ obtained a description of the Beneficiary's usual cost accounting practice to calculate unit costs; ○ reviewed whether the Beneficiary's usual cost accounting practice was applied for the Financial Statements subject of the present CFS; ○ verified the employees included in the sample were charged under the correct category (in accordance with the criteria used by the Beneficiary to establish personnel categories) by reviewing the contract/HR-record or analytical accounting records; ○ verified that there is no difference between the total amount of personnel costs used in calculating the cost per unit and the total amount of personnel costs recorded in the statutory accounts; ○ verified whether actual personnel costs were adjusted on the basis of budgeted or estimated elements and, if so, verified whether those elements used are actually relevant for the calculation, objective and supported by documents. 	11) The employees were charged under the correct category.	
		12) Total personnel costs used in calculating the unit costs were consistent with the expenses recorded in the statutory accounts.	
		13) Any estimated or budgeted element used by the Beneficiary in its unit-cost calculation were relevant for calculating personnel costs and corresponded to objective and verifiable information.	
	<p><u>For natural persons included in the sample and working with the Beneficiary under a direct contract other than an employment contract, such as consultants (no subcontractors).</u></p> <p>To confirm standard factual findings 14-18 listed in the next column the Auditor reviewed following information/documents provided by the Beneficiary:</p> <ul style="list-style-type: none"> ○ the contracts, especially the cost, contract duration, work description, place of work, ownership of the results and reporting obligations to the Beneficiary; 	14) The natural persons reported to the Beneficiary (worked under the Beneficiary's instructions).	
		15) They worked on the Beneficiary's premises (unless otherwise agreed with the Beneficiary).	

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	<ul style="list-style-type: none"> ○ the employment conditions of staff in the same category to compare costs and; ○ any other document that supports the costs declared and its registration (e.g. invoices, accounting records, etc.). 	16) The results of work carried out belong to the Beneficiary.	
		17) Their costs were not significantly different from those for staff who performed similar tasks under an employment contract with the Beneficiary.	
		18) The costs were supported by audit evidence and registered in the accounts.	
	<p><u>For personnel seconded by a third party and included in the sample (not subcontractors)</u></p> <p>To confirm standard factual findings 19-22 listed in the next column, the Auditor reviewed following information/documents provided by the Beneficiary:</p> <ul style="list-style-type: none"> ○ their secondment contract(s) notably regarding costs, duration, work description, place of work and ownership of the results; ○ if there is reimbursement by the Beneficiary to the third party for the resource made available (in-kind contribution against payment): any documentation that supports the costs declared (e.g. contract, invoice, bank payment, and proof of registration in its accounting/payroll, etc.) and reconciliation of the Financial Statement(s) with the accounting system (project accounting and general ledger) as well as any proof that the amount invoiced by the third party did not include any profit; 	19) Seconded personnel reported to the Beneficiary and worked on the Beneficiary’s premises (unless otherwise agreed with the Beneficiary).	
		20) The results of work carried out belong to the Beneficiary.	
		<p><i>If personnel is seconded against payment:</i></p> <p>21) The costs declared were supported with documentation and recorded in the</p>	

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	<ul style="list-style-type: none"> ○ if there is no reimbursement by the Beneficiary to the third party for the resource made available (in-kind contribution free of charge): a proof of the actual cost borne by the Third Party for the resource made available free of charge to the Beneficiary such as a statement of costs incurred by the Third Party and proof of the registration in the Third Party's accounting/payroll; ○ any other document that supports the costs declared (e.g. invoices, etc.). 	<p>Beneficiary's accounts. The third party did not include any profit.</p> <p><i>If personnel is seconded free of charge:</i></p> <p>22) The costs declared did not exceed the third party's cost as recorded in the accounts of the third party and were supported with documentation.</p>	
A.2	<p>PRODUCTIVE HOURS</p> <p>To confirm standard factual findings 23-28 listed in the next column, the Auditor reviewed relevant documents, especially national legislation, labour agreements and contracts and time records of the persons included in the sample, to verify that:</p> <ul style="list-style-type: none"> ○ the annual productive hours applied were calculated in accordance with one of the methods described below, ○ the full-time equivalent (FTEs) ratios for employees not working full-time were correctly calculated. 	<p>23) The Beneficiary applied method [<i>choose one option and delete the others</i>]</p> <p>[A: 1720 hours]</p> <p>[B: the 'total number of hours worked']</p> <p>[C: 'annual productive hours' used correspond to usual accounting practices]</p>	

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	<p>If the Beneficiary applied method B, the auditor verified that the correctness in which the total number of hours worked was calculated and that the contracts specified the annual workable hours.</p> <p>If the Beneficiary applied method C, the auditor verified that the ‘annual productive hours’ applied when calculating the hourly rate were equivalent to at least 90 % of the ‘standard annual workable hours’. The Auditor can only do this if the calculation of the standard annual workable hours can be supported by records, such as national legislation, labour agreements, and contracts.</p> <p><i>BENEFICIARY’S PRODUCTIVE HOURS’ FOR PERSONS WORKING FULL TIME SHALL BE ONE OF THE FOLLOWING METHODS:</i></p> <p><i>A. 1720 ANNUAL PRODUCTIVE HOURS (PRO-RATA FOR PERSONS NOT WORKING FULL-TIME)</i></p> <p><i>B. THE TOTAL NUMBER OF HOURS WORKED BY THE PERSON FOR THE BENEFICIARY IN THE YEAR (THIS METHOD IS ALSO REFERRED TO AS ‘TOTAL NUMBER OF HOURS WORKED’ IN THE NEXT COLUMN). THE CALCULATION OF THE TOTAL NUMBER OF HOURS WORKED WAS DONE AS FOLLOWS: ANNUAL WORKABLE HOURS OF THE PERSON ACCORDING TO THE EMPLOYMENT CONTRACT, APPLICABLE LABOUR AGREEMENT OR NATIONAL LAW PLUS OVERTIME WORKED MINUS ABSENCES (SUCH AS SICK LEAVE OR SPECIAL LEAVE).</i></p>	<p>24) Productive hours were calculated annually.</p> <p>25) For employees not working full-time the full-time equivalent (FTE) ratio was correctly applied.</p> <p><i>If the Beneficiary applied method B.</i></p> <p>26) The calculation of the number of ‘annual workable hours’, overtime and absences was verifiable based on the documents provided by the Beneficiary.</p> <p><i>If the Beneficiary applied method C.</i></p> <p>27) The calculation of the number of ‘standard annual workable hours’ was verifiable based on the documents provided by the Beneficiary.</p>	

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	<p><i>C. THE STANDARD NUMBER OF ANNUAL HOURS GENERALLY APPLIED BY THE BENEFICIARY FOR ITS PERSONNEL IN ACCORDANCE WITH ITS USUAL COST ACCOUNTING PRACTICES (THIS METHOD IS ALSO REFERRED TO AS 'TOTAL ANNUAL PRODUCTIVE HOURS' IN THE NEXT COLUMN). THIS NUMBER MUST BE AT LEAST 90% OF THE STANDARD ANNUAL WORKABLE HOURS.</i></p> <p><i>'ANNUAL WORKABLE HOURS' MEANS THE PERIOD DURING WHICH THE PERSONNEL MUST BE WORKING, AT THE EMPLOYER'S DISPOSAL AND CARRYING OUT HIS/HER ACTIVITY OR DUTIES UNDER THE EMPLOYMENT CONTRACT, APPLICABLE COLLECTIVE LABOUR AGREEMENT OR NATIONAL WORKING TIME LEGISLATION.</i></p>	<p>28) The 'annual productive hours' used for calculating the hourly rate were consistent with the usual cost accounting practices of the Beneficiary and were equivalent to at least 90 % of the 'annual workable hours'.</p>	
<p>A.3</p>	<p>HOURLY PERSONNEL RATES</p> <p><u>l) For unit costs calculated in accordance to the Beneficiary's usual cost accounting practice (unit costs):</u></p> <p>If the Beneficiary has a "Certificate on Methodology to calculate unit costs " (CoMUC) approved by the Commission, the Beneficiary provides the Auditor with a description of the approved methodology and the Commission's letter of acceptance. The Auditor verified that the Beneficiary has indeed used the methodology approved. If so, no further verification is necessary.</p> <p>If the Beneficiary does not have a "Certificate on Methodology" (CoMUC) approved by the</p>	<p>29) The Beneficiary applied [choose one option and delete the other]:</p> <p>[Option I: "Unit costs (hourly rates) were calculated in accordance with the Beneficiary's usual cost accounting practices"]</p> <p>[Option II: Individual hourly rates were applied]</p>	

