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A.S.A.P.

Actions for Systemic Aquifer Protection

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Value for Money – ASAP versus alternative approaches Perspective Evaluation Report

Actions for Systemic Aquifer Protection - Implementation and demonstration of a Protocol to scale down groundwater vulnerability to pollution due to overexploitation

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Thanks

This report is the result of the job of the A.S.A.P. Project Team.

Thanks to all those people who have offered their support in the difficult task to analyze every matter and patiently they have discussed them.

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Purpose of this document

The principal purpose of the document is to quantify the economic benefit obtained with the A.S.A.P. project.

The selected evaluation method is of comparative nature with the analysis of two alternative situations: with and without the A.S.A.P. project.

Warnings

1. 1.The authors of this document have tried, where it was possible, to use a comprehensible language for readers of different origins and users with different finalities, avoiding, where it was possible, the use of specific or sector terms.

1 ==>VALUE FOR MONEY – A.S.A.P. VERSUS ALTERNATIVE APPROACHES – PERSPECTIVE EVALUATION REPORT

This report is one of the deliverable provided by the A.S.A.P. Project centred on the acquifer of Bientina (Pisa, IT). In particular, this comparative analysis is in relationship with the *Task 5.- Evaluation and validation of the A.S.A.P. Protocol*.

1.1 ==>AIMS

Aim of the present document is to quantify the "value for money" obtained with the A.S.A.P. project.

Value for Money is the term used to evaluate if it has been achieved or not the maximum benefit by the results obtained with the A.S.A.P. project as regard the resources which have been destined to it.

In order to decide if it is a good value for money they are also considered the whole of qualities, cost, resources consumption, congruity with the purpose, timeliness and convenience.

The value for money can be described in a simple way examining 3 elements:

1) inexpensiveness, that is to do less employing less resources, therefore to make savings

2) efficiency, that is to do what it was done before, but with less resources (money, people, space, etc.)

3) effectiveness, that is to do more than it was done before using the same resources (or less).

In order to define with attention the value characteristics they would be also considered those advantages (or damages) caused by the investment to others and for which it doesn't exist the correspondent.

They are the externalities, positive or negative, that are the project effects (positive or negative) which revert out of it (on the consumers for example).

The partnership has partially faced these thematic in **D5.5. - Effects on the environment: disadvantages and benefits**.

The evaluation method selected in this report is the comparative one of two alternative situations: a hypothesis which considers the scenery which would be verified without the realization of the Project and the other following the consequent effects to its execution.

The principal economic components which have been taken in consideration are substantially two, retained the most meaningful for the analysis: the energetic costs and those related to the necessity of retrieval of new resource through the construction of new wells.

1.2 ==>EXECUTION AND RESPONSIBILITIES

Acque Ingegneria (ACQING) is responsible of the report layout and of the analysis.

2 ==>CONSIDERATION ABOUT THE NET MIDDLE AGE

In general we can affirm that the good operation of an acqueductistic net is tied up to the pipelines maintenance state. Nets with an elevated level of degrade are mostly subjected to sudden breakups and they often are not immediately localized with inevitable repercussions on the furnished service to the users.

To the functional degrade of a net they contribute both temporal and of exercise factors. A quite old net results mostly sensitive to sudden variations of pressure which to the meantime they contribute to the mechanical aging of the pipelines and of the all present control systems. In order to guarantee a good level of efficiency it is necessary on one side to not submit the nets to sudden variations of pressure and on the other side to possess pipelines in optimal conditions of maintenance.

