Réflexion stratégique pour une gestion durable et patrimoniale des réseaux d'eau potable

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Waterloss project

Réflexion stratégique pour une gestion durable et patrimoniale des réseaux d'eau potable

Marché public n°2012 SM

Responsable du marché public : Département de l'Hérault

Titulaire du marché public : IRSTEA

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SOMMAIRE

SOMMAIRE DÉTAILLÉ

Table des illustrations

➢ Figures

➢ Tableaux

Sigles, acronymes et abréviations

AGHTM Association Générale des Hygiénistes et Techniciens Municipaux
AMB Aire Métropolitaine de Barcelone, Espagne
AUTH Aristotle University of Thessaloniki, Grèce

CED Cercle des Eaux Disparues
CG Conseil Général
CI a Context Information
CIs some Context Information

DEYAK Kozani Municipal Water and Sewearage Utility, Grèce
DH conseil général du Département de l'Hérault, France
DSS Decision Support System

FNDAE Fonds National de Développement des Adductions d'Eau

ILI Infrastructure Leakage Index
IRSTEA Institut de Recherche en Sciences et Technologies pour l'Environnement et l'Agriculture, France
IWA International Water Association

LG autorita di bacino dei fiumi Liri Garigliano volturo, Italie
Ljub Ljubljana

MCD Minimum Charge Difference
mCE mètre de Colonne d'Eau
MOSARE MOdule Statistique d'Analyse des Réseaux d'Eau

NRW Non Revenue Water

PI Performance Indicator
PIs Performance Indicators
PMI Pressure Management Index
PO conseil général des Pyrénées Orientales, France

REQE Réseau, Epuration et Qualité des Eaux

SIE Syndicat Intercommunal des Eaux
SIV System Input Volume

UARL Unavoidable Annual Real Losses
UL Université de Ljubljana, Slovénie

V Variable
Vs Variables

WAT WATerloss
WBN Water Board of Nicosia, Chypres

Dictionnaire de l'anglais vers le français

Bulk meter = Compteur principal

Distribution network = Réseau de distribution
District Metered Area (DMA) = Secteur de distribution mesuré

Flow meter = Débitmètre

Minimum night flow = Débit nocturne minimal

Non-Revenue Water (NRW) = Eau Non Vendue

Pressure Reducing Valve (PRV) = Vanne de régulation de la pression

Service connection = Branchement

Target = Cible
Thresholds = Seuils

Unavoidable Annual Real Losses (UARL)= Pertes Réelles Annuelles Inévitables

Water balance = Bilan d'eau
Water loss = Pertes en eau
Water meter = Compteur d'eau
Water utility = Service des eaux

A partir de **[Oertlé, 2011]**.

Traduction en français de l'IWA « water balance »

<table>
<tr><td rowspan="6">System Input Volume (corrected for known errors)</td><td rowspan="3">Authorised consumption</td><td rowspan="2">Billed Authorised Consumption</td><td>Billed Metered Consumption (including water exported)</td><td rowspan="2">Revenue Water</td></tr>
<tr><td>Billed Unmetered Consumption</td></tr>
<tr><td rowspan="2">Unbilled Authorised Consumption</td><td>Unbilled Metered Consumption</td><td rowspan="4">Non-Revenue Water (NRW)</td></tr>
<tr><td>Unbilled Unmetered Consumption</td></tr>
<tr><td rowspan="3">Water losses</td><td rowspan="2">Apparent Losses</td><td>Unauthorised Consumption</td></tr>
<tr><td>Customer Metering Inaccuracies</td></tr>
<tr><td rowspan="3">Real Losses</td><td>Leakage on Transmission and/or Distribution Mains</td></tr>
<tr><td>Leakage and Overflows at Utility's Storage Tanks</td></tr>
<tr><td>Leakage on Service Connections up to point of Customer metering</td></tr>
</table>

Figure 1 : IWA « Water Balance » **[IWA, 2010]**

<table>
<tr><td rowspan="8">Volume introduit</td><td rowspan="5">Consommation autorisée</td><td rowspan="3">Consommation autorisée facturée</td><td>Eau facturée exportée (distribution en gros)</td><td rowspan="3">Eau vendue</td></tr>
<tr><td>Consommation facturée mesurée</td></tr>
<tr><td>Consommation facturée non mesurée</td></tr>
<tr><td rowspan="2">Consommation autorisée non facturée</td><td>Consommation non facturée mesurée</td><td rowspan="5">Eau non vendue</td></tr>
<tr><td>Consommation non facturée non mesurée</td></tr>
<tr><td rowspan="3">Pertes en eau</td><td>Pertes apparentes</td><td>Consommation non autorisée</td></tr>
<tr><td>Pertes apparentes</td><td>Sous-comptage des compteurs et erreurs de manipulation des données</td></tr>
<tr><td rowspan="3">Pertes réelles</td><td>Fuites sur les conduites d'adduction de de distribution</td></tr>
<tr><td>Pertes réelles</td><td>Fuite et débordements dans les réservoirs d'eau</td></tr>
<tr><td>Pertes réelles</td><td>Fuites sur les branchements jusqu'au point de comptage</td></tr>
</table>

Figure 2 : Le « bilan d'eau », traduction de l'IWA « Water Balance » par **[Oertlé, 2011]**

I Introduction

Les services des eaux sont depuis toujours confrontés à la question des pertes dans les réseaux d'eau, toutefois, elle a longtemps été essentiellement abordée sous un angle économique (coût de production et de transport de l'eau perdue, surdimensionnement des installations). Ce n'est que depuis une période récente que la question est abordée en termes de préservation de la ressource en eau. Cette évolution se concrétise en France par l'article 161 de la loi n° 2010-788 du 12 juillet 201 0 portant engagement national pour l'environnement (Grenelle II) qui incite fortement les services d'eau potable à atteindre une bonne performance en la matière.

La prise en compte de l'impact des fuites des réseaux d'eau potable sur les ressources en eau en fait un sujet qui dépasse le territoire de l'autorité en charge du service d'eau potable et donc nécessite l'intervention d'acteurs supra locaux tels que les Agences de l'eau et les Conseils Généraux. L'implication du Conseil Général de l'Hérault dans le projet européen WATERLOSS s'inscrit dans cette logique.

Le projet WATERLOSS aborde la question de la réduction des pertes dans les réseaux de distribution d'eau potable d'une façon très large. Cela présente l'intérêt de permettre la mobilisation des concepts développés par l'International Water Association (IWA) pour évaluer la performance, notamment le bilan d'eau (= « water balance ») et les indicateurs proposés par **[IWA = Alegre *et al.*, 2010].** En revanche cela rend, l'objectif de développement d'un outil d'aide à la décision très ambitieux.

Notre intervention, détaillée dans les paragraphes suivants, a été conçue pour apporter un appui, basé sur notre expertise et nos connaissances acquises, qui répond aux besoins exprimés par le conseil général de l'Hérault dans le cadre de sa participation au projet WATERLOSS.

Dans un premier temps il sera présenté le cadre d'intervention d'IRSTEA auprès du CG34. Puis dans un second temps nous détaillerons la méthode que nous avons employée pour nous approprier les résultats préalables et les objectifs du projet Waterloss. Après dans un troisième temps nous exposerons quelques outils emblématiques, différents de ceux employés par le projet Waterloss, pour réduire les pertes d'eau dans les réseaux d'eau potable. Ensuite nous dévoilerons les méthodes que nous avons employées et les résultats obtenues pour aider le CG34 à conceptualiser un système de management de la performance des réseaux d'eau potable. Enfin dans un dernier temps nous appliquerons ce système de décision à un cas pilote du département de l'Hérault (SIE de Lodève).

II Préambule

II.1 Cadre d'intervention d'IRSTEA auprès du CG34

IRSTEA intervient en tant que titulaire du marché public suivant, intitulé : « Réflexion stratégique pour une gestion durable et patrimoniale des réseaux d'eau potable ».

Le responsable de ce marché public est le Département de l'Hérault (via Caroline MULLER, Fabien RIVIERE et Gérard WOLFF).

Ce marché est passé dans le cadre du projet Européen WATERLOSS.

II.2 Echéances du marché public

- Début du marché public : 31 Mai 2012
- Fin du marché public : 31 Mai 2013


Après avoir présenté succinctement notre cadre d'intervention au sein du projet Waterloss. Nous allons maintenant exposer rapidement la méthode que nous avons employée pour nous approprier les résultats préalables et les objectifs du projet Waterloss.

III Tâche 0 : Appropriation du projet WATERLOSS

III.1 Cadre d'intervention du CG34 dans le projet WATERLOSS

Le titre officiel du projet Waterloss est : "Management of water losses in a drinking water supply system".

Project Lead Partner : Aristotle University of Thessaloniki, Greece

Code du projet : 2G-MED09-445

Le marché public présentée précédemment est passé en appui de la « Phase 4-1 » de la « Component C04 » du projet WATERLOSS

L'objectif de la « Component C04 » est : « Development of a DSS tool for appropriate non revenue water (NRW) reduction strategy ».

L'objectif de la « Phase 4-1 » est : « Preparation of a database of NRW management methods »

Phase 4-1 coordinating partner : Département de l'Hérault, France

III.2 Echéances du projet WATERLOSS

- Début du projet : 01 Juin 2010
- Fin du projet : 31 Mai 2013

- Début phase 4-1 : 01 Mai 2011
- Fin phase 4-1 : 31 Août 2012

III.3 Etudes des productions antérieures du projet Waterloss

Pour d'obtenir les résultats des composantes et des phases précédentes du projet Waterloss, et comprendre précisément les objectifs de la composante C04 et de la phase 4-1, nous avons analysés dans le détail les documents suivants :

- l'appel d'offre du projet Waterloss **[MED, 2010]** ;
- les 2 délivrables disponibles du projet **[Waterloss, 2012 a ; Waterloss, 2012 b]** ;
- le DSS tool en cours de construction par l'Université de Ljubljana ;
- de la bibliographie sur le sujet, issue des différents partenaires notamment lors de leurs réunions passées.

Nous avons alors pris connaissance des apports des différents partenaires de Waterloss, fait le point de l'avancement du projet et situé précisément la contribution en devenir du Conseil Général de l'Hérault.

III.4 Réunions

Nous avons participé aux réunions suivantes :

1°) Vendredi 8 Juin 2012 :

Réunion en face à face au CG34

Caroline MULLER (DH), Eddy RENAUD (IRSTEA), Aurore LARGE (IRSTEA), Caty WEREY (IRSTEA), Christophe WITTNER (IRSTEA)

2°) Mardi 24 Juillet 2012

Visioconférence avec :

- à l'IRSTEA Bordeaux : Eddy RENAUD et Aurore LARGE (IRSTEA)
- à l'Université de Ljubljana : Vasilis KANAKOUDIS (AUTH), Primoz BANOVEC (UL), Matej CERK (UL), Ajda CILENSEK (UL), George DEMETRIOU (WBN), Gérard WOLFF (DH).

3°) Mercredi 25 Juillet 2012

Réunion en face à face à l'Université de Ljubljana

Vasilis KANAKOUDIS (AUTH), Primoz BANOVEC (UL), Matej CERK (UL), Ajda CILENSEK (UL), George DEMETRIOU (WBN), Gérard WOLFF (DH), Eddy RENAUD (IRSTEA) et Aurore LARGE (IRSTEA).

4°) Jeudi 2 Août 2012

Visioconférence avec

- à l'IRSTEA Bordeaux : Aurore LARGE et Julie PILLOT (IRSTEA)
- à l'Université de Ljubljana : Matej CERK (UL)

5°) Mardi 21 Août 2012

Visioconférence avec :

- à l'IRSTEA Bordeaux : Eddy RENAUD et Aurore LARGE (IRSTEA)
- à l'Université de Ljubljana : Primoz BANOVEC (UL) et Matej CERK (UL)

6°) Mercredi 22 Août 2012

Visioconférence avec :

- à l'IRSTEA Bordeaux : Eddy RENAUD et Aurore LARGE (IRSTEA)
- à l'Université de Ljubljana : Primoz BANOVEC (UL) et Matej CERK (UL)

7°) Jeudi 23 Août 2012

Visioconférence avec :

- à l'IRSTEA Bordeaux : Eddy RENAUD et Aurore LARGE (IRSTEA)
- à l'Université de Ljubljana : Matej CERK (UL)

8°) Jeudi 30 Août 2012

Visioconférence avec :

- à l'IRSTEA Bordeaux : Eddy RENAUD et Aurore LARGE (IRSTEA)
- à l'Université de Ljubljana : Primoz BANOVEC (UL) et Matej CERK (UL)

9°) Mardi 4 Septembre 2012

Visioconférence avec :

- à l'IRSTEA Bordeaux : Eddy RENAUD et Aurore LARGE (IRSTEA)
- à l'Université de Ljubljana : Primoz BANOVEC (UL) et Matej CERK (UL)

10°) Lundi 17 Septembre 2012

Visioconférence avec :

- à l'IRSTEA Bordeaux : Eddy RENAUD et Aurore LARGE (IRSTEA)
- à l'Université de Ljubljana : Primoz BANOVEC (UL) et Matej CERK (UL)

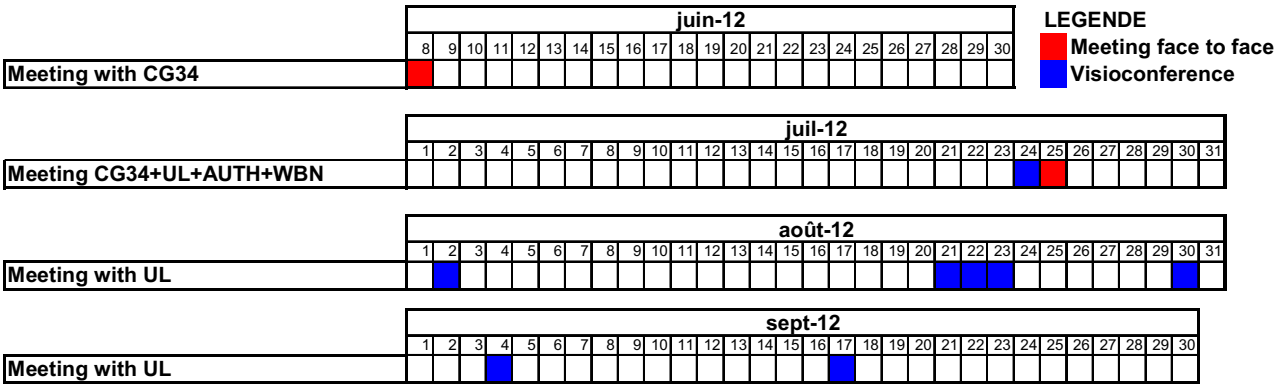

Figure 3 : Récapitulatif des réunions

Après avoir exposé brièvement les moyens que nous avons employés pour nous approprier les résultats préalables et les objectifs du projet Waterloss, nous allons maintenant présenter quelques outils emblématiques, différents de ceux adoptés par le projet Waterloss, pour réduire les pertes d'eau dans les réseaux d'eau potable.

IV Tâche 1 : Bilan des outils et méthodes en vigueur

IV.1 Cercle des eaux disparues utilisé par la « Lyonnaise des Eaux »

IV.1.1 Généralité

Le Cercle des Eaux Disparues (CED) est une méthode adoptée par les centres Lyonnaise des Eaux afin de faire le bilan d'eau des réseaux. Cette méthode se rapproche de celle qui est conseillée par l'IWA. **[Coussy, 2008, p 14]**

Voici un tableau résumant la démarche du CED qui s'inspire de la démarche proposée par l'IWA. Le Tableau 1 s'inspire du document technique FNDAE n°1 0 cf. **[Ajuste *et al.*, 2004]**

<table>
<tr><th colspan="3">Termes de l'IWA</th><th>Termes communs</th><th colspan="2">Termes du CED</th></tr>
<tr><td rowspan="8">Volume Distribué (1)</td><td rowspan="4">Volume consommé</td><td rowspan="2">Volume facturé</td><td>Volume mesuré</td><td rowspan="3">Volume consommé (2)</td><td rowspan="2">Volume facturé</td></tr>
<tr><td>Volume non mesuré</td></tr>
<tr><td rowspan="3">Volume autorisé non facturé</td><td>Volume de service</td><td rowspan="7">Volume non facturé</td></tr>
<tr><td>Volume mesuré</td><td rowspan="4">Autres pertes (5)</td></tr>
<tr><td>Volume non mesuré</td></tr>
<tr><td rowspan="4">Pertes</td><td rowspan="2">Pertes apparentes</td><td>Erreurs de facturation</td></tr>
<tr><td>Volume détourné</td></tr>
<tr><td>Sous comptage</td><td>Pertes par comptage (4)</td></tr>
<tr><td rowspan="2">Pertes physiques</td><td>Fuites visibles</td><td rowspan="2">Pertes physiques (3)</td></tr>
<tr><td>Fuites invisibles</td></tr>
</table>

Tableau 1 : Détail d'un bilan d'eau et des différentes définitions de volumes

Ce tableau emploie des termes qu'il convient de définir :

Volume distribué (1) = Volume non facturé + Volume facturé

Ce volume correspond au volume introduit dans le réseau auquel on décompte les volumes exportés.

Volume consommé (2) = Volume facturé + volume de service.

- Le volume facturé est le volume qui résulte de la relève des compteurs des abonnés.

- Le volume de service est un volume non mesuré mais estimé au plus proche. Il correspond au lavage des réservoirs, aux volumes utilisés lors des purges pour améliorer la qualité de l'eau suite à une plainte ou suite à une réparation de fuite.

Pertes physiques (3)

Ce sont les pertes réelles du réseau et des ouvrages de distribution. Elles résultent des fuites sur canalisation et sur branchement, des débordements aux réservoirs incontrôlés et des gaspillages par inadvertance (vannes de purges laissées ouvertes par exemple).

Ces pertes physiques se décomposent en deux parties :

- Fuites visibles : Ce sont les fuites qui affleurent à la surface du sol et qui sont signalés soit par la population soit par le personnel.
- Fuites invisibles : Ce sont les fuites qui n'affleurent pas à la surface du sol et qui peuvent être détectées par la recherche de fuite (sectorisation et campagne de recherche de fuite).

Pertes par comptage (4)

On distingue le :

- sous comptage inévitable (= systématique)
- du sous comptage dû aux compteurs obsolètes.

Le sous comptage systématique qui touche l'ensemble du parc compteur est dû par exemple au mauvais choix du calibre des compteurs. D'autre part, les compteurs clients qui sont mécaniques conduisent très souvent à un sous enregistrement de la consommation et ce pour des débits faibles.

Le sous comptage s'accentue avec l'âge. Par exemple, Lyonnaise des Eaux considère que les compteurs de diamètre compris entre 20 et 40 mm (compteur moyen) âgés de plus de 15 ans ont un sous comptage qui atteint 15% du volume facturé.

Autres pertes (5)

- Volume autorisé non facturé mesuré et
- Volume autorisé non facturé non mesuré

Il s'agit des consommations autorisées sur le réseau mais qui ne peuvent pas faire l'objet d'une facturation pour diverses raisons. Ces volumes correspondent par exemple aux essais de poteau incendie par les pompiers, au lavage des rues, à l'arrosage des espaces verts ou tout autre fourniture gratuite.

On distingue volume mesuré qui correspond pour la majeure partie à des dégrèvements, du volume non mesuré qui correspond aux essais de poteau incendie ou à l'arrosage communal.

- Erreurs de facturation

Ces pertes sont dues aux erreurs de relèves ou de facturation, aux compteurs oubliés ou sous estimés car non accessibles.

- Volume détourné = Volume volé

Ce sont les volumes soutirés au réseau de manière frauduleuse. Par exemple l'utilisation des poteaux incendie ou les branchements clandestins.

IV.1.2 Focus sur le cercle des eaux disparues de la Lyonnaise des Eaux

La méthode du CED propose d'évaluer les différentes pertes qui ont été définies plus haut.

Evaluation des pertes physiques

- Fuites visibles

Cette évaluation se base sur le nombre de réparations de fuite visible et la pression du réseau. Elle quantifie le volume d'eau perdu entre le moment où la fuite est signalée et la date de réparation. Ce volume est ainsi sous-évalué car une fuite avant d'être visible peut rester invisible pendant plusieurs jours voire plusieurs mois.

- Fuites invisibles

Le volume perdu est estimé à partir du nombre de fuites réparées suite à la recherche de fuite.

On considère que le débit de fuite d'une fuite visible est plus important que celui d'une fuite invisible. Ce volume est évalué en considérant la fuite coulant 365 jours dans l'année avec un débit donné. Ainsi, ce volume n'est pas réel, le résultat du calcul correspond plus à une estimation.

- Pertes physiques minimales

Les paragraphes suivants sont inspirés du dossier publié dans TSM sur la sectorisation des réseaux d'eau potable **[AGHTM, 2002]** et d'un document interne de la Lyonnaise des Eaux.

L'IWA considère qu'il existe un niveau de pertes physiques calculable sous lequel il est impossible de descendre sur le plan économique. Ce volume correspond au calcul de l'UARL « Unavoidable Annual Real Losses » ou littéralement « pertes réelles annuelles inévitables » que la Lyonnaise des Eaux nomme dans le CED « pertes physiques minimales ».

Le calcul de cette valeur, proposé par l'IWA est le suivant :

$$UARL(m^3) = 365 * \left(A \times L_m + B \times \mathrm{N_c} + C \times L_p\right) \times P$$

L_m = Longueur de réseau (km)

L_p = Longueur total des branchements (m)

N_c = Nombre de branchement

P = Pression de service moyenne en mCE

Avec les valeurs des paramètres suivants :

A = 18 l/km/j/mCE

B = 0.8 l/branchement/j/mCE

C = 25 l/km/j/mCE

Les valeurs des paramètres ont été calées à l'issue d'une étude se basant sur 27 réseaux de distribution d'une vingtaine de pays. Rien ne permet d'affirmer qu'une autre étude donnerait le même résultat. De plus, ce calcul est valable pour un réseau avec des conduites en bon état sur lequel est appliquée une politique intensive de recherche de fuite.

Le calcul de l'UARL estime ainsi les pertes par fuite sur le linéaire de canalisation et également sur toute la longueur des branchements que l'on ne peut pas éviter. Ce sont donc toutes les fuites invisibles indétectables mais aussi le volume de fuite correspondant au temps incompressible pour réparer les fuites détectées.

Evaluation des pertes par comptage

Par exemple sur le syndicat de Basse Dheune, la Lyonnaise des Eaux évalue le sous comptage du parc compteur à environ 2% du volume facturé.

Evaluation des autres pertes

Ce volume est évalué en retranchant au volume distribué, le volume consommé, le volume de pertes physiques et le volume de pertes par comptage.

IV.2 Méthodes employées chez les gestionnaires autre que la Lyonnaise

SAUR utilise une application appelée SECT'EAU. Sa stratégie de réduction des pertes est basée sur la sectorisation et le suivi des débits de nuit.

Véolia intègre sa démarche d'amélioration des pertes dans une démarche plus large de gestion patrimoniale qui utilise notamment le logiciel MOSARE (MOdule Statistique d'Analyse des Réseaux d'Eau) **[Cambrezy et Cousin, 2009].**
MOSARE utilise une approche statistique pour extrapoler ce qu'il est observé ponctuellement sur des conduites à l'ensemble du réseau, et anticiper les défaillances. Un indicateur de l'état des conduites, le taux de défaillances (fuites et casses), est calculé à l'échelle des conduites.


Après avoir exposé brièvement quelques outils, différents de ceux employés par le projet Waterloss, pour réduire les pertes d'eau dans les réseaux d'eau potable, nous allons maintenant découvrir les méthodes que nous avons adoptées et les résultats obtenues pour aider le CG34 à conceptualiser un système de management de la performance des réseaux d'eau potable.

V Tâche 2 : Appui à la conception d'un système de management de la performance

V.1 Démarche

1. Fixer les objectifs du premier questionnaire puis le rédiger
2. Envoyer le questionnaire à tous les partenaires
3. Analyser les retours du questionnaire
4. Construction d'un arbre hiérarchique (hierarchical tree)
5. Construction d'un arbre de décision (decision tree)
6. Envoi d'un deuxième questionnaire sur les seuils (thresholds)

V.2 Objectifs du premier questionnaire

Le premier questionnaire **[Measures questionnaire, 2012]**, envoyé à tous les partenaires du projet, avait pour but :

- d'éliminer les imprécisions sur les « water balance » envoyés lors de la phase précédente du projet waterloss (cf. les deux premières parties du questionnaire commençant par « Additional information ») ;

- de savoir,
  - quelles sont les actions que les partenaires du projet mettent en œuvre pour réduire le volume d'eau non vendue (NRW),
  - quels ont été leurs effets,
  - comment ont-elles été évaluées,

(cf. partie du questionnaire « NRW reduction measures ») ;

- de connaître l'opinion des partenaires du projet sur des actions pour réduire les volumes d'eau non vendue (NRW). (cf. question relevant/ non relevant) ;

- de recueillir des nouvelles actions proposées par les partenaires.

V.3 Envoi du premier questionnaire

1er envoi : Vendredi 8 Juin 2012 par Caroline Muller (Questionnaire 1ère version)

2ème envoi : Lundi 2 Juillet 2012 par Gérard Wolff (Questionnaire 2ème version + tableau des mesures) cf. **[Measures questionnaire, 2012]** (cf. **Annexe 1**).

V.4 Analyse des résultats du premier questionnaire

Nous avons eu 6 retours de questionnaires (cf. **Annexe 2**) dont nous avons fait une synthèse (cf. **Annexe 3** et **[Synthesis answers measures questionnaire , 2012]**) :

- Ville de Nicosie par WBN

- Ville d'Argelès-sur-Mer par les PO

- Ville de Castellbisbal par AMB

- SIE Lodève par DH.

- Melito di Napoli par LG

- Kozani par DEYAK

Figure 4 : Carte localisant les villes avec un retour de questionnaire (Source : Google Earth)

V.4.1 Période temporelle étudiée et continuité du service

		H1		H2
City	**Is the assessment period the billing period ?**	**Assessment period (day)**	**Intermittent supply ?**	**Time system is pressurised (hours in a year)**
Castellbisbal	No. Assessment period is 2010. Billing period is every 2 months.	365	No	8760
SIE Lodève	Yes. 2010	365	No	8760
Nicosie	No. Assessment period is the days of the year 2010.	365	Continuous supply was re-installed during the assessment period year 2010 (after intermittent sypply from 4/2008-1/2010).	8760
Argelès-sur-Mer	No. Assessment period is 2010. Billing period is every 6 months.	365	No	8760
Melito di Napoli	Yes, it has been assumed the period since utility is in charge of the network management	180	No	8760
Kozani	Assesment has been performed in annual basis 2010.	365	No	8760

Figure 5 : Assessment period of cities

Dans la plupart des cas, les données étudiées sont annuelles, sauf pour la ville de Naples (6 mois). Tous les services d'eau sont en continue (pas de distribution intermittente).

V.4.2 Quel est le système étudié ?

Does the system input volume (SIV) include raw water ?

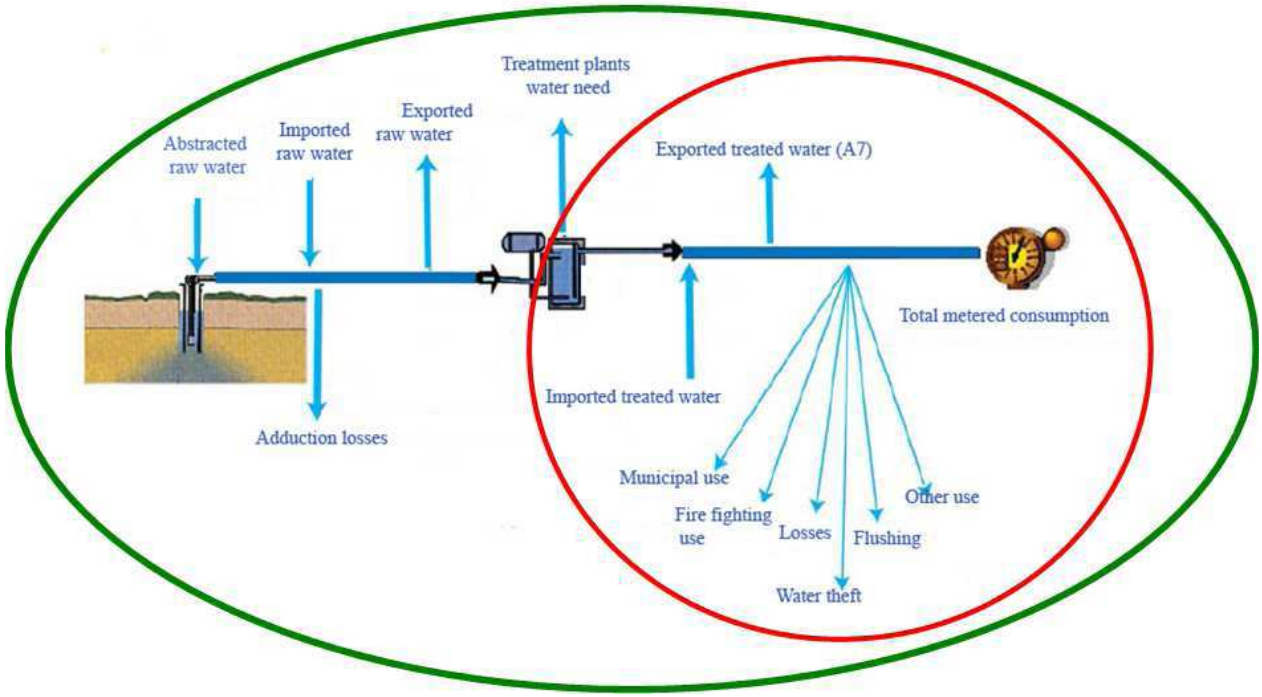

Figure 6 : A drinking water distribution system **[SAGE 33, 2004]**

City	SIV ?	Cercle ?

Argelès-sur-Mer	There is no treatment plant, just a gas chlorine	**Cercle vert = Cercle rouge**
Castellbisbal	SIV starts after treatment plant	**Cercle rouge**
Nicosie	There is no raw water in SIV	**Cercle rouge**
SIE Lodève	SIV include raw water	**Cercle vert**
Kozani	There is no raw water in SIV	**Cercle rouge**
Melito di Napoli	There is no raw water in SIV	**Cercle rouge**

Tableau 2 : Synthesis of what is the SIV for the 6 cities

En général le système étudié contient uniquement le système de distribution d'eau, sauf pour le SIE de Lodève où le système étudié contient aussi le système d'adduction d'eau brute.

V.4.3 Synthèse concernant la « water balance » de l'IWA

VAR-IWA		VAR-IWA	VAR-IWA	VAR-IWA	VAR-IWA	VAR-IWA	VAR-IWA	
A3		A8	A9	A11	A12	A16	A17	
SIV		**System Output Volumes (m3/year)**						
System Input Volume (m3/year)	**City**	**Billed metered consumption**	**Billed non-metered consumption**	**Unbilled metered consumption**	**Unbilled non-metered consumption**	**Unauthorised consumption**	**Meter under-registration and data handling error**	**Real losses**
2 445 454	Castellbisbal	2 194 336	0	0	9 782	9 782	29 345	202 209
1 436 640	SIE Lodève	557 134	0	0	3 000	2 000	6 025	868 481
23 838 611	Nicosie	14 467 783	13 310	1 490	6 760	103 570	414 290	8 831 408
2 123 191	Argelès-sur-Mer	1 695 092	0	0	7 160	2 260	26 350	392 329
4 193 300	Melito di Napoli	2 658 000	0	0	10 483	10 483	41 933	1 472 401
5 688 642	Kozani	2 369 301	0	0	113 773	56 886	236 930	2 911 752

Tableau 3 : Synthesis of normal IWA water balance for the 6 cities (m^3/year) in 2010

In yellow : figures are the same as **[Waterloss, 2012 a]**

In orange : figures are different from **[Waterloss, 2012 a]**

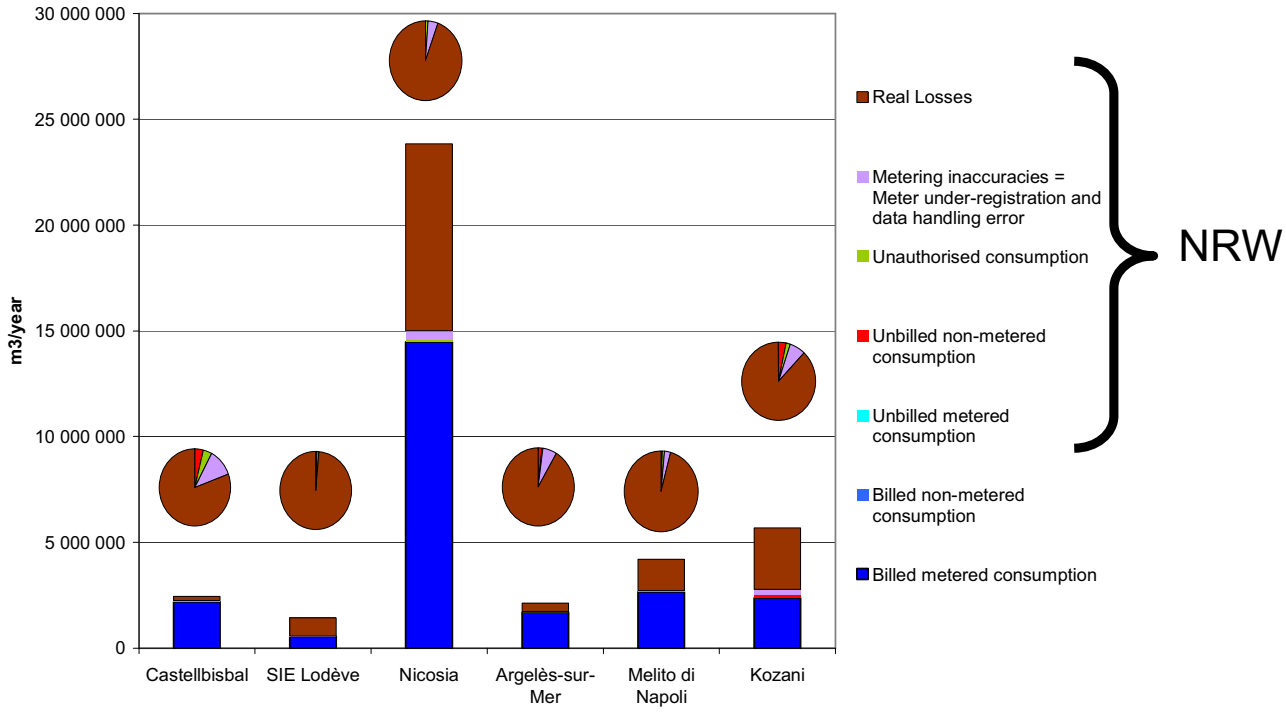

Figure 7 : System output volumes for each case study in 2010 (m^3/year) and diagrams of NRW for each case study

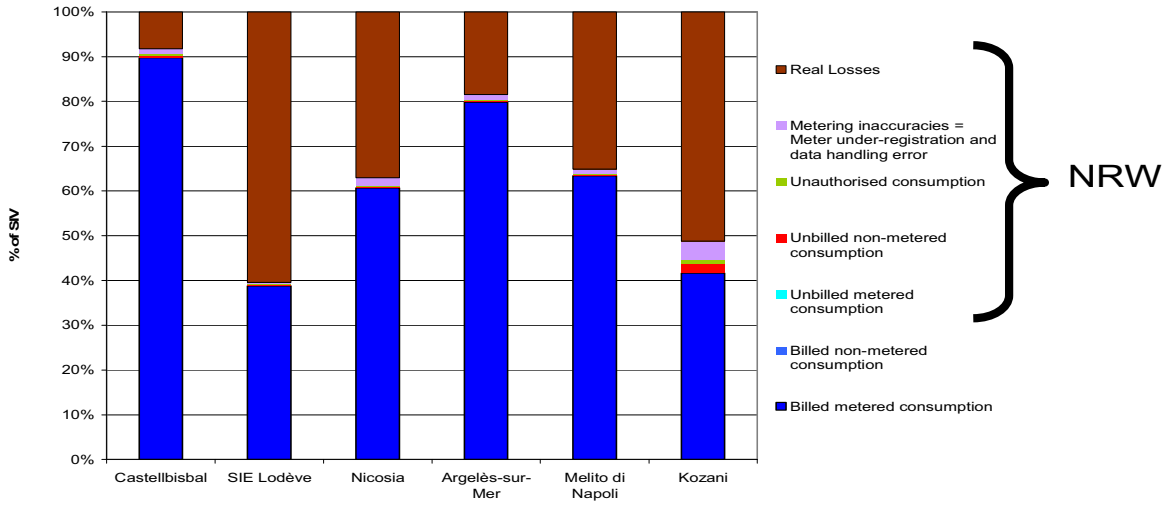

Figure 8 : System output volumes for each case study in 2010 (% of the SIV)

Le service d'eau ayant le pourcentage le plus important d'eau non vendue (NRW), par rapport au volume introduit dans le réseau (SIV), est le SIE de Lodève (cf. Figure 8). De ce point de vue, c'est le SIE de Lodève qui réalise la plus mauvaise performance parmi les 6 services d'eau partenaires du projet Waterloss.

Cependant le service d'eau qui a le plus d'eau non vendue (NRW), en valeur absolue (m^3/an), est le service d'eau de Nicosia (cf. Figure 7). En effet, Nicosia est le service le plus important par son nombre branchements et donc par ses divers volumes (cf.

Figure 9).

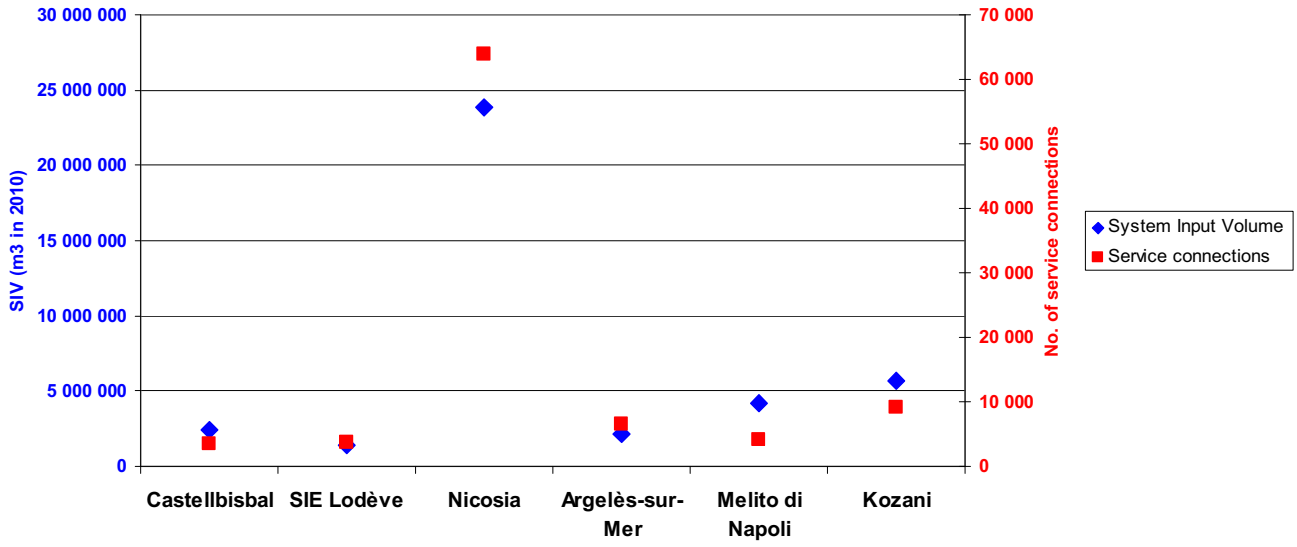

Figure 9 : Comparison of SIV and number of service connections for each case study

Le service d'eau ayant le pourcentage le plus bas d'eau non vendue (NRW), par rapport au volume introduit dans le réseau (SIV), est la ville de Castellbisbal (cf. Figure 8). De ce point de vue, c'est la

ville de Castellbisbal qui réalise la meilleure performance parmi les 6 services d'eau partenaires du projet Waterloss.

Ensuite pour les 6 cas d'étude du projet Waterloss, parmi les différents volumes d'eau non vendue (NRW), le plus important est le volume correspondant **aux pertes réelles (« Real losses »)** (cf. couleur marron sur les digrammes de la Figure 7). C'est donc sur le volume des pertes réelles qu'il faut se focaliser en priorité.

Néanmoins ces résultats sont à nuancer. En effet les 4 volumes suivant ne sont pas physiquement mesurés mais estimés :

- Billed non-metered consumption (A9)
- Unbilled authorised non-metered consumption (A12)
- Unauthorised consumption (A16)
- Meter under-registration and data handling error (A17).

Or le tableau suivant (cf. Tableau 4) nous présente la diversité des méthodes employées par les partenaires du projet Waterloss pour estimer ces volumes.

Par exemple pour le volume consommé autorisé non-mesuré non-facturé (A12), les estimations vont de 0,25% de l'eau entrant dans les canalisations, pour Naples à 2%, pour Kozani (cf. Tableau 4). Soit un facteur multiplicateur de 8 entre Naples et Kozani !

De même pour le volume consommé non-autorisé (A16), il y a un facteur 10 entre la méthode d'Argelès-sur-Mer et celle de Kozani !

La méthode employée a un impact important sur les bilans dans l' «IWA water balance», et interdit toute comparaison trop directe d'un service d'eau avec un autre.

	VAR-IWA A12	VAR-IWA A16	VAR-IWA A17
City	**Unbilled non-metered consumption**	**Unauthorised consumption**	**Meter under-registration and data handling error**
Castellbisbal	0,4% of SIV	0,4% of SIV	1,2% of SIV
SIE Lodève	Expert	Expert	It is considred empirically that (values taken from the averages observed from our calibration database). • Over 15 years of age under-value by an average of – 15 % x Q • Between 12 and 15 years of age under-value by an average of – 10 % x Q • Between 9 and 12 years of age under-value by an average of – 5 % x Q
Nicosie	1) Flushing : An estimation concerning the time the hydrant was left open and an average flow calculation. 2) Fire fighting and training : Fire brigade provides a monthly consumption estimate.	Internal statistical data	Statistical analysis and bench testing
Argelès-sur-Mer	1) Flushing : Roads service of the territory: Information on water storage capacity (washer truck)* nb of refills*nb of day in service 2) Fire fighting and training : • Reference ASTEE for training : nb of training (Hydrants)*duration(10min)*flow rate(60m3/h) • Estimation for fire fighting (extract from our external expertise) : about 20 m3/fire intervention 3) Other : • Reference ASTEE for networks purge : purge nb*duration(2h)*2,5m3/h • Reference ASTEE for disinfection of pipe ans connection after work : 8 times pipe volume or connection*0,2m3 • Reference ASTEE for pumps leakage volume (internal) : 90 m3/year/pump	0,1% of SIV	Meter inaccuracies because of meter ages. We are using as reference a study from water agencies.
Melito di Napoli	0,25% of SIV	Estimation have been done assuming literature data.	Estimation have been done assuming literature data.
Kozani	2% of SIV	1% of SIV	10% of billed authorised consumption.

Tableau 4 : Estimation of tree non-metered system output volumes by 6 cities.

Dans la composante précédente (C03) du projet Waterloss, la « water balance de l'IWA » a été modifiée 2 fois. Il a été ajouté aux volumes d'eau non vendue (NRW) de l'IWA le volume d'eau dont les factures n'ont pas été payées. Puis il a été soustrait aux volumes d'eau non vendue (NRW) de l'IWA un volume appelé « Minimum Charge Différence » (MCD) qui représente des volumes non consommés mais facturés au travers de la part fixe du tarif. Nous allons maintenant décrire les volumes indiqués dans le premier questionnaire, par chaque partenaire, concernant ces deux notions.

V.4.4 Synthèse concernant la « water balance » modifiée

	From	VAR-IWA		
	ID	A3		
year	**City**	**System Input Volume (m3/year)**	**MCD**	**Water billed not paid**
2010	Castellbisbal	2 445 454	0	0
2010	SIE Lodève	1 436 640	0	0
2010	Nicosie	23 838 611	3 331 144	8 500
2010	Argelès-sur-Mer	2 123 191	317 463	0
2010	Melito di Napoli	4 193 300	670 000	903 720
2010	Kozani	5 688 642	2 311 834	156 827

Tableau 5 : Synthesis of 2nd modified water balance for the 6 cities (m^3/year)

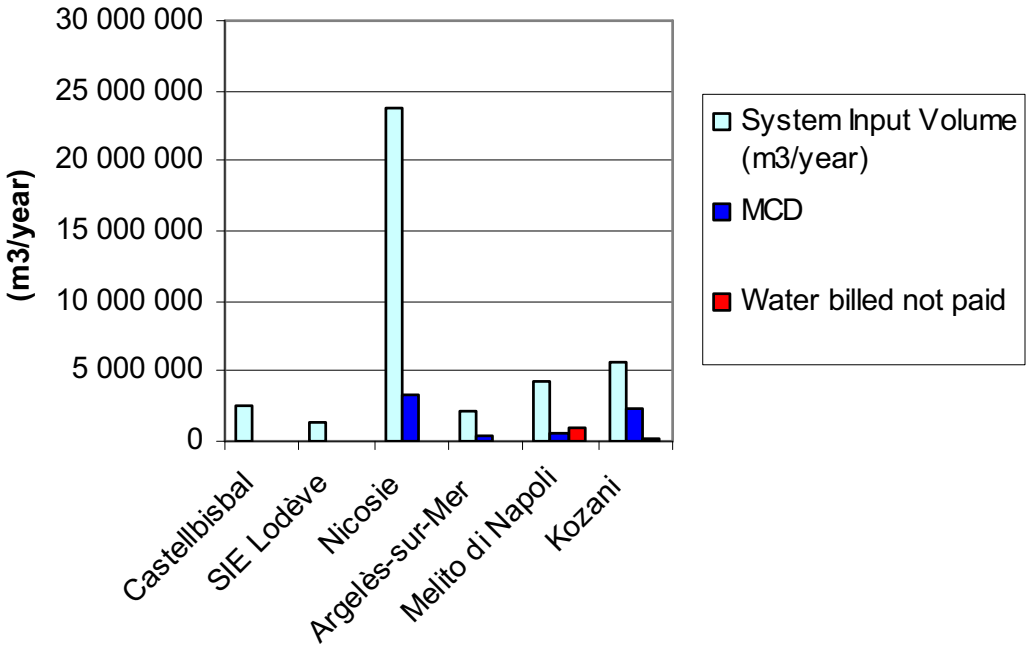

Figure 10 : Graph of 2nd modified water balance for the 6 cities (m^3/year)

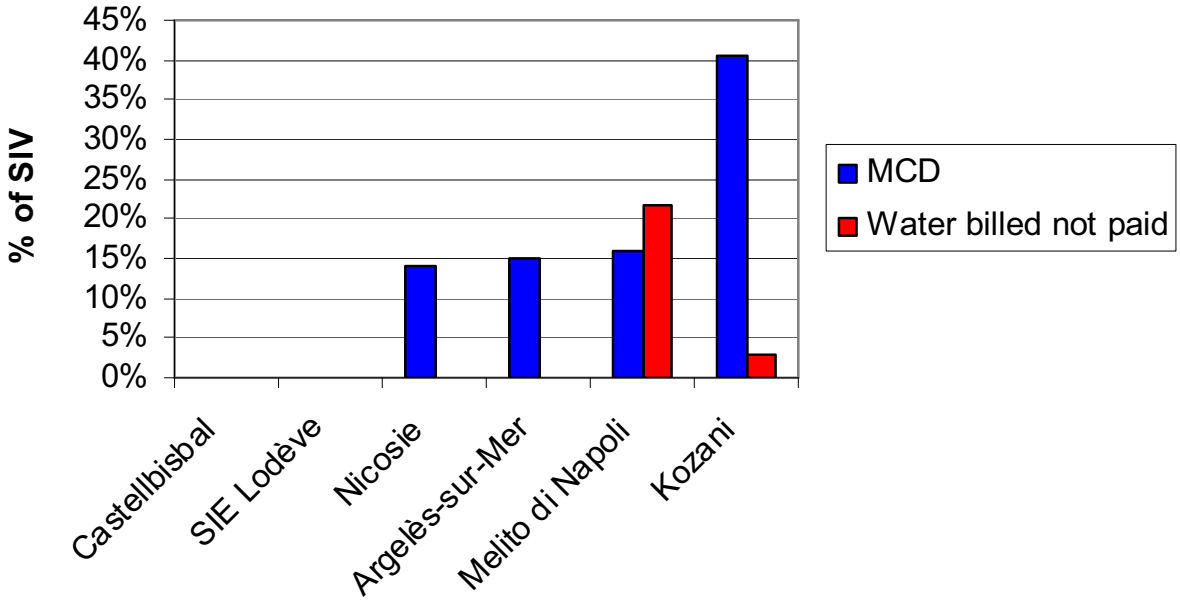

Figure 11 : Graph of 2nd modified water balance for the 6 cities (% of SIV)

Les volumes de l' «IWA water balance», sont des volumes annuels physiquement réels, alors que les deux volumes de la water balance modifiée 2 fois par le projet Waterloss sont :

- pour le MCD, un volume très abstrait
- pour les volumes « water billed not paid », en général des volumes pluriannuels.

Par conséquent ils ne peuvent pas être représentés graphiquement avec les volumes de l' «IWA water balance». Ils ne sont pas comparables.

Après avoir analysé de manière globale les 6 réponses au premier questionnaire, intitulé « NRW measures questionnaire », nous allons maintenant détailler le mode de construction de l'arbre hiérarchique.

V.5 Construction de l'arbre hiérarchique

V.5.1 Objectifs de l'arbre hiérarchique

L'arbre hiérarchique **[Hierarchical tree, 2012]** constitue la base de données des mesures que doit produire le CG34 dans le cadre du projet Waterloss (cf. **Annexe 4**).

Il a pour objectifs :

- de classer, trier, ranger, les mesures opérationnelles qui permettent de réduire les volumes d'eau non vendue (NRW) ;
- d'évaluer leur pertinence, leur efficacité et leur efficience.

V.5.2 Classification des mesures

Lors de la réunion à Ljubjana en 2012, il a été demandé au CG34 de classer les actions opérationnelles selon les catégories suivantes :

- Composantes pour les volumes d'eau non vendue (NRW)
- Sous-composantes pour les volumes d'eau non vendue (NRW)
- Stratégies = objectifs visés par ces mesures
- Description opérationnelle de la mesure

Le résultat de cette classification a abouti au fichier Excel **[Hierarchical tree, 2012].**

V.5.2.1 Composantes pour les volumes d'eau non vendue (NRW) dans l'arbre hiérarchique

A partir de **[Waterloss, 2012a ; IWA, 2010]** cinq composantes pour l'eau non vendue (NRW), ont été déterminées :

1. Unbilled authorised consumption
2. Apparent losses
3. Real losses
4. General measures for all components
5. Water billed not payed

Les trois premières composantes sont directement issues de l'«IWA water balance» **[IWA, 2010]** (cf. cercle rouge sur la Figure 12).

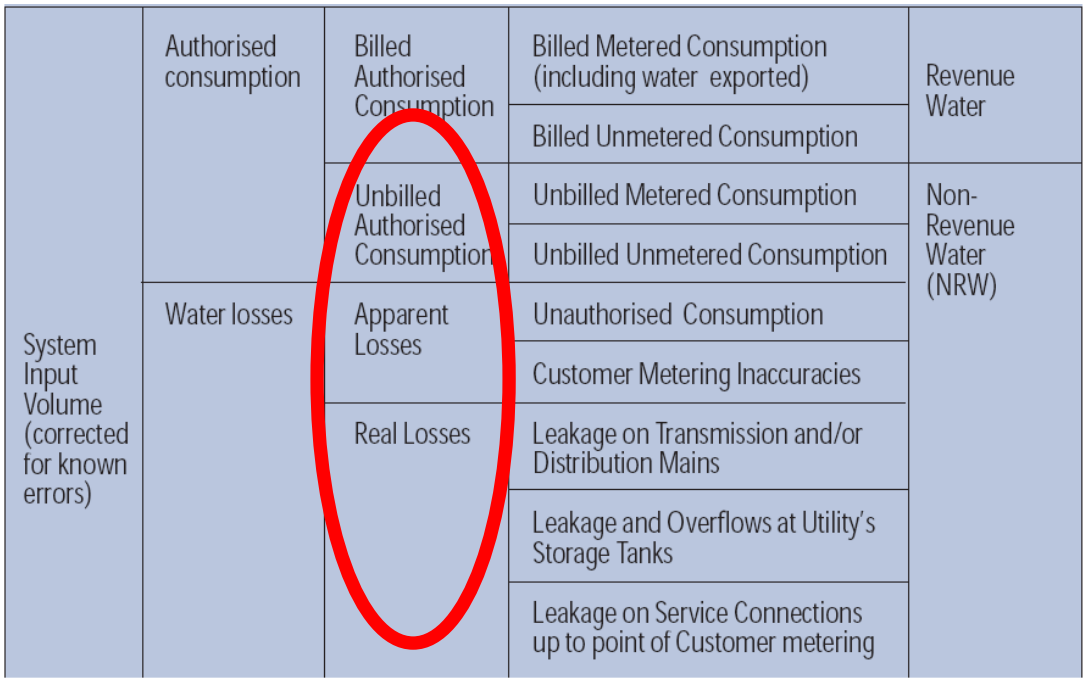

Figure 12 : The IWA « best practice » standard water balance **[IWA, 2010]**

Ensuite beaucoup d'actions de réduction de ces volumes sont transversales aux 3 premières composantes. C'est le cas, par exemple, de toutes les actions consistant à former/éduquer le personnel. C'est pourquoi il a été créé une quatrième composante nommé « actions générales pouvant s'inscrire dans toutes les composantes ».

