

# Stable Water Supply with Leakage Control

—Retrace about 100years History—

Yukio NISHIKAWA  
City of Nagoya

*For more development in  
Sri Lanka  
by Technique of Nagoya  
based on Leakage Ratio 3%.*

## Contents

1. History of Leakage Control
2. Project of Waterworks Facilities
  - 2-1 Water Distribution Mains  
/ Water Distribution pipes
  - 2-2 Water Service Installation

## Chap.1 History of Leakage Control

Stable Water Supply with Leakage Control

# Sri Lanka and Nagoya in Japan



	Sri Lanka (Country)	Nagoya (City)
Population	20,630,000 (2010)	2,380,000 (2010)(Service area)
Population served by water supply	36.9% (2009)	100% (2010)
Non-Revenue earning water ratio	31.1% (2009)	3.91% (2010)
Water charge	3 ~ 120 Rs/m3 (basic)	182.3 Rs/m3 (basic, $\phi 13,1Rs \approx \yen 0.6$ )

Stable Water Supply with Leakage Control

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Kiso River

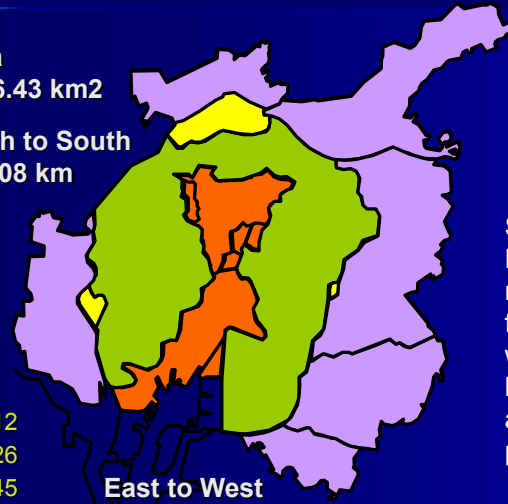
## Transition of City of Nagoya area

Area : 326.43 km<sup>2</sup>

North to South : 25.08 km

East to West : 24.55 km

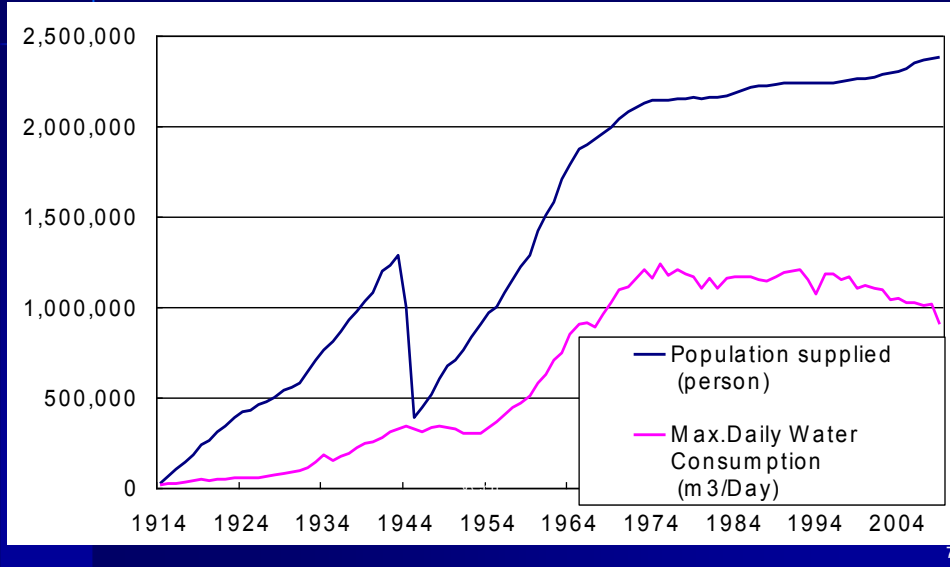
- ~1912
- ~1926
- ~1945
- 1945~



Since 1914 in City of Nagoya, we constructed new waterworks facilities corresponded water consumption based on expand city area and increasing population.

