CASE STUDY

Cape Agulhas Municipality's Transition Towards a Smart City 2.0

Cape Agulhas Municipality – Western Cape

Smart monitoring and management of groundwater sources to ensure long term sustainability.

Challenge

Cape Agulhas Municipality (CAM) is located in the Overberg district (**Figure 1**) and covers approximately 2 411km^2 with in-land towns of Bredasdorp and Napier, the coastal towns of Arniston, Struisbaai, L'Agulhas and Suiderstrand and the rural settlements of Protem and Klipdale. Elim, a private town, also falls within the jurisdiction this municipality. The jurisdiction of this municipality is in Bredasdorp.

Figure 1. Location of Cape Agulhas Municipality.

The municipality relies heavily on groundwater for water provision to the nine towns. Meticulous groundwater monitoring is required by the municipality to ensure adequate supply to the communities, especially over the end-of-year break when holidaymakers visit the coastal areas. It is therefore imperative to ensure the sustainable use of groundwater.

Historically, the municipality has relied on manual monitoring of the bulk water system, which has made it difficult to effectively manage the system, reduce non-revenue water and meet the monitoring requirements for its Water Use Licences. Manual monitoring of the boreholes and reservoirs entailed driving out to the borehole site (sometimes as much as 50km) to conduct measurements. During the Easter and Christmas breaks, manual reading trips can occur as often as 21 times a week, significantly contributing to the operating costs (vehicle expenses, fuel expenses and salaries) of the municipality.

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Solution

In order to address this challenge, the municipality identified the need to upgrade its groundwater monitoring and management system to leverage smart monitoring technologies. This upgrade forms part of a broader municipal objective of transitioning towards a "Smart City 2.0", which focuses on enhancing residents' experience by operating at the intersection of the digital transformation and human-centred design. The municipality appointed a service provider with the ability to work across data network, hardware and software, to help it develop a roadmap to transition in a phased approach.

The first phase involved setting up a municipal-wide Internet of Things (IoT) network using LoRaWAN technology, which, in addition to bulk water monitoring, will be applied to other elements of the project, such as reporting on air quality and residential smart water metering. The municipality owns the LoRaWAN network but pays a service provider a monthly fee to maintain and calibrate the remote monitoring equipment.

Once the municipal-wide network was deployed it enabled the second phase of the solution to commence.

This entailed the service provider digitising the related water infrastructure with their proprietary hardware and software to provide near real-time data and control for the improved management of resources. Suiderstrand (a small coastal town) was chosen to pilot a smart groundwater management system of the boreholes and the reservoirs.

Piezometer tubes and level sensors were installed in the reservoirs to provide real-time information on the reservoir water levels. The reservoir pumps were fitted with variable speed drives (VSDs) and downstream flow meters, to monitor and control the flow of water, based on inputs, such as the reservoir level or time of day.

The boreholes were also fitted with piezometers and the borehole pumps were fitted with VSDs and downstream flow meters.

The next phase of this project will expand on the groundwater management system into the other eight towns. The implementation of Pressure Management Zones is planned to allow for improved pressure management and leak detection. The smart system will also be extended to other areas within the water management system to include water infrastructure such as bulk metering, wastewater treatment works, water purification plants as well as household metering.

> *"The overarching goal is to have a real-time holistic view of the water network which will enable the municipality to manage their water infrastructure proactively, efficiently and sustainably."*

Matter Industries' Sentinel4, solar powered smart edge hardware, giving real-time reservoir level sensing.

Smart City Benefits

1 Ensuring consistent performance in service delivery

Utilising real-time monitoring increasingly provides CAM with more robust oversight of their water resources. The outputs stemming from the Smart City initiative now give CAM **a more holistic view of the supply side of water management versus the limited view that they historically operated with.** By better understanding resource availability and utilisation, CAM can now make more informed decisions and implement remedial measures in a more productive and prudent manner. They can thus more effectively manage the health and longevity of their aquifers.

