



European Union Water Initiative Plus for the Eastern Partnership (EUWI+ 4 EaP)

ARMENIA

Terms of References for Local Contractor

28 March 2018

Terms of Reference

Local Contractor for support in the delineation and characterisation of groundwater bodies and the design of a groundwater monitoring network in the Hrazdan and Lake Sevan River Basin Districts in ARMENIA

1. Financing

European Union (ENI / 2016 / 372-403)

2. Procedure

Single tender procedure according to EU PRAG

3. Contracting Authority

International Office for Water (IOW)

4. Thematic Leader

Umweltbundesamt GmbH (UBA)

5. Nature of contract

Service contract

6. Time period of implementation

4 May – 16 November 2018

7. Contract amount

Max. 17,500 Euro

I. INTRODUCTION AND BACKGROUND

The “European Union Water Initiative Plus for Eastern Partnership (EaP) Countries (EUWI+)” involves six eastern neighbours of the EU: Armenia, Azerbaijan, Belarus, Georgia, Moldova and Ukraine. The EUWI+ project addresses existing challenges in both development and implementation of efficient management of water resources. It specifically supports the EaP countries to move towards the approximation to EU acquis in the field of water management as identified by the EU Water Framework Directive (WFD).

River Basin Management Plans (RBMP) are the planning tools that give the overall orientation of water management in the River Basin District and the objectives to be reached, and the priorities in



the actions to be developed. In Armenia, the Hrazdan and Lake Sevan River Basin Districts (RBD) have been selected as pilot areas for the EUWI+ project.

Among the required actions and expected outputs of the project are the support to the delineation and characterisation of groundwater bodies (GWB) and groups of groundwater bodies and the support to the groundwater monitoring system according to the provisions of the WFD. Groundwater bodies are the management units within the 6-year cyclic groundwater management approach of the WFD. A management cycle includes a range of steps: the delineation of groundwater bodies, characterisation, pressure and risk assessment, the design and operation of monitoring systems, the assessment of chemical and quantitative status and chemical trends and the design and implementation of programmes of measures aiming to achieve good status of GWBs.

II. SCOPE OF SERVICE AND DELIVERABLES

The specific objective of this contract is to assist the main beneficiary, the Environmental Monitoring and Information Centre (EMIC) of the Ministry of Nature Protection of Armenia, in delineating and characterising the groundwater bodies in the Hrazdan and Lake Sevan River Basin Districts and to review and revise the existing groundwater monitoring network towards WFD conformity.

This service is to be based on the provisions laid down in the WFD and the methodologies given in the following guidance documents of the EU Common Implementation Strategy (CIS) for the WFD:

- CIS Guidance Document No. 2 on “Identification of Water Bodies”;
- CIS Guidance Document No. 15 on “Groundwater monitoring”;
- CIS Guidance Document No. 26 on “Risk Assessment and the Use of conceptual models for groundwater”;
- CIS Technical Report No. 2 on “Groundwater body characterisation”;
- CIS Technical Report No. 3 on “Groundwater Monitoring”.

The key provisions of the WFD on the delineation of groundwater bodies as well as a pragmatic stepwise approach and methodology for their delineation are attached as Annex 1.

This service is to be performed in close cooperation and coordination with the Environmental Monitoring and Information Centre, the EUWI+ local representative for results 2 and 3 and the EUWI+ Thematic Leader. A general roadmap for the service is provided in Annex 2.

Tasks to be performed by the Local Contractor

The selected Local Contractor for this assignment will assist the Environmental Monitoring and Information Centre and the EUWI+ Thematic Leader by performing the following tasks:

Groundwater bodies

- Delineate groundwater bodies according to the provisions of the WFD and the relevant CIS guidance documents of the EU Common Implementation Strategy, based on available and relevant information (e.g. geological maps, profiles etc.), and following the principles outlined in Annex 1;
- Give each groundwater body a code and a name according to the provisions of the Environmental Monitoring and Information Centre;