Enfin pour prendre en compte le travail réalisé dans le projet Waterloss **[Waterloss, 2012a]**, qui a modifié deux fois la « water balance » de l'IWA. Il a été créé une 5ème composante pour inclure les actions permettant de collecter l'argent des factures d'eau impayées.

V.5.2.2 Sous-composantes pour les volumes d'eau non vendue (NRW) dans l'arbre hiérarchique

Il n'a pas été possible d'utiliser à 100% les classifications de la « water balance » de l'IWA **[IWA, 2010]** pour déterminer les sous-composantes de l'arbre hiérarchiques. En effet l'«IWA water balance» consiste à diviser les volumes d'eau d'un point de vu comptable et financier.

Or il nous a été demandé d'y associer des mesures concrètes de terrains en cohérence avec des volumes techniques.

Par conséquent les composantes ont été divisées en 1 à 5 sous-composantes (cf. Tableau 6), en fonction de la bibliographie suivante :

- **[IWA, 2010]** ayant une vision financière
- **[Farley *et al.* 2008]** ayant vision plus technique, plus adaptée à des actions concrètes.

Cpt I	Components of NRW	Sub Cpt I	Subcomponent of NRW
1	Unbilled authorized consumption	11	Unbilled unmetered consumption
		12	Both unbilled unmetered and unbilled metered consumption
2	Apparent losses	21	Unauthorised consumption
		22	Metering inaccuracies water losses
3	Real losses	31	Active Leakage Control (ALC)
		32	Speed and quality of repairs
		33	Pressure management
		34	Pipeline and assets management : selection, installation, maintenance, rehabilitation, replacement
4	General M. FOR ALL COMPONENTS:	40	Improve knowledge and accuracy on NRW volumes
		41	Improve organisation work on NRW
		42	Economic resource availabiliy
		43	Comparison with other services or with reference indicators
		44	Reduction of consumer consumption
5	Water billed not paid	RM-42	Efficient and effective payment realization (100% payment of water bills).

Tableau 6 : Details of components and subcomponents in **[Hierarchical tree, 2012]**

Par exemple, pour déterminer les 4 sous-composantes de Real Losses, nous avons repris exactement les 4 piliers pour lutter contre les pertes réelles de **[Farley *et al.* 2008]** (cf. Figure 13).

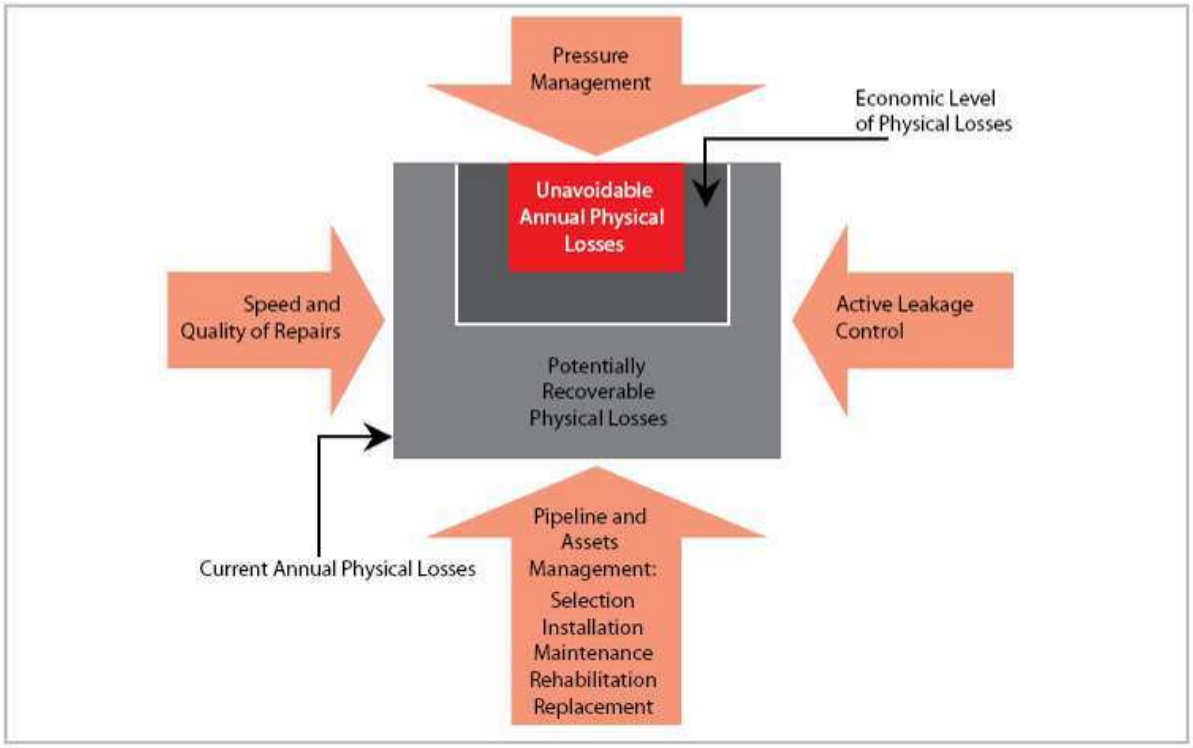

Figure 13 : The four pillars of a successful leakage management strategy **[Farley *et al.*, 2008, p 47]**

V.5.2.3 Objectifs visés par ces mesures

Les sous-composantes pour les volumes d'eau non vendue (NRW) ont ensuite été segmentées en fonction de l'objectif des actions opérationnelles pour réduire les volumes d'eau non vendue (NRW) (cf. Tableau 7).

Cpt ID	Components of NRW	Sub Cpt ID	Subcomponent of NRW	Str ap m ID	Strategic approach to measures
3	Real losses	32	Speed and quality of repairs	321	Improve organisation of work for repairs
				322	Improve quality of repairs
				323	Improve speed of repairs

Tableau 7 : Details of all “strategic approach to measure” for the sub-component “speed and quality of repair” in the component “Real losses”.

V.5.2.4 Description opérationnelle de la mesure

Une fois les objectifs définies, les mesures concrètes ont alors été décrites (cf. Tableau 8)

Cpt ID	Components of NRW	Sub Cpt ID	Subcomponent of NRW	Str ap m ID	Strategic approach to measures	OM ID	Operational measures
3	Real losses	32	Speed and quality of repairs	323	Improve speed of repairs	DH -RL04	Procedure to guarantee repair material availability
						Ljub-3231	Equipment of the repair teams for efficient and effective repair
						Ljub-3232	Communication with consumers and evaluation of complaints
						RM-37	Central registry of underground infrastructure
						RM-39	Public awareness campaign (i.e. did anybody see wetted spot around the valve)

Tableau 8 : Details of all “operational measures” in “strategic approach to measures” Improve speed of repair.

Nota Bene : « OM ID » est un identifiant qui permet de tracer l’origine de la mesure :

- DSS : mesures recensées par AUTH, sur le site du DSS tool, page web « DSS ».
- RM : mesures recensées par UL sur le site du DSS tool, page web « NRW Reduction Measures"
- Ljub : mesures créées lors du meeting de Ljubjana en 2012
- DH : mesures créées par DH

V.5.3 Evaluation des mesures opérationnelles

V.5.3.1 Le système d’évaluation

Chaque mesure opérationnelle est évalué selon six critères en utilisant un barème de 1 à 5 étoiles (cf. Tableau 9).

		1 star	2 stars	3 stars	4 stars	5 stars
Timeframe	How quickly the measure could be applied ?	t > 2 years	1 year < t ≤ 2 years	1 month < t ≤ 1 year	1 week < t ≤ 1 month	1 week ≥ t
Duration	How long the effects of the measures last ?	1 week ≥ t	1 week < t ≤ 1 month	1 month < t ≤ 1 year	1 year < t ≤ 2 years	t > 2 years
Importance	How the measure is effective for NRW reduction ?	very small volume of water saved	small volume of water saved	medium volume of water saved	large volume of water saved	very large volume of water saved
Organizational Complexity	What is the level of organizational complexity ?	Very difficult	Difficult	Medium	Easy	Very easy
Constructive or non constructive	Is it a non constructive measure ?	Constructive a lot		Constructive and non constructive		Non constructive at all
Cost-efficiency	Is the measure cost-efficient ?	High cost small efficiency	High cost medium efficiency	Medium cost medium efficiency	Medium cost high efficiency	Small cost high efficiency

Tableau 9 : Assessment system of each operational measure

Plus il y a d’étoiles, plus la mesure est intéressante pour le gestionnaire.

V.5.3.2 Les résultats de l'évaluation

Pour obtenir les résultats de l'évaluation, nous avons utilisé :

- en premier lieu, les 6 retours du questionnaire **[Measures questionnaire, 2012]** par les partenaires. Notamment la partie où ils indiquent si la mesure est pertinente (relevant) ou non pertinente (non relevant).
- en second lieu : nos connaissances sur le sujet.

Le résultat se présente sous la forme suivante :

Operational measures	Timeframe (stars)	Duration (stars)	Importance (stars)	Organizational Complexity (Stars)	Constructive / non constructive (Stars)	Cost efficiency Ratio (Stars)
Purchase and installation of meters, metering	3	5	**3**	3	3	2

Tableau 10 : Example of assessment of one operational measure.

Après avoir présenté l'arbre hiérarchique (cf. **Annexe 4**) nous allons maintenant détailler le mode de construction de l'arbre de décision. L'arbre hiérarchique est une liste classée d'actions à mettre en œuvre pour réduire les volumes d'eau non vendue (NRW). L'arbre de décision permet de sélectionner, au sein de l'arbre hiérarchique, un groupe restreint d'actions qui sont adaptés au contexte du service d'eau.

V.6 Construction de l'arbre de décision

V.6.1 Objectif de l'arbre de décision

L'arbre de décision constitue le modèle qui sera implémenté dans l'outil d'aide à la décision (cf. **Annexe 6**).

L'objectif de l'arbre de décision **[Decision tree, 2012]** est, pour un service d'eau donné, qu'il puisse déterminer quels groupes de mesures opérationnelles au sein de **[Hierarchical tree, 2012]** il doit mettre en place en priorité afin de diminuer son volume d'eau non vendue (NRW).

V.6.2 Méthode de construction de l'arbre de décision

Pour prendre en compte les caractéristiques spécifiques de chaque service d'eau, on utilise des valeurs de variables (Vs) et d'informations contextuelles (CIs), à partir desquelles des indicateurs (PIs) sont ensuite calculés.

Selon où se situe la valeur de l'indicateur (cf. Figure 14), par rapport à des seuils (thresholds) préalablement choisis, le cheminement dans l'arbre de décision ne sera pas le même, et les groupes de mesures opérationnelles sélectionnées, au sein de l'arbre hiérarchique, seront différents.

Ainsi, dans l'exemple ci-dessous (cf. Figure 14), si l'indicateur est en-dessous du seuil « bas » (ligne « Low » thresholds en **bleu**), l'action au sein du **[Decision tree, 2012]** sera **« STOP ».** Ce qui induira une sélection de quelques mesures opérationnelles au sein de **[Hierarchical tree, 2012].**

En revanche, si l'indicateur est au-dessus de seuil « bas », l'action au sein du **[Decision tree, 2012]** sera **« Go to next STEP ».** Il y aura donc des questions pour calculer d'autres indicateurs. A la fin du cheminement dans **[Decision tree, 2012]**, un autre groupe de mesures opérationnelles sera sélectionné dans **[Hierarchical tree, 2012]**.

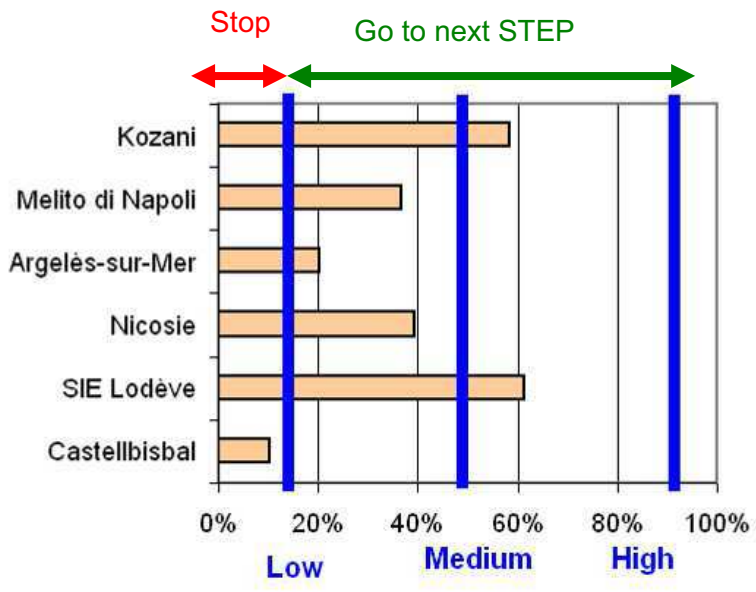

Figure 14 : Example of performance indicators values and thresholds used in the decision tree

Le cheminement au sein des différentes mesures de **[Hierarchical tree, 2012]** s'effectue au maximum via 5 étapes (cf. Figure 15).

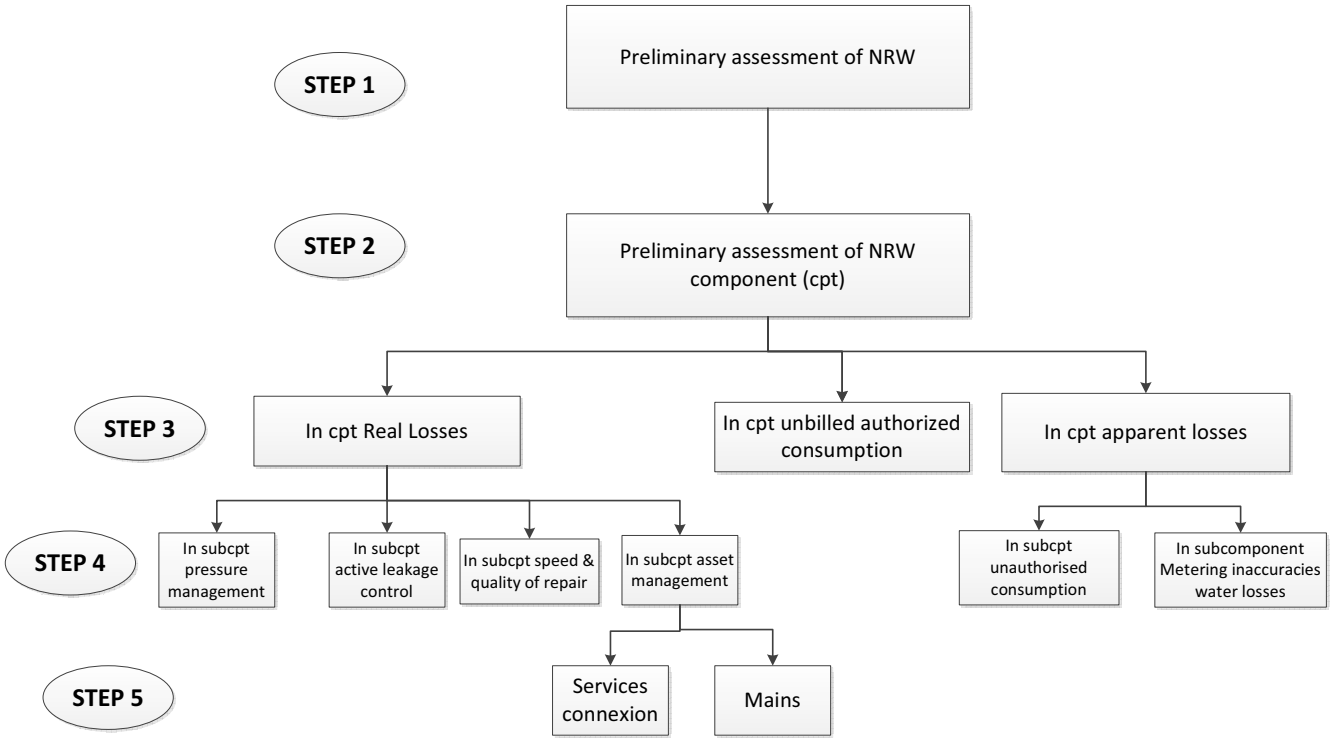

Figure 15 : Pathway in **[Hierarchical tree, 2012]** allowed by questions in **[Decision tree, 2012]**

V.6.3 L'arbre de décision

La Figure 16 présente le début, c'est-à-dire la première étape (STEP 1), de l'arbre de décision.

Selon les réponses aux questions (oui ou non) l'arbre de décision va renvoyer vers soit :

- des codes à **3 chiffres en bleu** qui correspondent à l'identifiant du groupe de mesures ayant la même stratégie (« strategic approach to measures ») de **[Hierarchical tree, 2012]** (cf. Figure 16).
- des codes avec **lettre et chiffre en vert** qui correspondent à un identifiant précis d'une mesure de **[Hierarchical tree, 2012]** précédés de l'identifiant de « strategic approach to measures ».
- une autre question.

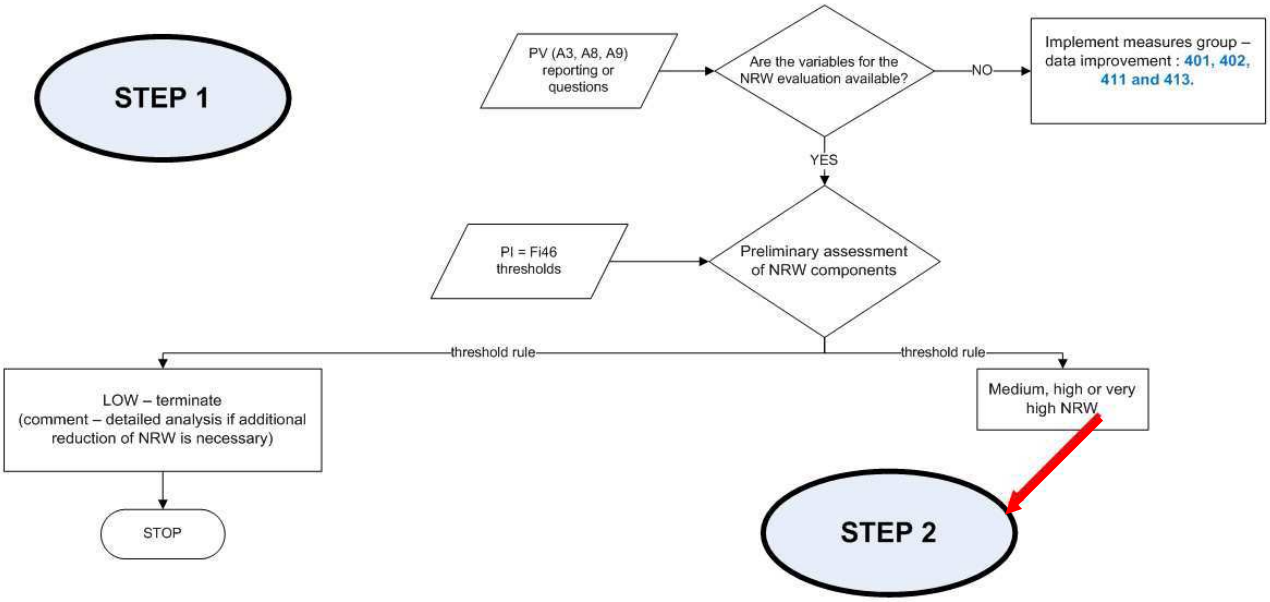

Figure 16 : STEP 1 in **[Decision tree, 2012]**

V.6.4 Choix des variables, informations contextuelles et indicateurs

Les variables (Vs), les informations contextuelles (CIs) et les indicateurs (PIs) ont été choisis en priorité dans cet ordre au sein des sources suivantes :

1) IWA + Waterloss Vs & PIs **[Waterloss, 2012b]**
2) IWA CIs **[IWA = Alegre *et al.*, 2010]**
3) DH questionnaire CIs **[Measures questionnaire, 2012]**
4) Si nécessaire des nouveaux PIs and CIs

Variables, informations contextuelles et indicateurs sont tous détaillés dans le fichier **[Steps of decision tree, 2012]** (cf. **Annexe 7**).

Source	Meaning
V-IWA	Variable from IWA **[IWA = Alegre *et al.*, 2010]**
V-WAT	Variable from Waterloss project **[Waterloss, 2012 b]**
CI-IWA	Context Information from IWA **[IWA = Alegre *et al.*, 2010]**
CI-DH	Context Information from DH
PI-IWA	Performance Indicator from IWA **[IWA = Alegre *et al.*, 2010]**
PI-DH	Performance Indicator from DH

Tableau 11 : Sources of variables, context information and indicators used in **[Decision tree, 2012]**

Après avoir présenté l'arbre de décision (cf. **Annexe 6**), nous allons maintenant détailler le mode de construction du questionnaire sur les seuils de décision, intitulé « thresholds questionnaire ».

V.7 Construction du questionnaire sur les seuils

Le passage, ou non, d'une étape à la suivante dans l'arbre de décision dépend si l'indicateur calculé est au-dessus ou en dessous d'un seuil de décision.

Certains seuils (= thresholds) peuvent être trouvés dans la littérature internationale (cf. **[Trow, 2009 ; Liemberger *et al.*, 2007]** pour les seuils sur l'indicateur « ILI »). Néanmoins la plupart des seuils de décisions sont inexistants dans la littérature. Ils sont à fixer en fonction du contexte local et des objectifs politiques de performance.

C'est pourquoi un questionnaire (cf. **[Thresholds questionnaire, 2012]** et cf. **Annexe 8**) a été créé afin que les partenaires du projet Waterloss fixent, pour chaque indicateur utilisé dans **[Decision tree, 2012]** les seuils de décision :

- bas (= low)
- moyen (= medium)
- high (= haut)

Après avoir présenté le cœur du système d'aide à la décision (DSS tool). Nous allons appliquer cette méthode au cas pilote du département de l'Hérault, à savoir le SIE de Lodève.

VI Tâche 3 : Application de l'arbre de décision au SIE de Lodève

Nota Bene : A l'heure actuelle, dans le projet Waterloss, les différents seuils (bas, moyen, haut) n'ont pas été fixés car nous attendons encore des retours sur le questionnaire « thresholds ». Par conséquent pour fixer les seuils ci-dessous nous nous sommes inspirés de **[Kingdom *et al.*, 2006 ; Liemberger *et al.*, 2007 ; Pearson et Trow, 2011]**

VI.1 STEP 1 : Preliminary assessment of NRW

Le SIE de Lodève sait déterminer ses variables A3, A8 et A9.

Par conséquent il est possible de calculer l'indicateur de performance Fi46 (Non Revenue Water Volume by System Input Volume) (cf. Figure 17).

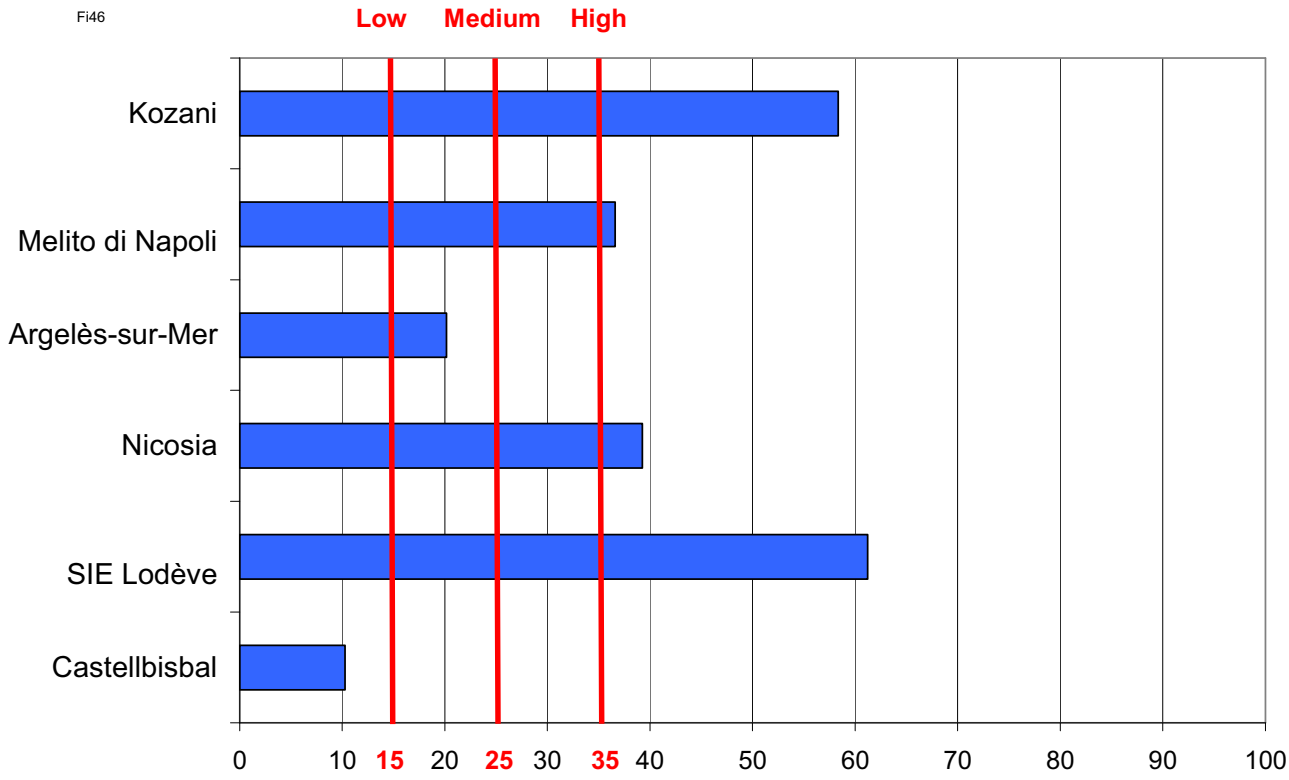

Figure 17 : Non Revenue Water Volume by System Input Volume = NRW / SIV (Fi46) (%)

Le SIE de Lodève a 61,2 % d'eau non vendue (NRW) par rapport au volume introduit (SIV). Ce qui est au-dessus du seuil haut (35%) par conséquent il a un volume d'eau très important non vendue. Ainsi, il doit passer à l'étape 2 (STEP 2).

VI.2 STEP 2 : Preliminary assessment of NRW component

VI.2.1 Real losses

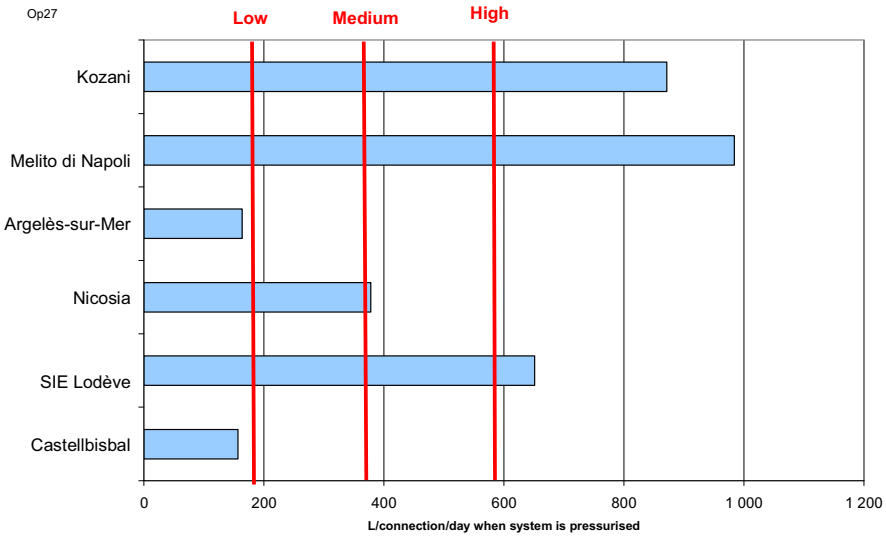

Figure 18 : Real losses per connection (Op27)

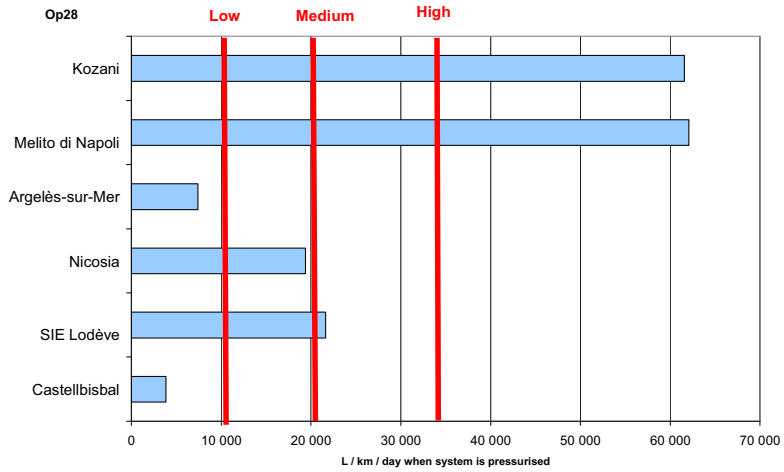

Figure 19 : Real losses per mains length (Op28)

Le SIE de Lodève a un très haut niveau de pertes réelles par branchement (cf. Figure 18) et un haut niveau de pertes réelles par km de canalisation (cf. Figure 19). Par conséquent il est nécessaire de continuer au sein de l'étape 3 de la composante des pertes réelles.

VI.2.2 Unbilled authorised consumption

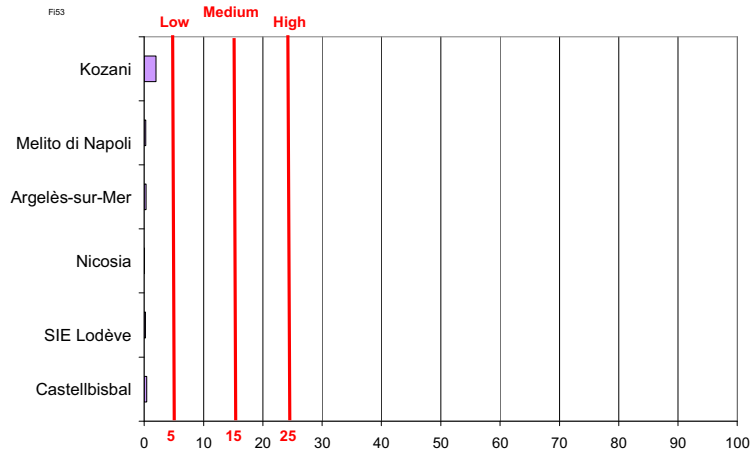

Figure 20 : Unbilled authorised annual consumption per system input volume (Fi53) (%)

Le SIE de Lodève a un bas niveau de consommations autorisées non facturées (cf. Figure 20). Par conséquent il n'est pas nécessaire de continuer les étapes suivantes au sein de cette composante.

VI.2.3 Apparent losses

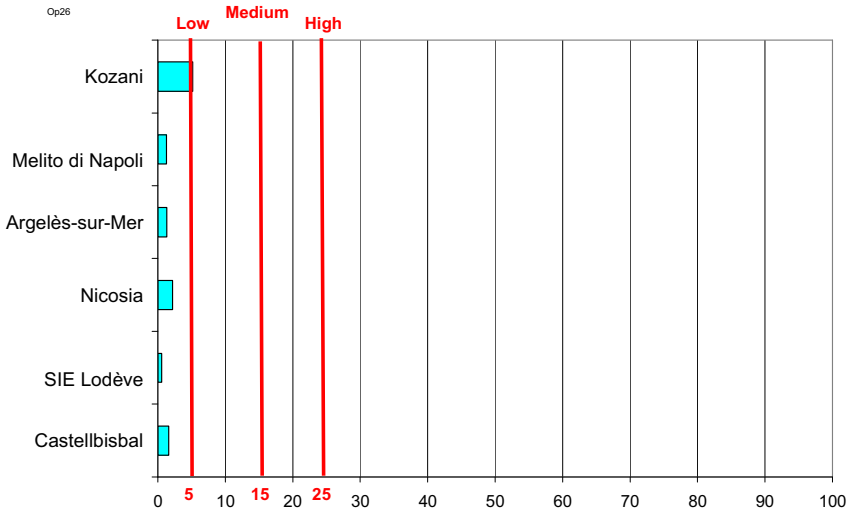

Figure 21 : Apparent losses per system input volume (Op26) (%)

Le SIE de Lodève a un bas niveau de pertes apparentes (cf. Figure 21). Par conséquent il n'est pas nécessaire de continuer les étapes suivantes au sein de cette composante.

VI.3 STEP 3 : In component real losses

VI.3.1 ILI

VI.3.1.1 Usage du DSS tool

Le SIE de Lodève ne connait pas la longueur moyenne de ses branchements (average service connection length). Donc il n'est pas possible de calculer l'indicateur ILI (Infrastructure Leakage Index) (cf. Figure 22).

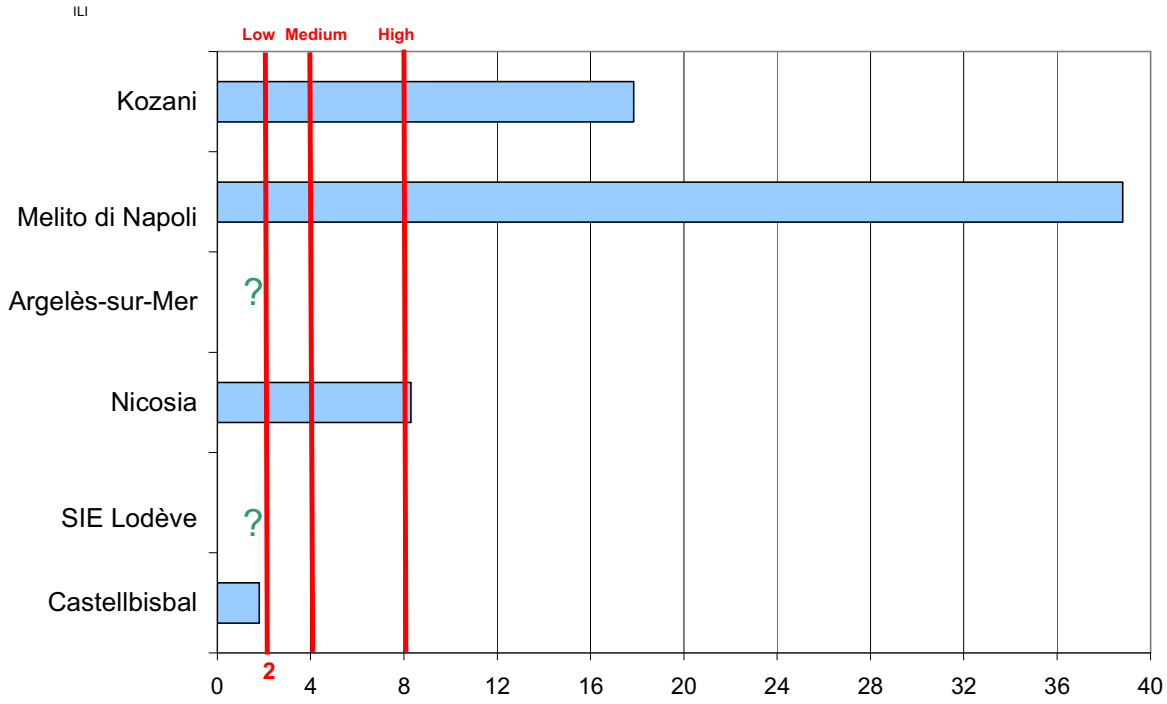

Figure 22 : Infrastructure Leakage Index ILI (Op29)

Par conséquent, le SIE de Lodève doit mettre en place les mesures des groupes stratégiques (401, 402, 411 et 413) (cf. Tableau 12).

Strap m ID	Strategic approach to measures	OM ID	Operational measures
401	Improve bulk meter accuracy and knowledge	DH-MA01	Volumetric accuracy checked using a second meter
		RM-04	Calibration of water meters, managing inaccuracy of water meters, age of water meters
402	Improve customer meter accuracy and knowledge	DH -MA02	Monitoring water quality (the build-up in sediment affects the meter's accuracy)
		DH -MA03	Monitoring intermittent water supply (sudden large increase in pressure damage the meter's components)
		DH -MA04	Test of a representative sample of customer meters
		DSS-OM4	Calibration of water use metering network
		RM-28	Metering of revenue water
411	Implement standards and procedures	DH -MA05	Establishment of guidelines for WB volumes calculation
		DSS-DA5	Systematic control of billing records
		Ljub-4111	Permitting procedures for other constructions in the impact zones of the WSS infrastructure, also permitting procedures for the re-classification of
		Ljub-4112	Revision of the procedures for the construction and maintenance of the
		Ljub-4113	Planning details and standards for example Soil type mapping (stability, aggresive, geology, etc.)
		Ljub-4114	Construction details and standards i.e. construction under frost depth
		Ljub-4115	Interaction with other underground services for example development and operation of the central cadastre of underground infrastructure
		RM-14	Planning process standards
		RM-17	Constructed WSS commission process standards
		RM-31	Supply chain management (verification of suppliers – CE standards?, supply standards and reliability)
		RM-34	Permitting procedures for other constructions in the impact zones of the WSS infrastructure, also permitting procedures for the re-classification of
		RM-36	Document management and archives in the management company (archiving the documents on construction, service connections, permits etc.)
		RM-50	Development of programme of measures for the NRW reduction (documentation, evaluation, designs…)
413	Education of staff	Ljub-4131	Education of staff on operational procedures taking into consideration existing affirmated practices
		RM-45	HRM – company culture (every drop counts), permanent, targeted education of employees,
		RM-46	HRM – adequate staffing for different processes, adequate tools, equipment, education

Tableau 12 : Measures group which must be implemented by SIE Lodève

Parmi ces 23 mesures opérationnelles, en priorité le SIE de Lodève doit mettre en place les mesures avec une importance de niveau 5, c'est-à-dire les 8 mesures opérationnelles suivantes (Tableau 13).

OM ID	Operational measures	Timeframe (stars)	Duration (stars)	Importance (stars)	Organizational Complexity (Stars)	Constructive/ non constructive (Stars)	Cost efficiency Ratio (Stars)
DH-MA01	Volumetric accuracy checked using a second meter	4	4	**5**	4	3	4
RM-04	Calibration of water meters, managing inaccuracy of water meters, age of water meters	4	4	**5**	4	3	4
RM-28	Metering of revenue water	3	5	**5**	3	3	5
DH -MA05	Establishment of guidelines for WB volumes calculation	4	5	**5**	5	5	5
RM-36	Document management and archives in the management company (archiving the documents on construction, service connections, permits etc.)	4	5	**5**	4	5	5
Ljub-4131	Education of staff on operational procedures taking into consideration existing affirmated practices	4	5	**5**	4	5	5
RM-45	HRM – company culture (every drop counts), permanent, targeted education of employees,	4	5	**5**	4	5	5
RM-46	HRM – adequate staffing for different processes, adequate tools, equipment, education	4	5	**5**	4	5	5

Tableau 13 : Operational measures which must be implemented in priority by SIE Lodève

Le jour où le SIE de Lodève connaitra sa longueur moyenne de branchements, alors il sera possible de continuer dans l'arbre de décision du DSS tool.

VI.3.1.2 Pour aller plus loin que le DSS tool

La longueur moyenne d'un branchement se situe en général entre 2 et 20 mètres.

En prenant ces deux hypothèses (min et max) dans tous les cas l'ILI est très élevé pour le SIE de Lodève (cf. Figure 23).

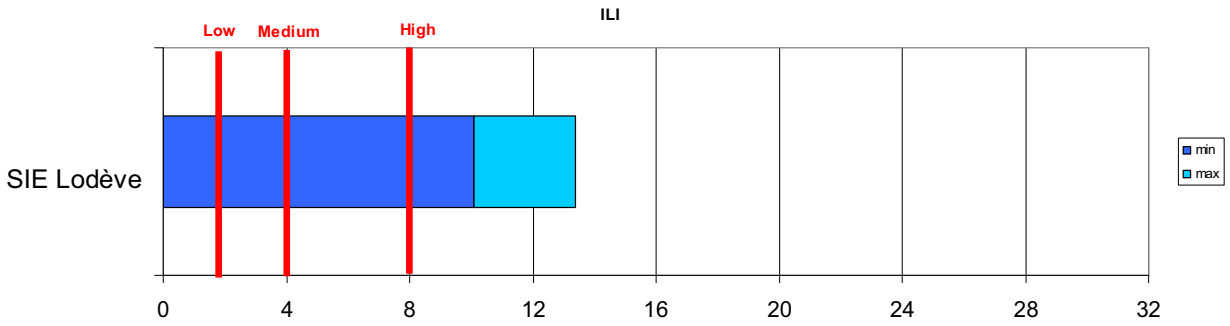

Figure 23 : Calculation of ILI with 2 hypothesis on average connection length

Cette valeur d'ILI indique que l'utilisation des ressources en eau brute est très inefficace, ce qui met en évidence un mauvais entretien des canalisations et un mauvais état du système en général.

Ce qui signifie que le SIE de Lodève devrait mettre en place en priorité des mesures de recherche active de fuite en commençant par exemple par la sectorisation de son réseau afin de suivre son débit nocturne. En effet le débit nocturne peut être assimilé, lors d'une première phase simpliste, par le volume de fuite. Cela lui permettrait de localiser plus précisément où sont ses fuites. Ensuite le SIE pourrait mettre en place des actions pour réparer au mieux et le plus rapidement ces fuites.

Enfin le renouvellement des canalisations ne doit-être envisagé que lorsque le SIE de Lodève aura une meilleure connaissance de son réseau !!

VI.3.2 PMI

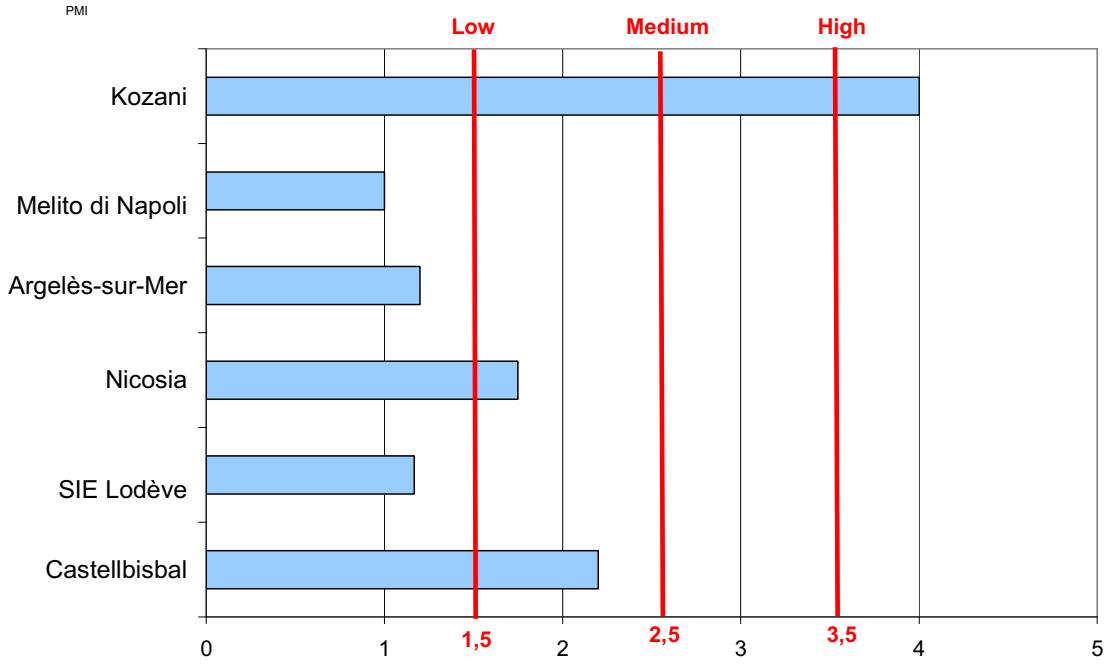

Figure 24 : Pressure management Index (PMI) (Op69)

Le niveau de PMI pour le SIE de Lodève est bas ce qui signifie que la pression dans ce réseau n'est pas trop élevé. Il n'y a pas de marge de manœuvre suffisante pour diminuer la pression. Par conséquent il n'est pas nécessaire de poursuivre l'étape suivante (STEP 4) dans la composante « pressure management ».

VII Conclusion

En fonction des priorités fixées par le CG34, notre intervention s'est principalement concentrée sur un appui au projet Waterloss.

Dans ce contexte, nous avons conçu les questionnaires et construit la base de données des actions de réduction des volumes non vendus, nécessaires au CG34 pour réaliser les productions attendues dans le cadre du projet Waterloss.

Nous avons, par ailleurs, en concertation étroite avec l'Université de Ljubljana, construit un arbre de décision qui pose les bases d'un outil d'aide à la décision et permet au CG34 de répondre aux attentes du projet concernant les valeurs cibles que peuvent viser les services étudiés.

Les productions issues de ce travail, intégralement fournies en appui du présent rapport, pourront servir de base à des travaux futurs adaptés au contexte français.

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Annexes

Annexe 1 : DH questionnaire on NRW measures

Annexe 2 : Answers of Waterloss project partners at DH questionnaire on NRW measures

1) Answer of AMB : Castellbisbal
2) Answer of DH : SIE de Lodève
3) Answer of WBN : Nicosia
4) Answer of PO : Argelès-sur-Mer
5) Answer of LG : Melito di Napoli
6) Answer of DEYAK : Kozani

Annexe 3 : Synthesis of project partners answers at DH questionnaire on NRW measures

Annexe 4 : Hierarchical tree of NRW measures

1) Legend
2) “Components”, “sub-components” and “strategic approaches to measure”
3) “Strategic approach to measure”, “operation measures”, assessment of operational measures.
4) Measures not in the hierarchical tree

Annexe 5 : Synthesis of the pathway between the different STEPs in decision tree

Annexe 6 : Decision tree

Annexe 7 : Synthesis of variables, context information and indicators used at each STEP

Annexe 8 : DH questionnaire on thresholds

Annexe 9 : Thresholds guide

Annexe 10 : Answers of Waterloss project partners at DH questionnaire on thresholds

1) Answer of PO : Argelès-sur-Mer
2) Answer of AMB : Castellbisbal

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Annex 1

DH questionnaire on NRW measures

WATERLOSS: Management of water losses in a drinking water supply system»
(Transnational Cooperation Programme MED – Project 2G-MED09-445)

Internal Reporting of Project Partners

NRW reduction measures experiences

Phase	**4.1_Development of a DSS tool for appropriate NRW reduction strategy**
Deliverable	**D41.1_ Database of NRW management measures**
Partner responsible for the Phase	**PP9: Department of Herault (DH)**
Partner responsible for the Project	**LP: Aristotle University of Thessaloniki (AUTH)**
Partner's No	
Partner's full NAME	
Partner's short NAME	
Partner's City	
Partner's Country	
Case Study Area	
Pilot Case Study Network	

SUMMARY

Additional information concerning WB assessment

Assessment period

Is the assessment period the billing period?	
How are estimated the starting and ending dates?	
Was there intermittent supply during the assessment period?	

ID	Variable	Unit	Value
	Beginning date of the assessment period	Date (m/d/y)	
	Ending date of the assessment period	Date (m/d/y)	
H1	Assessment period	Day	
H2	Time system is pressurised	Hour	

System Input Volume

Is the system input volume period consistent with the assessment period?	
Does the system input volume include raw water (abstracted or imported)?	
What is the reading frequency of abstraction, importation and exportation meters?	
Is there any correction of imported, exported and abstracted volumes? If so, describe the method.	
Is there any correction of billed metered volume? If so, describe the method.	
Is there any policy of bulk meters replacement? If so describe it.	

ID	Variable	Unit	Value
A3	System input volume	m^3	
A5	Exported raw water	m^3	
A6	Water produced	m^3	
A7	Exported treated water	m^3	
	Abstracted raw water	m^3	
	Imported raw water	m^3	
	Imported treated water	m^3	
C10	System flow meters	No.	

Bulk meters (number by type)

Type	Importation	Abstraction	Exportation	Total
Electromagnetic flow meter				
Ultrasonic flow meter				
Insertion meter				
Mechanical meter				
Venturi meter				
Calculation with pump curves				
Measure weirs in open channels				
Other				
Total				

Billed authorized consumption

Are there customers supplied by roof tanks? If so percentage?	
Is there any policy of customer meters replacement? If so describe it.	
Describe different categories of un-metered billed consumption the way they are evaluated and the number of customers concerned.	

ID	Variable	Unit	Value
A8	Billed metered consumption	m^3	
A9	Billed unmetered consumption	m^3	
C26	Roof tanks number	No.	
D42	Customer meter readings	No.	
D45	Meter replacement	No.	

Customer meters (number by diameter and metrological class)

Diameter	Class B	Class C	Class D	Other	Total	Average age (year)
15 mm						
20 mm						
> 20 mm						
Total						

Unbilled authorized consumption

Estimation methods of unbilled unmetered authorized consumptions

Category	Methods
Process water (for treatment plants)	
Flushing	
Frost protection	
Tank cleaning	
Fire fighting and training	
Municipal use	
Other (specify)	

ID	Variable	Unit	Value
A11	Unbilled metered consumption	m^3	
A12	Unbilled unmetered consumption	m^3	

Distribution of unbilled authorized consumptions (m^3)

Category	Metered	Unmetered	Total
Process water			
Flushing			
Frost protection			
Reservoir cleaning			
Municipal use			
Fire fighting and training			
Other (specify)			
Total			

Apparent losses and modified WB volumes

How is estimated unauthorized consumption and why?	
How are estimated meter inaccuracies and why?	
After how much time a not paid invoice is abandoned?	
What is the delay between the end of the assessment period and the estimation of not paid for volumes?	
Is there a fixed charge in volume? If so how much?	
Is there a fixed charge expressed in € related to water volumes? If so how much?	
Is there a fixed charge expressed in € without water volumes? If so how much?	

ID	Variable	Unit	Value
A16	Unauthorized consumption	m^3	
A17	Metering inaccuracies water losses	m^3	
A23	Billed but not paid for consumption	m^3	
A25	Minimum Charge Difference	m^3	

Additional information concerning the water supply system

Network subdivisions

Number of distribution units (zones where consumers drink the same water)	
Number of pressure levels (zones with the same pressure regime)	
Number of DMAs monitored by SCADA (daily night flow available)	
Number of other DMAs	

ID	Variable	Unit	Value
C11	District meters	No	

Assets

What are the methods used to measure and update mains length?	
What are the methods used to measure and update service connections number?	
What are the methods used to calculate and update average service connection length?	

ID	Variable	Unit	Value
C8	Mains length	km	
C24	Service connections	No.	
C25	Average service connection length	m	

Operation

Is a calibrated hydraulic model available?	
What are the methods used to update water demand?	
How frequently is it calibrated?	
Are mains failures registered?	
Are mains failures located at the section pipe level?	
Are service connection failures registered?	
Are failures reported in the GIS?	

ID	Variable	Unit	Value
D28	Mains failures	No.	
D29	Service connection failures	No.	

Pressure

Is estimating average pressure a standard practice of the utility?	
What are the methods used to evaluate average pressure?	
What is the weighting system used to calculate average pressure?	

ID	Variable	Unit	Value
C12	Pressure meters	No.	
D34	Average operating pressure	kPa	
MARP	Minimum Annual Reference Pressure (*)	kPa	

* MARP is the minimum standard of service pressure at the delivery point

NRW reduction measures

Legend

Measure	PIs	Results
Designation and description of the measure. Indicate parts of the WSS which are concerned and realisation period.	Mention diagnosis and evaluation PIs used to carry out the measure (with formula for non-IWA PIs)	Indicate capital and operational expenditures, expected lifespan of installations, annual volume of water savings (and how it is evaluated), other results and value of dedicated PIs before and after the action (with reference date or period).
Example: Pressure regulation of DMA7 (31 km of mains, 26% of network mains length). Installation of 2 PRVs and 3 section valves. Annual maintenance. Operating since April 2009.	Average Operating Pressure (AOP) and Annual Water Losses (AWL). Same formula as IWA PIs at DMA level.	Capex = 25 000 € (2009) Opex = 850 €/year Expected lifespan = 30 years Water savings (2010) = 7 500 m^3 (estimation based on DMA night flows) AOP 2008 = 65 m of pressure AOP 2010 = 43 m of pressure AWL 2008 = 35 500 m^3 AWL 2010 = 28 000 m^3

ID	Variable	Unit	Value
AOP	Average Operating Pressure (DMA level)	m of pressure	See above
AWL	Annual Water Losses (DMA level)	m^3	See above

In the following tables, measures from the DSS platform and examples from DH are proposed:

- **if a measure doesn't fit with your WSS, please, mention in the column "Result" : *"not implemented"* and indicate if in your opinion this measure is relevant or not.**
- **Otherwise, fill the form,**
- **add the other measures you have implemented or planned to implement.**

Explanation of measures codification:

- RM-xx : Measure number xx in the "NRW Reduction Measures" (RM) webpage in the DSS platform http://www.vokas.si/waterloss/dssplatform/AppSpec/WATERLOSS_WATERLOSS/CustomPages/MeasuresMatrix.aspx
- DSS-aaxx : Measure with the code aaxx in the "DSS" webpage in the DSS platform http://www.vokas.si/waterloss/dssplatform/AppSpec/WATERLOSS_WATERLOSS/CustomPages/DSS.aspx
- DH-aaxx : Measure given in example by DH.

