

Annex 8:

Lectures and Training Sessions

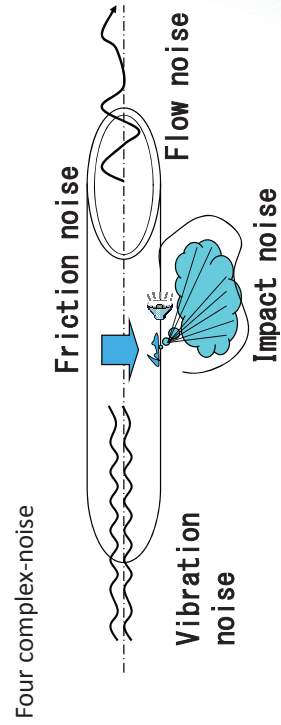
Leakage Sound - I

▶ JICA Expert Team
▶ Jun. 2015

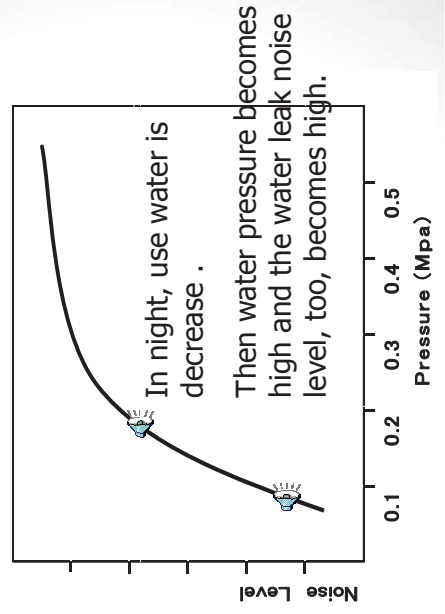
Mechanism of water leakage & Analysis of frequency

- Leak Noise
- Pipe-line transmission Attenuation property
- In soil transmission Attenuation property

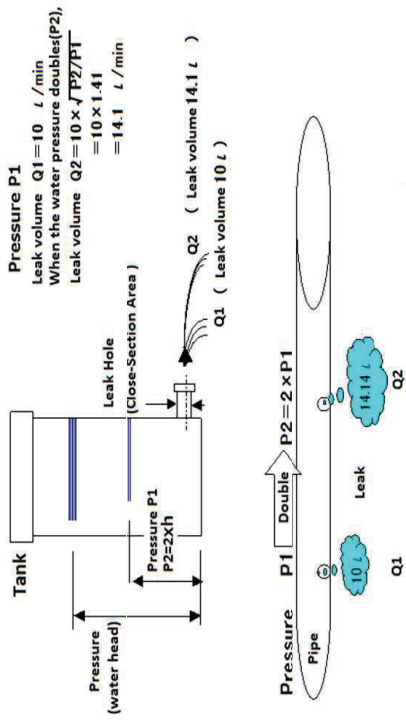
Mechanism of Generation of the water leak noise