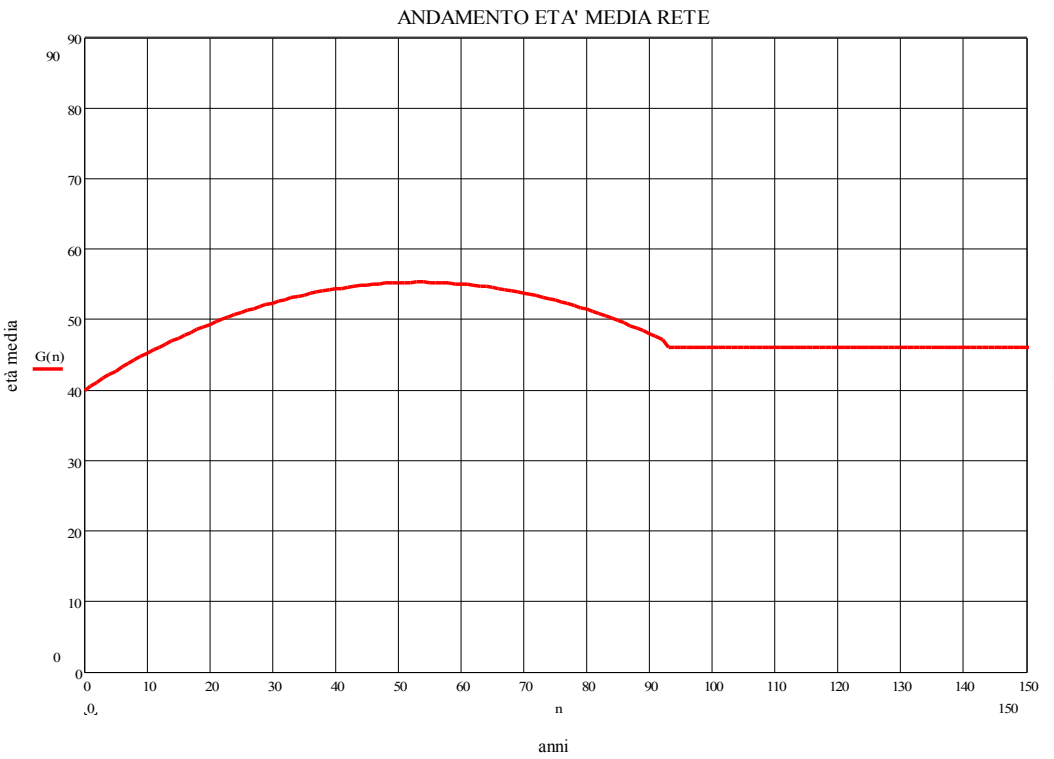
If we define with "middle age" of the net, the arithmetic average of the years in which every single line of pipeline has been in service, it is evident that, if the conditions to the contour remain unchanged, this parameter is greater, and it is greater the possibility to incur in sudden breakups and therefore in operation deficiencies not controllable.

Numerous studies but also the practical experience show that the course of the number of the breakups is proportional to the middle age of the pipelines (remaining constant the other operation conditions) according to a more linear law.

Possess “quite old” nets subjected to elevated pressures with frequent and sudden variations of load, it produces the appearance of breakups with a more and more elevated frequency. The acqueductistic system which belongs to the A.S.A.P. project includes totally around 860 km of distribution net, divided in a not uniform territory. Considering that they have been replaced around 9.3 Km of net a year and considering a 40 year-old initial middle age, it is possible to appraise the temporal course of the "middle " age of the net :

COMUNE	ANNO_MESSA_OP	KM
Bientina	2008	0.953
Bientina	2007	0.081
Calcinaia	2008	0.326
Calcinaia	2007	0.002
Cascina	2008	1.0156
Cascina	2007	3.223
Castelfranco di Sotto	2008	0.3943
Castelfranco di Sotto	2007	1.51
Castelfranco di Sotto	2006	0.01
Pontedera	2008	0.0477
Pontedera	2007	0.256
San Miniato	2008	4.23
San Miniato	2007	4.16
Santa Croce sull'Arno	2008	0.55362
Santa Croce sull'Arno	2007	0.093
Santa Maria a Monte	2008	3.8235
Santa Maria a Monte	2007	3.123
Vicopisano	2008	2.6682
Vicopisano	2007	1.301

Ill. 2.1: km of nets replaced on the A.S.A.P. project municipalities.



Ill. 2.2: Net middle age course substituting 9.25km/year

From the graph we can see how the system progressively goes growing old, reaching a point of equilibrium in which the "middle age" remains constant around 90 years from the beginning of the simulation.

Under such conditions, the elevated present pressures in association to the low mechanical efficiency of the pipelines would give origin to a progressive increase in the frequency of the breakups with elevated wastes of water resource and with consequent increase of the management costs.

In order to be able to contain the effects of the net structural degrade in absence of a suitable plain of pipelines substitution it is necessary to intervene both on the causes (high pressure with frequent jumps) and on the consequences (breakups) through a more rational and effective management.

The application of the A.S.A.P. protocol in its two principal components: search and reparation of hidden losses, districtualization and regulation of the pressure, it has allowed in comparison to the ordinary water net management, to reach a double result in a medium and brief term.

