v. 2, n. 17, 2022

Journal of
Engineering
Research

IMPLEMENTATION AND OPTIMIZATION OF THE WATER SUPPLY SECTOR GRAJAU AND JD. MARILDA

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Abstract: The Grajau Supply Sector is linked to the South Business Unit (MS), and is supplied by the Guarapiranga Supply System. The average volume available (DV) per billed connection in the period from February 2017 to March 2018 was 20.95 m3 per billed connection. The total number of connections in the sector is 144,192, with a population of 343,945 inhabitants and an unbilled water rate of 47.54%, or an Annual Lost Volume (VPA) of 18,174,536,000 liters of water per year. This was the scenario at the end of 2017, when we received a visit from the Business Unit's senior management and the perspectives in the best scenarios were to maintain losses at this level, or invest to change levels and create a rupture, really making it count. worth investing to earn in Lost Volume (VP). Therefore, it was possible to structure a project and demonstrate how hydraulic modeling, combined with good sectorization proposals, can not only achieve excellent results, but also safely anticipate the values that must be achieved after the execution of the works, thus serving as a benchmark. for the effectiveness of the proposed solutions.
Keywords: Loss Reduction, hydraulic modeling, Performance Contract.

INTRODUCTION

Actual Losses represent water losses from the supply system resulting from leaks in the distribution infrastructure and/or overflows in reservoirs.

Among the interventions to control actual losses, where corrective and preventive actions are carried out, focused on the main causes of Actual Losses are leaks in branches, leaks in networks, high pressures, among others. In addition to the infrastructure (station and network material, age, etc.) the physical factor of analysis must be the pressure per zone or area controlled by VRP (sectorization).

Energy efficiency is a valuable opportunity for basic sanitation companies to consolidate their sustainability with the creation of real value for the business and simultaneously for society and the environment, guaranteeing a minimum consumption of energy according to the real value. water flow/pressure needs for your systems.

GOAL

Reduce physical losses in the Grajau Supply Sector by at least 18%.

METHODOLOGY USED

The methodology chosen was the Case Study - Implementation and Optimization of the Grajau and Marilda Water Supply Sector.

BRIEF HISTORY OF THE SUPPLY SECTOR IN GRAJAU

In 2017, the Grajau supply sector had a population of 343,945 thousand inhabitants and had a network extension of 658 km and an area of 51 km2.

The supply sector was divided into 03 pressure zones (High Zone, Low Zone and a crown zone called the High Zone). As shown in figure 01.

	set/17	
VD	2.892.986	m3/month
	1488,16	l/s
VU	2.035.814	m3/month
	1047,23	l/s
For one VM	1.587.587	m3/month
	816,66	l/s
VP	1.305.399	m3/month
	230,57	l/s
Uses	448227	m3/month
Connection	134.094	
IPDT	213	Connection/ day
IANC	45,12%	

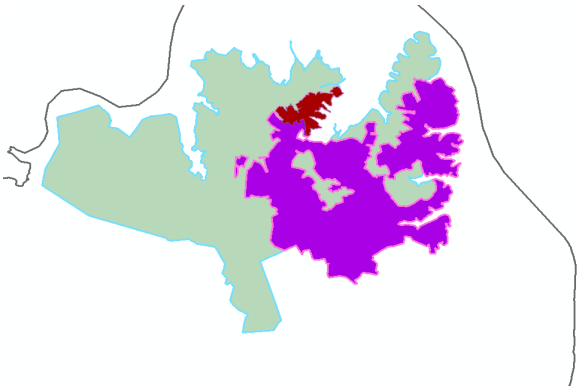


Figure 01 - Grajaú Sector and information table in 2017

The Figure 02 shows the supply system in the single-line format.

