CARIBBEAN WATER AND WASTEWATER ASSOCIATION

Implementation of best practices to reduce NRW in the Bahamas

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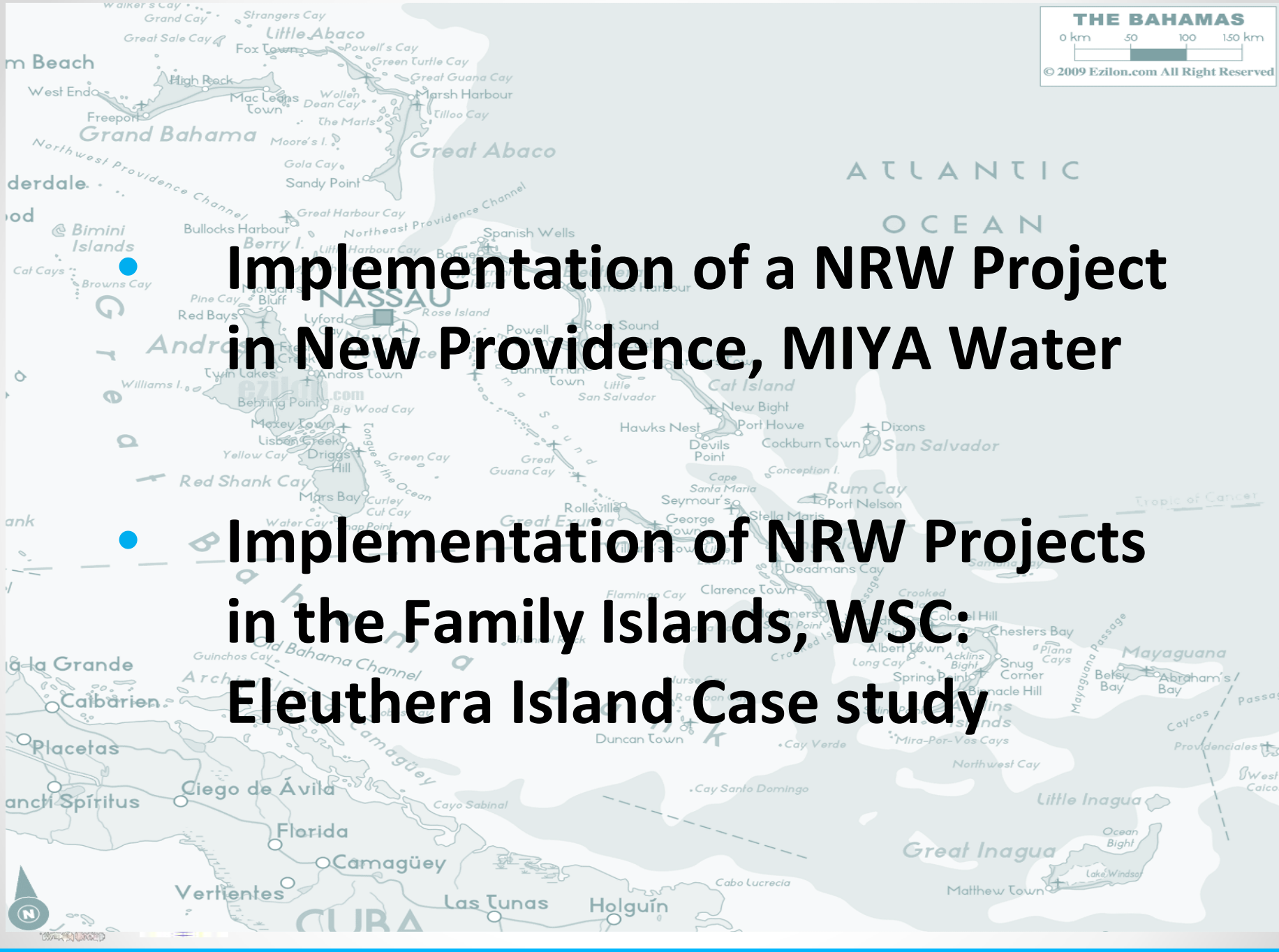
WATER AND SEWERAGE CORPORATION

miya
Arison Group



- **Implementation of a NRW Project in New Providence, MIYA Water**
- **Implementation of NRW Projects in the Family Islands, WSC: Eleuthera Island Case study**


New Providence
NRW Reduction
Project by MIYA

Project Overview

- **10 years project**
  - Reduce NRW to 2.5 MIGD (11.36 Mld) by end of year 5
    - Increase average system pressures to 25 psi (1.72 bar)
  - Reduce NRW to 2 MIGD (9.09 Mld) by end of year 7
  - Maintain at 2 MIGD (9.09 Mld) until the end of the project
- **Large component of Performance Based compensation**
- The project is designed to repay itself within its lifespan, with an expected double digit project IRR for WSC
- Over 10 Billion imperial gallons (45.46 billion Ml) of water will be saved
- **Project size: USD83 Million (USD51M financed by the IDB)**

Situation in New Providence (The Bahamas) up to 2012:

- Over 90% of the water came from desalination and once it got into the water supply system - 58% was getting lost (6.87 MIGD, 31Mld)
- Average price to consumers in New Providence: $12.1 per 1,000 gallons ($2.7 per m^3)! (compared to $1.5 per 1,000 gallons ($0.3 per m^3) in the U.S)
- For almost three decades WSC was coping with increasing levels of water losses
- WSC realized that a long term comprehensive approach should be taken

Project outline

Baseline Survey
Data gathering, economical analysis, testing and surveys

Water Balance &
NRW reduction Strategy Plan

Strategy and action plan with respect to:

- **Leak detection and repair**
- **DMA & Pressure Management**
- **Infrastructure replacement**
- **Commercial losses (Illegal connections, Meters)**
- **NRW management software (NETBASE)**

Baseline Survey

- 2011 NRW 6.6 MIGD
  - Significantly higher than the 5 MIGD of the RFP
  - average system pressure also higher – 24.6 psi
  - N^1 (pressure/leakage exponent) – 0.9
- Baseline was updated in 2013 with 2012 water balance
  - NRW 6.87 MIGD
  - average system pressure also higher–25.1 psi
  - N^1 (pressure/leakage exponent) – 0.9

NRW Reduction Strategy Development

- Annual water balance starting point
- Component analysis of losses
- Experience gained from Rapid Results Initiative
  - Understanding the causes of losses
- Condition and performance assessment of existing NRW reduction assets
- Economic analysis of NRW reduction options
  - Least cost mix of options to achieve targets selected
- Primary focus – real loss reduction
- Apparent losses also addressed