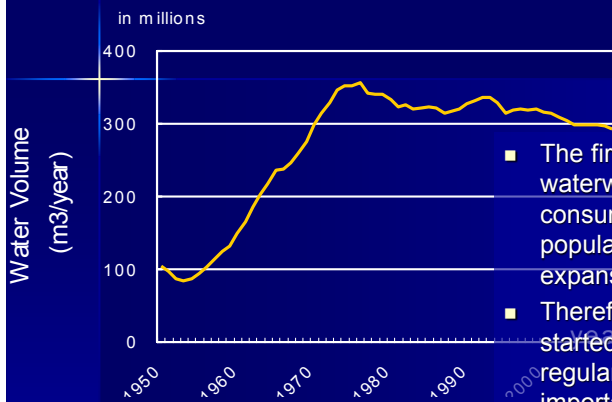
## Growth of Nagoya Waterworks [Population and Consumption]

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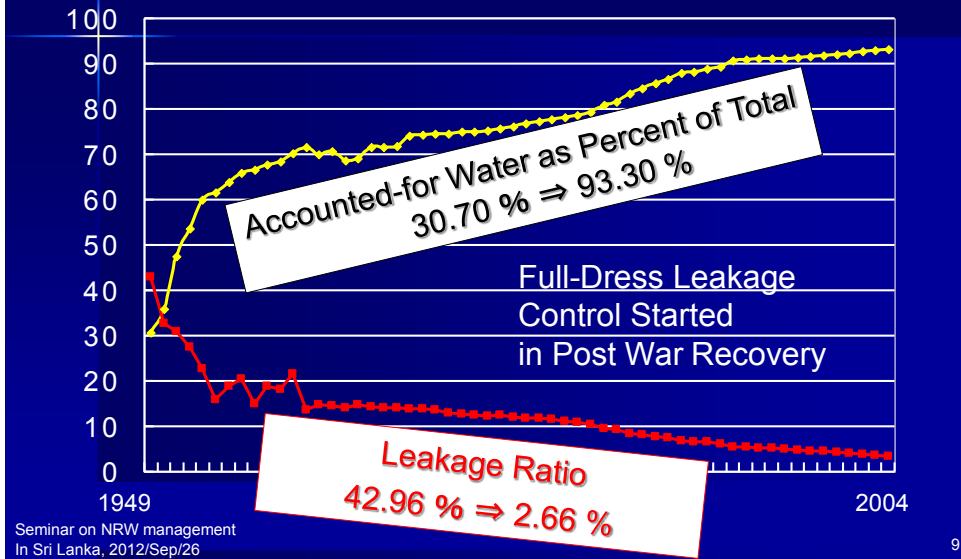
## Growth of Nagoya Waterworks [Yearly Water Volume]

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- The first object was construction of waterworks for correspond to water consumption based on increased population from foundation to expansion.
- Therefore leakage control was started behind construction after regular spread, but we recognized important of leakage control.
- How did we decrease leakage and work on project?
- Show you trend of Leakage ratio.

## Trend of Leakage Ratio and Accounted-for Water as Percent of Total



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Leakage Control

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## Period of Post War Recovery

- Damaged by air attack and earthquake, Service pipe damaged is 60%.
- Almost waterworks facilities is damaged, Leakage ratio is over 80%.
- Damaged of W. P. P. is happened, Pressure decline of Distribution mains and suspension of the water supply.
- First aid project is operated.

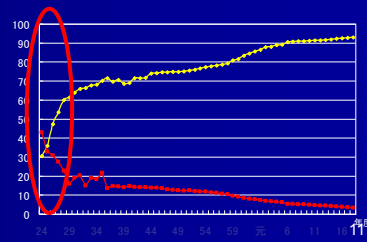
About 60 years ago



1<sup>st</sup> Stage since 1945.8

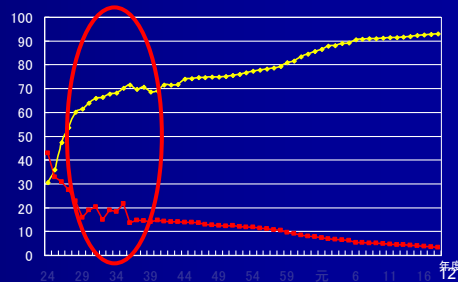
## First Aid Leakage Control

- Confirmation of burn down water service installation by setting leakage control team, Service pipe prevention of leakage by closed stop valve and serving pipe stoppage
- Cooperated with resident associate crushed

Seminar on NRW management  
In Sri Lanka, 2012/Sep/262<sup>nd</sup> Stage since 1949