- Provide the boundaries of the delineated groundwater bodies electronically in GIS format fulfilling the requirements laid down in Annex 3 (e.g. production of datasets, shapefile layers, QGIS maps and accompanying metadata);
- Characterise each groundwater body both in text form (max. 3 pages) and by completing the template attached in Annex 5, as far as the requested information is available;
- Identify all relevant aquatic ecosystems and terrestrial ecosystems which are connected with the groundwater body and for which the exchange of groundwater is significant for its status (chemical and quantitative perspective);
- Prepare two lists of all groundwater bodies in the Hrazdan and Lake Sevan River Basin Districts with code, name, size (km²), predominant aquifer type, sub-basin district to which the groundwater body is assigned, connection with aquatic or terrestrial ecosystem, significant groundwater-relevant human pressures (on chemistry and quantity) and the associated potential pollutants, based on available information and expert judgement;
- Assess groundwater resources in the Hrazdan and Lake Sevan River Basin Districts: collect and structure data on usable water resources (Exploitable reserves of groundwater resources of category A+B), strategic water reserve (Exploitable reserves of groundwater resources of category C₁) and national water reserve (Groundwater reserves of category C₂ or deep flow; prepare proposals for the improvement of data availability for future groundwater resource assessments;
- Prepare two summary descriptions of the Hrazdan and Lake Sevan River Basin Districts including topography, the (hydro)geological and climatic situation, the importance of groundwater for uses and ecosystems and the significant pressures (human and non-human);
- Prepare two summary texts (1–2 pages) about groundwater bodies in the Hrazdan and Lake Sevan River Basin Districts, which feed into the River Basin Management Plans;
- Prepare two summaries of open issues and data gaps which need to be addressed in future (e.g. further research, further data gathering, additional monitoring etc.);
- Prepare two summaries explaining in detail the applied methodologies and considered information (inclusion of references and literature).

Groundwater monitoring system (quantity and chemistry)

- Describe the current quantitative and chemical groundwater monitoring situations including: monitoring networks, monitoring frequencies, monitored parameters (quantity and chemistry), use of monitoring data, responsibilities and data management;
- Prepare an inventory of existing groundwater monitoring sites, the existing measuring equipment, their operating state and the technical condition;
- Characterise each existing groundwater monitoring site according to the template attached in Annex 6 of this document, as far as the requested information is available;
- Prepare two summaries explaining in detail the applied methodologies and considered information (inclusion of references and literature).

Organisation / communication

- Regularly review and update the detailed roadmap of tasks, deliverables and distribution of responsibilities in close coordination with the Environmental Monitoring and Information Centre and the EUWI+ Thematic Leader, depending on the progress made. A general groundwater roadmap for Armenia is provided in Annex 2;
- Organise and support the kick-off meeting and the working meetings foreseen in the roadmap, in the form of meeting logistics (e.g. locations), preparing draft agendas, writing the meeting

- minutes (incl. list of participants), providing the training material and providing translations between Russian and English in the meetings and of the documents;
- Translate the material provided by the EUWI+ Thematic Leader into Russian language (e.g. presentations);
 - Act as communication link between the Environmental Monitoring and Information Centre, the EUWI+ Thematic Leader and the EUWI+ local representative for results 2 and 3 in Armenia;
 - Proofread and translate into English language all elaborated draft and final text developed over the course of the implementation of the activities (e.g. agendas, meeting minutes, list of human pressures and associated potential pollutants, summary text for the RBMP, groundwater body and sampling site characterisation, description of the current groundwater monitoring situation, sampling handbook, summary of open issues and gaps, summary of applied methodologies, etc.).

Groundwater sampling training

- Support the conduction of the training on groundwater sampling, which will be given by the EUWI+ Thematic Leader. This will include organisational issues (location, participants, logistics), preparation of material and equipment, and translation support, in close cooperation with the Environmental Monitoring and Information Centre, the EUWI+ Thematic Leader and the EUWI+ local representative for results 2 and 3;
- Elaborate in close cooperation a detailed and tailored groundwater sampling handbook based on existing documents, including relevant Armenian norms, standards, and practices, the EPIRB Groundwater Sampling Guide, and the Austrian Sampling Handbook - the latter will be provided in English and Russian language.

Final report

- Provide a draft final and a final report summarising the progress made within this service contract with the main outputs of the tasks above, the deliverables below and detailed documentation on the applied methodologies and considered information (inclusion of references and literature). The report will follow the structure given in Annex 4 and will include text, tables and maps. To develop the final report based on the draft final report, the Local Contractor will consider all comments provided by the Environmental Monitoring and Information Centre, the EUWI+ Thematic Leader and the EUWI+ local representative for results 2 and 3.