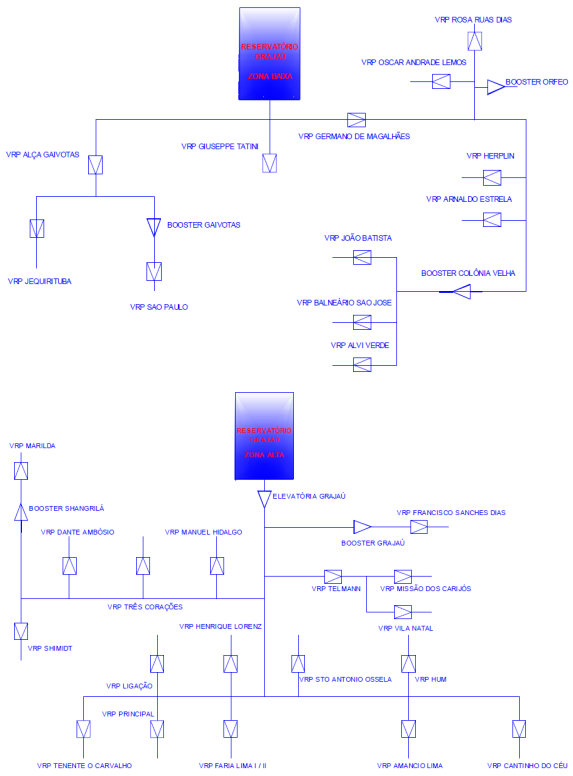


Figure 02 - Single-line scheme of the Water Distribution Network

In 2015 there was a period of water crisis and the government intensified the campaign for the rational use of water and the company launched a bonus and fines program directly impacting the measured Micro Volume. We can see this reduction in the 2014/2015

biennium in the DV x VM graph. This action caused a reduction in the measured volume that did not recover even with the end of the water crisis in 2016, as shown in figure 03.

The DV with the water crisis also changed levels, however, it soon stabilized and remained without major changes.

THE 2017 HYDRAULIC MODELING

The hydraulic model of the Grajau Supply Sector indicated several areas with a lack of water and others with high pressures.

With the modeling, it was possible to diagnose several anomalies in the system, such as high pressure points, highlighting new areas for the implementation of Pressure Reducing Valves, or to identify the problems that cause the occurrence of water shortages, or even stretches with high water loss. charge.

Once the problem is named, the root cause identified, a solution proposal is made that is quickly inserted into the model and instantly

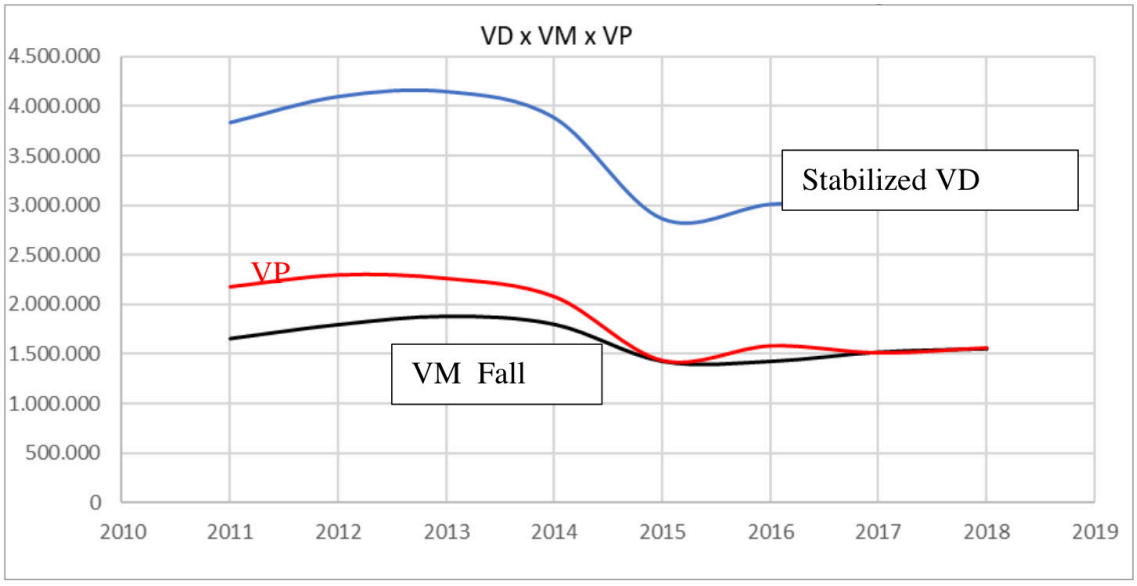


Figure 03 - Impacts on VD, VM and VP volumes.

