# Report 6.1– Guidance document on the preparation of the standardized pilot action

**Final Beneficiary 1:**

**VERITAS S.p.A. Joint Stock Company - Energy, Water Resources, Territory, Environment Utilities**

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DRINK ADRIA

Adriatic IPA
Cross Border Cooperation 2007-2013

The project is co-funded by the European Union,
Instrument for Pre-Accession Assistance

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## Introduction to DRINKADRIA project

Within this work package, implementation of the priority measures for more efficient and effective water supply and water resources management will be performed. The pilot cases reflect the reality that the ageing water supply infrastructure is currently the most challenging issue and water losses in the WSS above 40% are the reality. This is also providing pressure on available water resources and the reduction of water losses would significantly contribute to the economic as well as environmental efficiency. While rehabilitation of WSS with its excessive costs could not be part of the pilot actions, development of improved monitoring and modelling could provide important results and also provide necessary information for immediate actions like identification of zones with high water losses, localized information on leakage, pressure management, development of district metering areas, water quality and quantity. All the pilot actions will be developed in a way to provide also a learning tool for the water utilities involved in the project, as well as utilities involved in communication process.

The process will involve one important element which is identification of the governance structure in the pilot cases and how the governance structure is supporting management of WSS, also with identification of possibilities for improvements.

## Description of individual Pilot Actions

FB1, as WP 6 leader, coordinated and integrated the partner pilot cases; elaborated and distributed to all partners involved a questionnaire about Pilot Action to develop a common framework in order to compare different approaches in different countries.

The questionnaire concerned the detailed description of:

- the Pilot Action;
- the Pilot Area;
- the monitoring parameters and performance index;
- the equipment and investments;
- the time line chart;
- the expected results.

The FBs who had projects about losses gave some data about the water service connection and the water loss management too.

The main information acquired by questionnaires are:

- The main concern of 9 Pilot actions is about the water losses since the majority of pilot (**67%**) is focused on leakages and monitoring of fluxes in distribution systems;
- Other Pilot Actions (**33%**) are on water quantity, quality and on the intrusion of marine water into the coastal groundwater, one common problem in the Adriatic Region;
- **56%** of pilot actions (LB, FB2, FB14, FB4, FB 12, FB13) needs both investments and equipment;
- **33%** (FB1 and FB7) needs only equipment;
- **11%** (FB3) neither the one nor the other.

the planning and implementation of the pilot actions started between November 2013 and March 2014 except FB7's that will start in June 2014 (**Tab.1**).

**Tab. 1** Summary of pilot actions for WP6.

| INSTITUTION | FB | CITY | COUNTRY | PILOT | INVESTMENT | EQUIPMENT | START | STARTING DATE |
|---|---|---|---|---|---|---|---|---|
| CATO | LB | Trieste | Italy | water losses | YES | YES | YES | March, 2014 |
| VERITAS | 1 | Venezia | Italy | water losses; pollutants groundwater treatment | NO | YES | YES | November 1 , 2013 |
| ATO 3 Marche | 2 | Macerata | Italy | installation of metering systems and monitoring tools | YES | YES | YES | January 29, 2014 |
| CNR | 3 | Bari | Italy | groundwater flow and seawater intrusion | NO | NO | YES | November 1 , 2013 |
| Water Utility Nova Gorica | 4 | Nova Gorica | Slovenia | water losses; implementation of a network for water export to Italy | YES | YES | YES | December 16, 2013 |
| Water Utility of Istria | 7 | Buzet | Croatia | water losses; implementation of metering systems | NO | YES | NO | June 30, 2014 |
| Water Utility Neum + Hydro-Engineering | 13 + 12 | Neum + Sarajevo | Bosnia - Herzegovina | leak measurements<br>reconstruction activities and final measurements<br>testing IWA method to determine savings | YES<br><br>NO | NO<br><br>YES | YES | February 24 , 2014 |
| Public Utility Niksic | 14 | Niksic | Montenegro | develop of GIS + SCADA of water supply system<br>hydraulic model of water supply system<br>flow and pressures meters<br>monitoring losses | YES | YES | YES | December 24, 2013 |

## Description of individual Pilot Actions – Water losses

### LB CATO

The target of the project is to reduce the real loss in a pilot aqueduct of San Dorligo della Valle. The aqueduct is divided into three DMAs (district metered area).
The activity will be organized following the steps below:

1. Zone Flow Analysis
    a. District Metered Areas (DMA)
    b. Minimum night flow analysis
    c. Step testing
2. Acoustic Leak Surveys
    a. Basic Hydrant Survey
    b. Comprehensive Survey
    c. Noise and leak mapping
    d. Leak pinpointing & correlation
3. Acoustic Noise Logging
    a. Basic Noise Logging
    b. Correlating Noise Logging
4. Pressure Management
5. Numerical modeling of the water supply network.