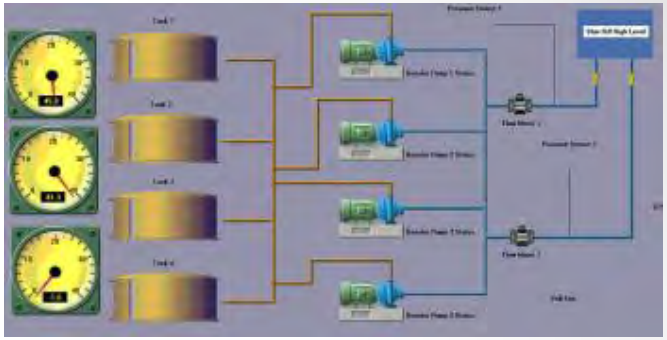
Components of NRW Reduction Strategy (1)

- Introduction of improved materials for service connections and leak repairs
- Selective service line replacement – 15,000 services
- Disconnection of inactive services ~10,000
- Selective mains replacement – 25,000 feet (WSC)
- Large revenue meter right sizing, replacement

Components of NRW Reduction Strategy (2)

- Advanced pressure management
  - Control from critical point
  - I2O controllers
- Replacement of all PRVs and bulk meters
- District metering (DMAs)
- Control of zone boundaries
- Netbase advanced network management
- Leak detection and repairs (2 surveys a year)

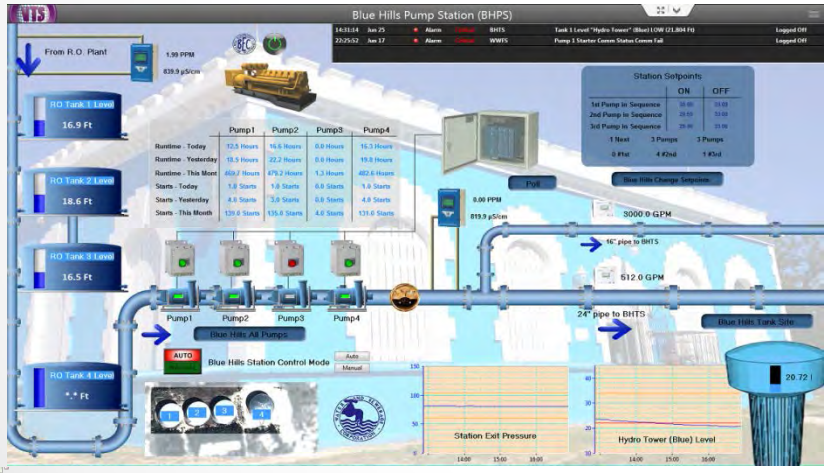
Components of NRW Reduction Strategy (3)

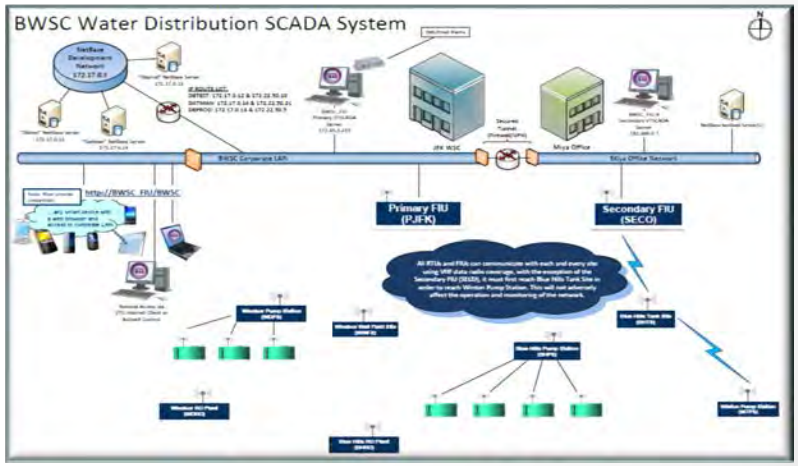


- Clean, exercise system valves
- GSM data loggers
- Hydraulic modelling
- System optimization
- SCADA
- GIS data improvement
- Allocate customers to DMAs
- Water efficiency education – schools program
- Customer win-back program

SCADA Implementation

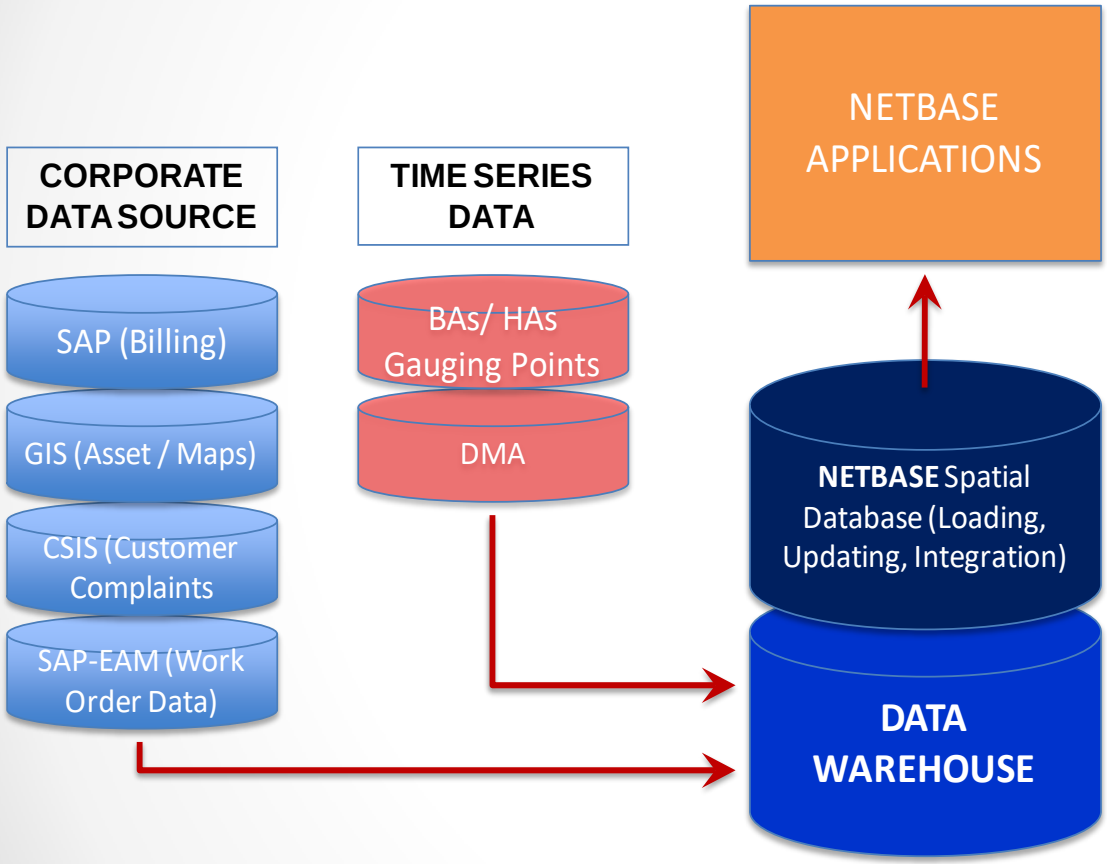
- Installed at each WSC plant
- Control of Pumps
- Monitor pumps, flows, levels, pressures, power
- SCADA servers installed in WSC Control Room and in Miya project office (read only)