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	<p>Commission, or if the methodology approved was not applied, then the Auditor:</p> <ul style="list-style-type: none"> ○ reviewed the documentation provided by the Beneficiary, including manuals and internal guidelines that explain how to calculate hourly rates; ○ recalculated the unit costs (hourly rates) of staff included in the sample following the results of the procedures carried out in A.1 and A.2. <p><u>II) For individual hourly rates:</u></p> <p>The Auditor:</p> <ul style="list-style-type: none"> ○ reviewed the documentation provided by the Beneficiary, including manuals and internal guidelines that explain how to calculate hourly rates; ○ recalculated the hourly rates of staff included in the sample following the results of the procedures carried out in A.1 and A.2. <p><u>“UNIT COSTS CALCULATED BY THE BENEFICIARY IN ACCORDANCE WITH ITS USUAL COST ACCOUNTING PRACTICES”:</u></p> <p><i>IT IS CALCULATED BY DIVIDING THE TOTAL AMOUNT OF PERSONNEL COSTS OF THE CATEGORY TO WHICH THE EMPLOYEE BELONGS VERIFIED IN LINE WITH PROCEDURE A.1 BY THE NUMBER OF FTE AND THE ANNUAL TOTAL PRODUCTIVE HOURS OF THE SAME CATEGORY CALCULATED BY THE BENEFICIARY IN ACCORDANCE WITH PROCEDURE A.2.</i></p> <p><u>HOURLY RATE FOR INDIVIDUAL ACTUAL PERSONAL COSTS:</u></p> <p><i>IT IS CALCULATED BY DIVIDING THE TOTAL AMOUNT OF PERSONNEL COSTS OF AN EMPLOYEE VERIFIED IN LINE WITH</i></p>	<p><i>For option I concerning unit costs and if the Beneficiary applies the methodology approved by the Commission (CoMUC):</i></p> <p>30) The Beneficiary used the Commission-approved methodology to calculate hourly rates. It corresponded to the organisation's usual cost accounting practices and was applied consistently for all activities irrespective of the source of funding.</p> <p><i>For option I concerning unit costs and if the Beneficiary applies a methodology not approved by the Commission:</i></p> <p>31) The unit costs re-calculated by the Auditor were the same as the rates applied by the Beneficiary.</p> <p><i>For option II concerning individual hourly rates:</i></p>	

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	<i>PROCEDURE A.1 BY THE NUMBER OF ANNUAL PRODUCTIVE HOURS VERIFIED IN LINE WITH PROCEDURE A.2.</i>	32) The individual rates re-calculated by the Auditor were the same as the rates applied by the Beneficiary.	
A.4	<p>TIME RECORDING SYSTEM</p> <p>To verify that the time recording system ensures the fulfilment of all minimum requirements and that the hours declared for the action were correct, accurate and properly authorised and supported by documentation, the Auditor made the following checks for the persons included in the sample that declare time as worked for the action on the basis of time records:</p> <ul style="list-style-type: none"> ○ description of the time recording system provided by the Beneficiary (registration, authorisation, processing in the HR-system); ○ its actual implementation; ○ time records were signed at least monthly by the employees (on paper or electronically) and authorised by the project manager or another manager; ○ the hours declared were worked within the project period; ○ there were no hours declared as worked for the action if HR-records showed absence due to holidays or sickness (further cross-checks with travels are carried out in B.1 below) ; 	<p>33) All persons recorded their time dedicated to the action on a daily/ weekly/ monthly basis using a paper/computer-based system. <i>(delete the answers that are not applicable)</i></p> <p>34) Their time-records were authorised at least monthly by the project manager or other superior.</p> <p>35) Hours declared were worked within the project period and were consistent with the presences/absences recorded in HR-records.</p>	

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	<p>○ the hours charged to the action matched those in the time recording system.</p> <p><i>ONLY THE HOURS WORKED ON THE ACTION CAN BE CHARGED. ALL WORKING TIME TO BE CHARGED SHOULD BE RECORDED THROUGHOUT THE DURATION OF THE PROJECT, ADEQUATELY SUPPORTED BY EVIDENCE OF THEIR REALITY AND RELIABILITY (SEE SPECIFIC PROVISIONS BELOW FOR PERSONS WORKING EXCLUSIVELY FOR THE ACTION WITHOUT TIME RECORDS).</i></p>	<p>36) There were no discrepancies between the number of hours charged to the action and the number of hours recorded.</p>	
	<p><u>If the persons are working exclusively for the action and without time records</u></p> <p>For the persons selected that worked exclusively for the action without time records, the Auditor verified evidence available demonstrating that they were in reality exclusively dedicated to the action and that the Beneficiary signed a declaration confirming that they have worked exclusively for the action.</p>	<p>37) The exclusive dedication is supported by a declaration signed by the Beneficiary's and by any other evidence gathered.</p>	
B	COSTS OF SUBCONTRACTING		
B.1	<p>The Auditor obtained the detail/breakdown of subcontracting costs and sampled _____ cost items selected randomly <i>(full coverage is required if there are fewer than 10 items, otherwise the sample should have a minimum of 10 item, or 10% of the total, whichever number is highest).</i></p> <p>To confirm standard factual findings 38-42 listed in the next column, the Auditor reviewed the</p>	<p>38) The use of claimed subcontracting costs was foreseen in Annex 1 and costs were declared in the Financial Statements under the subcontracting category.</p>	

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	<p>following for the items included in the sample:</p> <ul style="list-style-type: none"> ○ the use of subcontractors was foreseen in Annex 1; ○ subcontracting costs were declared in the subcontracting category of the Financial Statement; ○ supporting documents on the selection and award procedure were followed; ○ the Beneficiary ensured best value for money (key elements to appreciate the respect of this principle are the award of the subcontract to the bid offering best price-quality ratio, under conditions of transparency and equal treatment. In case an existing framework contract was used the Beneficiary ensured it was established on the basis of the principle of best value for money under conditions of transparency and equal treatment). <p>In particular,</p> <ul style="list-style-type: none"> i. if the Beneficiary acted as a contracting authority within the meaning of Directive 2004/18/EC or of Directive 2004/17/EC, the Auditor verified that the applicable national law on public procurement was followed and that the subcontracting complied with the Terms and Conditions of the Agreement. ii. if the Beneficiary did not fall under the above-mentioned category the Auditor verified that the Beneficiary followed their usual procurement rules and respected the Terms and Conditions of the Agreement.. <p>For the items included in the sample the Auditor also verified that:</p> <ul style="list-style-type: none"> ○ the subcontracts were not awarded to other Beneficiaries in the consortium; 	<p>39) There were documents of requests to different providers, different offers and assessment of the offers before selection of the provider in line with internal procedures and procurement rules. Subcontracts were awarded in accordance with the principle of best value for money.</p> <p><i>(When different offers were not collected the Auditor explains the reasons provided by the Beneficiary under the caption “Exceptions” of the Report. The Commission will analyse this information to evaluate whether these costs might be accepted as eligible)</i></p> <p>40) The subcontracts were not awarded to other Beneficiaries of the consortium.</p>	

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	<ul style="list-style-type: none"> ○ there were signed agreements between the Beneficiary and the subcontractor; ○ there was evidence that the services were provided by subcontractor; 	41) All subcontracts were supported by signed agreements between the Beneficiary and the subcontractor.	
		42) There was evidence that the services were provided by the subcontractors.	
C	COSTS OF PROVIDING FINANCIAL SUPPORT TO THIRD PARTIES		
C.1	<p>The Auditor obtained the detail/breakdown of the costs of providing financial support to third parties and sampled [redacted] cost items selected randomly <i>(full coverage is required if there are fewer than 10 items, otherwise the sample should have a minimum of 10 item, or 10% of the total, whichever number is highest).</i></p> <p>The Auditor verified that the following minimum conditions were met:</p> <ul style="list-style-type: none"> a) the maximum amount of financial support for each third party did not exceed EUR 60 000, unless explicitly mentioned in Annex 1; b) the financial support to third parties was agreed in Annex 1 of the Agreement and the other provisions on financial support to third parties included in Annex 1 were 	43) All minimum conditions were met	

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	respected.		