Metering accuracy

Bulk meter accuracy

Measure	PIs	Results
RM-4: Calibration of water meters, managing inaccuracy of water meters, age of water meters		
DH-MA01: Volumetric accuracy checked using a second meter		

ID	Variable	Unit	Value
D12	System flow meter calibration	No.	

Customer meter accuracy

Measure	PIs	Results
RM-28: Metering of revenue water		
DSS-OM4: Calibration of water use metering network		
DSS-OM5: Check of water use metering network		
DH-MA02: Monitoring water quality (the build-up in sediment affects the meter's accuracy)		
DH-MA03: Monitoring intermittent water supply (sudden large increase in pressure damage the meter's components)		
DH-MA04: Test of a representative sample of customer meters		

ID	Variable	Unit	Value

Data processing

Measure	PIs	Results
RM-38: Remote reading of meters in WSS		
DSS-DA5: Systematic control of billing records		
DH-MA05: Establishment of guidelines for WB volumes calculation		

ID	Variable	Unit	Value

Unbilled authorized consumption

Process water (for treatment plants)

Measure	PIs	Results
DSS-OM8: Improvement of water treatment techniques		
DH-AC01: Optimization of filter cleaning cycles		

ID	Variable	Unit	Value

Flushing

Measure	PIs	Results
RM-25: Reduction of operative water use (i.e. ensuring adequate water age) – usually expensive, should be prevented already in the design and development stage		
DH-AC02: Adaptation of the flushing duration		

ID	Variable	Unit	Value

Frost protection

Measure	PIs	Results
DH-AC03: Thermo insulation of non-buried pipes		

ID	Variable	Unit	Value

Tank cleaning

Measure	PIs	Results
DH-AC04: Beginning of tank cleaning when water level is low.		

ID	Variable	Unit	Value
D7	Storage tank cleaning	m^3	

Municipal use

Measure	PIs	Results
RM-5: Measurements of unbilled authorized consumption		
DH-AC05: Street washing with alternative water (from swimming-pools, rain, river, …)		

DH-AC06: Optimizing watering of parks and sports fields (methods, time, duration…)		
DH-AC07: Implementation of artificial turf on sports fields		

ID	Variable	Unit	Value

Fire fighting and training

Measure	PIs	Results
DH-AC08: Operators training		

ID	Variable	Unit	Value
C23	Hydrants	No.	
D11	Hydrants inspection	No.	

Other

Measure	PIs	Results
RM-27: Measurement of system water use (overflows, mud releases, pressure reduction valves…)		
RM-51: Rules for different water uses – especially large water users, transient phenomena, fire-fighters…		

ID	Variable	Unit	Value

Apparent losses

Meters under-registration

Measure	PIs	Results
DH-AL01: Replacement of low metrological class meters		

ID	Variable	Unit	Value

Water accounting errors

Measure	PIs	Results
DH-AL02: Improvement of the billing database		
DH-AL03: Meter reading with smart portable digital devices (Meter reader can control in the historical database)		

ID	Variable	Unit	Value

Water theft

Measure	PIs	Results
RM-6: Active search campaigns for illegal water connections		
RM-40: Legal measures (efficient prosecution of illegal connections) communication with the law enforcement authorities (prosecution process, evidence process, judicial procedures, penalties).		
DH-AL04: Addressing meter tampering		

ID	Variable	Unit	Value

Real losses

Active leakage control

Measure	PIs	Results
RM-1: Geophone (single -mobile)		
RM-2: Advanced hydraulic model development – continuous run of hydraulic model – nowcasting – verification with monitoring results		
RM-3: Leak noise correlators		
RM-13: Leakage and water loss identification by pressure variations		
RM-26: Continuous discharge measurements of water supplied to WSS - also other parameters (SCADA tool)		
RM-32: District metering (continuous discharge measurements)		
RM-33: Measurement campaigns (frequency) target measurement campaigns		
RM-58: Trace gas		
RM-59: Deployment of fixed noise loggers		
DSS-DA2: Implementation of leak detection techniques		
DSS-SS15: Installation of proper metering network		
DSS-SS16: Construction of alternative supply paths-mains		
DH-RL01: Night step-testing (reducing the size of the area by closing valves)		
DH-RL02: Implementation of a systematic leak detection planning		

ID	Variable	Unit	Value
D9	Leakage control	km	
D10	Leaks repaired due to active leakage control	No.	

Pressure management

Measure	PIs	Results
RM-10: Active identification and control of transient phenomena (identification of possibilities for transients etc.)		
RM-11: Pressure zoning (optimization of pressures)		
RM-12: Pressure reduction practice		
RM-22: Soft pump priming		
RM-23: Soft regulation of closing valves		
DSS-DA1: Hydraulic simulation of the system		
DSS-OM1: Change of valves settings		
DSS-SS1: Additional boosters & pressure reducing valves installation		
DSS-SS10: Installation of release valves		
DSS-SS19: Surge control		
DH-RL03: Pressure modulation		

ID	Variable	Unit	Value
D13	Pressure meter calibration	No.	

Speed of repairs

Measure	PIs	Results
RM-34: Permitting procedures for other constructions in the impact zones of the WSS infrastructure, also permitting procedures for the re-classification of roads		
RM-37: Central registry of underground infrastructure		
RM-39: Public awareness campaign (i.e. did anybody see wetted spot around the valve)		
DSS-OM3: Repair of leaks		
DSS-OM7: Proper checking of valves operation		
DH-RL04: Procedure to guarantee repair material availability		
DH-RL05: Reporting of repairing times		

ID	Variable	Unit	Value
C22	Isolating valves	No.	
D8	Network inspections	km	

Asset management

Measure	PIs	Results
RM-9: Thermography (Camera control of mains?)		

RM-8: Water consumption metering close to the mains (short service connections).		
RM-7: Identification of water losses from service connections (rehabilitation or replacement of service connections)		
RM-30: Register of pipe bursts interventions and identified leakage		
RM-24: Use of other specific equipment and rehabilitation tools in the case of identified leakage and pipe breach repair procedures (i.e. clamps, andorre type)		
RM-21 & DSS-SS13: Pipe cleaning and lining		
RM-20 & DSS-SS18: Pipe replacement (with corrosion-free material)		
RM-19: Observations of actual pipe aging (i.e. on test grounds)		
RM-18: Soil type mapping and soil stability standard		
RM-16: Construction process supervision and documentation		
RM-15: Construction process standards		
DSS-SS8: Improved pipe installation practices		
DSS-SS7: Avoid direct contact with electricity source		
DSS-SS6: Avoid bimetallic connections		
DSS-SS4: Cathodic protection		
DSS-SS17: Implementation of pipe insertion		
DSS-SS12: Check and repair of joints		
DH-RL06: Service connections replacement policy		
DH-RL07 : Use of a DSS to drive asset management policy (including breaks prediction tools)		

ID	Variable	Unit	Value
D20	Mains rehabilitation	km	
D21	Mains renovation	km	
D22	Mains replacement	km	
D23	Replaced valves	No.	
D24	Service connection rehabilitation	No.	

Other measures

Actions to reduce customer consumption

Measure	PIs	Results
DH-OM01: Installation of water efficient devices in households and public buildings		

ID	Variable	Unit	Value
D38	Days with restrictions to water service	day	

Actions to recover unpaid invoices

Measure	PIs	Results
RM-42: Efficient and effective payment realization (100% payment of water bills?).		
DH-OM02: Agreement with social services to fragment the debt		

ID	Variable	Unit	Value

Actions on tariffs

Measure	PIs	Results
RM-41 : Economic/financial measures (i.e. mangers of the WSS are awarded for the reduction of water losses, i.e. regional/central tax on the NRW)		
RM-48 : Pricing mechanism – cost recovery – target oriented water pricing		
RM-49 : Adequate pricing mechanisms covering all costs necessary for efficient water supply		
DH-OM03 : Fixed charge volume reduction		

ID	Variable	Unit	Value

Other actions

Measure	PIs	Results
RM-50: Development of programme of measures for the NRW reduction (documentation, evaluation, designs…)		
RM-54: Participation in target projects for the reduction of NRW		

ID	Variable	Unit	Value

DSS measures not yet assigned to a component

Measure	PIs	Results
RM-14: Planning process standards		
RM-17: Constructed WSS commission process standards		
RM-29 & DSS-DA3: System mapping using GIS. GIS development – information on system (gradual improvement of GIS functionalities)		
RM-31: Supply chain management (verification of suppliers – CE standards?, supply standards and reliability)		
RM-35: Change from intermittent water supply to continuous water supply		
RM-36: Document management and archives in the management company (archiving the documents on construction, service connections, permits etc.)		
RM-43: External supervision of the performance of the WSS (certification process)		
RM-44:Participation in the benchmarking schemes		
RM-45: HRM – company culture (every drop counts), permanent, targeted education of employees,		
RM-46: HRM – adequate staffing for different processes, adequate tools, equipment, education		
RM-47: Relative/absolute reduction of NRW – increase in water amount sold (Revenue water) is leading to relative reduction of NRW		
RM-52: Development of the microeconomic model for the WSS (actual supply and demand curve), i.e. demand flexibility, market behaviour analysis		
RM-53: Adequate economy of scale for the managers of the WSS		
RM-55: Improving the objective side of the NRW problem -artificial augmentation of the ressource		
RM-56: Improving the objective side of the NRW problem - Improved energy efficiency		
RM-57: Structural management of seasonal variation in water demand		
DSS-DA4: Keeping full data records (normal-abnormal)		
DSS-DA6: Intrusion control in high-risk points		
DSS-OM2: Regular pipe flushing		
DSS-OM6: pH adjustment of water		
DSS-SS11: Adoption of in-system chlorination		

DSS-SS14: Looped network operation		
DSS-SS2: Increase of tanks storage capacity		
DSS-SS5: Network cleaning		
DSS-SS9: Increase pumping capacity		

ID	Variable	Unit	Value

Annex 2

Answers of Waterloss project partners at DH questionnaire on NRW measures

1. Answer of AMB : Castellbisbal
2. Answer of DH : SIE de Lodève
3. Answer of WBN : Nicosia
4. Answer of PO : Argelès-sur-Mer
5. Answer of LG : Melito di Napoli
6. Answer of DEYAK : Kozani

WATERLOSS: Management of water losses in a drinking water supply system» (Transnational Cooperation Programme MED – Project 2G-MED09-445)

Internal Reporting of Project Partners

NRW reduction measures experiences

Phase	**4.1_Development of a DSS tool for appropriate NRW reduction strategy**
Deliverable	**D41.1_ Database of NRW management measures**
Partner responsible for the Phase	**PP9: Department of Herault (DH)**
Partner responsible for the Project	**LP: Aristotle University of Thessaloniki (AUTH)**
Partner's No	
Partner's full NAME	**Area Metropolitana de Barcelona**
Partner's short NAME	**AMB**
Partner's City	**Barcelona**
Partner's Country	**Spain**
Case Study Area	**Castellbisbal**
Pilot Case Study Network	**Castellbisbal**

SUMMARY

Additional information concerning WB assessment

Assessment period

Is the assessment period the billing period?	No. Assesment period is 2010. Billing period is every two months. WB calculation is done for 4 months period
How are estimated the starting and ending dates?	All 2010
Was there intermittent supply during the assessment period?	No

ID	Variable	Unit	Value
	Beginning date of the assessment period	Date (m/d/y)	1/1/2010
	Ending date of the assessment period	Date (m/d/y)	31/12/2010
H1	Assessment period	Day	365
H2	Time system is pressurised	Hour	24

System Input Volume

Is the system input volume period consistent with the assessment period?	Yes
Does the system input volume include raw water (abstracted or imported)?	No properly. Raw water goes to the Water Treatment Plant and SIV begins after this Water Treatment Plant
What is the reading frequency of abstraction, importation and exportation meters?	Abstraction.- it doesn't affect because abstraction is done before the SIV, but measures are automatically read every day

	Importation. Water coming to the system is read diary Exportation .- exported water is read diary
Is there any correction of imported, exported and abstracted volumes? If so, describe the method.	No
Is there any correction of billed metered volume? If so, describe the method.	No
Is there any policy of bulk meters replacement? If so describe it.	There aren't any bulk meters. The unique exportation point runs as a normal user.

ID	Variable	Unit	Value
A3	System input volume	m^3	2,445,454
A5	Exported raw water	m^3	0
A6	Water produced	m^3	1,410,144
A7	Exported treated water	m^3	3,294
	Abstracted raw water	m^3	1,476,591
	Imported raw water	m^3	0
A2	Imported treated water	m^3	1,035,310
C10	System flow meters	No.	11 (7 sectorisation, 3 bought water 1 sold water)

Bulk meters (number by type). It doesn't affect us !

Type	Importation	Abstraction	Exportation	Total
Electromagnetic flow meter				
Ultrasonic flow meter				
Insertion meter				
Mechanical meter				
Venturi meter				
Calculation with pump curves				
Measure weirs in open channels				
Other				
Total				

Billed authorized consumption

Are there customers supplied by roof tanks? If so percentage?	Yes. 18 domestic users. 0.35% of domestic user's or 0.31% total user's
Is there any policy of customer meters replacement? If so describe it.	There isn't any replacement policy. When a meter breaks down, then it's replaced.
Describe different categories of un-metered billed consumption the way they are evaluated and the number of customers concerned.	N/A

ID	Variable	Unit	Value
A8	Billed metered consumption	m^3	2,194,336
A9	Billed unmetered consumption	m^3	0

C26	Roof tanks number	No.	18
D42	Customer meter readings	No.	35,478
D45	Meter replacement	No.	267

Customer meters (number by diameter and metrological class).

Diameter	Class B	Class C	Class D	Other	Total	Average age (year) (*)
15 mm		5,246				
20 mm		213				
> 20 mm		264				
Total		**5,273**				

(*) At the present the water utility is updating the user's file management. Average age will be known in two years

Unbilled authorized consumption.

Estimation methods of unbilled unmetered authorized consumptions.

Category	Methods
Process water (for treatment plants).	NO. As the initial recommendations of the CO3 task group, the Water treatment Plant is not included on the WSS.
Flushing	YES
Frost protection	NO
Tank cleaning.	YES
Fire fighting and training.	YES
Municipal use.	NO
Other (specify).	
Comments	In general terms, unbilled unmetered authorized consumption is estimated about 0.4% of the SIV. It's very difficult to break down in the above terms.

ID	Variable	Unit	Value
A11	Unbilled metered consumption	m^3	0
A12	Unbilled unmetered consumption	m^3	9,782

Distribution of unbilled authorized consumptions (m^3). In general terms, unbilled unmetered authorized consumption is estimated about 0.4% of the SIV. It's very difficult to break down in the above terms.

Category	Metered	Unmetered	Total
Process water			
Flushing			
Frost protection			
Reservoir cleaning			
Municipal use			
Fire fighting and training			

Other (specify)			
Total			

Apparent losses and modified WB volumes

How is estimated unauthorized consumption and why?	0.4% of the SIV. There isn't any rule either policy to estimate it.
How are estimated meter inaccuracies and why?	1.2% of the SIV. There isn't any rule either policy to estimate it.
After how much time a not paid invoice is abandoned?	Time necessary to pass after a not paid bill received by the company and before to cut water is over two months
What is the delay between the end of the assessment period and the estimation of not paid for volumes?	The water utility knows when a water bill is not paid after 15 days since the water bill arrives at the bank
Is there a fixed charge in volume? If so how much?	no
Is there a fixed charge expressed in € related to water volumes? If so how much?	no
Is there a fixed charge expressed in € without water volumes? If so how much?	Yes. Depending on the meter user's diameter.

ID	Variable	Unit	Value
A16	Unauthorized consumption	m^3	9,782
A17	Metering inaccuracies water losses	m^3	29,345
A23	Billed but not paid for consumption	m^3	-
A25	Minimum Charge Difference	m^3	- (*)

(*) We've been sharing information with others Waterloss partners, studying the bibliography and CO3 translated document. We think that our mcd=0 because our fixed charge expressed in € is not related with the water consume, it's related with the meter diameter. Users pay all consumer water, from the first m3. We're still working

Additional information concerning the water supply system

Network subdivisions

Number of distribution units (zones where consumers drink the same water)	2
Number of pressure levels (zones with the same pressure regime)	Pressure average is 5,5 atm (550 kPa).
Number of DMAs monitored by SCADA (daily night flow available)	0 . SCADA shows the chlorine level at the water tanks and the product level at the Water treatment plant.
Number of other DMAs	Total DMA = 13

ID	Variable	Unit	Value
C11	District meters	No	7 (*)

(*) Only 7 DMA are monitored with CONTAZARA control system. This system basically allows to know minimum and maximum flow and consumption.

Assets

What are the methods used to measure and update mains length?	At the present, they're implementing a SIG (NETAQUA) to exactly know this measure
What are the methods used to measure and update service connections number?	At the present, they're implementing a SIG (NETAQUA) to exactly know this measure
What are the methods used to calculate and update average service connection length?	

ID	Variable	Unit	Value
C8	Mains length	km	144
C24	Service connections	No.	3,531
C25	Average service connection length	m	2 (estimation)

Operation

Is a calibrated hydraulic model available?	EPANET
What are the methods used to update water demand?	Doing a city planning analysis
How frequently is it calibrated?	City planning changes every 12 years
Are mains failures registered?	Yes. There are several work orders to register direct and undirect failures.
Are mains failures located at the section pipe level?	
Are service connection failures registered?	Yes. There are different work orders depending on the type of failure, domestic or industrial connection, irrigation or fire fighting connection
Are failures reported in the GIS?	no

ID	Variable	Unit	Value
D28	Mains failures	No.	53
D29	Service connection failures	No.	164

Pressure

Is estimating average pressure a standard practice of the utility?	Pressure average is 5,5 atm (550 kPa).
What are the methods used to evaluate average pressure?	DMA weighting
What is the weighting system used to calculate average pressure?	DMA weighting

ID	Variable	Unit	Value
C12	Pressure meters	No.	0
D34	Average operating pressure	kPa	550
MARP	Minimum Annual Reference Pressure (*)	kPa	250 (2.5 kg/cm2)

* MARP is the minimum standard of service pressure at the delivery point.

NRW reduction measures

AMB (Castellbisbal) note.
The utility is working on the following four axes in order to improve the management.

- Implementing a SIG
- Implementing a user's management and invoicing software. In order to have online characteristics about users and their meters, connections…
- Improvement of the existing meters software (flow and big consumer's meters). In order to update the software and to raise the number of running flow meters.
- Keep working on the SCADA to better know data about water and chlorine tanks level, working valves, and permanganate level at the Water treatment Plant (not included on the WSS reach)

Legend

Measure	**PIs**	**Results**
Designation and description of the measure. Indicate parts of the WSS which are concerned and realisation period.	Mention diagnosis and evaluation PIs used to carry out the measure (with formula for non-IWA PIs)	Indicate capital and operational expenditures, expected lifespan of installations, annual volume of water savings (and how it is evaluated), other results and value of dedicated PIs before and after the action (with reference date or period).
Example: Pressure regulation of DMA7 (31 km of mains, 26% of network mains length). Installation of 2 PRVs and 3 section valves. Annual maintenance. Operating since April 2009.	Average Operating Pressure (AOP) and Annual Water Losses (AWL). Same formula as IWA PIs at DMA level.	Capex = 25 000 € (2009) Opex = 850 €/year Expected lifespan = 30 years Water savings (2010) = 7 500 m^3 (estimation based on DMA night flows) AOP 2008 = 65 m of pressure AOP 2010 = 43 m of pressure AWL 2008 = 35 500 m^3 AWL 2010 = 28 000 m^3

ID	**Variable**	**Unit**	**Value**
AOP	Average Operating Pressure (DMA level)	m of pressure	See above
AWL	Annual Water Losses (DMA level)	m^3	See above

In the following tables, measures from the DSS platform and examples from DH are proposed:

- **if a measure doesn't fit with your WSS, please, mention in the column "Result" : *"not implemented"* and indicate if in your opinion this measure is relevant or not.**
- **Otherwise, fill the form,**

- **add the other measures you have implemented or planned to implement.**

Explanation of measures codification:

- RM-xx : Measure number xx in the "NRW Reduction Measures" (RM) webpage in the DSS platform http://www.vokas.si/waterloss/dssplatform/AppSpec/WATERLOSS_WATERLOSS/CustomPages/MeasuresMatrix.aspx
- DSS-aaxx : Measure with the code aaxx in the "DSS" webpage in the DSS platform http://www.vokas.si/waterloss/dssplatform/AppSpec/WATERLOSS_WATERLOSS/CustomPages/DSS.aspx
- DH-aaxx : Measure given in example by DH.

Note that the following comments show the opinion of relevance of the Water utility. It doesn't mean that the measures are implanted.

R= RELEVANT
NR= NOT RELEVANT

Metering accuracy

Bulk meter accuracy It doesn't affect us

Measure	PIs	Results
RM-4: Calibration of water meters, managing inaccuracy of water meters, age of water meters		
DH-MA01: Volumetric accuracy checked using a second meter		

ID	Variable	Unit	Value
D12	System flow meter calibration	No.	

Customer meter accuracy

Measure	PIs	Results
RM-28: Metering of revenue water		R.- At Castellbisbal all selled water is metered.
DSS-OM4: Calibration of water use metering network		NR
DSS-OM5: Check of water use metering network		What does exactly mean? More description
DH-MA02: Monitoring water quality (the build-up in sediment affects the meter's accuracy)		Not too relevant
DH-MA03: Monitoring intermittent water supply (sudden large increase in pressure damage the meter's components)		NR
DH-MA04: Test of a representative sample of customer meters		NR (*)

(*) Meters maker must have a periodic audit instead of testing customers meters.

ID	Variable	Unit	Value

Data processing

Measure	PIs	Results
RM-38: Remote reading of meters in WSS		Already done
DSS-DA5: Systematic control of billing records		R
DH-MA05: Establishment of guidelines for WB volumes calculation		R

ID	Variable	Unit	Value

Unbilled authorized consumption

Process water (for treatment plants). It doesn't affect us. Our WSS doesn't includes Water Treatment Plant

Measure	PIs	Results
DSS-OM8: Improvement of water treatment techniques		
DH-AC01: Optimization of filter cleaning cycles		

ID	Variable	Unit	Value

Flushing

Measure	PIs	Results
RM-25: Reduction of operative water use (i.e. ensuring adequate water age) – usually expensive, should be prevented already in the design and development stage		NR
DH-AC02: Adaptation of the flushing duration		R

ID	Variable	Unit	Value

Frost protection It doesn't affect us

Measure	PIs	Results
DH-AC03: Thermo insulation of non-buried pipes		

ID	Variable	Unit	Value

Tank cleaning. The utility cleans water tanks once a year. There isn't any formal procedure neither register. When tank is empty, a bypass is made on the network avoiding to fall water supply. Tanks are cleaned and filled again.

Measure	PIs	Results
DH-AC04: Beginning of tank cleaning when water level is low.		NR

ID	Variable	Unit	Value
D7	Storage tank cleaning	m^3	352 (estimation)

Municipal use

Measure	PIs	Results
RM-5: Measurements of unbilled authorized consumption		NR
DH-AC05: Street washing with alternative water (from swimming-pools, rain, river, …)		R
DH-AC06: Optimizing watering of parks and sports fields (methods, time, duration…)		R
DH-AC07: Implementation of artificial turf on sports fields		R

ID	Variable	Unit	Value

Fire fighting and training. The utility checks hydrants once a year. There isn't any formal procedure neither register.

Measure	PIs	Results
DH-AC08: Operators training		R.

Other proposed measures: firemen must inform the Water Utility every time they use water. Hydrants network under surveillance and control. Penalisation to the water thefts.

ID	Variable	Unit	Value
C23	Hydrants	No.	108
D11	Hydrants inspection	No.	108

Other

Measure	PIs	Results
RM-27: Measurement of system water use (overflows, mud releases, pressure reduction valves…)		R
RM-51: Rules for different water uses – especially large water users, transient phenomena, fire-fighters…		Not too Relevant

ID	Variable	Unit	Value

Apparent losses

Meters under-registration

Measure	PIs	Results
DH-AL01: Replacement of low metrological class meters		The users management and invoicing software will show data of the existing of this type of class meters

ID	Variable	Unit	Value

Water accounting errors

Measure	PIs	Results
DH-AL02: Improvement of the billing database		The users management and invoicing software is now implementing
DH-AL03: Meter reading with smart portable digital devices (Meter reader can control in the historical database)		

ID	Variable	Unit	Value

Water theft

Measure	PIs	Results
RM-6: Active search campaigns for illegal water connections		R
RM-40: Legal measures (efficient prosecution of illegal connections) communication with the law enforcement authorities (prosecution process, evidence process, judicial procedures, penalties).		R
DH-AL04: Addressing meter tampering		

ID	Variable	Unit	Value

Real losses

Active leakage control

Measure	PIs	Results
RM-1: Geophone (single -mobile)		Not too relevant
RM-2: Advanced hydraulic model development – continuous run of hydraulic model – nowcasting – verification with monitoring results		R
RM-3: Leak noise correlators		Not too relevant
RM-13: Leakage and water loss identification by pressure variations		R
RM-26: Continuous discharge measurements of water supplied to WSS - also other parameters (SCADA tool)		R
RM-32: District metering (continuous discharge measurements)		R
RM-33: Measurement campaigns (frequency) target measurement campaigns		NR
RM-58: Trace gas		NR
RM-59: Deployment of fixed noise loggers		NR
DSS-DA2: Implementation of leak detection techniques		RM1, RM3, … are the proper implementations. Answered before
DSS-SS15: Installation of proper metering network		R
DSS-SS16: Construction of alternative supply paths-mains		R
DH-RL01: Night step-testing (reducing the size of the area by closing valves)		R
DH-RL02: Implementation of a systematic leak detection planning		R

ID	Variable	Unit	Value
D9	Leakage control	Km	0
D10	Leaks repaired due to active leakage control	No.	0
D28	Pipes failures	No	53
D29	Connections failures	No	164
	AICSA doesn't have any leakage control system. When a failure is detected, a work sheet is opened to investigate and repair it.		Number of opened work sheets in order to repair the failure.

Pressure management

Measure	PIs	Results
RM-10: Active identification and control of transient phenomena (identification of possibilities for transients etc.)		R
RM-11: Pressure zoning (optimization of pressures)		R
RM-12: Pressure reduction practice		R
RM-22: Soft pump priming		NR
RM-23: Soft regulation of closing valves		Not too relevant
DSS-DA1: Hydraulic simulation of the system		R
DSS-OM1: Change of valves settings		NR
DSS-SS1: Additional boosters & pressure reducing valves installation		R
DSS-SS10: Installation of release valves		
DSS-SS19: Surge control		R
DH-RL03: Pressure modulation		R

ID	Variable	Unit	Value
D13	Pressure meter calibration	No.	0 . There aren't this type of meters

Speed of repairs

Measure	PIs	Results
RM-34: Permitting procedures for other constructions in the impact zones of the WSS infrastructure, also permitting procedures for the re-classification of roads		R
RM-37: Central registry of underground infrastructure		Not too relevant
RM-39: Public awareness campaign (i.e. did anybody see wetted spot around the valve)		NR
DSS-OM3: Repair of leaks		The Water utility doesn't control the speed. When the failure is detected, a work sheet is opened to investigate and repair it.
DSS-OM7: Proper checking of valves operation		Valves maker must have a periodic audit
DH-RL04: Procedure to guarantee repair material availability		Materials maker must have a periodic audit
DH-RL05: Reporting of repairing times		Not too relevant

ID	Variable	Unit	Value
C22	Isolating valves	No.	1012
D8	Network inspections	km	0

Asset management

Measure	PIs	Results
RM-9: Thermography (Camera control of mains?)		Not too relevant
RM-8: Water consumption metering close to the mains (short service connections).		R
RM-7: Identification of water losses from service connections (rehabilitation or replacement of service connections)		NR
RM-30: Register of pipe bursts interventions and identified leakage		R
RM-24: Use of other specific equipment and rehabilitation tools in the case of identified leakage and pipe breach repair procedures (i.e. clamps, andorre type)		NR
RM-21 & DSS-SS13: Pipe cleaning and lining		NR
RM-20 & DSS-SS18: Pipe replacement (with corrosion-free material)		R
RM-19: Observations of actual pipe aging (i.e. on test grounds)		NR
RM-18: Soil type mapping and soil stability standard		Not too relevant
RM-16: Construction process supervision and documentation		RELEVANT
RM-15: Construction process standards		Not too relevant
DSS-SS8: Improved pipe installation practices		What does it mean? More information needed
DSS-SS7: Avoid direct contact with electricity source		Not too relevant
DSS-SS6: Avoid bimetallic connections		R
DSS-SS4: Cathodic protection		Not too relevant
DSS-SS17: Implementation of pipe insertion		What does it mean? More information needed
DSS-SS12: Check and repair of joints		Not too relevant
DH-RL06: Service connections replacement policy		Not too relevant
DH-RL07 : Use of a DSS to drive asset management policy (including breaks prediction tools)		R

ID	Variable	Unit	Value
D20	Mains rehabilitation	km	0
D21	Mains renovation	km	0

D22	Mains replacement	km	2
D23	Replaced valves	No.	38
D24	Service connection rehabilitation	No.	12

Other measures

Actions to reduce customer consumption

Measure	PIs	Results
DH-OM01: Installation of water efficient devices in households and public buildings		R

ID	Variable	Unit	Value
D38	Days with restrictions to water service	day	0

Actions to recover unpaid invoices

Measure	PIs	Results
RM-42: Efficient and effective payment realization (100% payment of water bills?).		R
DH-OM02: Agreement with social services to fragment the debt		NR. Is better to act over the Social Services.

ID	Variable	Unit	Value

Actions on tariffs

Measure	PIs	Results
RM-41 : Economic/financial measures (i.e. mangers of the WSS are awarded for the reduction of water losses, i.e. regional/central tax on the NRW)		R
RM-48 : Pricing mechanism – cost recovery – target oriented water pricing		NR
RM-49 : Adequate pricing mechanisms covering all costs necessary for efficient water supply		R
DH-OM03 : Fixed charge volume reduction		N/A

ID	Variable	Unit	Value

Other actions

Measure	PIs	Results

RM-50: Development of programme of measures for the NRW reduction (documentation, evaluation, designs…)		R
RM-54: Participation in target projects for the reduction of NRW		R

ID	Variable	Unit	Value

DSS measures not yet assigned to a component

Measure	PIs	Results
RM-14: Planning process standards		NR
RM-17: Constructed WSS commission process standards		NR
RM-29 & DSS-DA3: System mapping using GIS. GIS development – information on system (gradual improvement of GIS functionalities)		R
RM-31: Supply chain management (verification of suppliers – CE standards?, supply standards and reliability)		R
RM-35: Change from intermittent water supply to continuous water supply		R
RM-36: Document management and archives in the management company (archiving the documents on construction, service connections, permits etc.)		R
RM-43: External supervision of the performance of the WSS (certification process)		NR
RM-44:Participation in the benchmarking schemes		R
RM-45: HRM – company culture (every drop counts), permanent, targeted education of employees,		R
RM-46: HRM – adequate staffing for different processes, adequate tools, equipment, education		R
RM-47: Relative/absolute reduction of NRW – increase in water amount sold (Revenue water) is leading to relative reduction of NRW		Not too relevant
RM-52: Development of the microeconomic model for the WSS (actual supply and demand curve), i.e. demand flexibility, market behaviour analysis		Not too relevant
RM-53: Adequate economy of scale for the managers of the WSS		NR

RM-55: Improving the objective side of the NRW problem -artificial augmentation of the ressource		Not too relevant
RM-56: Improving the objective side of the NRW problem - Improved energy efficiency		NR
RM-57: Structural management of seasonal variation in water demand		NR
DSS-DA4: Keeping full data records (normal-abnormal)		What does exactly mean? More information needed
DSS-DA6: Intrusion control in high-risk points		R
DSS-OM2: Regular pipe flushing		NR
DSS-OM6: pH adjustment of water		Not too relevant
DSS-SS11: Adoption of in-system chlorination		Chlorine control is done by the SCADA at the tanks
DSS-SS14: Looped network operation		R
DSS-SS2: Increase of tanks storage capacity		NR
DSS-SS5: Network cleaning		R
DSS-SS9: Increase pumping capacity		NR

ID	Variable	Unit	Value

WATERLOSS

WATERLOSS: Management of water losses in a drinking water supply system» (Transnational Cooperation Programme MED – Project 2G-MED09-445)

Internal Reporting of Project Partners

NRW reduction measures experiences

Phase	**4.1_Development of a DSS tool for appropriate NRW reduction strategy**
Deliverable	**D41.1_ Database of NRW management measures**
Partner responsible for the Phase	**PP9: Department of Herault (DH)**
Partner responsible for the Project	**LP: Aristotle University of Thessaloniki (AUTH)**
Partner's No	**9**
Partner's full NAME	**General council of Herault**
Partner's short NAME	**Departement of Herault**
Partner's City	**Montpellier**
Partner's Country	**France**
Case Study Area	**Intercommunal water syndicate of Lodève area (SIEL)**
Pilot Case Study Network	

SUMMARY

Additional information concerning WB assessment

Assessment period

Is the assessment period the billing period?	yes
How are estimated the starting and ending dates?	meters readings
Was there intermittent supply during the assessment period?	No

ID	Variable	Unit	Value
	Beginning date of the assessment period	Date (m/d/y)	01/01/2011
	Ending date of the assessment period	Date (m/d/y)	31/12/2011
H1	Assessment period	Day	365
H2	Time system is pressurised	Hour	24H

System Input Volume

Is the system input volume period consistent with the assessment period?	Yes
Does the system input volume include raw water (abstracted or imported)?	Yes
What is the reading frequency of abstraction, importation and exportation meters?	Once / year
Is there any correction of imported, exported and abstracted volumes? If so, describe the method.	No
Is there any correction of billed metered volume? If so, describe the method.	No
Is there any policy of bulk meters replacement? If so describe it.	No

ID	Variable	Unit	Value
A3	System input volume	m^3	1 436 640
A5	Exported raw water	m^3	0
A6	Water produced	m^3	1 436 640
A7	Exported treated water	m^3	66 990
	Abstracted raw water	m^3	1 436 640
	Imported raw water	m^3	0
	Imported treated water	m^3	0
C10	System flow meters	No.	21

Bulk meters (number by type)

Type	Importation	Abstraction	Exportation	Total
Electromagnetic flow meter		2		
Ultrasonic flow meter		0		
Insertion meter		0		
Mechanical meter		0	2	
Venturi meter		0		
Calculation with pump curves				
Measure weirs in open channels		2		
Other				
Total				

Billed authorized consumption

Are there customers supplied by roof tanks? If so percentage?	
Is there any policy of customer meters replacement? If so describe it.	No (replacing each 10 years is a recommendation)
Describe different categories of un-metered billed consumption the way they are evaluated and the number of customers concerned.	0

ID	Variable	Unit	Value
A8	Billed metered consumption	m^3	557 134
A9	Billed unmetered consumption	m^3	0
C26	Roof tanks number	No.	10
D42	Customer meter readings	No.	3655
D45	Meter replacement	No.	?

Customer meters (number by diameter and metrological class)

Diameter	Class B	Class C	Class D	Other	Total	Average age (year)
15 mm					3521	
20 mm					57	
> 20 mm					74	
Total					**3652**	

Total	Average age (year)
962	**Inf à 9 ans**
0	**9 -12 years**
0[2]	**12 – 15 years**
2691	**Sup à 15 years**

Unbilled authorized consumption

Estimation methods of unbilled unmetered authorized consumptions

Category	Methods
Process water (for treatment plants)	Statement of expert
Flushing	

Frost protection	
Tank cleaning	
Fire fighting and training	
Municipal use	Meters on the most part of the public site
Other (specify)	

ID	Variable	Unit	Value
A11	Unbilled metered consumption	m^3	0
A12	Unbilled unmetered consumption	m^3	3000

Distribution of unbilled authorized consumptions (m^3)

Category	Metered	Unmetered	Total
Process water			Minimum volume
Flushing			Most part
Frost protection			Minimum volume
Reservoir cleaning			Most part
Municipal use			Minimum volume
Fire fighting and training			Minimum volume
Other (specify)			
Total			3000

Apparent losses and modified WB volumes

How is estimated unauthorized consumption and why?	Statements of expert
How are estimated meter inaccuracies and why?	It is considred empirically that (values taken from the averages observed from our calibration database). • Over 15 years of age under-value by an average of – 15 % x Q • Between 12 and 15 years of age under-value by an average of – 10 % x Q • Between 9 and 12 years of age under-value by an average of – 5 % x Q
After how much time a not paid invoice is abandoned?	Before 2005, it is lost. It is managed by Tresor Public.
What is the delay between the end of the assessment period and the estimation of not paid for volumes?	
Is there a fixed charge in volume? If so how much?	0.80 €/m3
Is there a fixed charge expressed in € related to water volumes? If so how much?	
Is there a fixed charge expressed in € without water volumes? If so how much?	35 €

ID	Variable	Unit	Value
A16	Unauthorized consumption	m^3	2000
A17	Metering inaccuracies water losses	m^3	60 625
A23	Billed but not paid for consumption	m^3	?

A25	Minimum Charge Difference	m^3	

Additional information concerning the water supply system

Network subdivisions

Number of distribution units (zones where consumers drink the same water)	10
Number of pressure levels (zones with the same pressure regime)	2
Number of DMAs monitored by SCADA (daily night flow available)	
Number of other DMAs	

ID	Variable	Unit	Value
C11	District meters	No	22

Assets

What are the methods used to measure and update mains length?	According to the record drawings
What are the methods used to measure and update service connections number?	?
What are the methods used to calculate and update average service connection length?	?

ID	Variable	Unit	Value
C8	Mains length	km	110 km
C24	Service connections	No.	3655)
C25	Average service connection length	m	?

Operation

Is a calibrated hydraulic model available?	Epanet
What are the methods used to update water demand?	
How frequently is it calibrated?	At the beginning
Are mains failures registered?	Y
Are mains failures located at the section pipe level?	Y
Are service connection failures registered?	Y
Are failures reported in the GIS?	No GIS at the moment

ID	Variable	Unit	Value
D28	Mains failures	No.	?
D29	Service connection failures	No.	?

Pressure

Is estimating average pressure a standard practice of the utility?	Yes
What are the methods used to evaluate average pressure?	Supervision and manual control

What is the weighting system used to calculate average pressure?	?

ID	Variable	Unit	Value
C12	Pressure meters	No.	12
D34	Average operating pressure	kPa	3,5 kPa
MARP	Minimum Annual Reference Pressure (*)	kPa	3

* MARP is the minimum standard of service pressure at the delivery point

NRW reduction measures

Legend

Measure	PIs	Results
Designation and description of the measure. Indicate parts of the WSS which are concerned and realisation period.	Mention diagnosis and evaluation PIs used to carry out the measure (with formula for non-IWA PIs)	Indicate capital and operational expenditures, expected lifespan of installations, annual volume of water savings (and how it is evaluated), other results and value of dedicated PIs before and after the action (with reference date or period).
Example: Pressure regulation of DMA7 (31 km of mains, 26% of network mains length). Installation of 2 PRVs and 3 section valves. Annual maintenance. Operating since April 2009.	Average Operating Pressure (AOP) and Annual Water Losses (AWL). Same formula as IWA PIs at DMA level.	Capex = 25 000 € (2009) Opex = 850 €/year Expected lifespan = 30 years Water savings (2010) = 7 500 m^3 (estimation based on DMA night flows) AOP 2008 = 65 m of pressure AOP 2010 = 43 m of pressure AWL 2008 = 35 500 m^3 AWL 2010 = 28 000 m^3

ID	Variable	Unit	Value
AOP	Average Operating Pressure (DMA level)	m of pressure	See above
AWL	Annual Water Losses (DMA level)	m^3	See above

In the following tables, measures from the DSS platform and examples from DH are proposed:

- **if a measure doesn't fit with your WSS, please, mention in the column "Result" : *"not implemented"* and indicate if in your opinion this measure is relevant or not.**
- **Otherwise, fill the form,**
- **add the other measures you have implemented or planned to implement.**

Explanation of measures codification:

- RM-xx : Measure number xx in the "NRW Reduction Measures" (RM) webpage in the DSS platform http://www.vokas.si/waterloss/dssplatform/AppSpec/WATERLOSS_WATERLOSS/CustomPages/MeasuresMatrix.aspx
- DSS-aaxx : Measure with the code aaxx in the "DSS" webpage in the DSS platform http://www.vokas.si/waterloss/dssplatform/AppSpec/WATERLOSS_WATERLOSS/CustomPages/DSS.aspx
- DH-aaxx : Measure given in example by DH.

Metering accuracy

Bulk meter accuracy

Measure	PIs	Results
RM-4: Calibration of water meters, managing inaccuracy of water meters, age of water meters		
DH-MA01: Volumetric accuracy checked using a second meter		

ID	Variable	Unit	Value
D12	System flow meter calibration	No.	

Customer meter accuracy

Measure	PIs	Results
RM-28: Metering of revenue water		Almost all the municipal uses are metered since 2011. Approximately 40 meters have to be installed in the future..
DSS-OM4: Calibration of water use metering network		
DSS-OM5: Check of water use metering network		
DH-MA02: Monitoring water quality (the build-up in sediment affects the meter's accuracy)		
DH-MA03: Monitoring intermittent water supply (sudden large increase in pressure damage the meter's components)		
DH-MA04: Test of a representative sample of customer meters		

ID	Variable	Unit	Value

Data processing

Measure	PIs	Results
RM-38: Remote reading of meters in WSS		Remote management (since 2011) allow to identificate and to repair quickly the leaks.
DSS-DA5: Systematic control of billing records		
DH-MA05: Establishment of guidelines for WB volumes calculation		

ID	Variable	Unit	Value

Unbilled authorized consumption

Process water (for treatment plants)

Measure	PIs	Results
DSS-OM8: Improvement of water treatment techniques		
DH-AC01: Optimization of filter cleaning cycles		

ID	Variable	Unit	Value

Flushing

Measure	PIs	Results
RM-25: Reduction of operative water use (i.e. ensuring adequate water age) – usually expensive, should be prevented already in the design and development stage		
DH-AC02: Adaptation of the flushing duration		

ID	Variable	Unit	Value

Frost protection

Measure	PIs	Results
DH-AC03: Thermo insulation of non-buried pipes		

ID	Variable	Unit	Value

Tank cleaning

Measure	PIs	Results
DH-AC04: Beginning of tank cleaning when water level is low.		

ID	Variable	Unit	Value
D7	Storage tank cleaning	m^3	

Municipal use

Measure	PIs	Results
RM-5: Measurements of unbilled authorized consumption		
DH-AC05: Street washing with alternative water (from swimming-pools, rain, river, …)		

DH-AC06: Optimizing watering of parks and sports fields (methods, time, duration…)		
DH-AC07: Implementation of artificial turf on sports fields		

ID	Variable	Unit	Value

Fire fighting and training

Measure	PIs	Results
DH-AC08: Operators training		

ID	Variable	Unit	Value
C23	Hydrants	No.	
D11	Hydrants inspection	No.	

Other

Measure	PIs	Results
RM-27: Measurement of system water use (overflows, mud releases, pressure reduction valves…)		
RM-51: Rules for different water uses – especially large water users, transient phenomena, fire-fighters…		

ID	Variable	Unit	Value

Apparent losses

Meters under-registration

Measure	PIs	Results
DH-AL01: Replacement of low metrological class meters		Actually there is still 2691 meters older than 15 years. And 962 older than 9 years. Their replacement could occur 60 625 m3 / year.

ID	Variable	Unit	Value

Water accounting errors

Measure	PIs	Results
DH-AL02: Improvement of the billing database		
DH-AL03: Meter reading with smart portable digital devices (Meter reader can control in the historical database)		

ID	Variable	Unit	Value

Water theft

Measure	PIs	Results
RM-6: Active search campaigns for illegal water connections		
RM-40: Legal measures (efficient prosecution of illegal connections) communication with the law enforcement authorities (prosecution process, evidence process, judicial procedures, penalties).		
DH-AL04: Addressing meter tampering		

ID	Variable	Unit	Value

Real losses

Active leakage control

Measure	PIs	Results
RM-1: Geophone (single -mobile)		
RM-2: Advanced hydraulic model development – continuous run of hydraulic model – nowcasting – verification with monitoring results		
RM-3: Leak noise correlators		
RM-13: Leakage and water loss identification by pressure variations		
RM-26: Continuous discharge measurements of water supplied to WSS - also other parameters (SCADA tool)		Difficult to have a feedback because it is a recent equipment.
RM-32: District metering (continuous discharge measurements)		
RM-33: Measurement campaigns (frequency) target measurement campaigns		One compaign of three weeks to increase by 15 points the performance of the water network.
RM-58: Trace gas		
RM-59: Deployment of fixed noise loggers		
DSS-DA2: Implementation of leak detection techniques		
DSS-SS15: Installation of proper metering network		
DSS-SS16: Construction of alternative supply paths-mains		
DH-RL01: Night step-testing (reducing the size of the area by closing valves)		
DH-RL02: Implementation of a systematic leak detection planning		

ID	Variable	Unit	Value
D9	Leakage control	km	13729
D10	Leaks repaired due to active leakage control	No.	47 m3/h

Pressure management

Measure	PIs	Results
RM-10: Active identification and control of transient phenomena (identification of possibilities for transients etc.)		
RM-11: Pressure zoning (optimization of pressures)		
RM-12: Pressure reduction practice		
RM-22: Soft pump priming		
RM-23: Soft regulation of closing valves		
DSS-DA1: Hydraulic simulation of the system		
DSS-OM1: Change of valves settings		
DSS-SS1: Additional boosters & pressure reducing valves installation		
DSS-SS10: Installation of release valves		
DSS-SS19: Surge control		
DH-RL03: Pressure modulation		

ID	Variable	Unit	Value
D13	Pressure meter calibration	No.	

Speed of repairs

Measure	PIs	Results
RM-34: Permitting procedures for other constructions in the impact zones of the WSS infrastructure, also permitting procedures for the re-classification of roads		
RM-37: Central registry of underground infrastructure		
RM-39: Public awareness campaign (i.e. did anybody see wetted spot around the valve)		
DSS-OM3: Repair of leaks		One day delay, no more.
DSS-OM7: Proper checking of valves operation		
DH-RL04: Procedure to guarantee repair material availability		
DH-RL05: Reporting of repairing times		

ID	Variable	Unit	Value
C22	Isolating valves	No.	
D8	Network inspections	km	

Asset management

Measure	PIs	Results
RM-9: Thermography (Camera control of mains?)		

RM-8: Water consumption metering close to the mains (short service connections).		
RM-7: Identification of water losses from service connections (rehabilitation or replacement of service connections)		
RM-30: Register of pipe bursts interventions and identified leakage		systematic
RM-24: Use of other specific equipment and rehabilitation tools in the case of identified leakage and pipe breach repair procedures (i.e. clamps, andorre type)		
RM-21 & DSS-SS13: Pipe cleaning and lining		
RM-20 & DSS-SS18: Pipe replacement (with corrosion-free material)		
RM-19: Observations of actual pipe aging (i.e. on test grounds)		
RM-18: Soil type mapping and soil stability standard		
RM-16: Construction process supervision and documentation		
RM-15: Construction process standards		
DSS-SS8: Improved pipe installation practices		
DSS-SS7: Avoid direct contact with electricity source		
DSS-SS6: Avoid bimetallic connections		
DSS-SS4: Cathodic protection		
DSS-SS17: Implementation of pipe insertion		
DSS-SS12: Check and repair of joints		
DH-RL06: Service connections replacement policy		141 should be replaced
DH-RL07 : Use of a DSS to drive asset management policy (including breaks prediction tools)		

ID	Variable	Unit	Value
D20	Mains rehabilitation	km	
D21	Mains renovation	km	
D22	Mains replacement	km	
D23	Replaced valves	No.	
D24	Service connection rehabilitation	No.	141

Other measures

Actions to reduce customer consumption

Measure	PIs	Results
DH-OM01: Installation of water efficient devices in households and public buildings		

ID	Variable	Unit	Value
D38	Days with restrictions to water service	day	

Actions to recover unpaid invoices

Measure	PIs	Results
RM-42: Efficient and effective payment realization (100% payment of water bills?).		
DH-OM02: Agreement with social services to fragment the debt		

ID	Variable	Unit	Value

Actions on tariffs

Measure	PIs	Results
RM-41 : Economic/financial measures (i.e. mangers of the WSS are awarded for the reduction of water losses, i.e. regional/central tax on the NRW)		
RM-48 : Pricing mechanism – cost recovery – target oriented water pricing		
RM-49 : Adequate pricing mechanisms covering all costs necessary for efficient water supply		
DH-OM03 : Fixed charge volume reduction		

ID	Variable	Unit	Value

Other actions

Measure	PIs	Results
RM-50: Development of programme of measures for the NRW reduction (documentation, evaluation, designs…)		
RM-54: Participation in target projects for the reduction of NRW		

ID	Variable	Unit	Value

DSS measures not yet assigned to a component

Measure	PIs	Results
RM-14: Planning process standards		
RM-17: Constructed WSS commission process standards		
RM-29 & DSS-DA3: System mapping using GIS. GIS development – information on system (gradual improvement of GIS functionalities)		Actual GIS developpement with intercommunality.
RM-31: Supply chain management (verification of suppliers – CE standards?, supply standards and reliability)		
RM-35: Change from intermittent water supply to continuous water supply		
RM-36: Document management and archives in the management company (archiving the documents on construction, service connections, permits etc.)		
RM-43: External supervision of the performance of the WSS (certification process)		
RM-44:Participation in the benchmarking schemes		
RM-45: HRM – company culture (every drop counts), permanent, targeted education of employees,		
RM-46: HRM – adequate staffing for different processes, adequate tools, equipment, education		
RM-47: Relative/absolute reduction of NRW – increase in water amount sold (Revenue water) is leading to relative reduction of NRW		
RM-52: Development of the microeconomic model for the WSS (actual supply and demand curve), i.e. demand flexibility, market behaviour analysis		
RM-53: Adequate economy of scale for the managers of the WSS		
RM-55: Improving the objective side of the NRW problem -artificial augmentation of the ressource		
RM-56: Improving the objective side of the NRW problem - Improved energy efficiency		
RM-57: Structural management of seasonal variation in water demand		
DSS-DA4: Keeping full data records (normal-abnormal)		
DSS-DA6: Intrusion control in high-risk points		
DSS-OM2: Regular pipe flushing		
DSS-OM6: pH adjustment of water		
DSS-SS11: Adoption of in-system chlorination		

DSS-SS14: Looped network operation		
DSS-SS2: Increase of tanks storage capacity		
DSS-SS5: Network cleaning		
DSS-SS9: Increase pumping capacity		

ID	Variable	Unit	Value

WATERLOSS

WATERLOSS: Management of water losses in a drinking water supply system» (Transnational Cooperation Programme MED – Project 2G-MED09-445)

Internal Reporting of Project Partners

NRW reduction measures experiences

Phase	**4.1_Development of a DSS tool for appropriate NRW reduction strategy**
Deliverable	**D41.1_ Database of NRW management measures**
Partner responsible for the Phase	**PP9: Department of Herault (DH)**
Partner responsible for the Project	**LP: Aristotle University of Thessaloniki (AUTH)**
Partner's No	**PP4**
Partner's full NAME	**Water Board of Nicosia**
Partner's short NAME	**WBN**
Partner's City	**Nicosia**
Partner's Country	**Cyprus**
Case Study Area	**Water Distribution system of Nicosia**
Pilot Case Study Network	**DMA No. 15, 20**

SUMMARY

Additional information concerning WB assessment

Assessment period

Is the assessment period the billing period?	No. The assessment period is the days of the year. Intermediate assessment is also performed.
How are estimated the starting and ending dates?	Billing period corresponds to the date the recording of customer meter consumption is completed
Was there intermittent supply during the assessment period?	Continuous supply was re-installed during the assessment period year 2010, after intermittent supply from 4/2008-1/2010.

