

ADB



Knowledge Sharing Seminar

Overview of Taiwan Water Corporation's Water Loss Management and Smart Water Management

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Overview

I. About TWC

II. Water Loss Management

III. Smart Water Management



I. About TWC

■ History of Taiwan Water Corporation (TWC)

- Before 1974, most cities, counties or towns in Taiwan had their own water treatment plants
- In 1974, TWC was set up by merging 128 water treatment plants for increasing overall operational efficiency, and became a public enterprise
- In 1999, TWC has become a state-owned enterprise set up under Ministry of Economic Affairs (MoEA)



I. About TWC

■ Statistics

by the end of 2017

Water Supply Systems

144

Water Supply Capacity

11.82 million CMD

Average Daily Water Supply

8.79 million CMD

Percentage of Population Served

92.76%

Customers

6.98 million

Pipe Length

61,458 kilometers

Average Water Tariff of Taiwan
(surveyed by IWA, 2016)

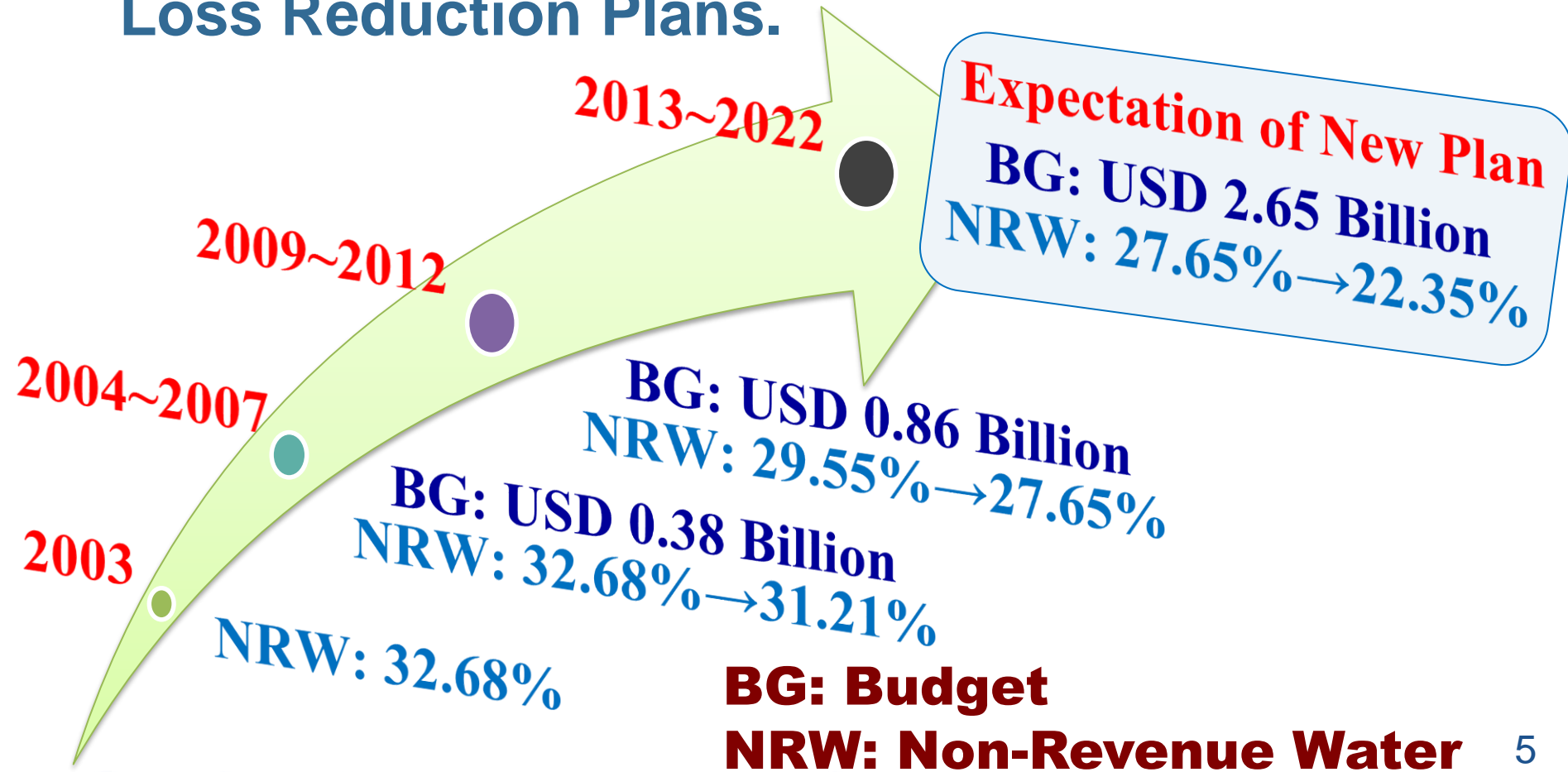
USD 0.308/M³
(one of the lowest
in the world)



I. About TWC

■ Water Loss Reduction Plan

- Since 2004, we have been implementing Water Loss Reduction Plans.

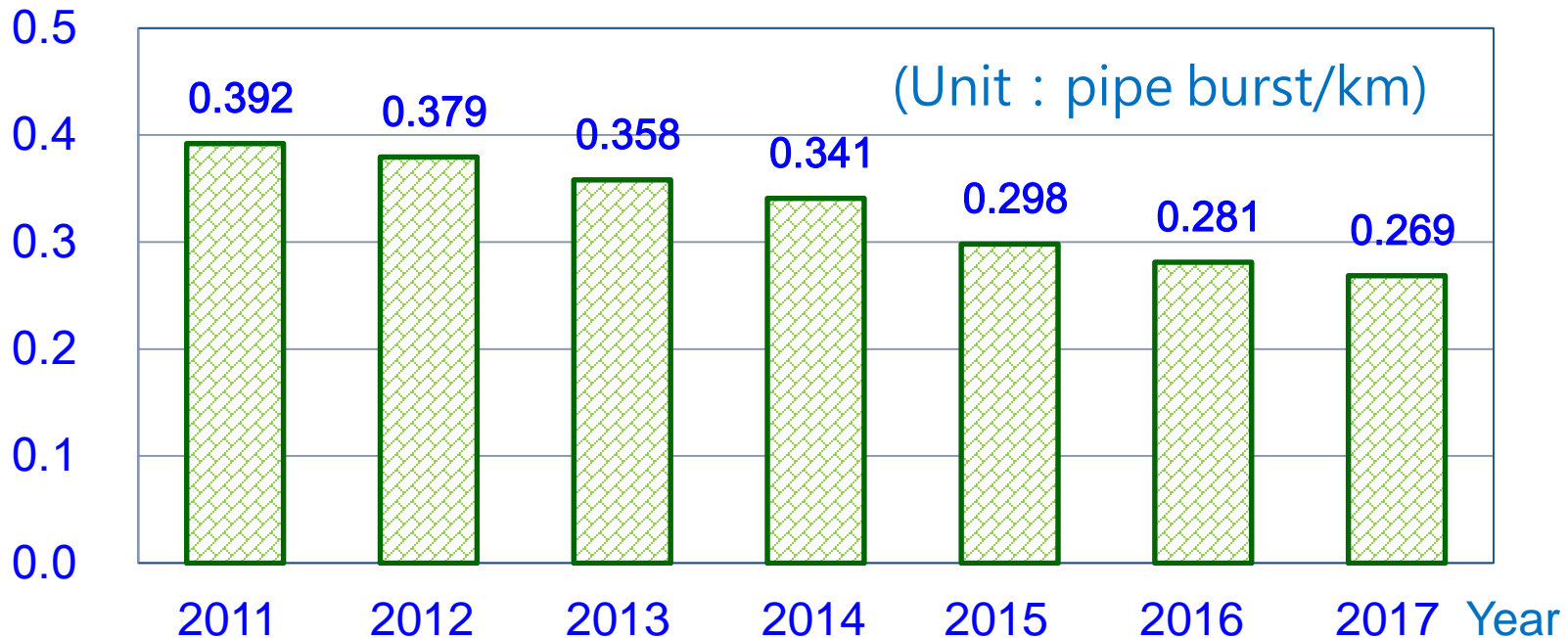




I. About TWC

■ Achievement

- The NRW has come down from 32.68% (2004) to 23.59% (2017).
- Pipe burst frequency has come down from 0.392(2011) to 0.269(2017).



I. About TWC

■ Real Losses Management Strategies

- We follow best practice in the Water Loss Reduction Plan.
- It includes.....



II. Water Loss Management

Water Pressure Management

➤ Our Strategies include...

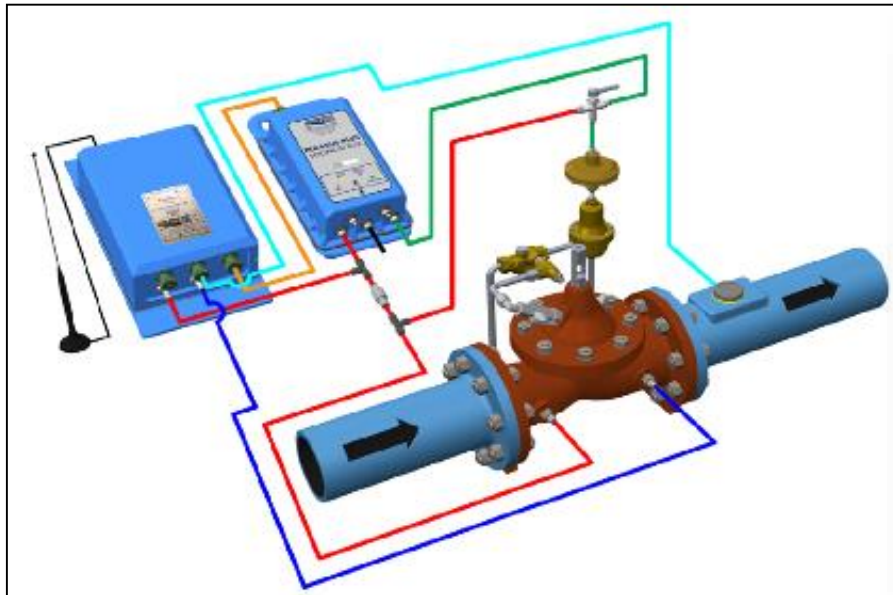
- installing Variable-frequency Drives in water treatment plants and pumping stations
- establishing water pressure monitoring stations
- installing pressure reducing valves (PRV)



II. Water Loss Management

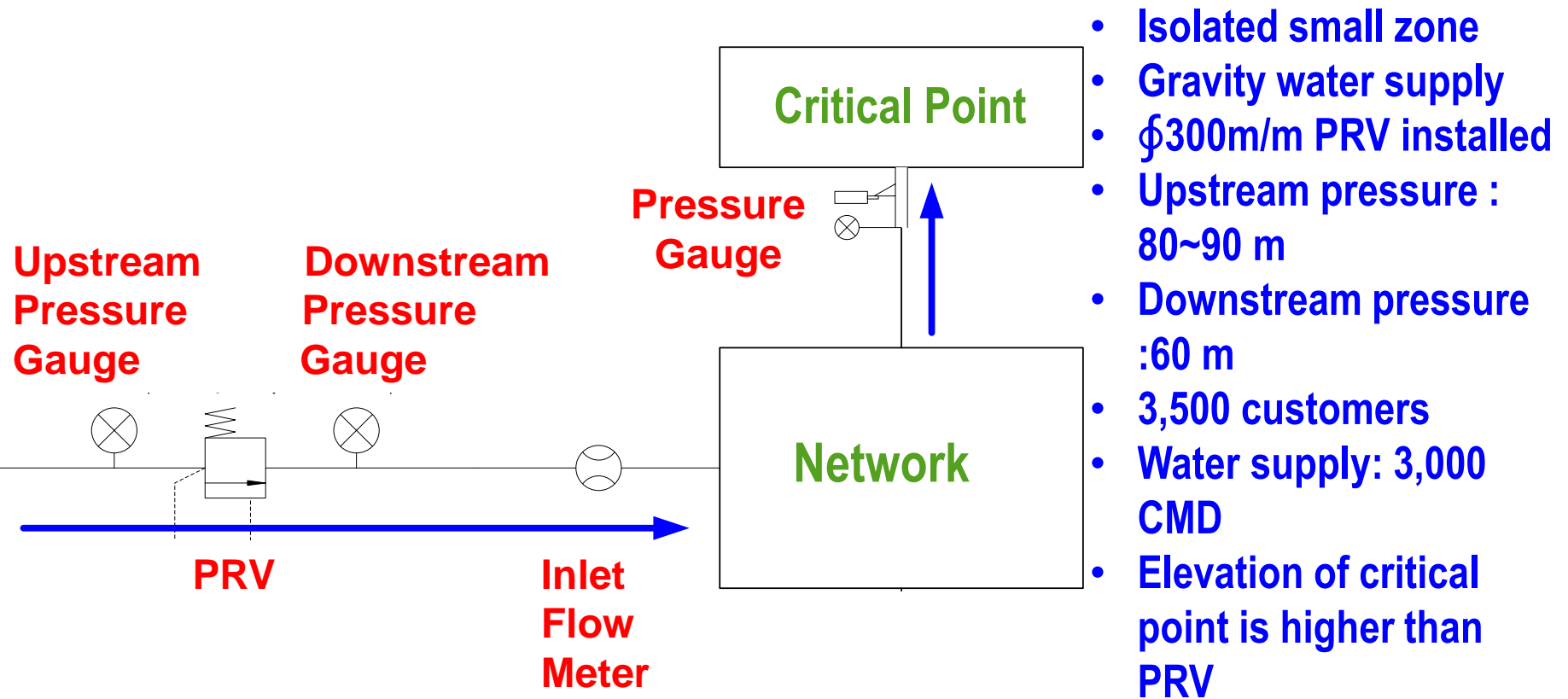
- installing Advanced Water Pressure Control System

- It means installing an advanced water pressure controller on the pressure reducing valve (PRV) to adjust outlet pressure for meeting critical point customer's need.