### FB1 – VERITAS S.p.A

The target of the project is to reduce the real loss in a pilot aqueduct of Murano Island in Venice Lagoon. Murano is an independent DMA (district metered area). The activity will be organized following the steps below:

1. Zone Flow Analysis
    a. District Metered Areas (DMA)
    b. Minimum night flow analysis
    c. Step testing
2. Pressure Management
3. Numerical modeling of the water supply network.

**Expected Results**

- The dedicated software will give an indication of the consumption in the districts and anomalies in the measurements.
- The water consumption, quality and pressure data will be automatically updated
- It will be possible to analyze their fluctuation in time to reduce water losses in water supply system

- Through the application of the numerical model and the information derived from the permanent monitoring system, it will be possible to carry out the best operations necessary to optimize the distribution of pressure, flow and quality of the water in the network.

Data obtained through this system will be used for mathematical modeling, development and expansion of water supply networks in the future (for example, network reconstruction and new branches)

## FB4-Water Utility Nova Gorica

The main targets of the project in the pilot area of Nova Gorica and the surroundings are:

- From DEM (digital elevation model) or with other devices determinate missing height of aqueduct in GIS.
- Manufacture hydraulic model of the existing data from the GIS and data from water sales department based on the hydraulic model set measurements points.
- Construction and installation of monitoring points with flow meters.
- Analyses data and comparison with the optimal situation in hydraulic model.
- Determination of the area with the most losses.

### Expected Results

- By separating the network and measuring the individual zones, and by comparing the results from the hydraulic model, they expect to identify areas with the most losses. They will focus primarily on the water network that directly affect the export of water in Italy.
- In the end, they expect that from the economic analysis we can calculate the needed cash injection to eliminate defects and efficiency of interventions in relation to the percentage of loss.

## FB7-Water Utility of Istria

The main target of the project are: to reduce water losses and thus operating costs and to increase revenues.

The project is in the area of Istria in Croatia, which is located in the northwestern area of Croatian and one around 230,000 inhabitants and an additional approximately 200,000 tourists in the summer.

**Expected results**

- reduce water losses in water supply system
- safer water supply for all users
- faster detection of failures in the distribution system
- greater accuracy and precision of the new water meter readings in comparison to existing;

data obtained through this system will be used for mathematical modeling and for a development and expansion of water supply networks in the future (for example, network reconstruction and new branches).

**FB12 + 13-Hydro-Engineering + Water Utility Neum**

The main targets of the project concerning the pilot area of the municipality of Neum are:

a) The initial measurement and Sound Leak Detection using Pre-location approach in order to determine pipelines which need to be replaced or repaired (FB12) and preparation for reconstruction action at urgent water supply system part (FB13);

b) Reconstruction activities. Considering the urgent condition, appropriate reconstruction will be implemented at one part of the network. It is assumed approximately 1500 m pipeline in very bad condition and will be reconstructed.

c) Final measurements in order to verify the results achieved (FB12);

d) The testing of IWA methodology in order to determine savings in the water supply system (FB12);

e) Recommendation and conclusions for improvements (FB12).

**Expected Results**

- First initial measurement in this zone and after that appropriate reconstruction measures will be implemented.

- Further the comprehensive flow and pressure campaign will be implemented.

- The calculation of the water balance and performance indicators will be realized using “Bottom – up” approach in accordance with IWA methodology.

## FB14-Public Utility Niksic

The main targets of the project concerning the pilot area of the city of Niksic are:

- Activity 1. To develop Geographic Information System (GIS) of the water supply system of the city of Niksic
- Activity 2. To create hydraulic model of the water supply system
- Activity 3. To divide the water supply system into district metering areas
- Activity 4. To procure measuring equipment and to integrate it into SCADA information system
- Activity 5. To link GIS and SCADA information system
- Activity 6. To define procedures for managing and reducing losses in the water supply system
- Activity 7. Balancing and analysis of the water supply system
- Activity 8. Field visits and removal of identified irregularities
-

**Expected Result 1**

- To reduce the level of losses in the water supply system by creating measurement points, defining DMAs and applying an active loss control.
- To reduce the level of actual loss by 10% compared to the level before the start of the project implementation.
- To reduce the number of illegal users by 50%.
- To reduce the amount of water that is distributed into the system by 20%.
- To raise public awareness on the rational use of water.