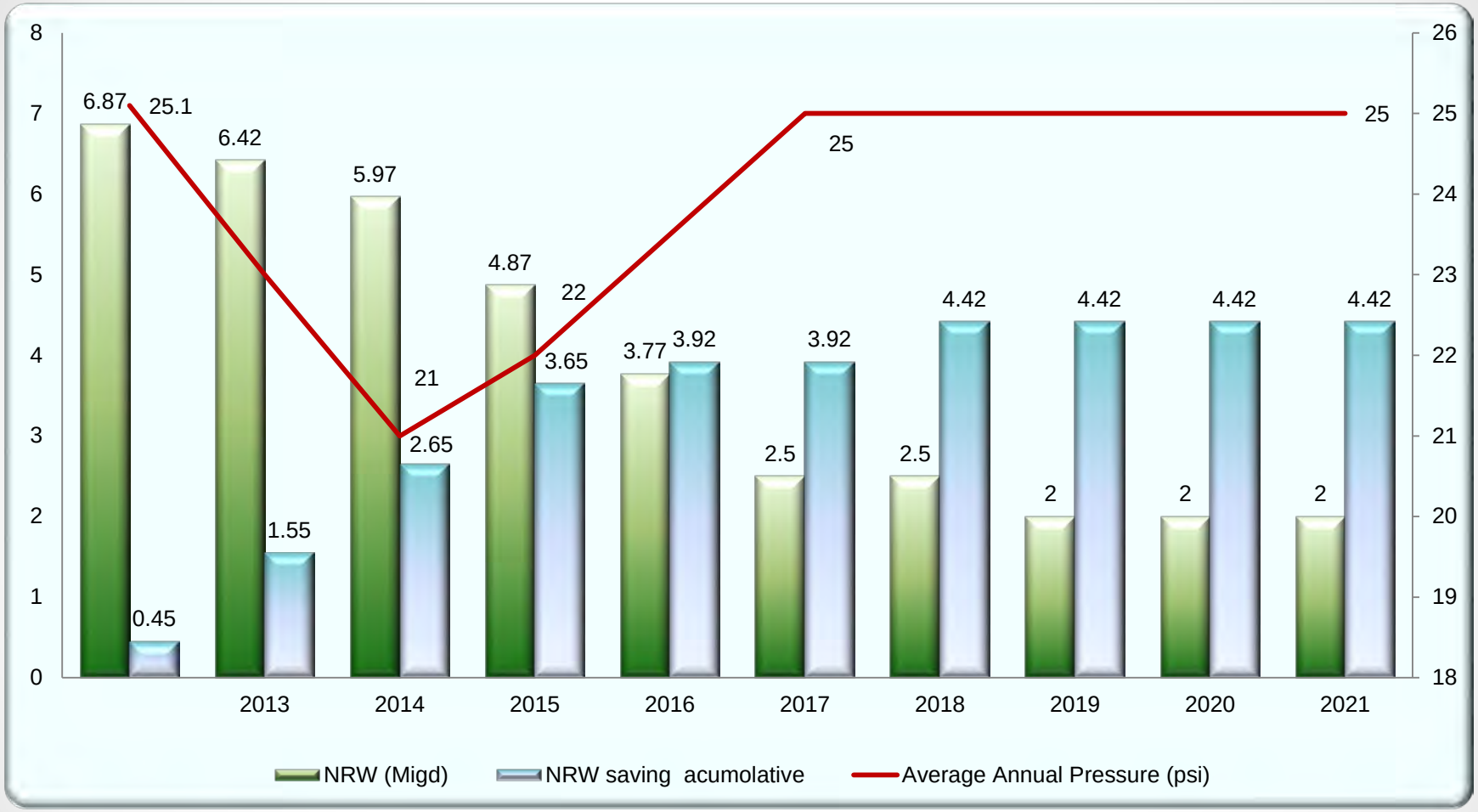
Netbase – Distribution Management System

- Near real-time monitoring of water resources and decision support tool to manage the network resources
- Data mining for leak detection and sensors for precise leak localization



- ✓ Network Information
- ✓ Configuration Tool
- ✓ LATIS
- ✓ Sumdat
- ✓ Leakage and Water Balance
- ✓ Campaigns
- ✓ Events
- ✓ Levels of Service Pressure
- ✓ Hydraulic Modelling
- ✓ Area Performance
- ✓ Asset Performance