In the first case through the installation of special valves in opportune net points, it has been possible to regulate the pressure in the net at inferior values in comparison to the usual ones, generally excessive and not homogeneous, guaranteeing to the meantime the level of service to the users in terms of delivery pressure and water resource, such as it is verifiable by the billing course.

Possess pressure levels quite lower and regular it means to submit the pipelines to inferior mechanical solicitations, delaying the aging and the frequency with which their breakups are produced.

In the second case, considering that the outgoing course of a breakup is a not linear function of the applied load according to the following type of formula:

$$Q = K \; P^{\gamma}$$

where K and y are characteristic parameters of the net, the reduction of the load involves the reduction of the lost water volume in the environment.

To this volume it has to be added the one recovered through the systematic search and reparation of the hidden losses. The application of the A.S.A.P. protocol has therefore obtained an immediate diminution of the necessary quantity of water that has to be introduced in the net, guaranteeing at the same time the requirement.

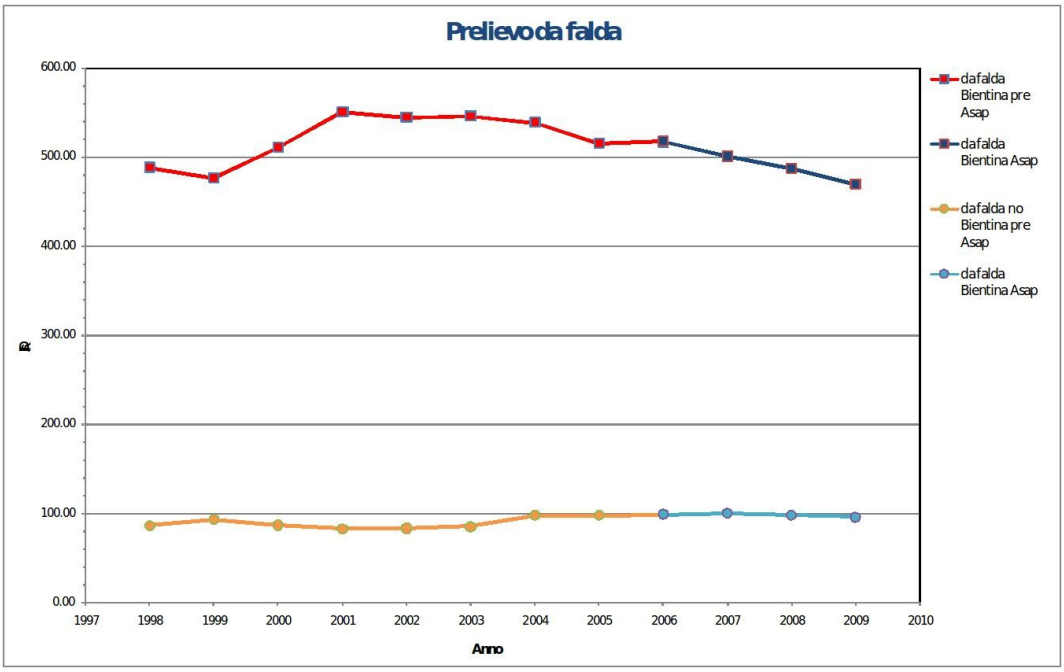
The water resource at disposition of the users which make part of the nine municipalities of the A.S.A.P. project, it exclusively comes from underground stratums for which it is necessary to have a wide system of capitation wells.

By the historical data brought in chart, it can be deduced as the Padule of Bientina stratum, object of the Project, represents the principal source of alimentation guaranteeing at medium the 85% of the annual water resource, while the rhyming percentage comes from other wells of smaller potentiality dispersed on the territory.

Prelievo medio annuo dalla falda					
anno	da falda Bientina l/s	fuori falda Bientina l/s	tot l/s	da falda Bientina %	fuori falda Bientina %
1998	488.03	86.49	574.53	84.95%	15.05%
1999	476.44	93.24	569.68	83.63%	16.37%
2000	510.70	86.94	597.64	85.45%	14.55%
2001	550.46	82.97	633.44	86.90%	13.10%
2002	544.56	83.49	628.05	86.71%	13.29%
2003	546.28	85.00	631.28	86.54%	13.46%
2004	538.73	98.14	636.87	84.59%	15.41%
2005	515.64	98.00	613.64	84.03%	15.97%
2006	517.03	99.04	616.07	83.92%	16.08%
2006	500.37	99.94	600.31	83.35%	16.65%
2007	486.78	97.96	584.74	83.25%	16.75%
2008	469.35	95.77	565.11	83.05%	16.95%
2009	480.81	95.41	576.23	83.44%	16.56%
			media=	**84.60%**	**15.40%**

Tab. 1: Stratum utilization report

From the data analysis, it emerges such as just with the pilot project of 2004 and then starting from the put in act of the A.S.A.P. project (2006) – the Bientina stratum collecting is progressively decreased while it has practically remained unchanged the one from the other wells. This is to point out that the management system adopted intervenes exclusively on the wastes of resource leaving the quality of the service unchanged.



