Challenges in moving to 24/7 water supply in Aguas de Saltillo City, Mexico

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Challenges in moving to 24x7 water supply in Saltillo City, Mexico

Bath 18th July

Aguas de Saltillo

The City of Saltillo

The City of Saltillo

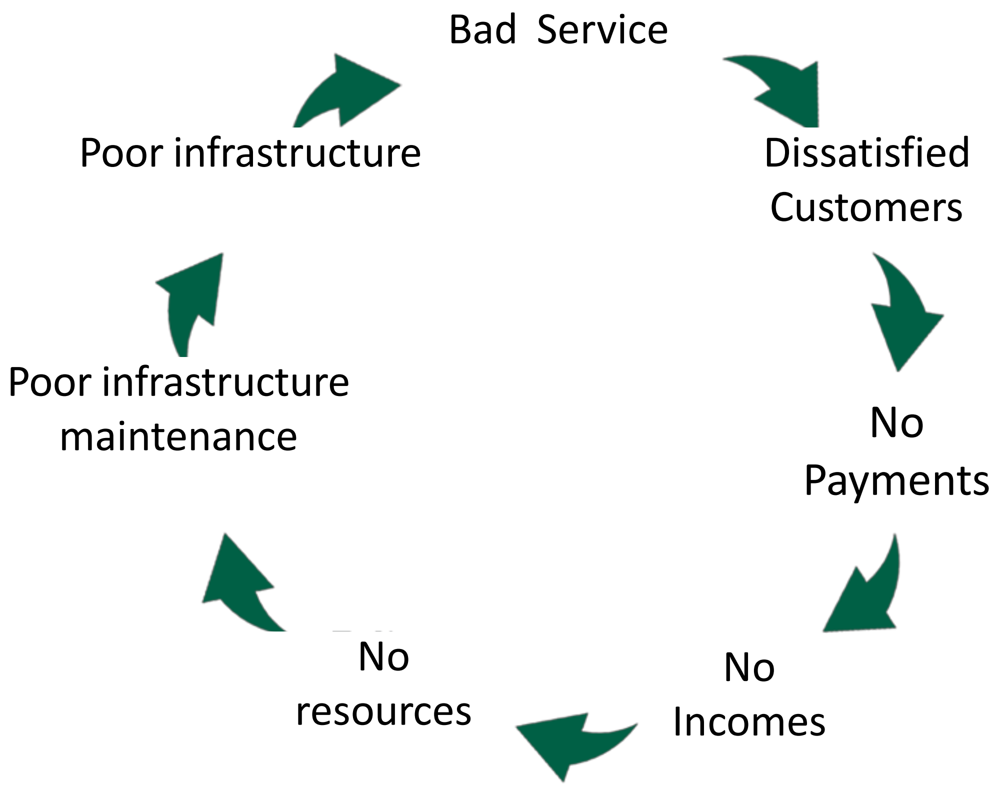
- 850,000 Inhabitants
- 1,600 meters above sea level
- Semi-arid climate – Chihuahuan Deserte
- Automotive-manufacturing cluster

Situation before 2001

Major Problems Faced in 2001

- The municipality-owned water supply company was not profitable
- Overexploited aquifers
- High **NRW** rate, **55%** of supplied water
- Little daily water supply coverage, less than 10% of the population had daily continuous supply
- Lack of technology and outdated management tools
- Lack of maintenance programs
- Well pumping stations needing hydraulic analysis studio.
- Outdated and poorly designed mechanical and electrical well pumping stations
- Outdated and deficient drinking water and sewer networks
- Poor quality materials used in domestic connections and secondary networks.

A Vicious Circle



Water supply perceived as the first municipal issue by the population

Creation of Aguas de Saltillo

"Aguas de Saltillo" was created in October 2001 under the **Public–Private Partnership** (**PPP**) scheme in order to solve the management problems.

Shareholders:

- **Municipality of Saltillo** (Public Partner)
- **AGBAR** (Private Partner). At present **SUEZ**.

Achievements to date

Aguas de Saltillo

- Service substantially improved. Best rated public service
- Sustainable aquifers management
- Generates profits for stockholders
- Energy efficient and well engineered pumps stations
- Leakage reduction
- Implementation of a preventive maintenance program
- Implementation of the Quality Management Standard ISO 9001:2008 and OHSAS 18000
- In process of implementation of the Quality Standard ISO 17025

	2001	2016	2017
% Registered water/input volume	46.00%	57.12%	60.00%
% time system is pressurized	10%	69%	73%
# Service Connections	142,326	244,195	249,389
% Prompt payment	65%	98.70%	98.70%

System Overview (Dec 16)

Aguas de Saltillo

Population	840,000
# Service Connections (main to 1st meter)	239,085
# Billed Properties (residential and non residential)	239,015
Bill Frecuency	monthly
% Metered Customers	100%
% Of customers with 24 H service	22.43%
Avg. Length of Underground Service Connection (m)	4.85
Length of Trunks Mains (Km)	103
Length of Distribution Mains (Km)	2,500.0
Avg. Operating Pressure (m)	30
% of time System is Pressurized	70.83
% of total mains subject to Active Pressure Management	25%

Av. time from location of mains leaks to shutoff or repair (Hours)	12	
Av. time from location of service connection leaks to shutoff or repair (Hours)	32	
Leaks on Mains (Number per 100Km/year)	50.9	
Leaks on Service Connections (Number per 1000 connections/year)	35.2	
% of System having active leakage control intervention each year	95	Focused mainly on Service Connections
Number of Water Treatment Plants	5	Chlorine addition
Water sources	Deep Wells	AVG 185 meters
Number of Wells	72	50 of them are non Urban Wells -> 91% of total production
Number of Pumping Stations	18	8% of total input volume (mainly operated by Gravity)
Number of distribution Reservoirs	110	

Aguas de Saltillo

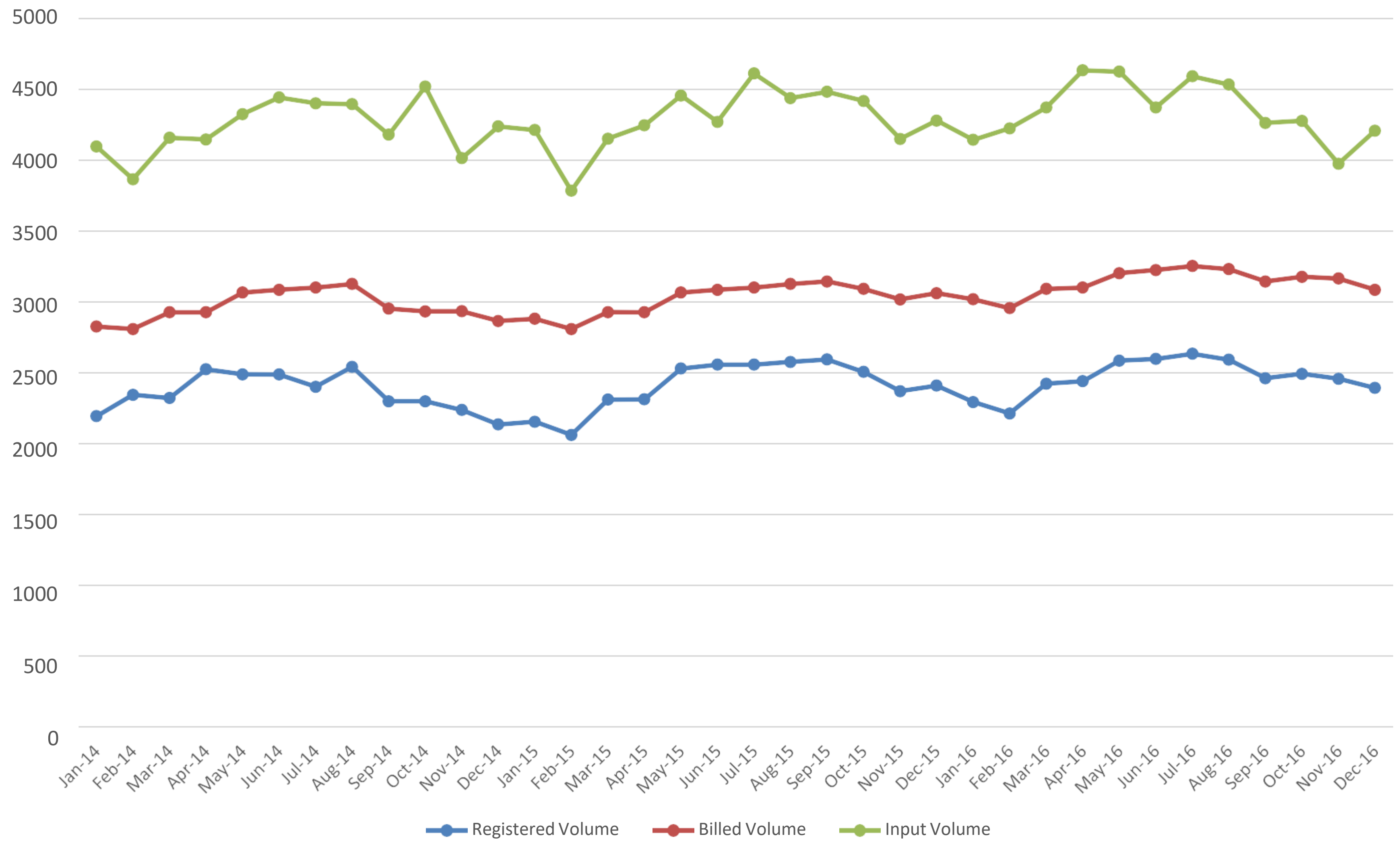
Production (m3/year)	51,502,671	
Energy Usage (Kwh/Year)	47,803,857	
Avg. unit cost of water resource (MXN/m3)	0.849	0.0388 Eur/m3 0.0412 USD/m3
Av. unit Cost of Production and Distribution	7	0.33 Eur/m3 0.35 USD/m3