## Description of individual Pilot Actions – Quality, Mercury decontamination

### FB1 – VERITAS S.p.A

The target of the project is to test two different treatment methods systems based on reverse osmosis Vs activated coal to reduce the amounts of Mercury and Iron found in some wells in the Pilot Area of Mogliano.

### Expected Results

- To assess efficiency and economic impact of the two different techniques in order to improve the quality of drinkable groundwater

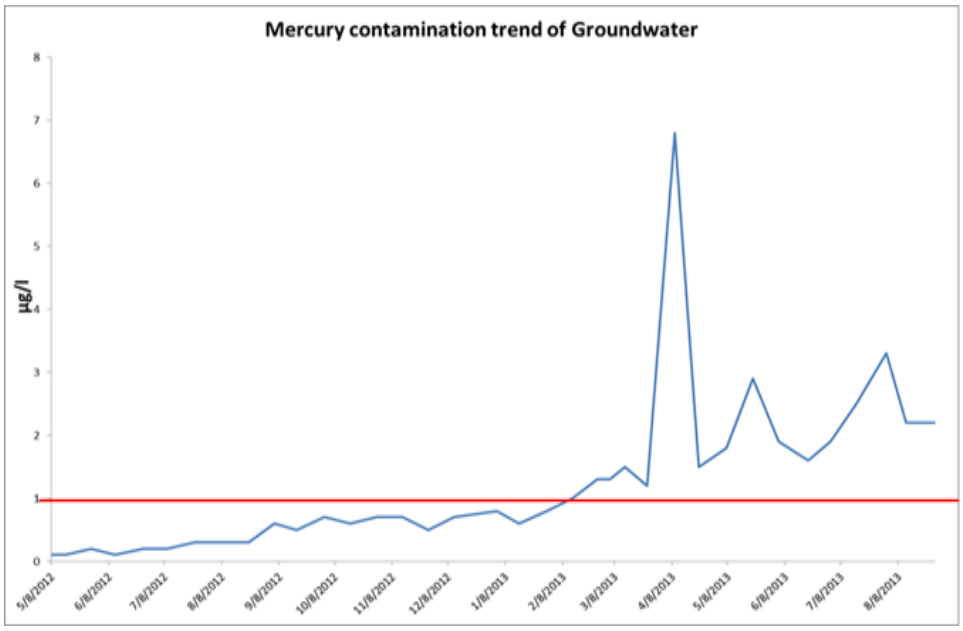


**Fig. 1.** Mercury groundwater contamination. Trend and threshold value

## Description of individual Pilot Actions – Quality, microbiological determination

### FB1 – VERITAS S.p.A

The target of the project is the microbiological quality, assessed according national and European regulations based on traditional and consolidated “Faecal Contamination Indicators”:

- *Escherichia coli*
- total coliform bacteria
- intestinal enterococci
- *Clostridium perfringens*

and to determine the presence of specific and relevant pathogenic microorganisms such as the bacteria:

- *Salmonella*
- *Legionella*

by bio-molecular technique (q-PCR)

- *Salmonella* enrichments
- Protozoa: *Giardia* and *Cryptosporidium.*

by Fluorescence in situ hybridization (FISH).

**Expected Results**

- the fast management of organisms in drinking water especially arising in biological threats.

## Description of individual Pilot Actions – Seawater intrusion

### FB3-CNR

The main target of this Pilot Action is to study groundwater flow and, in particular, seawater intrusion in Ostuni.
This because they would like to recover groundwater (actually unused) volume that could be useful for drinking water supply and, in particular, for touristic uses during summer.
Subsequently it should be underlined that:

- The model was developed by IRSA and was successfully applied in several fractured aquifers.