Deliverables

The selected Local Contractor for this assignment will deliver the following main products:

- A detailed roadmap documenting the implementation of the service over the contract period, based on the general roadmap provided in Annex 2;
- The datasets, metadata, shapefile layers and QGIS maps as detailed in Annex 3 for 1.) all delineated and characterised groundwater bodies in the Hrazdan and Lake Sevan River Basin Districts, 2.) all existing groundwater monitoring sites, following the principles outlined in Annex 1;
- Two lists of all groundwater bodies in the Hrazdan and Lake Sevan River Basin Districts with code, name, size (km²), predominant aquifer type, sub-basin district to which the groundwater body is assigned, connection with aquatic or terrestrial ecosystem, significant groundwater-relevant human pressures (on chemistry and quantity) and the associated pollutants, based on available information and expert judgement;
- Two summary descriptions of the River Basin Districts;

- Two summary texts (1–2 pages) about groundwater bodies in the Hrazdan and Lake Sevan River Basin Districts, which feed into the River Basin Management Plans;
- The characterisation of all groundwater bodies in the Hrazdan and Lake Sevan River Basin Districts, both in the form of text and by completed templates;
- Two assessments of groundwater resources in the Hrazdan and Lake Sevan River Basin Districts and proposals for the improvement of data availability for future groundwater resource assessments;
- Two summary descriptions of the current monitoring situations in the Hrazdan and Lake Sevan River Basin Districts;
- Two inventories of existing groundwater monitoring sites, the existing measuring equipment, their operating state and the technical condition;
- Two summaries explaining in detail the applied methodologies and considered information (inclusion of references and literature) both for the delineation and characterisation of groundwater bodies and the monitoring system;
- Two summaries of open issues and data gaps which need to be addressed in future (e.g. further research, further data gathering, additional monitoring etc.);
- Agendas and minutes of all working meetings – including lists of participants – held with participation of either a representative of the EUWI+ Thematic Leader or the Environmental Monitoring and Information Centre. Minutes of the groundwater sampling training, including lists of participants;
- A detailed groundwater sampling handbook tailored to the Armenian situation;
- Provided material translated into Russian and elaborated text provided in English and Russian, as specified under ‘tasks to be performed’;
- Draft final report and final report summarising the activities and products prepared under this contract, as specified under Annex 4 and delivered according to the given timeframe.

All listed deliverables and all data will be prepared in Russian and English languages. The final report and all data will be submitted to the Environmental Monitoring and Information Centre, the EUWI+ Thematic Leader and the EUWI+ local representative for results 2 and 3, in printed (1 copy in each language) and electronic versions (the report in Microsoft Word and PDF formats, tables in Microsoft Excel format). All GIS products shall be provided as shapefile layers and QGIS maps.

Meetings

A Teleconference/Skype meeting after the award of the contract to discuss the implementation modality and prepare the kick-off meeting currently scheduled for 14-15 May 2018.

A kick-off meeting at the beginning of the assignment currently scheduled for 14-15 May 2018, where the EUWI+ Thematic Leader will provide an introduction to the principles of the WFD in general and the objectives of the tendered tasks and deliverables. Hereby a first hands-on training on GWB delineation and monitoring network design using a selected case study will be performed.

Depending on the progress of the implementation, one or two interim working meetings will be organised where the progress and the draft work on the provided service will be discussed in order to ensure that the implementation is in line with the overall scope of the service both in terms of time and conformity with the WFD.

A final working meeting is foreseen at the end of the assignment for finalisation of the service provided out under this assignment and de-briefing of the EUWI+ local representative for results 2 and 3.



III. REPORTING

Regarding the progress of the provided services and for all day-to-day management issues the Local Contractor shall report to the EUWI+ Project Armenian Focal Point for Groundwater Monitoring, the EUWI+ local representative for results 2 and 3 and the EUWI+ Thematic Leader.

IV. TIMEFRAME

The duration of the assignment is expected to be **6.5 months**. The expected commencement of the assignment is 4 May 2018 and the completion date is 16 November 2018 at the latest.

The assignment will follow the mutually agreed groundwater roadmap for Armenia. A general roadmap is provided in Annex 2. Review and adaptation of the roadmap for detailed planning will be subject to the progress made and to agreement between the Environmental Monitoring and Information Centre and the EUWI+ Thematic Leader, and will be carried out by the Local Contractor.

The following table provides an overview of key dates for this contract.