ID	Variable	Unit	Value
	Beginning date of the assessment period	Date (m/d/y)	1/1/2010
	Ending date of the assessment period	Date (m/d/y)	31/12/2010
H1	Assessment period	Day	365
H2	Time system is pressurised	Hour	8760

System Input Volume

Is the system input volume period consistent with the assessment period?	Yes
Does the system input volume include raw water (abstracted or imported)?	No
What is the reading frequency of abstraction, importation and exportation meters?	Continuous monitoring
Is there any correction of imported, exported and abstracted volumes? If so, describe the method.	No
Is there any correction of billed metered volume? If so, describe the method.	Yes. The Billed metered volume is adjusted to correspond to the days of the year.
Is there any policy of bulk meters replacement? If so describe it.	Yes. Bulk meters are replaced when they malfunction

ID	Variable	Unit	Value
A3	System input volume	m^3	23,838,611
A5	Exported raw water	m^3	
A6	Water produced	m^3	
A7	Exported treated water (Not treated)	m^3	3,124,150
	Abstracted raw water	m^3	
	Imported raw water	m^3	
	Imported treated water	m^3	
C10	System flow meters	No.	56

Bulk meters (number by type)

Type	Importation	Abstraction	Exportation	Total
Electromagnetic flow meter	2		4	**6**
Ultrasonic flow meter				
Insertion meter				
Mechanical meter	42		8	**50**
Venturi meter				
Calculation with pump curves				
Measure weirs in open channels				
Other				
Total				**56**

Billed authorized consumption

Are there customers supplied by roof tanks? If so percentage?	Yes. 100% - WBN obliges all customers to be equipped with a roof tank (min. capacity 1m3)
Is there any policy of customer meters replacement? If so describe it.	Customer meters are replaced when they malfunction. Recently they are replaced if older than 10 years.
Describe different categories of un-metered billed consumption the way they are evaluated and the number of customers concerned.	Billed volume of water lost due to damage on the supply system by third parties. Billed volume of water to consumer when water theft if discovered from illegal connection

ID	Variable	Unit	Value
A8	Billed metered consumption	m^3	14,467,783
A9	Billed unmetered consumption	m^3	13,310
C26	Roof tanks number	No.	107,613
D42	Customer meter readings	No.	107,613
D45	Meter replacement	No.	3.400

Customer meters (number by diameter and metrological class)

Diameter	Class B	Class C	Class D	Other	Total	Average age (year)
15 mm						
20 mm						
> 20 mm						
Total						

Unbilled authorized consumption

Estimation methods of unbilled unmetered authorized consumptions

Category	Methods
Process water (for treatment plants)	N/A The WBN is not responsible for the production of water
Flushing	An estimate concerning the time the hydrant was left open and an average flow calculation
Frost protection	N/A
Tank cleaning	Periodically
Fire fighting and training	The Fire Brigade Department provides a

	monthly consumption estimate
Municipal use	
Other (specify)	

ID	Variable	Unit	Value
A11	Unbilled metered consumption	m^3	1,490
A12	Unbilled unmetered consumption	m^3	6,760

Distribution of unbilled authorized consumptions (m^3)

Category	Metered	Unmetered	Total
Process water			
Flushing		6,200	6,200
Frost protection			
Reservoir cleaning			
Municipal use			
Fire fighting and training		560	560
Other (specify)	1,490		1,490
Total		8,250	8,250

Apparent losses and modified WB volumes

How is estimated unauthorized consumption and why?	According to international statistical data
How are estimated meter inaccuracies and why?	Statistical analysis and bench testing
After how much time a not paid invoice is abandoned?	A not paid invoice is not abandoned, but the water supply to the consumer is disconnected until payment
What is the delay between the end of the assessment period and the estimation of not paid for volumes?	2-4 months
Is there a fixed charge in volume? If so how much?	No
Is there a fixed charge expressed in € related to water volumes? If so how much?	No.
Is there a fixed charge expressed in € without water volumes? If so how much?	Yes. The fixed charge for domestic users is 5.69 Euro/bimonthly

ID	Variable	Unit	Value
A16	Unauthorized consumption	m^3	103,570
A17	Metering inaccuracies water losses	m^3	414,290
A23	Billed but not paid for consumption	m^3	8,500
A25	Minimum Charge Difference	m^3	3,331,144

Additional information concerning the water supply system

Network subdivisions

Number of distribution units (zones where consumers drink the same water)	25
Number of pressure levels (zones with the same pressure regime)	23
Number of DMAs monitored by SCADA (daily	44

night flow available)	
Number of other DMAs	0

ID	Variable	Unit	Value
C11	District meters	No	42

Assets

What are the methods used to measure and update mains length?	Actual measurement
What are the methods used to measure and update service connections number?	Estimate according to the number of buildings (house and multi-storey buildings meters)
What are the methods used to calculate and update average service connection length?	Average of length of installed connections

ID	Variable	Unit	Value
C8	Mains length	km	1,250
C24	Service connections	No.	64,000
C25	Average service connection length	m	6

Operation

Is a calibrated hydraulic model available?	Yes
What are the methods used to update water demand?	?
How frequently is it calibrated?	
Are mains failures registered?	Yes
Are mains failures located at the section pipe level?	Yes since 2011
Are service connection failures registered?	Yes
Are failures reported in the GIS?	No

ID	Variable	Unit	Value
D28	Mains failures	No.	904
D29	Service connection failures	No.	5,839

Pressure

Is estimating average pressure a standard practice of the utility?	Yes
What are the methods used to evaluate average pressure?	Installment of portable pressure loggers in the distribution system in each DMA
What is the weighting system used to calculate average pressure?	According to the DMA mains length

ID	Variable	Unit	Value
C12	Pressure meters	No.	46
D34	Average operating pressure	kPa	3.5
MARP	Minimum Annual Reference Pressure (*)	kPa	2.0

- MARP is the minimum standard of service pressure at the delivery point

NRW reduction measures

Legend

Measure	PIs	Results
Designation and description of the measure. Indicate parts of the WSS which are concerned and realisation period.	Mention diagnosis and evaluation Pis used to carry out the measure (with formula for non-IWA Pis)	Indicate capital and operational expenditures, expected lifespan of installations, annual volume of water savings (and how it is evaluated), other results and value of dedicated Pis before and after the action (with reference date or period).
Example: Pressure regulation of DMA7 (31 km of mains, 26% of network mains length). Installation of 2 PRVs and 3 section valves. Annual maintenance. Operating since April 2009.	Average Operating Pressure (AOP) and Annual Water Losses (AWL). Same formula as IWA Pis at DMA level.	Capex = 25 000 € (2009) Opex = 850 €/year Expected lifespan = 30 years Water savings (2010) = 7 500 m^3 (estimation based on DMA night flows) AOP 2008 = 65 m of pressure AOP 2010 = 43 m of pressure AWL 2008 = 35 500 m^3 AWL 2010 = 28 000 m^3

ID	Variable	Unit	Value
AOP	Average Operating Pressure (DMA level)	m of pressure	See above
AWL	Annual Water Losses (DMA level)	m^3	See above

In the following tables, measures from the DSS platform and examples from DH are proposed:

- **if a measure doesn't fit with your WSS, please, mention in the column "Result" : "*not implemented*" and indicate if in your opinion this measure is relevant or not.**
- **Otherwise, fill the form,**
- **add the other measures you have implemented or planned to implement.**

Explanation of measures codification:

- RM-xx : Measure number xx in the "NRW Reduction Measures" (RM) webpage in the DSS platform http://www.vokas.si/waterloss/dssplatform/AppSpec/WATERLOSS_WATERLOSS/CustomPages/MeasuresMatrix.aspx
- DSS-aaxx : Measure with the code aaxx in the "DSS" webpage in the DSS platform http://www.vokas.si/waterloss/dssplatform/AppSpec/WATERLOSS_WATERLOSS/CustomPages/DSS.aspx
- DH-aaxx : Measure given in example by DH.

Metering accuracy

Bulk meter accuracy

Measure	Pis	Results
RM-4: Calibration of water meters, managing inaccuracy of water meters, age of water meters	Replacement of all bulk meters during 2011. Periodic maintenance. Consideration of telemetry readings.	Observed NRW in main pipes (from tanks to DMAs) – 2-3%.
DH-MA01: Volumetric accuracy checked using a second meter	Rarely	

ID	Variable	Unit	Value
D12	System flow meter calibration	No.	0

Customer meter accuracy

Measure	Pis	Results
RM-28: Metering of revenue water	Bimonthly recording of consumed volume	
DSS-OM4: Calibration of water use metering network		More explanation is needed
DSS-OM5: Check of water use metering network		More explanation is needed
DH-MA02: Monitoring water quality (the build-up in sediment affects the meter's accuracy)	We verify that it affects meter accuracy	Some meters may stop operating and need replacement or maintenance.
DH-MA03: Monitoring intermittent water supply (sudden large increase in pressure damage the meter's components)	We verify that sudden increase of pressure may damage some types of meters.	Not easy to make statistics.
DH-MA04: Test of a representative sample of customer meters	Not a representative sample. (year 2010) Evaluation of the accuracy of customer water meters in WBN test bench from a meter sample.	The inaccuracy varies from 2 to more than 60%.

ID	Variable	Unit	Value
	Average water meter inaccuracy at nominal flow	%	>4 % It may be of the order of 6-8% if we use old age meters. Ususally we perform test on meters that the consumers claim for overregistration.

Data processing

Measure	Pis	Results

RM-38: Remote reading of meters in WSS	Telemetry system is installed in WSS	It covers the entire distribution network.
DSS-DA5: Systematic control of billing records	Every two months	Some wrong recording is found and corrected at next billing period.
DH-MA05: Establishment of guidelines for WB volumes calculation	We follow a specific procedure to prepare water balance	

ID	Variable	Unit	Value

Unbilled authorized consumption

Process water (for treatment plants)

Measure	Pis	Results
DSS-OM8: Improvement of water treatment techniques	N/A	
DH-AC01: Optimization of filter cleaning cycles	N/A	

ID	Variable	Unit	Value

Flushing

Measure	Pis	Results
RM-25: Reduction of operative water use (i.e. ensuring adequate water age) – usually expensive, should be prevented already in the design and development stage	Performing flushing in network's dead ends and distanced points.	
DH-AC02: Adaptation of the flushing duration	Flushing duration is recorded.	Volume of water used for flushing is estimated.

ID	Variable	Unit	Value

Frost protection

Measure	Pis	Results

DH-AC03: Thermo insulation of non-buried pipes	N/A	

ID	Variable	Unit	Value

Tank cleaning

Measure	Pis	Results
DH-AC04: Beginning of tank cleaning when water level is low.	Tanks are cleaned periodically – Not often.	

ID	Variable	Unit	Value
D7	Storage tank cleaning	m^3	

Municipal use

Measure	Pis	Results
RM-5: Measurements of unbilled authorized consumption	Water used by municipalities is billed. Quantities used by Fire Brigade Service are estimated and recorded but not billed	
DH-AC05: Street washing with alternative water (from swimming-pools, rain, river, …)	N/A	
DH-AC06: Optimizing watering of parks and sports fields (methods, time, duration…)	N/A	
DH-AC07: Implementation of artificial turf on sports fields	N/A	

ID	Variable	Unit	Value

Fire fighting and training

Measure	Pis	Results
DH-AC08: Operators training	See RM -5	

ID	Variable	Unit	Value
C23	Hydrants	No.	3531

D11	Hydrants inspection	No./year	2000

Other

Measure	Pis	Results
RM-27: Measurement of system water use (overflows, mud releases, pressure reduction valves…)	Overflows can be quantified through telemetry system.	
RM-51: Rules for different water uses – especially large water users, transient phenomena, fire-fighters…	Three categories of consumers: Domestic-Commercial-Industrial.	

ID	Variable	Unit	Value

Apparent losses

Meters under-registration

Measure	Pis	Results
DH-AL01: Replacement of low metrological class meters	YES	A total number of 3,400 water meters were replaced during the year 2010, out of a total number of water meters of 111,800

ID	Variable	Unit	Value
	Percentage of customer water meter replaced	%	3.04%

Water accounting errors

Measure	Pis	Results
DH-AL02: Improvement of the billing database	YES	
DH-AL03: Meter reading with smart portable digital devices (Meter reader can control in the historical database)	Use of electronic recording of consumption. Not smart reading except in pilot areas with AMR.	

ID	Variable	Unit	Value

Water theft

Measure	Pis	Results
RM-6: Active search campaigns for illegal water connections	YES	Many thefts are recorded.
RM-40: Legal measures (efficient prosecution of illegal connections) communication with the law enforcement authorities (prosecution process, evidence process, judicial procedures, penalties).	YES	Illegal connections are reported to police.
DH-AL04: Addressing meter tampering	YES	Rare event

ID	Variable	Unit	Value

Real losses

Active leakage control

Measure	Pis	Results
We mainly use noise detectors with successful results		
RM-1: Geophone (single –mobile)	YES	
RM-2: Advanced hydraulic model development – continuous run of hydraulic model – nowcasting – verification with monitoring results	YES	
RM-3: Leak noise correlators	YES	
RM-13: Leakage and water loss identification by pressure variations	YES	
RM-26: Continuous discharge measurements of water supplied to WSS – also other parameters (SCADA tool)	YES	
RM-32: District metering (continuous discharge measurements)	YES	
RM-33: Measurement campaigns (frequency) target measurement campaigns	YES	Target of NRW < 18% by 2015
RM-58: Trace gas	N/A	
RM-59: Deployment of fixed noise loggers	YES	In critical areas. eg area 20
DSS-DA2: Implementation of leak detection techniques	YES	
DSS-SS15: Installation of proper metering network	YES	
DSS-SS16: Construction of alternative supply paths-mains	YES	
DH-RL01: Night step-testing (reducing the size of the area by closing valves)	YES	
DH-RL02: Implementation of a systematic leak detection planning	YES	

ID	Variable	Unit	Value
D9	Leakage control	km	470
D10	Leaks repaired due to active leakage control	No.	864

Pressure management

Measure	Pis	Results
RM-10: Active identification and control of transient phenomena (identification of possibilities for transients etc.)	Complex task	
RM-11: Pressure zoning (optimization of pressures)	YES	Under progress
RM-12: Pressure reduction practice	PRV	
RM-22: Soft pump priming	YES	
RM-23: Soft regulation of closing valves	YES	
DSS-DA1: Hydraulic simulation of the system	YES	
DSS-OM1: Change of valves settings	YES	
DSS-SS1: Additional boosters & pressure reducing valves installation	YES	
DSS-SS10: Installation of release valves	YES	
DSS-SS19: Surge control	YES	
DH-RL03: Pressure modulation	YES	
	YES	

ID	Variable	Unit	Value
D13	Pressure meter calibration	No.	5

Speed of repairs

Measure	Pis	Results
RM-34: Permitting procedures for other constructions in the impact zones of the WSS infrastructure, also permitting procedures for the re-classification of roads		More explanation needed
RM-37: Central registry of underground infrastructure	N/A	Individual for each authority
RM-39: Public awareness campaign (i.e. did anybody see wetted spot around the valve)	YES	Very close cooperation with the public. Consumers are very sensitive to matters of water shortage.
DSS-OM3: Repair of leaks	YES	Immediate action
DSS-OM7: Proper checking of valves operation	YES	
DH-RL04: Procedure to guarantee repair material availability	YES	Stock watching
DH-RL05: Reporting of repairing times	YES	Every event is recorded

ID	Variable	Unit	Value

C22	Isolating valves	No.	
D8	Network inspections	km	

Asset management

Measure	Pis	Results
RM-9: Thermography (Camera control of mains?)	Small Pilot case	At planning stage
RM-8: Water consumption metering close to the mains (short service connections).	Service connections are normally from 1 to 8m long from distribution system	
RM-7: Identification of water losses from service connections (rehabilitation or replacement of service connections)	YES	90% of events
RM-30: Register of pipe bursts interventions and identified leakage	YES	
RM-24: Use of other specific equipment and rehabilitation tools in the case of identified leakage and pipe breach repair procedures (i.e. clamps, andorre type)	Not yet	
RM-21 & DSS-SS13: Pipe cleaning and lining	NO	
RM-20 & DSS-SS18: Pipe replacement (with corrosion-free material)	YES	PVC
RM-19: Observations of actual pipe aging (i.e. on test grounds)	YES	From pieces of pipes replaced
RM-18: Soil type mapping and soil stability standard		Not systematic recording
RM-16: Construction process supervision and documentation	YES	
RM-15: Construction process standards	YES	
DSS-SS8: Improved pipe installation practices	YES	Best practices investigation to adopt.
DSS-SS7: Avoid direct contact with electricity source	YES	
DSS-SS6: Avoid bimetallic connections	YES	
DSS-SS4: Cathodic protection	YES	Where applicable
DSS-SS17: Implementation of pipe insertion	Not yet	
DSS-SS12: Check and repair of joints		Yes during installation. During operation when in doubt
DH-RL06: Service connections replacement policy	YES	Depends on age and material and on observations or statistics from one area or road.
DH-RL07 : Use of a DSS to drive asset management policy (including breaks prediction tools)	NO	

ID	Variable	Unit	Value
D20	Mains rehabilitation	km	N/A
D21	Mains renovation	km	N/A
D22	Mains replacement	km	14
D23	Replaced valves	No.	
D24	Service connection rehabilitation	No.	

Other measures

Actions to reduce customer consumption

Measure	Pis	Results
DH-OM01: Installation of water efficient devices in households and public buildings	Public awareness	Depends on individuals (private) action

ID	Variable	Unit	Value
D38	Days with restrictions to water service	day	Now is 0. during 2008 &2009 was 12 hours every 48 hours

Actions to recover unpaid invoices

Measure	PIs	Results
RM-42: Efficient and effective payment realization (100% payment of water bills?).	YES	80%. Debits are transferred to next bill. They are not written off.
DH-OM02: Agreement with social services to fragment the debt	NO	Some discussions were made .

ID	Variable	Unit	Value

Actions on tariffs

Measure	PIs	Results
RM-41 : Economic/financial measures (i.e. mangers of the WSS are awarded for the reduction of water losses, i.e. regional/central tax on the NRW)	NO	
RM-48 : Pricing mechanism – cost recovery – target oriented water pricing	YES	
RM-49 : Adequate pricing mechanisms covering all costs necessary for efficient water supply	YES	
DH-OM03 : Fixed charge volume reduction	NO	Fixed charge applied but not for water.

ID	Variable	Unit	Value

Other actions

Measure	PIs	Results
RM-50: Development of programme of measures for the NRW reduction (documentation, evaluation, designs…)	YES	Lowering the NRW.
RM-54: Participation in target projects for the reduction of NRW	YES	

ID	Variable	Unit	Value

DSS measures not yet assigned to a component

Measure	PIs	Results
RM-14: Planning process standards	Certain procedures are followed	
RM-17: Constructed WSS commission process standards	Certain procedures are followed	
RM-29 & DSS-DA3: System mapping using GIS. GIS development – information on system (gradual improvement of GIS functionalities)	Under progress	
RM-31: Supply chain management (verification of suppliers – CE standards?, supply standards and reliability)	Certain procedures are followed	
RM-35: Change from intermittent water supply to continuous water supply	Certain procedures are followed	
RM-36: Document management and archives in the management company (archiving the documents on construction, service connections, permits etc.)	Certain procedures are followed	
RM-43: External supervision of the performance of the WSS (certification process)	YES	Auditor General
RM-44:Participation in the benchmarking schemes	YES	Local and international
RM-45: HRM – company culture (every drop counts), permanent, targeted education of employees,	YES	Every year a message for water save is adopted
RM-46: HRM – adequate staffing for different processes, adequate tools, equipment, education	YES	Depends on previous policies for staffing.

RM-47: Relative/absolute reduction of NRW – increase in water amount sold (Revenue water) is leading to relative reduction of NRW		More explanation is required
RM-52: Development of the microeconomic model for the WSS (actual supply and demand curve), i.e. demand flexibility, market behaviour analysis	NO	
RM-53: Adequate economy of scale for the managers of the WSS	NO	
RM-55: Improving the objective side of the NRW problem -artificial augmentation of the ressource		More explanation is required
RM-56: Improving the objective side of the NRW problem - Improved energy efficiency	YES	
RM-57: Structural management of seasonal variation in water demand	YES	Organisation of the personnel depends on requirements each season.
DSS-DA4: Keeping full data records (normal-abnormal)	YES	To our best. Data are continuously enriched.
DSS-DA6: Intrusion control in high-risk points	YES	
DSS-OM2: Regular pipe flushing	YES	
DSS-OM6: pH adjustment of water		pH is adjusted at source by the supplier/producer
DSS-SS11: Adoption of in-system chlorination	YES	
DSS-SS14: Looped network operation	YES	
DSS-SS2: Increase of tanks storage capacity	YES	When needed
DSS-SS5: Network cleaning	YES	Periodically
DSS-SS9: Increase pumping capacity	YES	When needed

ID	Variable	Unit	Value

WATERLOSS

WATERLOSS: Management of water losses in a drinking water supply system» (Transnational Cooperation Programme MED – Project 2G-MED09-445)

Internal Reporting of Project Partners

NRW reduction measures experiences

Phase	**4.1_Development of a DSS tool for appropriate NRW reduction strategy**
Deliverable	**D41.1_ Database of NRW management measures**
Partner responsible for the Phase	**PP9: Department of Herault (DH)**
Partner responsible for the Project	**LP: Aristotle University of Thessaloniki (AUTH)**
Partner's No	**PP2**
Partner's full NAME	**Conseil Général des Pyrénées-Orientales**
Partner's short NAME	**PO**
Partner's City	**Perpignan**
Partner's Country	**France**
Case Study Area	**Argelès-sur-mer CS1**
Pilot Case Study Network	

SUMMARY

Additional information concerning WB assessment

- no information

Assessment period

Is the assessment period the billing period?	No. Assessment period is 2010. Billing period is every six months. WB calculation is done for both (6 period and 1 year period)
How are estimated the starting and ending dates?	All 2010 (1st January-31th December)
Was there intermittent supply during the assessment period?	NO

ID	Variable	Unit	Value
	Beginning date of the assessment period	Date (m/d/y)	01/01/10
	Ending date of the assessment period	Date (m/d/y)	12/31/10
H1	Assessment period	Day	365
H2	Time system is pressurised	Hour	24

System Input Volume

Is the system input volume period consistent with the assessment period?	YES
Does the system input volume include raw water (abstracted or imported)?	YES. In Argeles city all water supplied are imported from 2 production sites. There is no treatment plant, just a gas chlorine.
What is the reading frequency of abstraction, importation and exportation meters?	monthly
Is there any correction of imported, exported and abstracted volumes? If so, describe the method.	NO
Is there any correction of billed metered volume? If so, describe the method.	NO
Is there any policy of bulk meters replacement? If so describe it.	Priority of the municipality is to replaces all meters > 10 years

ID	Variable	Unit	Value
A3	System input volume	m^3	2123191
A5	Exported raw water	m^3	0
A6	Water produced	m^3	0
A7	Exported treated water	m^3	0
	Abstracted raw water	m^3	0
	Imported raw water	m^3	0
	Imported treated water	m^3	2123191
C10	System flow meters	No.	2 production sites : 2 water main meters also 3 meters on

			storage tanks

Bulk meters (number by type)

Type	Importation	Abstraction	Exportation	Total
Electromagnetic flow meter				-
Ultrasonic flow meter				-
Insertion meter				-
Mechanical meter				-
Venturi meter				-
Calculation with pump curves				-
Measure weirs in open channels				-
Other				-
Total				-

Billed authorized consumption

Are there customers supplied by roof tanks? If so percentage?	NO
Is there any policy of customer meters replacement? If so describe it.	About 10% of all customer meters / year Priority for meters > 10 years according to meter inaccuracies
Describe different categories of un-metered billed consumption the way they are evaluated and the number of customers concerned.	no un-metered billed consumption

ID	Variable	Unit	Value
A8	Billed metered consumption	m^3	1 695092
A9	Billed unmetered consumption	m^3	0
C26	Roof tanks number	No.	0
D42	Customer meter readings	No.	2
D45	Meter replacement	No.	524

Customer meters (number by diameter and metrological class)

Diameter	Class B	Class C	Class D	Other	Total	Average age (year)
15 mm						-
20 mm						-
> 20 mm						-
Total						-

Customer meters ages are available but for the moment we don't know diameters associated

Unbilled authorized consumption

Estimation methods of unbilled unmetered authorized consumptions

Category	Methods
Process water (for treatment plants)	-
Flushing	• Roads service of the territory: Information on water storage capacity (washer truck)* nb of refills*nb of day in service
Frost protection	-

Tank cleaning	• Estimation for tank cleaning (extract from our external expertise) : 1/4 of the total storage volume
Fire fighting and training	• Reference ASTEE for training : nb of training (Hydrants)*duration(10min)*flow rate(60m3/h) • Estimation for fire fighting (extract from our external expertise) : about 20 m3/fire intervention
Municipal use	• All metered
Other (specify)	• Reference ASTEE for networks purge : purge nb*duration(2h)*2,5m3/h • Reference ASTEE for disinfection of pipe ans connection after work : 8 times pipe volume or connection*0,2m3 • Reference ASTEE for pumps leakage volume (internal) : 90 m3/year/pump

ID	Variable	Unit	Value
A11	Unbilled metered consumption	m^3	0
A12	Unbilled unmetered consumption	m^3	7160

Distribution of unbilled authorized consumptions (m^3)

Category	Metered	Unmetered	Total
Process water	-	-	**-**
Flushing		Yes	**75**
Frost protection	-	-	**-**
Reservoir cleaning		Yes	**1375**
Municipal use	Yes		**0**
Fire fighting and training		Yes	**4970**
Other (specify)		Yes	**740**
Total			**7160**

Apparent losses and modified WB volumes

How is estimated unauthorized consumption and why?	• according estimation : 2260 m3 or 0,1 % of the SIV
How are estimated meter inaccuracies and why?	• Meter inaccuracies because of meter ages. We are using as reference a study from water agencies.
After how much time a not paid invoice is abandoned?	We don't know yet - asking to the manager
What is the delay between the end of the assessment period and the estimation of not paid for volumes?	We don't know yet - asking to the manager
Is there a fixed charge in volume? If so how much?	No
Is there a fixed charge expressed in € related to water volumes? If so how much?	No
Is there a fixed charge expressed in € without water volumes? If so how much?	Yes, about 71,34€ / year

ID	Variable	Unit	Value

A16	Unauthorized consumption	m^3	2260
A17	Metering inaccuracies water losses	m^3	26350
A23	Billed but not paid for consumption	m^3	0
A25	Minimum Charge Difference	m^3	317463

Additional information concerning the water supply system

Network subdivisions

Number of distribution units (zones where consumers drink the same water)	2
Number of pressure levels (zones with the same pressure regime)	There are two pressure reducing valves on the Argeles-sur-mer network. The first one is located on the lower part of the network overpressure. It serves several neighborhoods (range: 5.5 to 2.5 bar). The second one serves a pipe (about 250m long) and 10 domestic connections (Range: 8 to 3.8 bars).
Number of DMAs monitored by SCADA (daily night flow available)	Argeles city is using a SCADA system type 'WIT' which links all the production, storage, or pumping sites of the municipaly network. Operation by Modem and specialized Telecom lines - Log, a remote consultation and sent instructions. Monitoring of malfunctions parameters and site security (intrusion).
Number of other DMAs	-

ID	Variable	Unit	Value
C11	District meters	No	0

Assets

What are the methods used to measure and update mains length?	Using SIG
What are the methods used to measure and update service connections number?	Using SIG
What are the methods used to calculate and update average service connection length?	-

ID	Variable	Unit	Value
C8	Mains length	km	145
C24	Service connections	No.	6581
C25	Average service connection length	m	-

Operation

Is a calibrated hydraulic model available?	For the moment they don't have a simulation model available for the network but they plan to develop one.
What are the methods used to update water demand?	Distribution meters control / customer file - new connections registration
How frequently is it calibrated?	-

Are mains failures registered?	Yes
Are mains failures located at the section pipe level?	-
Are service connection failures registered?	Yes
Are failures reported in the GIS?	-

ID	Variable	Unit	Value
D28	Mains failures	No.	30 (not exactly failures but leaks)
D29	Service connection failures	No.	33 (not exactly failures but leaks)

Pressure

Is estimating average pressure a standard practice of the utility?	Yes
What are the methods used to evaluate average pressure?	manometer
What is the weighting system used to calculate average pressure?	-

ID	Variable	Unit	Value
C12	Pressure meters	No.	-
D34	Average operating pressure	kPa	300
MARP	Minimum Annual Reference Pressure (*)	kPa	250

* MARP is the minimum standard of service pressure at the delivery point

NRW reduction measures

Legend

Measure	PIs	Results
Designation and description of the measure. Indicate parts of the WSS which are concerned and realisation period.	Mention diagnosis and evaluation PIs used to carry out the measure (with formula for non-IWA PIs)	Indicate capital and operational expenditures, expected lifespan of installations, annual volume of water savings (and how it is evaluated), other results and value of dedicated PIs before and after the action (with reference date or period).
Example: Pressure regulation of DMA7 (31 km of mains, 26% of network mains length). Installation of 2 PRVs and 3 section valves. Annual maintenance. Operating since April 2009.	Average Operating Pressure (AOP) and Annual Water Losses (AWL). Same formula as IWA PIs at DMA level.	Capex = 25 000 € (2009) Opex = 850 €/year Expected lifespan = 30 years Water savings (2010) = 7 500 m^3 (estimation based on DMA night flows) AOP 2008 = 65 m of pressure AOP 2010 = 43 m of pressure AWL 2008 = 35 500 m^3 AWL 2010 = 28 000 m^3

ID	Variable	Unit	Value
AOP	Average Operating Pressure (DMA level)	m of pressure	See above
AWL	Annual Water Losses (DMA level)	m^3	See above

In the following tables, measures from the DSS platform and examples from DH are proposed:

- **if a measure doesn't fit with your WSS, please, mention in the column "Result" : *"not implemented"* and indicate if in your opinion this measure is relevant or not.**
- **Otherwise, fill the form,**
- **add the other measures you have implemented or planned to implement.**

Explanation of measures codification:

- RM-xx : Measure number xx in the "NRW Reduction Measures" (RM) webpage in the DSS platform http://www.vokas.si/waterloss/dssplatform/AppSpec/WATERLOSS_WATERLOSS/CustomPages/MeasuresMatrix.aspx
- DSS-aaxx : Measure with the code aaxx in the "DSS" webpage in the DSS platform http://www.vokas.si/waterloss/dssplatform/AppSpec/WATERLOSS_WATERLOSS/CustomPages/DSS.aspx
- DH-aaxx : Measure given in example by DH.

- no information or not relevant

Metering accuracy

Bulk meter accuracy

Measure	PIs	Results
RM-4: Calibration of water meters, managing inaccuracy of water meters, age of water meters		7592 customers meters : 2077 (0-4 years) 3487 (5-9 years) 1699 (10-14 years) 285 (15-19 years) 44 (> 20 years)
DH-MA01: Volumetric accuracy checked using a second meter		not implemented

ID	Variable	Unit	Value
D12	System flow meter calibration	No.	-

Customer meter accuracy

Measure	PIs	Results
RM-28: Metering of revenue water		1 695 092 m3 all revenue water are metered
DSS-OM4: Calibration of water use metering network		-
DSS-OM5: Check of water use metering network		-
DH-MA02: Monitoring water quality (the build-up in sediment affects the meter's accuracy)		compliance rate = 100 % Physical-chemical and microbiological tests carried out
DH-MA03: Monitoring intermittent water supply (sudden large increase in pressure damage the meter's components)		-
DH-MA04: Test of a representative sample of customer meters		not implemented interesting

ID	Variable	Unit	Value

Data processing

Measure	PIs	Results
RM-38: Remote reading of meters in WSS		-
DSS-DA5: Systematic control of billing records		-
DH-MA05: Establishment of guidelines for WB volumes calculation		not implemented interesting

ID	Variable	Unit	Value

Unbilled authorized consumption

Process water (for treatment plants)Our WSS doesn't includes Water Treatment Plant

Measure	PIs	Results
DSS-OM8: Improvement of water treatment techniques		-
DH-AC01: Optimization of filter cleaning cycles		-

ID	Variable	Unit	Value

Flushing

Measure	PIs	Results
RM-25: Reduction of operative water use (i.e. ensuring adequate water age) – usually expensive, should be prevented already in the design and development stage		
DH-AC02: Adaptation of the flushing duration		

ID	Variable	Unit	Value

Frost protection

Measure	PIs	Results
DH-AC03: Thermo insulation of non-buried pipes		-

ID	Variable	Unit	Value

Tank cleaning

Measure	PIs	Results
DH-AC04: Beginning of tank cleaning when water level is low.		-

ID	Variable	Unit	Value
D7	Storage tank cleaning	m^3	1375 (estimation)

Municipal use

Measure	PIs	Results
RM-5: Measurements of unbilled authorized consumption		Yes measured when it is possible or estimate or list volume taken (fire-fighters, municipality, roads service)

DH-AC05: Street washing with alternative water (from swimming-pools, rain, river, …)		interesting
DH-AC06: Optimizing watering of parks and sports fields (methods, time, duration…)		interesting
DH-AC07: Implementation of artificial turf on sports fields		-

ID	Variable	Unit	Value

Fire fighting and training

Measure	PIs	Results
DH-AC08: Operators training		-

ID	Variable	Unit	Value
C23	Hydrants	No.	247
D11	Hydrants inspection	No.	247

Other

Measure	PIs	Results
RM-27: Measurement of system water use (overflows, mud releases, pressure reduction valves…)		-
RM-51: Rules for different water uses – especially large water users, transient phenomena, fire-fighters…		interesting - work with fire-fighters could be good (share a journal of interventions) - also communication events on the impact of water taken on hydrants (illegal uses)

ID	Variable	Unit	Value

Apparent losses

Meters under-registration

Measure	PIs	Results
DH-AL01: Replacement of low metrological class meters		-

ID	Variable	Unit	Value

Water accounting errors

Measure	PIs	Results
DH-AL02: Improvement of the billing database		-
DH-AL03: Meter reading with smart portable digital devices (Meter reader can control in the historical database)		-

ID	Variable	Unit	Value

Water theft

Measure	PIs	Results
RM-6: Active search campaigns for illegal water connections		not implemented interesting
RM-40: Legal measures (efficient prosecution of illegal connections) communication with the law enforcement authorities (prosecution process, evidence process, judicial procedures, penalties).		not implemented interesting
DH-AL04: Addressing meter tampering		

ID	Variable	Unit	Value

Real losses

Active leakage control

Measure	PIs	Results
RM-1: Geophone (single -mobile)		-
RM-2: Advanced hydraulic model development – continuous run of hydraulic model – nowcasting – verification with monitoring results		not implemented interesting
RM-3: Leak noise correlators		interesting / Concerning leaks research, there is an agent that performs all the year systematic leaks research campaigns. We have different leaks control equipment. We try to make detection in all municipalities each year, but in practice, the priority is given to networks where we observe increasing consumption (on the curves of meters outlet tanks). In 2010 about 70% of the network was inspected for leaks detection.
RM-13: Leakage and water loss identification by pressure variations		-
RM-26: Continuous discharge measurements of water supplied to WSS - also other parameters (SCADA tool)		-
RM-32: District metering (continuous discharge measurements)		No
RM-33: Measurement campaigns (frequency) target measurement campaigns		-
RM-58: Trace gas		-
RM-59: Deployment of fixed noise loggers		-
DSS-DA2: Implementation of leak detection techniques		-
DSS-SS15: Installation of proper metering network		-
DSS-SS16: Construction of alternative supply paths-mains		-
DH-RL01: Night step-testing (reducing the size of the area by closing valves)		will be implement
DH-RL02: Implementation of a systematic leak detection planning		already implement

ID	Variable	Unit	Value
D9	Leakage control	km	101,5

D10	Leaks repaired due to active leakage control	No.	63

Pressure management

Measure	PIs	Results
RM-10: Active identification and control of transient phenomena (identification of possibilities for transients etc.)		Punctually, some pression decreasing problems are noted in relation with the population change during the summer period. These pressure problems are located at the end network system, opposite side of the tanks, mainly during periods of non pumping tank filling (NB: delivery-distribution network). There are two pressure reducing valves on the Argeles-sur-mer network. The first one is located on the lower part of the network overpressure. It serves several neighborhoods (range: 5.5 to 2.5 bar). The second one serves a pipe (about 250m long) and 10 domestic connections (Range: 8 to 3.8 bars).
RM-11: Pressure zoning (optimization of pressures)		-
RM-12: Pressure reduction practice		-
RM-22: Soft pump priming		yes
RM-23: Soft regulation of closing valves		-
DSS-DA1: Hydraulic simulation of the system		-
DSS-OM1: Change of valves settings		-
DSS-SS1: Additional boosters & pressure reducing valves installation		yes
DSS-SS10: Installation of release valves		-
DSS-SS19: Surge control		-
DH-RL03: Pressure modulation		-

ID	Variable	Unit	Value
D13	Pressure meter calibration	No.	-

Speed of repairs

Measure	PIs	Results

RM-34: Permitting procedures for other constructions in the impact zones of the WSS infrastructure, also permitting procedures for the re-classification of roads		-
RM-37: Central registry of underground infrastructure		-
RM-39: Public awareness campaign (i.e. did anybody see wetted spot around the valve)		not implemented interesting
DSS-OM3: Repair of leaks		-
DSS-OM7: Proper checking of valves operation		-
DH-RL04: Procedure to guarantee repair material availability		not implemented
DH-RL05: Reporting of repairing times		not implemented - no relevant

ID	Variable	Unit	Value
C22	Isolating valves	No.	654 (main valves)
D8	Network inspections	km	-

Asset management

Measure	PIs	Results
RM-9: Thermography (Camera control of mains?)		-
RM-8: Water consumption metering close to the mains (short service connections).		-
RM-7: Identification of water losses from service connections (rehabilitation or replacement of service connections)		-
RM-30: Register of pipe bursts interventions and identified leakage		Already done
RM-24: Use of other specific equipment and rehabilitation tools in the case of identified leakage and pipe breach repair procedures (i.e. clamps, andorre type)		-
RM-21 & DSS-SS13: Pipe cleaning and lining		-
RM-20 & DSS-SS18: Pipe replacement (with corrosion-free material)		Already done
RM-19: Observations of actual pipe aging (i.e. on test grounds)		-
RM-18: Soil type mapping and soil stability standard		-
RM-16: Construction process supervision and documentation		Already done
RM-15: Construction process standards		-
DSS-SS8: Improved pipe installation practices		-
DSS-SS7: Avoid direct contact with electricity source		-
DSS-SS6: Avoid bimetallic connections		-

DSS-SS4: Cathodic protection		-
DSS-SS17: Implementation of pipe insertion		-
DSS-SS12: Check and repair of joints		-
DH-RL06: Service connections replacement policy		relevant
DH-RL07 : Use of a DSS to drive asset management policy (including breaks prediction tools)		-

ID	Variable	Unit	Value
D20	Mains rehabilitation	~~km~~ ml (linear meter)	269
D21	Mains renovation	~~km~~ ml	
D22	Mains replacement	~~km~~ ml	347
D23	Replaced valves	No.	-
D24	Service connection rehabilitation	No.	9
	Pipe extension New connection	ml No	105 ml 27

Other measures

Actions to reduce customer consumption

Measure	PIs	Results
DH-OM01: Installation of water efficient devices in households and public buildings		not implemented interesting

ID	Variable	Unit	Value
D38	Days with restrictions to water service	day	-

Actions to recover unpaid invoices

Measure	PIs	Results
RM-42: Efficient and effective payment realization (100% payment of water bills?).		yes
DH-OM02: Agreement with social services to fragment the debt		-

ID	Variable	Unit	Value

Actions on tariffs

Measure	PIs	Results

RM-41 : Economic/financial measures (i.e. mangers of the WSS are awarded for the reduction of water losses, i.e. regional/central tax on the NRW)		not implemented interesting
RM-48 : Pricing mechanism – cost recovery – target oriented water pricing		-
RM-49 : Adequate pricing mechanisms covering all costs necessary for efficient water supply		-
DH-OM03 : Fixed charge volume reduction		-

ID	Variable	Unit	Value

Other actions

Measure	PIs	Results
RM-50: Development of programme of measures for the NRW reduction (documentation, evaluation, designs…)		relevant
RM-54: Participation in target projects for the reduction of NRW		relevant

ID	Variable	Unit	Value

DSS measures not yet assigned to a component

Measure	PIs	Results
RM-14: Planning process standards		-
RM-17: Constructed WSS commission process standards		?
RM-29 & DSS-DA3: System mapping using GIS. GIS development – information on system (gradual improvement of GIS functionalities)		relevant
RM-31: Supply chain management (verification of suppliers – CE standards?, supply standards and reliability)		-
RM-35: Change from intermittent water supply to continuous water supply		-
RM-36: Document management and archives in the management company (archiving the documents on construction, service connections, permits etc.)		relevant
RM-43: External supervision of the performance of the WSS (certification process)		relevant
RM-44:Participation in the benchmarking schemes		-

RM-45: HRM – company culture (every drop counts), permanent, targeted education of employees,		relevant
RM-46: HRM – adequate staffing for different processes, adequate tools, equipment, education		relevant
RM-47: Relative/absolute reduction of NRW – increase in water amount sold (Revenue water) is leading to relative reduction of NRW		relevant
RM-52: Development of the microeconomic model for the WSS (actual supply and demand curve), i.e. demand flexibility, market behaviour analysis		-
RM-53: Adequate economy of scale for the managers of the WSS		?
RM-55: Improving the objective side of the NRW problem -artificial augmentation of the ressource		-
RM-56: Improving the objective side of the NRW problem - Improved energy efficiency		-
RM-57: Structural management of seasonal variation in water demand		relevant - already done City with population multiply by 10 during summer - Pressure problems during the summer period in some areas away from the tanks. - Water coloration problems : the water can be 'red' in case of increased circulation. For example : in some areas early summer or when the service is back after works or during the fire hydrants testing. - Low water storage capacity on the municipality : tanks are filled two or three times per day in summer. - Balance needs / resources arduous during the summer. Sicky situation.
DSS-DA4: Keeping full data records (normal-abnormal)		relevant
DSS-DA6: Intrusion control in high-risk points		relevant - already done
DSS-OM2: Regular pipe flushing		-
DSS-OM6: pH adjustment of water		-
DSS-SS11: Adoption of in-system chlorination		relevant - already done
DSS-SS14: Looped network operation		-
DSS-SS2: Increase of tanks storage capacity		relevant - important problem
DSS-SS5: Network cleaning		relevant
DSS-SS9: Increase pumping capacity		-

ID	Variable	Unit	Value

WATERLOSS

WATERLOSS: Management of water losses in a drinking water supply system» (Transnational Cooperation Programme MED – Project 2G-MED09-445)

Internal Reporting of Project Partners

NRW reduction measures experiences

Phase	**4.1_Development of a DSS tool for appropriate NRW reduction strategy**
Deliverable	**D41.1_ Database of NRW management measures**
Partner responsible for the Phase	**PP9: Department of Herault (DH)**
Partner responsible for the Project	**LP: Aristotle University of Thessaloniki (AUTH)**
Partner's No	**7**
Partner's full NAME	**Autorità di Bacino dei Fiumi Liri-Garigliano e Volturno**
Partner's short NAME	**LG**
Partner's City	**Caserta**
Partner's Country	**Italy**
Case Study Area	**Melito di Napoli**
Pilot Case Study Network	**Melito di Napoli**

SUMMARY

Additional information concerning WB assessment

Assessment period

Is the assessment period the billing period?	YES
How are estimated the starting and ending dates?	It has been assumed the period since utility is in charge of the network management.
Was there intermittent supply during the assessment period?	NO.

ID	Variable	Unit	Value
	Beginning date of the assessment period	Date (m/d/y)	01/01/2007
	Ending date of the assessment period	Date (m/d/y)	12/31/2010
H1	Assessment period	Day	180
H2	Time system is pressurised	Hour	YES

System Input Volume

Is the system input volume period consistent with the assessment period?	YES
Does the system input volume include raw water (abstracted or imported)?	NO
What is the reading frequency of abstraction, importation and exportation meters?	Daily
Is there any correction of imported, exported and abstracted volumes? If so, describe the method.	NO
Is there any correction of billed metered volume? If so, describe the method.	NO
Is there any policy of bulk meters replacement? If so describe it.	NO

ID	Variable	Unit	Value
A3	System input volume	m^3	4’193’300
A5	Exported raw water	m^3	0
A6	Water produced	m^3	4’193’300
A7	Exported treated water	m^3	0
	Abstracted raw water	m^3	0
	Imported raw water	m^3	0
	Imported treated water	m^3	4’193’300
C10	System flow meters	No.	6

Bulk meters (number by type)

Type	Importation	Abstraction	Exportation	Total
Electromagnetic flow meter	6	0	0	**6**
Ultrasonic flow meter	0	0	0	**0**
Insertion meter	0	0	0	**0**
Mechanical meter	0	0	0	**0**
Venturi meter	0	0	0	**0**
Calculation with pump curves	0	0	0	**0**
Measure weirs in open channels	0	0	0	**0**
Other	0	0	0	**0**
Total	**6**	**0**	**0**	**6**

Billed authorized consumption

Are there customers supplied by roof tanks? If so percentage?	There are roof tanks just to let you know There is one pensile tank to serve customers in city centre.
Is there any policy of customer meters replacement? If so describe it.	Policy is in progress.
Describe different categories of un-metered billed consumption the way they are evaluated and the number of customers concerned.	There aren't unmetered billed consumptions.

ID	Variable	Unit	Value
A8	Billed metered consumption	m^3	2'658'000
A9	Billed unmetered consumption	m^3	0
C26	Roof tanks number	No.	n.a.
D42	Customer meter readings	No.	n.a.
D45	Meter replacement	No.	103

Customer meters (number by diameter and metrological class)

Diameter	Class B	Class C	Class D	Other	Total	Average age (year)
15 mm	n.a.	n.a.	n.a.	n.a.	n.a.	**n.a.**
20 mm	n.a.	n.a.	n.a.	n.a.	n.a.	**n.a.**
> 20 mm	n.a.	n.a.	n.a.	n.a.	n.a.	**n.a.**
Total	**n.a.**	**n.a.**	**n.a.**	**n.a.**	**n.a.**	**n.a.**

Unbilled authorized consumption

Estimation methods of unbilled unmetered authorized consumptions

Category	Methods
Process water (for treatment plants)	No
Flushing	No
Frost protection	No
Tank cleaning	No
Fire fighting and training	No
Municipal use	No
Other (specify)	Value include all component listed above. The

	amount has been estimated assuming that it is 0.25% of SIV

ID	Variable	Unit	Value
A11	Unbilled metered consumption	m^3	0
A12	Unbilled unmetered consumption	m^3	10’483

Distribution of unbilled authorized consumptions (m^3)

Category	Metered	Unmetered	Total
Process water	**n.a.**	**n.a.**	**n.a.**
Flushing	**n.a.**	**n.a.**	**n.a.**
Frost protection	**n.a.**	**n.a.**	**n.a.**
Reservoir cleaning	**n.a.**	**n.a.**	**n.a.**
Municipal use	**n.a.**	**n.a.**	**n.a.**
Fire fighting and training	**n.a.**	**n.a.**	**n.a.**
Other (specify)	**n.a.**	**n.a.**	**n.a.**
Total	**n.a.**	**10’483**	**10’483**

Apparent losses and modified WB volumes

How is estimated unauthorized consumption and why?	The estimation of unauthorized consumption have been done assuming literature data, because real data are not available.
How are estimated meter inaccuracies and why?	The estimation of meter inaccuracies have been done assuming literature data, because real data are not available.
After how much time a not paid invoice is abandoned?	Actually invoice not paid are not abandoned.
What is the delay between the end of the assessment period and the estimation of not paid for volumes?	At least three mounths.
Is there a fixed charge in volume? If so how much?	There is fixed charge in volume and it correspond to MCD.
Is there a fixed charge expressed in € related to water volumes? If so how much?	The fixed charge is related to volume. It is computed assuming that each customer consumes at least a minimum volume corresponding to fixed charge.
Is there a fixed charge expressed in € without water volumes? If so how much?	No.

ID	Variable	Unit	Value
A16	Unauthorized consumption	m^3	10’483
A17	Metering inaccuracies water losses	m^3	41’933
A23	Billed but not paid for consumption	m^3	903’720
A25	Minimum Charge Difference	m^3	670’000

Additional information concerning the water supply system

Network subdivisions

Number of distribution units (zones where consumers drink the same water)	n.a.

Number of pressure levels (zones with the same pressure regime)	11
Number of DMAs monitored by SCADA (daily night flow available)	No SCADA is available.
Number of other DMAs	No other DMAs.

ID	Variable	Unit	Value
C11	District meters	No	11

Assets

What are the methods used to measure and update mains length?	Data have been supplied by network manager.
What are the methods used to measure and update service connections number?	Service connection number have been defined taking in account connection to provide water for one or more customers (building with more than one customers).
What are the methods used to calculate and update average service connection length?	Calculation have been done using map information.

ID	Variable	Unit	Value
C8	Mains length	km	65
C24	Service connections	No.	4'100
C25	Average service connection length	m	7.30

Operation

Is a calibrated hydraulic model available?	No
What are the methods used to update water demand?	n.a.
How frequently is it calibrated?	n.a.
Are mains failures registered?	Yes, but not automatically.
Are mains failures located at the section pipe level?	Yes, but not automatically.
Are service connection failures registered?	n.a.
Are failures reported in the GIS?	No

ID	Variable	Unit	Value
D28	Mains failures	No.	88
D29	Service connection failures	No.	60

Pressure

Is estimating average pressure a standard practice of the utility?	No
What are the methods used to evaluate average pressure?	No
What is the weighting system used to calculate average pressure?	No

ID	Variable	Unit	Value
C12	Pressure meters	No.	30
D34	Average operating pressure	kPa	200

MARP	Minimum Annual Reference Pressure (*)	kPa	200

* MARP is the minimum standard of service pressure at the delivery point

NRW reduction measures

Metering accuracy

Bulk meter accuracy

Measure	PIs	Results
RM-4: Calibration of water meters, managing inaccuracy of water meters, age of water meters	n.a.	Not implemented – Relevant.
DH-MA01: Volumetric accuracy checked using a second meter	n.a.	Not implemented – Not relevant.

ID	Variable	Unit	Value
D12	System flow meter calibration	No.	0

Customer meter accuracy

Measure	PIs	Results
RM-28: Metering of revenue water		Implemented. Following
DSS-OM4: Calibration of water use metering network	n.a.	Not implemented – Relevant
DSS-OM5: Check of water use metering network	n.a.	Not implemented- Not relevant.
DH-MA02: Monitoring water quality (the build-up in sediment affects the meter's accuracy)	n.a.	Not implemented – Not relevant.
DH-MA03: Monitoring intermittent water supply (sudden large increase in pressure damage the meter's components)	No intermittent WSS.	No intermittent WSS.
DH-MA04: Test of a representative sample of customer meters	No	Not implemented – relevant.

ID	Variable	Unit	Value

Data processing

Measure	PIs	Results
RM-38: Remote reading of meters in WSS	PI's for water resources, and operational.	Remote reading is not referred to user meters, but only to some equipment for general monitoring of the network. The main result is the optimization of the whole network management.
DSS-DA5: Systematic control of billing records	n.a.	Not implemented – relevant.
DH-MA05: Establishment of guidelines for WB volumes calculation	n.a.	Not implemented – relevant.

ID	Variable	Unit	Value
A3	System input volume	m^3/year	4.193.300,00
C11	District meters	No.	11
C12	Pressure meters	No.	30
C13	Water level meters	No.	4

Unbilled authorized consumption

Process water (for treatment plants)

Measure	PIs	Results
DSS-OM8: Improvement of water treatment techniques		Not implemented – not relevant.
DH-AC01: Optimization of filter cleaning cycles		Not implemented – not relevant.

ID	Variable	Unit	Value

Flushing

Measure	PIs	Results
RM-25: Reduction of operative water use (i.e. ensuring adequate water age) – usually expensive, should be prevented already in the design and development stage		Not implemented – Relevant.
DH-AC02: Adaptation of the flushing duration		Not implemented – relevant.

ID	Variable	Unit	Value

Frost protection

Measure	PIs	Results
DH-AC03: Thermo insulation of non-buried pipes		Not implemented – relevant.

ID	Variable	Unit	Value

Tank cleaning

Measure	PIs	Results
DH-AC04: Beginning of tank cleaning when water level is low.		Not implemented – relevant.

ID	Variable	Unit	Value
D7	Storage tank cleaning	m^3	n.a.

Municipal use

Measure	PIs	Results
RM-5: Measurements of unbilled authorized consumption		Not implemented – relevant.

DH-AC05: Street washing with alternative water (from swimming-pools, rain, river, …)		Not implemented – relevant.
DH-AC06: Optimizing watering of parks and sports fields (methods, time, duration…)		Not implemented – not relevant
DH-AC07: Implementation of artificial turf on sports fields		Not implemented – not relevant.

ID	Variable	Unit	Value

Fire fighting and training

Measure	PIs	Results
DH-AC08: Operators training	Operational PI's.	Improvement of the operators know-how.

ID	Variable	Unit	Value
C23	Hydrants	No.	23
D11	Hydrants inspection	No.	11
B18	Total training time	Hours	64

Other

Measure	PIs	Results
RM-27: Measurement of system water use (overflows, mud releases, pressure reduction valves…)		Partially implemented. The main result is the control of the pressure level and of the flow rate in pipe.
RM-51: Rules for different water uses – especially large water users, transient phenomena, fire-fighters…		Not implemented – relevant.

ID	Variable	Unit	Value

Apparent losses

Meters under-registration

Measure	PIs	Results
DH-AL01: Replacement of low metrological class meters	Operational and water resources PI's.	The program defined by network manager is in progress.

ID	Variable	Unit	Value

Water accounting errors

Measure	PIs	Results
DH-AL02: Improvement of the billing database		n.a.
DH-AL03: Meter reading with smart portable digital devices (Meter reader can control in the historical database)		Not implemented – relevant.

ID	Variable	Unit	Value

Water theft

Measure	PIs	Results
RM-6: Active search campaigns for illegal water connections	Water resources, economic, and operational PI's.	The program defined by network manager is in progress.
RM-40: Legal measures (efficient prosecution of illegal connections) communication with the law enforcement authorities (prosecution process, evidence process, judicial procedures, penalties).		Not implemented – relevant.
DH-AL04: Addressing meter tampering	Water resources, economic, and operational PI's.	There is not relevant data.