- The model simulations on the seawater intrusion reduction will be supported by a seasonal monitoring and laboratory analyses of the water quality that will be carried out by IRSA

It will be monitored:

- Microbiological parameter: total bacteria count (37 and 20°), Escherichia coli, spores of sulphite-reducing *Clostridia, Salmonella*, somatic coliphages, Viruses (selected samples), *Giardia* and *Crypto* (selected samples), Antibiotic resistance gene (ARG)

- Chemical constituents: dissolved organic carbon (DOC), pH, T, specific conductance

- Hydrological data: water depth in wells

**Expected results:**

- Estimation of climate change impacts on groundwater
- Evaluation of quality status of surface and ground waters according to EU Directives;
- Models and methodology to remove seawater intrusion from the coastal aquifer;
- Methods to improve the management of groundwater supply;
- Groundwater modeling to demonstrate improved groundwater quality

## Description of individual Pilot Actions – Quantity

**FB2-ATO 3 Marche**

The main targets of the project concerning the pilot area that involves 20 out of the over 300 Water Resources in use in Marche region are:

- a better planning of WSSs interconnection
- definition of proper Drinking Water Protected Areas (DWPAs)
- management of emergency situations
- sharing data with different level Authorities and Civil Protection Department

### Expected Results

- 20 out of the over 300 Water Resources in use in ATO 3 could be equipped in order to provide real-time data concerning water input in the network and water discharge
- Collected data will improve planning of investment needed

## Analysis of each FBs project

The heterogeneity of the Pilot Actions and of the expected results are shown in Tab.1 and Tab.2 respectively:

e.g. estimation of climate change impacts on groundwater vs reduction of the number of illegal users by 50%.

**Tab. 2.** Summary of main Pilot Actions Parameters and results.

| INSTITUTION | FB | CITY | COUNTRY | Parameters | | PERFORMANCE INDEX | RESULTS |
|---|---|---|---|---|---|---|---|
| **CATO** | LB | Trieste | Italy | Flow, Pressure, pH, Chlorine, turbidity | | infrastucture leakage index (ILI) | — |
| **VERITAS** | 1 | Venezia | Italy | Quality: microbiological determination | Fecal contamination indicators, pathogenic microorganisms | selectivity, sensitiveness, quantification and detection time | applicability of q-PCR in fast management of organisms in drinking water |
| | | | | Quality: Mercury decontamination | Mercury and Iron concentration in groundwater wells | mercury and iron abatement percentage | efficiency and of two different techniques to improve the quality of drinking grounwater |
| | | | | Water losses | Flow, Pressure, pH, Chlorine, turbidity | % of water losses; infrastucture leakage index (ILI) | reduction of water losses; mathematical modeling; software related to consumption and anomalies |
| **ATO 3 Marche** | 2 | Macerata | Italy | Natural flow rate, groundwater level and seasonal variation, rainfalls amount, temperature, alcalinity, conductivity, nitrates | | — | real-time data concerning water input in the network and water discharge |
| **CNR** | 3 | Bari | Italy | Microbiological parameters (Fecal indicators and pathogenic microorganisms), chemical constituents (DOC, pH, temperature, specific conductance), water depth in wells | | groundwater scarcity, resources availability, climate change impacts, water quality | quality of surfaces and groundwaters, models and methodology to remove seawater intrusions, methods to improve the management of groundwater supply, groundwater modeling |
| **Water Utility Nova Gorica** | 4 | Nova Gorica | Slovenia | Flow, Pressure | | comparison of flow rates and pressure measurements with hydraulic model | construction and installation of monitoring points, identification of areas with most losses |
| **Water Utility of Istria** | 7 | Buzet | Croatia | Flow, Pressure | | Losses by $m^3$ | reduction of water losses; energy consumption; fast detection of failures; mathematical modeling |
| **Water Utility Neum + Hydro-Engineering** | 13 + 12 | Neum + Sarajevo | Bosnia - Herzegovina | Flow, Pressure | | unavoidable annual real losses, current annual real losses, infrastructure leakage | Reconstruction of 1500m pipelines, flow and pressure measurements implementation and water balance according to IWA Methodology |
| **Public Utility Niksic** | 14 | Niksic | Montenegro | Flow, Pressure | | — | active loss control, reduction of water losses, reduction of illegal users, 20% reduction of distributed water |

ILI = current annual real losses/unavoidable annual real losses

e.g. different budget and different timing (Fig. 2).