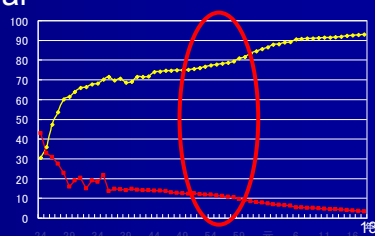
## Leakage Control

- Prevention of surface leakage
- Direct detection
- Leakage control and repair perfectly until no leakage every 2km

Seminar on NRW management  
In Sri Lanka, 2012/Sep/26

## 3<sup>rd</sup> Stage since 1982 Leakage Control

- Categorized survey area
  - All service area classification by frequency of leakage
  - Circuit for every one year to three years
- A part of control is entrusted by private enterprise.
- Introduction “Correlative leak detector” correspond to gradual decrease add to acoustic bar



Seminar on NRW management  
In Sri Lanka, 2012/Sep/26

## Technical Training Center

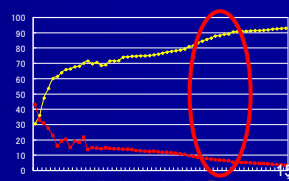
- Established in 1984
- Systematic training and guidance about skill for staff and constructor
- Education for new technique and new products

Seminar on NRW management  
In Sri Lanka, 2012/Sep/26

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## 4<sup>th</sup> Stage since 1988 Leakage Control

- Acoustic bar and Correlative leak detector
- Categorized survey area
  - All service area classification by underground condition
  - Important area = direct management
    - Every one year for areas of high density of old pipes and non-lining pipes
  - Around area = entrustment
    - Every three years for surrounding
  - Standard area = direct management
    - Every three years for other areas



Seminar on NRW management  
In Sri Lanka, 2012/Sep/26

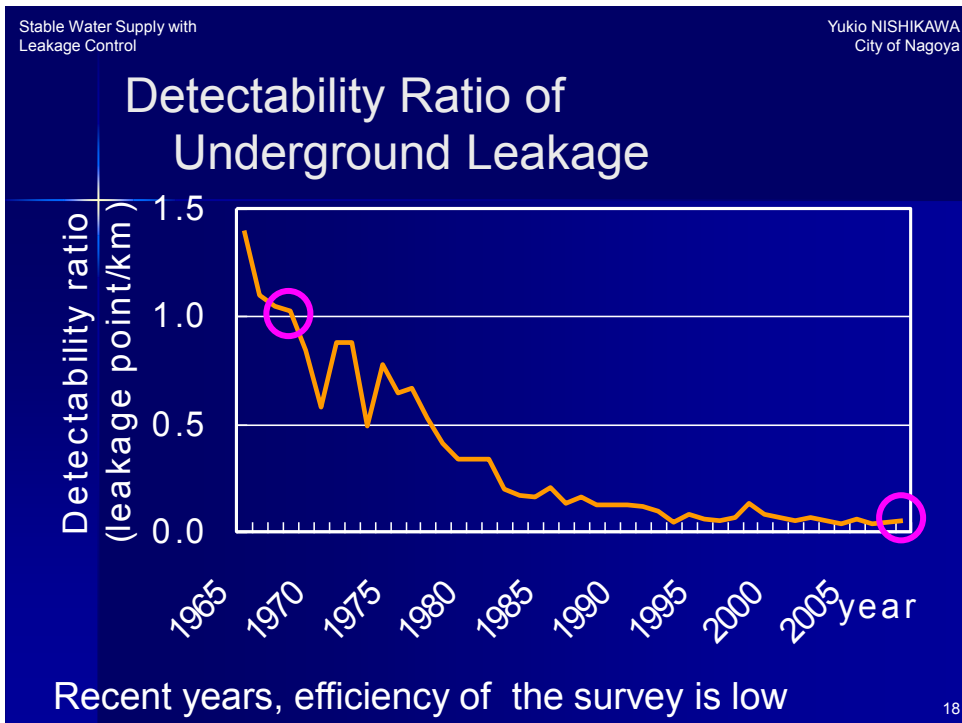
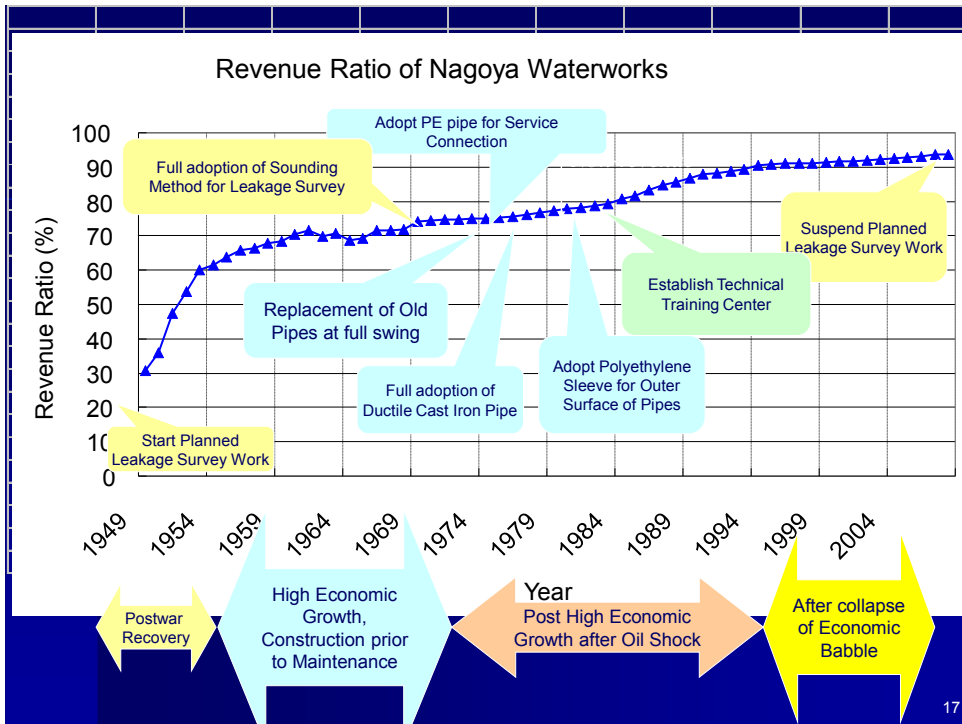
## Impulsion of Ministry of Health, Labour and Welfare