Ill. 2.3: Water pumping from the Bientina Aquifer

3 ==>EVALUATION OF THE SMALLER ENERGETIC COSTS

The A.S.A.P. system is a closed system composed by more alimentation points, by reservoirs of remuneration and accumulation and by necessary numerous fittings of mechanical lifting to the direct alimentation of the nets and the correct operation of the adduction system.

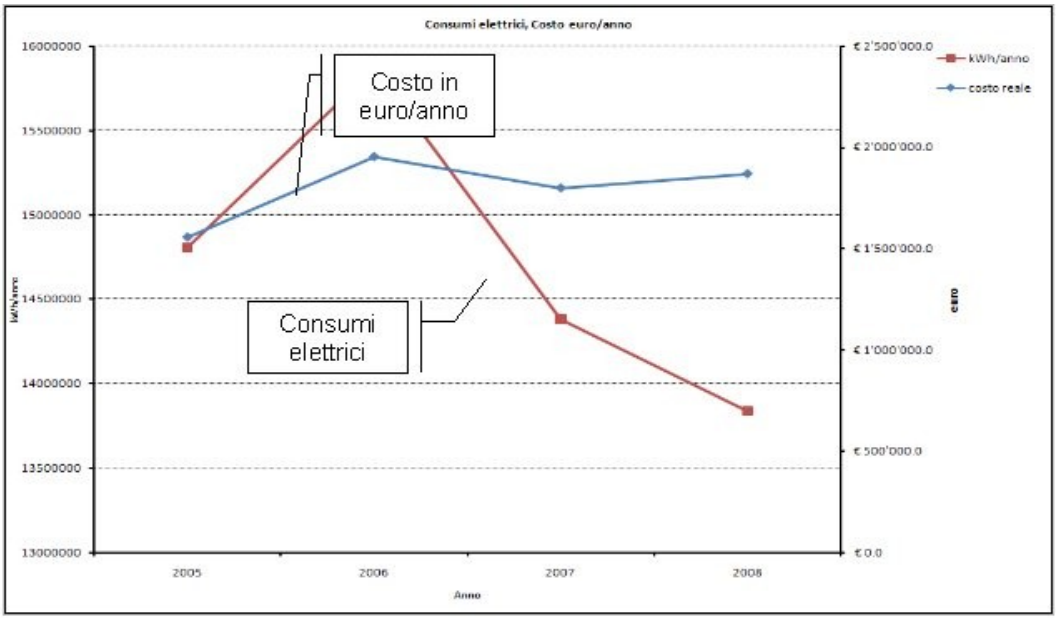
From the energetic point of view, the diminution of the resource that has to be introduced in the net involves a smaller use of the lifting systems, from the wells to the pushing pomp of the principal lifting plants, with an immediate saving on the electric energy consumption.

In the enclosure document **ENCL.1 – electric consumes table A.S.A.P. 2006 -2008** they are reported for single electric user the values of the consumed annual energy.

The synthesis of the three years project is the following one:

		CONSUMO ENERGIA 2006	CONSUMO ENERGIA 2007	CONSUMO ENERGIA 2008
	TOTALE (KWH/anno):	15868230	14379922	13835727
	VARIAZIONE % DEL CONSUMO RISPETTO AL 2006:	0.00	-9.38%	-12.81%
	COSTO MEDIO (euro/KWH):	0.123	0.125	0.135
1°SCENARIO	COSTO REALE (euro/anno):	€ 1'951'792.3	€ 1'797'490.3	€ 1'867'823.1
2°SCENARIO	COSTO CONSIDERNADO IL CONSUMO ELETTRICO 2006 (euro/anno):	€ 1'951'792.3	€ 1'983'528.8	€ 2'142'211.1
	DIFFERENZA TRA I DUE SCENARI (euro):	€ 0.0	€ 186'038.5	€ 274'387.9
	RISPARMIO COMULATO 07-08 (euro):	€ 460'426.41		