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

D	OTHER ACTUAL DIRECT COSTS		
D.1	<p>COSTS OF TRAVEL AND RELATED SUBSISTENCE ALLOWANCES</p> <p>The Auditor sampled [] cost items selected randomly <i>(full coverage is required if there are fewer than 10 items, otherwise the sample should have a minimum of 10 item, or 10% of the total, whichever number is the highest).</i></p> <p>The Auditor inspected the sample and verified that:</p> <ul style="list-style-type: none"> ○ travel and subsistence costs were consistent with the Beneficiary's usual policy for travel. In this context, the Beneficiary provided evidence of its normal policy for travel costs (e.g. use of first class tickets, reimbursement by the Beneficiary on the basis of actual costs, a lump sum or per diem) to enable the Auditor to compare the travel costs charged with this policy; ○ travel costs are correctly identified and allocated to the action (e.g. trips are directly linked to the action) by reviewing relevant supporting documents such as minutes of meetings, workshops or conferences, their registration in the correct project account, their consistency with time records or with the dates/duration of the workshop/conference; ○ no ineligible costs or excessive or reckless expenditure was declared. 	44) Costs were incurred, approved and reimbursed in line with the Beneficiary's usual policy for travels.	
		45) There was a link between the trip and the action.	
		46) The supporting documents were consistent with each other regarding subject of the trip, dates, duration and reconciled with time records and accounting.	
		47) No ineligible costs or excessive or reckless expenditure was declared.	
D.2	<p>DEPRECIATION COSTS FOR EQUIPMENT, INFRASTRUCTURE OR OTHER ASSETS</p> <p>The Auditor sampled [] cost items selected randomly <i>(full coverage is required if there are fewer than 10 items, otherwise the sample should have a minimum of 10 item, or 10% of the total, whichever number is the highest).</i></p> <p>For “equipment, infrastructure or other assets” [from now on called “asset(s)”] selected in the</p>	48) Procurement rules, principles and guides were followed.	
		49) There was a link between the grant agreement and the asset charged to the action.	

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

	<p>sample the Auditor verified that:</p> <ul style="list-style-type: none"> ○ the assets were acquired in conformity with the Beneficiary's internal guidelines and procedures; ○ they were correctly allocated to the action (with supporting documents such as delivery note invoice or any other proof demonstrating the link to the action) ○ they were entered in the accounting system; ○ the extent to which the assets were used for the action (as a percentage) was supported by reliable documentation (e.g. usage overview table); <p>The Auditor recalculated the depreciation costs and verified that they were in line with the applicable rules in the Beneficiary's country and with the Beneficiary's usual accounting policy (e.g. depreciation calculated on the acquisition value).</p> <p>The Auditor verified that no ineligible costs such as deductible VAT, exchange rate losses, excessive or reckless expenditure were declared (see Article 6.5 GA).</p>	<p>50) The asset charged to the action was traceable to the accounting records and the underlying documents.</p>	
		<p>51) The depreciation method used to charge the asset to the action was in line with the applicable rules of the Beneficiary's country and the Beneficiary's usual accounting policy.</p>	
		<p>52) The amount charged corresponded to the actual usage for the action.</p>	
		<p>53) No ineligible costs or excessive or reckless expenditure were declared.</p>	
<p>D.3</p>	<p>COSTS OF OTHER GOODS AND SERVICES</p> <p>The Auditor sampled [redacted] cost items selected randomly (<i>full coverage is required if there are fewer than 10 items, otherwise the sample should have a minimum of 10 item, or 10% of the total, whichever number is highest</i>).</p> <p>For the purchase of goods, works or services included in the sample the Auditor verified that:</p> <ul style="list-style-type: none"> ○ the contracts did not cover tasks described in Annex 1; 	<p>54) Contracts for works or services did not cover tasks described in Annex 1.</p>	
		<p>55) Costs were allocated to the correct action and the goods were not placed in the inventory of durable equipment.</p>	

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

	<ul style="list-style-type: none"> ○ they were correctly identified, allocated to the proper action, entered in the accounting system (traceable to underlying documents such as purchase orders, invoices and accounting); ○ the goods were not placed in the inventory of durable equipment; ○ the costs charged to the action were accounted in line with the Beneficiary’s usual accounting practices; ○ no ineligible costs or excessive or reckless expenditure were declared (see Article 6 GA). <p>In addition, the Auditor verified that these goods and services were acquired in conformity with the Beneficiary's internal guidelines and procedures, in particular:</p> <ul style="list-style-type: none"> ○ if Beneficiary acted as a contracting authority within the meaning of Directive 2004/18/EC or of Directive 2004/17/EC, the Auditor verified that the applicable national law on public procurement was followed and that the procurement contract complied with the Terms and Conditions of the Agreement. ○ if the Beneficiary did not fall into the category above, the Auditor verified that the Beneficiary followed their usual procurement rules and respected the Terms and Conditions of the Agreement. <p>For the items included in the sample the Auditor also verified that:</p> <ul style="list-style-type: none"> ○ the Beneficiary ensured best value for money (key elements to appreciate the respect of this principle are the award of the contract to the bid offering best price-quality ratio, under conditions of transparency and equal treatment. In case an existing framework contract was used the Auditor also verified that the Beneficiary ensured it was established on the basis of the principle of best value for money under conditions of transparency and equal treatment); <p><i>SUCH GOODS AND SERVICES INCLUDE, FOR INSTANCE, CONSUMABLES AND SUPPLIES, DISSEMINATION (INCLUDING OPEN ACCESS), PROTECTION OF RESULTS, SPECIFIC EVALUATION OF THE ACTION IF IT IS REQUIRED BY THE</i></p>	<p>56) The costs were charged in line with the Beneficiary’s accounting policy and were adequately supported.</p>	
		<p>57) No ineligible costs or excessive or reckless expenditure were declared. For internal invoices/charges only the cost element was charged, without any mark-ups.</p>	
		<p>58) Procurement rules, principles and guides were followed. There were documents of requests to different providers, different offers and assessment of the offers before selection of the provider in line with internal procedures and procurement rules. The purchases were made in accordance with the principle of best value for money.</p> <p><i>(When different offers were not collected the Auditor explains the reasons provided by the Beneficiary under the</i></p>	

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

	<p><i>AGREEMENT, CERTIFICATES ON THE FINANCIAL STATEMENTS IF THEY ARE REQUIRED BY THE AGREEMENT AND CERTIFICATES ON THE METHODOLOGY, TRANSLATIONS, REPRODUCTION.</i></p>	<p><i>caption “Exceptions” of the Report. The Commission will analyse this information to evaluate whether these costs might be accepted as eligible)</i></p>	
<p>D.4</p>	<p>AGGREGATED CAPITALISED AND OPERATING COSTS OF RESEARCH INFRASTRUCTURE</p> <p>The Auditor ensured the existence of a positive ex-ante assessment (issued by the EC Services) of the cost accounting methodology of the Beneficiary allowing it to apply the guidelines on direct costing for large research infrastructures in Horizon 2020.</p> <p><i>In the cases that a positive ex-ante assessment has been issued (see the standard factual findings 59-60 on the next column),</i></p> <p>The Auditor ensured that the beneficiary has applied consistently the methodology that is explained and approved in the positive ex ante assessment;</p> <p><i>In the cases that a positive ex-ante assessment has NOT been issued (see the standard factual findings 61 on the next column),</i></p> <p>The Auditor verified that no costs of Large Research Infrastructure have been charged as direct costs in any costs category;</p>	<p>59) The costs declared as direct costs for Large Research Infrastructures (in the appropriate line of the Financial Statement) comply with the methodology described in the positive ex-ante assessment report.</p>	
		<p>60) Any difference between the methodology applied and the one positively assessed was extensively described and adjusted accordingly.</p>	
		<p>61) The direct costs declared were free from any indirect costs items related to the Large Research Infrastructure.</p>	