ID	Variable	Unit	Value
A16	Unauthorised consumption	m^3	20.967,00
A23	Non-recovered water	m^3	903.720,00
G3	Sales revenue	€	Confidential information.

Real losses

Active leakage control

Measure	PIs	Results
RM-1: Geophone (single -mobile)		Not implemented – relevant.
RM-2: Advanced hydraulic model development – continuous run of hydraulic model – nowcasting – verification with monitoring results		Not implemented – relevant.
RM-3: Leak noise correlators		Not implemented – relevant.
RM-13: Leakage and water loss identification by pressure variations		Not implemented – relevant.
RM-26: Continuous discharge measurements of water supplied to WSS - also other parameters (SCADA tool)		Not implemented – relevant.
RM-32: District metering (continuous discharge measurements)	Water resources, and operational PI's.	It has been individuated 11 district for network management. Reduction of the pressure level and system input volume.
RM-33: Measurement campaigns (frequency) target measurement campaigns		Not implemented – relevant.
RM-58: Trace gas		Not implemented – relevant.
RM-59: Deployment of fixed noise loggers		Not implemented – relevant.
DSS-DA2: Implementation of leak detection techniques		Network manager individuated a specific program.
DSS-SS15: Installation of proper metering network	Water resources, and operational PI's.	Network manager is starting up a specific program.
DSS-SS16: Construction of alternative supply paths-mains	Water resources, and operational PI's.	Network manager activated a program to replace old pipe in order to reduce rupture occurrence and water losses related.
DH-RL01: Night step-testing (reducing the size of the area by closing valves)		Not implemented – relevant.
DH-RL02: Implementation of a systematic leak detection planning	Water resources, and operational PI's.	Network manager is starting up a specific program.

ID	Variable	Unit	Value
D9	Leakage control	Km	40
D10	Leaks repaired due to active leakage control	No.	15

Pressure management

Measure	PIs	Results
RM-10: Active identification and control of transient phenomena (identification of possibilities for transients etc.)		Not implemented – relevant.
RM-11: Pressure zoning (optimization of pressures)	Water resources, and operational PI's.	Network manager individuated 11 district for pressure regulation.
RM-12: Pressure reduction practice	Water resources, and operational PI's.	Network manager individuated 11 district for pressure regulation.
RM-22: Soft pump priming		Not implemented – relevant.
RM-23: Soft regulation of closing valves		Not implemented – relevant.
DSS-DA1: Hydraulic simulation of the system		Not implemented – relevant.
DSS-OM1: Change of valves settings	Water resources, and operational PI's.	It depends of network operating status.
DSS-SS1: Additional boosters & pressure reducing valves installation		Not implemented – relevant.
DSS-SS10: Installation of release valves		Not implemented – relevant.
DSS-SS19: Surge control		Not implemented – relevant.
DH-RL03: Pressure modulation	Water resources, and operational PI's.	Network manager individuated 11 district for pressure regulation.

ID	Variable	Unit	Value
D13	Pressure meter calibration	No.	n.a.

Speed of repairs

Measure	PIs	Results
RM-34: Permitting procedures for other constructions in the impact zones of the WSS infrastructure, also permitting procedures for the re-classification of roads		Not implemented – relevant.
RM-37: Central registry of underground infrastructure		Not implemented – relevant.
RM-39: Public awareness campaign (i.e. did anybody see wetted spot around the valve)		Implemented.
DSS-OM3: Repair of leaks		Implemented.
DSS-OM7: Proper checking of valves operation		Not implemented – relevant.

DH-RL04: Procedure to guarantee repair material availability		Not implemented.
DH-RL05: Reporting of repairing times		Implemented.

ID	Variable	Unit	Value
C22	Isolating valves	No.	n.a.
D8	Network inspections	Km	40

Asset management

Measure	PIs	Results
RM-9: Thermography (Camera control of mains?)		Not implemented – not relevant.
RM-8: Water consumption metering close to the mains (short service connections).		Not implemented – relevant.
RM-7: Identification of water losses from service connections (rehabilitation or replacement of service connections)		Not implemented – relevant.
RM-30: Register of pipe bursts interventions and identified leakage		Implemented.
RM-24: Use of other specific equipment and rehabilitation tools in the case of identified leakage and pipe breach repair procedures (i.e. clamps, andorre type)		Not implemented – relevant.
RM-21 & DSS-SS13: Pipe cleaning and lining		Not implemented – relevant.
RM-20 & DSS-SS18: Pipe replacement (with corrosion-free material)		Partially implemented – to be improved.
RM-19: Observations of actual pipe aging (i.e. on test grounds)		Not implemented – relevant.
RM-18: Soil type mapping and soil stability standard		Not implemented – relevant.
RM-16: Construction process supervision and documentation		Implemented.
RM-15: Construction process standards		Implemented.
DSS-SS8: Improved pipe installation practices		Implemented.
DSS-SS7: Avoid direct contact with electricity source		Implemented.
DSS-SS6: Avoid bimetallic connections		Not implemented – relevant.
DSS-SS4: Cathodic protection		Not implemented – relevant.
DSS-SS17: Implementation of pipe insertion		Not implemented – relevant.
DSS-SS12: Check and repair of joints		Partially implemented.
DH-RL06: Service connections replacement policy		Partially implemented.
DH-RL07 : Use of a DSS to drive asset management policy (including breaks prediction tools)		Not implemented – relevant.

ID	Variable	Unit	Value

D20	Mains rehabilitation	Km	n.a.
D21	Mains renovation	Km	n.a.
D22	Mains replacement	Km	0.24
D23	Replaced valves	No.	6
D24	Service connection rehabilitation	No.	102

Other measures

Actions to reduce customer consumption

Measure	PIs	Results
DH-OM01: Installation of water efficient devices in households and public buildings		Not implemented – relevant.

ID	Variable	Unit	Value
D38	Days with restrictions to water service	day	10

Actions to recover unpaid invoices

Measure	PIs	Results
RM-42: Efficient and effective payment realization (100% payment of water bills?).	Economic PI's.	Program is in progress.
DH-OM02: Agreement with social services to fragment the debt		Not implemented – relevant.

ID	Variable	Unit	Value
A23	Volume billed out but not paid	m^3	903.720,00

Actions on tariffs

Measure	PIs	Results
RM-41 : Economic/financial measures (i.e. mangers of the WSS are awarded for the reduction of water losses, i.e. regional/central tax on the NRW)	Economic PI's.	Information to be considered confidential.
RM-48 : Pricing mechanism – cost recovery – target oriented water pricing		Not implemented – relevant.
RM-49 : Adequate pricing mechanisms covering all costs necessary for efficient water supply		Not implemented – relevant.
DH-OM03 : Fixed charge volume reduction		Not implemented – relevant.

ID	Variable	Unit	Value

Other actions

Measure	PIs	Results

RM-50: Development of programme of measures for the NRW reduction (documentation, evaluation, designs…)		Programs specified in previous paragraph.
RM-54: Participation in target projects for the reduction of NRW		Not implemented – relevant. WATERLOSS can be considered a target project in order to improve practice level for management.

ID	Variable	Unit	Value

DSS measures not yet assigned to a component

Measure	PIs	Results
RM-14: Planning process standards		Not implemented – relevant.
RM-17: Constructed WSS commission process standards		Not implemented – not relevant.
RM-29 & DSS-DA3: System mapping using GIS. GIS development – information on system (gradual improvement of GIS functionalities)		Partially implemented. To be improved. Relevant measure.
RM-31: Supply chain management (verification of suppliers – CE standards?, supply standards and reliability)		Internal information of the network manager.
RM-35: Change from intermittent water supply to continuous water supply		WSS is already continuous.
RM-36: Document management and archives in the management company (archiving the documents on construction, service connections, permits etc.)		Implemented.
RM-43: External supervision of the performance of the WSS (certification process)		Not implemented – relevant.
RM-44:Participation in the benchmarking schemes		Not implemented – relevant.
RM-45: HRM – company culture (every drop counts), permanent, targeted education of employees,		Partially implemented. To be improved.
RM-46: HRM – adequate staffing for different processes, adequate tools, equipment, education		Not implemented – relevant.
RM-47: Relative/absolute reduction of NRW – increase in water amount sold (Revenue water) is leading to relative reduction of NRW		Not implemented – relevant.
RM-52: Development of the microeconomic model for the WSS (actual supply and demand curve), i.e. demand flexibility, market behaviour analysis		Not implemented – not relevant.
RM-53: Adequate economy of scale for the managers of the WSS		Not implemented – not relevant.

RM-55: Improving the objective side of the NRW problem -artificial augmentation of the ressource		Not implemented – not relevant.
RM-56: Improving the objective side of the NRW problem - Improved energy efficiency		Already realised. Energy consumption per month decreased from 12.000,00 € to 2.200,00 €.
RM-57: Structural management of seasonal variation in water demand		Not implemented – relevant.
DSS-DA4: Keeping full data records (normal-abnormal)		Implemented.
DSS-DA6: Intrusion control in high-risk points		Not implemented – not relevant.
DSS-OM2: Regular pipe flushing		Not implemented – not relevant.
DSS-OM6: pH adjustment of water		Not implemented – not relevant.
DSS-SS11: Adoption of in-system chlorination		Implemented.
DSS-SS14: Looped network operation		Not implemented – not relevant.
DSS-SS2: Increase of tanks storage capacity		Not implemented – not relevant.
DSS-SS5: Network cleaning		Not implemented – relevant.
DSS-SS9: Increase pumping capacity		Not implemented – not relevant.

ID	Variable	Unit	Value

WATERLOSS

WATERLOSS: Management of water losses in a drinking water supply system» (Transnational Cooperation Programme MED – Project 2G-MED09-445)

Internal Reporting of Project Partners

NRW reduction measures experiences

Phase	**4.1_Development of a DSS tool for appropriate NRW reduction strategy**
Deliverable	**D41.1_ Database of NRW management measures**
Partner responsible for the Phase	**PP9: Department of Herault (DH)**
Partner responsible for the Project	**LP: Aristotle University of Thessaloniki (AUTH)**
Partner's No	**PP6**
Partner's full NAME	**Kozani Water and Sewerage Utility**
Partner's short NAME	**DEYAK**
Partner's City	**Kozani**
Partner's Country	**Greece**
Case Study Area	**City of Kozani**
Pilot Case Study Network	**City of Kozani Water Distribution Network**

SUMMARY

Additional information concerning WB assessment

Assessment period

Is the assessment period the billing period?	Assessment has been performed (a) in annual basis; (b) in quarterly (4-month) basis for the years 2009 and 2010
How are estimated the starting and ending dates?	(a) Starting date is 01 January of each year; ending date is 31 December of each year (b) Starting dates: 01 January; 01 May; 01 September – Ending dates: 30 April; 31 August; 31 December
Was there intermittent supply during the assessment period?	No.

ID	Variable	Unit	Value
	Beginning date of the assessment period	Date (m/d/y)	01/01/2010
	Ending date of the assessment period	Date (m/d/y)	12/31/2010
H1	Assessment period	Day	365
H2	Time system is pressurised	Hour	8760

System Input Volume

Is the system input volume period consistent with the assessment period?	Yes
Does the system input volume include raw water (abstracted or imported)?	No
What is the reading frequency of abstraction, importation and exportation meters?	Daily (with SCADA)
Is there any correction of imported, exported and abstracted volumes? If so, describe the method.	No
Is there any correction of billed metered volume? If so, describe the method.	No
Is there any policy of bulk meters replacement? If so describe it.	There is no policy. Bulk meters are replaced when they fail.

ID	Variable	Unit	Value
A3	System input volume	m^3	5,688,642
A5	Exported raw water	m^3	0
A6	Water produced	m^3	0
A7	Exported treated water	m^3	0
	Abstracted raw water	m^3	5,688,642
	Imported raw water	m^3	0
	Imported treated water	m^3	0
C10	System flow meters	No.	95

Bulk meters (number by type)

Type	Importation	Abstraction	Exportation	Total
Electromagnetic flow meter				**35**
Ultrasonic flow meter				
Insertion meter				
Mechanical meter				**60**
Venturi meter				
Calculation with pump curves				
Measure weirs in open channels				
Other				
Total				**95**

Billed authorized consumption

Are there customers supplied by roof tanks? If so percentage?	There are some roof tanks but they are not actually used to supply the customers.
Is there any policy of customer meters replacement? If so describe it.	Customer meters are replaced after 5 years of installation.
Describe different categories of un-metered billed consumption the way they are evaluated and the number of customers concerned.	There is no un-metered billed consumption

ID	Variable	Unit	Value
A8	Billed metered consumption	m^3	2,369,301
A9	Billed unmetered consumption	m^3	0
C26	Roof tanks number	No.	0
D42	Customer meter readings	No.	84.843
D45	Meter replacement	No.	720

Customer meters (number by diameter and metrological class)

Diameter	Class B	Class C	Class D	Other	Total	Average age (year)
15 mm	5,800	16,483		4,450	26,733	
20 mm	400	120		450	970	
> 20 mm				60	60	
Total	**6,200**	**16,603**		**4,960**	**27,763**	

age

Commentaire [A1] : This table has been added by DEYAK

Age	Class B	Class C	Class D	Other	Total
< 5 years	50	4,250			4,300
5-10 years	450	12,353			12,803
> 10 years	5,700			4,960	10,660
Total	**6,200**	**16,603**		**4,960**	**27,763**

Unbilled authorized consumption

Estimation methods of unbilled unmetered authorized consumptions

Category	Methods
Process water (for treatment plants)	N/A (not available)
Flushing	N/A

Frost protection	N/A
Tank cleaning	N/A
Fire fighting and training	N/A
Municipal use	N/A
Other (specify)	The sum of all the above is assumed to be 2% of the SIV

ID	Variable	Unit	Value
A11	Unbilled metered consumption	m^3	0
A12	Unbilled unmetered consumption	m^3	113,773

Distribution of unbilled authorized consumptions (m^3)

Category	Metered	Unmetered	Total
Process water		113,733	**113,733**
Flushing			
Frost protection			
Reservoir cleaning			
Municipal use			
Fire fighting and training			
Other (specify)			
Total	**0**	**113,773**	**113,773**

Apparent losses and modified WB volumes

How is estimated unauthorized consumption and why?	Unauthorized consumption is assumed to be 1% of the SIV, according to the international literature, since the utility has never implemented such a study.
How are estimated meter inaccuracies and why?	Meter inaccuracies are assumed to be 10% of the billed authorised consumption
After how much time a not paid invoice is abandoned?	A not paid invoice is never abandoned. The utility first acknowledges the customer and then cuts the water supply. After that legal measures are implemented.
What is the delay between the end of the assessment period and the estimation of not paid for volumes?	An invoice is considered as a not paid one after the end of the period mentioned in the water bill.
Is there a fixed charge in volume? If so how much?	There is no fixed charge in volume
Is there a fixed charge expressed in € related to water volumes? If so how much?	No
Is there a fixed charge expressed in € without water volumes? If so how much?	There is a fixed charge of 17.00€ per 4 months.

ID	Variable	Unit	Value
A16	Unauthorized consumption	m^3	56,886
A17	Metering inaccuracies water losses	m^3	236,930
A23	Billed but not paid for consumption	m^3	156,827
A25	Minimum Charge Difference	m^3	2,311,834

Additional information concerning the water supply system

Network subdivisions

Number of distribution units (zones where consumers drink the same water)	There are 2 zones
Number of pressure levels (zones with the same pressure regime)	3 zones
Number of DMAs monitored by SCADA (daily night flow available)	There are no DMAs
Number of other DMAs	No DMAs exist

ID	Variable	Unit	Value
C11	District meters	No	35

Assets

What are the methods used to measure and update mains length?	N/A
What are the methods used to measure and update service connections number?	N/A
What are the methods used to calculate and update average service connection length?	N/A

ID	Variable	Unit	Value
C8	Mains length	km	129.584
C24	Service connections	No.	9,150
C25	Average service connection length	m	6

Operation

Is a calibrated hydraulic model available?	EPANET was used. Now it is out of use.
What are the methods used to update water demand?	Previous periods water demand and temperature (statistics).
How frequently is it calibrated?	It is not used by the water utility
Are mains failures registered?	No
Are mains failures located at the section pipe level?	No
Are service connection failures registered?	No
Are failures reported in the GIS?	No

ID	Variable	Unit	Value
D28	Mains failures	No.	15
D29	Service connection failures	No.	30

Pressure

Is estimating average pressure a standard practice of the utility?	Yes.
What are the methods used to evaluate average pressure?	Use of the zone's altitude and the hydraulic grade line
What is the weighting system used to calculate average pressure?	N/A

ID	Variable	Unit	Value
C12	Pressure meters	No.	8
D34	Average operating pressure	kPa	304-506.6
MARP	Minimum Annual Reference Pressure (*)	kPa	101.32

* MARP is the minimum standard of service pressure at the delivery point

NRW reduction measures

Legend

Measure	PIs	Results
Designation and description of the measure. Indicate parts of the WSS which are concerned and realisation period.	Mention diagnosis and evaluation PIs used to carry out the measure (with formula for non-IWA PIs)	Indicate capital and operational expenditures, expected lifespan of installations, annual volume of water savings (and how it is evaluated), other results and value of dedicated PIs before and after the action (with reference date or period).
Example: Pressure regulation of DMA7 (31 km of mains, 26% of network mains length). Installation of 2 PRVs and 3 section valves. Annual maintenance. Operating since April 2009.	Average Operating Pressure (AOP) and Annual Water Losses (AWL). Same formula as IWA PIs at DMA level.	Capex = 25 000 € (2009) Opex = 850 €/year Expected lifespan = 30 years Water savings (2010) = 7 500 m^3 (estimation based on DMA night flows) AOP 2008 = 65 m of pressure AOP 2010 = 43 m of pressure AWL 2008 = 35 500 m^3 AWL 2010 = 28 000 m^3

ID	Variable	Unit	Value
AOP	Average Operating Pressure (DMA level)	m of pressure	See above
AWL	Annual Water Losses (DMA level)	m^3	See above

In the following tables, measures from the DSS platform and examples from DH are proposed:

- **if a measure doesn't fit with your WSS, please, mention in the column "Result" : *"not implemented"* and indicate if in your opinion this measure is relevant or not.**
- **Otherwise, fill the form,**
- **add the other measures you have implemented or planned to implement.**

Explanation of measures codification:

- RM-xx : Measure number xx in the "NRW Reduction Measures" (RM) webpage in the DSS platform http://www.vokas.si/waterloss/dssplatform/AppSpec/WATERLOSS_WATERLOSS/CustomPages/MeasuresMatrix.aspx
- DSS-aaxx : Measure with the code aaxx in the "DSS" webpage in the DSS platform http://www.vokas.si/waterloss/dssplatform/AppSpec/WATERLOSS_WATERLOSS/CustomPages/DSS.aspx
- DH-aaxx : Measure given in example by DH.

Metering accuracy

Bulk meter accuracy

Measure	PIs	Results
RM-4: Calibration of water meters, managing inaccuracy of water meters, age of water meters		Not implemented
DH-MA01: Volumetric accuracy checked using a second meter		Not implemented

ID	Variable	Unit	Value
D12	System flow meter calibration	No.	N/A

Customer meter accuracy

Measure	PIs	Results
RM-28: Metering of revenue water	Billed metered cons. every 4 months	
DSS-OM4: Calibration of water use metering network		Not implemented
DSS-OM5: Check of water use metering network		Not implemented
DH-MA02: Monitoring water quality (the build-up in sediment affects the meter's accuracy)		By SCADA and tests
DH-MA03: Monitoring intermittent water supply (sudden large increase in pressure damage the meter's components)		Not implemented.
DH-MA04: Test of a representative sample of customer meters		Not implemented

ID	Variable	Unit	Value

Data processing

Measure	PIs	Results
RM-38: Remote reading of meters in WSS		Not implemented
DSS-DA5: Systematic control of billing records		Not implemented
DH-MA05: Establishment of guidelines for WB volumes calculation		Not implemented

ID	Variable	Unit	Value

Unbilled authorized consumption

Process water (for treatment plants)

Measure	PIs	Results
DSS-OM8: Improvement of water treatment techniques		Not implemented
DH-AC01: Optimization of filter cleaning cycles		Not implemented

ID	Variable	Unit	Value

Flushing

Measure	PIs	Results
RM-25: Reduction of operative water use (i.e. ensuring adequate water age) – usually expensive, should be prevented already in the design and development stage		Not implemented
DH-AC02: Adaptation of the flushing duration		Not implemented

ID	Variable	Unit	Value

Frost protection

Measure	PIs	Results
DH-AC03: Thermo insulation of non-buried pipes		Not implemented

ID	Variable	Unit	Value

Tank cleaning

Measure	PIs	Results
DH-AC04: Beginning of tank cleaning when water level is low.		Tanks cleaning takes place once a year.

ID	Variable	Unit	Value
D7	Storage tank cleaning	m^3	19,000

Municipal use

Measure	PIs	Results
RM-5: Measurements of unbilled authorized consumption	Not measured	Not implemented. The unbilled authorised consumption should be measured

DH-AC05: Street washing with alternative water (from swimming-pools, rain, river, …)		Not implemented
DH-AC06: Optimizing watering of parks and sports fields (methods, time, duration…)		Not implemented
DH-AC07: Implementation of artificial turf on sports fields		Not implemented

ID	Variable	Unit	Value

Fire fighting and training

Measure	PIs	Results
DH-AC08: Operators training		Not implemented

ID	Variable	Unit	Value
C23	Hydrants	No.	65
D11	Hydrants inspection	No.	130

Other

Measure	PIs	Results
RM-27: Measurement of system water use (overflows, mud releases, pressure reduction valves…)		Not implemented
RM-51: Rules for different water uses – especially large water users, transient phenomena, fire-fighters…		Not implemented

ID	Variable	Unit	Value

Apparent losses

Meters under-registration

Measure	PIs	Results
DH-AL01: Replacement of low metrological class meters	1.Number of customer meters replaced 2.Water volume saved (m3)	1. 20.000 (of volumetric class D and tachymetric/flowmeters class C) from 2006 to 2011 2. 200.000m3

ID	Variable	Unit	Value

Water accounting errors

Measure	PIs	Results
DH-AL02: Improvement of the billing database		Not implemented
DH-AL03: Meter reading with smart portable digital devices (Meter reader can control in the historical database)		Not implemented. Although possible

ID	Variable	Unit	Value

Water theft

Measure	PIs	Results
RM-6: Active search campaigns for illegal water connections		Not implemented. Should be done in pilot areas
RM-40: Legal measures (efficient prosecution of illegal connections) communication with the law enforcement authorities (prosecution process, evidence process, judicial procedures, penalties).		Legal measures take place.
DH-AL04: Addressing meter tampering		Not implemented.

ID	Variable	Unit	Value

Real losses

Active leakage control

Measure	PIs	Results
RM-1: Geophone (single -mobile)		Not implemented
RM-2: Advanced hydraulic model development – continuous run of hydraulic model – nowcasting – verification with monitoring results		Not implemented
RM-3: Leak noise correlators		Not implemented
RM-13: Leakage and water loss identification by pressure variations		Not implemented
RM-26: Continuous discharge measurements of water supplied to WSS - also other parameters (SCADA tool)		Not implemented
RM-32: District metering (continuous discharge measurements)		Not implemented
RM-33: Measurement campaigns (frequency) target measurement campaigns		Not implemented
RM-58: Trace gas		Not implemented
RM-59: Deployment of fixed noise loggers		Not implemented
DSS-DA2: Implementation of leak detection techniques		Not implemented
DSS-SS15: Installation of proper metering network		Not implemented
DSS-SS16: Construction of alternative supply paths-mains		Not implemented
DH-RL01: Night step-testing (reducing the size of the area by closing valves)		Not implemented
DH-RL02: Implementation of a systematic leak detection planning		Not implemented

Comment: Leakage Control takes place only when needed

ID	Variable	Unit	Value
D9	Leakage control	km	20
D10	Leaks repaired due to active leakage control	No.	20

Pressure management

Measure	PIs	Results
RM-10: Active identification and control of transient phenomena (identification of possibilities for transients etc.)		Not implemented
RM-11: Pressure zoning (optimization of pressures)		Not implemented
RM-12: Pressure reduction practice		Not implemented
RM-22: Soft pump priming		Not implemented
RM-23: Soft regulation of closing valves		Not implemented
DSS-DA1: Hydraulic simulation of the system		Not implemented
DSS-OM1: Change of valves settings		Not implemented
DSS-SS1: Additional boosters & pressure reducing valves installation		Not implemented
DSS-SS10: Installation of release valves		Not implemented
DSS-SS19: Surge control		Not implemented
DH-RL03: Pressure modulation		Not implemented

ID	Variable	Unit	Value
D13	Pressure meter calibration	No.	N/A

Speed of repairs

Measure	PIs	Results
RM-34: Permitting procedures for other constructions in the impact zones of the WSS infrastructure, also permitting procedures for the re-classification of roads	Number of applications	Other constructors apply to the water utility or to the municipality.
RM-37: Central registry of underground infrastructure		Not implemented
RM-39: Public awareness campaign (i.e. did anybody see wetted spot around the valve)		Not implemented
DSS-OM3: Repair of leaks		After its appearance
DSS-OM7: Proper checking of valves operation		Not implemented
DH-RL04: Procedure to guarantee repair material availability		Not implemented
DH-RL05: Reporting of repairing times		Not implemented

ID	Variable	Unit	Value
C22	Isolating valves	No.	2,968
D8	Network inspections	km	100

Asset management

Measure	PIs	Results
RM-9: Thermography (Camera control of mains?)		Not implemented

RM-8: Water consumption metering close to the mains (short service connections).		Not implemented
RM-7: Identification of water losses from service connections (rehabilitation or replacement of service connections)		Not implemented
RM-30: Register of pipe bursts interventions and identified leakage		Not implemented
RM-24: Use of other specific equipment and rehabilitation tools in the case of identified leakage and pipe breach repair procedures (i.e. clamps, andorre type)		Not implemented
RM-21 & DSS-SS13: Pipe cleaning and lining		Not implemented
RM-20 & DSS-SS18: Pipe replacement (with corrosion-free material)		Scheduled for 2012. 13.064 km of pipes of PVC, Asbestos cement and cast iron will be replaced by pipes of HDPE
RM-19: Observations of actual pipe aging (i.e. on test grounds)		Not implemented
RM-18: Soil type mapping and soil stability standard		Not implemented
RM-16: Construction process supervision and documentation		Not implemented
RM-15: Construction process standards		Not implemented
DSS-SS8: Improved pipe installation practices		Not implemented
DSS-SS7: Avoid direct contact with electricity source		Not implemented
DSS-SS6: Avoid bimetallic connections		Not implemented
DSS-SS4: Cathodic protection		Not implemented
DSS-SS17: Implementation of pipe insertion		Not implemented
DSS-SS12: Check and repair of joints		Not implemented
DH-RL06: Service connections replacement policy		Not implemented
DH-RL07 : Use of a DSS to drive asset management policy (including breaks prediction tools)		Not implemented

ID	Variable	Unit	Value
D20	Mains rehabilitation	km	N/A
D21	Mains renovation	km	N/A
D22	Mains replacement	km	2
D23	Replaced valves	No.	50
D24	Service connection rehabilitation	No.	20

Other measures

Actions to reduce customer consumption

Measure	PIs	Results
DH-OM01: Installation of water efficient devices in households and public buildings		Not implemented

ID	Variable	Unit	Value
D38	Days with restrictions to water service	day	0

Actions to recover unpaid invoices

Measure	PIs	Results
RM-42: Efficient and effective payment realization (100% payment of water bills?).	Not paid invoices (€)	
DH-OM02: Agreement with social services to fragment the debt		Not implemented

ID	Variable	Unit	Value

Actions on tariffs

Measure	PIs	Results
RM-41 : Economic/financial measures (i.e. mangers of the WSS are awarded for the reduction of water losses, i.e. regional/central tax on the NRW)		Not implemented
RM-48 : Pricing mechanism – cost recovery – target oriented water pricing		Not implemented
RM-49 : Adequate pricing mechanisms covering all costs necessary for efficient water supply		Not implemented
DH-OM03 : Fixed charge volume reduction		Not implemented

ID	Variable	Unit	Value

Other actions

Measure	PIs	Results
RM-50: Development of programme of measures for the NRW reduction (documentation, evaluation, designs…)		Not implemented
RM-54: Participation in target projects for the reduction of NRW		Participation in WATERLOSS.

ID	Variable	Unit	Value

DSS measures not yet assigned to a component

Measure	PIs	Results
RM-14: Planning process standards		Not implemented
RM-17: Constructed WSS commission process standards		Not implemented
RM-29 & DSS-DA3: System mapping using GIS. GIS development – information on system (gradual improvement of GIS functionalities)		Data included in layers are: Consumers: id water meter, shape, code, meter number, owner and consumer names, address, protocol id, x and y coordinates, meter registrations; Buildings addresses: id, street name and number, full address, shape length and area; Pipes: id, length; Streets: id, name, level, size, length; Service connections: id, address, x and y coordinates, length; Buildings: id, length, area; Zones: id, area, perimeter, code, acres, hectares, length, area; Blocks: id, length, block number, zone, length, area; Manholes: id, location, shape and code.
RM-31: Supply chain management (verification of suppliers – CE standards?, supply standards and reliability)		Not implemented right now. ISO standard will be used in the near future
RM-35: Change from intermittent water supply to continuous water supply		Not implemented
RM-36: Document management and archives in the management company (archiving the documents on construction, service connections, permits etc.)		Not implemented
RM-43: External supervision of the performance of the WSS (certification process)		ISO standard
RM-44:Participation in the benchmarking schemes		Not implemented
RM-45: HRM – company culture (every drop counts), permanent, targeted education of employees,		Not implemented
RM-46: HRM – adequate staffing for different processes, adequate tools, equipment, education		Not implemented
RM-47: Relative/absolute reduction of NRW – increase in water amount sold (Revenue water) is leading to relative reduction of NRW		Not implemented
RM-52: Development of the microeconomic model for the WSS (actual supply and demand curve), i.e. demand flexibility, market behaviour analysis		Not implemented

RM-53: Adequate economy of scale for the managers of the WSS		Not implemented
RM-55: Improving the objective side of the NRW problem -artificial augmentation of the ressource		Not implemented
RM-56: Improving the objective side of the NRW problem - Improved energy efficiency		Not implemented
RM-57: Structural management of seasonal variation in water demand		Not implemented
DSS-DA4: Keeping full data records (normal-abnormal)		Not implemented
DSS-DA6: Intrusion control in high-risk points		Not implemented
DSS-OM2: Regular pipe flushing		Not implemented
DSS-OM6: pH adjustment of water		Not implemented
DSS-SS11: Adoption of in-system chlorination		Not implemented
DSS-SS14: Looped network operation		Not implemented
DSS-SS2: Increase of tanks storage capacity		Not implemented
DSS-SS5: Network cleaning		Not implemented
DSS-SS9: Increase pumping capacity		Not implemented

ID	Variable	Unit	Value

Annex 3

Synthesis of project partners answers at DH questionnaire on NRW measures

New IWA ?	ID	Question	Units	Castellbisbal	SIE Lodève	Nicosie	Argelès-sur-Mer	Melito di Napoli	Kozani
		Is the assessment period the billing period?		No. Assesment period is 2010. Billing period is every two months. WB calculation is done for 4 months period	yes	No. The assessment period is the days of the year. Intermediate assessment is also performed.	No. Assessment period is 2010. Billing period is every six months. WB calculation is done for both (6 period and 1 year period)	YES	Assessment has been performed (a) in annual basis; (b) in quarterly (4-month) basis for the years 2009 and 2010
		How are estimated the starting and ending dates?		All 2010	meters readings	Billing period corresponds to the date the recording of customer meter consumption is completed	All 2010 (1st January-31th December)	It has been assumed the period since utility is in charge of the network management.	(a) Starting date is 01 January of each year; ending date is 31 December of each year (b) Starting dates: 01 January; 01 May; 01 September – Ending dates: 30 April; 31 August; 31 December
		Was there intermittent supply during the assessment period?		No	No	Continuous supply was re-installed during the assessment period year 2010, after intermittent supply from 4/2008-1/2010.	NO	NO.	No.
		Beginning date of the assessment period	Date (d/m/y)	01/01/2010	01/01/2011	01/01/2011	01/01/2010	01/01/2007	01/01/2010
		Ending date of the assessment period	Date (d/m/y)	31/12/2010	31/12/2011	31/12/2011	31/12/2010	12/31/2010	31/12/2010
	H1	Assessment period	Days	365	365	365	365	180	365
	H2	Time system is pressurised	Hours in a year	**8760**	**8760**	8760	**8760**	**8670**	**8760**
		Is the system input volume period consistent with the assessment period?		Yes	Yes	Yes	YES	YES	Yes
		Does the system input volume include raw water (abstracted or imported)?		No properly. Raw water goes to the Water Treatment Plant and SIV begins after this Water Treatment Plant	Yes	No	YES. In Argeles city all water supplied are imported from 2 production sites. There is no treatment plant, just a gas chlorine.	NO	No

New IWA ?	ID	Question	Units	Castellbisbal	SIE Lodève	Nicosie	Argelès-sur-Mer	Melito di Napoli	Kozani
		What is the reading frequency of abstraction, importation and exportation meters?		Abstraction.- it doesn't affect because abstraction is done before the SIV, but measures are automatically read every day Importation. Water coming to the system is read diary Exportation .- exported water is read diary	Once / year	Continuous monitoring	monthly	Daily	Daily (with SCADA)
		Is there any correction of imported, exported and abstracted volumes? If so, describe the method.		No	No	No	NO	NO	No
		Is there any correction of billed metered volume? If so, describe the method.		No	No	Yes. The Billed metered volume is adjusted to correspond to the days of the year.	NO	NO	No
		Is there any policy of bulk meters replacement? If so describe it.		There aren't any bulk meters. The unique exportation point runs as a normal user.	No	Yes. Bulk meters are replaced when they malfunction	Priority of the municipality is to replaces all meters > 10 years	NO	There is no policy. Bulk meters are replaced when they fail.
	A3	System input volume	m^3	2 445 454	1 436 640	23 838 611	2 123 191	4 193 300	5 688 642
	A5	Exported raw water	m^3	0	0		0	0	0
	A6	Water produced	m^3	1 410 144	1 436 640		0	4 193 300	0
	A7	Exported treated water	m^3	3 294	66 990	3 124 150	0	0	0
		Abstracted raw water	m^3	1 476 591	1 436 640		0	0	5 688 642
		Imported raw water	m^3	0	0		0	0	0
		Imported treated water	m^3	1 035 310	0		2 123 191	4 193 300	0
	C10	System flow meters	No.	11 (7 sectorisation, 3 bought water 1 sold water)	21	56	2 production sites : 2 water main meters also 3 meters on storage tanks	6	
		Are there customers supplied by roof tanks? If so percentage?		Yes. 18 domestic users. 0.35% of domestic user's or 0.31% total user's		Yes. 100% - WBN obliges all customers to be equipped with a roof tank (min. capacity 1m3)	NO	There are roof tanks just to let you know There is one pensile tank to serve customers in city centre.	There are some roof tanks but they are not actually used to supply the customers.

New IWA ?	ID	Question	Units	Castellbisbal	SIE Lodève	Nicosie	Argelès-sur-Mer	Melito di Napoli	Kozani
		Is there any policy of customer meters replacement? If so describe it.		There isn't any replacement policy. When a meter breaks down, then it's replaced.	No (replacing each 10 years is a recommendation)	Customer meters are replaced when they malfunction. Recently they are replaced if older than 10 years.	About 10% of all customer meters / year. Priority for meters > 10 years according to meter inaccuracies	Policy is in progress.	Customer meters are replaced after 5 years of installation.
		Describe different categories of un-metered billed consumption the way they are evaluated and the number of customers concerned.		N/A	0	Billed volume of water lost due to damage on the supply system by third parties. Billed volume of water to consumer when water theft if discovered from illegal connection	no un-metered billed consumption	There aren't unmetered billed consumptions.	There is no un-metered billed consumption
	A8	Billed metered consumption	m^3	2 194 336	557 134	14 467 783	1 695 092	2 658 000	2 369 301
	A9	Billed unmetered consumption	m^3	0	0	13 310	0	0	0
	C26	Roof tanks number	No.	18	10	107 613	0	n.a.	Unknown
	D42	Customer meter readings	No.	35 478	3 655	107 613	2	n.a.	84,843
	D45	Meter replacement	No.	267	?	3 400	524	103	
		Estimation methods of unbilled unmetered authorized consumptions.		In general terms, unbilled unmetered authorized consumption is estimated about 0.4% of the SIV. It's very difficult to break down in the above terms.				Value include all component listed above. The amount has been estimated assuming that it is 0.25% of SIV	
		Process water (for treatment plants).		NO. As the initial recommendations of the CO3 task group, the Water treatment Plant is not included on the WSS.	Statement of expert (Minimum volume)	N/A The WBN is not responsible for the production of water		No	N/A (not available)
		Flushing		YES	Statement of expert (Most part)	An estimate concerning the time the hydrant was left open and an average flow calculation	• Roads service of the territory: Information on water storage capacity (washer truck)* nb of refills*nb of day in service	No	N/A

New IWA ?	ID	Question	Units	Castellbisbal	SIE Lodève	Nicosie	Argelès-sur-Mer	Melito di Napoli	Kozani
		Frost protection		NO	Statement of expert (Minimum volume)	N/A		No	N/A
		Tank cleaning.		YES	Statement of expert (Most part)	Periodically	• Estimation for tank cleaning (extract from our external expertise) : 1/4 of the total storage volume	No	N/A
		Fire fighting and training.		YES	Statement of expert (Minimum volume)	The Fire Brigade Department provides a monthly consumption estimate	• Reference ASTEE for training : nb of training (Hydrants)*duration(10min)*flow rate(60m3/h) • Estimation for fire fighting (extract from our external expertise) : about 20 m3/fire intervention	No	N/A
		Municipal use.		NO	Meters on the most part of the public site (Minimum volume)		• All metered	No	N/A
		Other (specify).					• Reference ASTEE for networks purge : purge nb*duration(2h)*2,5m3/h • Reference ASTEE for disinfection of pipe ans connection after work : 8 times pipe volume or connection*0,2m3 • Reference ASTEE for pumps leakage volume (internal) : 90 m3/year/pump		The sum of all the above is assumed to be 2% of the SIV
	A11	Unbilled metered consumption	m^3	0	0	1 490	0	0	0
	A12	Unbilled unmetered consumption	m^3	9 782	3000	6 760	7 160	10 483	113 773
	New	**Distribution of unbilled authorized consumptions**		In general terms, unbilled unmetered authorized consumption is estimated about 0.4% of the SIV. It's very difficult to break down in the above terms.					

New IWA ?	ID	Question	Units	Castellbisbal	SIE Lodève	Nicosie	Argelès-sur-Mer	Melito di Napoli	Kozani
		How is estimated unauthorized consumption and why?		0.4% of the SIV. There isn't any rule either policy to estimate it.	Statements of expert	According to international statistical data	· according estimation : 2260 m3 or 0,1 % of the SIV	The estimation of unauthorized consumption have been done assuming literature data, because real data are not available.	Unauthorized consumption is assumed to be 1% of the SIV, according to the international literature, since the utility has never implemented such a study.
		How are estimated meter inaccuracies and why?		1.2% of the SIV. There isn't any rule either policy to estimate it.	It is considred empirically that (values taken from the averages observed from our calibration database). • Over 15 years of age under-value by an average of – 15 % x Q • Between 12 and 15 years of age under-value by an average of – 10 % x Q • Between 9 and 12 years of age under-value by an average of – 5 % x Q	Statistical analysis and bench testing	· Meter inaccuracies because of meter ages. We are using as reference a study from water agencies.	The estimation of meter inaccuracies have been done assuming literature data, because real data are not available.	Meter inaccuracies are assumed to be 10% of the billed authorised consumption
		After how much time a not paid invoice is abandoned?		Time necessary to pass after a not paid bill received by the company and before to cut water is over two months	Before 2005, it is lost. It is managed by Tresor Public.	A not paid invoice is not abandoned, but the water supply to the consumer is disconnected until payment	We don't know yet - asking to the manager	Actually invoice not paid are not abandoned.	A not paid invoice is never abandoned. The utility first acknowledges the customer and then cuts the water supply. After that legal measures are implemented.

New IWA ?	ID	Question	Units	Castellbisbal	SIE Lodève	Nicosie	Argelès-sur-Mer	Melito di Napoli	Kozani
		What is the delay between the end of the assessment period and the estimation of not paid for volumes?		The water utility knows when a water bill is not paid after 15 days since the water bill arrives at the bank		2-4 months	We don't know yet - asking to the manager	At least three mounths.	An invoice is considered as a not paid one after the end of the period mentioned in the water bill.
		Is there a fixed charge in volume? If so how much?		no	0.80 €/m3	No	No	There is fixed charge in volume and it correspond to MCD.	There is no fixed charge in volume
		Is there a fixed charge expressed in € related to water volumes? If so how much?		no		No.	No	The fixed charge is related to volume. It is computed assuming that each customer consumes at least a minimum volume corresponding to fixed charge.	No
		Is there a fixed charge expressed in € without water volumes? If so how much?		Yes. Depending on the meter user's diameter.	35 €	Yes. The fixed charge for domestic users is 5.69 Euro/bimonthly	Yes, about 71,34€ / year	No.	There is a fixed charge of 17.00€ per 4 months.
	A16	Unauthorized consumption	m^3	9 782	2000	103 570	2 260	10 483	56 886
	A17	Metering inaccuracies water losses	m^3	29 345	60 625	414 290	26 350	41 933	236 930
	A23	Billed but not paid for consumption	m^3	-	?	8 500	0	903 720	156 827
	A25	Minimum Charge Difference	m^3	We've been sharing information with others Waterloss partners, studying the bibliography and CO3 translated document. We think that our mcd=0 because our fixed charge expressed in € is not related with the water consume, it's related with the meter diameter. Users pay all consumer water, from the first m3. We're still working		3 331 144	317 463	670 000	2 311 834

New IWA ?	ID	Question	Units	Castellbisbal	SIE Lodève	Nicosie	Argelès-sur-Mer	Melito di Napoli	Kozani
		Number of distribution units (zones where consumers drink the same water)	No.	2	10	25	2	n.a.	There are 2 zones
		Number of pressure levels (zones with the same pressure regime)	No.	Pressure average is 5,5 atm (550 kPa).	2	23	There are two pressure reducing valves on the Argeles-sur-mer network. The first one is located on the lower part of the network overpressure. It serves several neighborhoods (range: 5.5 to 2.5 bar). The second one serves a pipe (about 250m long) and 10 domestic connections (Range: 8 to 3.8 bars).	11	3 zones
		Number of DMAs monitored by SCADA (daily night flow available)	No.	0 . SCADA shows the chlorine level at the water tanks and the product level at the Water treatment plant.		44	Argeles city is using a SCADA system type 'WIT' which links all the production, storage, or pumping sites of the municipaly network. Operation by Modem and specialized Telecom lines - Log, a remote consultation and sent instructions. Monitoring of malfunctions parameters and site security (intrusion).	No SCADA is available.	There are no DMAs
		Number of other DMAs	No.	Total DMA = 13 Only 7 DMA are monitored with CONTAZARA control system. This system basically allows to know minimum and maximum flow and consumption.		0		No other DMAs.	No DMAs exist
	C11	District meters	No.	7	22	42	0	11	35
		What are the methods used to measure and update mains length?		At the present, they're implementing a SIG (NETAQUA) to exactly know this measure	According to the record drawings	Actual measurement	Using SIG	Data have been supplied by network manager.	N/A

New IWA ?	ID	Question	Units	Castellbisbal	SIE Lodève	Nicosie	Argelès-sur-Mer	Melito di Napoli	Kozani
		What are the methods used to measure and update service connections number?		At the present, they're implementing a SIG (NETAQUA) to exactly know this measure	?	Estimate according to the number of buildings (house and multi-storey buildings meters)	Using SIG	Service connection number have been defined taking in account connection to provide water for one or more customers (building with more than one customers).	N/A
		What are the methods used to calculate and update average service connection length?			?	Average of length of installed connections		Calculation have been done using map information.	N/A
	C8	Mains length	km	144	110	1 250	145	65	129,584
	C24	Service connections	No.	3 531	3655	64 000	6 581	4 100	9 150
	C25	Average service connection length	m	2 (estimation)	?	6		7,3	6
		Is a calibrated hydraulic model available?		EPANET	Epanet	Yes	For the moment they don't have a simulation model available for the network but they plan to develop one.	No	EPANET was used. Now it is out of use.
		What are the methods used to update water demand?		Doing a city planning analysis		?	Distribution meters control / customer file - new connections registration	n.a.	Previous periods water demand and temperature (statistics).
		How frequently is it calibrated?		City planning changes every 12 years	At the beginning			n.a.	It is not used by the water utility
		Are mains failures registered?		Yes. There are several work orders to register direct and undirect failures.	Y	Yes	Yes	Yes, but not automatically.	No
		Are mains failures located at the section pipe level?			Y	Yes since 2011		Yes, but not automatically.	No
		Are service connection failures registered?		Yes. There are different work orders depending on the type of failure, domestic or industrial connection, irrigation or fire fighting connection	Y	Yes	Yes	n.a.	No
		Are failures reported in the GIS?		no	No GIS at the moment	No		No	No
	D28	Mains failures	No.	53	?	904	30 (not exactly failures but leaks)	88	15

New IWA ?	ID	Question	Units	Castellbisbal	SIE Lodève	Nicosie	Argelès-sur-Mer	Melito di Napoli	Kozani
	D29	Service connection failures	No.	164	?	5 839	33 (not exactly failures but leaks)	60	30
		Is estimating average pressure a standard practice of the utility?		Pressure average is 5,5 atm (550 kPa).	Yes	Yes	Yes	No	Yes
		What are the methods used to evaluate average pressure?		DMA weighting	Supervision and manual control	Installment of portable pressure loggers in the distribution system in each DMA	manometer	No	Use of the zone's altitude and the hydraulic grade line.
		What is the weighting system used to calculate average pressure?		DMA weighting	?	According to the DMA mains length		No	N/A
	C12	Pressure meters	No.	0	12	46		30	8
	D34	Average operating pressure	kPa	550	350	350	300	200	304-506,6
	CI16	Minimum Annual Reference Pressure (*)	kPa	250 (2.5 kg/cm2)	300	250	250	200	101,32

New IWA ?	ID	Question	Units	Castellbisbal	SIE Lodève	Nicosie	Argelès-sur-Mer	Melito di Napoli	Kozani
		NRW reduction measures		AMB (Castellbisbal) note. The utility is working on the following four axes in order to improve the management. • Implementing a SIG • Implementing a user's management and invoicing software. In order to have online characteristics about users and their meters, connections… • Improvement of the existing meters software (flow and big consumer's meters). In order to update the software and to raise the number of running flow meters. • Keep working on the SCADA to better know data about water and chlorine tanks level, working valves, and permanganate level at the Water treatment Plant (not included on the WSS reach)					
		RM-4: Calibration of water meters, managing inaccuracy of water meters, age of water meters		It doesn't affect us		Replacement of all bulk meters during 2011. Periodic maintenance. Consideration of telemetry readings. Observed NRW in main pipes (from tanks to DMAs) 2-3%.	7592 customers meters : 2077 (0-4 years) 3487 (5-9 years) 1699 (10-14 years) 285 (15-19 years) 44 (> 20 years)	Not implemented – Relevant.	Not implemented

New IWA ?	ID	Question	Units	Castellbisbal	SIE Lodève	Nicosie	Argelès-sur-Mer	Melito di Napoli	Kozani
		DH-MA01: Volumetric accuracy checked using a second meter		It doesn't affect us		Rarely	not implemented	Not implemented – Not relevant.	Not implemented
	D12	System flow meter calibration	No.			0		0	N/A
		RM-28: Metering of revenue water		R.- At Castellbisbal all selled water is metered.	Almost all the municipal uses are metered since 2011. Approximately 40 meters have to be installed in the future..	Bimonthly recording of consumed volume	1 695 092 m3 all revenue water are metered	Implemented. Following	Billed metered cons. every 4 months
		DSS-OM4: Calibration of water use metering network		NR		More explanation is needed		Not implemented – Relevant	Not implemented
		DSS-OM5: Check of water use metering network		What does exactly mean? More description		More explanation is needed		Not implemented- Not relevant.	Not implemented
		DH-MA02: Monitoring water quality (the build-up in sediment affects the meter's accuracy)		Not too relevant		We verify that it affects meter accuracy. Some meters may stop operating and need replacement or maintenance.	compliance rate = 100 % Physical-chemical and microbiological tests carried out	Not implemented – Not relevant.	By SCADA and tests
		DH-MA03: Monitoring intermittent water supply (sudden large increase in pressure damage the meter's components)		NR		We verify that sudden increase of pressure may damage some types of meters. Not easy to make statistics.		No intermittent WSS.	Not implemented.