- Waterworks Vision in 2004
  - 5 politics target for waterworks in Japan
  - “Ease”, “Stability”, “Sustainability”, “Environment”, “International”
  - On side of measure for reinforcement against environment and energy
  - Setting Effective water ratio target
    - Large waterworks           98% over
    - Under mid waterworks   95% over

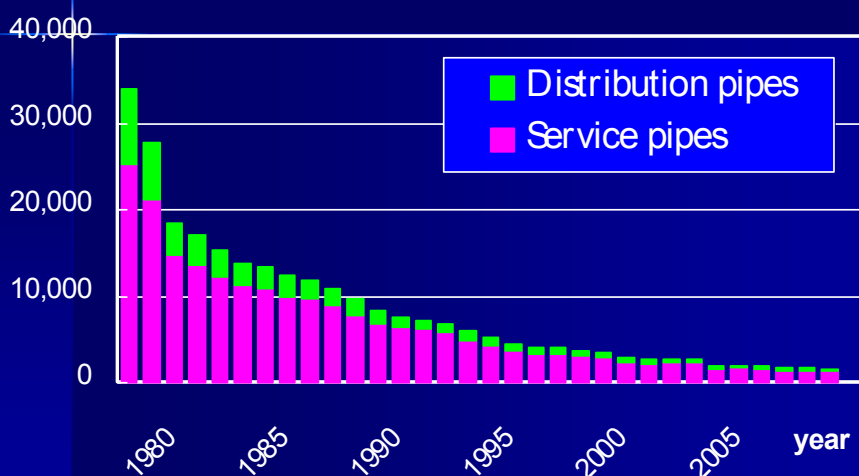
Effective water ratio is achieved for 97.21% in 2010

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## Number of Repaired Pipes



About 80% of Leakage proceed from service pipe.

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## Chap.1 Conclusion

- The 1<sup>st</sup> target is stopped leakage.
- The 2<sup>nd</sup> target hold surface leakage one after another for all service area.
- The 3<sup>rd</sup> target is new measuring method introduction for difficulty of detection.
- The 4<sup>th</sup> target is categorized service area for management object.
- Thus we changed leakage control corresponded to leakage ratio, age and other conditions, and continues to leakage control.
- As a result, leakage ratio is under 3% from maximum 80% over, Accounted-for water as percent of total is 93.3% from 30.7%.
- Show you concrete leakage control

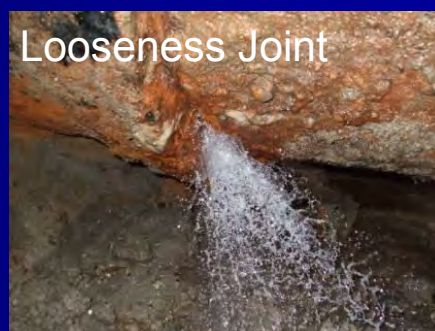
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# Chap.2 Project of Waterworks Facilities