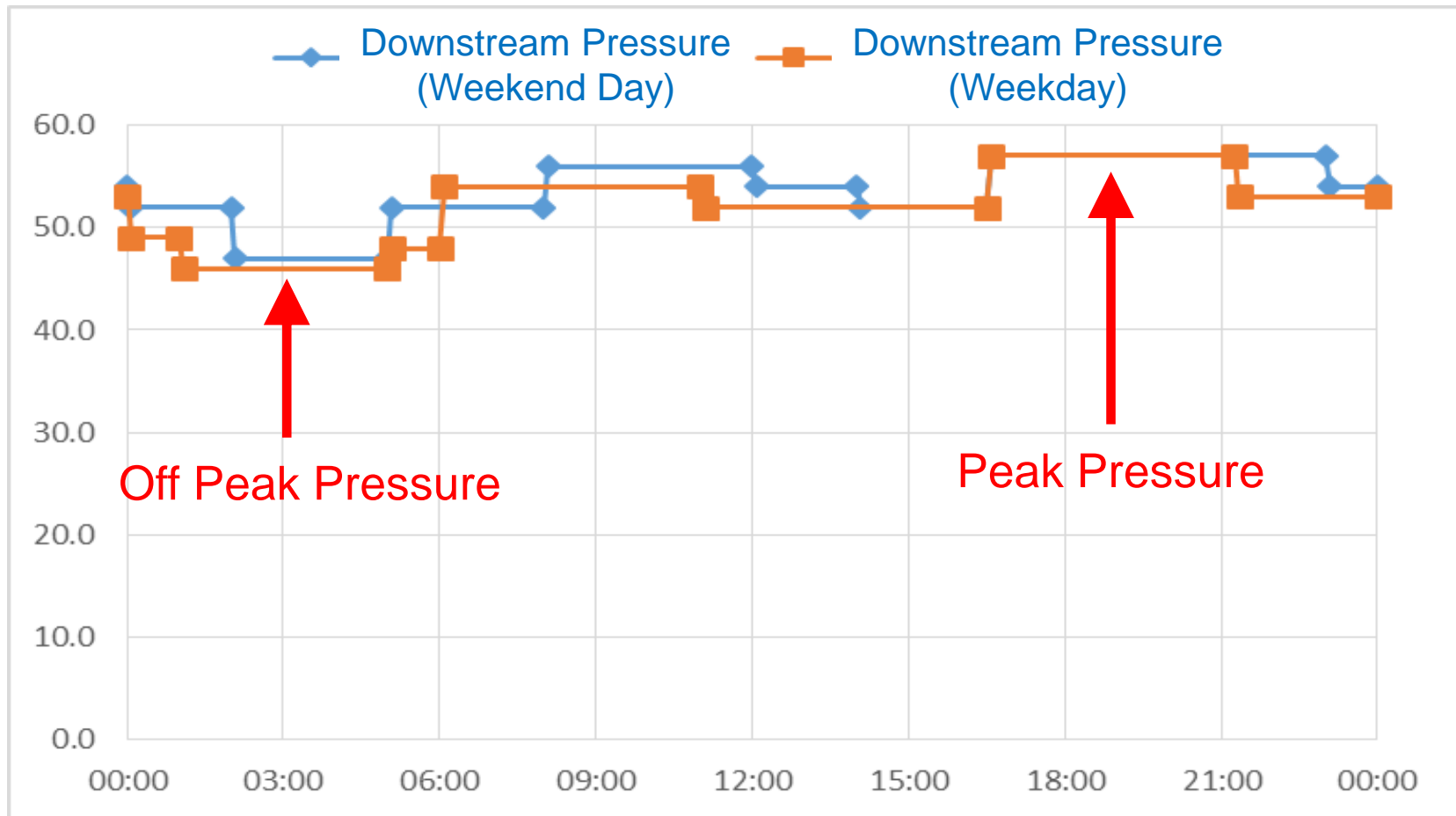
II. Water Loss Management

Case Study: Gong-guan DMA, Miaoli County, Taiwan



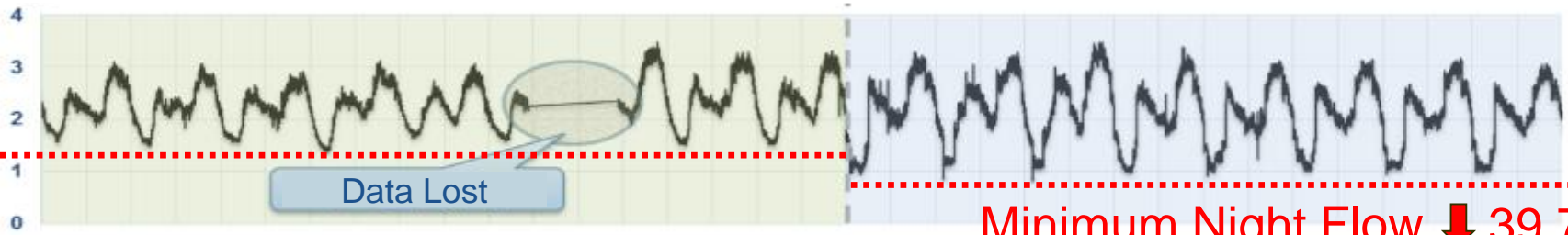
II. Water Loss Management

We adopted time-based modulation setting of this advanced water pressure controller ...



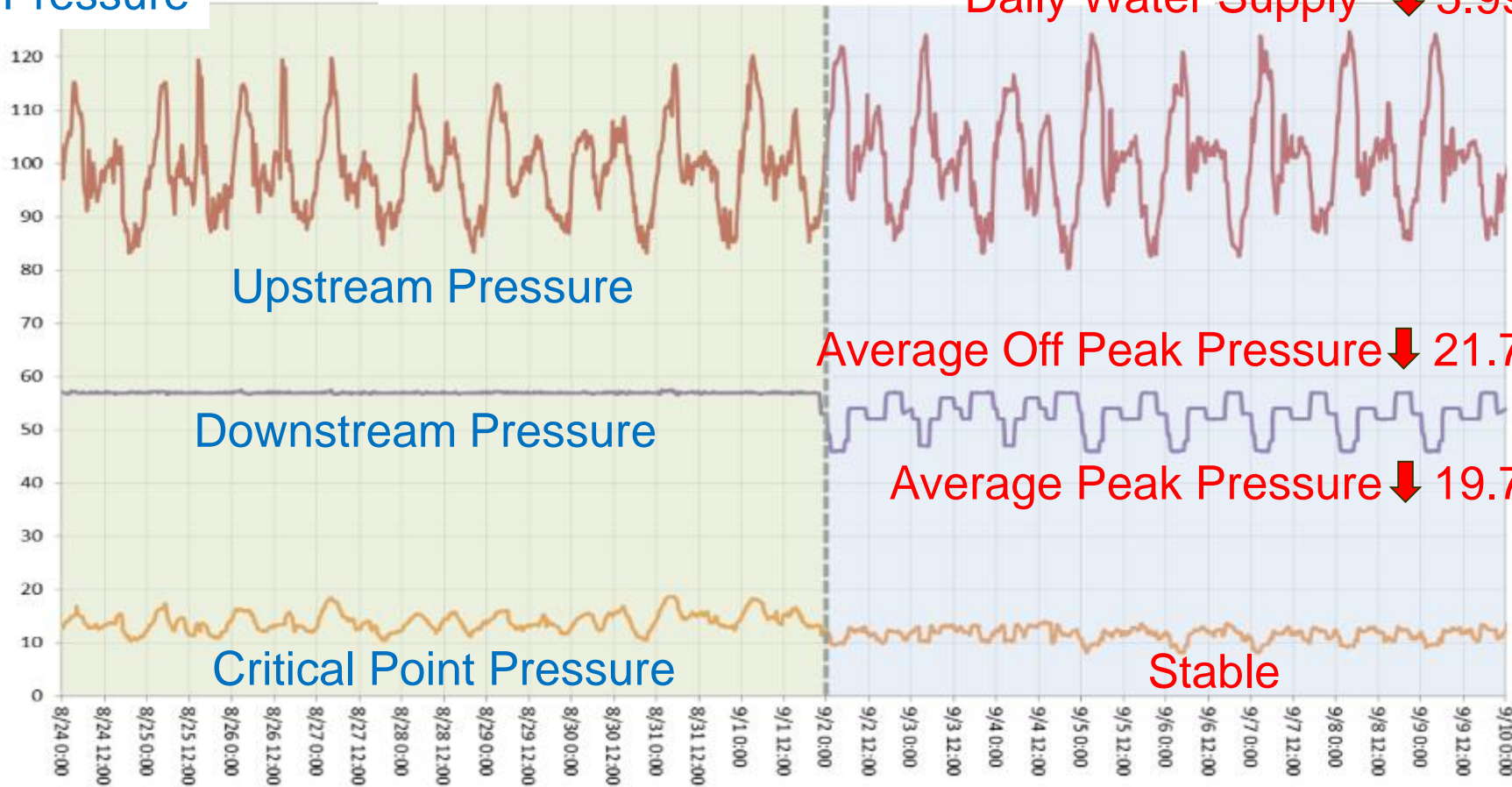
← Before Control → | ← After Control →

Flow of PRV



Minimum Night Flow ↓ 39.7%
Daily Water Supply ↓ 5.99%

Pressure



Average Off Peak Pressure ↓ 21.77%
Average Peak Pressure ↓ 19.71%

Stable



II. Water Loss Management

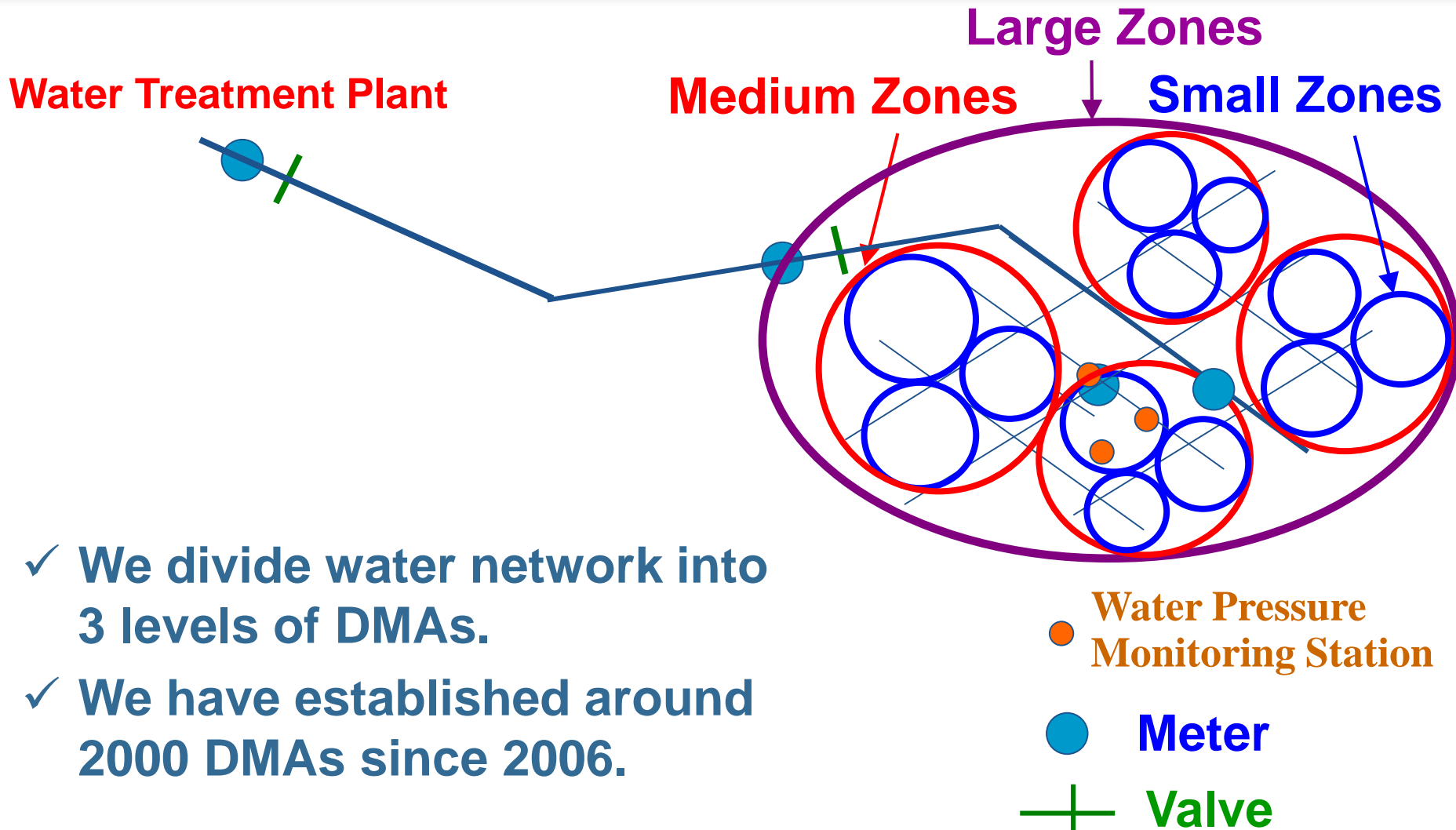
Active Leakage Control

➤ Our strategies include...