Units in Mexican Pesos (MXP) —> 1UDS = 20.7MXP

AVG Registered Consumption (m3/customer/month) TOTAL	M3	10.6
AVG Registered Consumption (m3/customer/month) DOMESTIC	M3	9.7
AVG Registered Consumption (m3/customer/month) BIG CONSUMERS (>150 m3 /Month)	M3	383
AVG Billing Price ($= water&wastewater/m3 billed)	$/m3	10.3
AVG Billing Price DOMESTIC USERS ($= water&wastewater/m3 billed)	$ /m3	8.2
AVG Billing Price BIG CONSUMERS ($= water&wastewater/m3 billed)	$ /m3	35.2

Monthly input and registered volume 2014 to 2016

Thousands of m³



Domestic Water Meter Installation

Two Factors that increase the apparent losses

- Low flows due to roof storage tanks (almost 100% users)
- Inclined Domestic Water meters installation

  35% of users wrong installation

  97% single or multijet

Roof Tanks

Most of the buildings are single or two story houses

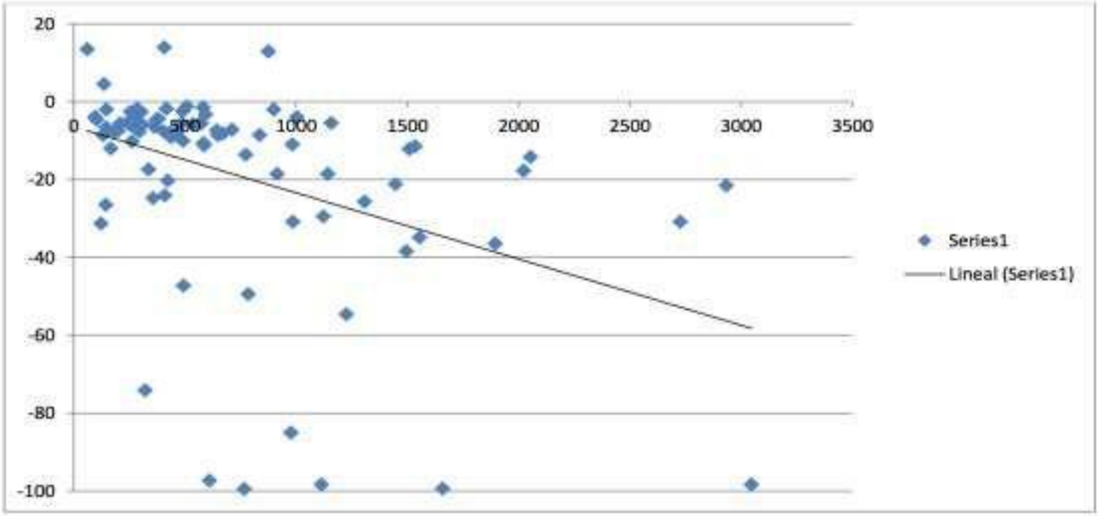
Ball Valves

Inlet typically 6 m above ground level
Tests show 25% undermetering

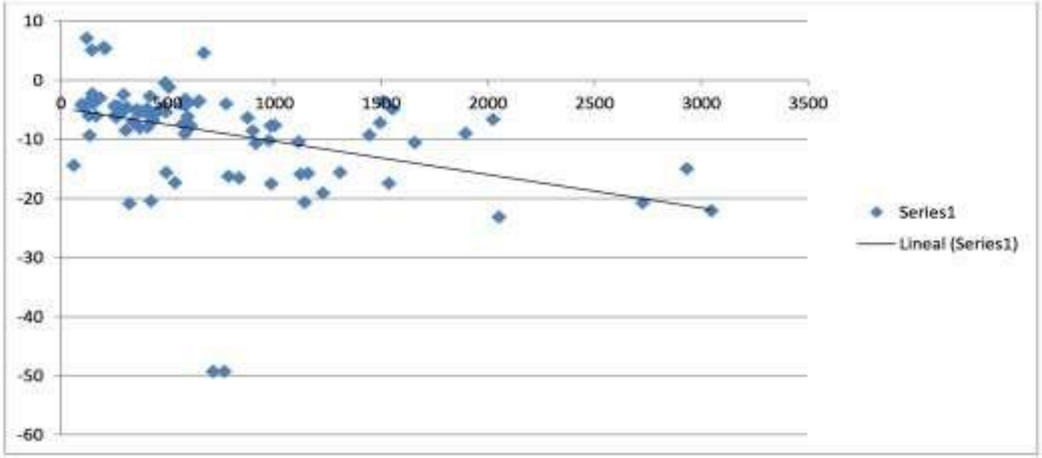
Assessing under metering

Agsal Domestic
Water Meter
Laboratory

Error Tests

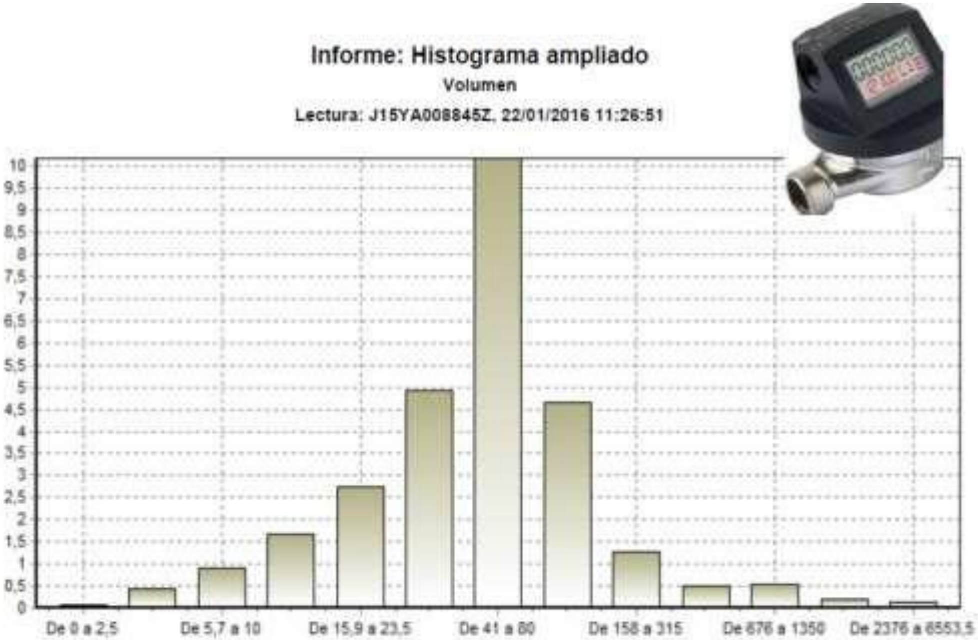


30 l/h

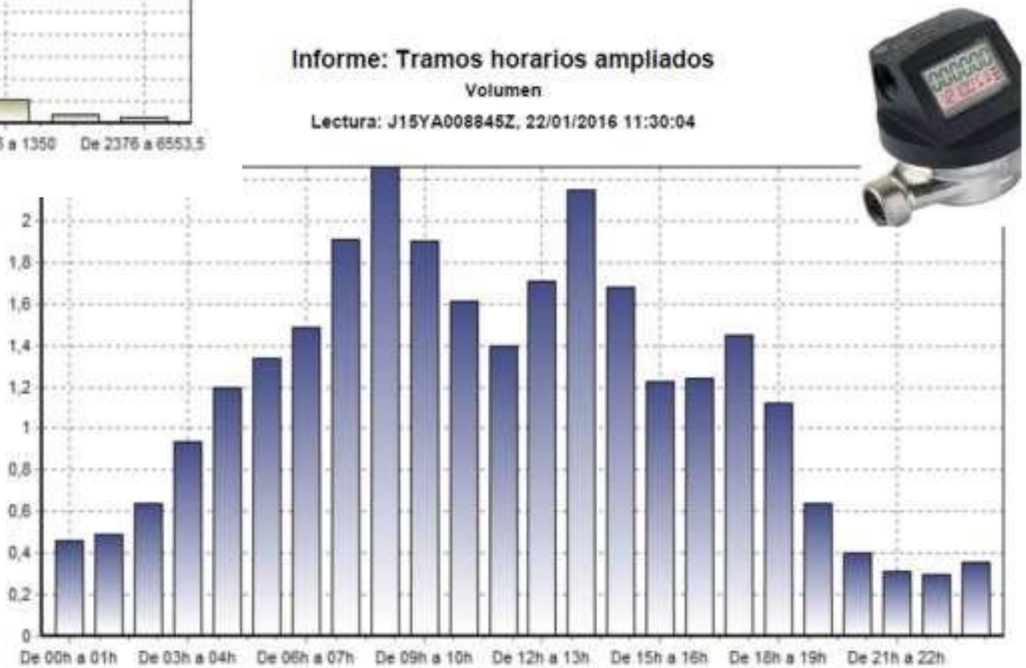


120 l/h

User Consumption Patterns

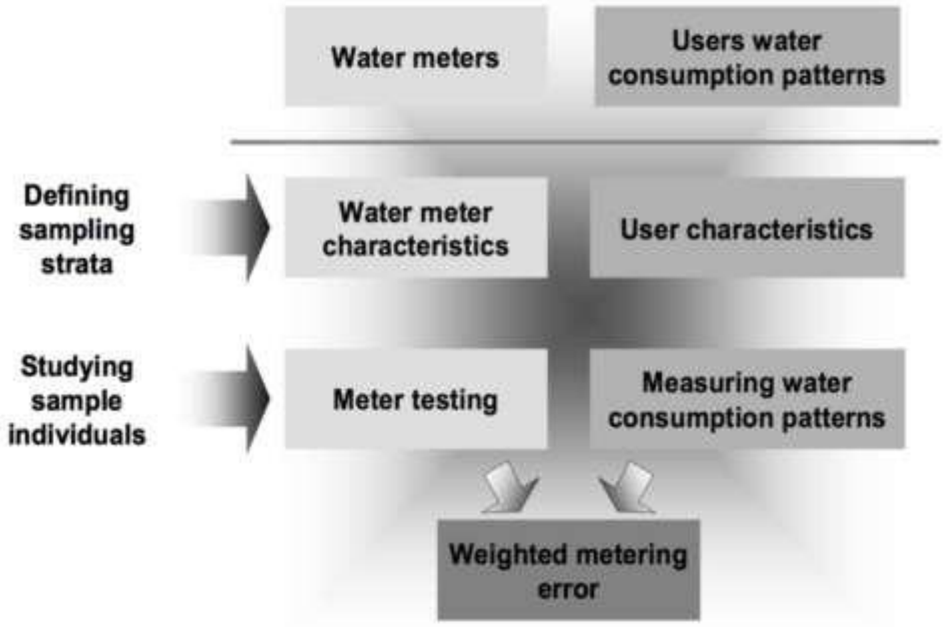


m³ consumed at different rate flows



m³ consumed at different times

Methodology