# 2-1 Water Distribution Mains / Water Distribution pipes

## Project

- Plan
- Design
- Construction
- Maintenance



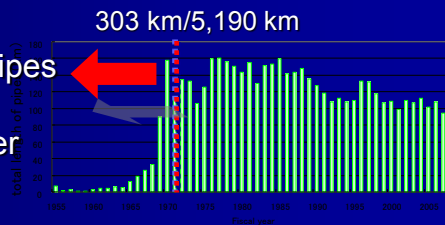
## Plan

- Conventional
  - We are practicing pipe maintenance project since 1975 after 61 years water service started.
- Present
  - 3<sup>rd</sup> Distribution Pipes Maintenance Project

## 3<sup>rd</sup> Distribution Pipes Maintenance Project

- 2011-2015
- Equalization replace against rapid increase.
- Important and high urgency mains replace move up.
- Normal cast-iron pipe sweep.
- Important distribution pipes replace aseismic.
- Aim for good taste water

Aged pipelines  
(Pipelines that have reached the end of their statutory useful life (40 years))



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## Design

- Conventional
  - Ductile iron pipes
  - Adopt Joint improved
- Present
  - Joints with a detachment prevention mechanism
  - Covered with polyethylene sleeves
  - Steel pipes



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# Construction

- Construction control by supervisor
  - Construction Schedule Control
  - Measured Value Control
  - Quality Control
  - Construction Photograph and Completion Drawing Control

# Construction Schedule Control

Construction schedule chart

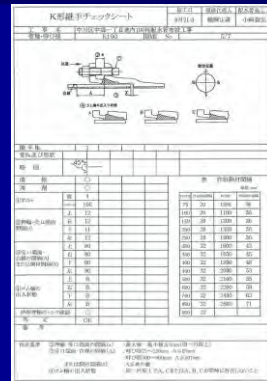
Construction items	Quantity	JUNE			JULY			AUGUST			SEPTEMBER			Notes	
		10	20	30	10	20	31	10	20	31	10	20	30		
Preparation	test excavation	█												100%	100%
Temporary pipe laying	200m	█	█												
Service pipe	40 houses			█										85%	
First connecting	3 points				█										
Pipe laying and removing	250m				█	█	█	█						50%	50%
Service pipe	40 houses						█								
Second connecting	3 points											█			
Temporary pipe removing	200m												█		
Finish															0%

and Construction plan

For these provision,  
Sure and appropriate construction with contractor

## Measured Value Control 1

- Ductile iron pipe
  - gap between a pipe's spigot end and a socket bottom
  - Location of socket
  - Tightening with standard torque
  - Contractor shall submit joint check sheet to supervisor
  - Measuring hydraulic pressure



For these provision,  
Function of pipes exercise maximum.

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## Measured Value Control 2

- Work
  - Sand around pipe (30cm)
  - Frequency of cover (every under 20cm compaction by fastening machine)
  - Quality of backfill (sand and earth)
  - Secure of clearance with other structure

For these provision,  
Promote to protection of pipes

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## Quality Control

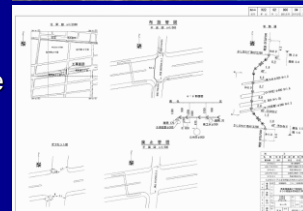
- Standard
  - JIS (Japanese Industrial Standards)
  - JWWA (Japan Water Works Association)
  - JDDA (Japan Ductile Pipe Association)
- Quality inspection
  - Products shall pass inspection of JWWA.
- Receiving inspection
- License
  - JWWA provides pipe joint license in Japan.
  - In addition, Nagoya city provides original license, because of specialty of pipe material adopted.

For these provision,  
Appropriate construction prevent dispersion by contractor.

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## Construction Photograph and Completion Drawing Control

- Photograph
  - Confirmation each invisible construction it was right or not.  
(ex. compaction of backfill)
  - Supervisor examines photographs sub completion of construction.
- Completion drawing
  - Location, Plan, Cross section, Pipeline Extinct pipe



For these provision,  
Adequacy construction and maintenance easily

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## Inspection of Completion and Rating for Contract Work

- Inspection
  - Completion drawing
  - Construction plan
  - Record of measured value control
  - Record of construction photograph
  - Record of quality control
  - Installed length on the scene & showing
- Rating
  - Evaluation and proper selection of a constructor
  - Leading and training constructors

For these provision,  
Construction was finished, we continue to  
observation contractors.