- implementing Annual Water Loss Detection Plan
- establishing and maintaining District Metered Areas (DMAs)

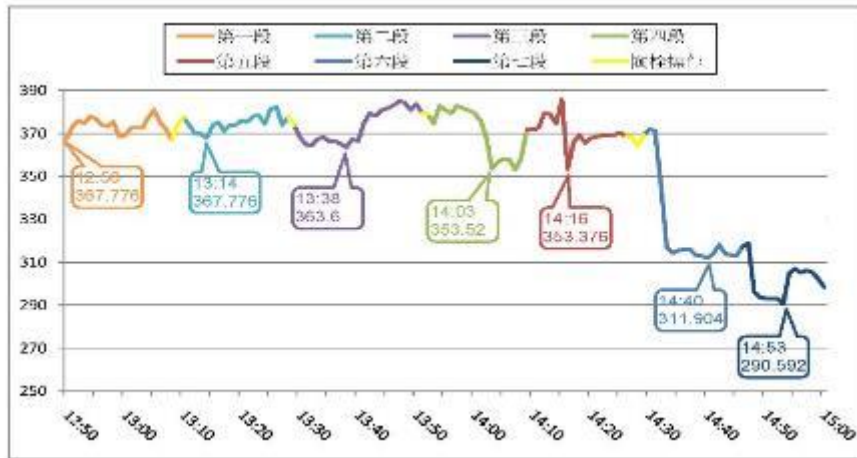
• DMA means a hydraulically isolated sub-zone in a distribution network for which the water consumption is monitored by water meters.

II. Water Loss Management



II. Water Loss Management

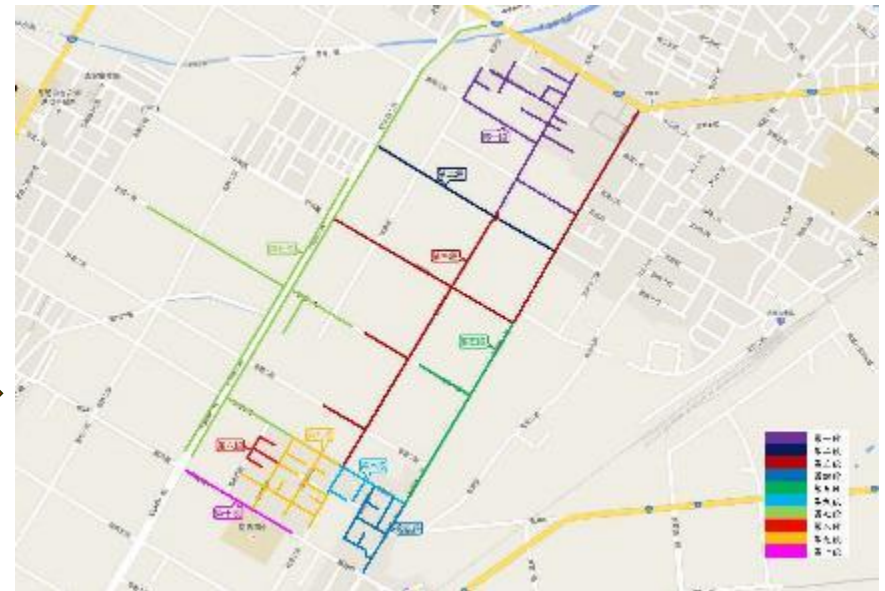
Step Test



管段	漏水量	口徑(mm)	管種	管線年份
一	34.6CMD	80,100,200	PVCP,DIP,DIP	2002,2012,2006
二	16.2CMD	50	PVCP	1987
三	74.9CMD	80,200,200,200	PVCP,DIP,DIP,DIP	1989,1998,2006,2012
四	45.1CMD	80	PVCP	無資料
五	164.5CMD	200	DIP	1998
六	72.9CMD	80,200	PVCP,DIP	無資料,1999
七	430.6CMD	100,200,300,400	PVCP,DIP,SP,SP	無資料,1999,1996,1996
八	16.6CMD	80	PVCP	無資料
九	33.1CMD	100,200	PVCP,DIP	無資料,1999
十	132.5CMD	300	DIP	1999
合計	1020.9CMD			

Leakage Calculation

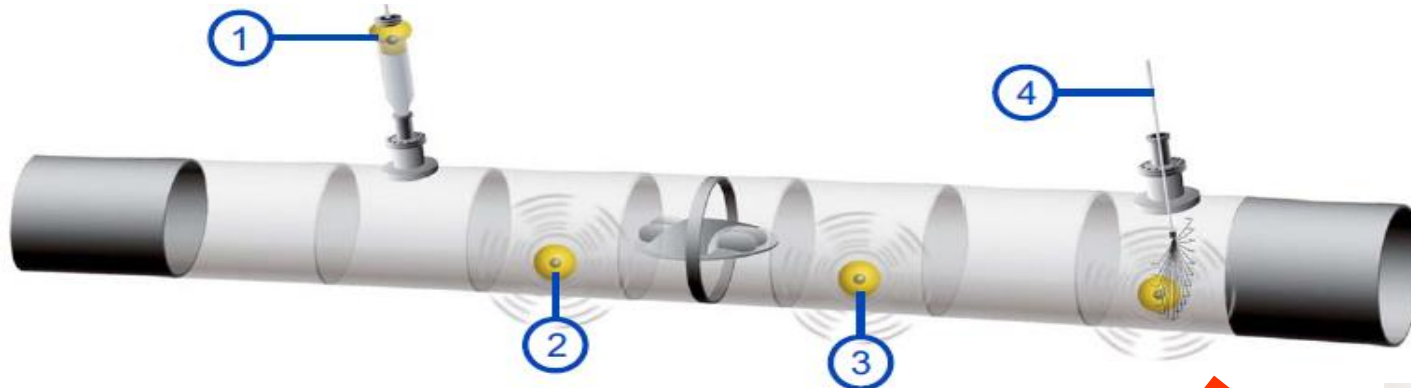
✓ In case of leakage recurrent or high frequency leakage in DMAs, we'll replace those pipe sections ASAP.



Distribution Diagram of Leakage

II. Water Loss Management

- **Case Study:** We have adopted SmartBall leakage detection technology in large diameter pipelines ...
- for leakage detection and condition assessment
 - innovative free-swimming in-line leakage detection technology designed to operate in a live pipeline

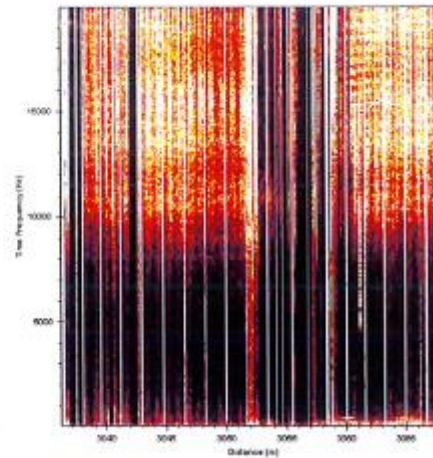
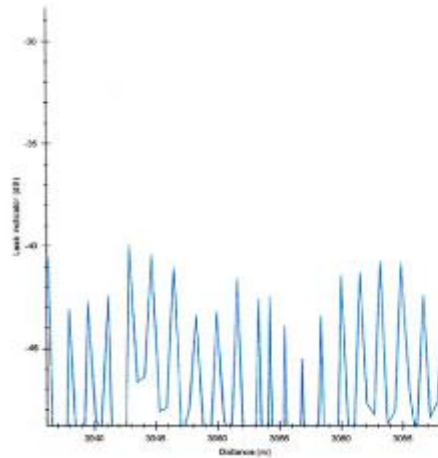


- ①- inlet point
- ②③- leakage detection
- ④- retrieval point



source: <http://www.puretechltd.com>

- ✓ The pilot project was in north of Taiwan in 2011.
- ✓ We found that $\phi 1,000\text{mm}$ PCCP was leaking, but the leaking points were difficult to detect.
- ✓ Pipe Length of Leakage Detection was 6.5km.



Sound spectrum



II. Water Loss Management

- Result:
We found 4 leaking points.



a leaking exhaust valve

II. Water Loss Management

Speed and Quality of Repairs

➤ Our strategies include ...

- establishing leakage repair management information system to record repair information, location of leaking point, expenditure, etc.



The screenshot shows a software interface with a search form at the top and a table of repair records below. The search form includes fields for '事件編號' (Event ID), '開始時間' (Start Time), '結束時間' (End Time), '事件位置' (Event Location), and '事件方式' (Event Type). The table has columns for '地址' (Address), '案號' (Case No.), '受理時間' (Received Time), '事件位置' (Event Location), and '現狀及位置' (Status and Location). A red circle highlights the third row of the table, which is also pointed to by a red arrow from the map on the right.

地址	案號	受理時間	事件位置	現狀及位置
	SP0902180	20101103 11:35	雲林縣斗南鎮中正路(在黃市頭的旁邊)	●
	SP0902181	20101103 11:37	斗南鎮南門外(在黃市頭的後面)	●
	SP0902180	20101103 11:37	雲林縣斗南鎮南門外(在黃市頭的後面)	●
	SP0902189	20101103 12:00	斗南鎮南門外(在黃市頭的後面)	●
	SP0902188	20101103 10:15	斗南鎮大林東街(在黃市頭的後面)	●
	SP0902187	20101103 10:40	雲林縣斗南鎮南門外(在黃市頭的後面)	●
	SP0902186	20101103 10:40	雲林縣斗南鎮東仁里(在黃市頭的後面)	●
	SP0902185	20101103 10:40	雲林縣斗南鎮東仁里(在黃市頭的後面)	●
	SP0902184	20101103 10:40	雲林縣斗南鎮北門外(在黃市頭的後面)	●
	SP0902183	20101103 10:40	雲林縣斗南鎮北門外(在黃市頭的後面)	●





II. Water Loss Management

- increasing Leakage Repair Rate

- **Leakage Repair Rate: the proportion of leakage that was repaired in 1 or 3 days**

Year	Leakage Repair Rate in 1 day	Leakage Repair Rate in 3 days
2013	92.92%	99.53%
2014	90.86%	98.60%
2015	92.02%	98.50%
2016	92.31%	97.47%
2017	95.35%	99.03%



II. Water Loss Management

Pipeline and Assets Management

- Our strategies include ...
 - On average we replace 800km pipelines each year (around 1.3%).
 - We set out rules for pipe replacement. The main indicators are “**age**”, “**leakage frequency** (leaking points/km)”, and “**material**”.

II. Water Loss Management

- We adopt DIP as distribution pipe , and we also adopt HIWP, SSP, or DIP (diameter under ϕ 100mm) as service pipe.
- According to our analysis, 70% of leaking points were found in the service pipes. We replace distribution pipes together with connected service pipes.