NRW reduction plan



Current Status Progress

YEAR 4

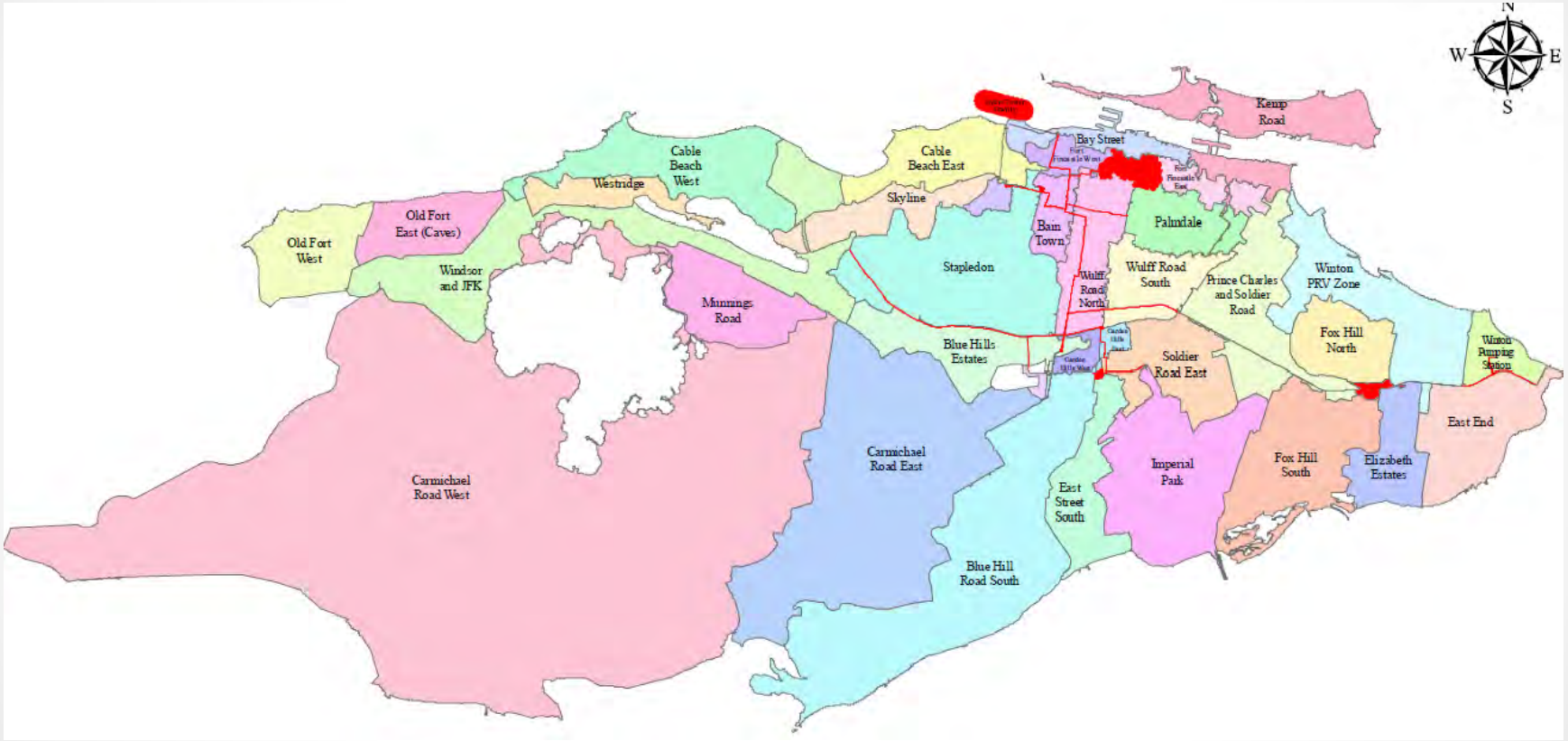
Technical Works (from 2013 up to September 2016)

Activities	Number of works
Replaced active service connections	16,335
Disconnections of inactive service connections	5,336
Leak repairs on mains	866
Total leaks repaired (ALC)	4,976
Pipes replaced by WSC due to heavy leakage (out of 52,000 ft proposed)	approx. 32,000 ft

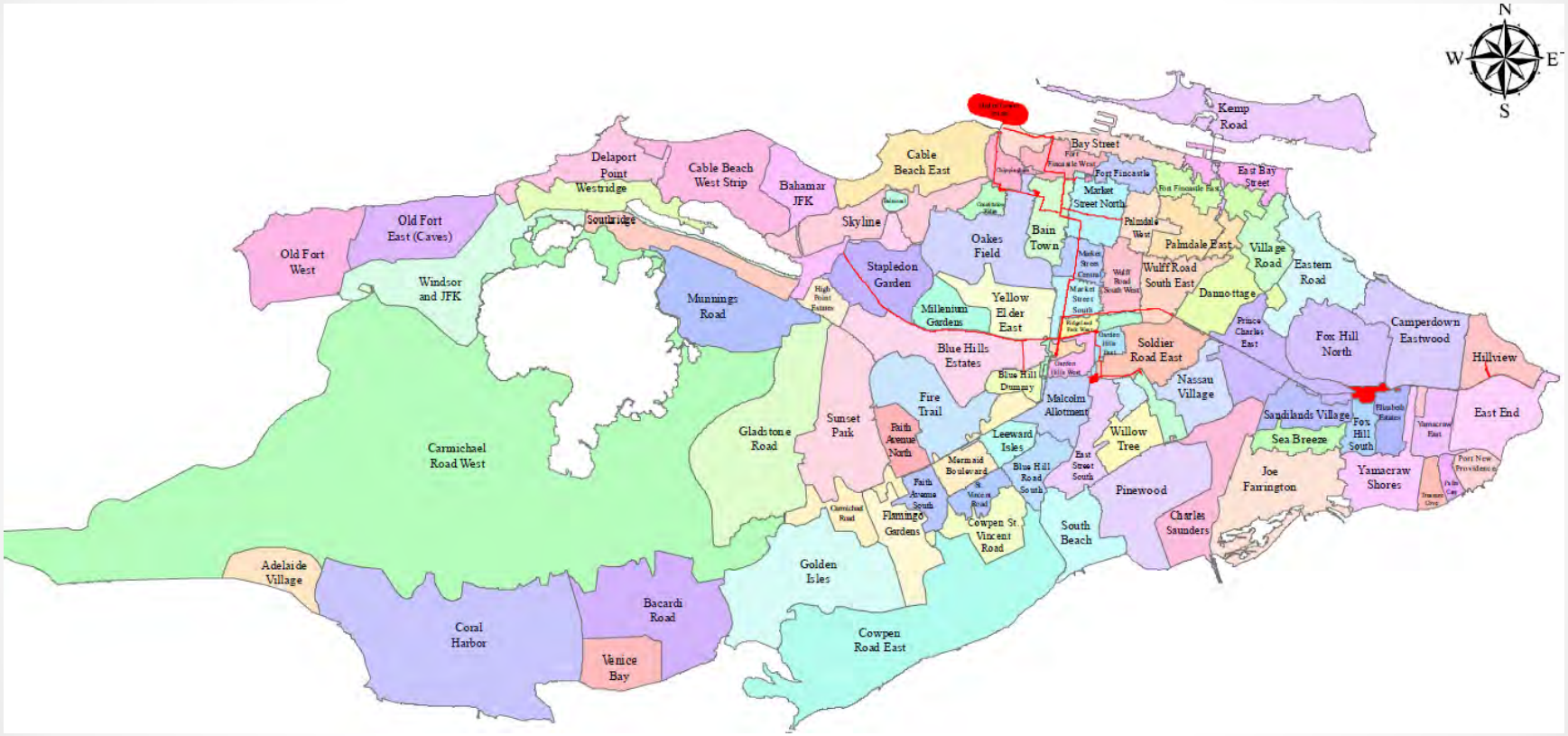
Pressure Zones/DMAs Establishment

Activities	Number
Pressure Zones	36
• PRVs	33
• Gravity Supplied	1
• Supplied directly by PS	2
DMAs	89