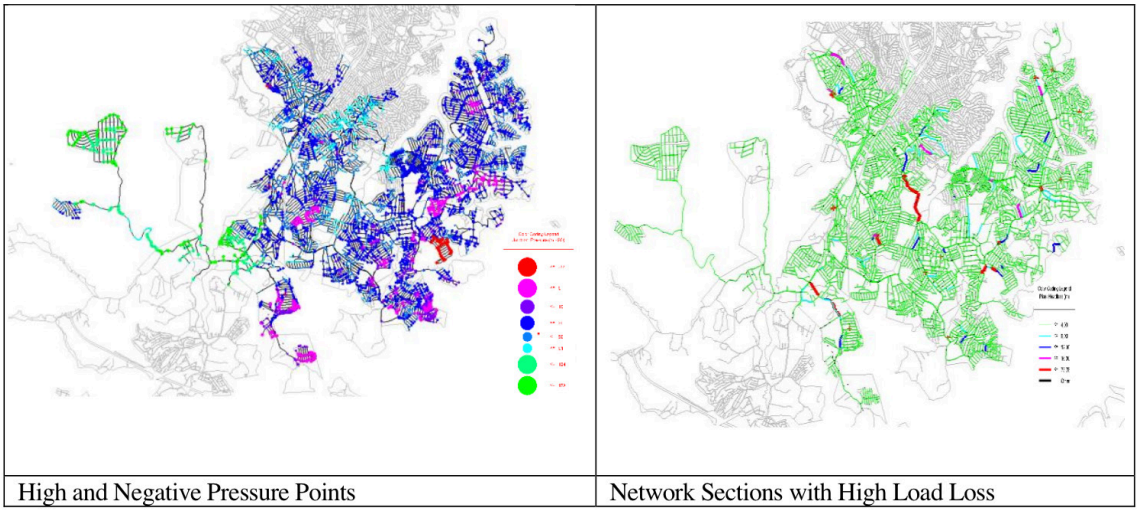


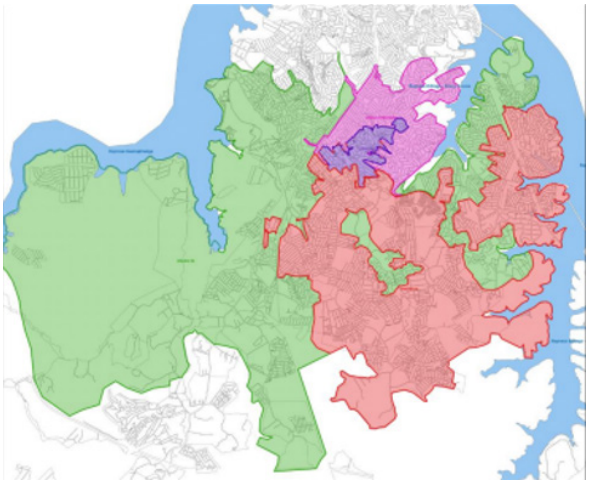
Figure 04 - Presentation of extreme pressure load points and with high pressure drop.

it is known whether the solution will be effective or not, and more, it is also possible to know if the proposed solution causes any other problem to be upstream or downstream of its implementation.

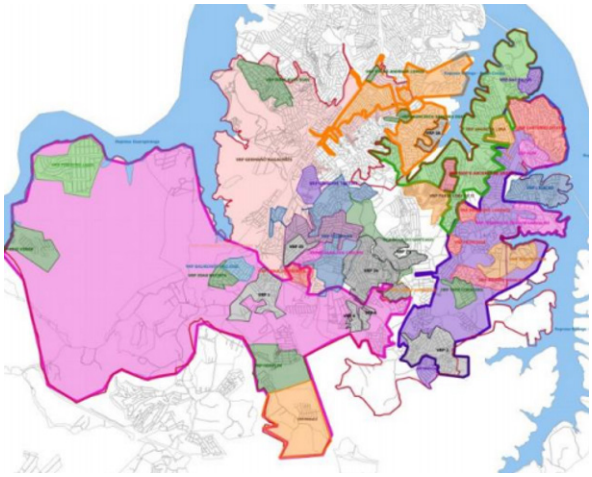
The objective to be achieved is to maintain the piezometric quota between 10mca and 30mca.