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

	<p><i>In the cases that a draft ex-ante assessment report has been issued with recommendation for further changes (see the standard factual findings 61 on the next column),</i></p> <ul style="list-style-type: none"> The Auditor followed the same procedure as above (when a positive ex-ante assessment has NOT yet been issued) and paid particular attention (testing reinforced) to the cost items for which the draft ex-ante assessment either rejected the inclusion as direct costs for Large Research Infrastructures or issued recommendations. 		
E	USE OF EXCHANGE RATES		
E.1	<p><u>a) For Beneficiaries with accounts established in a currency other than euros</u></p> <p>The Auditor sampled [redacted] cost items selected randomly and verified that the exchange rates used for converting other currencies into euros were in accordance with the following rules established in the Agreement (full coverage is required if there are fewer than 10 items, otherwise the sample should have a minimum of 10 item, or 10% of the total, whichever number is highest):</p> <p><i>COSTS INCURRED IN ANOTHER CURRENCY SHALL BE CONVERTED INTO EURO AT THE AVERAGE OF THE DAILY EXCHANGE RATES PUBLISHED IN THE C SERIES OF OFFICIAL JOURNAL OF THE EUROPEAN UNION (https://www.ecb.int/stats/exchange/eurofxref/html/index.en.html), DETERMINED OVER THE CORRESPONDING REPORTING PERIOD.</i></p> <p><i>IF NO DAILY EURO EXCHANGE RATE IS PUBLISHED IN THE OFFICIAL JOURNAL OF THE EUROPEAN UNION FOR THE CURRENCY IN QUESTION, CONVERSION SHALL BE MADE AT THE AVERAGE OF THE MONTHLY ACCOUNTING RATES ESTABLISHED BY THE COMMISSION AND PUBLISHED ON ITS WEBSITE (http://ec.europa.eu/budget/contracts_grants/info_contracts/inforeuro/inforeuro_en.cfm),</i></p>	62) The exchange rates used to convert other currencies into Euros were in accordance with the rules established of the Grant Agreement and there was no difference in the final figures.	

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

	<p><i>DETERMINED OVER THE CORRESPONDING REPORTING PERIOD.</i></p>		
	<p><u>b) For Beneficiaries with accounts established in euros</u></p> <p>The Auditor sampled [redacted] cost items selected randomly and verified that the exchange rates used for converting other currencies into euros were in accordance with the following rules established in the Agreement (full coverage is required if there are fewer than 10 items, otherwise the sample should have a minimum of 10 item, or 10% of the total, whichever number is highest):</p> <p><i>COSTS INCURRED IN ANOTHER CURRENCY SHALL BE CONVERTED INTO EURO BY APPLYING THE BENEFICIARY’S USUAL ACCOUNTING PRACTICES.</i></p>	<p>63) The Beneficiary applied its usual accounting practices.</p>	

[legal name of the audit firm]

[name and function of an authorised representative]

[dd Month yyyy]

<Signature of the Auditor>

ANNEX 6

MODEL FOR THE CERTIFICATE ON THE METHODOLOGY

- For options [*in italics in square brackets*]: choose the applicable option. Options not chosen should be deleted.
- For fields in [grey in square brackets]: enter the appropriate data.

TABLE OF CONTENTS

TERMS OF REFERENCE FOR AN AUDIT ENGAGEMENT FOR A METHODOLOGY CERTIFICATE IN CONNECTION WITH ONE OR MORE GRANT AGREEMENTS FINANCED UNDER THE HORIZON 2020 RESEARCH AND INNOVATION FRAMEWORK PROGRAMME.....	2
INDEPENDENT REPORT OF FACTUAL FINDINGS ON THE METHODOLOGY CONCERNING GRANT AGREEMENTS FINANCED UNDER THE HORIZON 2020 RESEARCH AND INNOVATION FRAMEWORK PROGRAMME	7

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

Terms of reference for an audit engagement for a methodology certificate in connection with one or more grant agreements financed under the Horizon 2020 Research and Innovation Framework Programme

This document sets out the **‘Terms of Reference (ToR)’** under which

[OPTION 1: [insert name of the beneficiary] (‘the Beneficiary’)] [OPTION 2: [insert name of the linked third party] (‘the Linked Third Party’), third party linked to the Beneficiary [insert name of the beneficiary] (‘the Beneficiary’)]

agrees to engage

[insert legal name of the auditor] (‘the Auditor’)

to produce an independent report of factual findings (‘the Report’) concerning the *[Beneficiary’s]* *[Linked Third Party’s]* usual accounting practices for calculating and claiming direct personnel costs declared as unit costs (‘the Methodology’) in connection with grant agreements financed under the Horizon 2020 Research and Innovation Framework Programme.

The procedures to be carried out for the assessment of the methodology will be based on the grant agreement(s) detailed below:

[title and number of the grant agreement(s)] (‘the Agreement(s)’)

The Agreement(s) has(have) been concluded between the Beneficiary and *[OPTION 1: the European Union, represented by the European Commission (‘the Commission’)] [OPTION 2: the European Atomic Energy Community (Euratom,) represented by the European Commission (‘the Commission’)] [OPTION 3: the [Research Executive Agency (REA)] [European Research Council Executive Agency (ERCEA)] [Innovation and Networks Executive Agency (INEA)] [Executive Agency for Small and Medium-sized Enterprises (EASME)] (‘the Agency’), under the powers delegated by the European Commission (‘the Commission’)].*

[H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014](#)

The *[Commission] [Agency]* is mentioned as a signatory of the Agreement with the Beneficiary only. The *[European Union] [Euratom] [Agency]* is not a party to this engagement.

1.1 Subject of the engagement

According to Article 18.1.2 of the Agreement, beneficiaries *[and linked third parties]* that declare direct personnel costs as unit costs calculated in accordance with their usual cost accounting practices may submit to the *[Commission] [Agency]*, for approval, a certificate on the methodology ('CoMUC') stating that there are adequate records and documentation to prove that their cost accounting practices used comply with the conditions set out in Point A of Article 6.2.

The subject of this engagement is the CoMUC which is composed of two separate documents:

- the Terms of Reference ('the ToR') to be signed by the *[Beneficiary] [Linked Third Party]* and the Auditor;
- the Auditor's Independent Report of Factual Findings ('the Report') issued on the Auditor's letterhead, dated, stamped and signed by the Auditor which includes; the standard statements ('the Statements') evaluated and signed by the *[Beneficiary] [Linked Third Party]*, the agreed-upon procedures ('the Procedures') performed by the Auditor and the standard factual findings ('the Findings') assessed by the Auditor. The Statements, Procedures and Findings are summarised in the table that forms part of the Report.

The information provided through the Statements, the Procedures and the Findings will enable the Commission to draw conclusions regarding the existence of the *[Beneficiary's] [Linked Third Party's]* usual cost accounting practice and its suitability to ensure that direct personnel costs claimed on that basis comply with the provisions of the Agreement. The Commission draws its own conclusions from the Report and any additional information it may require.

1.2 Responsibilities

The parties to this agreement are the *[Beneficiary] [Linked Third Party]* and the Auditor.