Pressure Zones



Separation into DMAs



Replacement of Large Customers meters
(Bulk meters 2” up to 6”)

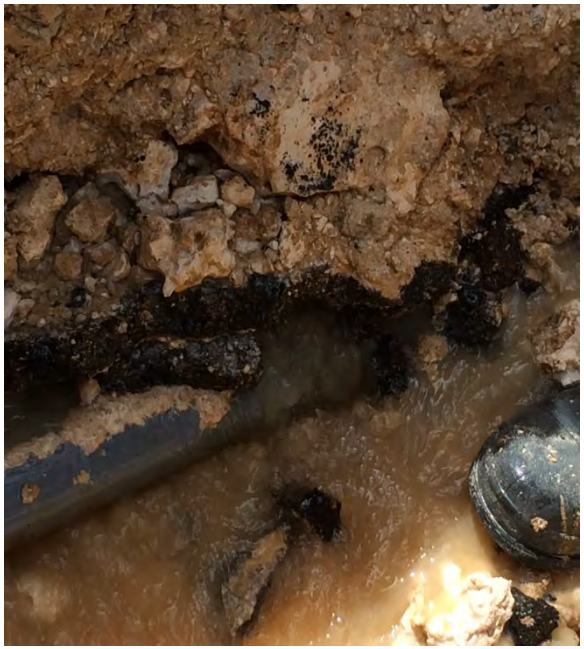
- Replaced - up to now - 47 old bulk meters with **ARAD ultrasonic meters** (OCTAVE)
- High precision meter (according to MID R500, Q3/Q1=500)
- Body from stainless steel 316
- Check valve installed

Intensive Leakage Detection

Causes of Leaks:

- Inappropriate materials

- Bad installation (no specifications followed, pipes very shallow, no suitable bedding/backfilling materials)
- Lack of proactive maintenance




2" EVANITE
PVC 1120 ASTM D-2241

Leak Detection (1)

- 14 local staff recruited and trained by IWA Water Loss leak detection expert
- Team led by experienced local leakage inspector (14+1)

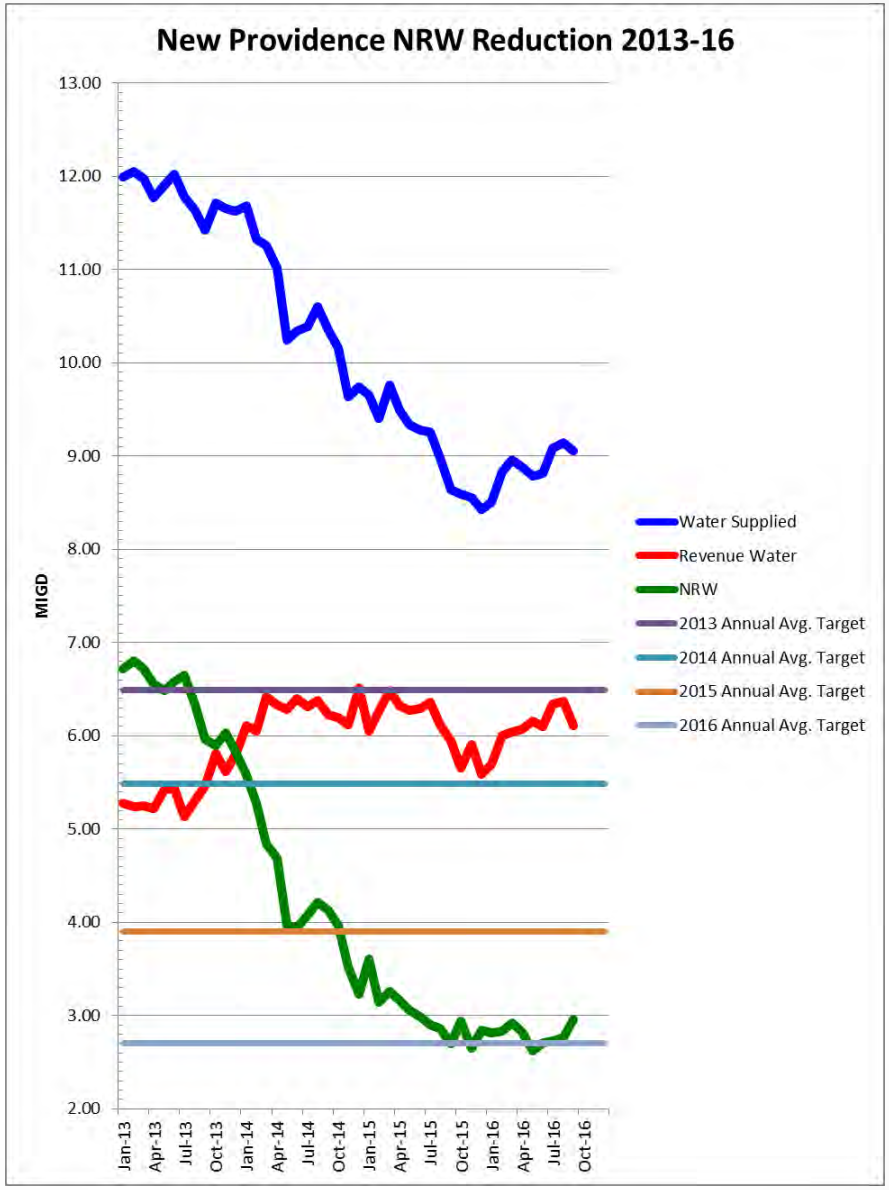
- Work prioritized based on DMAs with highest leakage
- Illegal connections, stuck meters, missing meters, disconnected services etc.

Leak Detection (2)

- Difficulties in finding leaks due to
  - Low pressure
  - Plastic materials
  - Heavy traffic (noise)
  - Electric interference

- Methodology
  - Sounding of meters
  - Sounding of pipes and pinpointing the leaks
  - Step testing to detect the areas of high leakage
  - Gas detection (used) & tethered technology (investigator)
  - 2 equivalent surveys of New Providence annually


Results
&
Conclusions
(To Date)


New Providence NRW Reduction 2013-16
MIGD
13.00
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
Jan-13
Apr-13
Jul-13
Oct-13
Jan-14
Apr-14
Jul-14
Oct-14
Jan-15
Apr-15
Jul-15
Oct-15
Jan-16
Apr-16
Jul-16
Oct-16
Water Supplied
Revenue Water
NRW
2013 Annual Avg. Target
2014 Annual Avg. Target
2015 Annual Avg. Target
2016 Annual Avg. Target

Project is Delivering!