New IWA ?	ID	Question	Units	Castellbisbal	SIE Lodève	Nicosie	Argelès-sur-Mer	Melito di Napoli	Kozani
		DH-MA04: Test of a representative sample of customer meters		NR Meters maker must have a periodic audit instead of testing customers meters.		Not a representative sample. (year 2010) Evaluation of the accuracy of customer water meters in WBN test bench from a meter sample. The inaccuracy varies from 2 to more than 60%.	not implemented -interesting	Not implemented – relevant.	Not implemented
	New	New WBN : Average water meter inaccuracy at nominal flow	%			>4 % It may be of the order of 6- 8% if we use old age meters. Ususally we perform test on meters that the consumers claim for overregistration.			
		RM-38: Remote reading of meters in WSS		Already done	Remote management (since 2011) allow to identificate and to repair quickly the leaks.	Telemetry system is installed in WSS. It covers the entire distribution network.		Remote reading is not referred to user meters, but only to some equipment for general monitoring of the network. The main result is the optimization of the whole network management.	Not implemented
		DSS-DA5: Systematic control of billing records		R		Every two months. Some wrong recording is found and corrected at next billing period.		Not implemented – relevant	Not implemented
		DH-MA05: Establishment of guidelines for WB volumes calculation		R		We follow a specific procedure to prepare water balance	not implemented interesting	Not implemented – relevant.	Not implemented
New	C13	LG: Water level meters	No.					4	
		DSS-OM8: Improvement of water treatment techniques		It doesn't affect us. Our WSS doesn't includes Water Treatment Plant		N/A		Not implemented – not relevant.	Not implemented

New IWA ?	ID	Question	Units	Castellbisbal	SIE Lodève	Nicosie	Argelès-sur-Mer	Melito di Napoli	Kozani
		DH-AC01: Optimization of filter cleaning cycles		It doesn't affect us. Our WSS doesn't includes Water Treatment Plant		N/A		Not implemented – not relevant.	Not implemented
		RM-25: Reduction of operative water use (i.e. ensuring adequate water age) – usually expensive, should be prevented already in the design and development stage		NR		Performing flushing in networks dead ends and distanced points.		Not implemented – Relevant.	Not implemented
		DH-AC02: Adaptation of the flushing duration		R		Flushing duration is recorded. Volume of water used for flushing is estimated.		Not implemented – Relevant.	Not implemented
		DH-AC03: Thermo insulation of non-buried pipes		It doesn't affect us		N/A		Not implemented – Relevant.	Not implemented
		DH-AC04: Beginning of tank cleaning when water level is low.		NR The utility cleans water tanks once a year. There isn't any formal procedure neither register. When tank is empty, a bypass is made on the network avoiding to fall water supply. Tanks are cleaned and filled again.		Tanks are cleaned periodically- Not often.		Not implemented – Relevant.	Tanks cleaning takes place once a year.
	D7	Storage tank cleaning	m^3	352 (estimation)			1375 (estimation)	n.a.	N/A
		RM-5: Measurements of unbilled authorized consumption		NR		Water used by municipalities is billed. Quantities used by Fire Brigade Service are estimated and recorded but not billed.	Yes measured when it is possible or estimate or list volume taken (fire-fighters, municipality, roads service)	Not implemented – Relevant.	Not measured. Not implemented. The unbilled authorised consumption should be measured
		DH-AC05: Street washing with alternative water (from swimming-pools, rain, river, …)		R		N/A	interesting	Not implemented – Relevant.	Not implemented

New IWA ?	ID	Question	Units	Castellbisbal	SIE Lodève	Nicosie	Argelès-sur-Mer	Melito di Napoli	Kozani
		DH-AC06: Optimizing watering of parks and sports fields (methods, time, duration…)		R		N/A	interesting	Not implemented – not relevant.	Not implemented
		DH-AC07: Implementation of artificial turf on sports fields		R		N/A		Not implemented – not relevant.	Not implemented
		DH-AC08: Fireman Operators training		R. The utility checks hydrants once a year. There isn't any formal procedure neither register.		See RM -5		Improvement of the operators know-how.	Not implemented
		New-Ester 01 : firemen must inform the Water Utility every time they use water.		R					
		New-Ester 02 : Hydrants network under surveillance and control.		R					
	New	New-Ester 02 : Penalisation to the water thefts.		R					
	C23	Hydrants	No.	108		3531	247	23	
	D11	Hydrants inspection	No.	108		2000	247	11	
New	B18	LG : Total training time	Hours					64	
		RM-27: Measurement of system water use (overflows, mud releases, pressure reduction valves…)		R		Overflows can be quantified through telemetry system.		Partially implemented. The main result is the control of the pressure level and of the flow rate in pipe.	Not implemented
		RM-51: Rules for different water uses – especially large water users, transient phenomena, fire-fighters…		Not too Relevant		Three categories of consumers: Domestic-Commercial-Industrial.	interesting - work with fire-fighters could be good (share a journal of interventions) - also communication events on the impact of water taken on hydrants (illegal uses)	Not implemented – relevant.	Not implemented

New IWA ?	ID	Question	Units	Castellbisbal	SIE Lodève	Nicosie	Argelès-sur-Mer	Melito di Napoli	Kozani
		DH-AL01: Replacement of low metrological class meters		The users management and invoicing software will show data of the existing of this type of class meters	Actually there is still 2691 meters older than 15 years. And 962 older than 9 years. Their replacement could occur 60 625 m3 / year.	YES. A total number of 3,400 water meters were replaced during the year 2010, out of a total number of water meters of 111,800.		The program defined by network manager is in progress.	1.Number of customer meters replaced 1. 20.000 (of volumetric class D and tachymetric/flowmeters class C) from 2006 to 2011 2.Water volume saved (m3) 2. 200.000m3
	New	New WBN : Percentage of customer water meter replaced	%			3,04%			
		DH-AL02: Improvement of the billing database		The users management and invoicing software is now implementing		YES		n.a.	Not implemented
		DH-AL03: Meter reading with smart portable digital devices (Meter reader can control in the historical database)				Use of electronic recording of consumption. Not smart reading except in pilot areas with AMR.		Not implemented – relevant.	Not implemented. Although possible
		RM-6: Active search campaigns for illegal water connections		R		Yes. Many thefts are recorded.	not implemented interesting	The program defined by network manager is in progress.	Not implemented. Should be done in pilot areas
		RM-40: Legal measures (efficient prosecution of illegal connections) communication with the law enforcement authorities (prosecution process, evidence process, judicial procedures, penalties).		R		Yes. Illegal connections are reported to police.	not implemented interesting	Not implemented – relevant.	Legal measures take place.
New	A23	LG :Non-recovered water	m^3					903 720	
New	G3	LG : Sales revenue	€					Confidential information.	
		DH-AL04: Addressing meter tampering				Yes. Rare event		There is not relevant data.	Not implemented.
		RM-1: Geophone (single - mobile)		Not too relevant		Yes.		Not implemented – relevant.	Not implemented

New IWA ?	ID	Question	Units	Castellbisbal	SIE Lodève	Nicosie	Argelès-sur-Mer	Melito di Napoli	Kozani
		RM-2: Advanced hydraulic model development – continuous run of hydraulic model – nowcasting – verification with monitoring results		R		Yes.	not implemented interesting	Not implemented – relevant.	Not implemented
		RM-3: Leak noise correlators		Not too relevant		Yes.	interesting / Concerning leaks research, there is an agent that performs all the year systematic leaks research campaigns. We have different leaks control equipment. We try to make detection in all municipalities each year, but in practice, the priority is given to networks where we observe increasing consumption (on the curves of meters outlet tanks). In 2010 about 70% of the network was inspected for leaks detection.	Not implemented – relevant.	Not implemented
		RM-13: Leakage and water loss identification by pressure variations		R		Yes.		Not implemented – relevant.	Not implemented
		RM-26: Continuous discharge measurements of water supplied to WSS - also other parameters (SCADA tool)		R	Difficult to have a feedback because it is a recent equipment.	Yes.		Not implemented – relevant.	Not implemented
		RM-32: District metering (continuous discharge measurements)		R		Yes.	No	It has been individuated 11 district for network management. Reduction of the pressure level and system input volume.	Not implemented
		RM-33: Measurement campaigns (frequency) target measurement campaigns		NR	One compaign of three weeks to increase by 15 points the performance of the water network.	Yes. Target of NRW < 18% by 2015		Not implemented – relevant.	Not implemented

New IWA ?	ID	Question	Units	Castellbisbal	SIE Lodève	Nicosie	Argelès-sur-Mer	Melito di Napoli	Kozani
		RM-58: Trace gas		NR		N/A		Not implemented – relevant.	Not implemented
		RM-59: Deployment of fixed noise loggers		NR		Yes. In critical areas. eg area 20		Not implemented – relevant.	Not implemented
		DSS-DA2: Implementation of leak detection techniques		RM1, RM3, … are the proper implementations. Answered before		YES		Network manager individuated a specific program.	Not implemented
		DSS-SS15: Installation of proper metering network		R		YES		Network manager is starting up a specific program.	Not implemented
		DSS-SS16: Construction of alternative supply paths-mains		R		YES		Network manager activated a program to replace old pipe in order to reduce rupture occurrence and water losses related.	Not implemented
		DH-RL01: Night step-testing (reducing the size of the area by closing valves)		R		YES	will be implement	Not implemented – relevant.	Not implemented
		DH-RL02: Implementation of a systematic leak detection planning		R		YES	already implement	Network manager is starting up a specific program	Not implemented
	D9	Leakage control	Km	0	13 729	470	101,5	40	20
	D10	Leaks repaired due to active leakage control	No.	0	47 m3/h	864	63	15	20
	New	AMB-01 : AICSA doesn't have any leakage control system. When a failure is detected, a work sheet is opened to investigate and repair it.		Number of opened work sheets in order to repair the failure.					

New IWA ?	ID	Question	Units	Castellbisbal	SIE Lodève	Nicosie	Argelès-sur-Mer	Melito di Napoli	Kozani
		RM-10: Active identification and control of transient phenomena (identification of possibilities for transients etc.)		R		Complex task	Punctually, some pression decreasing problems are noted in relation with the population change during the summer period. These pressure problems are located at the end network system, opposite side of the tanks, mainly during periods of non pumping tank filling (NB: delivery-distribution network). There are two pressure reducing valves on the Argeles-sur-mer network. The first one is located on the lower part of the network overpressure. It serves several neighborhoods (range: 5.5 to 2.5 bar). The second one serves a pipe (about 250m long) and 10 domestic connections (Range: 8 to 3.8 bars).	Not implemented – relevant.	Not implemented
		RM-11: Pressure zoning (optimization of pressures)		R		YES. Under progress.		Network manager individuated 11 district for pressure regulation.	Not implemented
		RM-12: Pressure reduction practice		R		PRV		Network manager individuated 11 district for pressure regulation.	Not implemented
		RM-22: Soft pump priming		NR		YES	yes	Not implemented – relevant.	Not implemented
		RM-23: Soft regulation of closing valves		Not too relevant		YES		Not implemented – relevant.	Not implemented
		DSS-DA1: Hydraulic simulation of the system		R		YES		Not implemented – relevant.	Not implemented
		DSS-OM1: Change of valves settings		NR		YES		It depends of network operating status.	Not implemented
		DSS-SS1: Additional boosters & pressure reducing valves installation		R		YES	yes	Not implemented – relevant.	Not implemented
		DSS-SS10: Installation of release valves				YES		Not implemented – relevant.	Not implemented

New IWA ?	ID	Question	Units	Castellbisbal	SIE Lodève	Nicosie	Argelès-sur-Mer	Melito di Napoli	Kozani
		DSS-SS19: Surge control		R		YES		Not implemented – relevant.	Not implemented
		DH-RL03: Pressure modulation		R		YES		Network manager individuated 11 district for pressure regulation.	Not implemented
	D13	Pressure meter calibration	No.	0 . There aren't this type of meters		5		n a	N/A
		RM-34: Permitting procedures for other constructions in the impact zones of the WSS infrastructure, also permitting procedures for the re-classification of roads		R		More explanation needed		Not implemented – relevant.	Number of applications - Other constructors apply to the water utility or to the municipality.
		RM-37: Central registry of underground infrastructure		Not too relevant		N/A. Individual for each authority		Not implemented – relevant.	Not implemented
		RM-39: Public awareness campaign (i.e. did anybody see wetted spot around the valve)		NR		YES. Very close cooperation with the public. Consumers are very sensitive to matters of water shortage.	not implemented interesting	Implemented.	Not implemented
		DSS-OM3: Repair of leaks		The Water utility doesn't control the speed. When the failure is detected, a work sheet is opened to investigate and repair it.	One day delay, no more.	Immediate action		Implemented.	
		DSS-OM7: Proper checking of valves operation		Valves maker must have a periodic audit				Not implemented – relevant.	Not implemented
		DH-RL04: Procedure to guarantee repair material availability		Materials maker must have a periodic audit		Stock watching	not implemented	Not implemented.	Not implemented
		DH-RL05: Reporting of repairing times		Not too relevant		Every event is recorded	not implemented - no relevant	Implemented.	Not implemented
	C22	Isolating valves	No.	1 012			654 (main valves)	n.a.	2968
	D8	Network inspections	km	0				40	100
		RM-9: Thermography (Camera control of mains?)		Not too relevant		Small Pilot case. At planning stage		Not implemented – not relevant.	Not implemented

New IWA ?	ID	Question	Units	Castellbisbal	SIE Lodève	Nicosie	Argelès-sur-Mer	Melito di Napoli	Kozani
		RM-8: Water consumption metering close to the mains (short service connections).		R		Service connections are normally from 1 to 8m long from distribution system		Not implemented – relevant.	Not implemented
		RM-7: Identification of water losses from service connections (rehabilitation or replacement of service connections)		NR		YES. 90% of events		Not implemented – relevant.	Not implemented
		RM-30: Register of pipe bursts interventions and identified leakage		R	systematic	YES	Already done	Implemented.	Not implemented
		RM-24: Use of other specific equipment and rehabilitation tools in the case of identified leakage and pipe breach repair procedures (i.e. clamps, andorre type)		NR		Not yet		Not implemented – relevant.	Not implemented
		RM-21 & DSS-SS13: Pipe cleaning and lining		NR		NO		Not implemented – relevant.	Not implemented
		RM-20 & DSS-SS18: Pipe replacement (with corrosion-free material)		R		YES. PVC	Already done	Partially implemented – to be improved.	Scheduled for 2012. 13.064 km of pipes of PVC, Asbestos cement and cast iron will be replaced by pipes of HDPE
		RM-19: Observations of actual pipe aging (i.e. on test grounds)		NR		YES. From pieces of pipes replaced.		Not implemented – relevant.	Not implemented
		RM-18: Soil type mapping and soil stability standard		Not too relevant		Not systematic recording.		Not implemented – relevant.	Not implemented
		RM-16: Construction process supervision and documentation		RELEVANT		YES	Already done	Implemented.	Not implemented
		RM-15: Construction process standards		Not too relevant		YES		Implemented.	Not implemented
		DSS-SS8: Improved pipe installation practices		What does it mean? More information needed		YES. Best practices investigation to adopt.		Implemented.	Not implemented

New IWA ?	ID	Question	Units	Castellbisbal	SIE Lodève	Nicosie	Argelès-sur-Mer	Melito di Napoli	Kozani
		DSS-SS7: Avoid direct contact with electricity source		Not too relevant		YES		Implemented.	Not implemented
		DSS-SS6: Avoid bimetallic connections		R		YES		Not implemented – relevant.	
		DSS-SS4: Cathodic protection		Not too relevant		YES. Where applicable		Not implemented – relevant.	Not implemented
		DSS-SS17: Implementation of pipe insertion		What does it mean? More information needed		Not yet		Not implemented – relevant.	Not implemented
		DSS-SS12: Check and repair of joints		Not too relevant		Yes during installation. During operation when in doubt		Partially implemented.	Not implemented
		DH-RL06: Service connections replacement policy		Not too relevant	141 should be replaced	YES. Depends on age and material and on observations or statistics from one area or road.	relevant	Partially implemented.	Not implemented
		DH-RL07 : Use of a DSS to drive asset management policy (including breaks prediction tools)		R		NO		Not implemented – relevant.	Not implemented
	D20	Mains rehabilitation	km	0		N/A	**0,616**	n.a.	N/A
	D21	Mains renovation	km	0		N/A	**0,269**	n.a.	N/A
	D22	Mains replacement	km	2		14	**0,347**	0,24	2
	D23	Replaced valves	No.	38				6	50
	D24	Service connection rehabilitation	No.	12	141		**9**	102	20
	New	New-PO-01 :Pipe extension	km				**0,105**		
	New	New-PO-02 : New connections	No.				**27**		
		DH-OM01: Installation of water efficient devices in households and public buildings		R		Public awareness. Depends on individuals (private) action.	not implemented interesting	Not implemented – relevant.	Not implemented
	D38	Days with restrictions to water service	day	0		Now is 0. during 2008 & 2009 was 12 hours every 48 hours.		10	0

New IWA ?	ID	Question	Units	Castellbisbal	SIE Lodève	Nicosie	Argelès-sur-Mer	Melito di Napoli	Kozani
		RM-42: Efficient and effective payment realization (100% payment of water bills?).		R		YES. 80%. Debits are transferred to next bill. They are not written off.	yes	Program is in progress.	Not paid invoices (€)
		DH-OM02: Agreement with social services to fragment the debt		NR. Is better to act over the Social Services.		NO. Some discussions were made .		Not implemented – relevant	Not implemented
		RM-41 : Economic/financial measures (i.e. mangers of the WSS are awarded for the reduction of water losses, i.e. regional/central tax on the NRW)		R		NO	not implemented interesting	Information to be considered confidential.	Not implemented
		RM-48 : Pricing mechanism – cost recovery – target oriented water pricing		NR		YES		Not implemented – relevant.	Not implemented
		RM-49 : Adequate pricing mechanisms covering all costs necessary for efficient water supply		R		YES		Not implemented – relevant.	Not implemented
		DH-OM03 : Fixed charge volume reduction		N/A		NO. Fixed charge applied but not for water.		Not implemented – relevant.	Not implemented
		RM-50: Development of programme of measures for the NRW reduction (documentation, evaluation, designs…)		R		YES. Lowering the NRW.	relevant	Programs specified in previous paragraph.	Not implemented
		RM-54: Participation in target projects for the reduction of NRW		R		YES	relevant	Not implemented – relevant. WATERLOSS can be considered a target project in order to improve practice level for management.	Participation in WATERLOSS.
		RM-14: Planning process standards		NR		Certain procedures are followed		Not implemented – relevant.	Not implemented
		RM-17: Constructed WSS commission process standards		NR		Certain procedures are followed	?	Not implemented – not relevant.	Not implemented

New IWA ?	ID	Question	Units	Castellbisbal	SIE Lodève	Nicosie	Argelès-sur-Mer	Melito di Napoli	Kozani
		RM-29 & DSS-DA3: System mapping using GIS. GIS development – information on system (gradual improvement of GIS functionalities)		R	Actual GIS developpement with intercommunality.	Under progress	relevant	Partially implemented. To be improved. Relevant measure.	Data included in layers are: Consumers: id water meter, shape, code, meter number, owner and consumer names, address, protocol id, x and y coordinates, meter registrations; Buildings addresses: id, street name and number, full address, shape length and area; Pipes: id, length; Streets: id, name, level, size, length; Service connections: id, address, x and y coordinates, length; Buildings: id, length, area; Zones: id, area, perimeter, code, acres, hectares, length, area; Blocks: id, length, block number, zone, length, area; Manholes: id, location, shape and code.
		RM-31: Supply chain management (verification of suppliers – CE standards?, supply standards and reliability)		R		Certain procedures are followed		Internal information of the network manager.	Not implemented right now. ISO standard will be used in the near future
		RM-35: Change from intermittent water supply to continuous water supply		R		Certain procedures are followed		WSS is already continuous.	Not implemented

New IWA ?	ID	Question	Units	Castellbisbal	SIE Lodève	Nicosie	Argelès-sur-Mer	Melito di Napoli	Kozani
		RM-36: Document management and archives in the management company (archiving the documents on construction, service connections, permits etc.)		R		Certain procedures are followed	relevant	Implemented.	Not implemented
		RM-43: External supervision of the performance of the WSS (certification process)		NR		YES. Auditor General	relevant	Not implemented – relevant.	ISO standard
		RM-44:Participation in the benchmarking schemes		R		YES. Local and international		Not implemented – relevant.	Not implemented
		RM-45: HRM – company culture (every drop counts), permanent, targeted education of employees,		R		YES. Every year a message for water save is adopted.	relevant	Partially implemented. To be improved.	Not implemented
		RM-46: HRM – adequate staffing for different processes, adequate tools, equipment, education		R		YES. Depends on previous policies for staffing.	relevant	Not implemented – relevant.	Not implemented
		RM-47: Relative/absolute reduction of NRW – increase in water amount sold (Revenue water) is leading to relative reduction of NRW		Not too relevant		More explanation is required	relevant	Not implemented – relevant.	Not implemented
		RM-52: Development of the microeconomic model for the WSS (actual supply and demand curve), i.e. demand flexibility, market behaviour analysis		Not too relevant		NO		Not implemented – not relevant.	Not implemented
		RM-53: Adequate economy of scale for the managers of the WSS		NR		NO	?	Not implemented – not relevant.	Not implemented
		RM-55: Improving the objective side of the NRW problem -artificial augmentation of the ressource		Not too relevant		More explanation is required		Not implemented – not relevant.	Not implemented

New IWA ?	ID	Question	Units	Castellbisbal	SIE Lodève	Nicosie	Argelès-sur-Mer	Melito di Napoli	Kozani
		RM-56: Improving the objective side of the NRW problem - Improved energy efficiency		NR		YES		Already realised. Energy consumption per month decreased from 12.000,00 € to 2.200,00 €.	Not implemented
		RM-57: Structural management of seasonal variation in water demand		NR		YES. Organisation of the personnel depends on requirements each season.	relevant - already done City with population multiply by 10 during summer - Pressure problems during the summer period in some areas away from the tanks. - Water coloration problems : the water can be 'red' in case of increased circulation. For example : in some areas early summer or when the service is back after works or during the fire hydrants testing. - Low water storage capacity on the municipality : tanks are filled two or three times per day in summer. - Balance needs / resources arduous during the summer. Sicky situation.	Not implemented – relevant.	Not implemented
		DSS-DA4: Keeping full data records (normal-abnormal)		What does exactly mean? More information needed		YES. To our best. Data are continuously enriched.	relevant	Implemented.	Not implemented
		DSS-DA6: Intrusion control in high-risk points		R		YES	relevant - already done	Not implemented – not relevant.	Not implemented
		DSS-OM2: Regular pipe flushing		NR		YES		Not implemented – not relevant.	Not implemented
		DSS-OM6: pH adjustment of water		Not too relevant		pH is adjusted at source by the supplier/producer		Not implemented – not relevant.	Not implemented
		DSS-SS11: Adoption of in-system chlorination		Chlorine control is done by the SCADA at the tanks		YES	relevant - already done	Implemented.	Not implemented
		DSS-SS14: Looped network operation		R		YES		Not implemented – not relevant.	Not implemented

New IWA ?	ID	Question	Units	Castellbisbal	SIE Lodève	Nicosie	Argelès-sur-Mer	Melito di Napoli	Kozani
		DSS-SS2: Increase of tanks storage capacity		NR		YES. When needed	relevant - important problem	Not implemented – not relevant.	Not implemented
		DSS-SS5: Network cleaning		R		YES. Periodically	relevant	Not implemented – relevant.	Not implemented
		DSS-SS9: Increase pumping capacity		NR		YES. When needed		Not implemented – not relevant.	Not implemented

Annex 4

Hierarchical tree of NRW measures

1. Legend
2. “Components”, “sub-components” and “strategic approaches to measure”
3. “Strategic approach to measure”, “operation measures”, assessment of operational measure.
4. Measures not in the hierarchical tree

Legend for sheet "Hierarchical tree"

Title of columns	Meaning
Cpt ID	Components of NRW ID
Sub Cpt ID	Subcomponent of NRW ID
From	Bibliography where Subcomponent of NRW comes from
Str ap m ID	Strategic approach to measures ID
OM ID	Operational measures ID. - DSS : Measures from the "DSS" webpage of DSS tool. - RM : Measures from "NRW Reduction Measures" webpage of DSS tool. - DH : Measures given for example by DH in the questionnaire. - Lubj : Measures created in lubjana meeting in 2012.

		1 star	2 stars	3 stars	4 stars	5 stars	Qualitative Unit
Timeframe (stars)	How quickly the measure could be applied ? (1->5)	t > 2 years	1 year < t ≤ 2 years	1 month < t ≤ 1 year	1 week < t ≤ 1 month	1 week ≥ t	Year
Duration (stars)	How long the effects of the measures last ? (1->5)	1 week ≥ t	1 week < t ≤ 1 month	1 month < t ≤ 1 year	1 year < t ≤ 2 years	t > 2 years	Year
Importance (stars)	How the measure is effective for NRW reduction ? (1->5)	very small volume of water saved	small volume of water saved	medium volume of water saved	large volume of water saved	very large volume of water saved	m^3
Organizational Complexity (stars)	What is the level of organizational complexity ? (1->5)	Very difficult	Difficult	Medium	Easy	Very easy	adimensional
Constructive or non constructive (stars)	Is it a non constructive measure ? (1->5)	Constructive a lot		Constructive and non constructive		Non constructive at all	adimensional
Cost-efficiency (stars)	Is the measure cost-efficient ? (1->5)	High cost small efficiency	High cost medium efficiency	Medium cost medium efficiency	Medium cost high efficiency	Small cost high efficiency	€/m^3

Castellbisbal	Answers of AMB in DH questionnaire on the measure
C	Synthsesis of AMB opinion on the measure (1 = relevant, 0 = doesn't understand or no opinion, -1 = not too relevant, -2 = not relevant)
SIE Lodève	Answers of DH in DH questionnaire on the measure
Nicosie	Answers of WBN in DH questionnaire on the measure
Argelès-sur-Mer	Answers of PO in DH questionnaire on the measure
A	Synthesis of PO opinion on the measure (1 = relevant)
Melito di Napoli	Answers of LG in DH questionnaire on the measure
M	Synthsesis of LG opinion on the measure (1 = relevant, -2 = not relevant)
Kozani	Answers of DEYAK in DH questionnaire on the measure

Color of cells	Meaning
White	Columns from Ljubjana meeting in 2012
Orange	Columns added by DH and UL after Ljubjana meeting in 2012
Yellow	Measures in DH questionnaire

Cpt ID	Components of NRW	Sub Cpt ID	Subcomponent of NRW	Strap m ID	Strategic approach to measures
1	Unbilled authorized consumption	11	Unbilled unmetered consumption	111	Review the estimation practice (of volumes, discharges) applied-Introduction of (pilot) metering project for current unbilled unmetered consumption
		12	Unbilled unmetered and unbilled metered consumption	121	Reconsider the need for "treatment plant" consumptions
				122	Reconsider the need for "municipal" consumptions
				123	Reconsider the need for "operational water" consumptions (flushing, tank cleaning, frost protection, …)
				124	Reconsider the need for "fire fighting" consumptions -volume reduction = water use restrictions
2	Apparent losses	21	Unauthorised consumption	211	Improve organisation of work and knowledge for water theft and illegal use
				212	Improve research methods in order to find water theft and protection from illegal use
				213	Stricter legislation on water theft and illegal use
		22	Metering inaccuracies water losses	221	Evaluation of volumes under-registered and where they are
				222	Improve organisation of work in order to solve customer meters under-registration issue
				223	Methods in order to reduce volumes under-registered
				224	Addressing data handling errors
3	Real losses	31	Active Leakage Control (ALC)	311	Improve organisation of work for ALC
				312	Reduction of the scale
				313	Implementation of permanent methods/techniques for ALC and detection
				314	Implementation of punctual methods/techniques for leakage detection
		32	Speed and quality of repairs	321	Improve organisation of work for repairs
				322	Improve quality of repairs
				323	Improve speed of repairs
		33	Pressure management	331	Preliminary : pressure measurement and analyse
				332	Preliminary : installation of equipment which have an impact on pressure
				333	Pressure modulation in order to reduce the level of losses (leaks or breaks)
				334	Pressure reduction in order to reduce the level of losses (leaks or breaks)
		34	Pipeline and assets management : selection, installation, maintenance, rehabilitation, replacement	341	Improve organisation of work and knowledge for asset management
				344	Improve pipe protection and renovation (against corrosion)
				345	Improve service connections replacement
				348	Improve pipes (and other assets) replacement techniques
4	General M. FOR ALL COMPONENTS:	40	Improve knowledge and accuracy on NRW volumes	401	Improve bulk meter accuracy and knowledge
				402	Improve customer meter accuracy and knowledge
		41	Improve organisation work on NRW	411	Implement standards and procedures
				412	Introduce sofware and new technologies to facilitate work
				413	Education of staff
		42	Economic resource availabiliy	421	Reviewing the pricing policy
		43	Comparison with other services or with reference indicators	431	Auditing
				432	Networking
		44	Reduction of consumer consumption	441	Action to reduce customer comsumption
5	Water billed not paid	RM-42	Efficient and effective payment realization (100% payment of water bills).	511	Reduction of water billed not paid

Str ap m ID	Strategic approach to measures	OM ID	Operational measures	Timeframe (stars)	Duration (stars)	Importance (stars)	Organizational Complexity (Stars)	Constructive/ non constructive (Stars)	Cost efficiency Ratio (Stars)
111	Review the estimation practice (of volumes, discharges) applied- Introduction of (pilot) metering project for current unbilled unmetered consumption	Ljub-1111	Purchase and installation of meters, metering	3	5	3	3	3	2
		RM-05	Measurements of unbilled authorized consumption	3	5	3	3	2	2
		RM-27	Measurement of system water use (overflows, mud releases, pressure reduction valves…)	3	5	3	3	2	2
121	Reconsider the need for "treatment plant" consumptions	DH -AC01	Optimization of filter cleaning cycles	3	4	2	3	3	2
		DSS-OM8	Improvement of water treatment techniques	3	4	2	3	3	2
122	Reconsider the need for "municipal" consumptions	DH -AC05	Street washing with alternative water (from swimming-pools, rain, river, …)	3	5	3	2	3	3
		DH -AC06	Optimizing watering of parks and sports fields (methods, time, duration…)	3	5	3	2	3	3
		DH -AC07	Implementation of artificial turf on sports fields	3	5	2	2	3	3
		Ljub-1222	Rain harvesting for irrigation of city parks	3	5	3	2	3	3
		Ljub-1223	Grey and recycled water use for irrigation	3	5	3	2	3	3
		Ljub-1224	Introduction of billing practice to different users of water	1	5	2	2	5	2
		Lubj-1221	Rain harvesting and small water resources activation procedures	3	5	3	2	3	3
		RM-47	Introduce new water tariffs : Relative/absolute reduction of NRW – increase in water amount sold (Revenue water) is leading to relative reduction of NRW	3	4	1	3	5	3
123	Reconsider the need for "operational water" consumptions (flushing, tank cleaning, frost protection, …)	DH -AC02	Adaptation of the flushing duration	5	2	2	5	5	3
		DH -AC03	Thermo insulation of non-buried pipes	2	5	3	2	2	3
		DH -AC04	Beginning of tank cleaning when water level is low.	5	2	2	5	5	4
		DH -AC08	Operators training	4	5	4	4	5	5
		RM-25	(i.e. ensuring adequate water age) – usually expensive, should be prevented already in the design and development stage) = Pipe rehablitation in order to reduce operational volume	2	5	3	2	2	2
124	Reconsider the need for "fire fighting" consumptions -volume reduction = water use restrictions	Ljub-1241	Fireman training	2	4	4	3	5	5
		RM-51	Rules for different water uses – especially large water users, transient phenomena, fire-fighters…	2	4	4	3	5	5
211	Improve organisation of work and knowledge for water theft and illegal use	Ljub-2111	Implement a water theft tracing project (variable scale project)	1	5	2	1	3	2
		Ljub-2112	Analysis of consumption pattern over several years	3	5	5	3	4	4
212	Improve research methods in order to find water theft and protection from illegal use	DH -AL04	Addressing meter tampering	1	1	2	1	5	2
		Ljub-2121	Identification of water theft by remote sensing and other sensoring methods	1	1	2	1	3	2
		Ljub-2122	Inspection of water meters and their security seals	3	1	2	3	5	2
		Ljub-2123	Supervise fire hydrants for illegal water use and implement measures	3	1	2	3	5	3
		RM-06	Search campaigns for illegal water connections	3	1	2	3	4	2
213	Stricter legislation on water theft and illegal use	Ljub-2131	Impose high fines on water theft and other legal actions	1	5	2	1	5	1

Str ap m ID	Strategic approach to measures	OM ID	Operational measures	Timeframe (stars)	Duration (stars)	Importance (stars)	Organizational Complexity (Stars)	Constructive/ non constructive (Stars)	Cost efficiency Ratio (Stars)
		Ljub-2132	Impose high fines on irregularites on metering devices	3	5	2	1	5	1
		RM-40	Legal measures (efficient prosecution of illegal connections) communication with the law enforcement authorities (prosecution process, evidence process, judicial procedures, penalties).	1	5	2	1	5	1
221	Evaluation of volumes under-registered and where they are	Ljub-2211	Implement a pilot project to define a water metering errors level	3	3	3	3	3	4
		Ljub-2212	Monitor water consumption pattern	3	3	3	2	3	3
		Ljub-2213	Find meters presenting sudden changes	4	3	2	3	5	2
		Ljub-2214	Implement a pilot project to find a water meter under/over registration levels	3	3	3	3	3	4
222	Improve organisation of work in order to solve customer meters under-registration issue	Ljub-2221	Training programs for people recording water meters	4	5	4	4	5	5
		Ljub-2222	Install automated meter readings (AMR system)	2	5	2	2	1	2
		Ljub-2223	Define water meters optimal replacement time, age and aging factors considered	3	3	3	3	4	4
		Ljub-2224	Purchase of technological equipment	2	5	2	2	1	2
223	Methods in order to reduce volumes under-registered	DH -AL01	Replacement of low metrological class meters	4	3	3	4	3	3
		Ljub-2231	Replacement of non-functioning (stopped) water meters	4	3	3	4	3	3
		Ljub-2232	Install UFR (unmetered flow reducer)	3	5	3	4	2	3
		Ljub-2233	Resizing of water meters based upon the actual consumption pattern	3	3	2	2	2	2
		Ljub-2234	Replace the aged water meters	3	3	2	3	3	3
		Ljub-2235	Install UFR (unmetered flow reducer) in roof tanks	3	5	3	4	2	3
		Ljub-2236	Abolition of roof tanks where possible	3	5	3	4	2	3
224	Addressing data handling errors	DH -AL02	Improvement of the billing database	3	5	4	3	5	4
		DH -AL03	Meter reading with smart portable digital devices (Meter reader can control in the historical database)	3	5	3	3	3	3
		Ljub-2241	Define the significance/fequency of the water accounting errors level (volume)	3	4	3	3	4	3
		Ljub-2242	Training programmes to the employees handling water accounting	2	5	4	3	5	3
		Ljub-2243	Install data handling quality assurance system	2	4	2	2	5	3
		Ljub-2244	Install automated meter readings (AMR system)	2	5	2	1	2	3
311	Improve organisation of work for ALC	DH -RL02	Implementation of a systematic leak detection planning	4	5	3	4	5	4
		Ljub-3111	Form and activate teams for ALC	2	4	4	3	5	5
		Ljub-3112	Train team members for ALC	2	4	4	3	5	5
		Ljub-3113	Use of portable ALC equipment	3	4	2	2	3	3
		Ljub-3114	Use leaks location software (classification of identified leaks by cause)	2	5	5	2	5	5
312	Reduction of the scale	Lubj3211	DMAs with minimum night flow measurement and calculation	2	5	5	3	2	5
		RM-32	District metering (continuous discharge measurements) formation	2	5	5	3	3	5
313	Implementation of permanent methods/techniques for ALC and detection	RM-59	Install permanent Noise (acoustic) loggers	2	5	4	2	2	3
314	Implementation of punctual methods/techniques for leakage detection	DH -RL01	Night step-testing (reducing the size of the area by closing valves)	5	2	4	3	2	4
		RM-01	Geophone (single -mobile)	5	2	3	5	4	5
		RM-03	Correlators	5	2	3	5	4	5
		RM-13	Leakage and water loss localisation by pressure variations	3	2	2	2	2	2
		RM-33	Measurement campaigns (frequency) target	2	2	2	2	4	3
		RM-58	Trace gas	5	2	1	3	3	1
321	Improve organisation of work for repairs	DH -RL05	Reporting of repairing times	3	5	4	3	4	5

Str ap m ID	Strategic approach to measures	OM ID	Operational measures	Timeframe (stars)	Duration (stars)	Importance (stars)	Organizational Complexity (Stars)	Constructive/ non constructive (Stars)	Cost efficiency Ratio (Stars)
		Ljub-3211	Development of operational guidelines for the leak repairs for the water utility	4	5	4	4	5	5
		Ljub-3212	Define and use emergency leak repair units	5	3	3	4	5	3
		Ljub-3213	Stock management programme	4	3	3	4	2	3
		Ljub-3214	Subcontractor management programme	3	3	1	3	5	1
322	Improve quality of repairs	DH-n02	Inserts valves (so people do not have water cut)	3	5	4	4	2	4
		DSS-OM7	Proper checking of valves operation	3	4	3	3	4	3
		Ljub-3221	Form and train the teams	3	4	4	3	5	5
323	Improve speed of repairs	DH -RL04	Procedure to guarantee repair material availability	3	3	3	3	3	4
		Ljub-3231	Equipment of the repair teams for efficient and effective repair	3	3	3	3	3	4
		Ljub-3232	Communication with consumers and evaluation of complaints	2	2	2	2	4	2
		RM-37	Central registry of underground infrastructure	3	4	5	3	5	5
		RM-39	Public awareness campaign (i.e. did anybody see wetted spot around the valve)	2	2	2	2	4	2
331	Preliminary : pressure measurement and analyse	DSS-DA1	Hydraulic simulation of the system	1	5	3	2	5	4
		DSS-SS19	Surge control	3	4	4	4	2	3
		Ljub-3312	System monitoring (pressure and discharge monitoring) - dynamic (min, max, and average values)	3	5	4	3	3	4
		RM-10	Active identification of transient phenomena (identification of possibilities for transients etc.) Reduction of transient phenomena (identification of possibilities for transients etc.)	4	5	3	3	4	3
		RM-11	Pressure zoning (optimization of pressures) = pressure zone formation	2	5	5	3	2	4
332	Preliminary : installation of equipment which have an impact on pressure	DSS-SS1	Additional boosters & pressure reducing valves	3	3	3	3	2	3
		DSS-SS10	Installation of release valves	3	3	3	3	2	3
		Ljub-3321	Installing the PRV	3	3	3	3	2	3
333	Pressure modulation in order to reduce the level of losses (leaks or breaks)	DH -RL03	Pressure modulation	2	3	5	3	3	4
		Ljub-3331	Soft regulation of water abstractions from WSS	3	3	3	3	4	3
		RM-22	Soft pump priming	3	3	3	3	4	3
		RM-23	Soft regulation of closing valves	3	3	3	3	4	3
334	Pressure reduction in order to reduce the level of losses (leaks or breaks)	RM-12	Pressure reduction practice	2	4	5	3	3	4
341	Improve organisation of work and knowledge for asset management	DH -RL07	Use of a DSS to drive asset management policy (including breaks prediction tool)	4	5	4	5	5	4
		Ke-RM-18	Soil type mapping and soil stability standard	2	4	3	2	3	3
		Ke-RM-19	Observations of actual pipe aging (i.e. on test grounds)	1	1	1	1	1	1
		Kp-Ljub-3421	Safety and security of the assets (video surveillance, intrusion signals…)	2	2	1	2	2	1
		Kp-Ljub-3422	Monitoring of assets	3	3	3	3	3	3
		Kp-RM-09	Thermography (Camera control of mains?)	2	2	1	2	3	1
		Ljub-3411	Full pipe asset cadastre (including all crucial parameters and documents)	3	4	3	4	4	4
		Ljub-3412	Develop a full record on service connections and mains (age, material, length, diameter, location) and of their failures at the section pipe level (by causes and impacts)	2	4	5	2	5	5
		Ljub-3413	Record of interventions (measures already taken)	3	4	4	3	5	5
		Ljub-3414	WSS construction site supervision process	2	4	3	4	4	3

Str ap m ID	Strategic approach to measures	OM ID	Operational measures	Timeframe (stars)	Duration (stars)	Importance (stars)	Organizational Complexity (Stars)	Constructive/ non constructive (Stars)	Cost efficiency Ratio (Stars)
		Ljub-3415	Define optimal replacement time (pipes, valves, pumps, other) and replacements programming	2	4	5	2	5	5
		RM-16	Construction process supervision and documentation	3	5	4	3	3	4
		RM-30	Register of pipe bursts interventions and identified leakage	2	4	5	2	5	5
344	Improve pipe protection and renovation (against corrosion)	DSS-OM6	pH adjustment of water	2	1	1	2	3	2
		DSS-SS13	Pipe cleaning and lining	4	4	2	3	2	2
		DSS-SS6	Avoid bimetallic connections	3	4	3	3	2	3
		RM-21	In lining (internal laying of existing pipes)	3	4	3	3	1	3
345	Improve service connections replacement	DH -RL06	Service connections replacement policy	3	3	4	3	5	5
		DH -RLn1	Replacement of lead service connections	2	5	2	3	1	1
348	Improve pipes (and other assets) replacement techniques	DSS-SS17	Implementation of pipe insertion	3	3	2	3	1	2
		DSS-SS18	Pipe replacement with corrosion-free material	3	4	3	3	2	4
		DSS-SS4	Cathodic protection	3	3	2	3	2	3
		j-DSS-SS12	Check and repair of joints	4	5	4	3	2	4
		Ljub-3493	WSS construction site supervision process	1	4	3	3	3	3
		RM-15	Construction process standards	2	5	4	4	4	4
		RM-20	Pipe replacement	3	5	3	3	1	2
		RM-24	Use of other specific equipment and rehabilitation tools in the case of identified leakage and pipe breach repair procedures (i.e. clamps, andorre type)	3	4	3	3	2	4
		v-DSS-OM1	Change of valves settings	4	4	2	3	2	3
		v-Ljub-3481	Closure valves on reservoir supply pipes preventing reservoir overflows	4	2	2	3	2	3
401	Improve bulk meter accuracy and knowledge	DH-MA01	Volumetric accuracy checked using a second meter	4	4	5	4	3	4
		RM-04	Calibration of water meters, managing inaccuracy of water meters, age of water meters	4	4	5	4	3	4
402	Improve customer meter accuracy and knowledge	DH -MA02	Monitoring water quality (the build-up in sediment affects the meter's accuracy)	2	2	3	3	3	3
		DH -MA03	Monitoring intermittent water supply (sudden large increase in pressure damage the meter's components)	3	3	4	3	3	4
		DH -MA04	Test of a representative sample of customer meters	3	3	4	4	3	4
		DSS-OM4	Calibration of water use metering network	3	4	4	3	3	4
		RM-28	Metering of revenue water	3	5	5	3	3	5
411	Implement standards and procedures	DH -MA05	Establishment of guidelines for WB volumes calculation	4	5	5	5	5	5
		DSS-DA5	Systematic control of billing records	3	3	4	3	4	4
		Ljub-4111	Permitting procedures for other constructions in the impact zones of the WSS infrastructure, also permitting procedures for the re-classification of roads	3	4	3	3	4	3
		Ljub-4112	Revision of the procedures for the construction and maintenance of the roads	2	4	3	2	4	4
		Ljub-4113	Planning details and standards for example Soil type mapping (stability, aggresive, geology, etc.)	2	5	3	3	5	2
		Ljub-4114	Construction details and standards i.e. construction under frost depth	3	5	4	4	5	4
		Ljub-4115	Interaction with other underground services for example development and operation of the central cadastre of underground infrastructure	3	3	3	3	5	3
		RM-14	Planning process standards	3	5	4	3	5	3

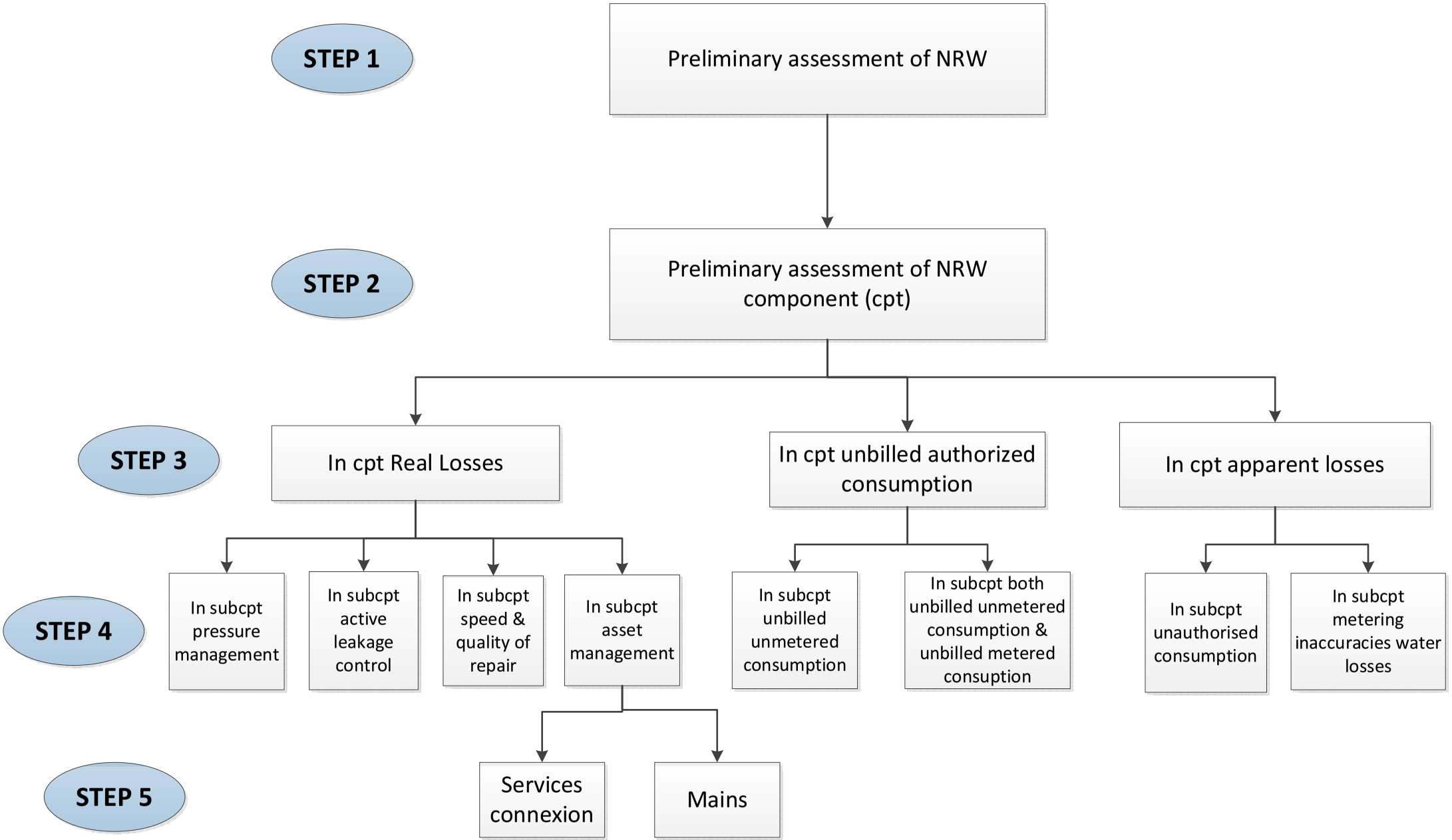
Str ap m ID	Strategic approach to measures	OM ID	Operational measures	Timeframe (stars)	Duration (stars)	Importance (stars)	Organizational Complexity (Stars)	Constructive/ non constructive (Stars)	Cost efficiency Ratio (Stars)
		RM-17	Constructed WSS commission process standards	3	3	3	3	4	3
		RM-31	Supply chain management (verification of suppliers – CE standards?, supply standards and reliability)	2	2	2	2	4	2
		RM-34	Permitting procedures for other constructions in the impact zones of the WSS infrastructure, also permitting procedures for the re-classification of roads	2	3	3	2	4	3
		RM-36	Document management and archives in the management company (archiving the documents on construction, service connections, permits etc.)	4	5	5	4	5	5
		RM-50	Development of programme of measures for the NRW reduction (documentation, evaluation, designs…)	3	5	4	4	5	5
412	Introduce sofware and new technologies to facilitate work	RM-02	Advanced hydraulic model development – continuous run of hydraulic model – nowcasting – verification with monitoring results	2	4	4	2	5	3
		RM-26	Continuous discharge measurements of water supplied to WSS - also other parameters (SCADA tool)	2	4	3	4	3	3
		RM-29	GIS development – information on system (gradual improvement of GIS functionalities)	2	2	3	3	4	4
		RM-38	Remote reading of meters in WSS	2	2	2	2	2	2
413	Education of staff	Ljub-4131	Education of staff on operational procedures taking into consideration existing affirmated practices	4	5	5	4	5	5
		RM-45	HRM – company culture (every drop counts), permanent, targeted education of employees,	4	5	5	4	5	5
		RM-46	HRM – adequate staffing for different processes, adequate tools, equipment, education	4	5	5	4	5	5
421	Reviewing the pricing policy	DH - OM03	Fixed charge volume reduction	2	2	2	2	5	2
		Ljub-4211	Restructure the tariff structure (including the fixed charge)	2	2	2	2	5	2
		Ljub-4212	Change of tariff levels	2	2	2	2	5	2
		Ljub-4213	Introduction of new levels	2	2	2	2	5	2
		RM-41	Economic/financial measures (i.e. managers of the WSS are awarded for the reduction of water losses, i.e. regional/central tax on the NRW)	2	4	4	2	5	3
		RM-48	Pricing mechanism – cost recovery – target oriented water pricing	2	2	2	2	5	1
		RM-49	Adequate pricing mechanisms covering all costs necessary for efficient water supply	2	2	2	2	5	3
431	Auditing	RM-43	External supervision of the performance of the WSS (certification process)	2	2	2	2	5	2
432	Networking	RM-44	Participation in the benchmarking schemes	2	2	3	2	5	3
		RM-54	Participation in target projects for the reduction of NRW	3	3	4	3	5	3
441	Action to reduce customer comsumption	DH - OM01	Installation of water efficient devices in households and public buildings	4	5	5	4	2	5
		Lubj-4411	Information programmes for consumers	3	2	5	3	5	3
511	Reduction of water billed not paid	DH - OM02	Agreement with social services to fragment the debt	4	5	3	4	5	3

Measures not assigned in hierarchical tree (HT)

ID	Measure Name	Castellbisbal	SIE Lodève	Nicosie	Argelès-sur-Mer	Melito di Napoli	Kozani
DSS-DA2	Implementation of leak detection techniques	RM1, RM3, …	are the prope	YES		Network mana	Not implemented
DSS-DA4	Keeping full data records (normal-abnormal)	What does exactly mean? M		YES. To our b	relevant	Implemented.	Not implemented
DSS-DA6	Intrusion control in high-risk points	R		YES	relevant - alre	Not implemen	Not implemented
DSS-OM2	Regular pipe flushing	NR		YES		Not implemen	Not implemented
DSS-OM3	Repair of leaks	The Water uti	One day dela	Immediate action		Implemented.	
DSS-OM4	Calibration of water use metering network	What does exactly mean? M		More explanation is needed		Not implemen	Not implemented
DSS-SS11	Adoption of in-system chlorination	Chlorine control is done by t		YES	relevant - alre	Implemented.	Not implemented
DSS-SS14	Looped network operation	R		YES		Not implemen	Not implemented
DSS-SS15	Installation of proper metering network	R		YES		Network mana	Not implemented
DSS-SS16	Construction of alternative supply paths-mains	R		YES		Network mana	Not implemented
DSS-SS2	Increase of tanks storage capacity	NR		YES. When n	relevant - imp	Not implemen	Not implemented
DSS-SS5	Network cleaning	R		YES. Periodic	relevant	Not implemen	Not implemented
DSS-SS7	Avoid direct contact with electricity source	Not too relevant		YES		Implemented.	Not implemented
DSS-SS8	Improved pipe installation practices	What does it mean? More in		YES. Best practices investig		Implemented.	Not implemented
DSS-SS9	Increase pumping capacity	NR		YES. When needed		Not implemen	Not implemented
Ljub-3416	Define methodologies and describe tools for the mains						
Ljub-3417	Define methodologies and describe tools for service pipes						
Ljub-34931	Final certification and collaudation process						
Lubj-3222	Reduction of operational losses due to less third party damages						
RM-07	Identification of water losses from service connections (rehabilitation or replacement of service connections)	NR		YES. 90% of events		Not implemen	Not implemented
RM-08	Water consumption metering close to the mains (short service connections).	R		Service connections are non		Not implemen	Not implemented
RM-35	Change from intermittent water supply to continuous water supply	R		Certain procedures are follo		WSS is alread	Not implemented
RM-52	Development of the microeconomic model for the WSS (actual supply and demand curve), i.e. demand flexibility, market behaviour analysis	Not too relevant		NO		Not implemen	Not implemented
RM-53	Adequate economy of scale for the managers of the WSS	NR		NO	?	Not implemented – not relevant.	Not implemented
RM-55	Improving the objective side of the NRW problem -artificial augmentation of the ressource	Not too relevant		More explanation is required		Not implemented – not relevant.	Not implemented
RM-56	Improving the objective side of the NRW problem - Improved energy efficiency	NR		YES		Already realis	Not implemented
RM-57	Structural management of seasonal variation in water demand	NR		YES. Organis	relevant - alre	Not implemen	Not implemented

Annex 5

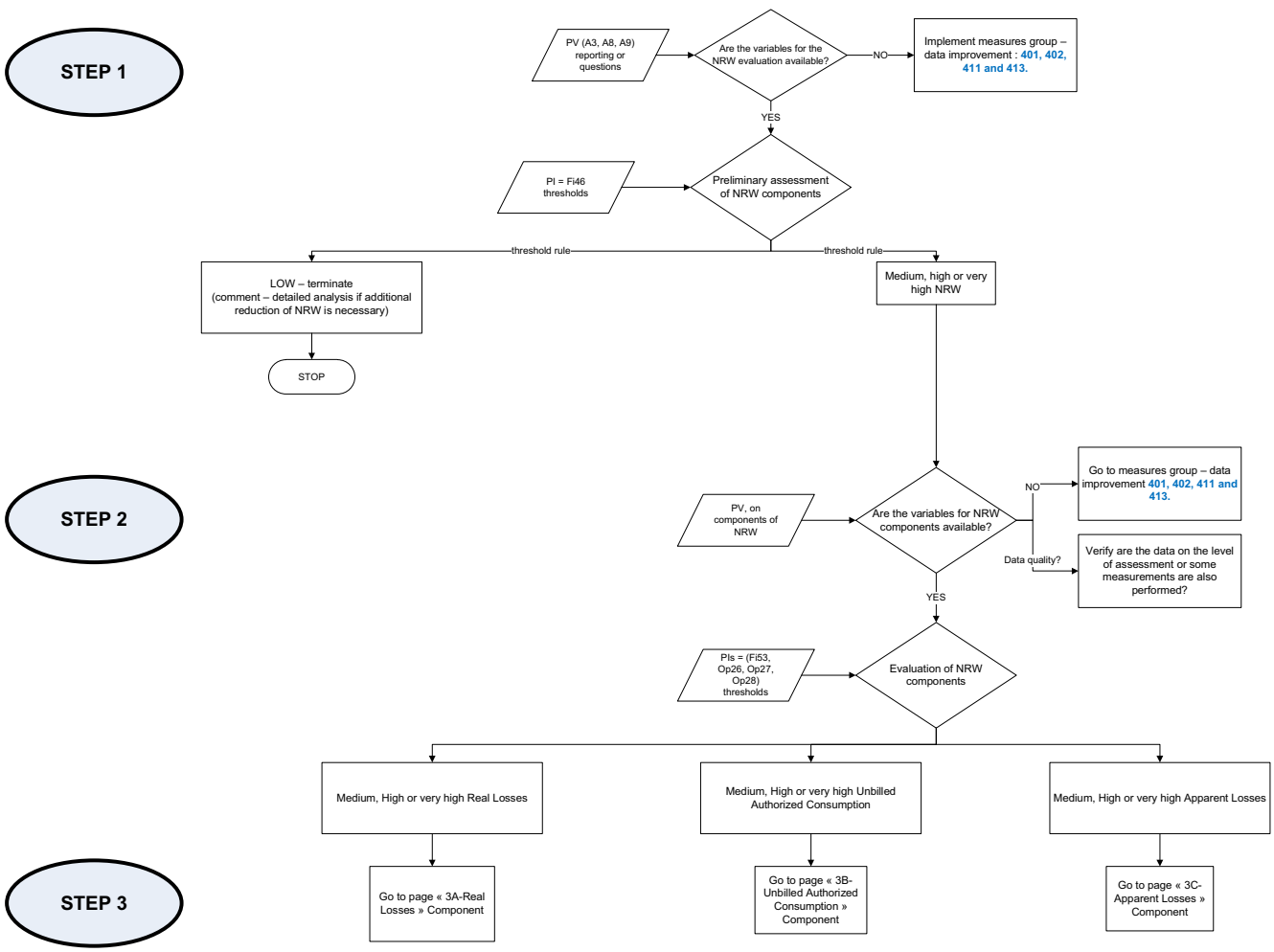
Synthesis of the pathway between the different STEPs in decision tree