Ill. 3.1: Electric consumption and monetary cost



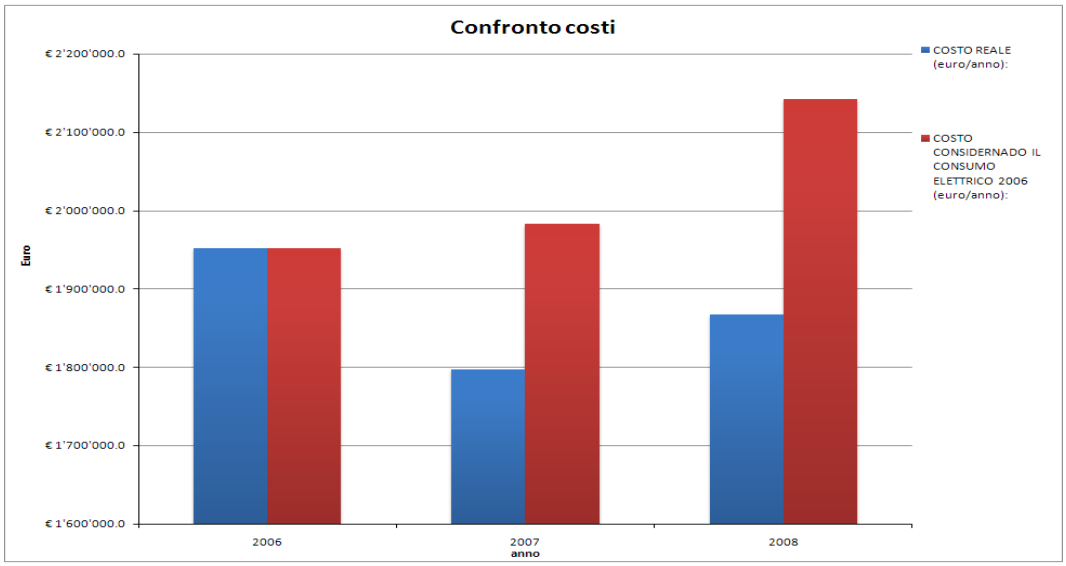
III. 3.2: Electric consumption A.S.A.P. peripherals, Euros cost/year

Considering also the previous year of the put in act of the A.S.A.P. project and taking as reference the year 2006, in the two following years the electric consumption in kWh / year has been of around the 9.38% and of the 12.81% inferior.

To this sudden diminution it has not corresponded an analogous reduction of the annual cost that, such as it is visible from the graph, has decreased in modest measure in the year 2007 and then it increases in 2008 attesting itself to similar values of the 2006 ones.

This kind of course is caused by the energy annual middle cost increase that in the three years monitored has passed from 0.123 € / 2006 kWh to 0.135 € / kWh of the 2008.

Then, in order to be able to quantify the economic saving accumulated in the years by the A.S.A.P. project, the actual scenery is compared with the one obtained considering the middle course of the energy price in € / real kWh, with the constant supposed electric consumption in the years 2007-2008 and analogous to the 2006 one.



Ill. 3.3: Lifting costs comparison

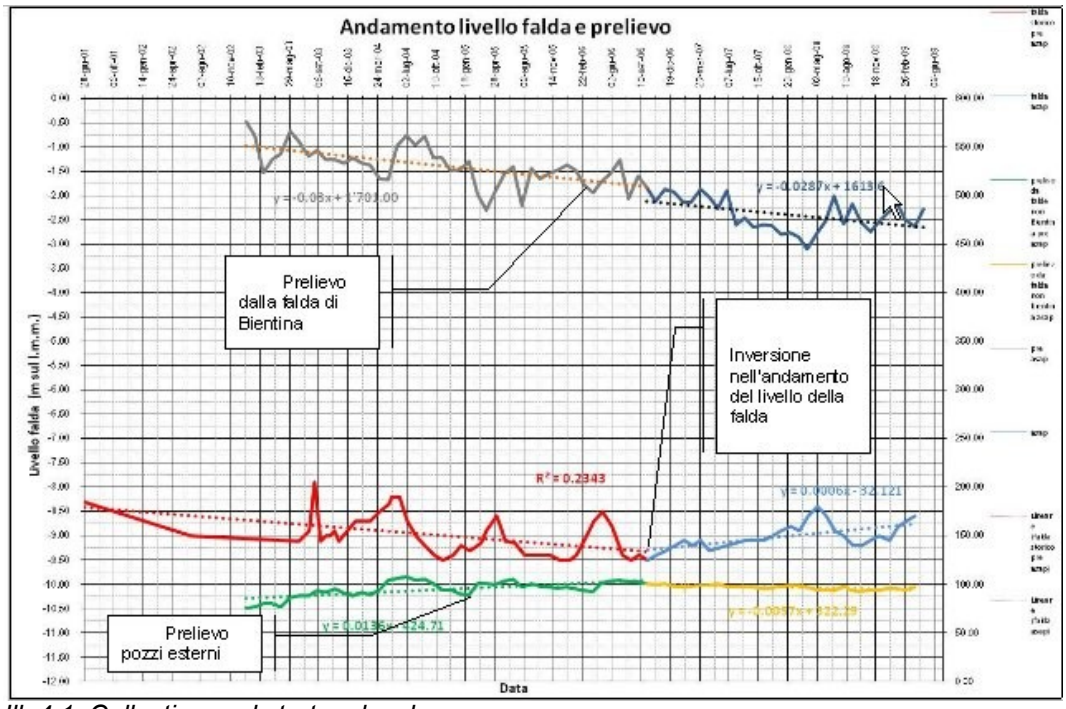
The obtainable annual saving is of € 186.038,5 in 2007 and of € 274.387,9 in 2008.