From this point, a set of solutions begins to be listed (already tested in alternatives and scenarios in the hydraulic model) in order to compose a package that will be budgeted and tendered.

The average pressure plane had changed from 42 mca to 32 mca, as shown in figure 05.



Grajau's old sectorization: Average pressure of 42mca.



New sectorization of Grajau: Average pressure of 32mca.

Figure 05 - Average pressures in the sector before and after the new sectorization.

Another very weak point in the old sector was the operation by Booster. At SA Grajau, there were 02 large boosters in the pressure zone, and when there was a problem either related to maintenance or lack of electricity, the number of complaints of lack of water grew exponentially.

The Critical analysis of the Dec/2017 month of the Water Shortage indicator, relates the numbers of occurrences of the year 2017 with the failures of the various Boosters in the Grajau Sector. Figure 06 brings the critical analysis and areas of influence.

Critical analysis:

The indicator remained below the forecast target for practically the entire year, except for the months of March, when we had several occurrences of power outages and equipment maintenance. In May, we had insufficient supply, due to the cleaning and disinfection of the Grajau reservoir, lack of electricity in the EEA and a lot of equipment maintenance.

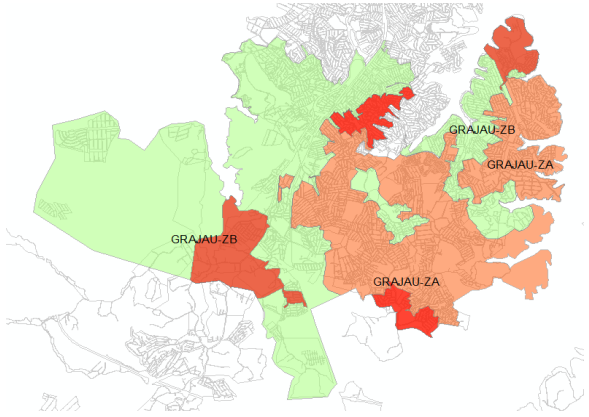


Figure 06 – Critical Analysis of the year 2017 the map of the Boosters' areas of influence.

Another important point and that the piezometric plane of the Zona Alta Grajau was fixed, at the minimum pressure of 38 mca

and during the day it reached 40 mca, this operational procedure had become mandatory due to the project of the Zona Alta Grajau Booster. At the time of its implementation, the designers did not believe that the holding pressures would be below 40 mca, so when sizing the Booster, they chose to work with pumps in series. However, over the years and with the fine adjustment of the Supply Sector, we were able to reach the level of efficiency in which we could operate with lower pressures, however for this it would be necessary to implement a new Booster as shown in Figure 07, this one operating individually, releasing the High Zone Pumping Station to be able to operate with pressures of 30 mca.

This implies a gain of the order of 12 mca in the entire Upper Zone of the Grajau Sector.

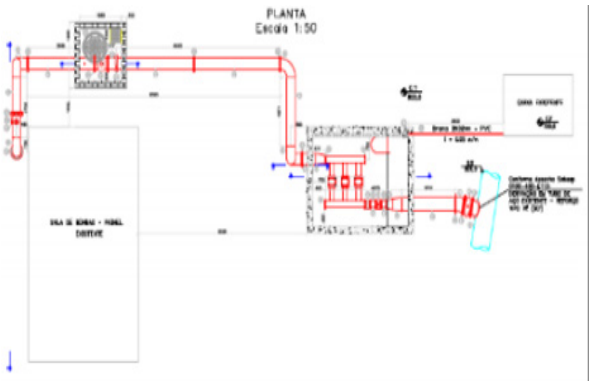


Figure 07 – Remodeled project of the new Booster Zona Alíssima, straight from the network.

THE LOST VOLUME PERFORMANCE CONTRACTING PROPOSAL (VP)

The proposal arising from the hydraulic modeling scenarios, pointed to the creation of a new supply sector (Jardim Marilda), as shown in figure 08. This reservoir was already part of the PMA and must be built at the point opposite the Grajau reservoir, at the highest level of the system. With this new reservoir, it would open the possibility for the deactivation of most boosters, with the inclusion of new Pressure Reducing Valves, in order to control the system by handles.