III. Smart Water Management

III. Smart Water Management

■ Basic Framework of Smart Water Management

Management Needs

Customer Service

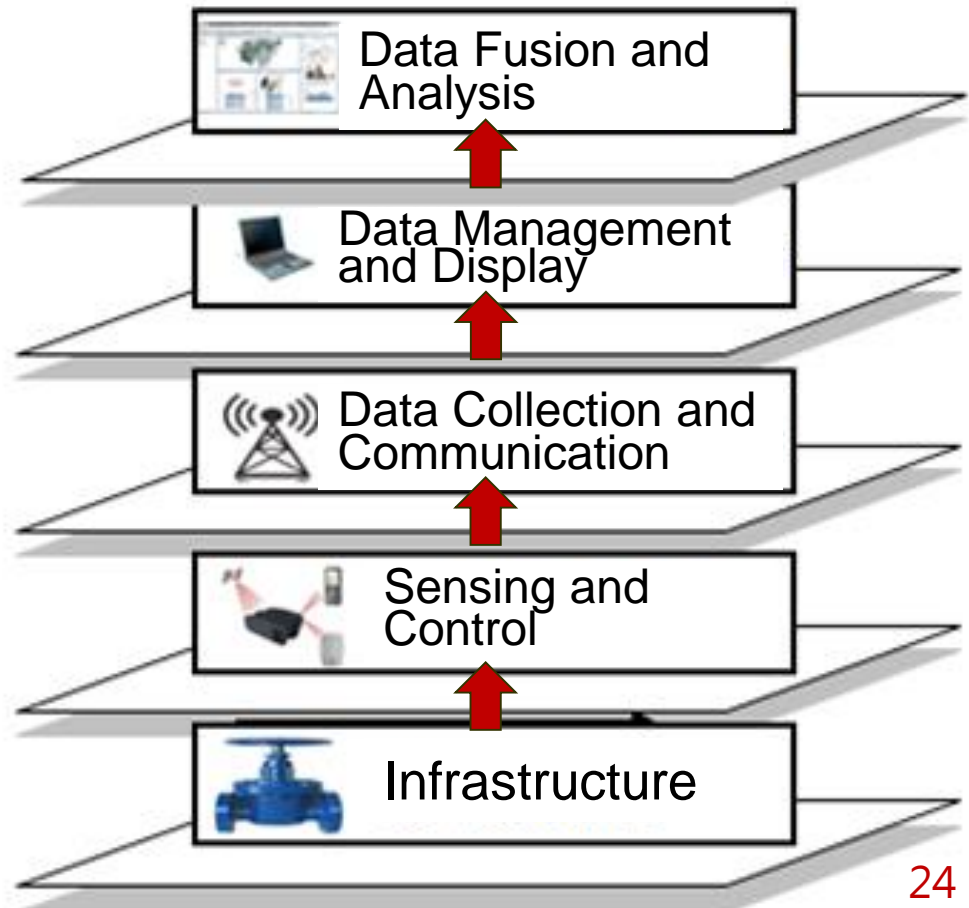
Decision-Making

Data Management

Water Supply
Monitoring

Pipelines and
Assets Management

Smart Water Framework





III. Smart Water Management

Pipeline and Assets Management

➤ **GIS establishment**

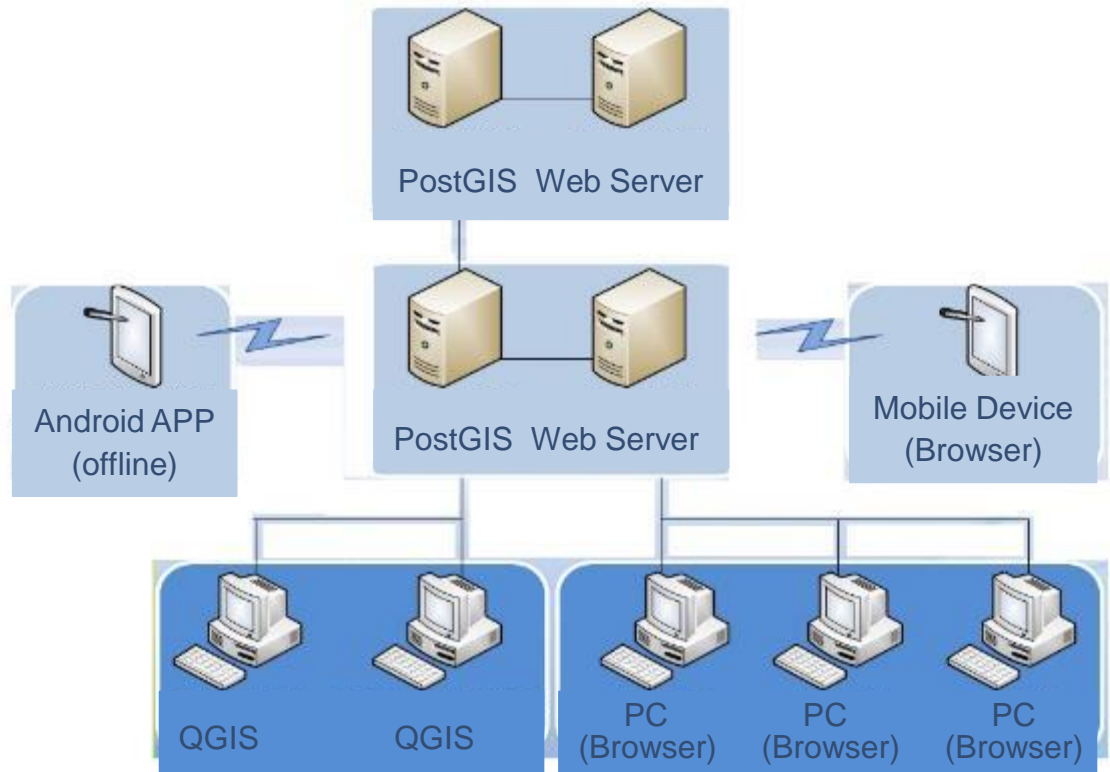
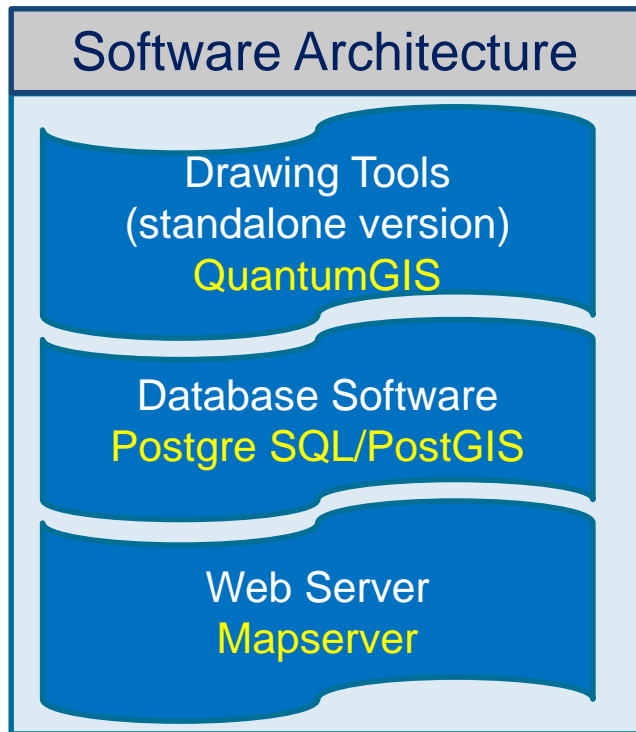
- 2004 --- Set up a “GIS Promotion Task Force”
- 2005 – 2015 --- digitalized all the paper maps into digital format
- 2016-2017 : We had upgraded GIS software to free and open-source software

• Previous GIS was costly to upgrade when new OSs were announced each time. After evaluation, we adopted free and open-source GIS software (QGIS).



III. Smart Water Management

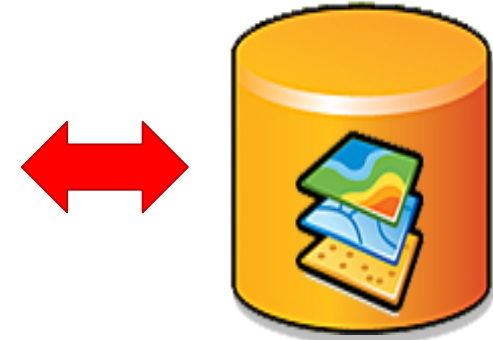
● GIS Renewal Project



III. Smart Water Management

- The spatial database consists of many map layers.

NO.	Layer Code	Layer Name
1	eumeter	Customer Meter
2	eupipe	Service Pipe
3	hydrant	Fire Hydrant
4	hydrantl	Hydrant Pipe
5	saddle	Tapping Saddle
6	meter	Bulk Meter
7	valve	Valve
8	manhole	Manhole
9	pipe	Pipe
10	station	Monitoring Station
11	stationl	Water Treatment Plant
12	smallarea	District Metered Area



Spatial Database



III. Smart Water Management

- The basic function is to display spatial data on the map.

The screenshot displays a GIS application window titled '地圖查詢系統'. The interface includes a search panel on the left and a map area on the right. The search panel shows the following information:

- 查詢單位: 第四區管理處
- 查詢對象: 閘閘
- 您查詢的閘閘: 0462006217667180400161
- 資料查詢結果:

深度 (m)	識別碼
0.000	046200621766718040016

Below the table, there is a '照片' section with the following details:

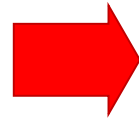
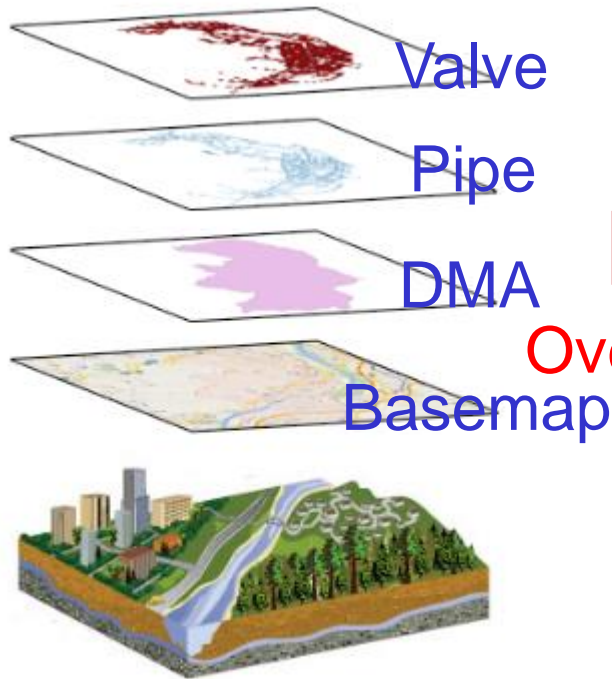
- 編號: 161
- 種類: 制水閘
- 埋設位置: [未指定]
- 深度(m): 0.000
- 埋設日期: 2011年07月20日

The map area shows a street network with labels such as '五權路', '錦南街', and '五權路一段'. Various plot numbers are visible, including '3-21號', '5-21號', '7-21號', '212-2號', '212-3號', '216號', '220號', '222號', '226號', '230號', '234號', '24號', '24-Z-2', '24-Z-19號', '24-Z-14號', '50號', '50-21號', '56號', '58號', '60號', '21號', '25號', '29號', '33號', and '37號'. A scale bar is located at the bottom left of the map area.

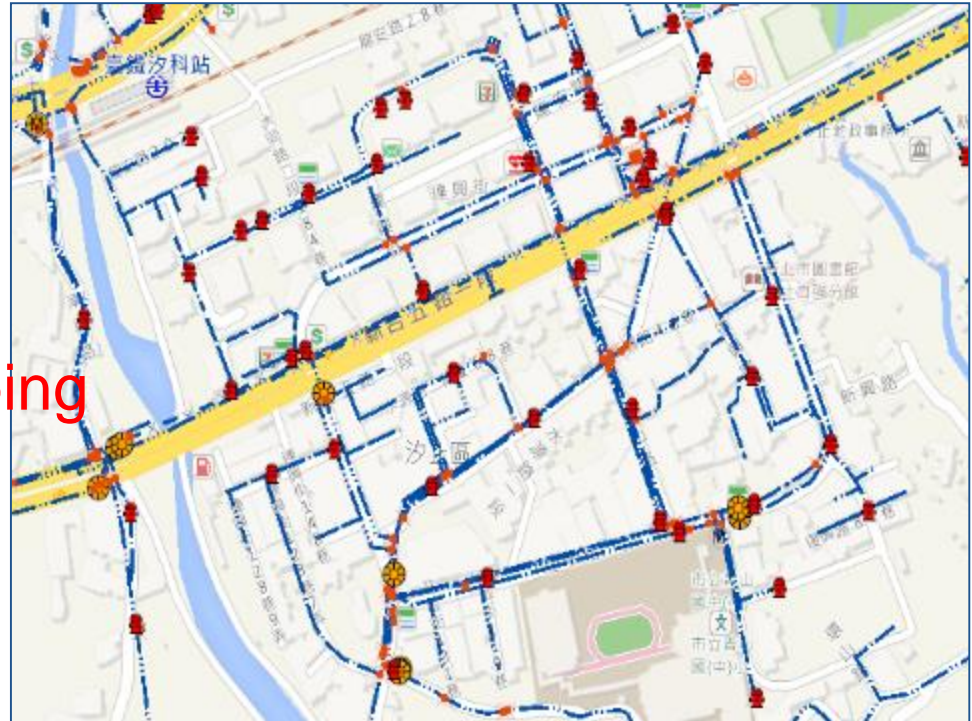


III. Smart Water Management

- We also overlap the spatial data to create theme maps.