$$\varepsilon_{global} = \frac{\sum \frac{\text{Registered volume}_i}{1-\varepsilon_i} - \sum \text{Registered volume}_i}{\sum \frac{\text{Registered volume}_i}{1-\varepsilon_i}} = 1 - \frac{\sum \text{Registered volume}_i}{\sum \frac{\text{Registered volume}_i}{1-\varepsilon_i}}$$

Estimated Global Error:

19% of true volume

23% of registered volume

Dealing with reported Leaks

- Leaks on mains or service connections are usually reported by customers to the call center
- The call center translate the report to the zone manager (the network is divided in 5 operational zones)
- Typical shutoff times are 24h for burst in mains and 72h for burst on services connections

What happen if the leak is after the meter?

- If commercial software shows an alarm of possible leak, the customer is made aware by Aguas de Saltillo

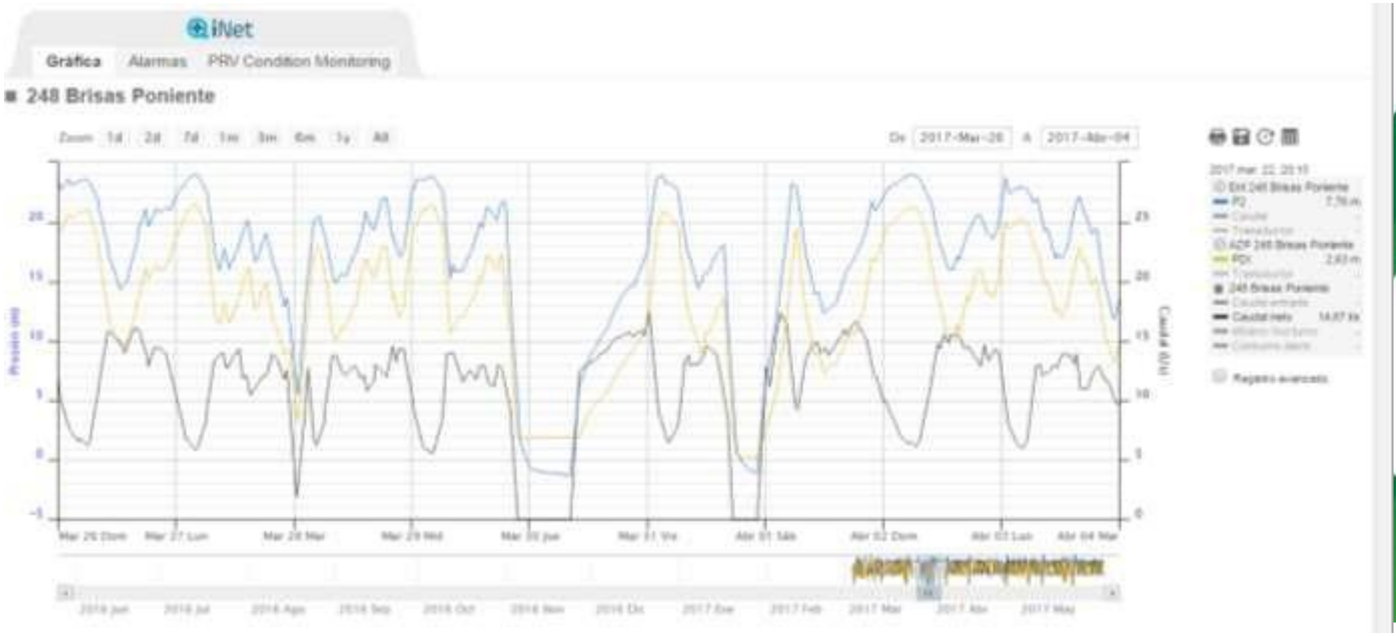
- Aguas de Saltillo does not provide the repair service of leaks after the meter

Active leakage control

- Almost 95% of service connections are revised every year using electronic ground microphones
- 3 brigades of two people each
- In august 2016 Agsal implemented a methodology of leak detection by using 70 units of Permanet+ (leak noise loggers) and 8 units of correlating noise loggers
- This methodology required Agsal to build “listening” points on the network