2 Reduction in operating expenditure

Remote monitoring has brought about considerable financial benefits for the municipality. The savings associated with the reduction in time and effort to perform manual readings of boreholes, reservoirs and dams is **forecast to generate a return on investment (ROI) of 32% over three years.** This ROI is projected to increase to 103% over a five-year period.

The significant reduction in time spent on performing manual readings has enabled CAM to free up its infrastructure resources to concentrate on other activities that further improve the efficiency of service delivery, such as addressing sources of non-revenue water. This reallocation of resources has enabled CAM to **reduce its spend on manual reading related wages by roughly R1.2m.**

Based on the benefits observed to date, CAM anticipate total annual savings of R1.4m compared to an initial investment of R2.7m resulting in a project payback period of 24 months on their initial capital outlay.

3 Improving CAM's sustainability credentials

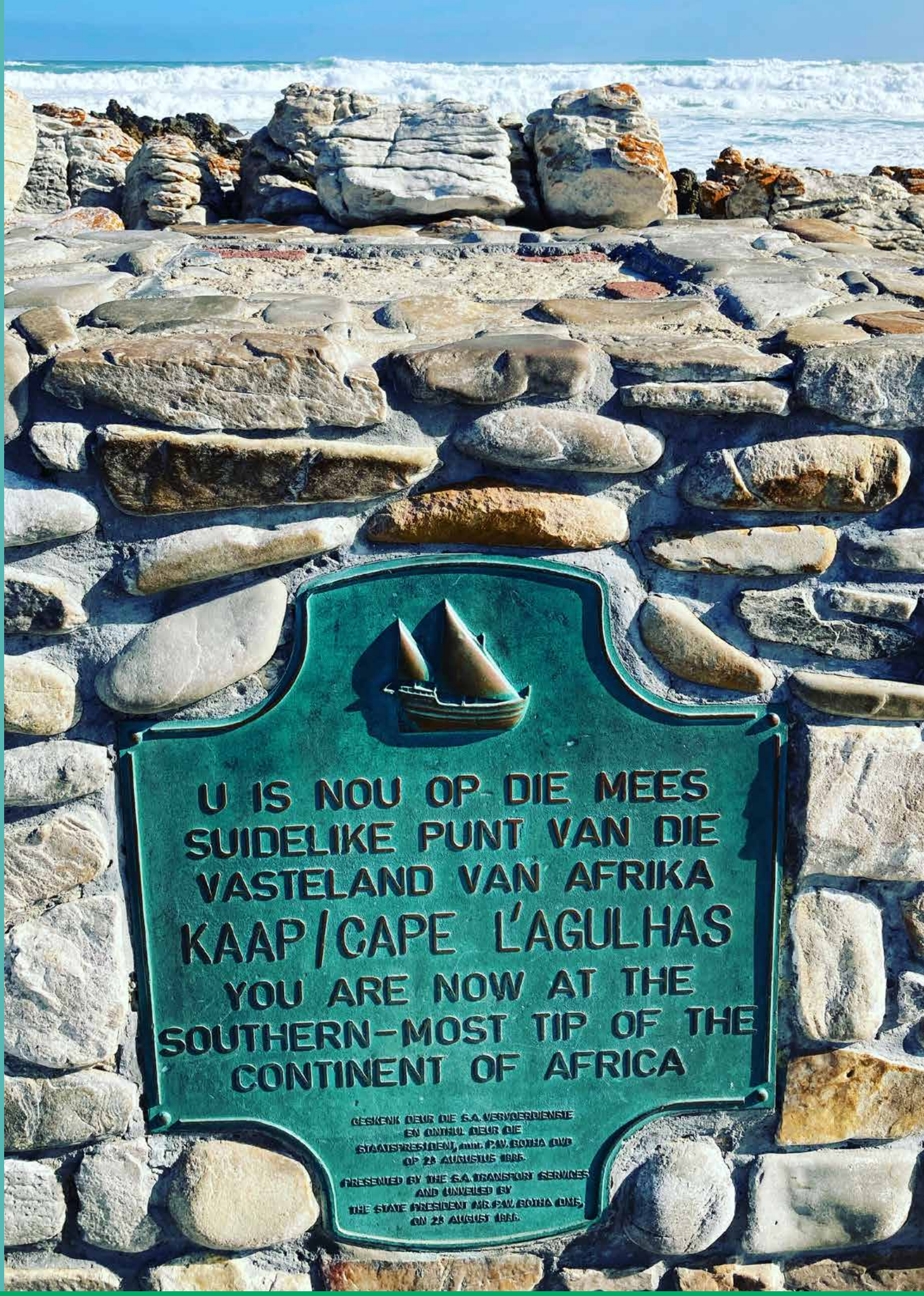
Remote monitoring has driven an 83% reduction in the number of trips undertaken to perform manual readings. Based on trip savings observed to date, the municipality anticipates a reduction of 50 279km in travel per annum. This travel saving represents an **80% reduction in carbon emissions** associated with bulk water monitoring and furthers CAM strategic imperative to enhance service delivery on an environmentally sustainable basis.