KPI		2013	2016
NRW	**MIGD**	**6.9**	**2.8**
NRW	%	57.8	30.3
ILI	**-**	**27.5**	**9.1**
NRW	IG/con/day	147.0	68.2
Real Losses	IG/con/day	138.0	60.5
Apparent Losses	IG/con/day	9.0	7.7
Average Pressure	psi	25.1	24.5

Project is Delivering!

- Exceeding initial performance targets
- Recovered from dangerous situation due to intermittent supply operation – 2013
  - Pressure management savings reduced
- WSC pleased with progress
  - Now have few breaks to repair!
  - Remote control of pressures
  - Improved customer service
  - Improved infrastructure
  - WSC now using the improved materials
  - SCADA / Netbase


Family Island
Operations
By WSC

CORPORATE STRATEGIC OBJECTIVE

- Reduce Non Revenue Water within Family Island Operations.

NRW Reduction Strategy
Eleuthera Island - Bahamas

Success with ongoing New Providence Non Revenue Water Project produced a model for WSC to replicate in other locations with high NRW.

- Objective – Implement a similar strategy to reduce NRW in South Eleuthera.

Water Supply Model - Major Islands

- Ground Water Extraction
  - 36 WF
- Alternate Supply/Primary
  - Reverse Osmosis water supply
  - 27 Plants

Area of Focus – South Eleuthera

WSC Baseline Assessment

KPI's

Waterford Supply Zone

- RO plant production capacity 95 KIGD
- Active customer – 450

Water Purchase Price/1,000 USG	$16.11
System Input / Day	105K USG
Water Sales / Day	42K USG
NRW / Day	63K USG
NRW percentage	60%
NRW Losses / day	$ 1,014.93
Financial Impact	$ 370,449.45

Network Baseline Assessment

- Excavation to assess condition existing infrastructure
- Interview Field Staff to determine type of failures in the Network. (SL/meters/saddles & fittings/pipeline burst)
- Review of Network piping configuration

Findings


Unmetered
connection


Unmetered
connection


Blocked
connection


Leak at meter

Pressure Management

One of the most critical components in NRW Project, (1)

- Pressure Reducing Valves (PRV)
- Electronic controllers to modulate pressure
- Loggers to measure critical point pressure in the network.

Project Execution Scope

Define and measurable deliverables

- Install Pressure Mgmt Equipment
- Replace 450 – ¾ inch service connections
- Cancel all inactive service connection
- Repair ALL leaks
- At project completion, perform leak detection on newly installed service connections.

Pressure Management Equipment

PRV

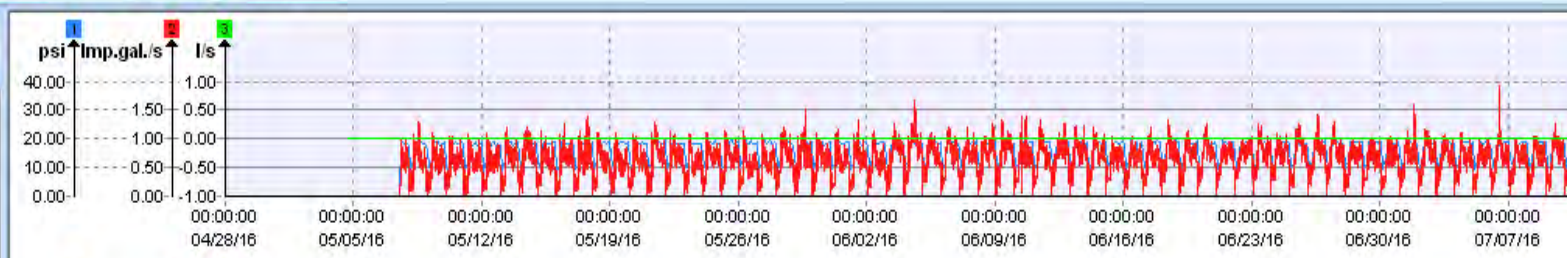
Logger

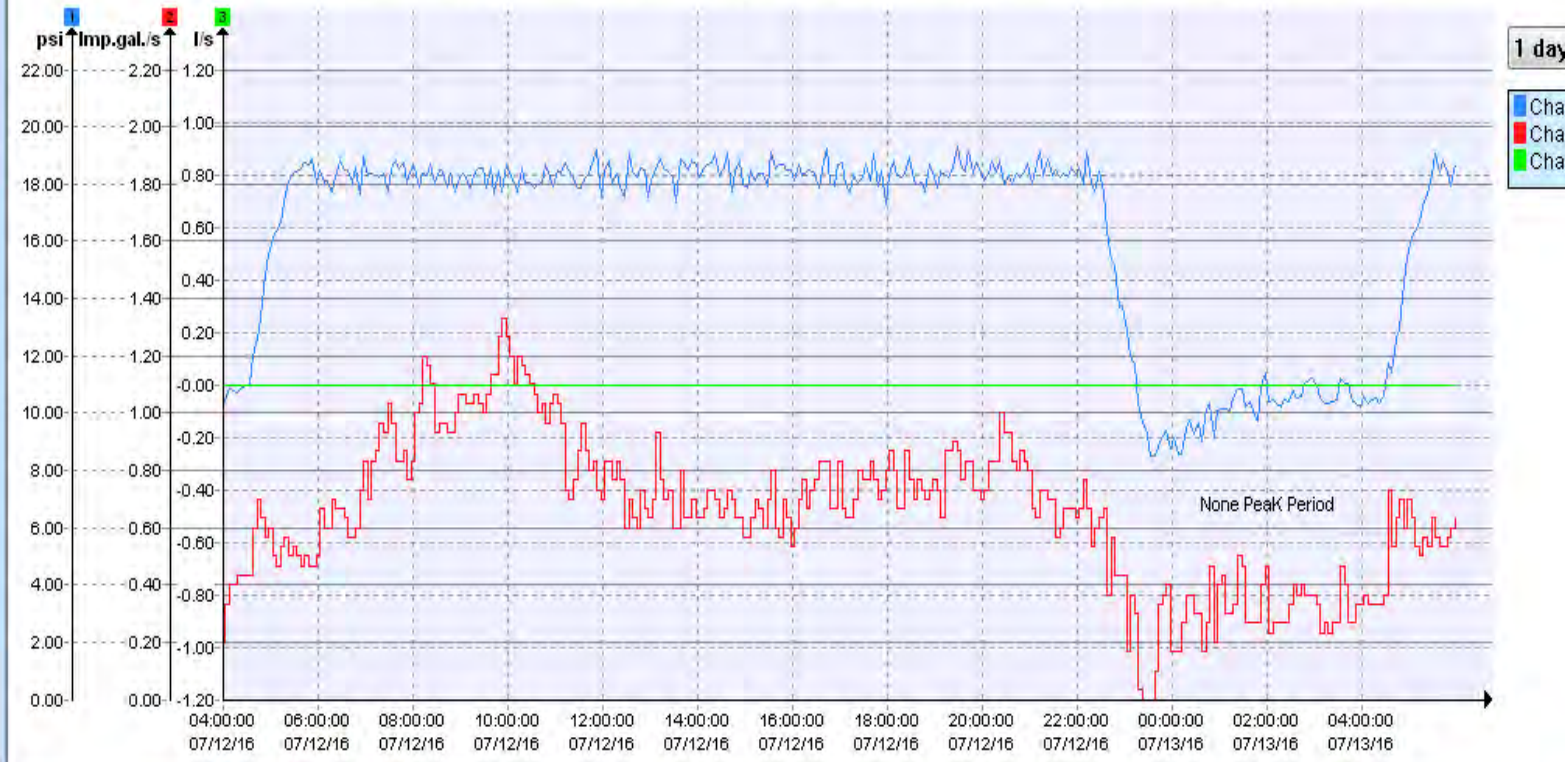
Seba Data View - [LogDX-ID: 001734 - Water Ford RO Plant (Waterford)]