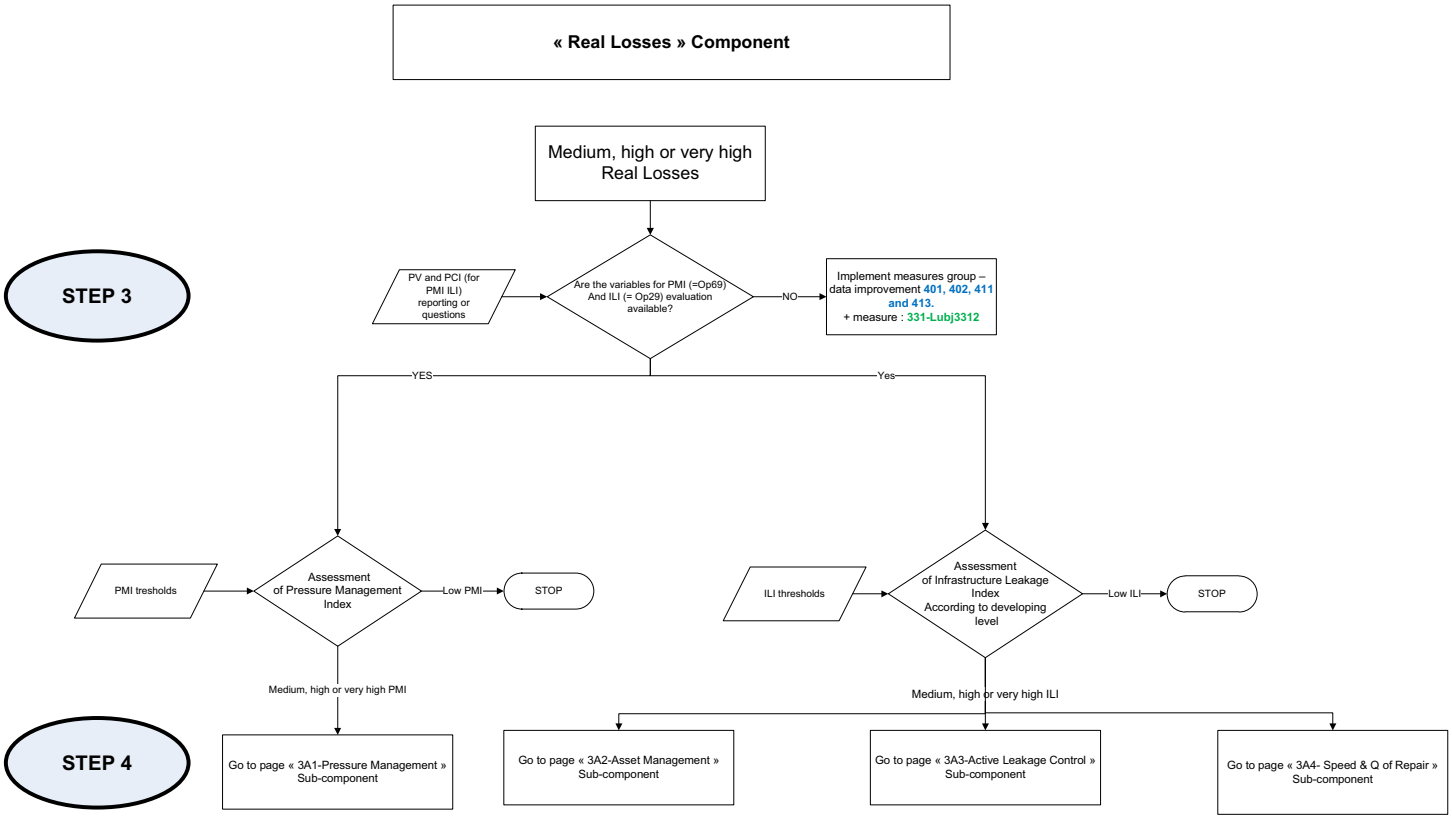

STEP 1
Preliminary assessment of NRW
STEP 2
Preliminary assessment of NRW component (cpt)
STEP 3
In cpt Real Losses
In cpt unbilled authorized consumption
In cpt apparent losses
STEP 4
In subcpt pressure management
In subcpt active leakage control
In subcpt speed & quality of repair
In subcpt asset management
In subcpt unbilled unmetered consumption
In subcpt both unbilled unmetered consumption & unbilled metered consuption
In subcpt unauthorised consumption
In subcpt metering inaccuracies water losses
STEP 5
Services connexion
Mains

Annex 6

Decision tree

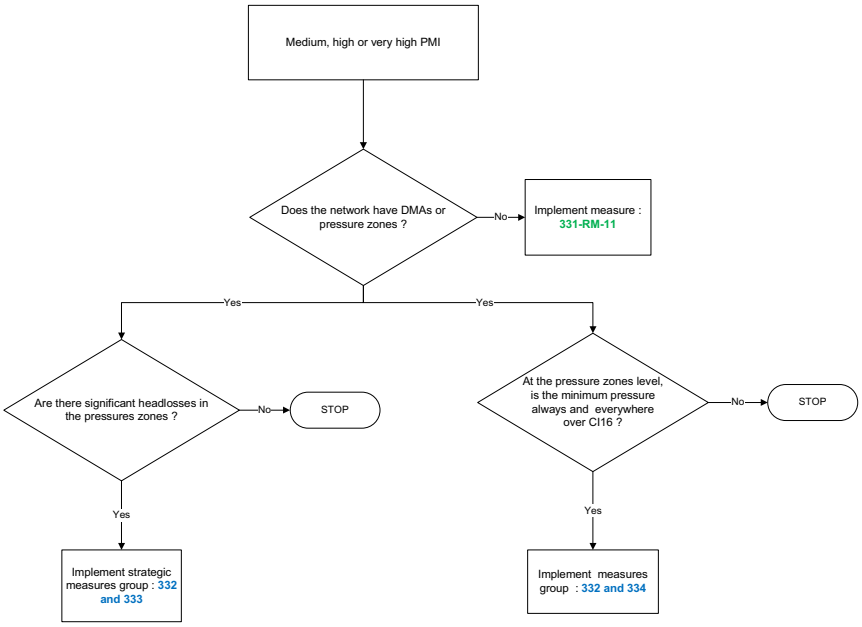
WATERLOSS - DECISION TREE OF THE NRW REDUCTION DSS

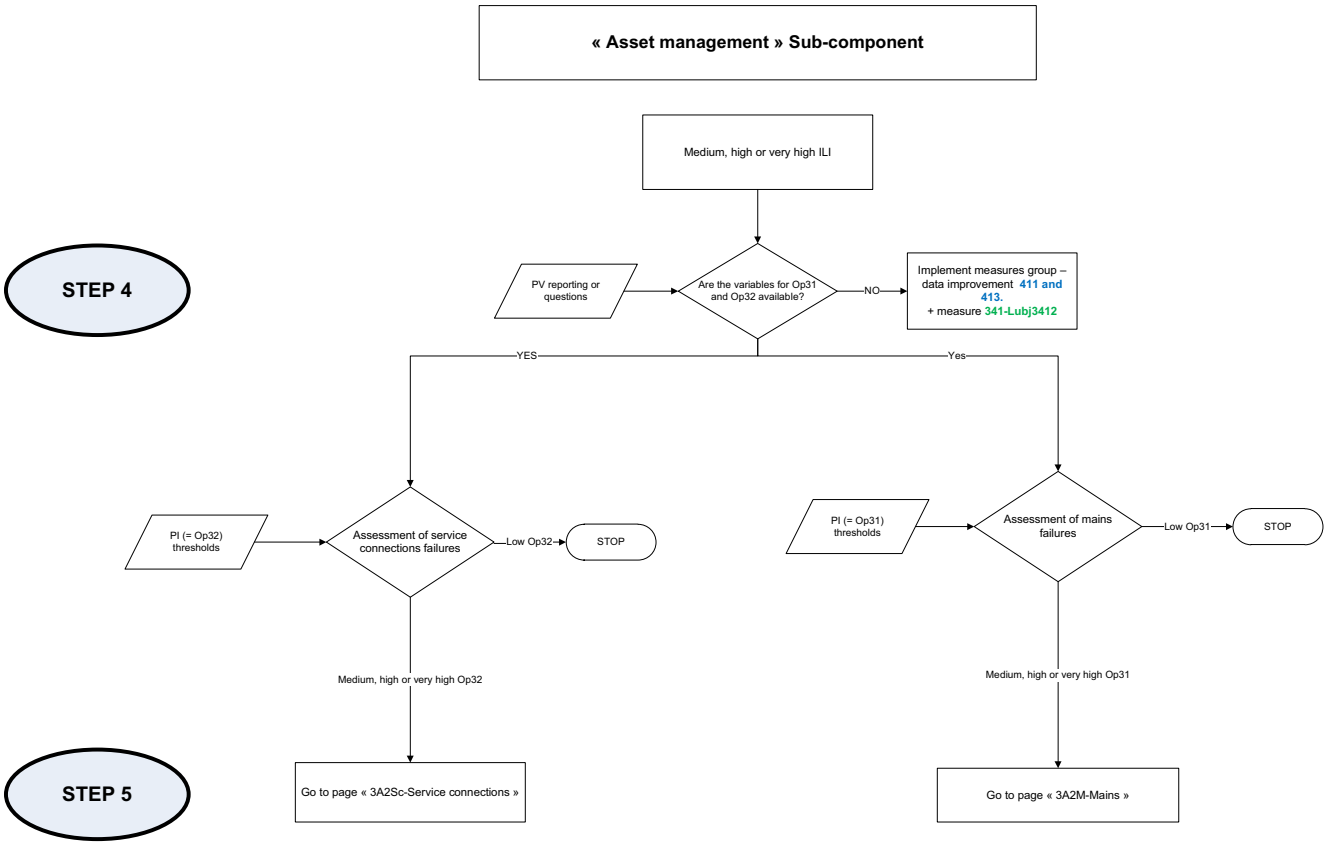



« Real Losses » Component
Medium, high or very high Real Losses
STEP 3
PV and PCI (for PMI ILI) reporting or questions
Are the variables for PMI (=Op69) And ILI (= Op29) evaluation available?
NO
Implement measures group – data improvement 401, 402, 411 and 413.
+ measure : 331-Lubj3312
YES
Yes
PMI tresholds
Assessment of Pressure Management Index
Low PMI
STOP
ILI thresholds
Assessment of Infrastructure Leakage Index According to developing level
Low ILI
STOP
Medium, high or very high PMI
Medium, high or very high ILI
STEP 4
Go to page « 3A1-Pressure Management » Sub-component
Go to page « 3A2-Asset Management » Sub-component
Go to page « 3A3-Active Leakage Control » Sub-component
Go to page « 3A4- Speed & Q of Repair » Sub-component

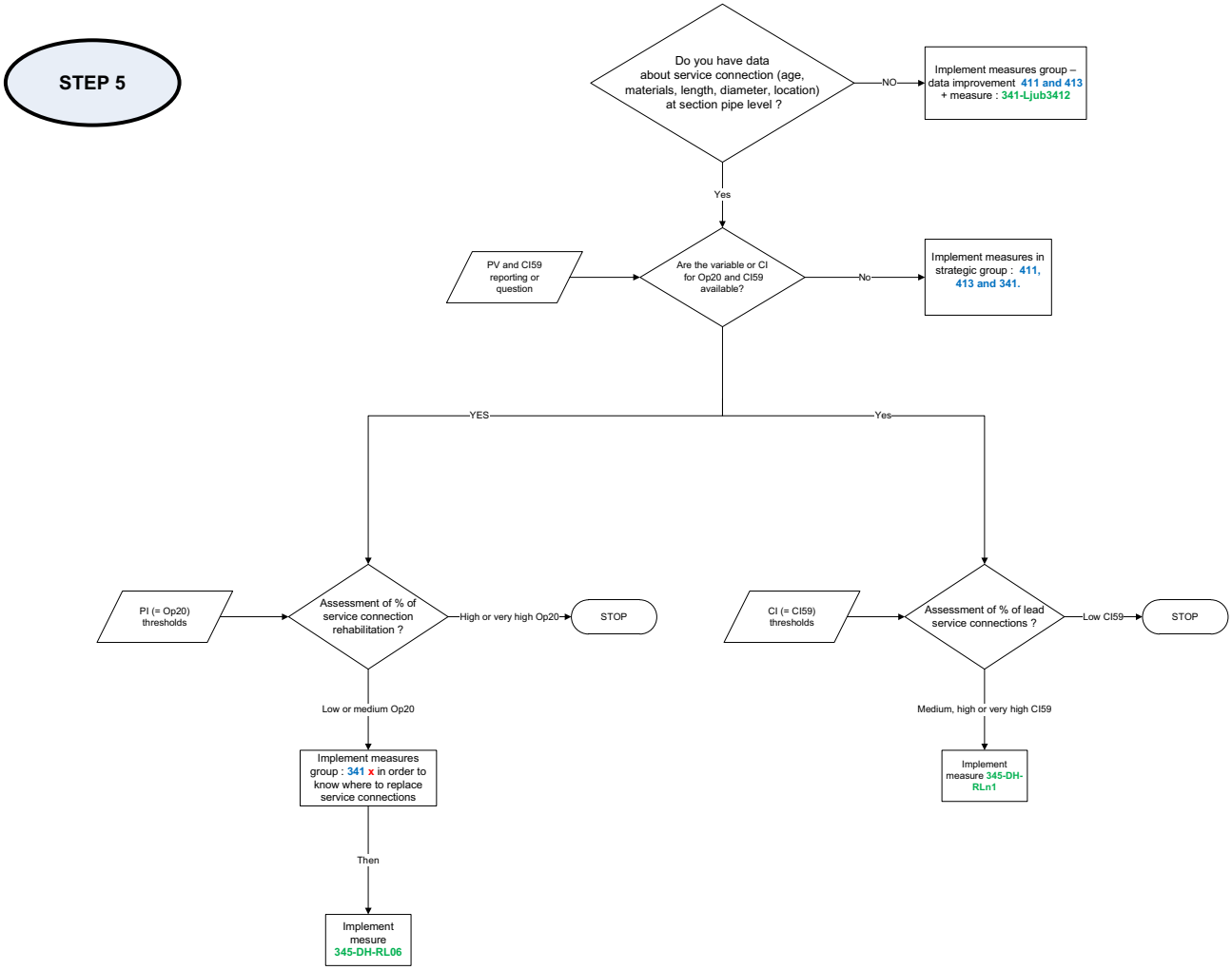
« Pressure Management » Sub-component

STEP 4

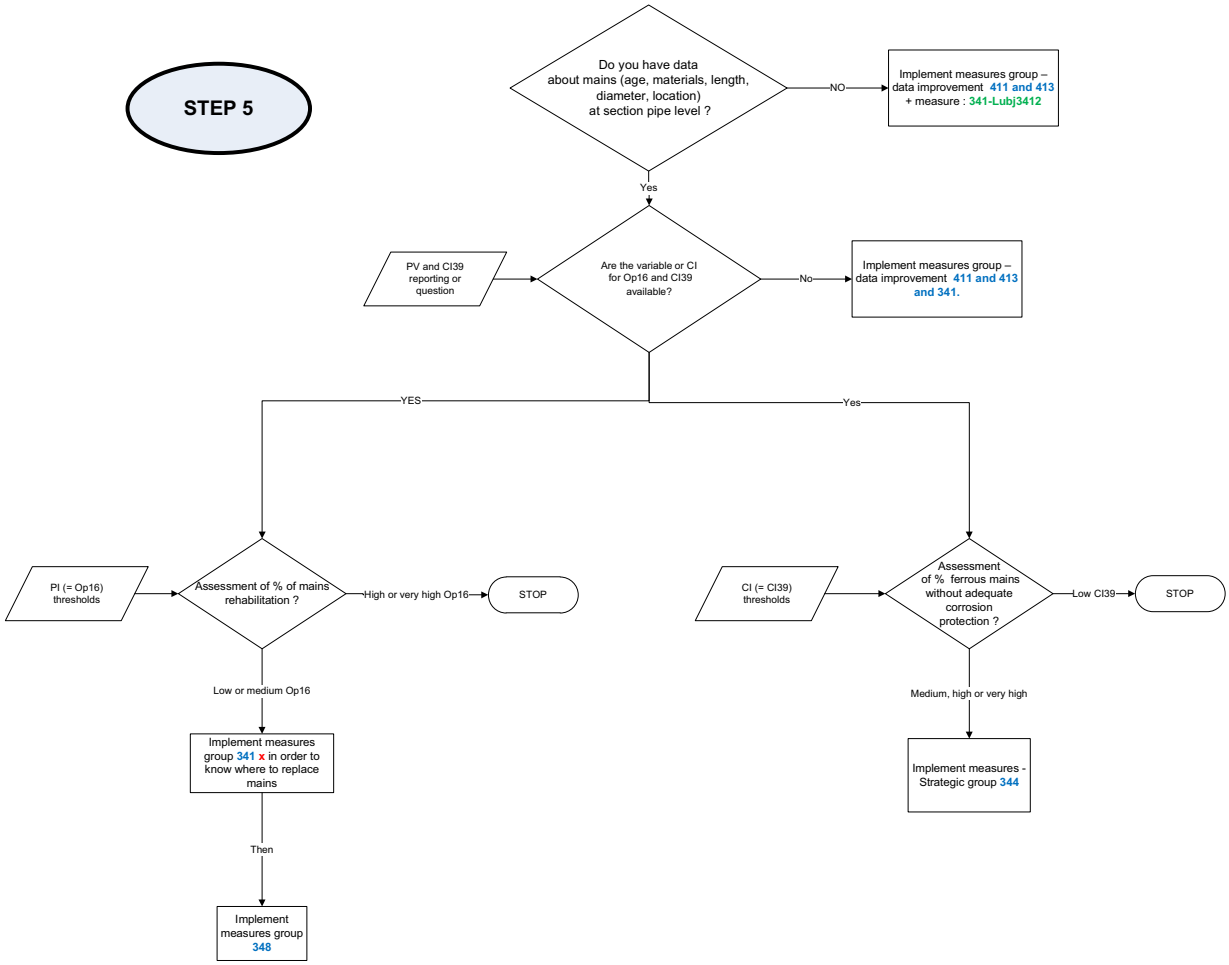



« Asset management » Sub-component
Medium, high or very high ILI
STEP 4
PV reporting or questions
Are the variables for Op31 and Op32 available?
NO
Implement measures group – data improvement 411 and 413.
+ measure 341-Lubj3412
YES
Yes
PI (= Op32) thresholds
Assessment of service connections failures
Low Op32
STOP
PI (= Op31) thresholds
Assessment of mains failures
Low Op31
STOP
Medium, high or very high Op32
Medium, high or very high Op31
STEP 5
Go to page « 3A2Sc-Service connections »
Go to page « 3A2M-Mains »

« Service connections » in « Asset Management » sub-component

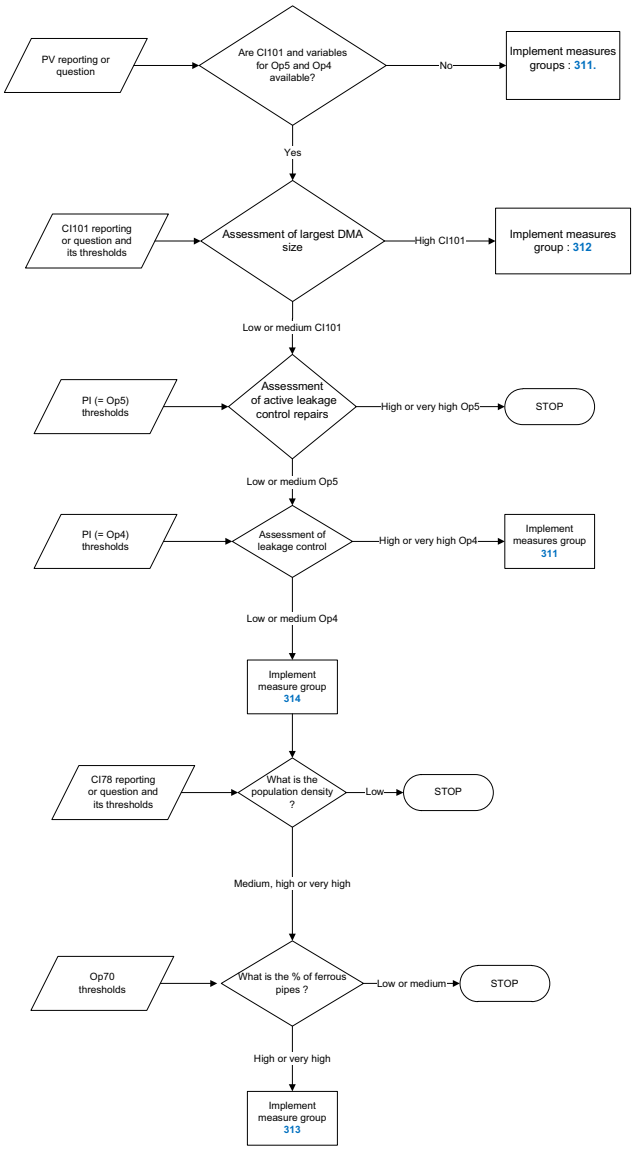


« Mains » in « Asset Management » sub-component



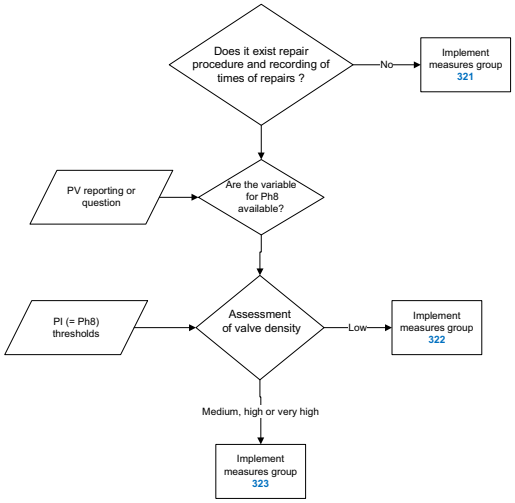
« Active Leakage Control » Sub-component

STEP 4

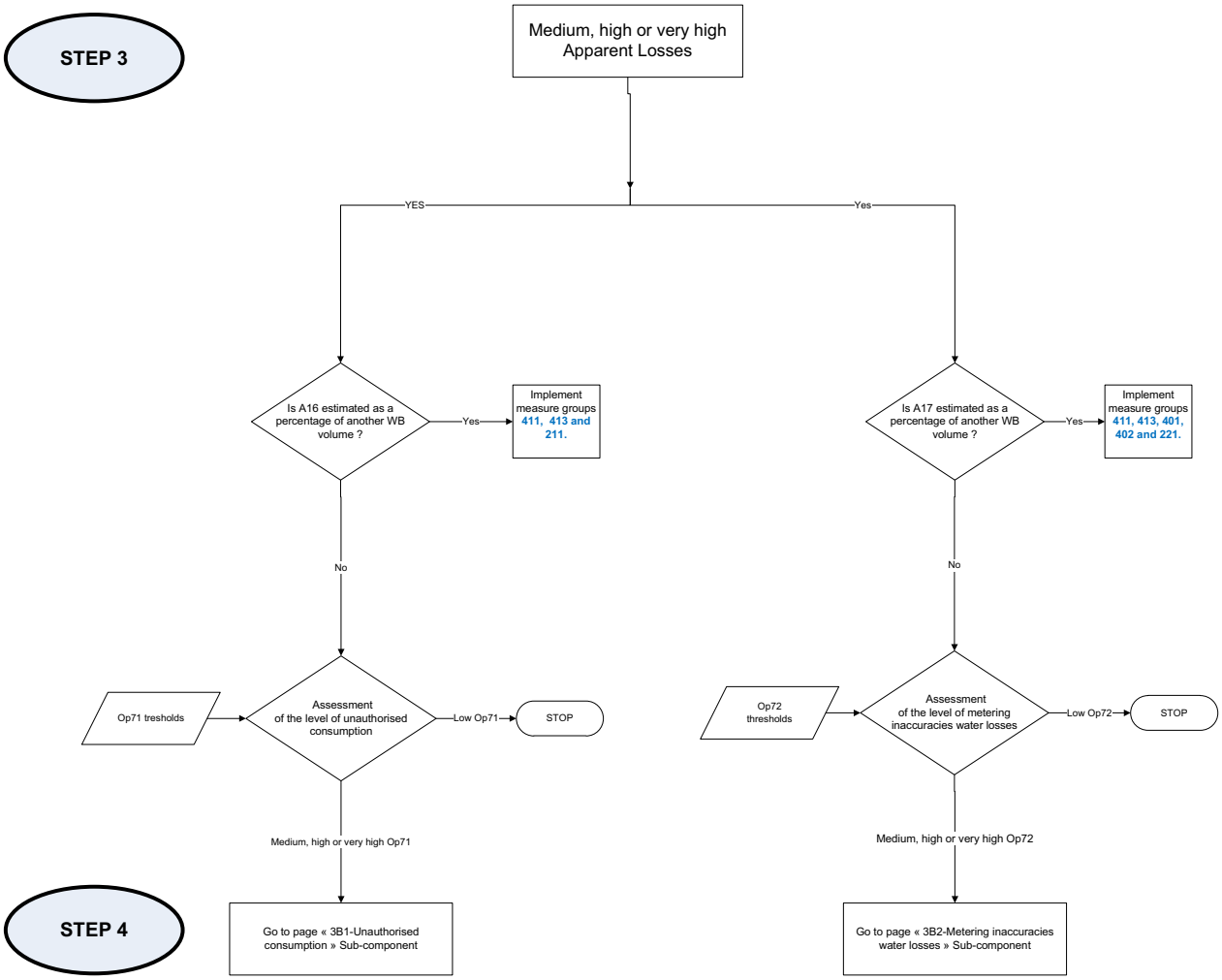


« Speed and quality of repairs » Sub-component

STEP 4

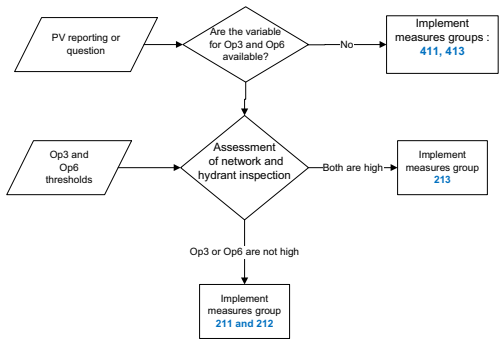


« Apprent Losses » Component



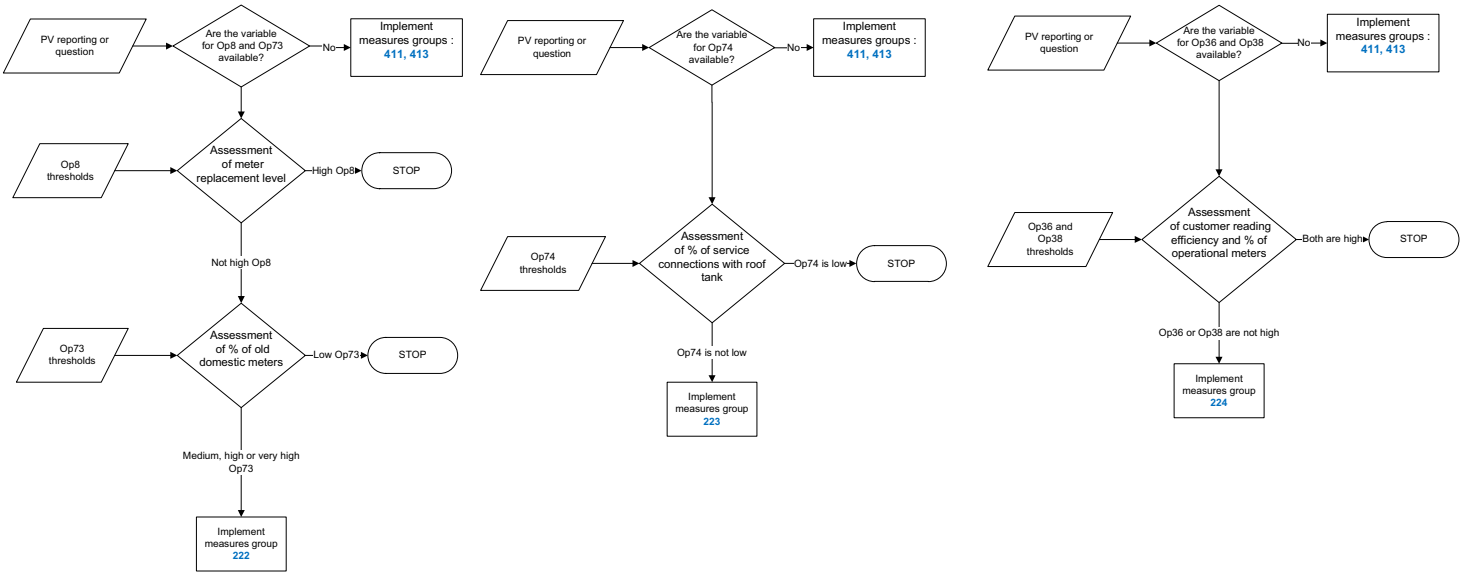
« unauthorised consumption » Sub-component

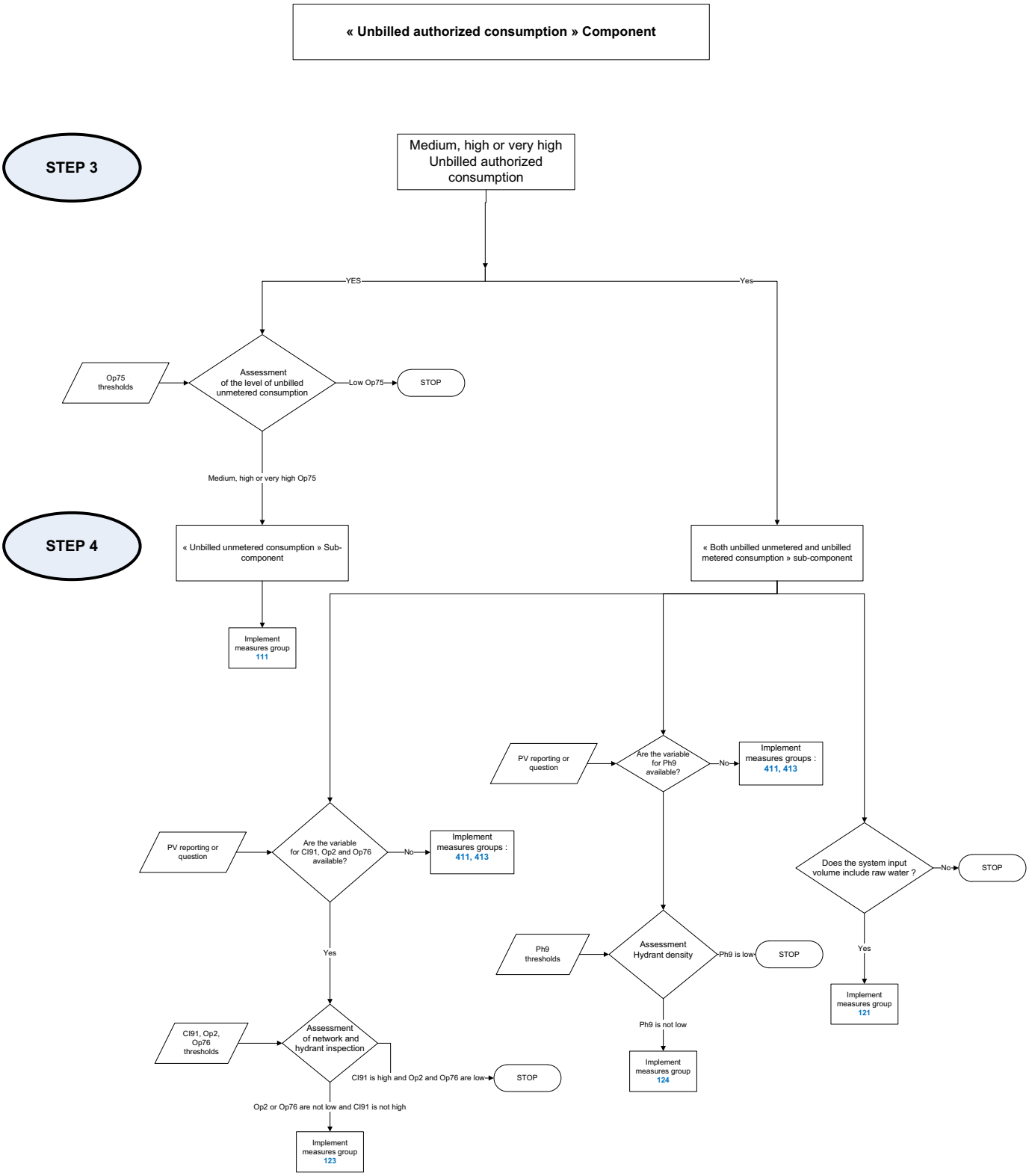
STEP 4



«Water metering inaccuracies water losses » Sub-component

STEP 4




« Unbilled authorized consumption » Component
STEP 3
Medium, high or very high Unbilled authorized consumption
YES
Yes
Op75 thresholds
Assessment of the level of unbilled unmetered consumption
Low Op75
STOP
Medium, high or very high Op75
STEP 4
« Unbilled unmetered consumption » Sub-component
« Both unbilled unmetered and unbilled metered consumption » sub-component
Implement measures group 111
PV reporting or question
Are the variable for Ph9 available?
No
Implement measures groups : 411, 413
PV reporting or question
Are the variable for Cl91, Op2 and Op76 available?
No
Implement measures groups : 411, 413
Does the system input volume include raw water ?
No
STOP
Yes
Ph9 thresholds
Assessment Hydrant density
Ph9 is low
STOP
Yes
Implement measures group 121
Ph9 is not low
Implement measures group 124
Cl91, Op2, Op76 thresholds
Assessment of network and hydrant inspection
Cl91 is high and Op2 and Op76 are low
STOP
Op2 or Op76 are not low and Cl91 is not high
Implement measures group 123

Annex 7

Synthesis of variables, context information and indicators used at each STEP

Sheet « 1-Start »

STEP 1 : preliminary assessment of NRW

1) Are the values of compulsory variables for step 1 available?

V-IWA	A3	System input Volume (m3/year)
V-IWA	A8	Billed metered consumption (m3/year)
V-IWA	A9	Billed non-metered consumption (m3/year)

2) If **yes**, calculate this PI

PI-IWA	Fi46	= A21/A3 x100 = (A3-A8-A9)/A3 x100 = % Non revenue water by volume

STEP 2 : preliminary assessment of NRW component

1) Are the values of compulsory variables for step 2 available?

V-IWA	A11	Unbilled metered consumption (m3/an)
V-IWA	A12	Unbilled non-metered consumption (m3/an)
V-IWA	A16	Unauthorised consumption (m3/an)
V-IWA	A17	Metering inaccuracies water losses (m3/an)
V-IWA	H2	Time system is pressured (hours in a year)
V-IWA	C8	Main length (km)
V-IWA	C24	Service connexions (No.)

2) If **yes**, calculate this 4 PIs

Unbilled Authorized Consumption

PI-DH	Fi53	= A13/A3 x 100 = (A11+A12)/A3 x100 = % Unbilled A C / SIV

Apparent Losses

PI-IWA	Op26	= A18/A3 x 100 = (A16+A17)/A3 x 100 = % Apparent losses /SIV

Real Losses

PI-IWA	Op27	= A19 x 1000 / (C24 x H2 /24) = (A3-A8-A9-A11-A12-A16-A17) x1000 / (C24 x H2 /24) = Real Losses / connexion
PI-IWA	Op28	= A19 x 1000 / (C8 x H2 /24) = (A3-A8-A9-A11-A12-A16-A17) x1000 / (C8 x H2 /24) = Real losses / mains length

Sheet "3A-Real Losses"

STEP 3 in Component "Real losses"

1) Are the values of compulsory variables or context information for step 3 available?

V-IWA	C25	Average service connection length (m)
V-IWA	D34	Average operating pressure (kPa)
CI-IWA	CI16	Minimum service Pressure (standards)

2) If yes, calculate this 2 PIs

PI-IWA	Op29	= Op27/ (18xC8/C24+0,8+0,025xC25)/(D34/10) = [A19x1000/(C24xH2/24)]/(18xC8/C24+0,8+0,025xC25)/(D34/10) = [(A3-A8-A9-A11-A12-A16-A17)x1000/(C24xH2/24)]/ (18xC8/C24+0,8+0,025xC25)/(D34/10) = Infrastructure Leakage Index (ILI)
PI-DH	Op69	= D34/CI16 = Pressure management index (PMI) **cf. [Trow, 2009, p 16]**

Sheet "3A1-Pressure Management"

STEP 4 in Subcomponent "pressure management"

Sheet "3A2-Asset management"

STEP 4 in subcomponent 34 = Pipeline and assets management

1) Are the values of compulsory variables or context information for STEP 4 bis available?

V-IWA	D29	Service connection failures (No)
V-IWA	H1	Assessment period
V-IWA	D28	Mains failures (No)

If Yes, calculate this PIs

PI-IWA	Op32	= (D29 x 365 / H1) / C24 x 1000 = Service connection failures (No/1000 connexions /year)
PI-IWA	Op31	= (D28 x 365 / H1) / C8 x 100 = Mains failures (No / 100km / year)

Sheet "3A2Sc-Service connections"

STEP 5 : Service connections in subcomponent 34 = Pipeline and assets management

1) Are the values of compulsory context information for STEP 5 available?

CI-IWA	CI59	Lead service connections (%)
V-IWA	D24	Service connection rehabilitation (No)

If Yes, calculate this PI

PI-IWA	Op20	= (D24 x 365 / H1) / C24 x 100 = Service connection rehabilitation (% /year)

Sheet "3A2M-Mains"

STEP 5 : Mains in subcomponent 34 = Pipeline and assets management

1) Are the values of compulsory context information for STEP 5 available ?

CI-IWA	CI39	Ferrous mains without adequate corrosion protection, as proportion of total ferrous mains (%)
V-IWA	D20	Mains rehabilitation (km)

If Yes, calculate this PI

PI-IWA	Op16	= (D20 x 365 / H1) / C8 x 100 = Mains rehabilitation (% /year)

Sheet "3A3-Active Leakage Control"

STEP 4 in subcomponent 31 = Active leakage control

1) Are the values of compulsory variable for STEP 4 available ?

CI-DH	CI101	Size of the largest DMA (Number of connections)
V-IWA	D10	Leaks repaired due to active leakage control (No)
V-IWA	D9	Leakage control (km)

If Yes, calculate this PI

PI-IWA	Op5	= (D10 x 365 / H1) / C8 x 100 = Active leakage control repairs (No/100km/year)
PI-IWA	Op4	= (D9 x 365 / H1) / C8 x 100 = Leakage control (%/year)

2) Are the values of compulsory context information for STEP 4 available?

CI-IWA	CI78	Population density (person/km2)
CI-IWA	CI36	Gray cast iron mains (%)
CI-IWA	CI37	Ductile iron mains (%)
CI-IWA	CI38	Steel mains (%)

If Yes, calculate this PI

PI-DH	Op70	= ((CI36 + CI37 + CI38) / C8) x 100 = % of ferrous mains as proportion of mains length

Sheet "3A4-Speed &Q of repairs"

STEP 4 in subcomponent 32= Speed and quality of repairs

1) Are the values of compulsory variable for STEP 4 available?

V-IWA	C9	Distribution mains length (km)
V-IWA	C22	Isolating valves (No)

If yes, calculate this PI

PI-IWA	Ph8	= C22/C9 = Valve density (No/km)

Sheet "3B-Apparent Losses"

STEP 3 in Component "Apparent losses"

Calculate this PIs

PI-DH	Op71	= (A16 / A3) x 100 = Unauthorised consumption per system input volume (%)
PI-DH	Op72	= (A17 / A3) x 100 = Metering inaccuracies water losses per system input volume (%)

Sheet "3B1-Unauthaurised consumption"

STEP 4 in subcomponent 21: Unauthorised consumption

1) Are the values of compulsory variable for STEP 4 available?

V-IWA	H1	Assessment period (Days)
V-IWA	D8	Network inspection (km)
V-IWA	D11	Hydrant inspection (No)
V-IWA	C23	Hydrants (No)

If yes, calculate this PI

PI-IWA	Op3	= [(D8 x 365)/H1/C8] x 100 = Network inspection
PI-IWA	Op6	= [(D11 x 365)/H1]/C23 = Hydrant inspection

Sheet "3B2-Metering inaccuracies water losses"

STEP 4 in subcomponent 22: Water metering inaccuracies water losses

1) Are the values of compulsory variable for STEP 4 available?

V-WAT	C26	Roof tanks number (No)
V-WAT	C28	Domestic water meters aged less than 5 years (No)
V-WAT	C29	Domestic water meters aged between 5 -10 years old (No)
V-IWA	H1	Assessment period (Days)
V-IWA	D39	Residential customer meter reading frequency (No/meter/year)
V-IWA	D40	Industrial customer meter reading frequency (No/meter/year)
V-IWA	D41	Bulk customer meter reading frequency (No/meter/year)
V-IWA	D42	Customer meter readings (No)
V-IWA	D44	Operational meters (No)
V-IWA	D45	Meter replacement (No)
V-IWA	E6	Direct customer meters (No)
V-IWA	E7	Residential customer meters (No)
V-IWA	E8	Industrial customer meters (No)
V-IWA	E9	Bulk customer meters (No)

If yes, calculate this PI

PI-DH	Op8	= (D45 x 365 / H1) /E6 = Meter replacement (-/year)
PI-DH	Op73	= ((E7-(C28+C29)) / E7) x 100 = % of residential meters aged more than 10 years
PI-DH	Op74	= (C26 / C24) x 100 = % of service connection supplying roof tanks
PI-IWA	Op36	= [(D42 x 365)/H1]/(E7 x D39+E8 x D40+E9 x D41) = Customer reading efficiency
PI-IWA	Op38	= (D44/E6) x 100 = Operational meters

Sheet "3C-Unbilled authorized consumption"

STEP 3 in Component "Unbilled authorised consumption"

PI-DH	Op75	= (A11 / A3) x 100 = Unbilled unmetered consumption per system input volume (%)

STEP 4 in subcomponent 11: Unbilled unmetered consumption

STEP 4 in subcomponent 12: Both unbilled unmetered and unbilled metered consumption

1) Are the values of compulsory variable for STEP 4 available?

V-IWA	C2	Treated water storage capacity (m3)
V-IWA	C9	Distribution mains length (km)
V-IWA	C23	Hydrants (No)
CI-IWA	CI91	Daily minimum air temperature (°C)
CI-DH	CI102	Flushing volume during the assessment period (m3)
V-IWA	H1	Assessment period (Days)
V-IWA	D7	Storage Tank Cleaning (m3)

If yes, calculate this PI

PI-IWA	Ph9	= C23/C9 = Hydrant density
PI-IWA	Op2	= [(D7 x 365)/H1]/C2 = Storage tank cleaning
PI-DH	Op76	= (CI102 x 365)/ C9 = Annual flushing volume per kilometre of distribution main

New PIs – New Cis – Used IWA Cis

PI-DH	Fi53	= A13/A3 x 100 = (A11+A12)/A3 x100 = % Unbilled A C / SIV
PI-DH	Op69	= D34/CI16 = Pressure management index (PMI)
PI-DH	Op70	= ((CI36 + CI37 + CI38) / C8)x100 = % of ferrous mains as proportion of mains length
PI-DH	Op71	= (A16 / A3) x 100 = Unauthorised consumption per system input volume (%)
PI-DH	Op72	= (A17 / A3) x 100 = Metering inaccuracies water losses per system input volume (%)
PI-DH	Op73	= ((E7-(C28+C29)) / E7) x 100 = % of residential meters aged more than 10 years
PI-DH	Op74	= (C26 / C24) x 100 = % of service connection supplying roof tanks
PI-DH	Op75	= (A11 / A3) x 100 = Unbilled unmetered consumption per system input volume (%)
PI-DH	Op76	= (CI102 x 365)/ C9 = Annual flushing volume per kilometre of distribution main

CI-DH	CI101	Size of the largest DMA (Number of connections)	PI
CI-DH	CI102	Flushing volume during the assessment period (m3)	Variable

CI-IWA	CI16	Minimum service Pressure (standards)	Variable
CI-IWA	CI59	Lead service connections (%)	PI
CI-IWA	CI39	Ferrous mains without adequate corrosion protection, as proportion of total above material categories (%)	PI
CI-IWA	CI78	Population density (person/km2)	PI
CI-IWA	CI36	Gray cast iron mains (%)	Variable
CI-IWA	CI37	Ductile iron mains (%)	Variable
CI-IWA	CI38	Steel mains (%)	Variable
CI-IWA	CI91	Daily minimum air temperature (°C)	PI

All Pis used

Source	Id	Formula and name	Sheet
PI-IWA	Fi46	= A21/A3 x100 = (A3-A8-A9)/A3 x100 = % NRW/SIV	1
PI-DH	Fi53	= A13/A3 x 100 = (A11+A12)/A3 x100 = % Unbilled A C / SIV	1
PI-IWA	Op26	= A18/A3 x 100 = (A16+A17)/A3 x 100 = % Apparent losses /SIV	1
PI-IWA	Op27	= A19 x 100 / (C24 x H2 /24) = (A3-A8-A9-A11-A12-A16-A17) x100 / (C24 x H2 /24) = Real Losses / connexion	1
PI-IWA	Op28	= A19 x 1000 / (C8 x H2 /24) = (A3-A8-A9-A11-A12-A16-A17) x1000 / (C8 x H2 /24) = Real losses / mains length	1
PI-IWA	Op29	= Op27/ (18xC8/C24+0,8+0,025xC25)/(D34/10) = [A19x1000/(C24xH2/24)]/(18xC8/C24+0,8+0,025xC25)/(D34 /10) = [(A3-A8-A9-A11-A12-A16-A17)x1000/(C24xH2/24)]/ (18xC8/C24+0,8+0,025xC25)/(D34/10) = Infrastructure Leakage Index (ILI)	3A
PI-DH	Op69	= D34/CI16 = Pressure management index (PMI)	3A
PI-IWA	Op32	= (D29 x 365 / H1) / C24 x 1000 = Service connection failures (No/1000 connexions /year)	3A2
PI-IWA	Op31	= (D28 x 365 / H1) / C8 x 100 = Mains failures (No / 100km / year)	3A2
PI-IWA	Op20	= (D24 x 365 / H1) / C24 x 100 = Service connection rehabilitation (% /year)	3A2Sc
PI-IWA	Op16	= (D21 x 365 / H1) / C8 x 100 = Mains rehabilitation (% /year)	3A2M
PI-IWA	Op5	= (D10 x 365 / H1) / C8 x 100 = Active leakage control repairs (No/100km/year)	3A3
PI-IWA	Op4	= (D9 x 365 / H1) / C8 x 100 = Leakage control (%/year)	3A3
PI-DH	Op70	= ((CI36 + CI37 + CI38) / C8)*100 = % of ferrous mains as proportion of mains length	3A3
PI-IWA	Ph8	= C22/C9 = Valve density (No/km)	3A4
PI-DH	Op71	= (A16 / A3) x 100 = Unauthorised consumption per system input volume (%)	3B
PI-DH	Op72	= (A17 / A3) x 100 = Metering inaccuracies water losses per system input volume (%)	3B

Source	Id	Formula and name	Sheet
PI-IWA	Op3	= [(D8 x 365)/H1/C8] x 100 = Network inspection	3B1
PI-IWA	Op6	=[(D11 x 365)/H1]/C23 = Hydrant inspection	3B1
PI-DH	Op8	= (D45 x 365 / H1) /E6 = Meter replacement (-/year)	3B2
PI-DH	Op73	= ((E7-(C28+C29)) / E7) x 100 = % of residential meters aged more than 10 years	3B2
PI-DH	Op74	= (C26 / C24) x 100 = % of service connection supplying roof tanks	3B2
PI-IWA	Op36	= [(D42 x 365)/H1]/(E7 x D39+E8 x D40+E9 x D41) = Customer reading efficiency	3B2
PI-IWA	Op38	=(D44/E6) x 100 =Operational meters	3B2
PI-DH	Op75	= (A11 / A3) x 100 = Unbilled unmetered consumption per system input volume (%)	3C
PI-IWA	Ph9	=C23/C9 = Hydrant density	3C
PI-IWA	Op2	= [(D7 x 365)/H1]/C2 = Storage tank cleaning	3C
PI-DH	Op76	= [(CI 102 x 365)/H1]/ C9 = Annual flushing volume per kilometre of distribution main	3C

All variables and Cis used

Source	Id	Name	Sheet
V-IWA	A11	Unbilled metered consumption (m3/an)	1
V-IWA	A12	Unbilled non-metered consumption (m3/an)	1
V-IWA	A16	Unauthorised consumption (m3/an)	1
V-IWA	A17	Metering inaccuracies water losses	1
V-IWA	A3	System input Volume (m3/year)	1
V-IWA	A8	Billed metered consumption (m3/year)	1
V-IWA	A9	Billed non-metered consumption (m3/year)	1
V-IWA	C24	Service connexions (No.)	1
V-IWA	C8	Main length (km)	1
V-IWA	H2	Time system is pressured (hours in a year)	1
CI-IWA	CI16	Minimum service Pressure (standards)	3A
V-IWA	C25	Average service connection length (m)	3A
V-IWA	D34	Average operating pressure (kPa)	3A
V-IWA	D28	Mains failures (No)	3A2
V-IWA	D29	Service connection failures (No)	3A2
V-IWA	H1	Assessment period (Days)	3A2 3B1 3B2 3C
CI-IWA	CI39	Ferrous mains without adequate corrosion protection, as proportion of total ferrous mains (%)	3A2M
V-IWA	D20	Mains rehabilitation (km)	3A2M
CI-IWA	CI59	Lead service connections (%)	3A2Sc
V-IWA	D24	Service connection rehabilitation (No)	3A2Sc
CI-DH	CI101	Size of the largest DMA (Number of connections)	3A3
CI-IWA	CI36	Gray cast iron mains (%)	3A3
CI-IWA	CI37	Ductile iron mains (%)	3A3
CI-IWA	CI38	Steel mains (%)	3A3
CI-IWA	CI78	Population density (person/km2)	3A3
V-IWA	D10	Leaks repaired due to active leakage control (No)	3A3
V-IWA	D9	Leakage control (km)	3A3
V-IWA	C22	Isolating valves (No)	3A4
V-IWA	C9	Distribution mains length (km)	3A4 3C
V-IWA	D11	Hydrant inspection (No)	3B1
V-IWA	D8	Network inspection (km)	3B1
V-IWA	C23	Hydrants (No)	3B1 3C
V-IWA	D39	Residential customer meter reading frequency (No/meter/year)	3B2
V-IWA	D40	Industrial customer meter reading frequency (No/meter/year)	3B2
V-IWA	D41	Bulk customer meter reading frequency (No/meter/year)	3B2
V-IWA	D42	Customer meter readings (No)	3B2
V-IWA	D44	Operational meters (No)	3B2
V-IWA	D45	Meter replacement (No)	3B2
V-IWA	E6	Direct customer meters (No)	3B2
V-IWA	E7	Residential customer meters (No)	3B2

Source	Id	Name	Sheet
V-IWA	E8	Industrial customer meters (No)	3B2
V-IWA	E9	Bulk customer meters (No)	3B2
V-WAT	C26	Roof tanks number (No)	3B2
V-WAT	C28	Domestic water meters aged less than 5 years (No)	3B2
V-WAT	C29	Domestic water meters aged between 5 -10 years old (No)	3B2
CI-DH	CI102	Annual flushing volume (m3)	3C
CI-IWA	CI91	Daily minimum air temperature (°C)	3C
V-IWA	C2	Treated water storage capacity (m3)	3C
V-IWA	D7	Storage tank cleaning (m3)	3C

Annex 8

DH questionnaire on thresholds

Legend for sheet "ThresholdsPIs+CIs" & "PPsValues"

Color of cells	Meaning
Yellow	Waterloss partners must fill the cell (if it is not already filled),
Blue	PIs or CIs used as key indicators in the "Decision tree" file (automatic calculation).
White	First time the variable, the PIs or the CI appears in the sheets.
Gray	Second time or third or fouth or fiveth or sixth time the variable or the CI appears in the sheets (there's an automatic link with the first one).

Color of text	Meaning
red	DH made a correction (for example about the unit on this variable or CI) on partners answer in DH questionnaire.