Altogether in the two years 2007-2008 the monetary deficit would have been quantifiable in around **460.000,00** €.

4 ==>EVALUATION OF THE SMALLER COSTS FOR A NEW RESOURCE RETRIEVAL

The other economic aspect joined to the water request diminution by the system is the not necessity to retrieve new resource that, given the lack of alternative sources, would be due to reach through the construction of new external wells to the Bientina stratum.

In order to be able to value the saving achieved in monetary terms, it is necessary to analyze the historical course of the Bientina stratum in relationship to the course withdrawn from it and from the one coming from the wells not directly alimented.



Ill. 4.1: Collecting and stratum level

The stratum level, obviously susceptible of the quantity of due recharge to the raininess, has progressively gone decreasing in the years up to the end of 2006 where the least value has been reached of -9.50 meters u.s.l.

In order to oppose the level lowering and the consequent subsistence increase, in the preceding period the beginning of A.S.A.P. it has been tried to diversify the provisioning sources building new wells external to the stratum in order to decrease the collecting from that.

However, the adopted management methodology has not demonstrated sufficient to reorganize the excessive exploitation of the stratum up to sustainable values from its potentialities.

The inversion of tendency in the level course has had after a further diminution of the collecting owed to the systematic application of the A.S.A.P. method on the nets of the interested municipalities, to forehead of a not increase of the collecting from the external wells.

In order to quantify economically the advantages brought by the nets management subsequently applied to 2006 it is necessary to compare the two separate methodologies of intervention.

With

- $\overline{Q}_{asap} = 479.95 \frac{l}{\sec}$, we indicate the annual medium course of the collecting from the Bientina stratum in the protocol application period, to which it corresponds an increase in the stratum level.
- $\overline{Q}_{pre-asap} = 529.96 \frac{l}{\sec}$ we indicate the annual medium course of the collecting from the Bientina stratum in the preceding period to the protocol application, to which it corresponds a diminution and worsening of the stratum level.

Continuing to manage the system with the traditional methodology and wanting to reduce the collecting from the Bientina stratum until analogous values to the ones obtained with the A.S.A.P. protocol application, necessaries to reach the inversion in the level course, it would have been necessary to retrieve $\overline{Q}_{pre-asap} - \overline{Q}_{asap} \quad 50.01 \frac{l}{\sec}$ for year, through the construction and the put in service of new wells.

Approximately, the ability of a well in the Bientina aquifer zone is valued in around 15 l/sec therefore it would have served around 3.33 wells more than the existing ones.

Considering that the initial expense for a well is of around $90.000 \frac{euro}{pozzo}$ the necessary general expense would have been of around:

$$3.33\,pozzi\ 90.000\ \frac{euro}{pozzo} = 300.069{,}00\ Euro$$

Considering both the saving hypotheses consequent to the realization of the A.S.A.P. project it results that in the three years of realization the achieved clean saving is of around **460.000,00 € +300.069,00 € =760.069,00 €**.

5 ==>INDEXES

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6 ==>ENCLOSURES

- ENCL. 1 - Electric consumptions A.S.A.P. 2006 -2008 table.

This document is available on the Internet at

http://www.klink.it/asap