Month	Milestones
4 May 2018	Contract start
14-15 May 2018	Kick-off meeting
June 2018	1 st interim working meeting
19 October 2018	Draft final report delivered
16 November 2018	Final report delivered and completion of the contract

V. IMPLEMENTATION MODALITY

The service shall be implemented by a local company or consortia of NGO(s), university, research institution, etc. that are not representing the project beneficiaries.

The Local Contractor has to provide all means and technical equipment (e.g. hardware, software) necessary for the successful implementation of the tendered services.

The Local Contractor has to implement the service in close contact and cooperation with the Environmental Monitoring and Information Centre, the EUWI+ local representative for results 2 and 3 and the EUWI+ Thematic Leader.

All key correspondence and documents related to these services must be written in English.

The Local Contractor will organise the necessary meetings in close coordination with the EUWI+ Thematic Leader, the EUWI+ local representative for results 2 and 3 and the Environmental Monitoring and Information Centre.

The EUWI+ Thematic Leader will support the Local Contractor by providing technical guidance and support in groundwater body delineation and characterisation and monitoring system design as considered necessary.



Any adaptations of the tasks and deliverables as defined under the present Terms of Reference require mutual written agreement.

All costs arising from the implementation of the tasks and deliverables under the present Terms of Reference are covered by the contract amount.

The Local Contractor agrees to adhere to the EU visibility guidelines.

VI. CONTACT DETAILS

The EUWI+ Project Armenian Focal Points for Groundwater Monitoring is Mr Simon Papyan of the Environmental Monitoring and Information Centre (EMIC) of the Ministry of Nature Protection of Armenia.

The EUWI+ local representative for results 2 and 3 is Mr Vahagn Tonoyan, vahagn.tonoyan@euwipluseast.eu.

The EUWI+ Thematic Leader for groundwater is Mr Christoph Leitner, Umweltbundesamt GmbH (UBA), christoph.leitner@umweltbundesamt.at

VII. PARTICIPATION TO THE TENDER

Interested parties (natural and legal persons) are invited to request the full tender dossier containing instructions and further information about the tender procedure from Christoph Leitner (christoph.leitner@umweltbundesamt.at).

The deadline for submission of the technical and financial offer is 17 April 2018, 15:00 CET. Tenders submitted after the deadline will not be considered.

Annex 1 – Principles of GWB delineation

The Water Framework Directive (2000/60/EC) considers a **groundwater body** as a coherent management unit assigned to a River Basin District which has to meet the environmental objectives (Article 4). The term “body of groundwater” should therefore be understood in the context of the hierarchy of relevant definitions provided under Article 2 of the WFD:

- According to WFD Article 2.2, “**Groundwater**” means all water which is below the surface of the ground in the saturated zone and in direct contact with the ground or subsoil;
- According to Article 2.11, “**Aquifer**” means a subsurface layer or layers of rock or other geological strata of sufficient porosity and permeability to allow either a significant flow of groundwater or the abstraction of significant quantities of groundwater;
- According to Article 2.12, “**Groundwater body**” means a distinct volume of groundwater within an aquifer or aquifers.

According to the definitions and the specifications laid down in the WFD, groundwater bodies are **management units** with the main purpose of enabling their quantitative and qualitative status to be accurately described and compared to the environmental objectives, and of implementing the measures necessary for achieving these objectives. Groundwater management has to consider groundwater in relation to its uses and functions and its interactions with connected aquatic and terrestrial ecosystems, and in relation to the natural conditions (geology, hydrogeology etc.) and human influences (pressures).

Principal aim: To delineate groundwater bodies (GWB) in a way that enables an appropriate description of the quantitative and chemical status of groundwater (only minor groundwater flow from one GWB to another). The bodies should be units of one chemical and one quantitative status that can be characterised and managed to allow the effective achievement of the WFD’s objectives.

Not the aim: A body of groundwater does **not** have to be delineated so that it is homogeneous in terms of its natural characteristics, or the concentrations of pollutants or level alterations within it. This can be the case, but does not have to be the case.

The following guidance documents of the EU Common Implementation Strategy (CIS) for the WFD provide relevant methodologies:

- CIS Guidance Document No. 2 on “Identification of Water Bodies”;
- CIS Guidance Document No. 26 on “Risk Assessment and the Use of conceptual models for groundwater”;
- CIS Technical Report No. 2 on “Groundwater body characterisation”.