The *[Beneficiary] [Linked Third Party]*:

[H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014](#)

- is responsible for preparing financial statements for the Agreement(s) ('the Financial Statements') in compliance with those Agreements;
- is responsible for providing the Financial Statement(s) to the Auditor and enabling the Auditor to reconcile them with the [Beneficiary's] [Linked Third Party's] accounting and bookkeeping system and the underlying accounts and records. The Financial Statement(s) will be used as a basis for the procedures which the Auditor will carry out under this ToR;
- is responsible for its Methodology and liable for the accuracy of the Financial Statement(s);
- is responsible for endorsing or refuting the Statements indicated under the heading 'Statements to be made by the Beneficiary/ Linked Third Party' in the first column of the table that forms part of the Report;
- must provide the Auditor with a signed and dated representation letter;
- accepts that the ability of the Auditor to carry out the Procedures effectively depends upon the [Beneficiary] [Linked Third Party] providing full and free access to the [Beneficiary's] [Linked Third Party's] staff and to its accounting and other relevant records.

The Auditor:

- *[Option 1 by default: is qualified to carry out statutory audits of accounting documents in accordance with Directive 2006/43/EC of the European Parliament and of the Council of 17 May 2006 on statutory audits of annual accounts and consolidated accounts, amending Council Directives 78/660/EEC and 83/349/EEC and repealing Council Directive 84/253/EEC or similar national regulations].*
- *[Option 2 if the Beneficiary or Linked Third Party has an independent Public Officer: is a competent and independent Public Officer for which the relevant national authorities have established the legal capacity to audit the Beneficiary].*
- *[Option 3 if the Beneficiary or Linked Third Party is an international organisation: is an [internal] [external] auditor in accordance with the internal financial regulations and procedures of the international organisation].*

The Auditor:

- must be independent from the Beneficiary [and the Linked Third Party], in particular, it must not have been involved in preparing the Beneficiary's [and Linked Third Party's] Financial Statement(s);
- must plan work so that the Procedures may be carried out and the Findings may be assessed;
- must adhere to the Procedures laid down and the compulsory report format;
- must carry out the engagement in accordance with these ToR;
- must document matters which are important to support the Report;
- must base its Report on the evidence gathered;
- must submit the Report to the [Beneficiary] [Linked Third Party].

The Commission sets out the Procedures to be carried out and the Findings to be endorsed by the Auditor. The Auditor is not responsible for their suitability or pertinence. As this engagement is not an assurance engagement the Auditor does not provide an audit opinion or a statement of assurance.

1.3 Applicable Standards

The Auditor must comply with these Terms of Reference and with¹:

- the International Standard on Related Services ('ISRS') 4400 *Engagements to perform Agreed-upon Procedures regarding Financial Information* as issued by the International Auditing and Assurance Standards Board (IAASB);
- the *Code of Ethics for Professional Accountants* issued by the International Ethics Standards Board for Accountants (IESBA). Although ISRS 4400 states that independence is not a requirement for engagements to carry out agreed-upon procedures, the Commission requires that the Auditor also complies with the Code's independence requirements.

The Auditor's Report must state that there was no conflict of interests in establishing this Report between the Auditor and the Beneficiary [*and the Linked Third Party*] that could have a bearing on the Report, and must specify – if the service is invoiced - the total fee paid to the Auditor for providing the Report.

1.4 Reporting

The Report must be written in the language of the Agreement (see Article 20.7 of the Agreement).

Under Article 22 of the Agreement, the Commission, [*the Agency*], the European Anti-Fraud Office and the Court of Auditors have the right to audit any work that is carried out under the action and for which costs are claimed from [*the European Union*] [*Euratom*] budget. This includes work related to this engagement. The Auditor must provide access to all working papers related to this assignment if the Commission, [*the Agency*], the European Anti-Fraud Office or the European Court of Auditors requests them.

1.5 Timing

The Report must be provided by [dd Month yyyy].

¹ Supreme Audit Institutions applying INTOSAI-standards may carry out the Procedures according to the corresponding International Standards of Supreme Audit Institutions and code of ethics issued by INTOSAI instead of the International Standard on Related Services ('ISRS') 4400 and the Code of Ethics for Professional Accountants issued by the IAASB and the IESBA.

1.6 Other Terms

[The [Beneficiary] [Linked Third Party] and the Auditor can use this section to agree other specific terms, such as the Auditor’s fees, liability, applicable law, etc. Those specific terms must not contradict the terms specified above.]

[legal name of the Auditor] [legal name of the [Beneficiary] [Linked Third Party]]

[name & title of authorised representative] [name & title of authorised representative]

[dd Month yyyy] [dd Month yyyy]

Signature of the Auditor Signature Signature of the [Beneficiary] [Linked Third Party]

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

Independent report of factual findings on the methodology concerning grant agreements financed under the Horizon 2020 Research and Innovation Framework Programme

(To be printed on letterhead paper of the auditor)

To

[name of contact person(s)], [Position]

[[Beneficiary's] [Linked Third Party's] name]

[Address]

[dd Month yyyy]

Dear [Name of contact person(s)],

As agreed under the terms of reference dated [dd Month yyyy]

with [OPTION 1: [insert name of the beneficiary] ('the Beneficiary')] [OPTION 2: [insert name of the linked third party] ('the Linked Third Party'), third party linked to the Beneficiary [insert name of the beneficiary] ('the Beneficiary')],

we

[name of the auditor] ('the Auditor'),

established at

[full address/city/state/province/country],

represented by

[name and function of an authorised representative],

[H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014](#)

have carried out the agreed-upon procedures ('the Procedures') and provide hereby our Independent Report of Factual Findings ('the Report'), concerning the [Beneficiary's] [Linked Third Party's] usual accounting practices for calculating and declaring direct personnel costs declared as unit costs ('the Methodology').

You requested certain procedures to be carried out in connection with the grant(s)

[title and number of the grant agreement(s)] ('the Agreement(s)').

The Report

Our engagement was carried out in accordance with the terms of reference ('the ToR') appended to this Report. The Report includes: the standard statements ('the Statements') made by the [Beneficiary] [Linked Third Party], the agreed-upon procedures ('the Procedures') carried out and the standard factual findings ('the Findings') confirmed by us.

The engagement involved carrying out the Procedures and assessing the Findings and the documentation requested appended to this Report, the results of which the Commission uses to draw conclusions regarding the acceptability of the Methodology applied by the [Beneficiary] [Linked Third Party].

The Report covers the methodology used from [dd Month yyyy]. In the event that the [Beneficiary] [Linked Third Party] changes this methodology, the Report will not be applicable to any Financial Statement² submitted thereafter.

The scope of the Procedures and the definition of the standard statements and findings were determined solely by the Commission. Therefore, the Auditor is not responsible for their suitability or pertinence.

Since the Procedures carried out constitute neither an audit nor a review made in accordance with International Standards on Auditing or International Standards on Review Engagements, we do not

² Financial Statement in this context refers solely to Annex 4 of the Agreement by which the Beneficiary declares costs under the Agreement.

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

give a statement of assurance on the costs declared on the basis of the [Beneficiary's] [Linked Third Party's] Methodology. Had we carried out additional procedures or had we performed an audit or review in accordance with these standards, other matters might have come to its attention and would have been included in the Report.

Exceptions

Apart from the exceptions listed below, the [Beneficiary] [Linked Third Party] agreed with the standard Statements and provided the Auditor all the documentation and accounting information needed by the Auditor to carry out the requested Procedures and corroborate the standard Findings.

List here any exception and add any information on the cause and possible consequences of each exception, if known. If the exception is quantifiable, also indicate the corresponding amount.

.....

Explanation of possible exceptions in the form of examples (to be removed from the Report):

- i. the [Beneficiary] [Linked Third Party] did not agree with the standard Statement number ... because...;*
- ii. the Auditor could not carry out the procedure ... established because (e.g. due to the inability to reconcile key information or the unavailability or inconsistency of data);*
- iii. the Auditor could not confirm or corroborate the standard Finding number ... because*

Remarks

We would like to add the following remarks relevant for the proper understanding of the Methodology applied by the [Beneficiary] [Linked Third Party] or the results reported:

Example (to be removed from the Report):

Regarding the methodology applied to calculate hourly rates ...