The scope will comprise engineering services to reduce wasted volume (VP) across three benefit programs:

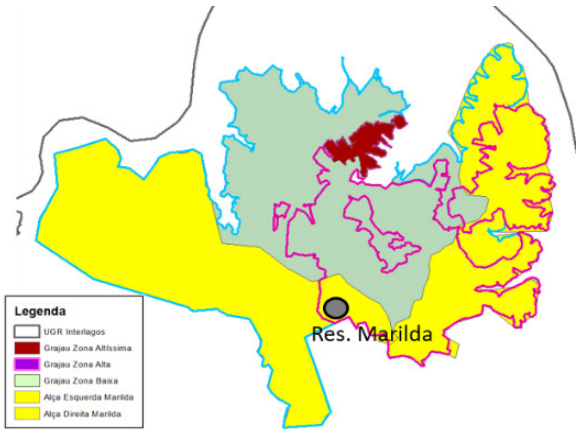


Figure 08 – Remodeled project of the new Booster Zona Alíssima, straight from the network.

Sectorization for the implementation of a new Jardim Marilda supply sector:

1 – Program to reduce pressure on networks (works for sectorization):

A – Studies, projects AND execution of a metallic reservoir (10,000 m^3) for the new sectorization of the Grajaú sector, Figure 10.

B – Executive project and implementation of approximately 500 meters of Ø 700 mm steel pipeline in 1.2-meter ARMCO tunnels to create the new Grajaú supply sector and Ø 700 mm interconnection to supply the new Reservoir;

Figure 09 – New Jd Reservoir. Marilda. Metallic: 10.000m3.

2 - Program for pressure management in networks (engineering services):

A – Studies, projects AND implementation of the high zone booster for the new Grajaú sectorization;

B – Studies, projects AND adequacy of the Grajaú/Parelheiros Water Pumping Station;

C – Studies, projects AND implementation of 11 (eleven) VRP's in the Grajaú supply sector;

D - Executive project and implementation of networks and interconnections 13,500 meters (110 to 400 mm) for sectorization of the new Grajaú supply sector.

E – Studies, mathematical modeling, field measurements, executive projects and technical specifications.

F – Study and diagnosis of energy efficiency in sanitation facilities.

3 - Active leak control program (detection of non-visible leaks, repair, branch exchange and regularization):

A – Studies, work plan and execution of a scanning program to detect leaks that are not visible in 1,322 km of networks.

B - Repairs of leaks in the network, branch and branch exchanges;

In order to achieve the objective, the semi-integrated contracting regime was chosen, regulated by Law 13.303/16 and governed by the Internal Regulations for Bidding and Contracting, for the provision of technical engineering services, preparation of studies, projects and the implementation of plans of work through a Performance contract.

In this type of contract, the global value of the contract, offered by the Contractor, corresponds to a composition of the Basic Remuneration plus the Performance bonus, which will be calculated at 20% of the Basic Remuneration. The contractual term scheduled was 60 (sixty) consecutive and uninterrupted months, counted from the date of execution of the term, being: 18 months - Implementation of the mandatory scope with Variable Remuneration, 12 months - Performance measurement with Variable Remuneration, 30 months - Fixed Remuneration.

The great advantage of this type of contract is that the construction company becomes an interested partner in achieving results after the implementation of the proposed solutions. As a result, involvement becomes daily, seeking quick solutions to operational problems.

OBTAINED OR EXPECTED RESULTS

As a result of this project, a saving of 18% of the PV was expected, or 308,802 m3/month, but the intention is to reach the value of 370,563 m3/month, about 120% or an annual savings of 4,446,750,000 liters of water per year, or 25% of all Lost Volume in the Grajau Sector.

The result obtained in the calculation of the first 5 months of performance verification was a saving of 1,680,301,000 liters or a monthly average of 420,075 m3/month, a value higher than expected in the contract, as shown in Figure 10.

When analyzing the scenarios created with the modeling, with the analysis we arrived at these numbers that, after the works were completed, were very close to the modeled scenarios. (Table 1).