Overlapping



III. Smart Water Management

- **Example:** We overlap the layers of material, age, information of leakage points, etc., for evaluation of pipe replacement.



Leakage Points

III. Smart Water Management

- Our GIS includes Mobile Equipment Inspection System for valves and hydrants management.





III. Smart Water Management

- We also provide API (Application Programming Interface) for sharing spatial data with external systems.

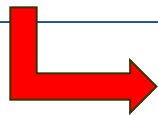
TwcApi

SOAP 1.1

下列是 SOAP 1.1 要求與回應的範例 + 預留位置顯示之處必須代入實際的值 +

```
POST /TWCapi/API.asmx HTTP/1.1
Host: localhost
Content-Type: text/xml; charset=utf-8
Content-Length: length
SOAPAction: "http://www.water.gov.tw/Coordinate"

<?xml version="1.0" encoding="utf-8"?>
<soap:Envelope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/">
  <soap:Body>
    <Coordinate xmlns="http://www.water.gov.tw/">
      <crs>string</crs>
      <x>double</x>
      <y>double</y>
    </Coordinate>
  </soap:Body>
</soap:Envelope>
```



Example: sharing spatial data with Water Outage Query System



III. Smart Water Management

Water Supply Monitoring & Data Management

1999

2002

2007

2009

2011

2013

2014

2017

➤ **Standalone Monitoring System**

- adopted PLCs (Programmable Logic Controller) to connect sensors with computers
- **standalone system for single water treatment plant without connecting to branch office**
- **User Interface of DOS**
- connected to external monitoring system by communication card





III. Smart Water Management

1999

2002

2007

2009

2011

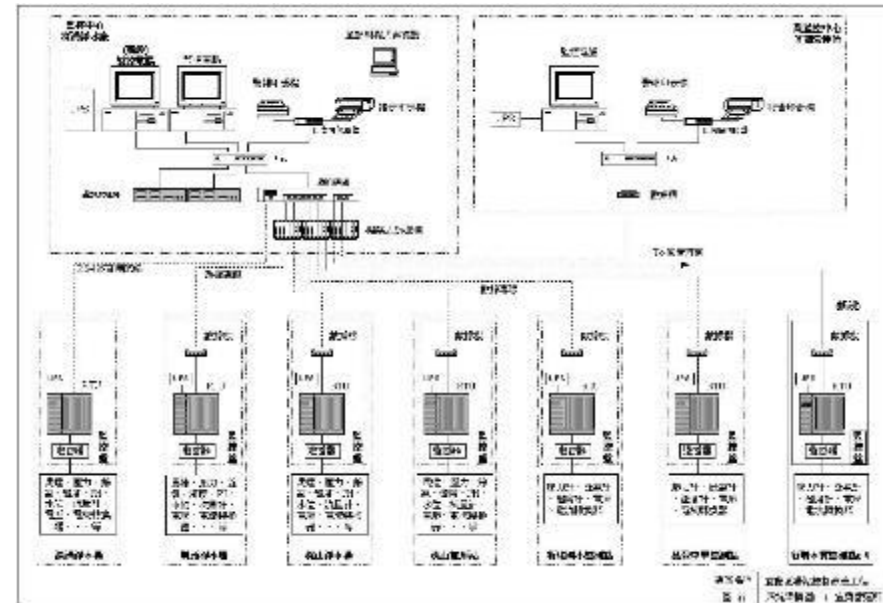
2013

2014

2017

➤ Client-Server SCADA System (1st Generation)

- adopted Client-Server architecture to integrate monitoring terminals of WTPs and branch office
- **Graphic User Interface of Windows**
- **monitoring terminals were connected to the others by dial-up internet connection (low speed)**
- new and old PLCs coexisted



III. Smart Water Management

1999

2002

2007

2009

2011

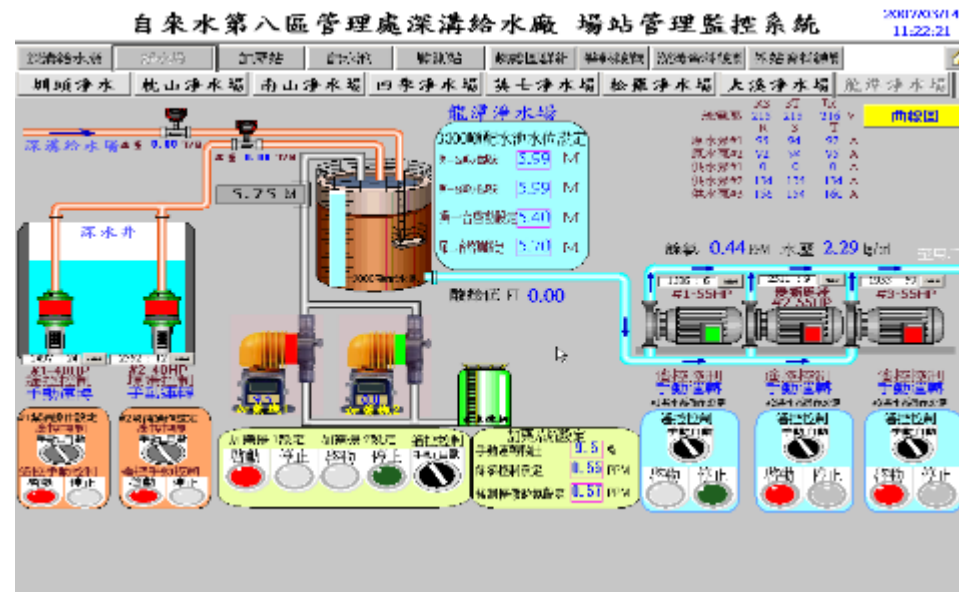
2013

2014

2017

➤ Integrated SCADA System (2nd Generation)

- upgraded and rehabilitated hardware and software
- **Graphic User Interface of Windows**
- **monitoring terminals were connected to the others by broad-band network (higher speed)**
- PLCs were Integrated and upgraded
- Started Web-based SCADA system pilot project





III. Smart Water Management

1999

2002

2007

2009

2011

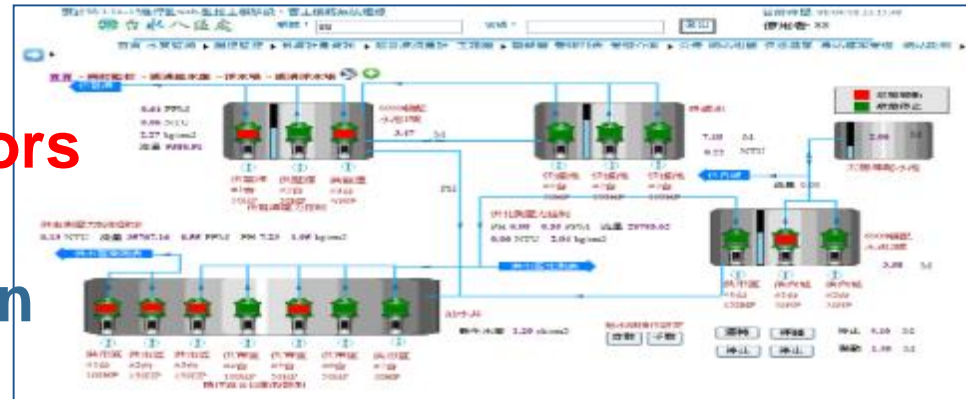
2013

2014

2017

➤ Web-based SCADA System (2nd Generation)

- shared data for administrators of branch office
- added data analysis function
- installed mobile (GPRS) pressure and flow sensing devices
- integrated Automatic Meter Reading (AMR) system into SCADA system