Intermittent Supply

- Rotational or intermittent supply is the ordinary way to distribute water, it has not to do with seasonal demand or drought periods
- One of its causes is the operation of main reservoirs; they are filled one after another manually every day, so are the influence zones
- The wells stop according to there sustainable levels and on high demand electricity hours



Main Challenges

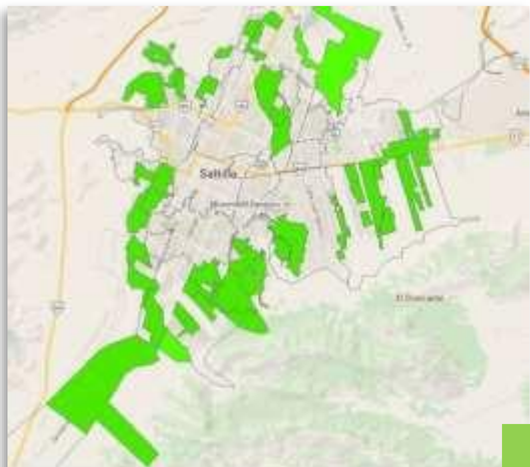
- Improve System Efficiency, great losses both real and apparent
- Moving from IWS to Continuous Supply
- Advanced Active Pressure Control
- How to interpret night flows and assess changes in leakage
- Reduction of bursts on services connections and mains
- Better assessment of apparent losses and fraud

First Answer: Sectorization (Sep 2015)

Aguas de Saltillo

To reduce NRW, need to reduce Real Losses by moving towards 24/7 supply

Initial plan was 200 DMA's



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Optimal Management of the water network

DATOS BÁSICOS	
Red de distribución	2,418 Km
N° Usuarios	238,190 Usuarios

HIPÓTESIS DE BASE			
	Minimo	**Media**	Máximo
Km Red/Sector	10	**12**	16
N° Usuarios/Sector	1,000	**1,200**	1,400
N° Sectores Propuesto	**200**		

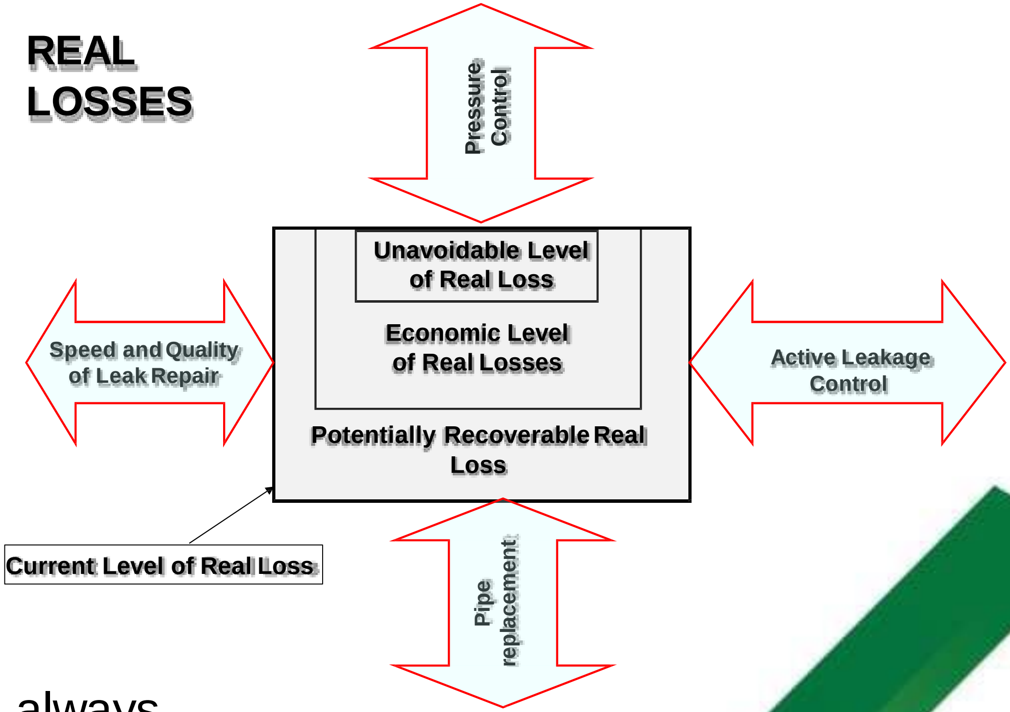
Sectorization Plan

Aguas de Saltillo

PMAs and DMAs Implementation Schedule 2016-2019				
	2016	**2017**	**2018**	**2019**
# of DMAs Implemented (end of year)	100	150	200	200
# of DMAs monitored (end of year)	80	130	180	200
	$1.43 M	$1.43 M	$1.43 M	$1.43 M

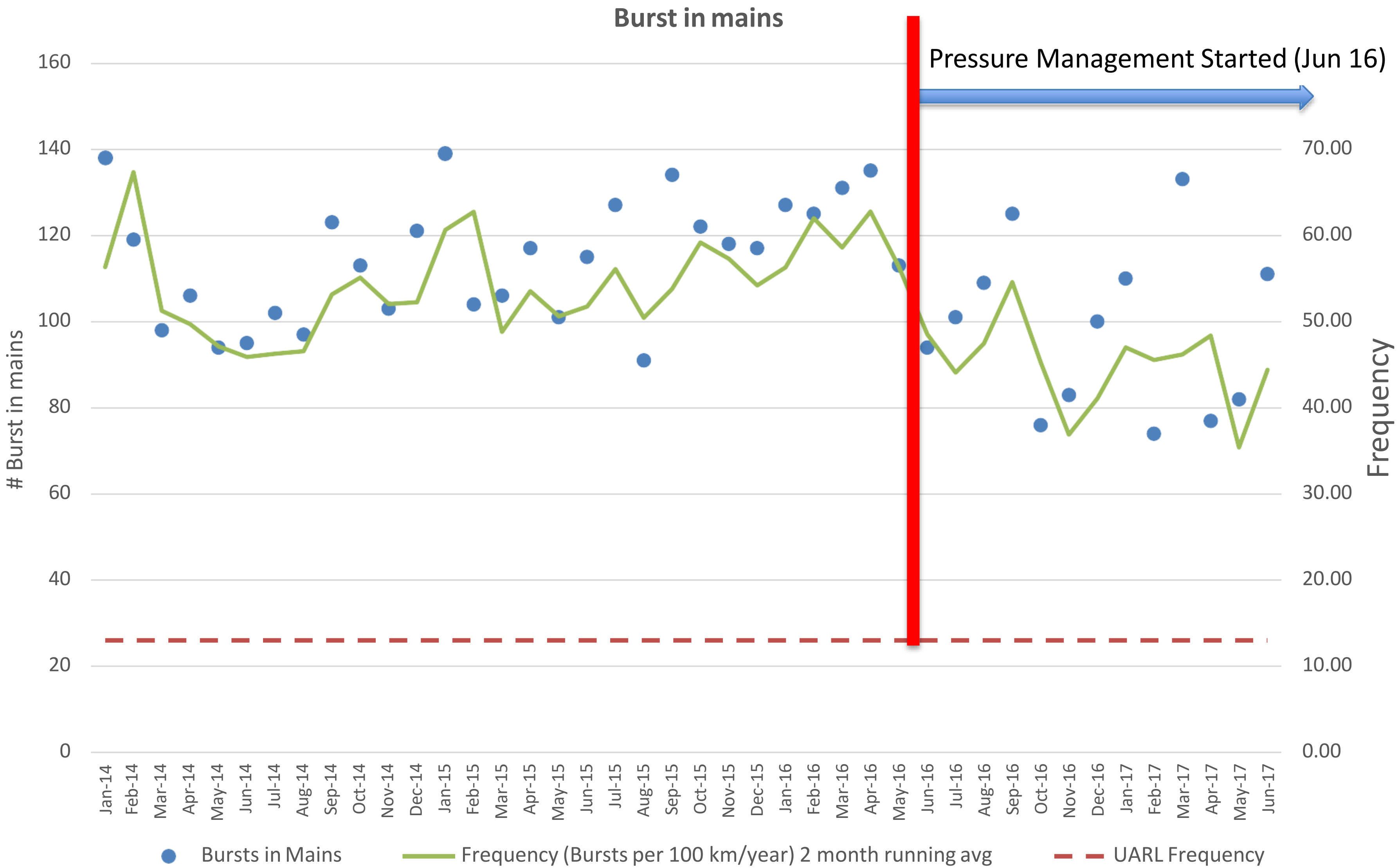
Second Answer: Pressure Management (Apr 2016)