Regarding standard Finding 15 it has to be noted that ...

The [Beneficiary] [Linked Third Party] explained the deviation from the benchmark statement XXIV concerning time recording for personnel with no exclusive dedication to the action in the following manner:

...

Annexes

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

Please provide the following documents to the auditor and annex them to the report when submitting this CoMUC to the Commission:

1. Brief description of the methodology for calculating personnel costs, productive hours and hourly rates;
2. Brief description of the time recording system in place;
3. An example of the time records used by the [Beneficiary] [Linked Third Party];
4. Description of any budgeted or estimated elements applied, together with an explanation as to why they are relevant for calculating the personnel costs and how they are based on objective and verifiable information;
5. A summary sheet with the hourly rate for direct personnel declared by the [Beneficiary] [Linked Third Party] and recalculated by the Auditor for each staff member included in the sample (the names do not need to be reported);
6. A comparative table summarising for each person selected in the sample a) the time claimed by the [Beneficiary] [Linked Third Party] in the Financial Statement(s) and b) the time according to the time record verified by the Auditor;
7. A copy of the letter of representation provided to the Auditor.

Use of this Report

This Report has been drawn up solely for the purpose given under Point 1.1 Reasons for the engagement.

The Report:

- is confidential and is intended to be submitted to the Commission by the [Beneficiary] [Linked Third Party] in connection with Article 18.1.2 of the Agreement;
- may not be used by the [Beneficiary] [Linked Third Party] or by the Commission for any other purpose, nor distributed to any other parties;
- may be disclosed by the Commission only to authorised parties, in particular the European Anti-Fraud Office (OLAF) and the European Court of Auditors.
- relates only to the usual cost accounting practices specified above and does not constitute a report on the Financial Statements of the [Beneficiary] [Linked Third Party].

No conflict of interest³ exists between the Auditor and the Beneficiary [and the Linked Third Party] that could have a bearing on the Report. The total fee paid to the Auditor for producing the Report was EUR [] (including EUR [] of deductible VAT).

³ A conflict of interest arises when the Auditor's objectivity to establish the certificate is compromised in fact or in appearance when the Auditor for instance:

- was involved in the preparation of the Financial Statements;

[H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014](#)

We look forward to discussing our Report with you and would be pleased to provide any further information or assistance which may be required.

Yours sincerely

[legal name of the Auditor]

[name and title of the authorised representative]

[dd Month yyyy]

Signature of the Auditor

-
- stands to benefit directly should the certificate be accepted;
 - has a close relationship with any person representing the beneficiary;
 - is a director, trustee or partner of the beneficiary; or
 - is in any other situation that compromises his or her independence or ability to establish the certificate impartially.

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

Statements to be made by the Beneficiary/Linked Third Party ('the Statements') and Procedures to be carried out by the Auditor ('the Procedures') and standard factual findings ('the Findings') to be confirmed by the Auditor

The Commission reserves the right to provide the auditor with guidance regarding the Statements to be made, the Procedures to be carried out or the Findings to be ascertained and the way in which to present them. The Commission reserves the right to vary the Statements, Procedures or Findings by written notification to the Beneficiary/Linked Third Party to adapt the procedures to changes in the grant agreement(s) or to any other circumstances.

If this methodology certificate relates to the Linked Third Party's usual accounting practices for calculating and claiming direct personnel costs declared as unit costs any reference here below to 'the Beneficiary' is to be considered as a reference to 'the Linked Third Party'.

Please explain any discrepancies in the body of the Report.	
Statements to be made by Beneficiary	Procedures to be carried out and Findings to be confirmed by the Auditor
<p>A. Use of the Methodology</p> <p>I. The cost accounting practice described below has been in use since [dd Month yyyy].</p> <p>II. The next planned alteration to the methodology used by the Beneficiary will be from [dd Month yyyy].</p>	<p>Procedure:</p> <p>✓ The Auditor checked these dates against the documentation the Beneficiary has provided.</p> <p>Factual finding:</p> <p>1. The dates provided by the Beneficiary were consistent with the documentation.</p>
<p>B. Description of the Methodology</p> <p>III. The methodology to calculate unit costs is being used in a consistent manner and is reflected in the relevant procedures.</p> <p><i>[Please describe the methodology your entity uses to calculate <u>personnel</u> costs, productive hours and hourly rates, present your description to the Auditor and annex it to this certificate]</i></p> <p><i>[If the statement of section "B. Description of the methodology" cannot be endorsed by the Beneficiary or there is no written methodology to calculate unit costs it should be listed here below and reported as exception by the Auditor in the main Report of</i></p>	<p>Procedure:</p> <p>✓ The Auditor reviewed the description, the relevant manuals and/or internal guidance documents describing the methodology.</p> <p>Factual finding:</p> <p>2. The brief description was consistent with the relevant manuals, internal guidance and/or other documentary evidence the Auditor has reviewed.</p> <p>3. The methodology was generally applied by the Beneficiary as part of its usual costs accounting practices.</p>

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

Please explain any discrepancies in the body of the Report.	
Statements to be made by Beneficiary	Procedures to be carried out and Findings to be confirmed by the Auditor
<i>Factual Findings:</i> - ...]	
<p>C. Personnel costs</p> <p><u>General</u></p> <p>IV. The unit costs (hourly rates) are limited to salaries including during parental leave, social security contributions, taxes and other costs included in the remuneration required under national law and the employment contract or equivalent appointing act;</p> <p>V. Employees are hired directly by the Beneficiary in accordance with national law, and work under its sole supervision and responsibility;</p> <p>VI. The Beneficiary remunerates its employees in accordance with its usual practices. This means that personnel costs are charged in line with the Beneficiary's usual payroll policy (e.g. salary policy, overtime policy, variable pay) and no special conditions exist for employees assigned to tasks relating to the European Union or Euratom, unless explicitly provided for in the grant agreement(s);</p> <p>VII. The Beneficiary allocates its employees to the relevant group/category/cost centre for the purpose of the unit cost calculation in line with the usual cost accounting practice;</p> <p>VIII. Personnel costs are based on the payroll system and accounting system.</p> <p>IX. Any exceptional adjustments of actual personnel costs resulted from relevant budgeted or estimated elements and were based on objective and verifiable information. <i>[Please describe the 'budgeted or estimated elements' and their relevance to personnel costs, and explain how they were reasonable and based on objective and verifiable information, present your explanation to the Auditor and annex it to this certificate].</i></p> <p>X. Personnel costs claimed do not contain any of the following ineligible costs: costs related to return on capital; debt and debt service charges; provisions for future losses</p>	<p>Procedure:</p> <p><i>The Auditor draws a sample of employees to carry out the procedures indicated in this section C and the following sections D to F.</i></p> <p><i>[The Auditor has drawn a random sample of 10 full-time equivalents made up of employees assigned to the action(s). If fewer than 10 full-time equivalents are assigned to the action(s), the Auditor has selected a sample of 10 full-time equivalents consisting of all employees assigned to the action(s), complemented by other employees irrespective of their assignments.]. For this sample:</i></p> <ul style="list-style-type: none"> ✓ the Auditor reviewed all documents relating to personnel costs such as employment contracts, payslips, payroll policy (e.g. salary policy, overtime policy, variable pay policy), accounting and payroll records, applicable national tax , labour and social security law and any other documents corroborating the personnel costs claimed; ✓ in particular, the Auditor reviewed the employment contracts of the employees in the sample to verify that: <ul style="list-style-type: none"> i. they were employed directly by the Beneficiary in accordance with applicable national legislation; ii. they were working under the sole technical supervision and responsibility of the latter; iii. they were remunerated in accordance with the Beneficiary's usual practices; iv. they were allocated to the correct group/category/cost centre for the purposes of calculating the unit cost in line with the Beneficiary's usual cost accounting practices; ✓ the Auditor verified that any ineligible items or any costs claimed under other costs categories or costs covered by other types of grant or by other grants financed from the European Union budget have not been taken