We can verify through the numbers presented that all the solutions presented in the different scenarios that were proposed in the hydraulic modeling process, had the desired effect and that the economic and financial analysis of the enterprise, which demonstrated its technical and economic feasibility, were correct.

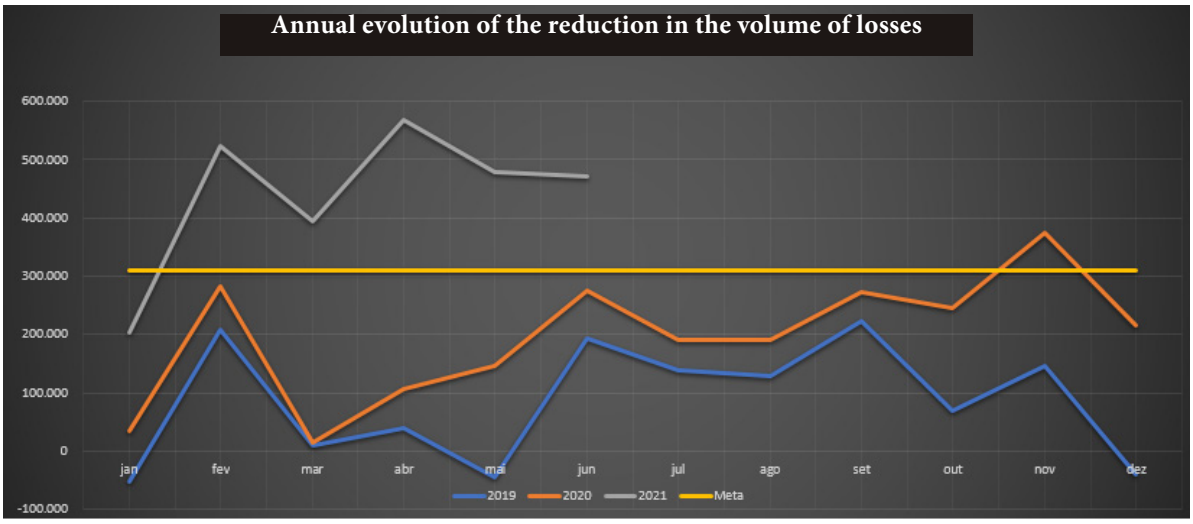


Figure 10 – Graph with the reduction in Loss Volume and 18% VP target.

	Indicators	Projection		Verified	
		Sep/ 2017		June/ 2021	
Grajau	VD	1.575.015	m3/ month	2.208.656	m3/ month
	VM	1.014.183	m3/ month	1.695.351	m3/ month
	VP	560.832	m3/ month	513.305	m3/ month
	IPDT	140	Connec-tion/ day	187,00	Connec-tion/ day
	Ianc	35,61	&	23,24%	&
	Connec-tions	85.662	units	90.244	units

	Indicators	Projection		Verified	
		Sep/ 2017		June/ 2021	
Marilda	VD	871.776	m3/ month	833.610	m3/ month
	VM	573.404	m3/ month	653.854	m3/ month
	VP	298.372	m3/ month	179.756	m3/ month
	IPDT	102	Connec-tion/ day	98,43	Connec-tion/ day
	Ianc	34,23	&	21,56%	&
	Connec-tions	48.432	units	60.039	units

Table 1: Comparison of Projected and Achieved Indicators in Losses.

ANALYSIS AND DISCUSSION OF RESULTS

When we observe the evolution of the Economy (m3/month) related to the Grajaú Supply Sector over the years (2015-2018) it is possible to identify small variations month by month, which were justified by questions of temperature and demand, but generally not there was one more significant development in the economy. This meant a stagnation in the level of losses, compatible with the values made available in the maintenance of the system.

Julian Thornton, a component of the IWA task force, points out in Aquino (2007) that: "When you are trying to reduce losses, continuous management is necessary. It is more important than the technique itself, if you don't manage it continuously, you won't be able to reduce losses in a sustainable way"

Up to "how much" must loss reduction be pursued? The "technical limit" for losses at a given location ("inevitable" losses) was previously defined, but there is another limit, almost always above that, which is the "economic limit", that is, there is a point at which costs to reduce losses (in the case of this example, the real ones) exceed the costs of production and distribution of water (or the marginal costs for the development of a new water producing system) reflects TARDELLI (2016).