- Sectorization just a diagnosis tool
- Quick goals needed
- A mantra: “every metre counts”
- Squeezing the box

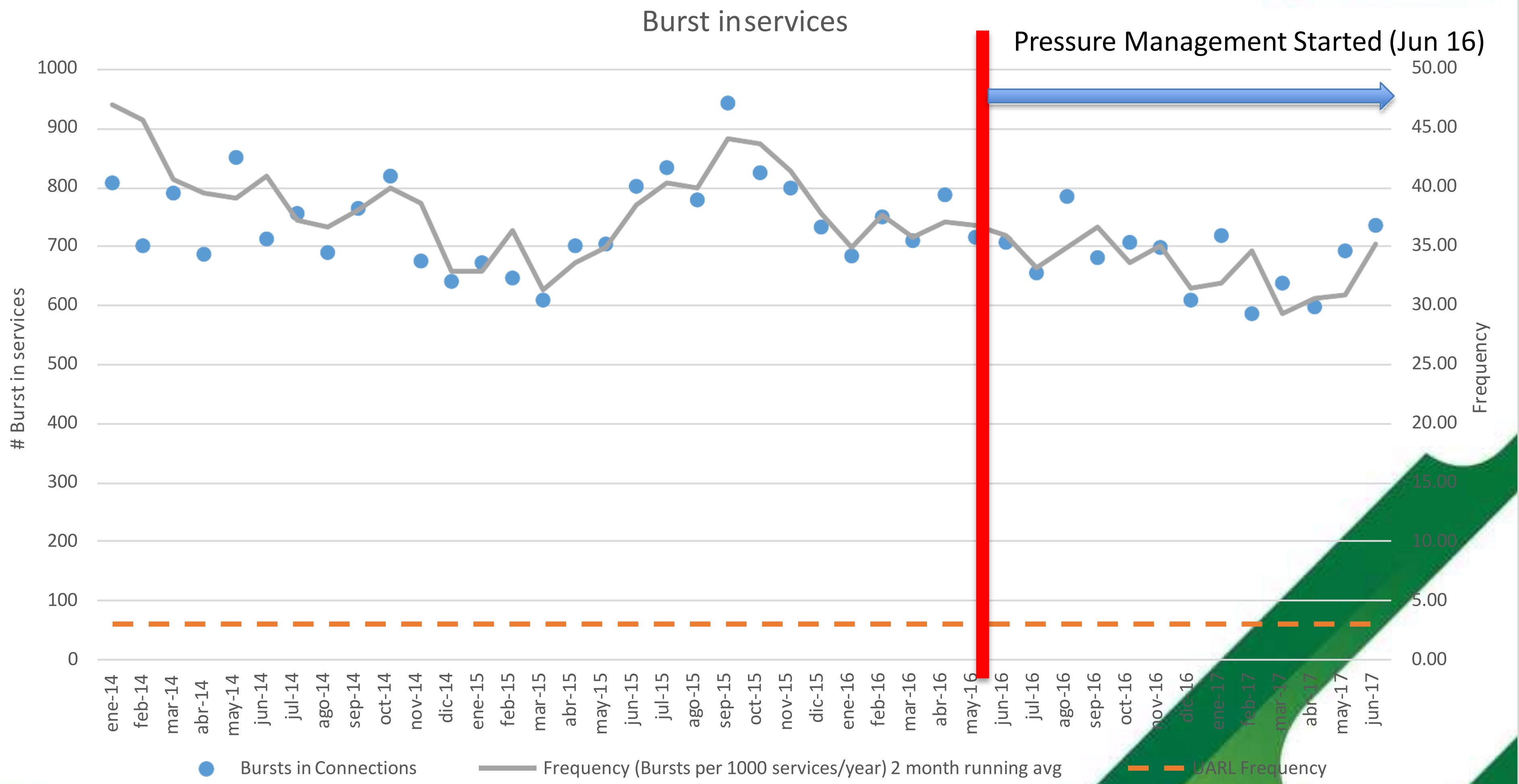


- Pressure Management
  - Cheapest
  - Preventive
  - Immediate impact
  - First logical action, always before the rest of them
  - Two benefits:
    - Burst frequency reduction
    - Reduction of leak flow

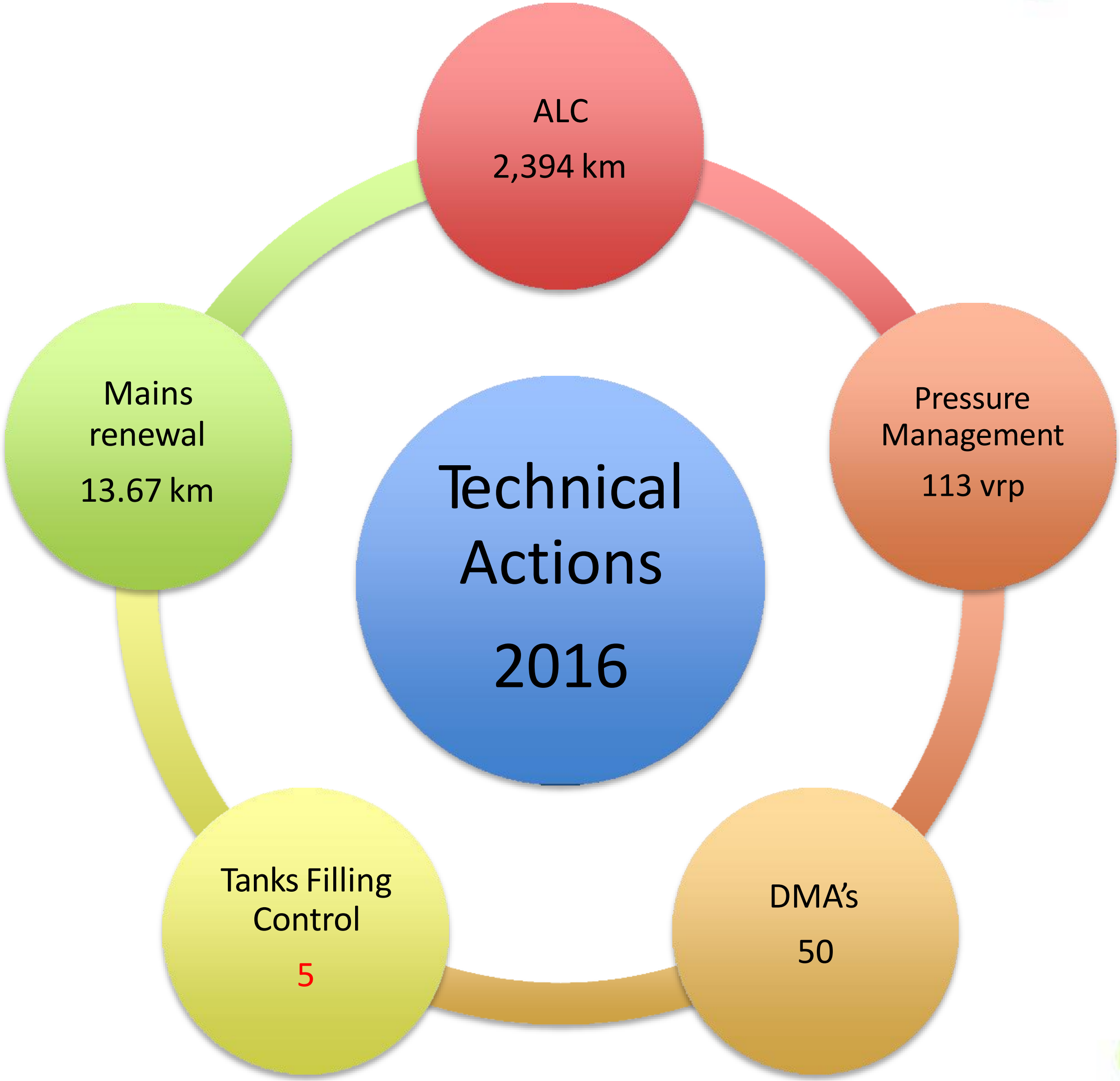
An unexpected effect (for me)