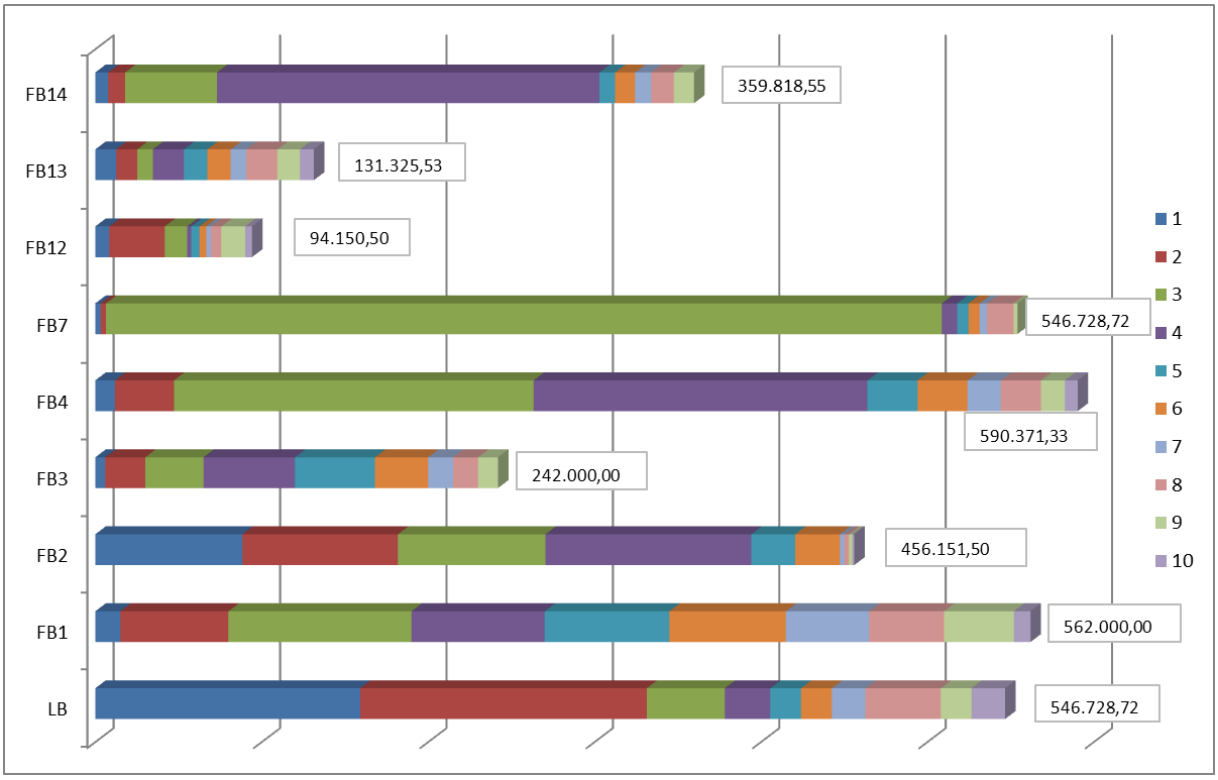


**Fig.2.** WP6 budget and timing for each FB (1-10 target periods).

Anyway a common final target can be recognized in a better use of the resource, reduction of costs, improvement in quality and quantity and forecast model of future scenarios related to climate change.

## Guidance to the development of a common analytical framework for the Pilot Action

To achieve common approaches towards the development and modelling of Pilot Actions, the FBs have to follow the same Pilot scheme and monitoring parameters, and to report monthly and quarterly a synthesis of the activities performed to FB1 as WP6 leader.

### Pilot Scheme

The Pilot actions are identified by the three acts:

act. 6.1: development of common framework;
act. 6.2: development of individual pilot actions among the common framework;

act. 6.3: provision of information on the development and effects of the pilot and validation of results.

The synthesis is the following scheme to observe and integrate:

- Pilot planning
- Pilots guidelines
- Execute
- Validate

## Parameters

The following parameters have been chosen for the monitoring in each kind of pilot action:

### Water losses

Financial parameters (financial performance indicators)

- Non-revenue water as percentage by volume
- Non-revenue water as percentage by cost
- Annual cost of apparent losses
- Annual cost of real losses

Operational efficiency parameters (technical performance indicators)

- Apparent losses per service connection per day
- Real losses per service connection per day
- Real losses per length of main per day
- Real losses per service connection per day
- Unavoidable annual real losses (UARL)
- Infrastructure leakage index (ILI – real losses/UARL)

Numerical model

- Identification of the trend of pressure, the flow rate values, and the flow direction.
- Upload of previously recorded data and simulation of the network behavior in that period/situation.
- Execution of **water balances** of the consumptions in the district analyzed putting in evidence **mean**, **maximum** and **minimum** values to better evaluate the water losses of the district.
- Execution of **a quantification** of continuous industrial water consumptions
- Possibility of viewing data as **stored** (mean value in one hour) or **complete**.