III. Smart Water Management

1999

2002

2007

2009

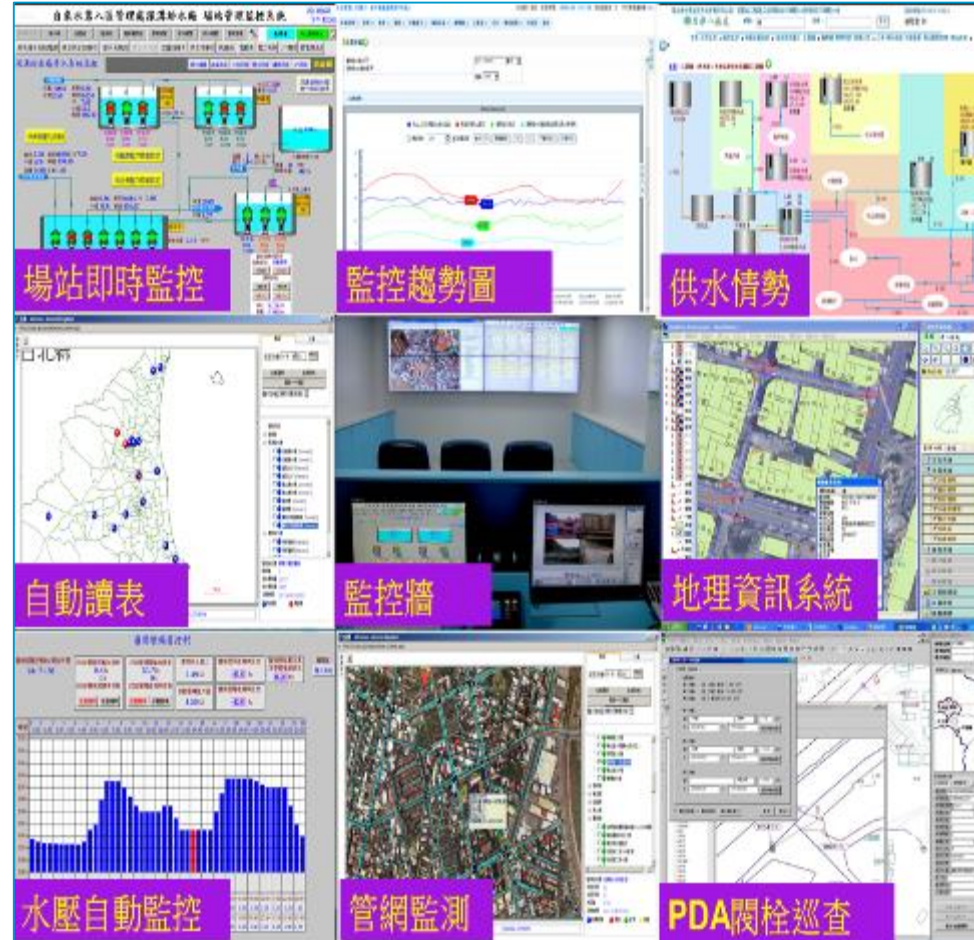
2011

2013

2014

2017

- Integrated GIS with SCADA
- established Maintenance Information System



III. Smart Water Management

1999

2002

2007

2009

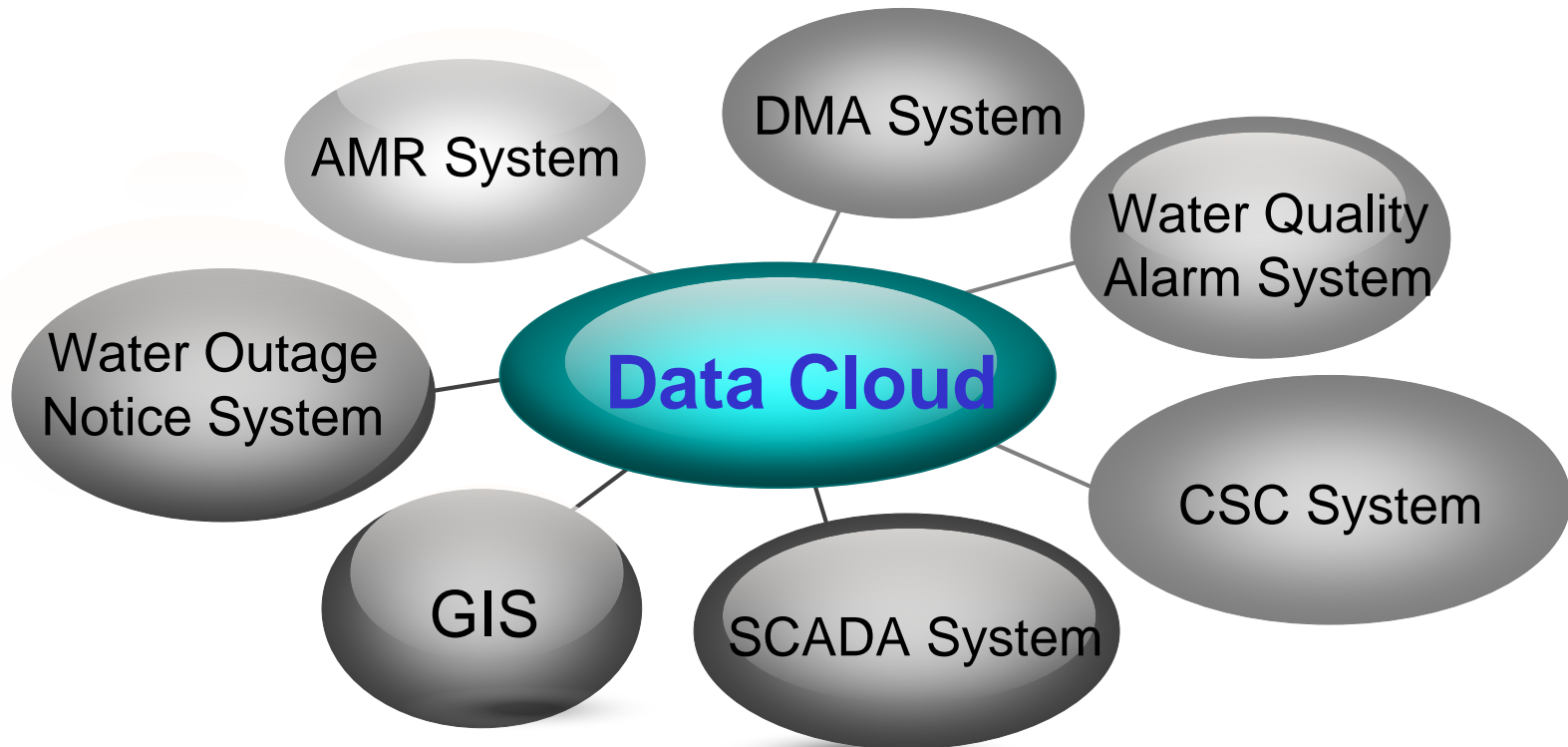
2011

2013

2014

2017

- integrated monitoring data into the data cloud built in TWC's headquarters
- Integrated Customer Service Center (CSC) System



III. Smart Water Management

1999

2002

2007

2009

2011

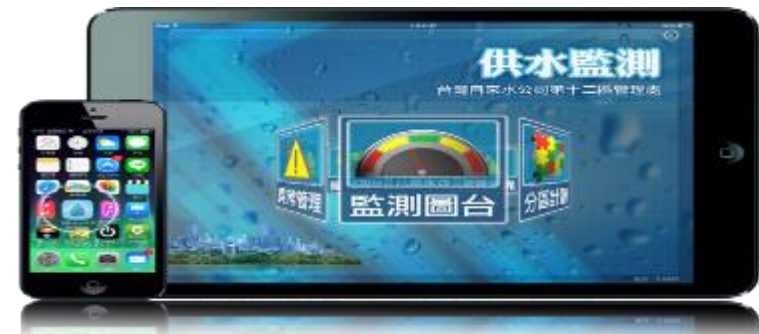
2013

2014

2017

➤ Integrated Water Treatment Plant Information System (3rd Generation)

- adopted web-based SCADA System
- remote data backup
- established Water Supply Monitoring Platform
- adopted broad-band network to communicate among sensing devices, SCADA system, WTPs, and branch offices





III. Smart Water Management



Flow Pressure


Water Quality (pH, turbidity, residual chlorine)


Water Level


Valve


Electronic Meter


• We collect 8 kinds of real-time monitoring data into Data Cloud.

監測站	傳訊點	數值範圍	瞬間值	傳訊時間	
更寮國小	餘氯		29.00 ppm	16:45:00	
	電導度		397.00 uS/cm	16:45:00	
	PH		7.17 pH	16:45:00	
	濁度		7.66 °C	16:45:00	
海墘王	濁度		0.34 NTU	16:45:00	
	餘氯		0.83 ppm	16:45:00	
	電導度		156.99 uS/cm	16:45:00	
	PH		0.00 pH	16:45:00	
			溫度	23.44 °C	16:45:00



III. Smart Water Management

Data Management

■ Data Cloud -- data storage and exchange

Senslink 台灣自來水公司供水監控整合雲 語言: 繁體中文 | cablessoft | 登出

[前往查詢功能頁面](#)
[前往管理功能頁面](#)
[前往客服系統介接平台](#)
[前往客服系統後端管理平台](#)
[Web監控元件](#)
[使用手冊](#)

目前DB伺服器剩餘容量: 755.1 GB (773261 MB) 總容量 1TB

區處	累積出水量	平均(清水)餘氯	出水平均濁度	出水平均餘氯度	出水平均壓力
濟洲OPC	系統沒有昨日資料	0.00 ppm	0.00 NTU	0 無單位	0.00 kgf/cm2
八區OPC	58209_CMD	0.46 ppm	0.15 NTU	7	0.45 kgf/cm2

It collects data from 12 branch offices & over 100 WTPs.

八區OPC 出水平均濁度

每頁顯示 10 紀錄 搜尋

監測站名稱	量測項目名稱	值
九山淨水場	2000噸配水池濁度 * 清水瞬間流量	0.11 * 524.96
大鶯淨水場	深井濁度 * 供大鶯清水瞬間流量	0.18 * 12.38
大鶯淨水場	深井濁度 * 供蔴車清水瞬間流量	0.18 * 26.43
天送埤淨水場	深井濁度 * #1清水瞬間流量	0.00 * 0.00
壽溪淨水場	1000噸配水池濁度 * 清水供上部塔瞬間流量	0.09 * 63.16
寮溪淨水場	1000噸配水池濁度 * 清水供下部塔瞬間流量	0.10 * 996.89
廣興淨水場	10000噸清水池濁度 * 10000噸清水池流量	0.20 * 724.23
廣興淨水場	10000噸清水池濁度	0.20 * 0
廣興淨水場	10000噸清水池濁度	0.20 * 0
東源淨水場	深井濁度 * 清水瞬間流量	1.09 * 12.88

顯示 1 到 10 的 32 紀錄 ◀ 上頁 下頁 ▶

III. Smart Water Management

■ Water Supply Monitoring System (for displaying all collected data from data cloud)