The problem of bursts in services

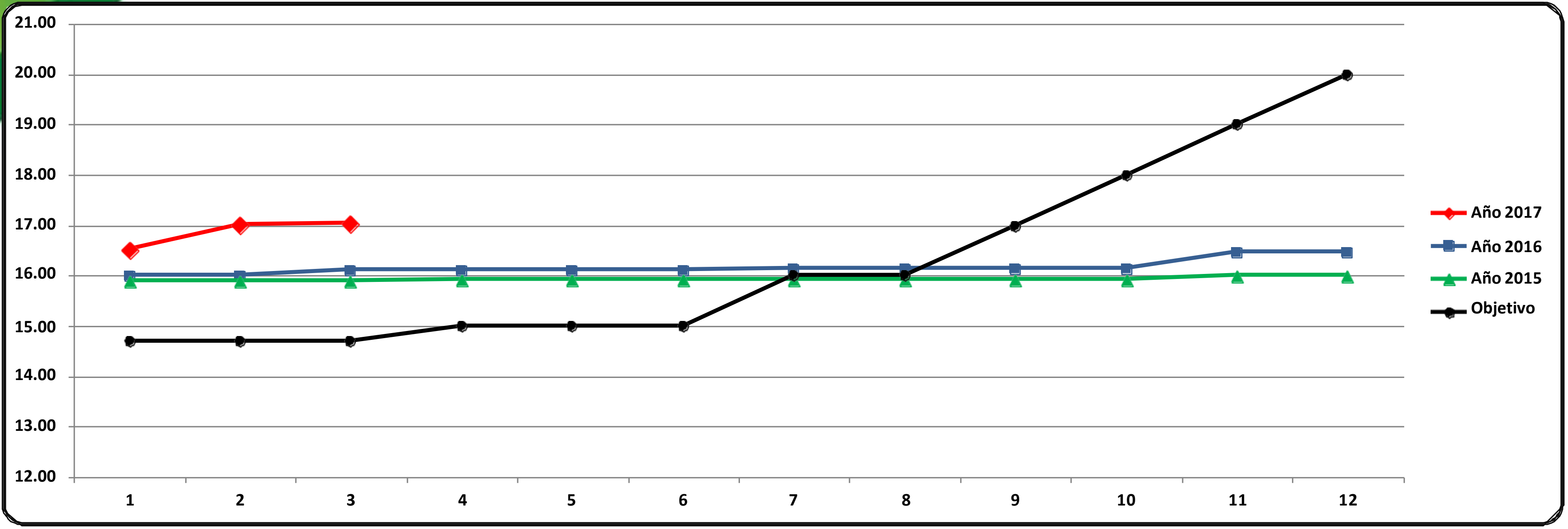


Action Plan 2016



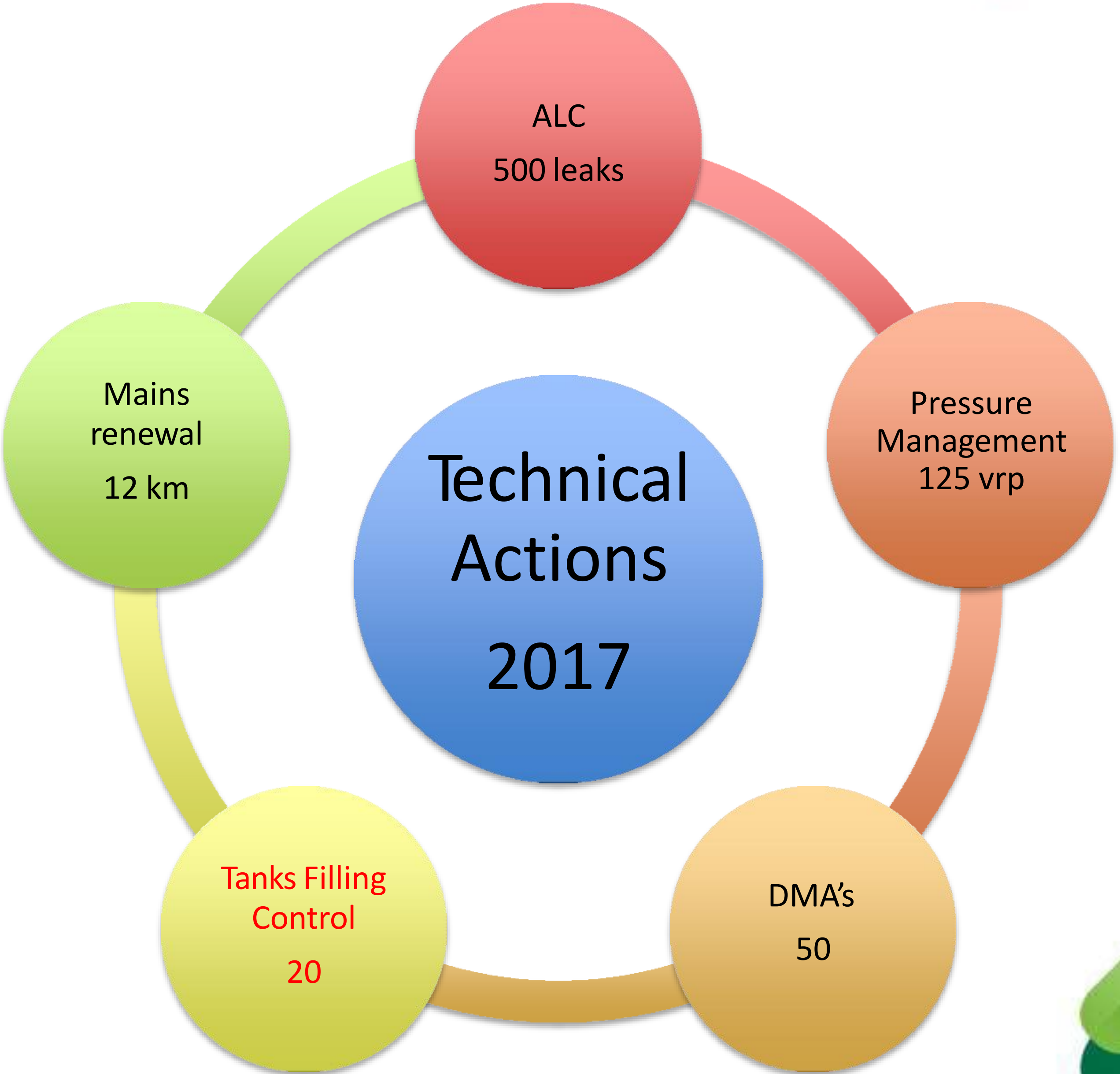
Action Plan 2016

Evolution of service frequency
(hours per day)