- possibility of viewing the water volumetric balance once the desired period is set.

FBs have to fill every two months the Water Loss Worksheet in Annex.

**Quality**

- Mercury and Iron concentration in groundwater wells;
- Metals abatement percentage;
- Fecal contamination indicators, pathogenic microorganisms:

  Selectivity;
  Sensitiveness;
  Quantification;
  Detection time.

The reference for chemical and biological parameters are available in "WHO – Guidelines for Drinking-water Quality" in Annex

**Quantity**

- Natural flow rate
- Groundwater level and seasonal variation;
- Rainfalls amount;
- Chemical-physical parameters:
  Temperature;
  Alkalinity;
  Conductivity;
  Nitrates

**Seawater intrusion**

- Microbiological parameters:
  Faecal indicators;
  pathogenic microorganisms;
- Chemical-physical parameters:
  DOC;
  pH;
  Temperature;
  Conductivity.
- Water depth in wells;

### Monthly Report

In order to develop shared monitoring methods (concepts) and a common decision-making framework, every partner should fill a monthly report to send to FB1 about:

- Short description of monthly actions:
- Installed Equipment:
- Investments:
- Parameters monitoring:
- System/Method employed:
- Obtained monitoring data:
- Encountered difficulties:
- Annex: (tendering, datasheets, maps, photos etc.)

### Quarterly Report

In order to evaluate the implementation progress of the Pilot Action, every partner should prepare a quarterly report to send to FB1 about:

- Description of performed activities
- Elaborated monitoring data
- Obtained results (according to parameters chosen from FB1)
- Encountered difficulties, and applied solutions
- Estimation of Pilot action progress (percentage)
- Goals achieved
- Annex

## Results

Such kind of collected data, elaborated by FB1 in cooperation with research partners and authority partners, should lead to an improvement of water resources management, especially groundwater, its quality and quantity as well as the water supply systems through individual improvements and integration of good practice with other.

# List of annexes

Annex 1 – Questionnaires:

- Reporting questionnaire Work Package 6: pilot actions
- Reporting questionnaire of Area Council for Eastern Integrated Water Service of Trieste (CATO) (LB)
- Reporting questionnaire of VERITAS S.p.A. Joint Stock Company - Energy, Water Resources, Territory, Environment, Utilities (FB1) - Quantity Pilot Action
- Reporting questionnaire of VERITAS S.p.A. Joint Stock Company - Energy, Water Resources, Territory, Environment, Utilities (FB1) + Italian National Council - Water Research Institute (CNR-IRSA) (FB3) – Quality Pilot Action
- Reporting questionnaire of Optimal Territorial Area Authority n. 3 Marche Centro – Macerata (FB2)
- Reporting questionnaire and report (draft) of Italian National Council - Water Research Institute (CNR-IRSA) (FB3)
- Reporting questionnaire of Water Utility of Nova Gorica - Sector of Development and Investment - Water System Mrzlek – Gorizia (FB4)
- Reporting questionnaire of Water Utility of Istria (FB7)
- Reporting questionnaire of P.C.Utility Neum - Gabela-Hutovo-Neum (Dubrovačko primorje detachment) (FB13) + Hydro-Engineering Institute of Civil Engineering faculty University of Sarajevo (FB12)
- Reporting questionnaire of Public Utility "Vodovod i kanalizacija" Niksic – Technical Department (FB14) + Jaroslav Černi Institute - Regional Water supply system Rzav (RWS Rzav) (FB10)

Annex 2 – Monthly Report

Annex 3 – Water Loss Worksheet

Annex 4 – WHO – Guidelines for Drinking – water Quality:
http://whqlibdoc.who.int/publications/2011/9789241548151_eng.pdf

Annex 5 – Control and mitigation of drinking water losses in distribution systems – EPA
http://water.epa.gov/type/drink/pws/smallsystems/upload/Water_Loss_Control_508_FINALDEc.pdf

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