Brief summary approach for the delineation of groundwater bodies:

1. Identification of all relevant aquifers:

- Check if more than 10m³/day groundwater could be abstracted;
- Check whether surface waters or terrestrial ecosystems (wetlands) are connected to the groundwater within the aquifer and could be damaged if groundwater quantity (levels or flow direction) or groundwater chemistry in the aquifer changes;

If one of these conditions is true, then the aquifer is relevant for further consideration under WFD groundwater management;

If neither of these conditions is true, then the aquifer is not relevant for further consideration under WFD groundwater management.

2. Separate high productive aquifers from low productive aquifers.

3. Delineation of groundwater bodies – horizontal dimension:

- Start delineation along hydrogeological boundaries;
- You can consider groundwater flow divides or river catchments and geological boundaries;
- Consider variations of human pressures on groundwater: Where the human pressure situation is consistent, large GWBs may be delineated; Where the human pressure situation is very diverse and different between parts of GWBs (e.g. different land use) sub-divide the GWB;
- A coastline could be a boundary, as long as the groundwater beyond the coastline is not an important resource;
- Consider existing boundaries of hydrographical entities which are already subject to a local management plan;
- Identify bodies of groundwater so that there is only minor groundwater flow from one GWB to another;

4. Delineation of groundwater bodies – vertical dimension:

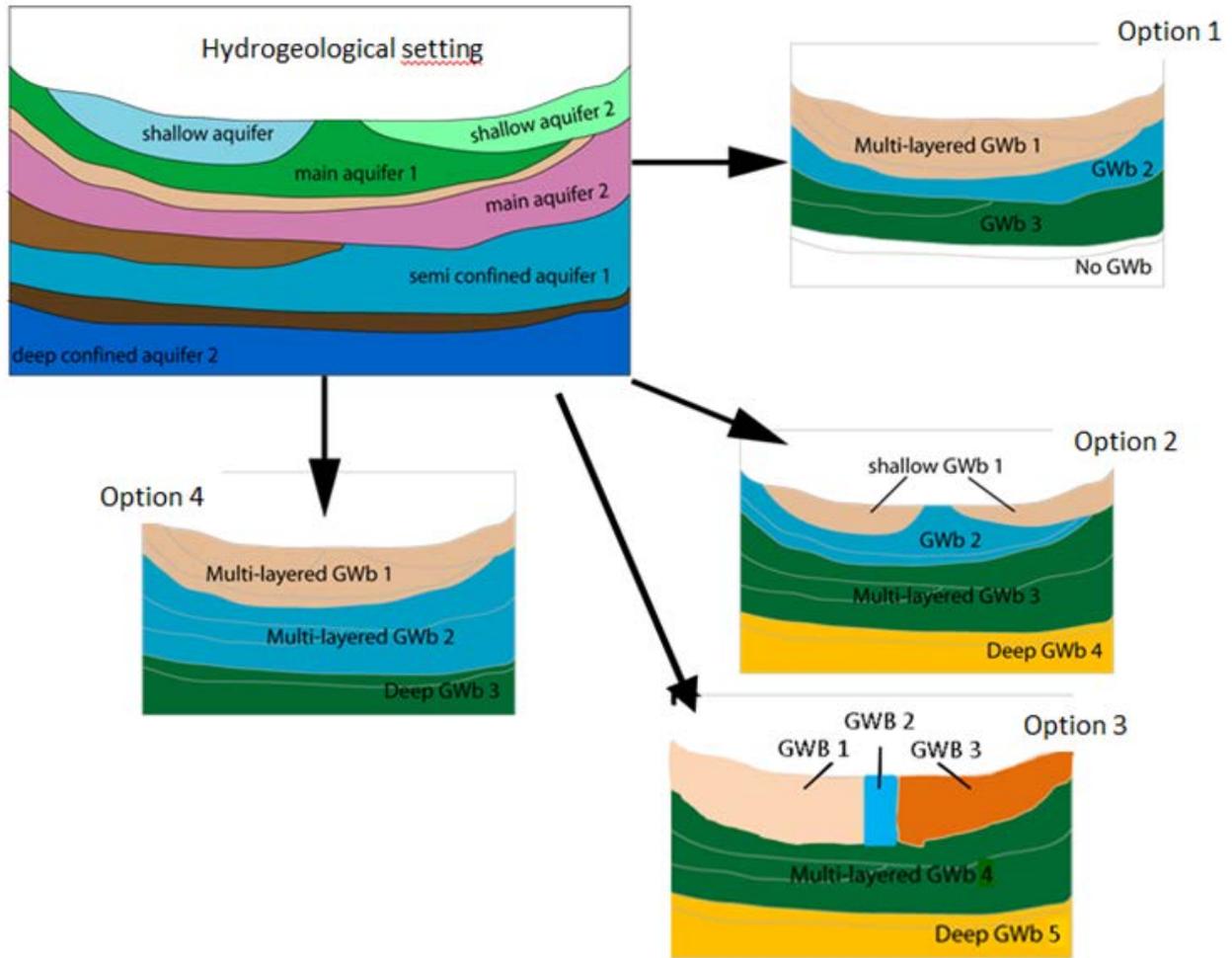
- Delineate the GWB in three dimensions;
- Consider the objectives of the WFD: is the groundwater in the aquifer used or planned to be used in future? Is the groundwater connected with rivers or terrestrial ecosystems (wetlands) which could be damaged if groundwater flows or chemistry changes?