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## Maintenance

- Conventional
  - We are practicing leakage control project since 1945 after 31 years water service started.
- Present
  - 4<sup>th</sup> Distribution Maintenance Work Project

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## 4<sup>th</sup> Distribution Maintenance Work Project

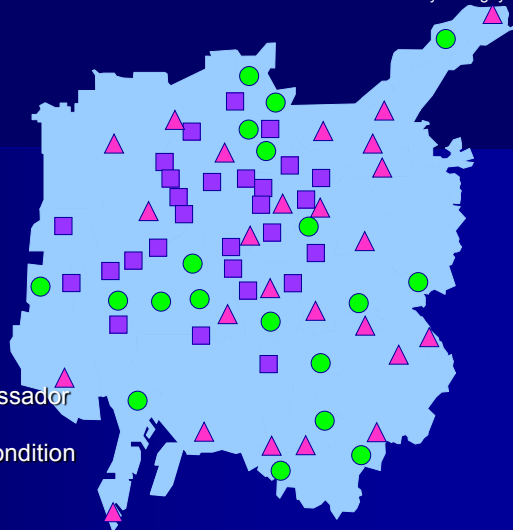
- 2011-2015
- Command information in pipes
  - Pressure, Residual chlorine etc.
- Improvement pipes inside
  - Cleaning for inside and object
- Analysis distribution
- Prevention of leakage and burst
  - Survey under railways
  - Old polyethylene pipe replace
- Reinforce of pipelines
  - Replace to ductile iron pipe
- Check and repair
  - Hydrant and Air valve

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## Telemeters

- Water Pressure Telemeters  
16(at work)
- Water Flow and Pressure  
Telemeters 26(at work)
- ▲ Water Quality Telemeters  
27(at work)

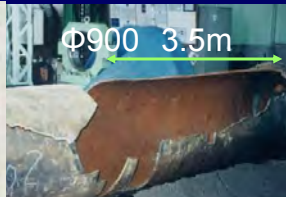
Telemeters are set on ambassador  
of each distribution area for  
observation of distribution condition  
at all times.



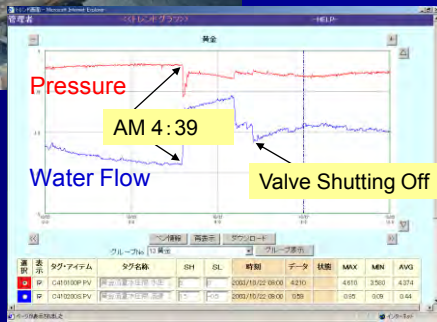
For these provision,  
When distribution condition changes, we can check  
and manage the accident quickly.

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# For Example Burst of Water Distribution Mains - Quick Response to Rupture of Pipeline -

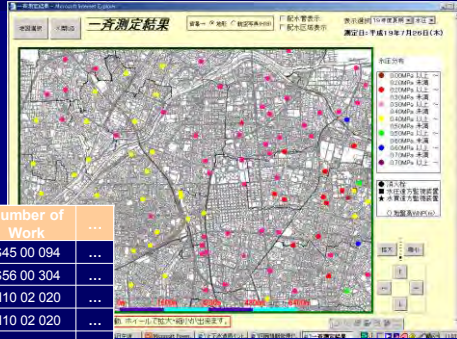


- Shut off after about 3hours
- Laying for 40 years
- Decline in pipe thickness because of corrosion from inner side