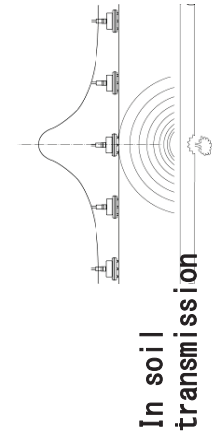
Noise generation & Pressure



Leak Quantity & Pressure



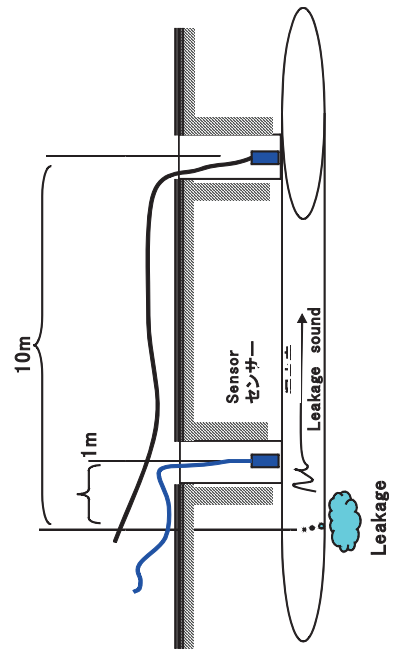
Water leak noise transmission



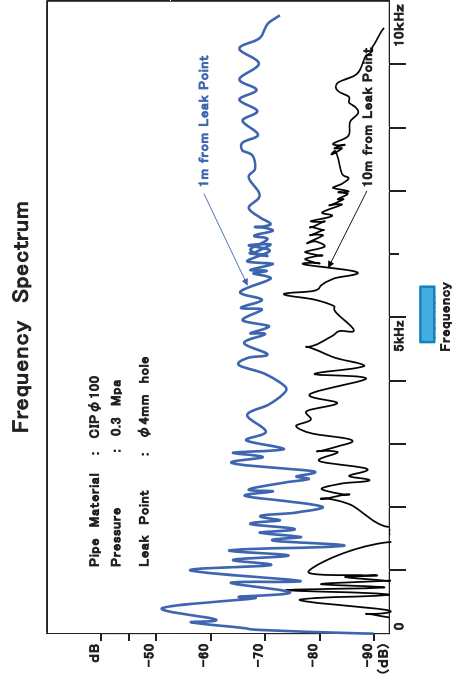
Pipe-line transmission



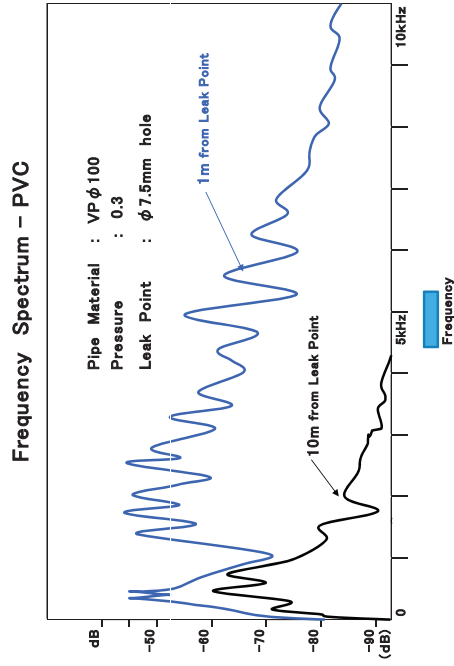
Frequency Spectrum



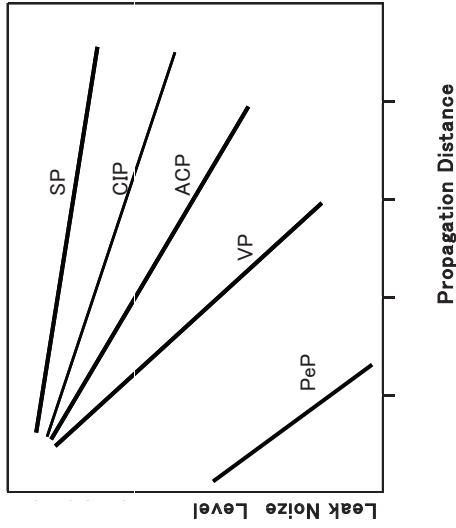
Frequency Spectrum -GIP



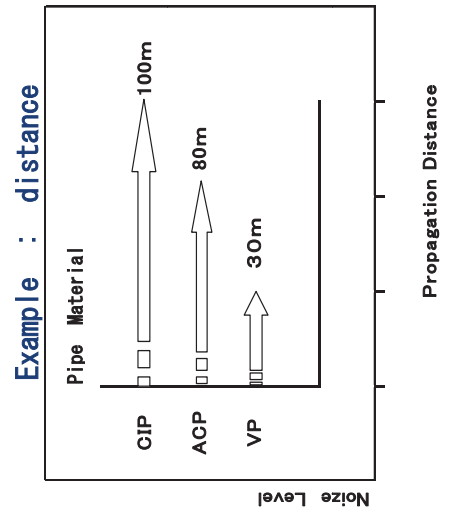
Frequency Spectrum - PVC



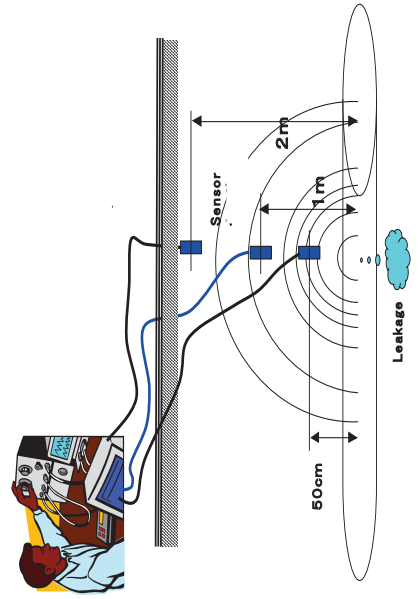
Pipe-line transmission attenuation property