The vertical heterogeneity/variability of a hydrogeological setting can lead to many different arrangements of differently delineated GWBs. If hydrogeology is not the only factor considered (which is probably the case), many additional ways of delineation and types of configuration are possible.

Avoid the fragmentation of aquifers into unmanageable numbers of GWB, keeping in mind the further steps of WFD groundwater management including the necessities to characterise, monitor, assess risk, assess status and design and implement the measures needed to keep or achieve good status.

The vertical heterogeneity/variability of a hydrogeological setting can lead to many different possible arrangements of differently delineated GWBs. Hydrogeology is not the only factor considered, also human pressures should be taken into account, therefore many additional ways of delineation and types of configuration are possible. The following figure illustrates one example hydrogeological setting and 4 different possible options of GWB delineation and arrangements.

Figure: Four different (non-exhaustive) options of GWB delineation for one specific hydrogeological context



Source: European Commission. 2014: WFD Reporting Guidance 2016 Final V6.0.6

Annex 2 – General groundwater roadmap for Armenia

Meetings with attendance of: Environmental Monitoring and Information Centre; EUWI+ Thematic Leader; EUWI+ local representative for results 2 and 3; Local Contractor.

	Steps of implementation	Date (Location)
1.	<p>Kick-off meeting</p> <ul style="list-style-type: none"> - Overall purpose of work and legal frame (e.g. WFD); - Scope of 2018 work and expected results/deliverables; - Presentation and discussion of methodology for GWB delineation and characterisation; - Experiences from Austria and EU Member States; - Exemplified, practical hands-on training of GWB delineation and monitoring network design on a case study; - Planning of further steps (roadmap) and discussion of working modality. 	<p>1.5 days</p> <p>14-15 May 2018</p>
3.	<p>Preparatory work by Local Contractor:</p> <ul style="list-style-type: none"> - Draft delineation of GWBs: <ul style="list-style-type: none"> i. Compilation of hydrogeological information (maps, profiles...); ii. Selection of aquifers which are relevant from a WFD perspective (used, intended to be used, linked to ecosystems); iii. Compilation of available pressure information (maps, inventories); iv. First draft delineation of all GWBs in the River Basin Districts. - Compilation of a draft list of GW-relevant pressures for each GWB; - Inventory of existing monitoring sites; - Compilation of a draft list of potential pollutants related to the relevant pressures. 	
4.	<p>1st Working meeting</p> <p>Discussion of:</p> <ul style="list-style-type: none"> - Draft groundwater bodies and hands-on revision; - Adjustment of characterisation template and structure of text description to national needs and data availability; - List of identified GW-relevant human pressures; - and adjustment of characterisation template for monitoring sites to national needs and data availability; - 	<p>2–3 days</p> <p>June 2018</p>
5.	<p>Preparatory work by Local Contractor:</p> <ul style="list-style-type: none"> - Revision of GWB delineation according to the conclusions of the 1st working meeting. Preparation of GIS layers and metadata; - Characterisation of each GWB by template and text; - Characterisation of existing monitoring sites by template; <p>Documentation of applied methodology and considered information. Drafting of final report.</p>	