- **web edition** for PC & laptop

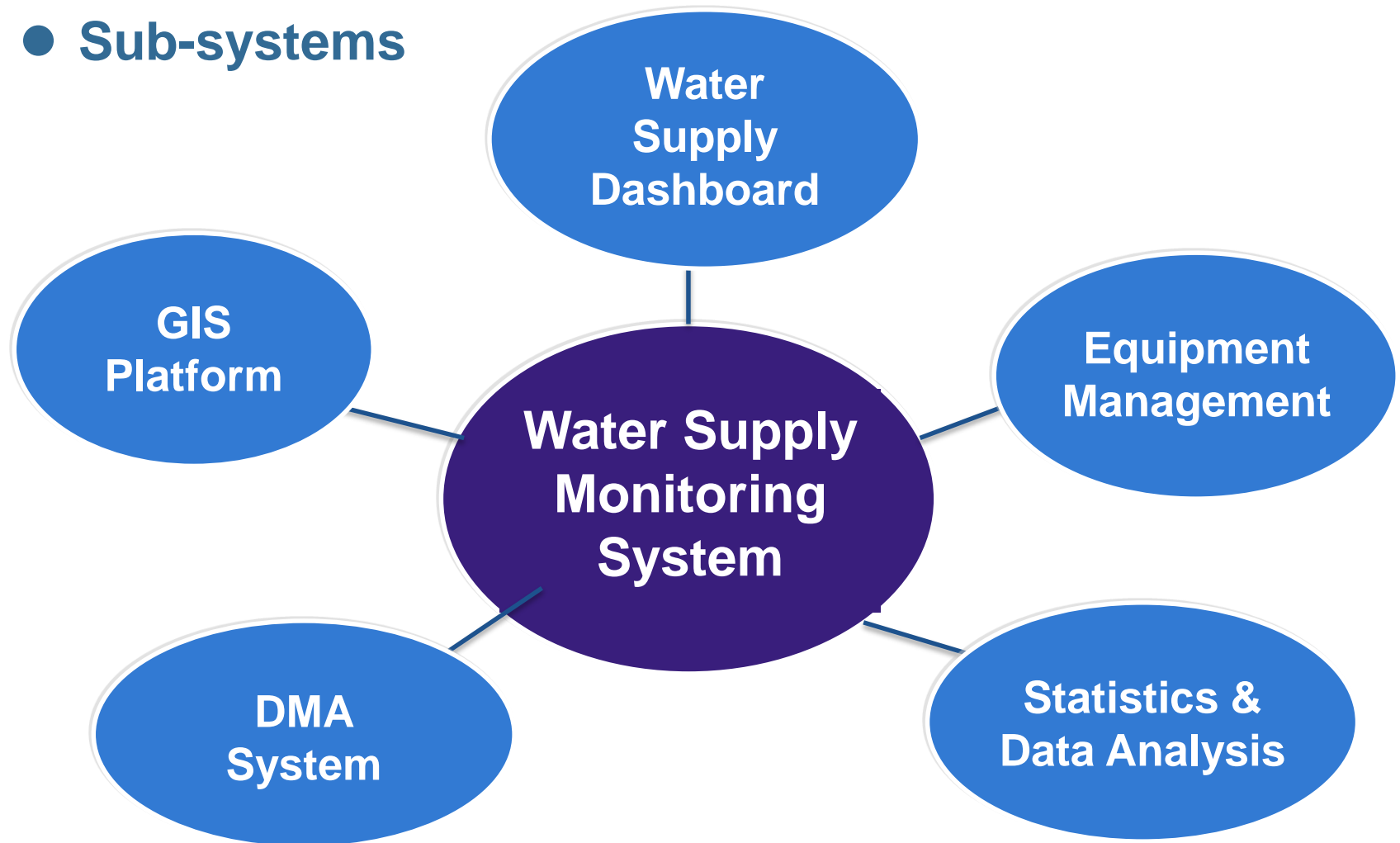


- **app edition** for tablet & smartphone



III. Smart Water Management

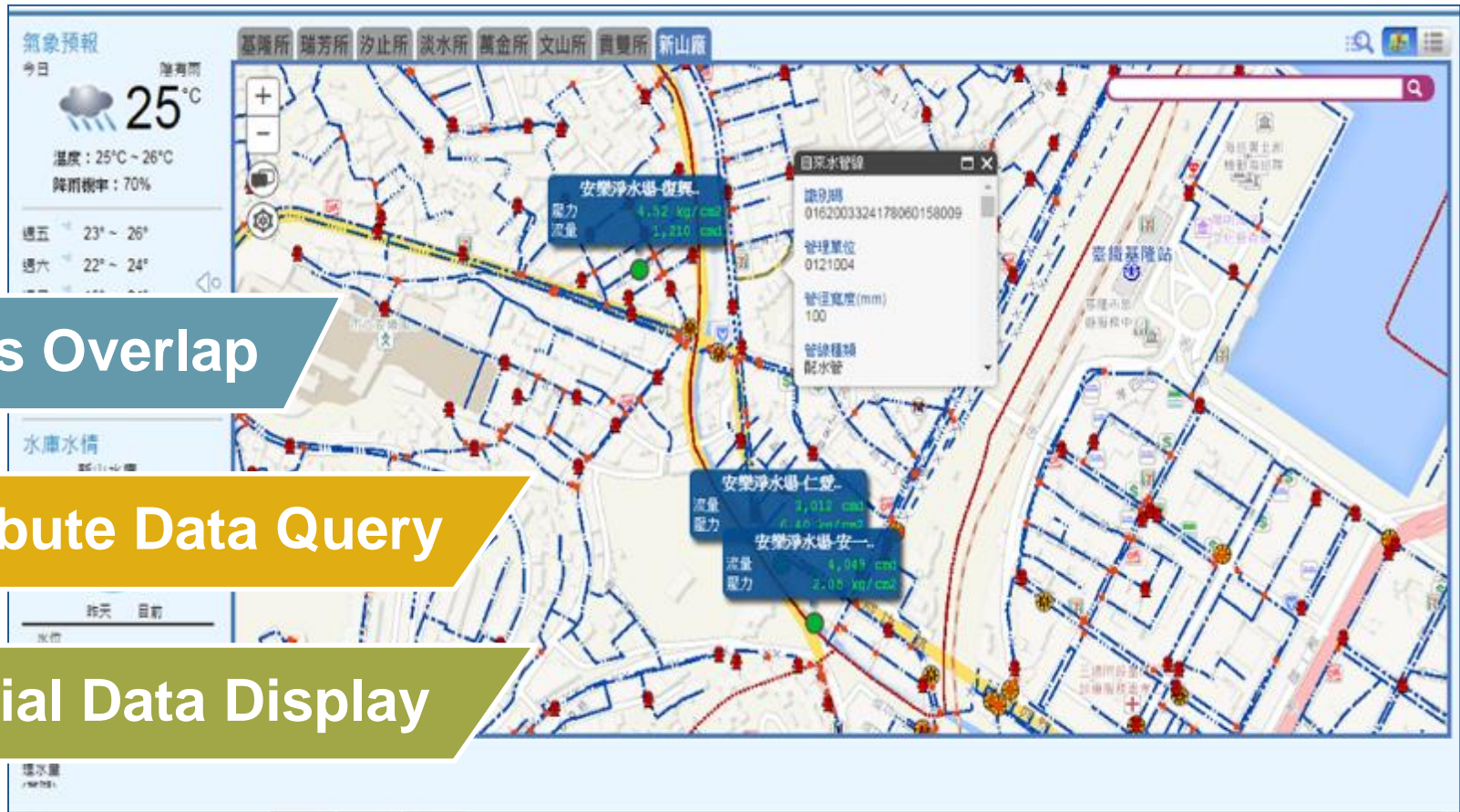
- Sub-systems





III. Smart Water Management

GIS Platform



Maps Overlap

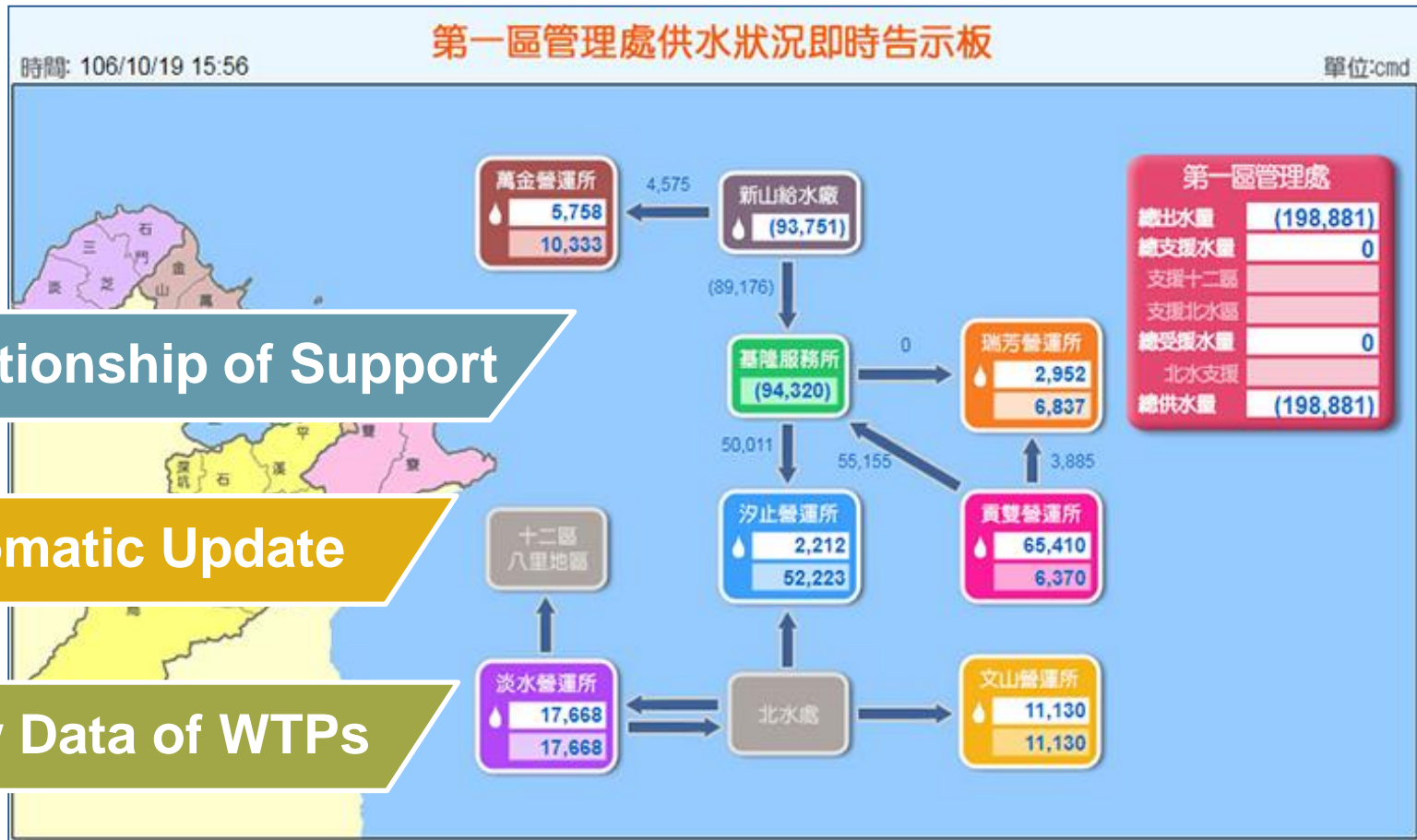
Attribute Data Query

Spatial Data Display



III. Smart Water Management

Water Supply Dashboard



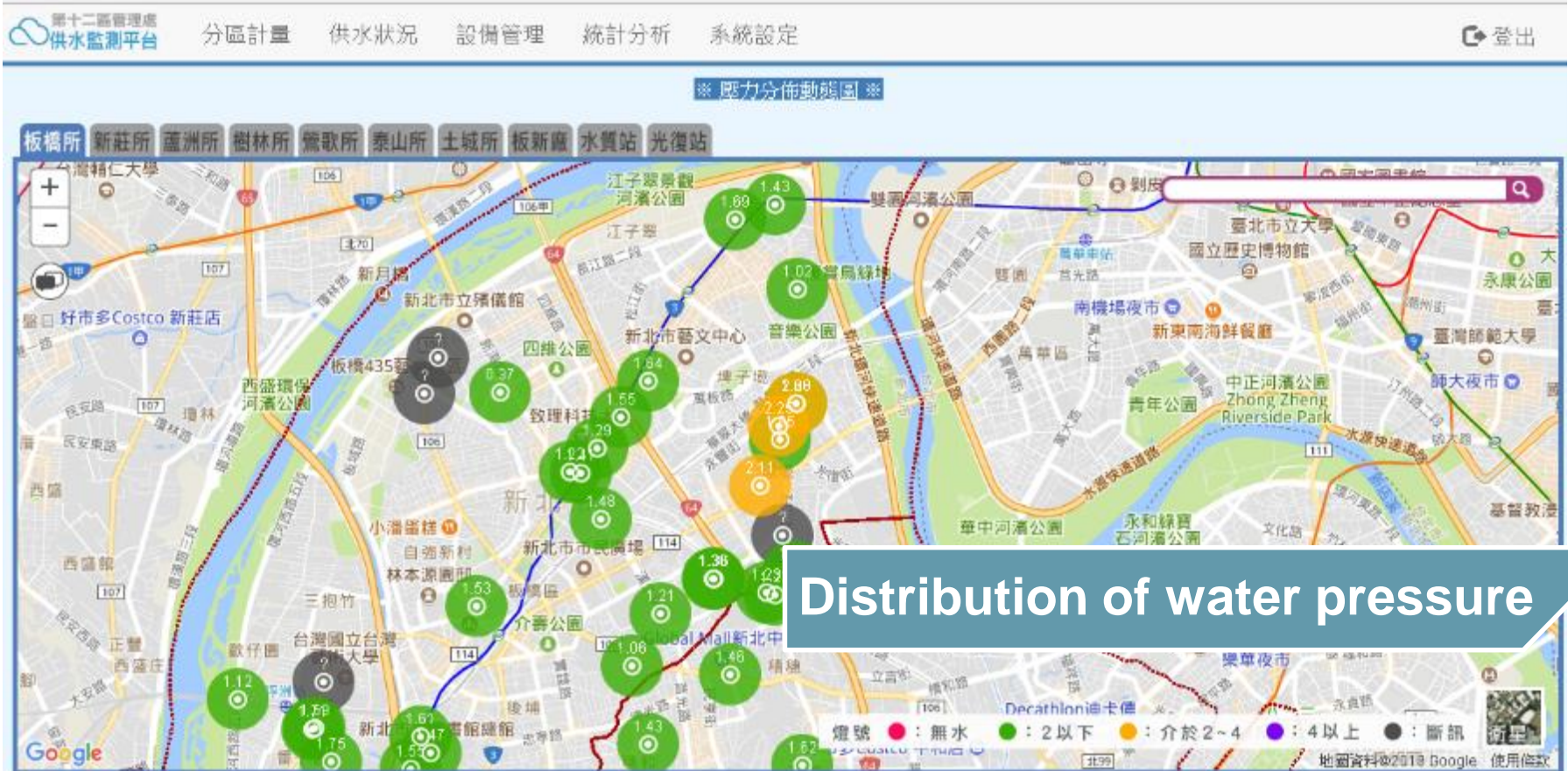
Relationship of Support

Automatic Update

Flow Data of WTPs



III. Smart Water Management





III. Smart Water Management

DMA System

GIS & Satellite Map

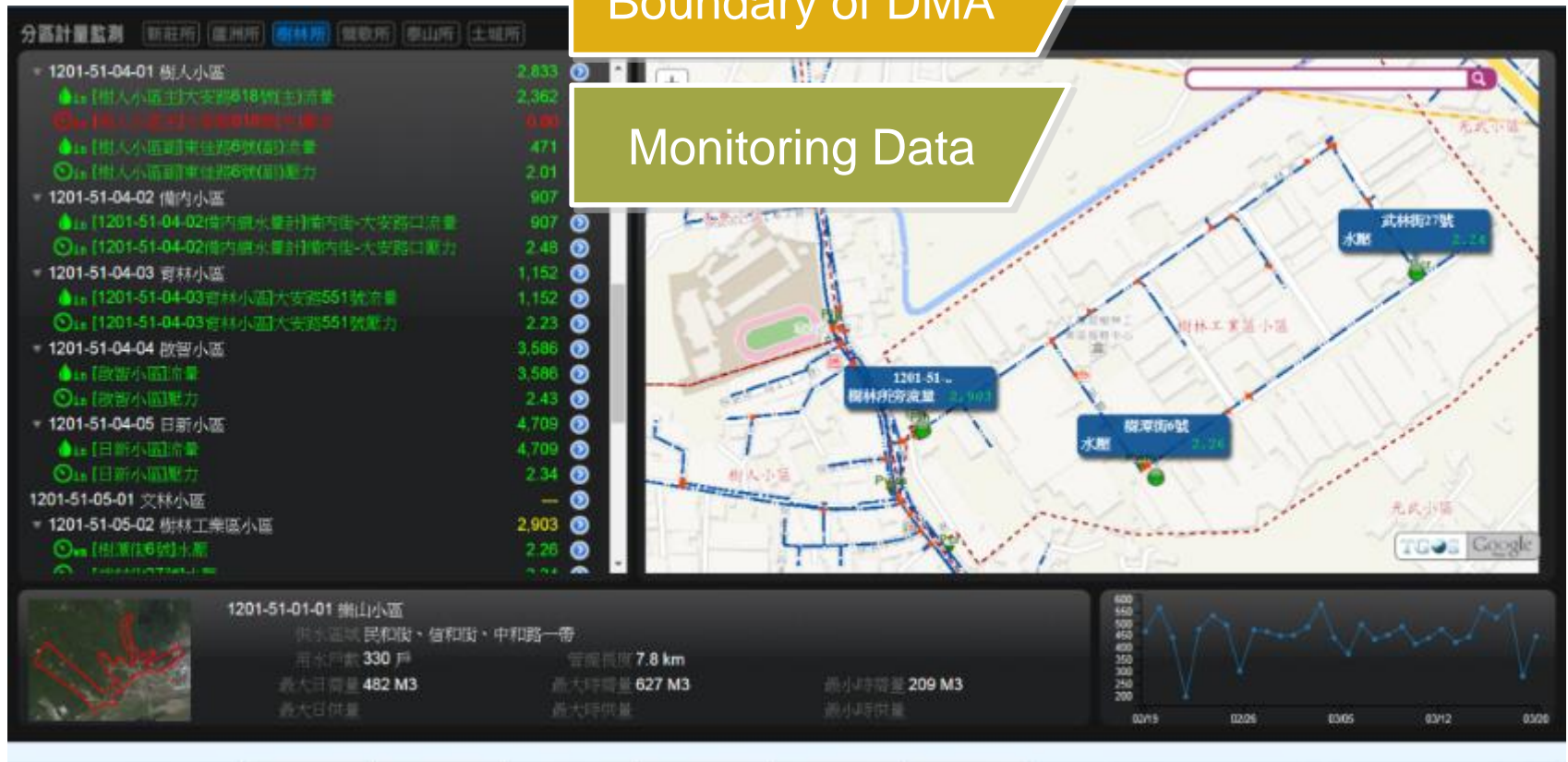




III. Smart Water Management

Boundary of DMA

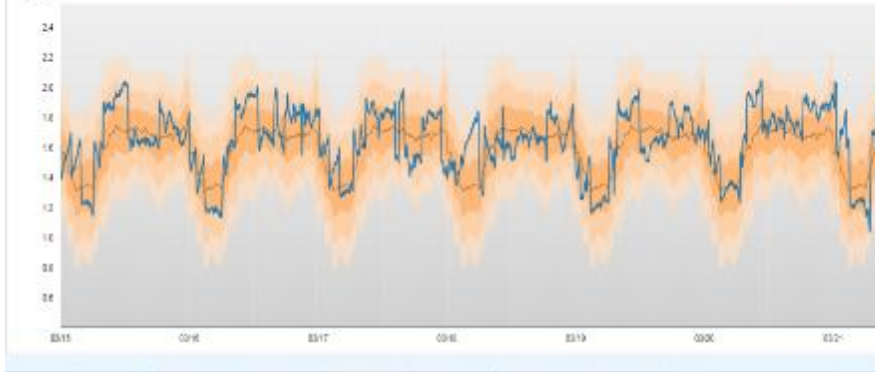
Monitoring Data





III. Smart Water Management

Statistics & Data Analysis





III. Smart Water Management

Equipment Management

* 壓力計管理查詢 *

管理單位: 設置地點:

[搜尋結果共 246 筆]

管理單位	卡號	設置地點	基本資料	檢查紀錄	修單紀錄
板橋服務所		三民路二段150號前 (傳訊點: [民享小區1201-04-05-02]壓力)	HC82 ...	(無)	(無)
板橋服務所		大觀路一段38巷184號前 (傳訊點: [榮中一街1201-04-01-04]壓力)	HC82 ...	(無)	(無)
板橋服務所		大觀路一段59號天橋右側 (傳訊點: [台新			
板橋服務所		大觀路一段59號對面 (傳訊點: [華僑中學			
板橋服務所		大觀路二段47巷 (傳訊點: [徐氏之家			
板橋服務所		大觀路二段339號 (傳訊點: [寶六12			
板橋服務所		大觀路二段57號 (傳訊點: [大觀路			
板橋服務所		大觀路二段59巷對面 (傳訊點: [大觀路			
板橋服務所		大觀路二段650巷2號 (傳訊點: [大觀路			
板橋服務所		中山(二)中區 (傳訊點: [中山(二)中區			

* 壓力計資料的詳細基本資料 *

管理單位: 卡號:

設置地點:

 (緯度: 經度: 高程:

品牌:
 廠商國家:
 型式:
 測定範圍: kg/cm²
 傳送距離: M
 電壓: V

指示計:
 使用溫度範圍: °C
 出力信號:
 測定原理:
 代理廠商及地址:

現況照片一: 
此張照片上傳時使用傳訊點基本資料檢核功能。

現況照片二: 
此張照片上傳時使用傳訊點基本資料檢核功能。



III. Smart Water Management

Decision Making

■ Emergency Response Platform

- web-based
- displayed on LED TV wall
- established in Emergency Response Center of the branch office
- Including monitoring data, weather, etc.





III. Smart Water Management

Customer Service

●Water Outage Query



●Water Quality Query

平均水質查詢

平均水質查詢-新山淨水場
(Sinshan)基隆市麥金路720號

淨水場：	新山淨水場 (Sinshan)基隆市 麥金路720號	最大限 值
英文：	Sinshan	
自由有效餘氯 (mg/L)：	0.71	0.2-1.0
濁度(NTU)：	0.45	2
色度(鉑鈷單 位)：	<5	5
臭度(初嗅數)：	<1	3
總鹼度(mg/L)：	28.5	-
pH值(-)：	7.1	6.0-8.5
氯鹽(mg/L)：	17.6	250

●Water Tariff Query

台灣自來水公司
TAIWAN WATER CORPORATION

我的水費資訊

您的帳單資料 共有 11筆

帳單資料 第1筆

[前往優惠活動專區](#)

水號： 4158824 * * *

水號地址： * * * 1 2 號 1 1 樓

繳費年月： 10705

帳單到期日： 107/05/21

用水度數(不含分攤度數): 61度

合計度數(含分攤度數): 61度

應繳金額: 631元

實繳金額: 元

銷帳日期:

繳費狀況: 未繳費 [顯示繳費條碼](#)

與去年比較增減度數: N/A

省水比例(含分攤度數): N/A

省水比例(不含分攤度數): N/A

帳單資料 第2筆

[前往優惠活動專區](#)

52

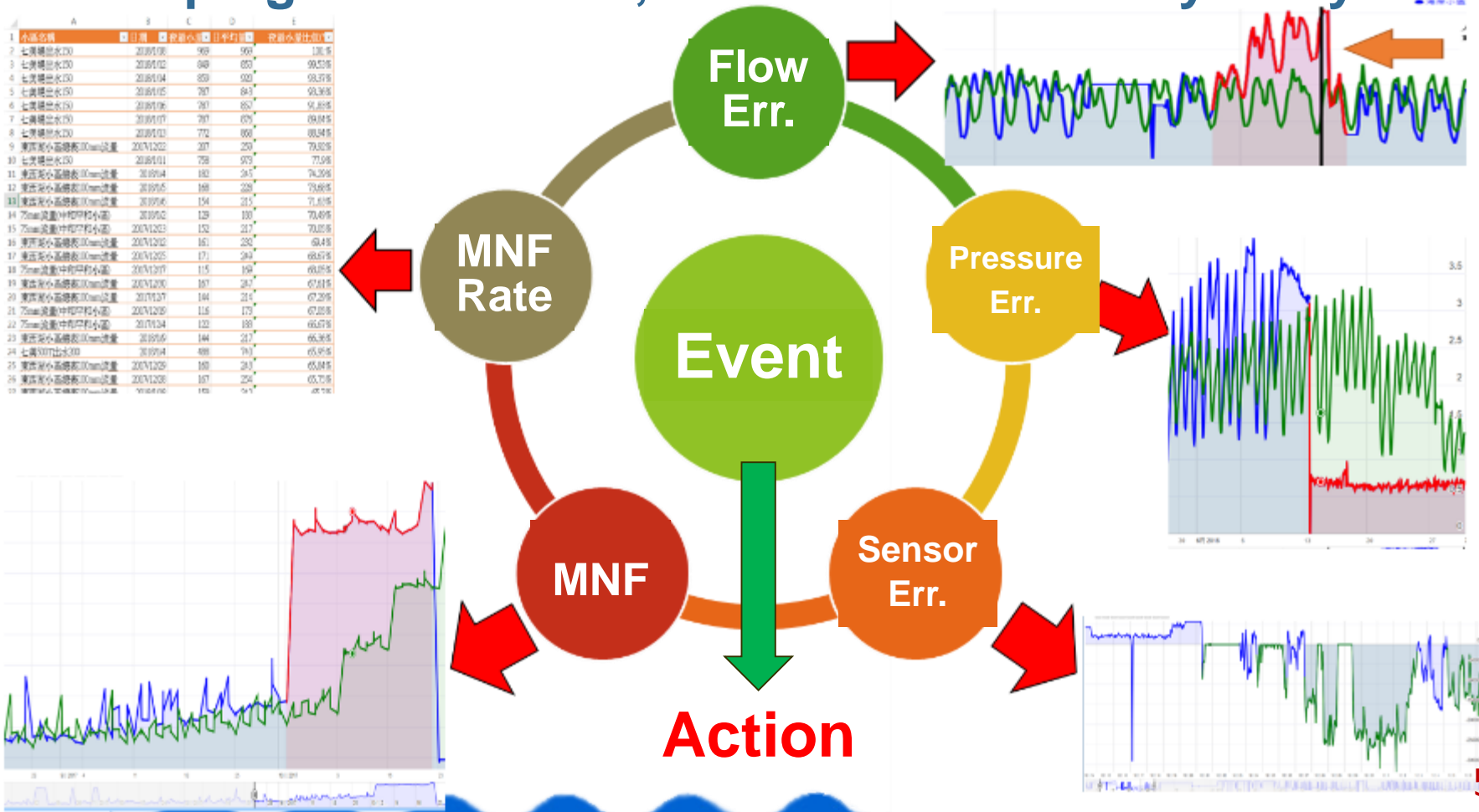