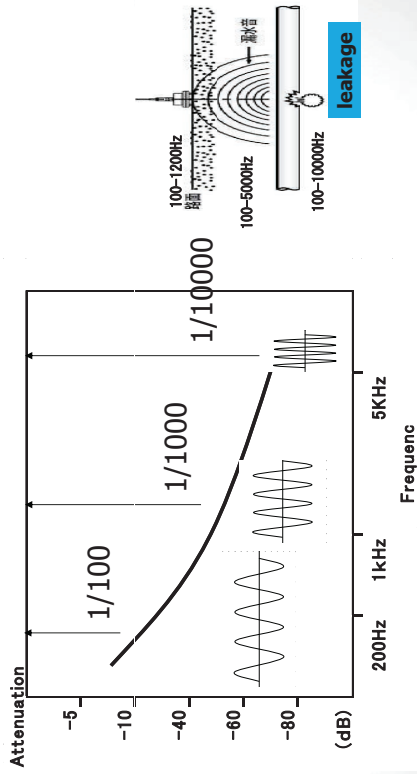
Pipe-line transmission attenuation property



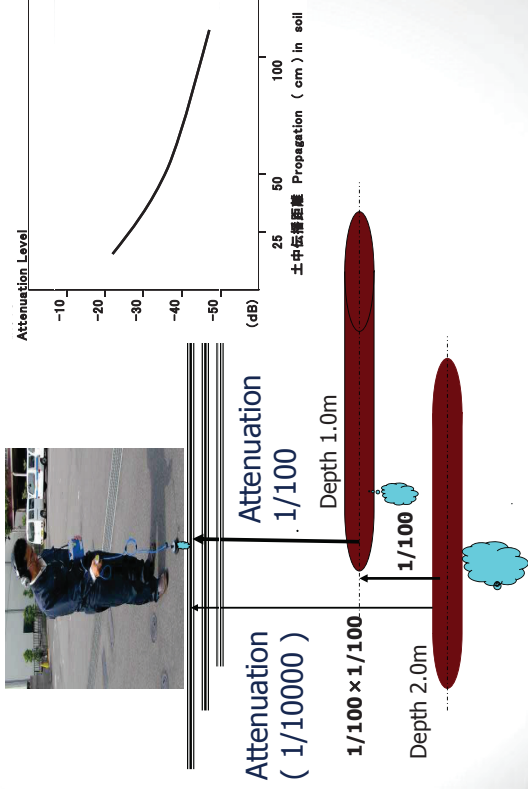
In soil transmission attenuation property



In soil transmission attenuation property



In soil transmission attenuation property



Conclusion of Leakage noise

Condition	Noise level	characteristic
Leakage Q	small	Small amount of leak makes small leak sound.
	large	Large amount of leak makes large leak sound.
Pipe material	plastic	Soft Material of Pipeline absorbs Leak Noise
	metal	Hard material of Pipe transmits leak noise longer.
pipe diameter	small	Leak sound travels longer in small diameter pipe.
	large	Leak sound diffuses in large diameter pipe.
Water Pressure	low	Leak amount, and Noise level increase in response to
	high	water pressure.
pipe depth	shallow	Soil absorbs Leak sound.
	deep	The deeper, the smaller sound we can get from surface.
soil density	low	Leak sound travels better in high density soil.
	high	Low density soil absorbs Leak sound.