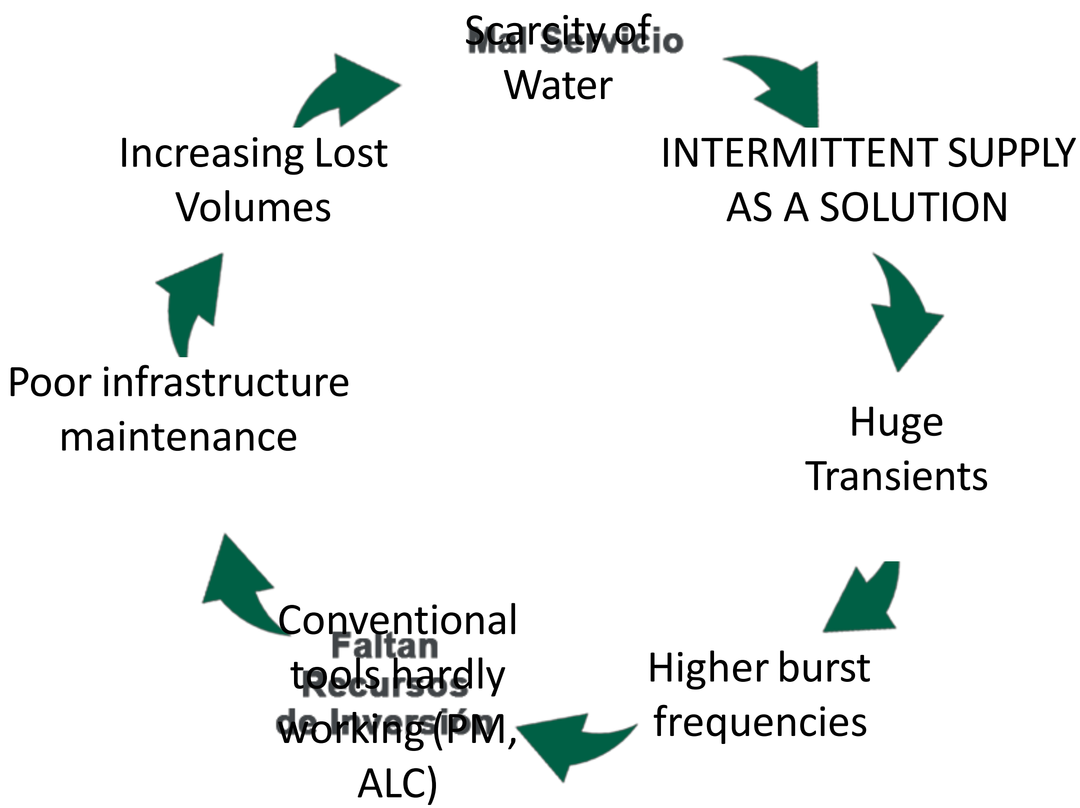
Mes	Ene	Feb	Mar	Abr	May	Jun	Jul	Ago	Sep	Oct	Nov	Dic	Suma	Media
Año 2017	16.52	17.02	17.03											16.86
Año 2016	16.01	16.01	16.13	16.13	16.13	16.13	16.14	16.15	16.15	16.15	16.47	16.48		16.17
Año 2015	15.90	15.91	15.91	15.92	15.92	15.93	15.93	15.94	15.94	15.94	16.00	16.01		15.94
Objetivo	14.70	14.70	14.70	15.00	15.00	15.00	16.00	16.00	17.00	18.00	19.00	20.00		16.26

Action Plan 2017



Action Plan 2017

How to break this vicious circle?



MasterClass (Nov 2016)

Emphasis to Pressure Management Zones as the foundation strategy

IWS (Intermittent Water Supply)

Aguas de Saltillo

The recommended solution is to move to a 24/7 policy of continuous supply, but this is easier said than done.

IWS is like having two hearts attacks per day.

(Allan Lambert)

17 h/user/day → **24/7**

Key Performace Indicator:

- Availability in h/user/day (zonal and system-wide)
- Track # and frequency of mains repairs per 100 km/day (system-wide)
- Track # and frequency of service repairs per 1000 conns/day (system-wide)
- Zonal pressure reduction with overnight pressure reduction
- Automatic N1 tests every Sunday morning
- Allan Lambert's new fast-track FAVAD approach for AZP vs leak flow rates

2016

Aguas de Saltillo

'LEAKS' Suite of LEAKAGE EVALUATION and ASSESSMENT KNOW-HOW SOFTWARE									
CheckCalcs - a free software for identifying Leakage and Pressure Management Opportunities								If Intermittent supply,calculate Real Losses 'when system pressurised' (wsp)	
CheckCalcs	HIC & LAMIC	Special for AgSal	08/12/2016	Mexico	Mex002	© ILMSS Ltd			
ORKSHEET IS USED TO CALCULATE NON-REVENUE WATER, CURRENT ANNUAL REAL LOSSES AND POTENTIALLY RECOVERABLE REAL L									
Colour coding:	Data entry	Essential data entry	Default Values	Calculated Values	ata from another Workshee				
SIMPLIFIED IWA WATER BALANCE CALCULATION			Aguas de Saltillo		Whole System			68.8%	100.0%
Period from	01/01/2016	to	31/12/2016	=	366	Units	Ml/day	Lit/conn/d	Lit/conn/d
Enter data for your system in the yellow cells. Check the default %s in the purple cells, and change them if you have better information which will improve the reliability of the calculation.	VOLUME INPUT FROM YOUR OWN SOURCES				52288	Ml	142.86		
	Water Imported to this system				0	Ml	0.00		
	SYSTEM INPUT VOLUME				52288	Ml	142.86		
	Water Exported from this system				0	Ml	0.00		
	WATER SUPPLIED TO THIS SYSTEM				52288	Ml	142.86		
	Billed Metered Consumption				29579	Ml	80.82		
	Billed Unmetered Consumption				0	Ml	0.00		
	NON-REVENUE WATER NRW				22709	Ml	62.05		
	Unbilled Authorised Consumption	0.50%	of Billed Metered Consumption		148	Ml	0.40		
	WATER LOSSES				22561	Ml	61.64		
	Unauthorised Consumption	0.25%	of Billed Metered Consumption		74	Ml	0.20		
	Customer Metering Inaccuracies	19.00%	of Billed Metered Consumption		6938	Ml	18.96		
	APPARENT LOSSES - system with customer storage tanks				7012	Ml	19.16		
	CURRENT ANNUAL REAL LOSSES CARL				15549	Ml	42.48	252	367
	UNAVOIDABLE ANNUAL REAL LOSSES UARL if pressurised 68.75% of time				1835	Ml	5.01	30	43
	INFRASTRUCTURE LEAKAGE INDEX ILI = CARL/UARL				8.47			8.47	8.47

To move to 24/7 + 326 l/s NEEDED (28,166 m³/day)

AVAILABLE REDUCING LOSSES 433 l/s

DO WE HAVE ENOUGH WATER?

Aguas de Saltillo

'LEAKS' Suite of LEAKAGE EVALUATION and ASSESSMENT KNOW-HOW SOFTWARE						
CheckCalcs - a free software for identifying Leakage and Pressure Management Opportunities						
CheckCalcs	HIC & LAMIC	Special for AgSal	08/12/2016	Mexico	Mex002	© ILMSS Ltd
ORKSHEET IS USED TO CALCULATE NON-REVENUE WATER, CURRENT ANNUAL REAL LOSSES AND POTENTIALLY RECOVERABLE REAL L						
Colour coding:	Data entry	Essential data entry	Default Values	Calculated Values	ata from another Workshee	

If intermittent supply,calculate Real Losses 'when system pressurised' (w sp)

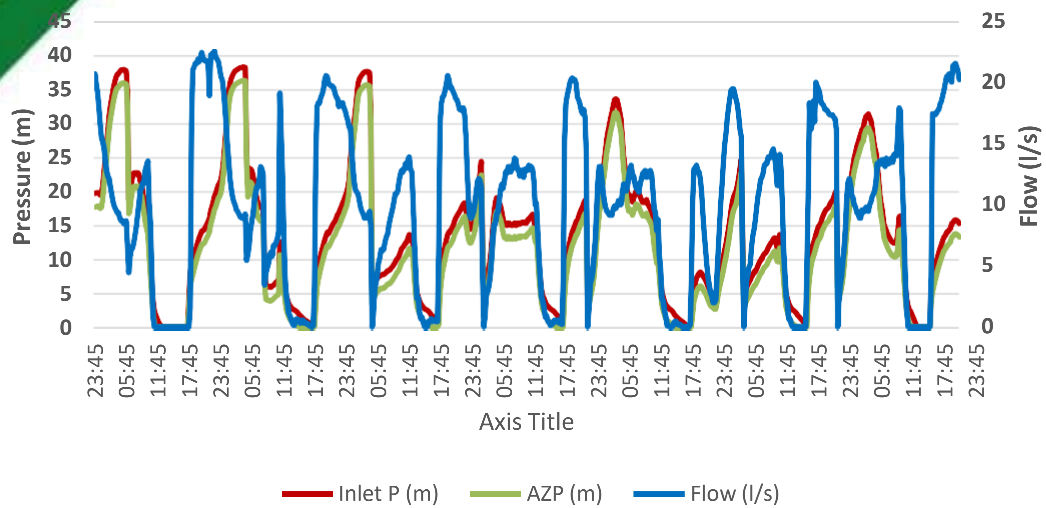
SIMPLIFIED IWA WATER BALANCE CALCULATION			Aguas de Saltillo		Whole System		72.5%	100.0%
Period from	01/01/2017	to	30/06/2017	=	181	Units	Ml/day	Lit/conn/d	Lit/conn/d
Enter data for your system in the yellow cells. Check the default %s in the purple cells, and change them if you have better information which will improve the reliability of the calculation.	VOLUME INPUT FROM YOUR OWN SOURCES				26551	Ml	146.69		
	Water Imported to this system				0	Ml	0.00		
	SYSTEM INPUT VOLUME				26551	Ml	146.69		
	Water Exported from this system				0	Ml	0.00		
	WATER SUPPLIED TO THIS SYSTEM				26551	Ml	146.69		
	Billed Metered Consumption				15629	Ml	86.35		
	Billed Unmetered Consumption				0	Ml	0.00		
	NON-REVENUE WATER NRW				10922	Ml	60.34		
	Unbilled Authorised Consumption	0.50%	of Billed Metered Consumption		78	Ml	0.43		
	WATER LOSSES				10844	Ml	59.91		
	Unauthorised Consumption	0.25%	of Billed Metered Consumption		39	Ml	0.22		
	Customer Metering Inaccuracies	19.00%	of Billed Metered Consumption		3666	Ml	20.25		
	APPARENT LOSSES - system with customer storage tanks				3705	Ml	20.47		
	CURRENT ANNUAL REAL LOSSES CARL				7139	Ml	39.44	220	304
	UNAVOIDABLE ANNUAL REAL LOSSES UARL if pressurised 72.5% of time				955	Ml	5.28	29	41
	INFRASTRUCTURE LEAKAGE INDEX ILI = CARL/UARL				7.47			7.47	7.47