III. Smart Water Management

What's next.....?

We are now setting up a **Big Data Analysis Task Force**, and developing a web-based, automatic data analysis system.

站名	日期	流量(m³)	压力(kPa)	流量(m³)
1 北湾供水站	2015/06	950	950	130.5
2 北湾供水站	2015/02	940	850	99.558
3 北湾供水站	2015/04	850	920	98.378
4 北湾供水站	2015/05	780	840	98.368
5 北湾供水站	2015/06	780	850	98.828
6 北湾供水站	2015/07	780	870	98.848
7 北湾供水站	2015/08	770	860	98.848
8 北湾供水站	2015/09	770	870	98.848
9 北湾供水站	2015/10	750	870	98.848
10 北湾供水站	2015/11	750	870	98.848
11 北湾供水站	2015/12	750	870	98.848
12 北湾供水站	2016/01	750	870	98.848
13 北湾供水站	2016/02	750	870	98.848
14 北湾供水站	2016/03	750	870	98.848
15 北湾供水站	2016/04	750	870	98.848
16 北湾供水站	2016/05	750	870	98.848
17 北湾供水站	2016/06	750	870	98.848
18 北湾供水站	2016/07	750	870	98.848
19 北湾供水站	2016/08	750	870	98.848
20 北湾供水站	2016/09	750	870	98.848
21 北湾供水站	2016/10	750	870	98.848
22 北湾供水站	2016/11	750	870	98.848
23 北湾供水站	2016/12	750	870	98.848
24 北湾供水站	2017/01	750	870	98.848
25 北湾供水站	2017/02	750	870	98.848
26 北湾供水站	2017/03	750	870	98.848
27 北湾供水站	2017/04	750	870	98.848
28 北湾供水站	2017/05	750	870	98.848
29 北湾供水站	2017/06	750	870	98.848
30 北湾供水站	2017/07	750	870	98.848
31 北湾供水站	2017/08	750	870	98.848
32 北湾供水站	2017/09	750	870	98.848
33 北湾供水站	2017/10	750	870	98.848
34 北湾供水站	2017/11	750	870	98.848
35 北湾供水站	2017/12	750	870	98.848
36 北湾供水站	2018/01	750	870	98.848
37 北湾供水站	2018/02	750	870	98.848
38 北湾供水站	2018/03	750	870	98.848
39 北湾供水站	2018/04	750	870	98.848
40 北湾供水站	2018/05	750	870	98.848
41 北湾供水站	2018/06	750	870	98.848
42 北湾供水站	2018/07	750	870	98.848
43 北湾供水站	2018/08	750	870	98.848
44 北湾供水站	2018/09	750	870	98.848
45 北湾供水站	2018/10	750	870	98.848
46 北湾供水站	2018/11	750	870	98.848
47 北湾供水站	2018/12	750	870	98.848
48 北湾供水站	2019/01	750	870	98.848
49 北湾供水站	2019/02	750	870	98.848
50 北湾供水站	2019/03	750	870	98.848
51 北湾供水站	2019/04	750	870	98.848
52 北湾供水站	2019/05	750	870	98.848
53 北湾供水站	2019/06	750	870	98.848
54 北湾供水站	2019/07	750	870	98.848
55 北湾供水站	2019/08	750	870	98.848
56 北湾供水站	2019/09	750	870	98.848
57 北湾供水站	2019/10	750	870	98.848
58 北湾供水站	2019/11	750	870	98.848
59 北湾供水站	2019/12	750	870	98.848
60 北湾供水站	2020/01	750	870	98.848





Concluding Remarks

- Providing high standard service and high quality drinking water has been a goal that TWC has persistently pursued.
- TWC hopes to become a leader among the domestic water utilities and keep pace with the best international water utilities.



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Thank You



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