4:39am 22.August in 1998 37

# Computer Mapping System /Measure of Water Pressure Census



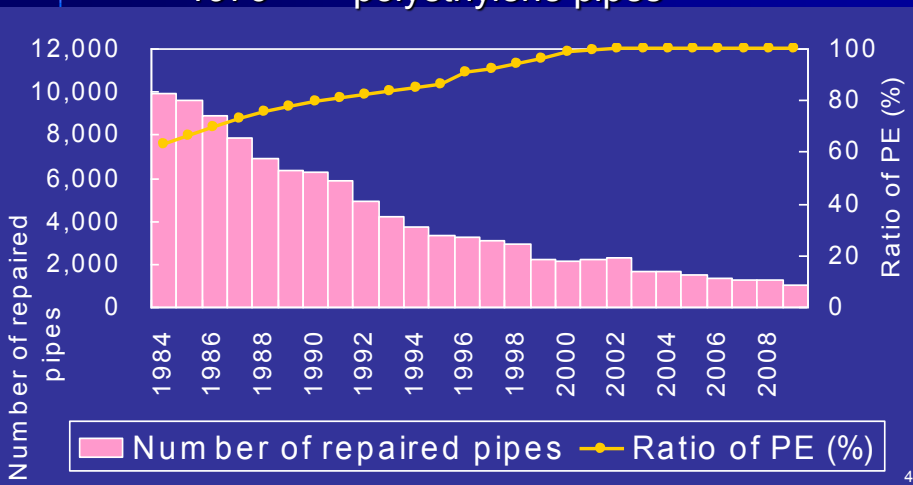
FY	Material	Joint	Internal	External	Diameter	Length	Number of Work	...
S45	D	A	L		150	25.2577	S45 00 094	...
S56	D	A	L		150	18.6944	S56 00 304	...
H10	D	K	L	P	150	24.1768	H10 02 020	...
H10	D	K	L	P	100	3.8951	H10 02 020	...
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮

For these provision,  
We can manage information of pipes unitively and  
develop more improvement.

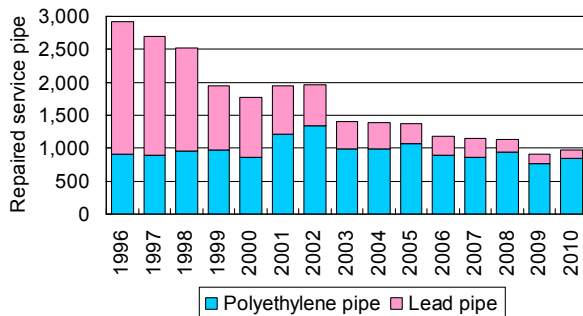
## 2-2 Water Service Installation

## Service Pipe Material

~1975      Lead pipes  
1976 ~      polyethylene pipes



## Leakage of Polyethylene Pipes

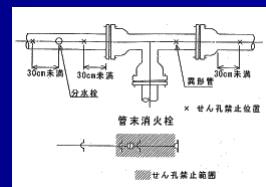
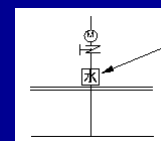


Decrepit O-ring

- Old polyethylene pipes need to be replaced to reduce leakage more

## Design and Construction

- Setting standard of construction for water service installation
  - Materials decided by "Structure and material of water service installation (ministerial ordinance)"
  - Secure of clearance with neighboring branch pipe
  - Expression indication of lying
  - Placed by stop valve for maintenance
- Confirmation of service installation works construction
  - License, tools
  - Inspection by licensed dealer and waterworks

Prohibition of  
nearly branch

Block of indication

## Chap.2 Conclusion

- In Nagoya we wrestled leakage control at every stage for Plan, Design, Construction, Maintenance.
- These means leakage control is not only new pipelines construction but also always observation.
- Quality of construction and command of facilities information is important.

## For Future of Sri Lanka

- We have a big object for limited water resource is not waste, not only our waterworks but also citizen and enterprise.
- Leakage control improvement needs long terms and much cost, but you will find the method matched Sri Lanka, be much better.
- We invite to have same object and continue leakage control in future in Sri Lanka.