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

Please explain any discrepancies in the body of the Report.	
Statements to be made by Beneficiary	Procedures to be carried out and Findings to be confirmed by the Auditor
<p>or debts; interest owed; doubtful debts; currency exchange losses; bank costs charged by the Beneficiary's bank for transfers from the Commission/Agency; excessive or reckless expenditure; deductible VAT or costs incurred during suspension of the implementation of the action.</p> <p>XI. Personnel costs were not declared under another EU or Euratom grant (including grants awarded by a Member State and financed by the EU budget and grants awarded by bodies other than the Commission/Agency for the purpose of implementing the EU budget).</p> <p><u>If additional remuneration as referred to in the grant agreement(s) is paid</u></p> <p>XII. The Beneficiary is a non-profit legal entity;</p> <p>XIII. The additional remuneration is part of the beneficiary's usual remuneration practices and paid consistently whenever the relevant work or expertise is required;</p> <p>XIV. The criteria used to calculate the additional remuneration are objective and generally applied regardless of the source of funding;</p> <p>XV. The additional remuneration included in the personnel costs used to calculate the hourly rates for the grant agreement(s) is capped at EUR 8 000 per full-time equivalent (reduced proportionately if the employee is not assigned exclusively to the action).</p> <p><u>If certain statement(s) of section "C. Personnel costs" cannot be endorsed by the Beneficiary they should be listed here below and reported as exception by the Auditor in the main Report of</u></p>	<p>into account when calculating the personnel costs;</p> <ul style="list-style-type: none"> ✓ the Auditor numerically reconciled the total amount of personnel costs used to calculate the unit cost with the total amount of personnel costs recorded in the statutory accounts and the payroll system. ✓ to the extent that actual personnel costs were adjusted on the basis of budgeted or estimated elements, the Auditor carefully examined those elements and checked the information source to confirm that they correspond to objective and verifiable information; ✓ if additional remuneration has been claimed, the Auditor verified that the Beneficiary was a non-profit legal entity, that the amount was capped at EUR 8000 per full-time equivalent and that it was reduced proportionately for employees not assigned exclusively to the action(s). ✓ the Auditor recalculated the personnel costs for the employees in the sample. <p>Factual finding:</p> <ol style="list-style-type: none"> 4. All the components of the remuneration that have been claimed as personnel costs are supported by underlying documentation. 5. The employees in the sample were employed directly by the Beneficiary in accordance with applicable national law and were working under its sole supervision and responsibility. 6. Their employment contracts were in line with the Beneficiary's usual policy; 7. Personnel costs were duly documented and consisted solely of salaries, social security contributions (pension contributions, health insurance, unemployment fund contributions, etc.), taxes and other statutory costs included in the remuneration (holiday pay, thirteenth month's pay, etc.); 8. The totals used to calculate the personnel unit costs are consistent with those registered in the payroll and accounting records; 9. To the extent that actual personnel costs were adjusted on the basis of budgeted or estimated elements, those elements were

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

Please explain any discrepancies in the body of the Report.	
Statements to be made by Beneficiary	Procedures to be carried out and Findings to be confirmed by the Auditor
<p>Factual Findings:</p> <p>- ...]</p>	<p>relevant for calculating the personnel costs and correspond to objective and verifiable information. The budgeted or estimated elements used are: — (indicate the elements and their values).</p> <p>10. Personnel costs contained no ineligible elements;</p> <p>11. Specific conditions for eligibility were fulfilled when additional remuneration was paid: a) the Beneficiary is registered in the grant agreements as a non-profit legal entity; b) it was paid according to objective criteria generally applied regardless of the source of funding used and c) remuneration was capped at EUR 8000 per full-time equivalent (or up to up to the equivalent pro-rata amount if the person did not work on the action full-time during the year or did not work exclusively on the action).</p>
<p>D. Productive hours</p> <p>XVI. The number of productive hours per full-time employee applied is <i>[delete as appropriate]</i>:</p> <p>A. 1720 productive hours per year for a person working full-time (corresponding pro-rata for persons not working full time).</p> <p>B. the total number of hours worked in the year by a person for the Beneficiary</p> <p>C. the standard number of annual hours generally applied by the beneficiary for its personnel in accordance with its usual cost accounting practices. This number must be at least 90% of the standard annual workable hours.</p> <p><u>If method B is applied</u></p> <p>XVII. The calculation of the total number of hours worked was done as follows: annual workable hours of the person according to the employment contract, applicable labour agreement or national law plus overtime worked minus absences (such as sick leave and special leave).</p> <p>XVIII. 'Annual workable hours' are hours</p>	<p>Procedure (same sample basis as for Section C: Personnel costs):</p> <ul style="list-style-type: none"> ✓ The Auditor verified that the number of productive hours applied is in accordance with method A, B or C. ✓ The Auditor checked that the number of productive hours per full-time employee is correct and that it is reduced proportionately for employees not exclusively assigned to the action(s). ✓ If method B is applied the Auditor verified i) the manner in which the total number of hours worked was done and ii) that the contract specified the annual workable hours by inspecting all the relevant documents, national legislation, labour agreements and contracts. ✓ If method C is applied the Auditor reviewed the manner in which the standard number of working hours per year has been calculated by inspecting all the relevant documents, national legislation, labour agreements and contracts and verified that the number of productive hours per year used for these calculations was at least 90% of the standard number of working hours per year.

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

Please explain any discrepancies in the body of the Report.	
Statements to be made by Beneficiary	Procedures to be carried out and Findings to be confirmed by the Auditor
<p>during which the personnel must be working, at the employer’s disposal and carrying out his/her activity or duties under the employment contract, applicable collective labour agreement or national working time legislation.</p> <p>XIX. The contract (applicable collective labour agreement or national working time legislation) do specify the working time enabling to calculate the annual workable hours.</p> <p><u>If method C is applied</u></p> <p>XX. The standard number of productive hours per year is that of a full-time equivalent; for employees not assigned exclusively to the action(s) this number is reduced proportionately.</p> <p>XXI. The number of productive hours per year on which the hourly rate is based i) corresponds to the Beneficiary’s usual accounting practices; ii) is at least 90% of the standard number of workable (working) hours per year.</p> <p>XXII. Standard workable (working) hours are hours during which personnel are at the Beneficiary’s disposal performing the duties described in the relevant employment contract, collective labour agreement or national labour legislation. The number of standard annual workable (working) hours that the Beneficiary claims is supported by labour contracts, national legislation and other documentary evidence.</p> <p><i>[If certain statement(s) of section “D. Productive hours” cannot be endorsed by the Beneficiary they should be listed here below and reported as exception by the Auditor:</i></p> <p>- ...]</p>	<p>Factual finding:</p> <p><u>General</u></p> <p>12. The Beneficiary applied a number of productive hours consistent with method A, B or C detailed in the left-hand column.</p> <p>13. The number of productive hours per year per full-time employee was accurate and was proportionately reduced for employees not working full-time or exclusively for the action.</p> <p><u>If method B is applied</u></p> <p>14. The number of ‘annual workable hours’, overtime and absences was verifiable based on the documents provided by the Beneficiary and the calculation of the total number of hours worked was accurate.</p> <p>15. The contract specified the working time enabling to calculate the annual workable hours.</p> <p><u>If method C is applied</u></p> <p>16. The calculation of the number of productive hours per year corresponded to the usual costs accounting practice of the Beneficiary.</p> <p>17. The calculation of the standard number of workable (working) hours per year was corroborated by the documents presented by the Beneficiary.</p> <p>18. The number of productive hours per year used for the calculation of the hourly rate was at least 90% of the number of workable (working) hours per year.</p>
<p>E. Hourly rates</p> <p>The hourly rates are correct because:</p> <p>XXIII. Hourly rates are correctly calculated since they result from dividing annual personnel</p>	<p>Procedure</p> <ul style="list-style-type: none"> ✓ The Auditor has obtained a list of all personnel rates calculated by the Beneficiary in accordance with the methodology used. ✓ The Auditor has obtained a list of all the relevant employees, based on which the