It was this reality that led to the proposed investment, and the objective of causing a rupture in the indicators of the Grajau supply sector, as shown in figure 11, which was largely achieved and even surpassed as we can see in the chart below.

As improvements implemented throughout the term of the contract, we also have

- Optimization of manpower, materials and equipment resources;
- Optimization of the execution time of activities and/or operations
- Reliable macromeasurement framework
- Guarantee of improved operational efficiency, better recovery of supply
- New structure of Pressure Reducing Valves.

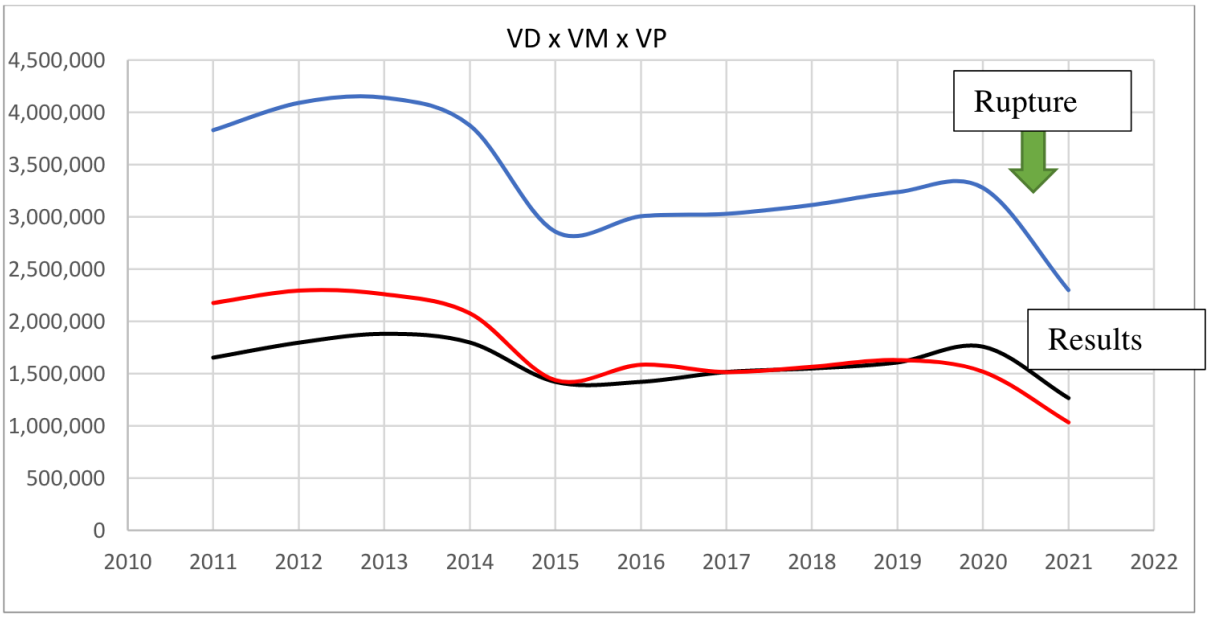


Figure 11 – Graph showing the reduction in Losses Volume and target of 18% of VP, breakage in Losses.

CONCLUSIONS/ RECOMMENDATIONS

The study of the new Sectorization, carried out in 2017, for the implementation of the new Marilda sector supported by hydraulic modeling, combined with good proposals and consistent execution, managed to break an established level in losses in the Grajau Sector and safely point out the indicators of losses in the new Marilda sector.

Investments in loss reduction have the effect of improving the quality of services by improving management and operational control, and with tools such as hydraulic modeling and qualified engineering professionals, it becomes possible to predict the final results with great assertiveness.

Finally, we bring the record made by TARDELLI (2016) of a speech by LAMBERT (2013), and summarizes the effort made in this work:

> "The first step is to be honest and admit that you have a problem; then begin to quantify this problem and prioritize the most appropriate sequence of actions for each system's situation. Don't be afraid to listen and learn from the experience of your team and others. There is no 'straightforward', no magic bullet, only gradual progress achieved through rational methods, applied by dedicated professionals, and supported by a management that truly recognizes that loss management is an ongoing activity, and forever."

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