Leakage Sound - II

- ▶ JICA Expert Team
- ▶ Jun. 2015

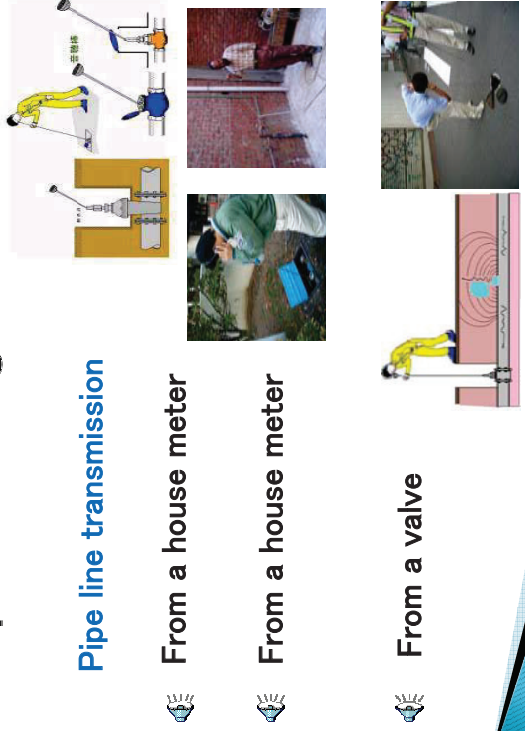
Sample of Leakage Sound

Pipe line transmission

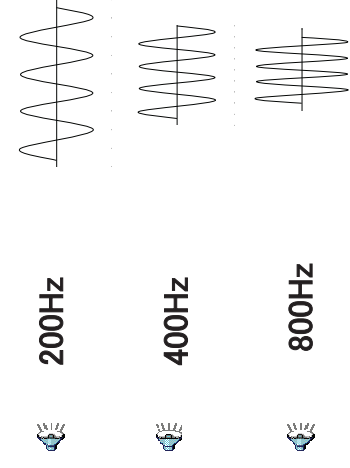
From a house meter

From a house meter

From a valve

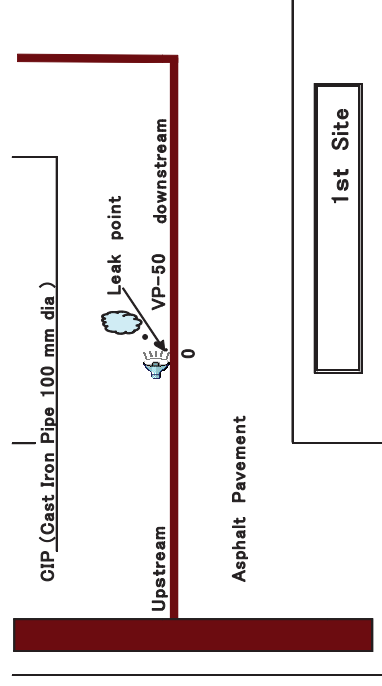


Sound of Basic Frequencies



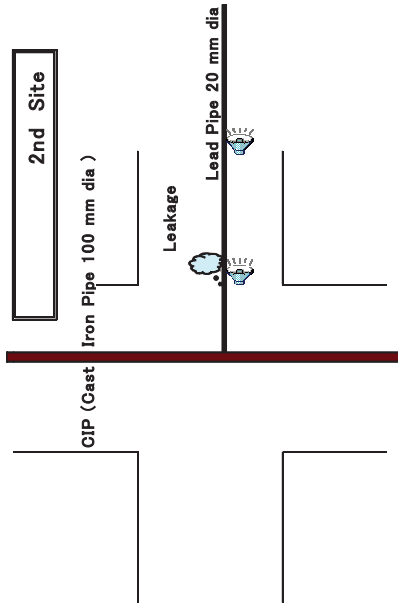
Leakage Sound Case - 1

In soil transmission



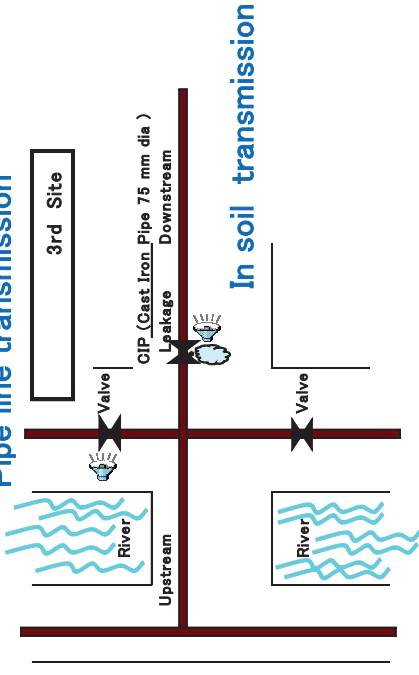
Leakage Sound Case-2

In soil transmission







Leakage Sound Case-3

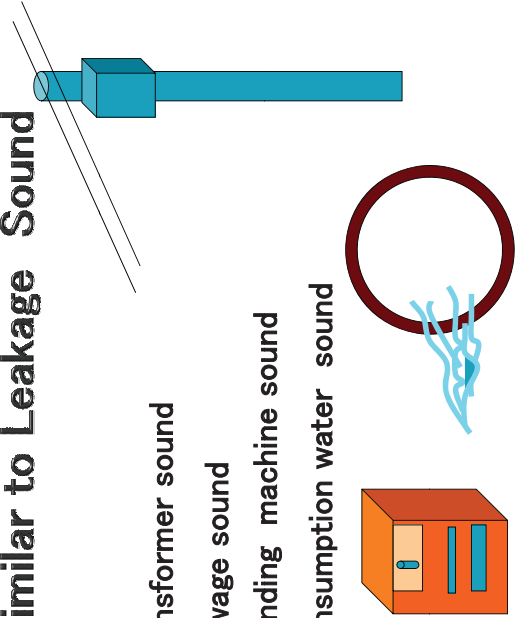
Pipe line transmission



In soil transmission







Sound Similar to Leakage Sound

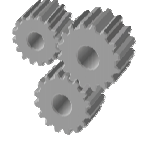
-  Transformer sound
-  Sewage sound
-  Vending machine sound
-  Consumption water sound



Mixed Sound

of Noise and Leakage Sound

-  Leakage sound & car passage sound 
-  Leakage sound occurring just aside of sewage manhole 
-  Leakage sound occurring next to noisy factory 



Method for Leak Detection

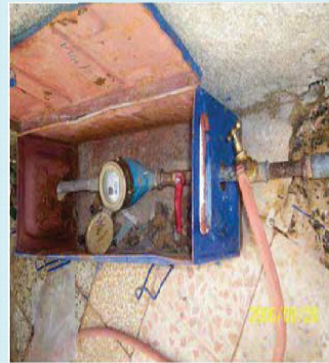
JICA Expert Team
Jun. 2015

Water Balance Sheet (IWA)

Raw Water		Water Distribution Volume		Revenue Water	