Directory | LogD | LogDX | LogN3 | GSMBox3 | LogP

Read | Show data | Export — Measurement data
Program | Realtime measurement — Communication
Show — Event list
Window arrangement — Window

- aData
- MIYA
  - MIYA (142)
    - LogDX (142)
- WSC
- FID
  - Waterford (1)
    - LogDX (1)
      - 1734 - Water Ford RO Plant
  - Rock Sound (1)
    - LogDX (1)
  - Tarpum Bay (1)
    - LogDX (1)
  - Inagua (1)
  - Waterford CP (1)
    - LogDX (1)
      - 1735
  - George Town (1)
  - Farmers Hill (1)
  - Exuma RO (1)
  - Bimini (1)
- GRWWTP (0)
- BAHAMAR (0)





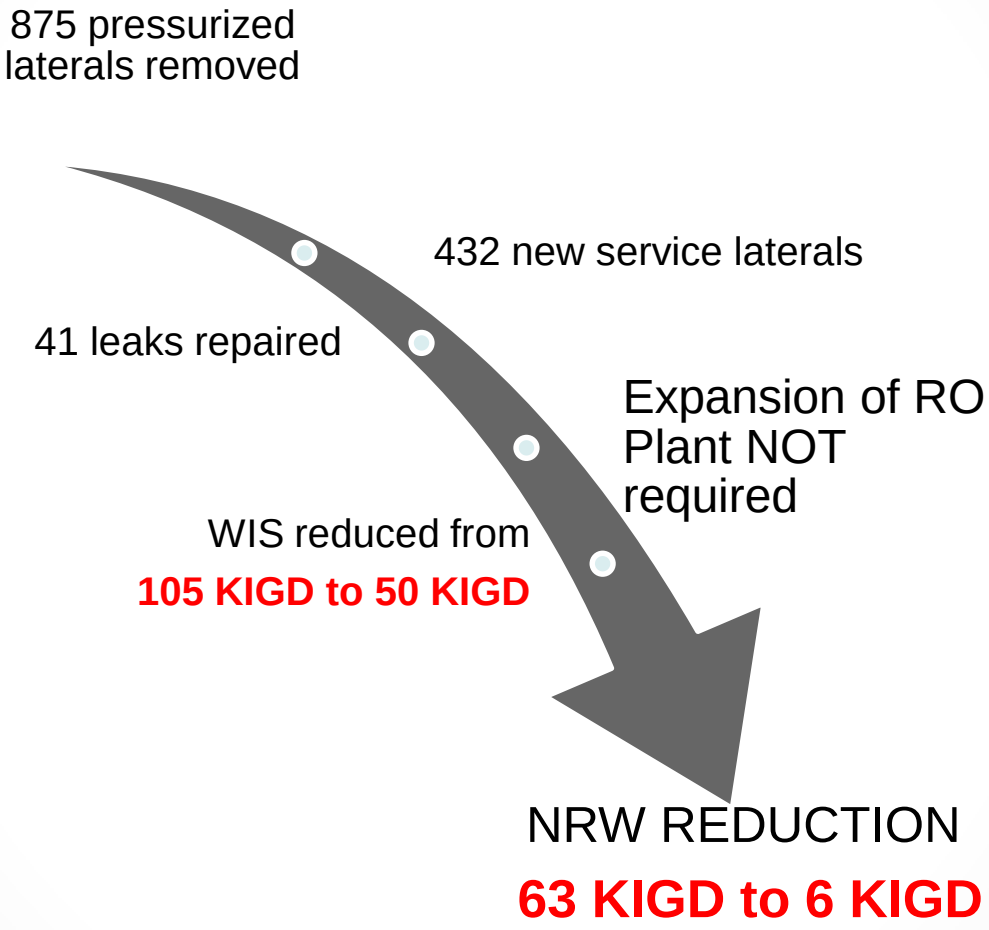
Work In Progress/ Findings

Cancelled connection with new tap

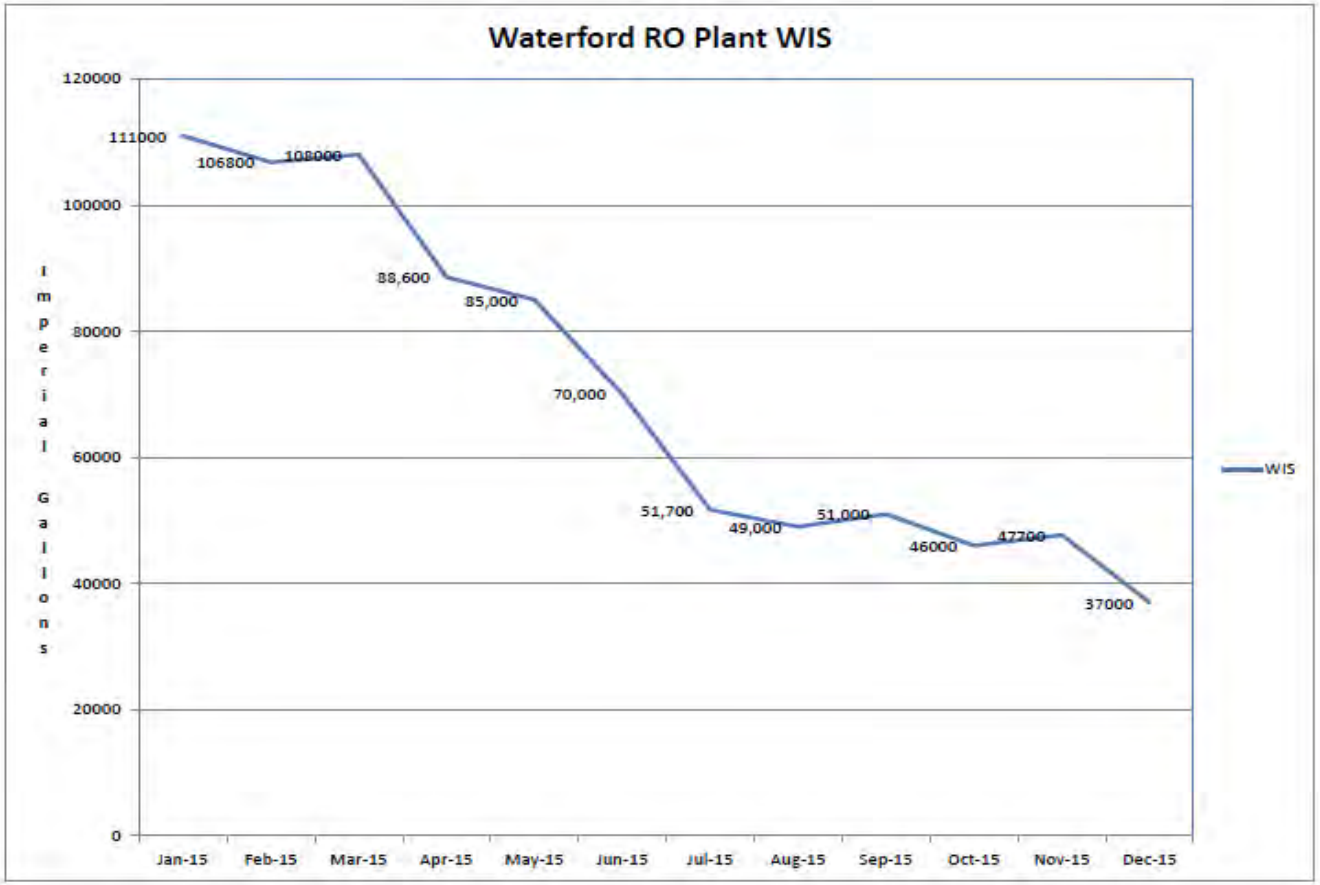