6.	<p>2nd Working meeting – focus depends on progress made so far:</p> <ul style="list-style-type: none"> - Discussion/Finalisation of GWB delineation and characterisation; - Discussion/Finalisation of inventory and characterisation of monitoring sites. <p>Discussion of documentation of the applied methodology and the draft final report.</p>	2–3 days ...2018
7.	<p>Preparatory work by Local Contractor.</p> <p>Depending on the progress made so far:</p> <ul style="list-style-type: none"> - Completion of GWBs delineation and characterisation; - Completion of inventory and characterisation of monitoring sites. <p>Documentation of the applied methodology and considered information. Compilation of final report.</p>	
8.	<p>3rd Working meeting (optional) – Focus depends on the progress made so far:</p> <ul style="list-style-type: none"> - Finalisation of GWB delineation and characterisation; - Finalisation of the inventory and characterisation of monitoring sites. 	
9.	<p>Preparatory work by national experts:</p> <ul style="list-style-type: none"> - Finalisation of work. 	
10.	<p>Final meeting</p> <ul style="list-style-type: none"> - Finalisation of open issues. 	
11.	<p>Hand-over and acceptance by representatives of the Environmental Monitoring and Information Centre and the EUWI+ Thematic Leader.</p>	16 Nov 2018

Sampling training

	Sampling training – Steps of implementation	Timing
1.	<p>Sampling training Workshop:</p> <ul style="list-style-type: none"> a. Theoretical and practical training on GW sampling (quality and quantity); b. Presentation and discussion of sampling handbook. 	2 days in Jun 2018
2.	<p>Preparatory work by Local Contractor:</p> <ul style="list-style-type: none"> a. Tailoring the sampling handbook to the national circumstances and needs; b. Support to the preparation of a survey manual. 	Jun–Sep 2018

Annex 3: Specifications for datasets, metadata and maps production

It is not allowed to present / use datasets in a map or an indicator if the corresponding data set:

- is not described in the catalogue of metadata established by the EUWI+ project;
- Is not made available in the national FTP

As a consequence, the task of the Local Contractor should include:

- To collect the necessary datasets at the level of the producers
- To work with the data producers in order that the dataset provided are described on line into the metadata catalogue made available by the project
- To copy the raw data made available by each producer on the ftp made available by the project

The corresponding expected results can be formulated as follow:

- All datasets used are described in English and in Russian into the metadata catalogue
- All raw dataset used are available on ftp

Methodology for metadata production

The letter of request for data should include the obligation that the data producer provides the corresponding metadata sheet fulfilled (to be provided by EUWI+ project).

The Local Contractor will insure that the metadata are entered in the catalogue with in addition:

- Capture of a thumbnail
- Capture of geographical limits
- Translation in English/Russian of all metadata entered
- Description of right of dissemination
- Declare of public access in the metadata sheet

About specifications of data to be collected

- Layers the closest possible of scale 1/50 000
- Layers in Esri format (.shp)

Specifications for map production

- Maps are produced in QGIS format
- Maps are produced using the map template A4 or A3 prepared by the project
- Maps respects the standard GCS_WGS_1984 projection or the official projection adopted at national level

Maps include only layers and dataset described into the metadata catalogue and having raw data available on ftp.

Annex 4: Proposed Outline of the Final Report

Groundwater bodies

- Summary descriptions of the Hrazdan and Lake Sevan River Basin Districts including topography, the (hydro-)geological and climatic situation, the importance of groundwater for uses and ecosystems and the significant pressures (human and non-human);
- Summary texts (1–2 pages) about groundwater bodies in the Hrazdan and Lake Sevan River Basin Districts, which feed into the River Basin Management Plans;
- Characterisation of each groundwater body in verbal (text) form summarising the hydrogeological characteristics, the main anthropogenic pressures and the importance of groundwater and their main uses (e.g. public and private drinking water, industry, mining, agriculture etc.) as well as the relevant aquatic ecosystems (surface waters) and terrestrial ecosystems (e.g. wetlands) which are connected to the groundwater body;
- Lists of significant groundwater relevant human pressures and associated potential chemical pollutants per groundwater body.

Groundwater monitoring

- Summary descriptions of the current monitoring situation;
- The inventories of the existing monitoring sites, the measuring equipment and their operating state

Documentation

- Final version of the detailed roadmap as implemented;
- Detailed documentation of the applied methodologies and implementation steps and considered information (inclusion of references and literature);
- Lists of open issues or data gaps to be addressed in future.