In 1914



In 2012

*We hope to go far to  
waterworks in Sri Lanka.*

*Thank you for your  
attention*



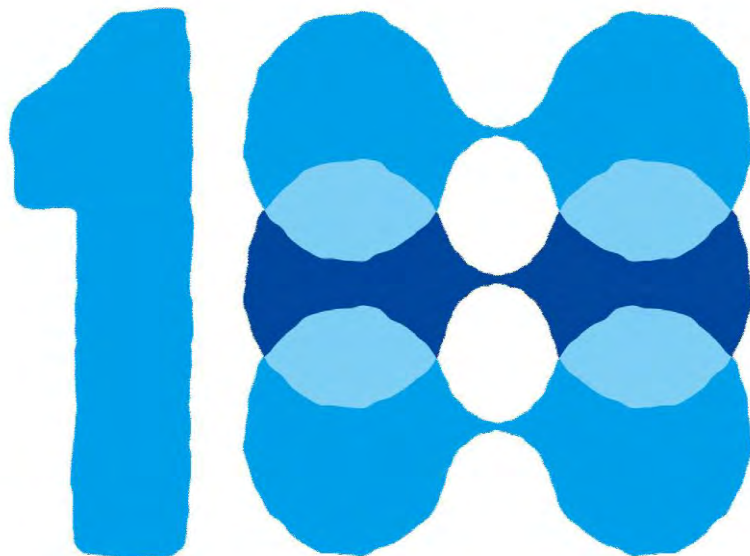
In 1914



In 2012

# Renovation and maintenance of pipe network

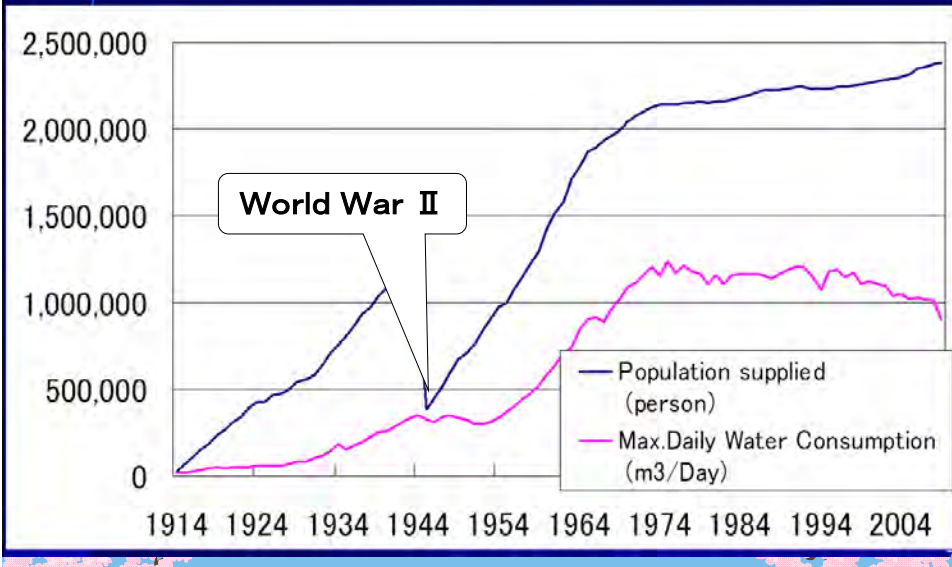
Sigeto YASUHARA  
Pipeworks Design Division 1,  
Waterworks & Sewerage Bureau,  
City of Nagoya





# Growth of Nagoya Waterworks [Population and Consumption]

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City of Nagoya



## Distribution Pipeline Improvement (1)

Year	Project	Length	Target
1975-1987	Distribution Pipe Improvement	3,244 km	<ul style="list-style-type: none"> <li>• Old PVC and AC pipes</li> <li>• Old pipe with much rust at inside</li> <li>• Other pipes with rust or high leakage ratio</li> </ul>
About 250km/year			
1988-1991	Distribution Pipe Network system Improvement Phase I	831 km	<ul style="list-style-type: none"> <li>• additionally above,</li> <li>• small size PVC D=25mm</li> <li>• Treat new demand</li> <li>• Replace to earthquake-proof type at soft ground area</li> </ul>
About 210km/year			
1992-1997	Distribution Pipe Network system Improvement Phase II	854 km	<ul style="list-style-type: none"> <li>• Promote installation of earthquake-proof type</li> <li>• Synchronize with service reservoir reconstruction</li> </ul> <p>Direct water supply to 3rd floor by pressure in pipes</p>
About 140km/year			

## Distribution Pipeline Improvement (2)

Year	Project	Length	Target
1998-2002	Distribution Pipe Network system improvement Phase II	663km	<ul style="list-style-type: none"> <li>• promote above mentioned project</li> </ul>
About 130km/year			
2003-2005	Distribution Pipe Network Improvement Phase I	327 km	<ul style="list-style-type: none"> <li>• Replace aging pipes</li> <li>• Install earthquake-type pipes all over the city</li> <li>• Promote earthquake-proof pipe at the way to hospital and important facilities</li> <li>• Promote direct water supply unto 5th floor</li> </ul>
About 109km/year			
2006-2010	Distribution Pipe Network system Improvement	528km	<ul style="list-style-type: none"> <li>• Replace aging ductile cast iron pipes</li> <li>• Install earthquake-proof pipes at the route to emergency water supply points</li> </ul>
About 106km/year			