Table 1: Projected savings from real time monitoring

CATEGORY	BASELINE	FORECAST	SAVING	REDUCTION
Number of trips per week	93	16	77	83%
Distance covered per year (km)	63 164	12 884	50 279	80%
Travel cost per year	R265 287	R54 114	R211 173	80%
Labour cost per year	R1 396 677	R248 395	R1 148 282	82%

Table 2: Reduction in CO_2 emissions

BASED ON SA AVERAGE DIESEL VEHICLE (166 GCO2/KM)	
Baseline annual emissions (tCO_2)	10.49
Forecast annual emissions (tCO_2)	2.14
Reduction (tCO_2)	8.35
% Reduction	80%


U IS NOU OP DIE MEES
SUIDELIKE PUNT VAN DIE
VASTELAND VAN AFRIKA
KAAP/CAPE L'AGULHAS
YOU ARE NOW AT THE
SOUTHERN-MOST TIP OF THE
CONTINENT OF AFRICA
GESKENK DEUR DIE S.A. VERVOERDIENSTE
EN ONTHUL DEUR DIE
STAATSPRESIDENT, mnr. P.W. BOTHA DMD
OP 28 AUGUSTUS 1986.
PRESENTED BY THE S.A. TRANSPORT SERVICES
AND UNVEILED BY
THE STATE PRESIDENT MR P.W. BOTHA DMS,
ON 28 AUGUST 1986.

Smart City Benefits

Reduction in consultancy fees

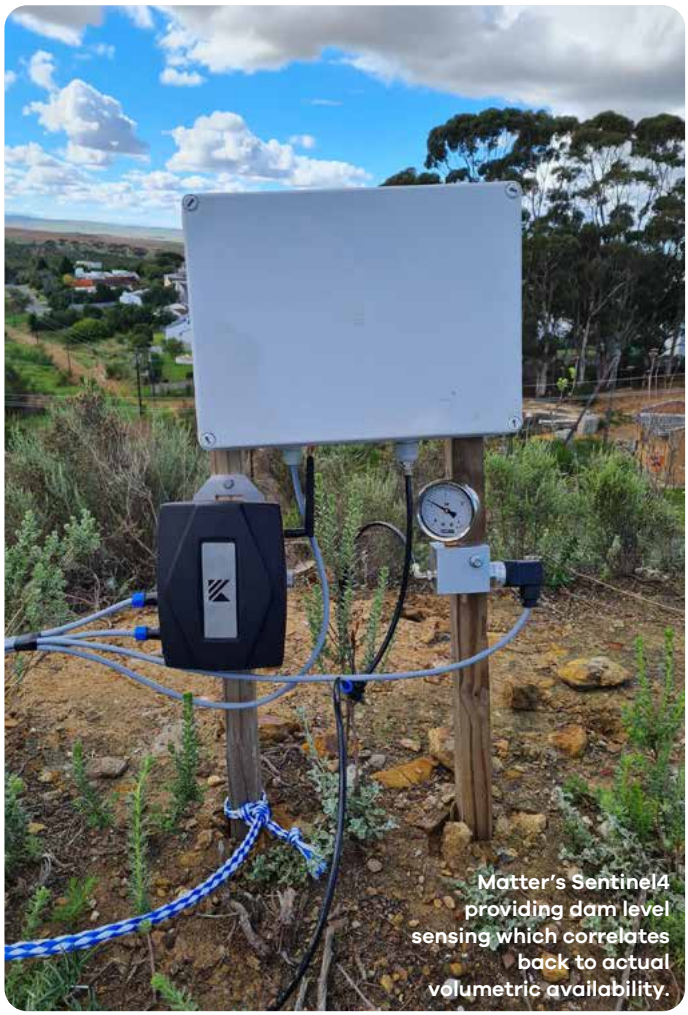
Accurate records of groundwater abstraction volumes per borehole are critical for aquifer management and protection, as well as to comply with DWS water use licensing conditions. The need to hire outside consultants on a bi-annual basis to design a groundwater management plan has decreased to an annual basis and may decrease further in the future as the system implementation expands. This is mainly because the municipality now has access to accurate real-time data and can adapt groundwater management strategies accordingly.