Decision tree page	Source	Id	Name	Formula	Unit	Order of magnitude	Threshold "LOW"	Threshold "MEDIUM"	Threshold "HIGH"
1-Start	PI-IWA	**Fi46**	Non-revenue water by volume	Fi46=(A21/A3)*100	%	(10-60)			
1-Start	PI-DH	**Fi53**	Unbilled annual consumption per system input volume	Fi53=(A13/A3)*100	%	(0-50)			
1-Start	PI-IWA	**Op26**	Apparent losses per system input volume	Op26=A18/A3	%	(0-50)			
1-Start	PI-IWA	**Op27**	Real losses per connection	Op27=[(A19*1000)/(C24*H2)/24	L/connection/day when system is pressurised	(50-1000)			
1-Start	PI-IWA	**Op28**	Real losses per mains length	Op28=[(A19*1000)/(C8*H2)/24	L/km/day when system is pressurised	(500-50000)			
3A-Real Losses	PI-IWA	**Op29**	Infrastructure Leakage Index (ILI)	Op29=Op27/(18*C8+0,8+0,025*C25)/(D34/10)	Adimensional	(1-20)			
3A-Real Losses	PI-DH	**Op69**	Pressure management index (PMI)	Op69=D34/CI16	Adimensional	(1-5)			
3A2-Asset management	PI-IWA	**Op32**	Service connection failures	Op32=[(D29*365)/H1/C24]*1000	No./1000 connections / year	(2-20)			
3A2-Asset management	PI-IWA	**Op31**	Mains failures	Op31=[(D28*365)/H1/C8]*100	No./100km/year	(5-50)			
3A2Sc-Service connections	CI-IWA	**CI59**	Lead service connections	CI59=CI59	%	(0-100)			
3A2Sc-Service connections	PI-IWA	**Op20**	Service connection rehabilitation	Op20=[(D24*365)/H1/C24]*100	% / year	(0.5-10)			
3A2M-Mains	CI-IWA	**CI39**	Ferrous mains without adequate corrosion protection, as proportion of total ferrous mains	CI39=CI39	%	(0-80)			
3A2M-Mains	PI-IWA	**Op16**	Mains rehabilitation	Op16=[(D20*365)/H1/C8]*100	% / year	(0.2-2)			
3A3-Active Leakage Control	CI-DH	**CI101**	Size of the largest DMA	CI101=CI101	connections	(300-10000)			
3A3-Active Leakage Control	PI-IWA	**Op5**	Active leakage control repairs	Op5=[(D10*365)/H1/C8]*100	No./100km/year	(5-50)			
3A3-Active Leakage Control	PI-IWA	**Op4**	Leakage control	Op4=[(D9*365)/H1/C8]*100	% / year	(0-50)			
3A3-Active Leakage Control	CI-IWA	**CI78**	Population density	CI78=CI78	person/km2	(5-5000)			
3A3-Active Leakage Control	PI-DH	**Op70**	% of ferrous mains as proportion of mains length	Op70=((CI36 + CI37 + CI38)/C8)*100	%	(0-100)			
3A4-Speed &Q of repairs	PI-IWA	**Ph8**	Valve density	Ph8=C22/C9	No./km	(1-10)			
3B-Apparent losses	PI-DH	**Op71**	Unauthorised consumption per system input volume	Op71=(A16/A3)*100	%	(0-50)			
3B-Apparent losses	PI-DH	**Op72**	Metering inaccuracies water losses per system input volume	Op72=(A17/A3)*100	%	(1-20)			
3B1-Unauthorised consumption	PI-IWA	**Op3**	Network inspection	Op3=[(D8*365)/H1/C8]*100	% / year	(0-50)			
3B1-Unauthorised consumption	PI-IWA	**Op6**	Hydrant inspection	Op6=[(D11*365)/H1]/C23	/ year	(0-1)			
3B2-Metering inaccuracies	PI-IWA	**Op8**	Meter replacement	Op8=[(D45*365)/H1]/E6	/ year	(0.05-0.1)			
3B2-Metering inaccuracies	PI-DH	**Op73**	% of residential meters aged more than 10 years	Op73=((E7-(C28+C29))/E7)*100	%	(10-50)			

3B2-Metering inaccuracies	PI-DH	**Op74**	% of service connection supplying roof tanks	Op74=(C26/C24)*100	%	(0-100)			
3B2-Metering inaccuracies	PI-IWA	**Op36**	Customer reading efficiency	Op36=[(D42*365)/H1]/(E7*D39+E8*D40+E9*D41)	Adimensional	(0.7-1)			
3B2-Metering inaccuracies	PI-IWA	**Op38**	Operational meters	Op38=(D44/E6)*100	%	(80-100)			
3C-Unbilled authorized	PI-DH	**Op75**	Unbilled unmetered consumption per system input volume (%)	Op75=(A11/A3)*100	%	(0-50)			
3C-Unbilled authorized	CI-IWA	**CI91**	Daily minimum air temperature	CI91=CI91	℃	(-20-10)			
3C-Unbilled authorized	PI-IWA	**Ph9**	Hydrant density	Ph9=C23/C9	No./km	(1-10)			
3C-Unbilled authorized	PI-IWA	**Op2**	Storage tank cleaning	Op2=[(D7*365)/H1]/C2	/ year	(0.5-1)			
3C-Unbilled authorized	PI-DH	**Op76**	Annual flushing volume per kilometre of distribution main	Op76=[(CI102*365)/H1]/C9	m3/km/year	(0.5-200)			

Decision tree page	Source	ID	Name	Formula	Unit	AMB Castellbisbal	DH SIE Lodève	DH Vias	WBN Nicosia	WBN Aglantzia	PO Argelès-sur-Mer	PO Baho	PO Thuir	LG Melito di Napoli	DEYAK Kozani	*Order of magnitude*
			Year of the assessment period		Year	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	
1-Start	V-IWA	**A3**	System Input Volume		m3/year	2 445 454	1 436 640	?	23 838 611	?	2 123 191	?	?	4 193 300	5 688 642	
1-Start	V-IWA	**A8**	Billed metered consumption		m3/year	2 194 336	557 134	?	14 467 783	?	1 695 092	?	?	2 658 000	2 369 301	
1-Start	V-IWA	**A9**	Billed non-metered consumption		m3/year	0	0	?	13310	?	0	?	?	0	0	
1-Start	V-IWA	**A11**	Unbilled metered consumption		m3/year	0	0	?	1490	?	0	?	?	0	0	
1-Start	V-IWA	**A12**	Unbilled non-metered consumption		m3/year	9 782	3 000	?	6 760	?	7 160	?	?	10 483	113 773	
1-Start	V-IWA	**A16**	Unauthorised consumption		m3/year	9 782	2 000	?	103 570	?	2 260	?	?	10 483	56 886	
1-Start	V-IWA	**A17**	Metering inaccuracies = Meter under-registration and data handling error		m3/year	29 345	6 025	?	414 290	?	26 350	?	?	41 933	236 930	
1-Start	V-IWA	**H2**	Time system is pressurised		Hours in a year	8 760	8 760	?	8 760	?	8 760	?	?	8 760	8 760	*(6000-8760)*
1-Start	V-IWA	**C24**	Service connexions		No	3 531	3 655	?	64 000	?	6 581	?	?	4 100	9 150	
1-Start	V-IWA	**C8**	Main Length		km	144	110	?	1 250	?	145	?	?	65	130	
1-Start	PI-IWA	**Fi46**	Non-revenue water by volume	(A3-A8-A9)/A3x100	%	10,3	61,2	#VALEUR!	39,3	#VALEUR!	20,2	#VALEUR!	#VALEUR!	36,6	58,4	*(10-60)*
1-Start	PI-DH	**Fi53**	Unbilled annual consumption per system input volume	(A11+A12)/A3x100	%	0,4	0,2	#VALEUR!	0,0	#VALEUR!	0,3	#VALEUR!	#VALEUR!	0,2	2,0	*(0-50)*
1-Start	PI-IWA	**Op26**	Apparent losses per system input volume	(A16+A17)/A3x100	%	1,6	0,6	#VALEUR!	2,2	#VALEUR!	1,3	#VALEUR!	#VALEUR!	1,2	5,2	*(0-50)*
1-Start	PI-IWA	**Op27**	Real losses per connection	(A3-A8-A9-A11-A12-A16-A17)x1000/(C24xH2/24)	L/connection/day when system is pressurised	157	651	#VALEUR!	378	#VALEUR!	163	#VALEUR!	#VALEUR!	984	872	*(50-1000)*
1-Start	PI-IWA	**Op28**	Real losses per mains length	(A3-A8-A9-A11-A12-A16-A17)x1000/(C8xH2/24)	L/km/day when system is pressurised	3 847	21 631	#VALEUR!	19 357	#VALEUR!	7 413	#VALEUR!	#VALEUR!	62 061	61 562	*(500-50000)*
3A-Real Losses	V-IWA	**C8**	Main Length		km	144	110	?	1250	?	145	?	?	65	129,58	
3A-Real Losses	V-IWA	**C24**	Service connexions		No	3 531	3 655	?	64 000	?	6 581	?	?	4 100	9 150	
3A-Real Losses	V-IWA	**C25**	Average service connexion length		m	2,0	?	?	6,0	?	?	?	?	7,3	6,0	*(2-20)*
3A-Real Losses	V-IWA	**D34**	Average Operating pressure		kPa	550	350	?	350	?	300	?	?	200	405	*(100-1000)*
3A-Real Losses	CI-IWA	**CI16**	Minimum service pressure (standards)		kPa	250	300	?	200	?	250	?	?	200	101,32	*(50-300)*
3A-Real Losses	PI-IWA	**Op29**	Infrastructure Leakage Index (ILI)	Op27/(18xC8/C24+0.8+0.025xC25)/(D34/10)	Adimensional	1,8	#VALEUR!	#VALEUR!	8,3	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	38,8	17,9	*(1-20)*
3A-Real Losses	PI-DH	**Op69**	Pressure management Index (PMI)	D34/CI16	Adimensional	2,2	1,2	#VALEUR!	1,8	#VALEUR!	1,2	#VALEUR!	#VALEUR!	1,0	4,0	*(1-5)*
3A2-Asset management	V-IWA	**C24**	Service connexions		No	3 531	3 655	?	64 000	?	6 581	?	?	4 100	9 150	
3A2-Asset management	V-IWA	**C8**	Main Length		km	144	110	?	1250	?	145	?	?	65	129,58	
3A2-Asset management	V-IWA	**H1**	Assessment period		Days	365	365	?	365	?	365	?	?	180	365	*(90-365)*
3A2-Asset management	V-IWA	**D29**	Service connection failures		No	53	?	?	904	?	30	?	?	88	30	
3A2-Asset management	V-IWA	**D28**	Mains failures		No	164	?	?	5839	?	33	?	?	60	15	
3A2-Asset management	PI-IWA	**Op32**	Service connection failures	(D29x365/H1)/C24x1000	No./1000 connections / year	15,0	#VALEUR!	#VALEUR!	14,1	#VALEUR!	4,6	#VALEUR!	#VALEUR!	43,5	3,3	*(2-20)*
3A2-Asset management	PI-IWA	**Op31**	Mains failures	(D28x365/H1)/C8x100	No./100 km/year	113,9	#VALEUR!	#VALEUR!	467,1	#VALEUR!	22,8	#VALEUR!	#VALEUR!	187,2	11,6	*(5-50)*

Decision tree page	Source	ID	Name	Formula	Unit	AMB Castellbisbal	DH SIE Lodève	DH Vias	WBN Nicosia	WBN Aglantzia	PO Argelès-sur-Mer	PO Baho	PO Thuir	LG Melito di Napoli	DEYAK Kozani	*Order of magnitude*
3A2Sc-Service connections	V-IWA	**H1**	Assessment period		Days	365	365	?	365	?	365	?	?	180	365	
3A2Sc-Service connections	V-IWA	**C24**	Service connexions		No	3531	3655	?	64000	?	6581	?	?	4100	9150	
3A2Sc-Service connections	CI-IWA	**CI59**	Lead service connections		%	?	?	?	?	?	?	?	?	?	?	*(0-100)*
3A2Sc-Service connections	V-IWA	**D24**	Service connection rehabilitation		No	12	141	?	?	?	9	?	?	102	20	
3A2Sc-Service connections	CI-IWA	**CI59**	Lead service connections	CI59	%	?	?	?	?	?	?	?	?	?	?	*(0-100)*
3A2Sc-Service connections	PI-IWA	**Op20**	Service connection rehabilitation	(D24x365)/H1/C24x100	% / year	0,3	3,9	#VALEUR!	#VALEUR!	#VALEUR!	0,1	#VALEUR!	#VALEUR!	5,0	0,2	*(0.5-10)*
3A2M-Mains	V-IWA	**H1**	Assessment period		Days	365	365	?	365	?	365	?	?	180	365	
3A2M-Mains	V-IWA	**C8**	Main Length		km	144	110	?	1250	?	145	?	?	65	129,584	
3A2M-Mains	CI-IWA	**CI39**	Ferrous mains without adequate corrosion protection, as proportion of total ferrous mains		%	?	?	?	?	?	?	?	?	?	?	*(0-100)*
3A2M-Mains	V-IWA	**D20**	Mains rehabilitation		km	0	?	?	?	?	**0,616**	?	?	?	?	
3A2M-Mains	CI-IWA	**CI39**	Ferrous mains without adequate corrosion protection, as proportion of total ferrous mains	CI39	%	?	?	?	?	?	?	?	?	?	?	*(0-80)*
3A2M-Mains	PI-IWA	**Op16**	Mains rehabilitation	[(D20 x 365)/H1/C8]x100	% / year	0,0	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	0,4	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	*(0.2-2)*
3A3-Active Leakage Control	V-IWA	**H1**	Assessment period		Days	365	365	?	365	?	365	?	?	180	365	
3A3-Active Leakage Control	V-IWA	**C8**	Main Length		km	144	110	?	1250	?	145	?	?	65	130	
3A3-Active Leakage Control	CI-DH	**CI101**	Size of the largest DMA		No. of service connection	?	?	?	?	?	?	?	?	?	?	
3A3-Active Leakage Control	V-IWA	**D10**	Leaks repaired due to active leakage control		No	0	?	?	864	?	63	?	?	15	20	
3A3-Active Leakage Contro	V-IWA	**D9**	Leakage control		km	0,00	13,73	?	470,00	?	101,50	?	?	40,00	20,00	
3A3-Active Leakage Control	CI-DH	**CI101**	Size of the largest DMA	CI101	connections	?	?	?	?	?	?	?	?	?	?	*(300-10000)*
3A3-Active Leakage Control	PI-IWA	**Op5**	Active leakage control repairs	D10x365/H1/C8x100	No./100km/year	0,00	#VALEUR!	#VALEUR!	69,12	#VALEUR!	43,45	#VALEUR!	#VALEUR!	46,79	15,43	*(5-50)*
3A3-Active Leakage Control	PI-IWA	**Op4**	Leakage control	D9x365/H1/C8x100	% / year	0,0	12,5	#VALEUR!	37,6	#VALEUR!	70,0	#VALEUR!	#VALEUR!	124,8	15,4	*(0-50)*
3A3-Active Leakage Control	V-IWA	**C8**	Main Length		km	144	110	?	1250	?	145	?	?	65	129,584	
3A3-Active Leakage Control	CI-IWA	**CI78**	Population density		person/km2	**394,29**	**0,14**	?	84,00	?	**171,75**	?	?	**9 249,33**	**130,04**	*(10-10000)*
3A3-Active Leakage Control	CI-IWA	**CI36**	Gray cast iron mains		%	?	?	?	?	?	?	?	?	?	?	*(0-100)*
3A3-Active Leakage Control	CI-IWA	**CI37**	Ductile iron mains		%	?	?	?	?	?	?	?	?	?	?	*(0-100)*
3A3-Active Leakage Control	CI-IWA	**CI38**	Steel mains		%	?	?	?	?	?	?	?	?	?	?	*(0-100)*
3A3-Active Leakage Control	CI-IWA	**CI78**	Population density	CI78	person/km2	394,29	0,14	?	84,00	?	171,75	?	?	9 249,33	130,04	*(5-5000)*
3A3-Active Leakage Control	PI-DH	**Op70**	% of ferrous mains as proportion of mains length	((CI36+CI37+CI38)/C8)x100	%	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	*(0-100)*
3A4-Speed &Q of repairs	V-IWA	**C22**	Isolating valves		No	1 012,0	?	?	?	?	654,0	?	?	?	2 968,0	
3A4-Speed &Q of repairs	V-IWA	**C9**	Distribution mains length		km	?	?	?	?	?	?	?	?	?	?	
3A4-Speed &Q of repairs	PI-IWA	**Ph8**	Valve density	C22/C9	No./km	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	*(1-10)*

Decision tree page	Source	ID	Name	Formula	Unit	AMB Castellbisbal	DH SIE Lodève	DH Vias	WBN Nicosia	WBN Aglantzia	PO Argelès-sur-Mer	PO Baho	PO Thuir	LG Melito di Napoli	DEYAK Kozani	*Order of magnitude*
3B-Apparent losses	V-IWA	**A3**	System Input Volume		m3/year	2 445 454	1 436 640	?	23 838 611	?	2 123 191	?	?	4 193 300	5 688 642	
3B-Apparent losses	V-IWA	**A16**	Unauthorised consumption		m3/year	9 782	2 000	?	103 570	?	2 260	?	?	10 483	56 886	
3B-Apparent losses	V-IWA	**A17**	Metering inaccuracies = Meter under-registration and data handling error		m3/year	29 345	6 025	?	414 290	?	26 350	?	?	41 933	236 930	
3B-Apparent losses	PI-DH	**Op71**	Unauthorised consumption per system input volume	(A16/A3)x100	%	0,4	0,1	#VALEUR!	0,4	#VALEUR!	0,1	#VALEUR!	#VALEUR!	0,2	1,0	*(0-50)*
3B-Apparent losses	PI-DH	**Op72**	Metering inaccuracies water losses per system input volume	(A17/A3)x100	%	1,2	0,4	#VALEUR!	1,7	#VALEUR!	1,2	#VALEUR!	#VALEUR!	1,0	4,2	*(1-20)*
3B1-Unauthorised consumption	V-IWA	**H1**	Assessment period		Days	365	365	?	365	?	365	?	?	180	365	
3B1-Unauthorised consumption	V-IWA	**C8**	Main Length		km	144	110	?	1250	?	145	?	?	65	129,58	
3B1-Unauthorised consumption	V-IWA	**D8**	Network inspection		km	0,0	?	?	?	?	?	?	?	40,0	100,0	
3B1-Unauthorised consumption	V-IWA	**D11**	Hydrant inspection		No	108,0	?	?	2 000,0	?	247,0	?	?	11,0	?	
3B1-Unauthorised consumption	V-IWA	**C23**	Hydrants		No	108,0	?	?	3 531,0	?	247,0	?	?	23,0	?	
3B1-Unauthorised consumption	PI-IWA	**Op3**	Network inspection	D8x365/H1/C8x100	% / year	0,0	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	124,8	77,2	*(0-50)*
3B1-Unauthorised consumption	PI-IWA	**Op6**	Hydrant inspection	D11x365/H1/C23	/ year	1,00	#VALEUR!	#VALEUR!	0,57	#VALEUR!	1,00	#VALEUR!	#VALEUR!	0,97	#VALEUR!	*(0-1)*
3B2-Metering inaccuracies	V-IWA	**H1**	Assessment period		Days	365	365	?	365	?	365	?	?	180	365	
3B2-Metering inaccuracies	V-IWA	**C24**	Service connexions		No	3 531	3 655	?	64 000	?	6 581	?	?	4 100	9 150	
3B2-Metering inaccuracies	V-IWA	**D45**	Meter replacement		No	267,0	?	?	3 400,0	?	524,0	?	?	103,0	?	
3B2-Metering inaccuracies	V-IWA	**E6**	Direct customer meters		No	?	?	?	?	?	?	?	?	?	?	
3B2-Metering inaccuracies	V-IWA	**E7**	Residential customer meters		No	?	?	?	?	?	?	?	?	?	?	
3B2-Metering inaccuracies	V-WAT	**C28**	Domestic water meters aged less than 5 years		No	?	?	?	?	?	?	?	?	?	?	
3B2-Metering inaccuracies	V-WAT	**C29**	Domestic water meters aged between 5 -10 years old		No	?	?	?	?	?	?	?	?	?	?	
3B2-Metering inaccuracies	V-WAT	**C26**	Roof tanks number		No	18	10	?	107 613	?	0	?	?	?	?	
3B2-Metering inaccuracies	V-IWA	**D39**	Residential customer meter reading frequency		No/meter/year	?	?	?	?	?	?	?	?	?	?	*(1-12)*
3B2-Metering inaccuracies	V-IWA	**D40**	Industrial customer meter reading frequency		No/meter/year	?	?	?	?	?	?	?	?	?	?	*(1-12)*
3B2-Metering inaccuracies	V-IWA	**D41**	Bulk customer meter reading frequency		No/meter/year	?	?	?	?	?	?	?	?	?	?	*(1-12)*
3B2-Metering inaccuracies	V-IWA	**D42**	Customer meter readings		No	?	?	?	?	?	?	?	?	?	?	
3B2-Metering inaccuracies	V-IWA	**E8**	Industrial customer meters		No	?	?	?	?	?	?	?	?	?	?	
3B2-Metering inaccuracies	V-IWA	**E9**	Bulk customer meters		No	?	6,0	?	112,0	?	?	?	?	6,0	?	
3B2-Metering inaccuracies	V-IWA	**D44**	Operational meters		No	?	?	?	?	?	?	?	?	?	?	
3B2-Metering inaccuracies	PI-IWA	**Op8**	Meter replacement	D45x365/H1/E6	/ year	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	*(0.05-0.1)*
3B2-Metering inaccuracies	PI-DH	**Op73**	% of residential meters aged more than 10 years	(E7-C28-C29)/E7)x100	%	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	*(10-50)*
3B2-Metering inaccuracies	PI-DH	**Op74**	% of service connection supplying roof tanks	C26/C24x100	%	0,5	0,3	#VALEUR!	168,1	#VALEUR!	0,0	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	*(0-100)*

Decision tree page	Source	ID	Name	Formula	Unit	AMB Castellbisbal	DH SIE Lodève	DH Vias	WBN Nicosia	WBN Aglantzia	PO Argelès-sur-Mer	PO Baho	PO Thuir	LG Melito di Napoli	DEYAK Kozani	*Order of magnitude*
3B2-Metering inaccuracies	PI-IWA	**Op36**	Customer reading efficiency	D42x365/H1/(E7xD39+E8xD40+E9xD41)	Adimensional	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	*(0.7-1)*
3B2-Metering inaccuracies	PI-IWA	**Op38**	Operational meters	D44/E6x100	%	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	*(80-100)*
3C-Unbilled authorized consumption	V-IWA	**A11**	Unbilled metered consumption		m3/year	0	0	?	1490	?	0	?	?	0	0	
3C-Unbilled authorized consumption	V-IWA	**A3**	System Input Volume		m3/year	2 445 454	1 436 640	?	23 838 611	?	2 123 191	?	?	4 193 300	5 688 642	
3C-Unbilled authorized consumption	V-IWA	**H1**	Assessment period		Days	365	365	?	365	?	365	?	?	180	365	
3C-Unbilled authorized consumption	V-IWA	**C23**	Hydrants		No	108	?	?	3531	?	247	?	?	23	?	
3C-Unbilled authorized consumption	V-IWA	**C9**	Distribution mains length		km	?	?	?	?	?	?	?	?	?	?	
3C-Unbilled authorized consumption	CI-IWA	**CI91**	Daily minimum air temperature		°C	?	?	?	?	?	?	?	?	?	?	*(-20-10)*
3C-Unbilled authorized consumption	V-IWA	**D7**	Storage tank cleaning		m3	352	?	?	?	?	1375	?	?	?	?	
3C-Unbilled authorized consumption	V-IWA	**C2**	Treated water storage capacity		m3	?	?	?	?	?	?	?	?	?	?	
3C-Unbilled authorized consumption	CI-DH	**CI102**	Flushing volume during the assessment period		m3	?	?	?	?	?	?	?	?	?	?	
3C-Unbilled authorized consumption	PI-DH	**Op75**	Unbilled unmetered consumption per system input volume (%)	(A11/A3)x100	%	0,0	0,0	#VALEUR!	0,0	#VALEUR!	0,0	#VALEUR!	#VALEUR!	0,0	0,0	*(0-50)*
3C-Unbilled authorized consumption	CI-IWA	**CI91**	Daily minimum air temperature	CI91	°C	?	?	?	?	?	?	?	?	?	?	*(-20-10)*
3C-Unbilled authorized consumption	PI-IWA	**Ph9**	Hydrant density	C23/C9	No./km	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	*(1-10)*
3C-Unbilled authorized consumption	PI-IWA	**Op2**	Storage tank cleaning	D7x365/H1/C2	/ year	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	*(0.5-1)*
3C-Unbilled authorized consumption	PI-DH	**Op76**	Annual flushing volume per kilometre of distribution main	CI102x365/H1/C9	m3/km/year	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	*(0.5-200)*

Annex 9

Thresholds guide

Waterloss C4.1

Guide to fill the file related to performance indicators thresholds.

The decision making process set in place to reduce NRW is based on a hierarchical tree (**05-HierarchicalTree_12-09-26.xls**) that classifies the measures according to the following categories (from general to specific):

- Component of NRW
- Sub-component of NRW
- Strategic approach to measures
- Operational measures

Then, the DSS procedure uses a decision tree (**03-DecisionTree_12-09-26.vsd**). Questions and tests on the values of PIs provide a path in the hierarchical tree. The result of the decision tree is a set of possible measures proposed to user. Performance indicators (PIs) and Context information (CI), used in the procedure were chosen in this priority:

1) IWA + Waterloss PIs [Waterloss D3.2.2, 2012]
2) IWA CIs [Alegre *et al.*, 2006]
3) DH questionnaire CI
4) If necessary new PIs and CI

A synthesis of PIs, CI and variables used at each step of the decision tree is provided in file **04-StepsOfDecisionTree_12-09-26**.

For each PI used in the decision tree, thresholds values are necessary to take a decision. For example: **If** Fi46 value (Non revenue water by volume) < Low threshold of Fi46 **then** "Stop or detailed analysis", **if not** "go to next step".

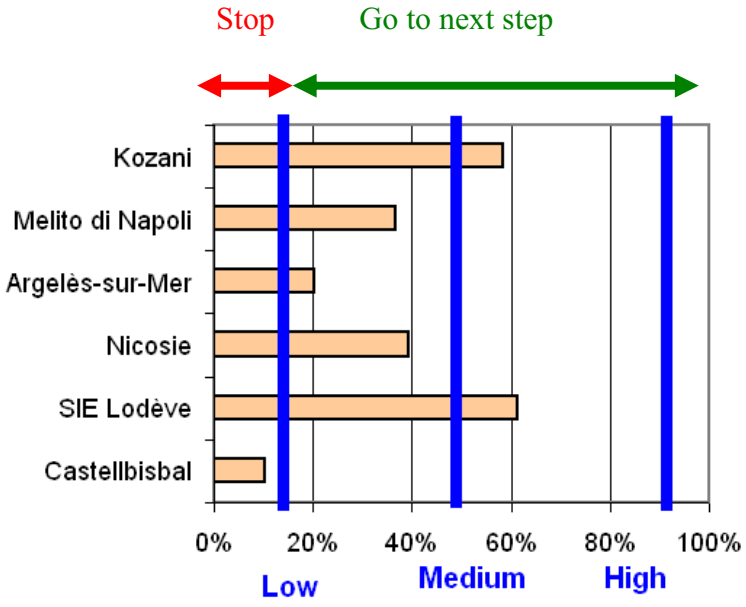


Figure 1 : Example of performance indicators thresholds used in the decision tree

Some threshold values can be found in international literature but they must be adapted to the context. It's why project partners are asked to fill sheet **ThresholdsPIs+CIs** of file **02-ThresholdsQuestionnaire_12-09-26.xls** with thresholds values which are relevant in their cases. These values can be derived from as well international literature that national rules or references specific to WSS.

The columns of sheet **ThresholdsPIs+CIs**

Column	Title	Contents
A	Decision tree page	Name of the page in file **03-DecisionTree_12-09-26.vsd** where the PI is used
B	Source	Origin of the PI, CI or Variable (table below)
C	Id	PI, CI or variable codification (consistant with IWA)
D	Name	Name of the PI, CI or Variable
E	Formula	Formula of the PI using CI or variables
F	Unit	Unit of the PI, CI or Variable
G	Order of magnitude	Range in which values are commonly (but not always!)
H	Threshold "LOW"	Value considered to be the low threshold of the PI or CI (to fill)
I	Threshold "MEDIUM"	Value considered to be the low threshold of the PI or CI (to fill)
J	Threshold "HIGH"	Value considered to be the low threshold of the PI or CI (to fill)
K	Comments	Free comment, bibliographical reference or source when available

Source	Meaning
CI-IWA	Context Information from IWA [Alegre *et al.*, 2006]
PI-IWA	Performance Indicator from IWA [Alegre *et al.*, 2006]
V-IWA	Variable from IWA [Alegre *et al.*, 2006]
V-WAT	Variable from Waterloss project [Waterloss D3.2.2, 2012]
CI-DH	Context Information from DH
PI-DH	Performance Indicator from DH

File **02-ThresholdsQuestionnaire_12-09-26.xls** includes also sheet **PPsValues** which includes all the variables, CIs and PIs used for the procedure, the values provided by partners and PIs calculations.

Alegre H., Baptista J.M., Cabrera E., Cubillo F., Duarte P., Hirner W., Merkel W. and Parena R. (2006). Performance Indicators for Water Supply Services, 2nd Edition. Manual of Best Practice, IWA Publishing. 289p.

Waterloss : Management of water losses in a drinking water supply system, D3.2.2: Group of appropriate performance indicators adapted to regional conditions. (2012), Project report 185p.

Annex 10

Answers of Waterloss project partners at DH questionnaire on thresholds

1. Answer of PO : Argelès-sur-Mer
2. Answer of AMB : Castellbisbal

PO

Decision tree page	Source	Id	Name	Formula	Unit	Order of magnitude	Threshold "LOW"	Threshold "MEDIUM"	Threshold "HIGH"	Comments
1-Start	PI-IWA	**Fi46**	Non-revenue water by volume	Fi46=(A21/A3)*100	%	(10-60)	0	20,2		
1-Start	PI-DH	**Fi53**	Unbilled annual consumption per system input volume	Fi53=(A13/A3)*100	%	(0-50)	0	0,3		
1-Start	PI-IWA	**Op26**	Apparent losses per system input volume	Op26=A18/A3	%	(0-50)	0	1,3		
1-Start	PI-IWA	**Op27**	Real losses per connection	Op27=[(A19*1000)/(C24*H2)/24	L/connection/day when system is pressurised	(50-1000)	0	163		
1-Start	PI-IWA	**Op28**	Real losses per mains length	Op28=[(A19*1000)/(C8*H2)/24	L/km/day when system is pressurised	(500-50000)		7413		
3A-Real Losses	PI-IWA	**Op29**	Infrastructure Leakage Index (ILI)	Op29=Op27/(18*C8+0,8+0,025*C25)/(D34/10)	Adimensional	(1-20)	1		16	
3A-Real Losses	PI-DH	**Op69**	Pressure management index (PMI)	Op69=D34/CI16	Adimensional	(1-5)		1,2		
3A2-Asset management	PI-IWA	**Op32**	Service connection failures	Op32=[(D29*365)/H1/C24]*1000	No./1000 connections / year	(2-20)	0	4,6		
3A2-Asset management	PI-IWA	**Op31**	Mains failures	Op31=[(D28*365)/H1/C8]*100	No./100km/year	(5-50)	0	22,8		
3A2Sc-Service connections	CI-IWA	**CI59**	Lead service connections	CI59=CI59	%	(0-100)				
3A2Sc-Service connections	PI-IWA	**Op20**	Service connection rehabilitation	Op20=[(D24*365)/H1/C24]*100	% / year	(0.5-10)		10		
3A2M-Mains	CI-IWA	**CI39**	Ferrous mains without adequate corrosion protection, as proportion of total ferrous mains	CI39=CI39	%	(0-80)				
3A2M-Mains	PI-IWA	**Op16**	Mains rehabilitation	Op16=[(D20*365)/H1/C8]*100	% / year	(0.2-2)		0,4		
3A3-Active Leakage Control	CI-DH	**CI101**	Size of the largest DMA	CI101=CI101	connections	(300-10000)				
3A3-Active Leakage Control	PI-IWA	**Op5**	Active leakage control repairs	Op5=[(D10*365)/H1/C8]*100	No./100km/year	(5-50)		43,45		
3A3-Active Leakage Control	PI-IWA	**Op4**	Leakage control	Op4=[(D9*365)/H1/C8]*100	% / year	(0-50)		70	100	
3A3-Active Leakage Control	CI-IWA	**CI78**	Population density	CI78=CI78	person/km2	(5-5000)		171,75		
3A3-Active Leakage Control	PI-DH	**Op70**	% of ferrous mains as proportion of mains length	Op70=((CI36 + CI37 + CI38)/C8)*100	%	(0-100)				
3A4-Speed &Q of repairs	PI-IWA	**Ph8**	Valve density	Ph8=C22/C9	No./km	(1-10)				
3B-Apparent losses	PI-DH	**Op71**	Unauthorised consumption per system input volume	Op71=(A16/A3)*100	%	(0-50)	0	0,1		
3B-Apparent losses	PI-DH	**Op72**	Metering inaccuracies water losses per system input volume	Op72=(A17/A3)*100	%	(1-20)	2,5	1,2	21,1	Study results from Water agency
3B1-Unauthorised consumption	PI-IWA	**Op3**	Network inspection	Op3=[(D8*365)/H1/C8]*100	% / year	(0-50)		43,45	100	
3B1-Unauthorised consumption	PI-IWA	**Op6**	Hydrant inspection	Op6=[(D11*365)/H1]/C23	/ year	(0-1)	0	1	1	
3B2-Metering inaccuracies waterlosses	PI-IWA	**Op8**	Meter replacement	Op8=[(D45*365)/H1]/E6	/ year	(0.05-0.1)		0,1		National average- recommandations
3B2-Metering inaccuracies waterlosses	PI-DH	**Op73**	% of residential meters aged more than 10 years	Op73=((E7-(C28+C29))/E7)*100	%	(10-50)	0	30		
3B2-Metering inaccuracies waterlosses	PI-DH	**Op74**	% of service connection supplying roof tanks	Op74=(C26/C24)*100	%	(0-100)		0		
3B2-Metering inaccuracies waterlosses	PI-IWA	**Op36**	Customer reading efficiency	Op36=[(D42*365)/H1]/(E7*D39+E8*D40+E9*D41)	Adimensional	(0.7-1)				
3B2-Metering inaccuracies waterlosses	PI-IWA	**Op38**	Operational meters	Op38=(D44/E6)*100	%	(80-100)		100	100	
3C-Unbilled authorized consumption	PI-DH	**Op75**	Unbilled unmetered consumption per system input volume (%)	Op75=(A11/A3)*100	%	(0-50)		0		
3C-Unbilled authorized consumption	CI-IWA	**CI91**	Daily minimum air temperature	CI91=CI91	°C	(-20-10)				
3C-Unbilled authorized consumption	PI-IWA	**Ph9**	Hydrant density	Ph9=C23/C9	No./km	(1-10)		2		
3C-Unbilled authorized consumption	PI-IWA	**Op2**	Storage tank cleaning	Op2=[(D7*365)/H1]/C2	/ year	(0.5-1)		1		
3C-Unbilled authorized consumption	PI-DH	**Op76**	Annual flushing volume per kilometre of distribution main	Op76=[(CI102*365)/H1]/C9	m3/km/year	(0.5-200)		10		

AMB

Decision tree page	Source	Id	Name	Formula	Unit	Order of magnitude	Threshold "LOW"	Threshold "MEDIUM"	Threshold "HIGH"
1-Start	PI-IWA	**Fi46**	Non-revenue water by volume	Fi46=(A21/A3)*100	%	(10-60)	x		
1-Start	PI-DH	**Fi53**	Unbilled annual consumption per system input volume	Fi53=(A13/A3)*100	%	(0-50)	x		
1-Start	PI-IWA	**Op26**	Apparent losses per system input volume	Op26=A18/A3	%	(0-50)	x		
1-Start	PI-IWA	**Op27**	Real losses per connection	Op27=[(A19*1000)/(C24*H2)/24	L/connection/day when system is pressurised	(50-1000)	x		
1-Start	PI-IWA	**Op28**	Real losses per mains length	Op28=[(A19*1000)/(C8*H2)/24	L/km/day when system is pressurised	(500-50000)	x		
3A-Real Losses	PI-IWA	**Op29**	Infrastructure Leakage Index (ILI)	Op29=Op27/(18*C8+0,8+0,025*C25)/(D34/10)	Adimensional	(1-20)	x		
3A-Real Losses	PI-DH	**Op69**	Pressure management index (PMI)	Op69=D34/CI16	Adimensional	(1-5)	x		
3A2-Asset management	PI-IWA	**Op32**	Service connection failures	Op32=[(D29*365)/H1/C24]*1000	No./1000 connections / year	(2-20)		x	
3A2-Asset management	PI-IWA	**Op31**	Mains failures	Op31=[(D28*365)/H1/C8]*100	No./100km/year	(5-50)		x	
3A2Sc-Service connections	CI-IWA	**CI59**	Lead service connections	CI59=CI59	%	(0-100)		x	
3A2Sc-Service connections	PI-IWA	**Op20**	Service connection rehabilitation	Op20=[(D24*365)/H1/C24]*100	% / year	(0.5-10)	x		
3A2M-Mains	CI-IWA	**CI39**	Ferrous mains without adequate corrosion protection, as proportion of total ferrous mains	CI39=CI39	%	(0-80)			
3A2M-Mains	PI-IWA	**Op16**	Mains rehabilitation	Op16=[(D20*365)/H1/C8]*100	% / year	(0.2-2)			
3A3-Active Leakage Control	CI-DH	**CI101**	Size of the largest DMA	CI101=CI101	connections	(300-10000)			
3A3-Active Leakage Control	PI-IWA	**Op5**	Active leakage control repairs	Op5=[(D10*365)/H1/C8]*100	No./100km/year	(5-50)			
3A3-Active Leakage Control	PI-IWA	**Op4**	Leakage control	Op4=[(D9*365)/H1/C8]*100	% / year	(0-50)			
3A3-Active Leakage Control	CI-IWA	**CI78**	Population density	CI78=CI78	person/km2	(5-5000)	x		
3A3-Active Leakage Control	PI-DH	**Op70**	% of ferrous mains as proportion of mains length	Op70=((CI36 + CI37 + CI38)/C8)*100	%	(0-100)			
3A4-Speed &Q of repairs	PI-IWA	**Ph8**	Valve density	Ph8=C22/C9	No./km	(1-10)		x	
3B-Apparent losses	PI-DH	**Op71**	Unauthorised consumption per system input volume	Op71=(A16/A3)*100	%	(0-50)	x		
3B-Apparent losses	PI-DH	**Op72**	Metering inaccuracies water losses per system input volume	Op72=(A17/A3)*100	%	(1-20)	x		
3B1-Unauthorised consumption	PI-IWA	**Op3**	Network inspection	Op3=[(D8*365)/H1/C8]*100	% / year	(0-50)			
3B1-Unauthorised consumption	PI-IWA	**Op6**	Hydrant inspection	Op6=[(D11*365)/H1]/C23	/ year	(0-1)	x		
3B2-Metering inaccuracies	PI-IWA	**Op8**	Meter replacement	Op8=[(D45*365)/H1]/E6	/ year	(0.05-0.1)	x		
3B2-Metering inaccuracies	PI-DH	**Op73**	% of residential meters aged more than 10 years	Op73=((E7-(C28+C29))/E7)*100	%	(10-50)		x	
3B2-Metering inaccuracies	PI-DH	**Op74**	% of service connection supplying roof tanks	Op74=(C26/C24)*100	%	(0-100)			
3B2-Metering inaccuracies	PI-IWA	**Op36**	Customer reading efficiency	Op36=[(D42*365)/H1]/(E7*D39+E8*D40+E9*D41)	Adimensional	(0.7-1)		x	
3B2-Metering inaccuracies	PI-IWA	**Op38**	Operational meters	Op38=(D44/E6)*100	%	(80-100)	x		
3C-Unbilled authorized	PI-DH	**Op75**	Unbilled unmetered consumption per system input volume (%)	Op75=(A11/A3)*100	%	(0-50)	x		
3C-Unbilled authorized	CI-IWA	**CI91**	Daily minimum air temperature	CI91=CI91	°C	(-20-10)			
3C-Unbilled authorized	PI-IWA	**Ph9**	Hydrant density	Ph9=C23/C9	No./km	(1-10)	x		
3C-Unbilled authorized	PI-IWA	**Op2**	Storage tank cleaning	Op2=[(D7*365)/H1]/C2	/ year	(0.5-1)	x		
3C-Unbilled authorized	PI-DH	**Op76**	Annual flushing volume per kilometre of distribution main	Op76=[(CI102*365)/H1]/C9	m3/km/year	(0.5-200)			

Source	ID	Name	Formula	Unit	AMB Castellbisbal	DH SIE Lodève	WBN Nicosia	PO Argelès-sur-Mer	LG Melito di Napoli	DEYAK Kozani	*Order of magnitude*
		Year of the assessment period		Year	2010	2010	2010	2010	2010	2010	
V-IWA	**A3**	System Input Volume		m3/year	2 445 454	1 436 640	23 838 611	2 123 191	4 193 300	5 688 642	
V-IWA	**A8**	Billed metered consumption		m3/year	2 194 336	557 134	14 467 783	1 695 092	2 658 000	2 369 301	
V-IWA	**A9**	Billed non-metered consumption		m3/year	0	0	13310	0	0	0	
V-IWA	**A11**	Unbilled metered consumption		m3/year	0	0	1490	0	0	0	
V-IWA	**A12**	Unbilled non-metered consumption		m3/year	9 782	3 000	6 760	7 160	10 483	113 773	
V-IWA	**A16**	Unauthorised consumption		m3/year	9 782	2 000	103 570	2 260	10 483	56 886	
V-IWA	**A17**	Metering inaccuracies = Meter under-registration and data handling error		m3/year	29 345	6 025	414 290	26 350	41 933	236 930	
V-IWA	**H2**	Time system is pressurised		Hours in a year	**8 760**	**8 760**	8 760	**8 760**	**8 760**	**8 760**	*(6000-8760)*
V-IWA	**C24**	Service connexions		No	3 531	3 655	64 000	6 581	4 100	9 150	
V-IWA	**C8**	Main Length		km	143	110	1 250	145	65	130	
PI-IWA	**Fi46**	Non-revenue water by volume	(A3-A8-A9)/A3x100	%	10,3	61,2	39,3	20,2	36,6	58,4	*(10-60)*
PI-DH	**Fi53**	Unbilled annual consumption per system input volume	(A11+A12)/A3x100	%	0,4	0,2	0,0	0,3	0,2	2,0	*(0-50)*
PI-IWA	**Op26**	Apparent losses per system input volume	(A16+A17)/A3x100	%	1,6	0,6	2,2	1,3	1,2	5,2	*(0-50)*
PI-IWA	**Op27**	Real losses per connection	(A3-A8-A9-A11-A12-A16-A17)x1000/(C24xH2/24)	L/connection/day when system is pressurised	157	651	378	163	984	872	*(50-1000)*
PI-IWA	**Op28**	Real losses per mains length	(A3-A8-A9-A11-A12-A16-A17)x1000/(C8xH2/24)	L/km/day when system is pressurised	3 874	21 631	19 357	7 413	62 061	61 562	*(500-50000)*
V-IWA	**C8**	Main Length		km	143	110	1250	145	65	129,58	
V-IWA	**C24**	Service connexions		No	3 531	3 655	64 000	6 581	4 100	9 150	
VAR IWA	**C25**	Average service connexion length		m	2	?	6,0	?	7,3	6,0	*(2-20)*
VAR IWA	**D34**	Average Operating pressure		kPa	550	**350**	**350**	300	200	**405**	*(100-1000)*
CI-IWA	**CI16**	Minimum service pressure (standards)		kPa	250	300	200	250	200	?	*(50-300)*
PI-IWA	**Op29**	Infrastructure Leakage Index (ILI)	Op27/(18xC8/C24+0.8+0.025xC25)/(D34/10)	Adimensional	1,8	#VALEUR!	8,3	#VALEUR!	38,8	17,9	*(1-20)*

PI-DH	**Op69**	Pressure management Index (PMI)	D34/CI16	Adimensional	2,2	1,2	1,8	1,2	1,0	#VALEUR!	*(1-5)*
V-IWA	**C24**	Service connexions		No	3 531	3 655	64 000	6 581	4 100	9 150	
V-IWA	**C8**	Main Length		km	143	110	1250	145	65	129,58	
V-IWA	**H1**	Assessment period		Days	365	365	365	365	180	365	*(90-365)*
V-IWA	**D29**	Service connection failures		No	164	?	904	30	88	?	
V-IWA	**D28**	Mains failures		No	53	?	5839	33	60	?	
PI-IWA	**Op32**	Service connection failures	(D29x365/H1)/C24x1000	No./1000 connections / year	46,4	#VALEUR!	14,1	4,6	43,5	#VALEUR!	*(2-20)*
PI-IWA	**Op31**	Mains failures	(D28x365/H1)/C8x100	No./100 km/year	37,1	#VALEUR!	467,1	22,8	187,2	#VALEUR!	*(5-50)*
V-IWA	**H1**	Assessment period		Days	365	365	365	365	180	365	
V-IWA	**C24**	Service connexions		No	3531	3655	64000	6581	4100	9150	
CI-IWA	**CI59**	Lead service connections		%	39	?	?	?	?	?	*(0-100)*
V-IWA	**D24**	Service connection rehabilitation		No	12	141	?	9	102	?	
CI-IWA	**CI59**	Lead service connections	CI59	%	39,0	?	?	?	?	?	*(0-100)*
PI-IWA	**Op20**	Service connection rehabilitation	(D24x365)/H1/C24x100	% / year	0,3	3,9	#VALEUR!	0,1	5,0	#VALEUR!	*(0.5-10)*
V-IWA	**H1**	Assessment period		Days	365	365	365	365	180	365	
V-IWA	**C8**	Main Length		km	143	110	1250	145	65	129,584	
CI-IWA	**CI39**	Ferrous mains without adequate corrosion protection, as proportion of total ferrous mains		%	?	?	?	?	?	?	*(0-100)*
V-IWA	**D20**	Mains rehabilitation		km	0	?	?	**0,616**	?	?	
CI-IWA	**CI39**	Ferrous mains without adequate corrosion protection, as proportion of total ferrous mains	CI39	%	?	?	?	?	?	?	*(0-80)*
PI-IWA	**Op16**	Mains rehabilitation	[(D20 x 365)/H1/C8]x100	% / year	0,0	#VALEUR!	#VALEUR!	0,4	#VALEUR!	#VALEUR!	*(0.2-2)*
V-IWA	**H1**	Assessment period		Days	365	365	365	365	180	365	
V-IWA	**C8**	Main Length		km	143	110	1250	145	65	130	
CI-DH	**CI101**	Size of the largest DMA		No. of service connection	?	?	?	?	?	?	

V-IWA	**D10**	Leaks repaired due to active leakage control		No	0	?	864	63	15	?	
V-IWA	**D9**	Leakage control		km	0,00	13,73	470,00	101,50	40,00	?	
CI-DH	**CI101**	Size of the largest DMA	CI101	connections	?	?	?	?	?	?	*(300-10000)*
PI-IWA	**Op5**	Active leakage control repairs	D10x365/H1/C8x100	No./100km/year	0,00	#VALEUR!	69,12	43,45	46,79	#VALEUR!	*(5-50)*
PI-IWA	**Op4**	Leakage control	D9x365/H1/C8x100	% / year	0,0	12,5	37,6	70,0	124,8	#VALEUR!	*(0-50)*
V-IWA	**C8**	Main Length		km	143	110	1250	145	65	129,584	
CI-IWA	**CI78**	Population density		person/km2	**394,29**	**0,14**	84,00	**171,75**	**9 249,33**	**130,04**	*(10-10000)*
CI-IWA	**CI36**	Gray cast iron mains		%	?	?	?	?	?	?	*(0-100)*
CI-IWA	**CI37**	Ductile iron mains		%	?	?	?	?	?	?	*(0-100)*
CI-IWA	**CI38**	Stell mains		%	?	?	?	?	?	?	*(0-100)*
CI-IWA	**CI78**	Population density	CI78	person/km2	394,29	0,14	84,00	171,75	9 249,33	130,04	*(5-5000)*
PI-DH	**Op70**	% of ferrous mains as proportion of mains length	((CI36+CI37+CI38)/C8)x100	%	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	*(0-100)*
V-IWA	**C22**	Isolating valves		No	1 012,0	?	?	654,0	?	?	
V-IWA	**C9**	Distribution mains length		km	131,0	?	?	?	?	?	
PI-IWA	**Ph8**	Valve density	C22/C9	No./km	7,7	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	*(1-10)*
V-IWA	**A3**	System Input Volume		m3/year	2 445 454	1 436 640	23 838 611	2 123 191	4 193 300	5 688 642	
V-IWA	**A16**	Unauthorised consumption		m3/year	9 782	2 000	103 570	2 260	10 483	56 886	
V-IWA	**A17**	Metering inaccuracies = Meter under-registration and data handling error		m3/year	29 345	6 025	414 290	26 350	41 933	236 930	
PI-DH	**Op71**	Unauthorised consumption per system input volume	(A16/A3)x100	%	0,4	0,1	0,4	0,1	0,2	1,0	*(0-50)*
PI-DH	**Op72**	Metering inaccuracies water losses per system input volume	(A17/A3)x100	%	1,2	0,4	1,7	1,2	1,0	4,2	*(1-20)*
V-IWA	**H1**	Assessment period		Days	365	365	365	365	180	365	
V-IWA	**C8**	Main Length		km	143	110	1250	145	65	129,58	
V-IWA	**D8**	Network inspection		km	0,0	?	?	?	40,0	?	

V-IWA	**D11**	Hydrant inspection		No	108,0	?	2 000,0	247,0	11,0	?	
V-IWA	**C23**	Hydrants		No	108,0	?	3 531,0	247,0	23,0	?	
PI-IWA	**Op3**	Network inspection	D8x365/H1/C8x100	% / year	0,0	#VALEUR!	#VALEUR!	#VALEUR!	124,8	#VALEUR!	*(0-50)*
PI-IWA	**Op6**	Hydrant inspection	D11x365/H1/C23	/ year	1,00	#VALEUR!	0,57	1,00	0,97	#VALEUR!	*(0-1)*
V-IWA	**H1**	Assessment period		Days	365	365	365	365	180	365	
V-IWA	**C24**	Service connexions		No	3 531	3 655	64 000	6 581	4 100	9 150	
V-IWA	**D45**	Meter replacement		No	267,0	?	3 400,0	524,0	103,0	?	
V-IWA	**E6**	Direct customer meters		No	5 759,0	?	?	?	?	?	
V-IWA	**E7**	Residential customer meters		No	5 416,0	?	?	?	?	?	
V-WAT	**C28**	Domestic water meters aged less than 5 years		No	?	?	?	?	?	?	
V-WAT	**C29**	Domestic water meters aged between 5 -10 years old		No	?	?	?	?	?	?	
V-WAT	**C26**	Roof tanks number		No	18	10	107 613	0	?	?	
V-IWA	**D39**	Residential customer meter reading frequency		No/meter/year	6,0	?	?	?	?	?	*(1-12)*
V-IWA	**D40**	Industrial customer meter reading frequency		No/meter/year	12,0	?	?	?	?	?	*(1-12)*
V-IWA	**D41**	Bulk customer meter reading frequency		No/meter/year	0,0	?	?	?	?	?	*(1-12)*
V-IWA	**D42**	Customer meter readings		No	35 478,0	?	?	?	?	?	
V-IWA	**E8**	Industrial customer meters		No	5 759,0	?	?	?	?	?	
V-IWA	**E9**	Bulk customer meters		No	0,0	6,0	112,0	?	6,0	?	
V-IWA	**D44**	Operational meters		No	5 759,0	?	?	?	?	?	
PI-IWA	**Op8**	Meter replacement	D45x365/H1/E6	/ year	0,05	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	*(0.05-0.1)*
PI-DH	**Op73**	% of residential meters aged more than 10 years	(E7-C28-C29)/E7)x100	%	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	*(10-50)*
PI-DH	**Op74**	% of service connection supplying roof tanks	C26/C24x100	%	0,5	0,3	168,1	0,0	#VALEUR!	#VALEUR!	*(0-100)*
PI-IWA	**Op36**	Customer reading efficiency	D42x365/H1/(E7xD39+E8 xD40+E9xD41)	Adimensional	0,35	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	*(0.7-1)*

PI-IWA	**Op38**	Operational meters	D44/E6x100	%	100,0	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	*(80-100)*
V-IWA	**A11**	Unbilled metered consumption		m3/year	0	0	1490	0	0	0	
V-IWA	**A3**	System Input Volume		m3/year	2 445 454	1 436 640	23 838 611	2 123 191	4 193 300	5 688 642	
V-IWA	**H1**	Assessment period		Days	365	365	365	365	180	365	
V-IWA	**C23**	Hydrants		No	108	?	3531	247	23	?	
V-IWA	**C9**	Distribution mains length		km	131	?	?	?	?	?	
CI-IWA	**CI91**	Daily minimum air temperature		°C	?	?	?	?	?	?	*(-20-10)*
V-IWA	**D7**	Storage tank cleaning		m3	352	?	?	1375	?	?	
V-IWA	**C2**	Treated water storage capacity		m3	7 848,0	?	?	?	?	?	
CI-DH	**CI102**	Flushing volume during the assessment period		m3	?	?	?	?	?	?	
PI-DH	**Op75**	Unbilled unmetered consumption per system input volume (%)	(A11/A3)x100	%	0,0	0,0	0,0	0,0	0,0	0,0	*(0-50)*
CI-IWA	**CI91**	Daily minimum air temperature	CI91	°C	?	?	?	?	?	?	*(-20-10)*
PI-IWA	**Ph9**	Hydrant density	C23/C9	No./km	0,82	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	*(1-10)*
PI-IWA	**Op2**	Storage tank cleaning	D7x365/H1/C2	/ year	0,04	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	*(0.5-1)*
PI-DH	**Op76**	Annual flushing volume per kilometre of distribution main	CI102x365/H1/C9	m3/km/year	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	*(0.5-200)*