To move to 24/7 + 240 l/s NEEDED (20,747 m³/day)

AVAILABLE REDUCING LOSSES 395 l/s

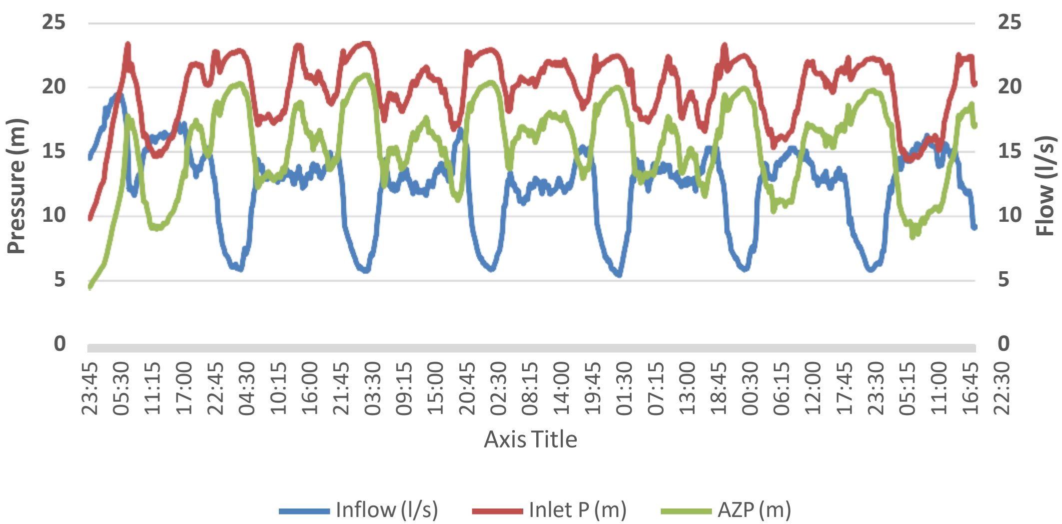
Pressure Management

248 Brisas Poniente (Dec 11 to Dec 18)



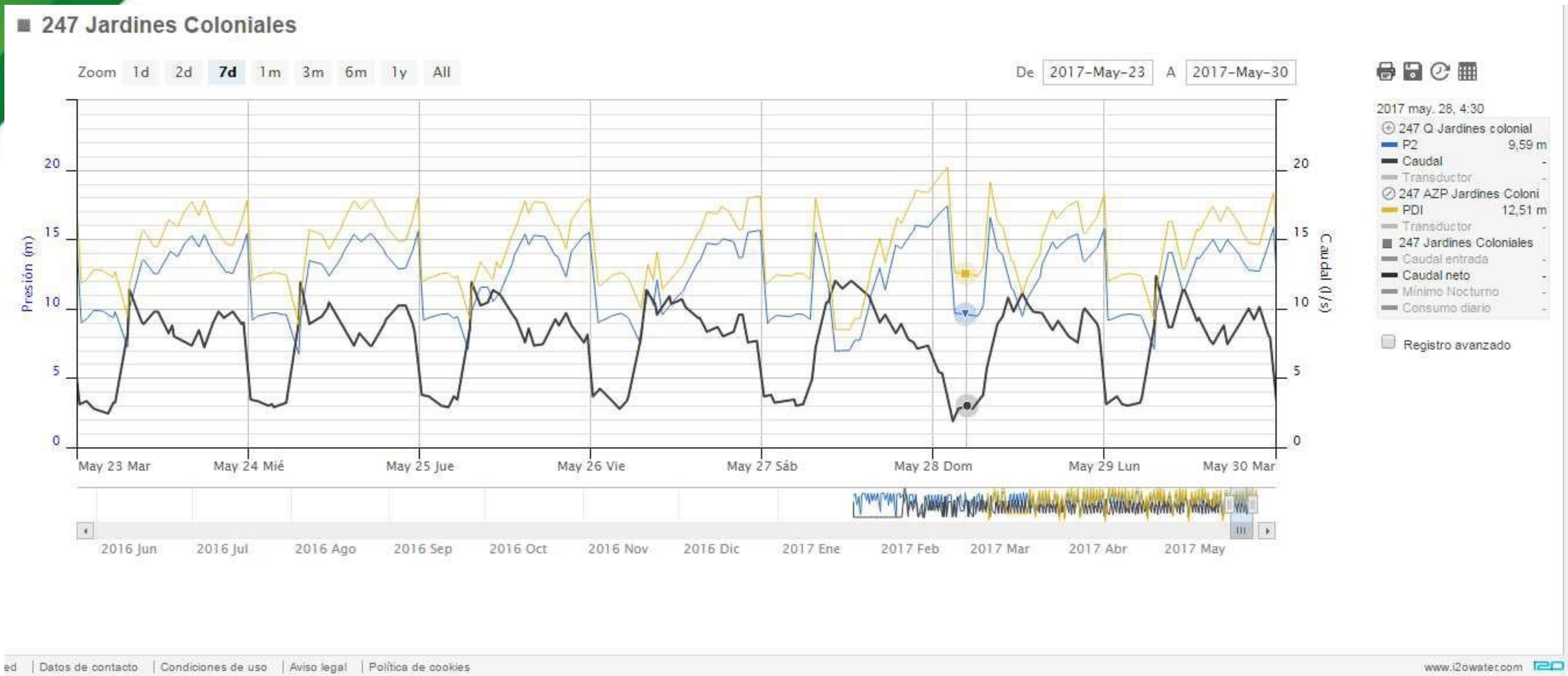
Weekly Inflow: 5,985 m^3
Avg AZP: 11.68 m
Max AZP: 36.22 m
Supply time:9 h/day

248 Brisas Poniente (May 21 to May 28)



Weekly Inflow: 11,964 m^3
Avg AZP: 15.33 m
Max AZP: 20.89 m
Supply time:24 h/day

Pressure Management
247 Jardines Coloniales



- Continuous supply achieved from march
- Night pressure control automated
- Automatic night test on Sunday morning (2:00 to 7:00 a.m.):
    - Good set of readings at steady flow and AZNP
    - Roof tanks are full at this time
    - Other days of the week more variable

Succeses and Lessons Learnt

- In fact it is POSSIBLE to move to 24/7
- Moving to 24/7 is more a process than a decision
- You should expect some initial problems:
  - Opposition to change (people used to work in a traditional way)
  - Temporary disruption of service during installations
  - Criticism of new policies
- When achieved 24/7:
  - It is possible to start controlling pressures
  - Burst frequencies start to decrease
  - Users start to perceive the benefits

NEXT STEPS

- Going on improving network efficiency. Recovering more water:
  - Advanced Active Pressure Control
  - Sectorization
  - Active Leakage Control
  - Infrastructure renewal
- Increasing availability by zones. Water recovered used to supply the next zone.
- Abandoning Valve opening and shutting off
- Looking for new sources in the Medium Term according with the development of the city