Enhancing operational efficiency

The ongoing implementation of variable speed drives (VSD) versus legacy technologies such as min-max control systems will also positively contribute to resource management. The VSD solution will increasingly provide CAM with the ability to remotely control pumps on a schedule or using algorithms enabling CAM to more efficiently manage pumping schedules and reduce energy consumption. The solution is currently being rolled out in Suiderstrand – a town that is entirely reliant on groundwater. Thereafter it will be implemented across all towns in the municipality.

Reduction of non-revenue water

With the current borehole monitoring and management system in place CAM is able to monitor night time flows when consumption is expected to be low. There have been occurrences where high flows have been observed in off-peak times signalling potential infrastructure failure which could then be resolved proactively.



Matter's Sentinel4 providing dam level sensing which correlates back to actual volumetric availability.

Matter's Sentinel4 providing borehole depth and flow rates on a real-time basis.

Challenges and lessons learned

1. **It is imperative that smart systems address a well-defined problem.** In the case of this municipality, the need for improved groundwater management was identified as the key challenge with quite a bit of time spent to deep-dive into possible solutions.

2. **It is therefore imperative that smart systems address a well-defined network infrastructure,** which can be complex to implement and cannot always be applied as a solution when the problem is not well defined and understood. The municipality then runs the risk of the system not being used by the municipal officials.

3. **CAM attributes the success of this project in part to the identification of a pilot town, being Suiderstrand.** This is a small coastal town where design and programming snags could be rapidly identified and rectified whilst not disrupting a major segment of the municipality.

4. **A key success factor was getting political and management support for the groundwater project and vision of becoming a Smart City 2.0.** During the development of the Smart City Strategy all relevant stakeholders were consulted. It was important to understand the needs of the municipality as a whole. Stakeholder engagements proved to be instrumental in developing the Smart City Strategy and both politicians and municipal employees across all departments were engaged. This process about 8 months. The inclusive stakeholder engagement strategy proved to be especially valuable when major changes in leadership and political management occurred.

5. **Inter-departmental collaborations are key to the success of the implementation of such a project.** Communication channels need to be open. In this instance the water and IT department worked closely to implement this project.

6. **Most of the boreholes and reservoirs are remotely located, further highlighting the need for a reliable available network.** As such, the tender required the appointed service provider to implement a proprietary IoT network (LoRaWAN) for the municipality. Other network related challenges included issues such as overcoming electrical interference. Once all base stations were established it gave them the ability to install sensory equipment not only relating to this project, but for any future sensory or IoT based projects as identified by the municipality.

7. Procurement in the municipal sector is often one of the most cumbersome and daunting challenges. **Planning of this project proved to be a key success factor.** The municipality spent eight months developing the requirements of the tender and included key specifications to address various aspects and goals of the project. One of these relates to IoT development and projects related to infrastructure and infrastructure management.

8. **Appointing an agile service provider that has the right capabilities is instrumental to the successful implementation of such a project.** CAM acknowledged that not all elements could be provided by a singular entity and chose to rather appoint a service provider with the ability to be agile in their methodology and inclusive of other service providers in their design of solutions to contribute towards economic development in other sectors.