Annexes

- Lists of all groundwater bodies in the Hrazdan and Lake Sevan River Basin Districts with code, name, size (km²), predominant aquifer type, sub-basin district to which the groundwater body is assigned, connection with aquatic or terrestrial ecosystem, significant groundwater-relevant human pressures (on chemistry and quantity) and the associated potential pollutants, based on available information and expert judgement;
- Completed characterisation templates for each groundwater body;
- Completed characterisation templates for each existing monitoring site;
- Overview of produced layers and datasets including full metadata;
- QGIS maps of groundwater bodies with indication of aquifer types and human pressures (e.g. chemical point and diffuse pollution, major abstraction points etc.), with existing monitoring network;
- Agendas and minutes of all meetings including lists of participants;
- Groundwater sampling handbook tailored to the Armenian situation.

Annex 5: Template for Characterisation of Groundwater bodies

Parameter	unit	Value
GWB code		
GWB name		

GWB area	[km ²]	
GWB thickness	Min–Max, Mean [m]	
GWB type		
Individual GWB or group of GWBs		
Transboundary	[yes/no, country]	
GWB horizon		
Depth to GW level	Min–Max, Mean [m]	
Average annual fluctuation of GW level	Mean [m]	
Aquifer type (predominantly)		
Aquifer – Pressure situation		
Aquifer – Petrography, lithological description		
Aquifer – Geological age		
Aquifer – Geochemistry (main cations and anions)		
Overlying layers – Petrography		
Overlying layers – Average thickness	[m]	
Impermeable overlying layers	[yes/no]	
Impermeable overlying layers – Average coverage	[%]	
Hydraulic conductivity (kf)	Min–Max, Mean [m/s]	
Transmissivity (T)	Min–Max, Mean [m ² /s]	
Mean residence time of groundwater	Mean [a]	
Number of chemical monitoring sites		
Number of quantitative monitoring sites		
Number of abstraction wells		
Purpose of abstraction		
Annual groundwater abstraction	[m ³ /a]	
Main recharge source		
Annual precipitation	Min–Max, Mean [mm]	
Associated aquatic ecosystems	[yes/no]	
Associated terrestrial ecosystems	[yes/no]	
GW level trend		
Prevailing human pressures		
Land use	[%]	
GWB chemical status		
GWB quantitative status		
Confidence level of information		
GWB chemical trend		

Annex 6: Template for Characterisation of monitoring sites (wells or springs)

Identification	unit	Value
Monitoring site code		
Monitoring site name		
Monitoring site principle type		
Location		
GWB code		
GWB name		
Administrative unit code		
Protection zone		
Coordinate system		
Coordinate system – x coordinates		
Coordinate system – y coordinates		
Elevation of reference point above sea level	[m a.s.l.]	
Access description		
Sketch of the access route		
Location plan / site plan		
Owner		
Name of owner		
Street of owner		
Post code and city of owner		
Phone number of owner		
Email of owner		
Contact person		
Name of contact person		
Street of contact person		
Post code and city of contact person		
Phone number of contact person		
Email of contact person		
Life time cycle		
Information entered / updated by		
Date of collection of information	[DD.MM.YYYY]	
Start of monitoring	[MM.YYYY]	
End of monitoring	[MM.YYYY]	
Replacement of which site		
Replaced by which site		
Status of monitoring site		
Reason for closing		
Type of chemical monitoring		
Significant changes		

Technical specification of monitoring site		
Drilling profile available		
Drilling profile of the well		
Development plan available		
Development plan of the well		
Pressure type of groundwater		
Material of capture		
Material of pipes		
Characterisation of monitoring site		
Use of the monitoring site		
Purpose of monitoring site		
Sub type of monitoring site		
Remark to other type of monitoring site		
Construction year	[YYYY]	
Diameter of well	[mm]	
Sampling method		
Distance between abstraction and sampling	[m]	
Sampling depth	[m]	
Frequency of water abstraction		
Springs (further information)		
Spring recharge area identified		
Size of spring recharge area	[km ²]	
Average elevation of spring recharge area above sea level	[m a.s.l.]	
Average residence time	[a]	
Precipitation monitoring		
Pressure situation		
Influence by industry and manufacturing		
Influence by old deposits / brownfield		
Influence by waste deposits		
Influence by transportation network		
Influence by sewer treatment and percolation		
Influence by oil and gas enterprises		
Influence by agriculture		
Other influences		
Monitoring		
Monitoring of quantity		
Monitoring frequency of quantity		
Monitoring of chemistry		
Monitoring frequency of chemistry		
Monitoring of drinking water quality		