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

Please explain any discrepancies in the body of the Report.	
Statements to be made by Beneficiary	Procedures to be carried out and Findings to be confirmed by the Auditor
<p>costs by the productive hours of a given year and group (e.g. staff category or department or cost centre depending on the methodology applied) and they are in line with the statements made in section C. and D. above.</p> <p><i>[If the statement of section 'E. Hourly rates' cannot be endorsed by the Beneficiary they should be listed here below and reported as exception by the Auditor:</i></p> <p>- ...]</p>	<p>personnel rate(s) are calculated.</p> <p>For 10 full-time equivalent employees selected at random (same sample basis as Section C: Personnel costs):</p> <ul style="list-style-type: none"> ✓ The Auditor recalculated the hourly rates. ✓ The Auditor verified that the methodology applied corresponds to the usual accounting practices of the organisation and is applied consistently for all activities of the organisation on the basis of objective criteria irrespective of the source of funding. <p>Factual finding:</p> <p>19. No differences arose from the recalculation of the hourly rate for the employees included in the sample.</p>
<p>F. Time recording</p> <p>XXIV. Time recording is in place for all persons with no exclusive dedication to one Horizon 2020 action. At least all hours worked in connection with the grant agreement(s) are registered on a daily/weekly/monthly basis <i>[delete as appropriate]</i> using a paper/computer-based system <i>[delete as appropriate]</i>;</p> <p>XXV. For persons exclusively assigned to one Horizon 2020 activity the Beneficiary has either signed a declaration to that effect or has put arrangements in place to record their working time;</p> <p>XXVI. Records of time worked have been signed by the person concerned (on paper or electronically) and approved by the action manager or line manager at least monthly;</p> <p>XXVII. Measures are in place to prevent staff from:</p> <ul style="list-style-type: none"> i. recording the same hours twice, ii. recording working hours during absence periods (e.g. holidays, sick leave), iii. recording more than the number of productive hours per year used to calculate the hourly rates, and 	<p>Procedure</p> <ul style="list-style-type: none"> ✓ The Auditor reviewed the brief description, all relevant manuals and/or internal guidance describing the methodology used to record time. <p>The Auditor reviewed the time records of the random sample of 10 full-time equivalents referred to under Section C: Personnel costs, and verified in particular:</p> <ul style="list-style-type: none"> ✓ that time records were available for all persons with not exclusive assignment to the action; ✓ that time records were available for persons working exclusively for a Horizon 2020 action, or, alternatively, that a declaration signed by the Beneficiary was available for them certifying that they were working exclusively for a Horizon 2020 action; ✓ that time records were signed and approved in due time and that all minimum requirements were fulfilled; ✓ that the persons worked for the action in the periods claimed; ✓ that no more hours were claimed than the productive hours used to calculate the hourly

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

Please explain any discrepancies in the body of the Report.	
Statements to be made by Beneficiary	Procedures to be carried out and Findings to be confirmed by the Auditor
<p>iv. recording hours worked outside the action period.</p> <p>XXVIII. No working time was recorded outside the action period;</p> <p>XXIX. No more hours were claimed than the productive hours used to calculate the hourly personnel rates.</p> <p><i>[Please provide a brief description of the <u>time recording system</u> in place together with the measures applied to ensure its reliability to the Auditor and annex it to the present certificate⁴].</i></p> <p><i>[If certain statement(s) of section “F. Time recording” cannot be endorsed by the Beneficiary they should be listed here below and reported as exception by the Auditor:</i></p> <p>- ...]</p>	<p>personnel rates;</p> <ul style="list-style-type: none"> ✓ that internal controls were in place to prevent that time is recorded twice, during absences for holidays or sick leave; that more hours are claimed per person per year for Horizon 2020 actions than the number of productive hours per year used to calculate the hourly rates; that working time is recorded outside the action period; ✓ the Auditor cross-checked the information with human-resources records to verify consistency and to ensure that the internal controls have been effective. In addition, the Auditor has verified that no more hours were charged to Horizon 2020 actions per person per year than the number of productive hours per year used to calculate the hourly rates, and verified that no time worked outside the action period was charged to the action. <p>Factual finding:</p> <ol style="list-style-type: none"> 20. The brief description, manuals and/or internal guidance on time recording provided by the Beneficiary were consistent with management reports/records and other documents reviewed and were generally applied by the Beneficiary to produce the financial statements. 21. For the random sample time was recorded or, in the case of employees working exclusively for the action, either a signed declaration or time records were available; 22. For the random sample the time records were signed by the employee and the action manager/line manager, at least monthly. 23. Working time claimed for the action occurred in the periods claimed; 24. No more hours were claimed than the number productive hours used to calculate the hourly

⁴ The description of the time recording system must state among others information on the content of the time records, its coverage (full or action time-recording, for all personnel or only for personnel involved in H2020 actions), its degree of detail (whether there is a reference to the particular tasks accomplished), its form, periodicity of the time registration and authorisation (paper or a computer-based system; on a daily, weekly or monthly basis; signed and countersigned by whom), controls applied to prevent double-charging of time or ensure consistency with HR-records such as absences and travels as well as its information flow up to its use for the preparation of the Financial Statements.

H2020 Model Grant Agreements: H2020 General MGA — Multi: September 2014

Please explain any discrepancies in the body of the Report.	
Statements to be made by Beneficiary	Procedures to be carried out and Findings to be confirmed by the Auditor
	<p>personnel rates;</p> <p>25. There is proof that the Beneficiary has checked that working time has not been claimed twice, that it is consistent with absence records and the number of productive hours per year, and that no working time has been claimed outside the action period.</p> <p>26. Working time claimed is consistent with that on record at the human-resources department.</p>

[official name of the [Beneficiary] [Linked Third Party]]

[official name of the Auditor]

[name and title of authorised representative]

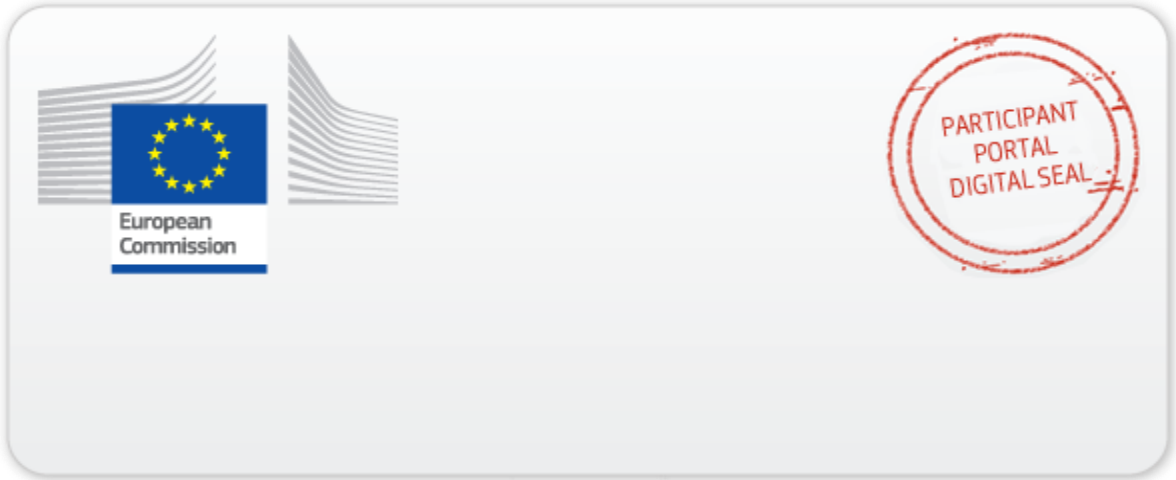
[name and title of authorised representative]

[dd Month yyyy]

[dd Month yyyy]

<Signature of the [Beneficiary] [Linked Third Party]>

<Signature of the Auditor>



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