dis-similar materials

Cancelled pressurized connections not in use at vacant properties

Project Performance Indicators



Waterford RO Plant

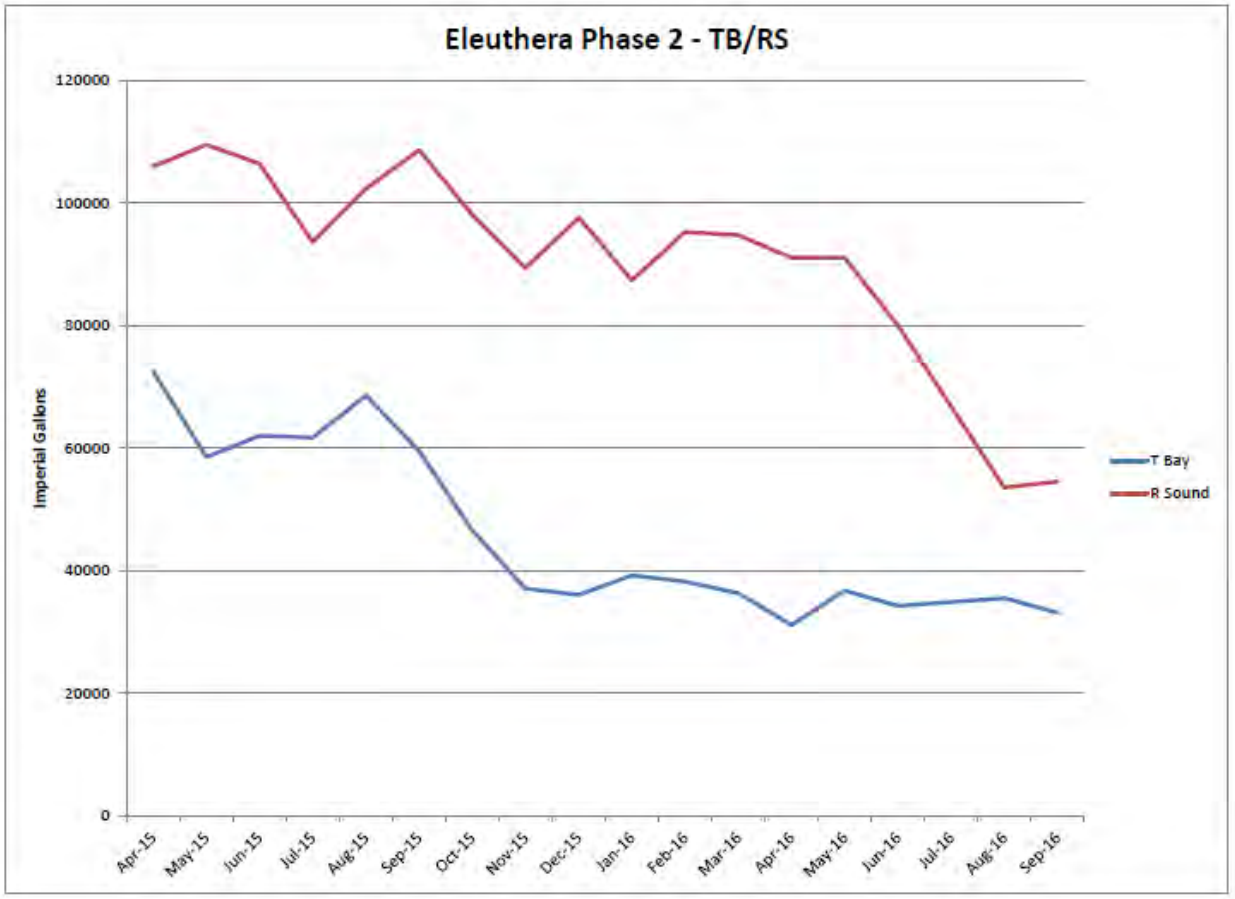


South Eleuthera Phase 2
NRW Project

Additional DMA's reviewed with base line assessment completed with ongoing works to address high NRW.

- Pressure Mgmt systems
- District Improvements

Network Performance



Network Efficiencies

- Inline Booster system to allow adequate system pressure at higher elevations.

GRUNDFOS

Company name:
Created by:
Phone:

Date: 6/23/2016

Position	Count	Description
	1	HYDRO MULTI-B/E 2 CME3-3

Any Questions?

Many thanks for your attention

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