Authorized Consumption		Water Losses		Water Sold	
Billed Authorized Consumption	Unbilled Authorized Consumption	Billed Metered Consumption (Billed amount collected)	Unbilled Metered Consumption (Consumption more than the billed amount)	Commercial Losses	NRW
Apparent Losses	Real Losses (Leakage)	Unbilled Unmetered Consumption	Unsubsidized Consumption	Physical Losses	
		Metering Inaccuracies	Leakage in Transmission and/or Distribution Mains		
		Leakage and Overflows at Utility's Storage Tanks	Leakage on Service Connections up to point of customer metering		
Treatment Losses (Backwash, etc.)		Evaporation			

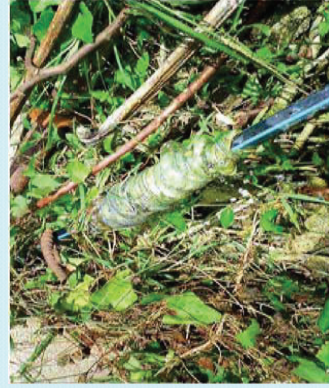
Leak Detection Technology

EX : Illegal connection



Mount a tap before meter

2015/6/27



Diverge from service line

3

EX : Illegal connection



Diverge from the main pipe for the house construction



Diverge from the main pipe for the settlement

2015/6/27

4

EX : Destroy and Remove of Meter



Destroy the meter



Remove the meter

2015/6/27

5

EX : Destroy and Remove of Meter



Remove the water meter

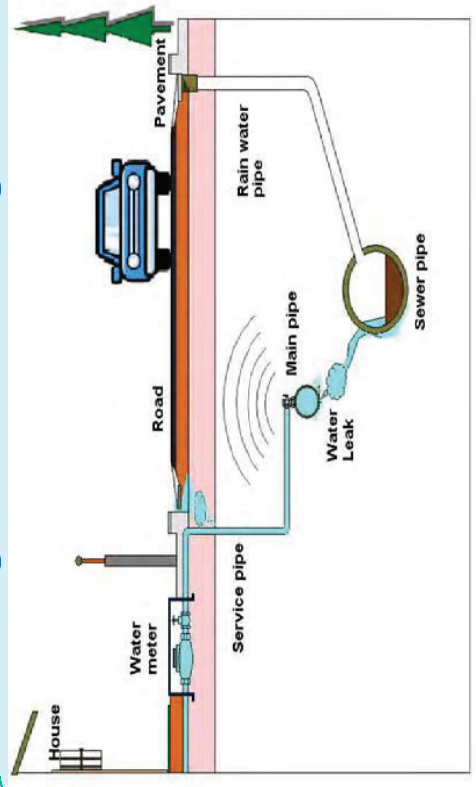


Remove the inside parts

2015/6/27

6

Image of Water Leakage

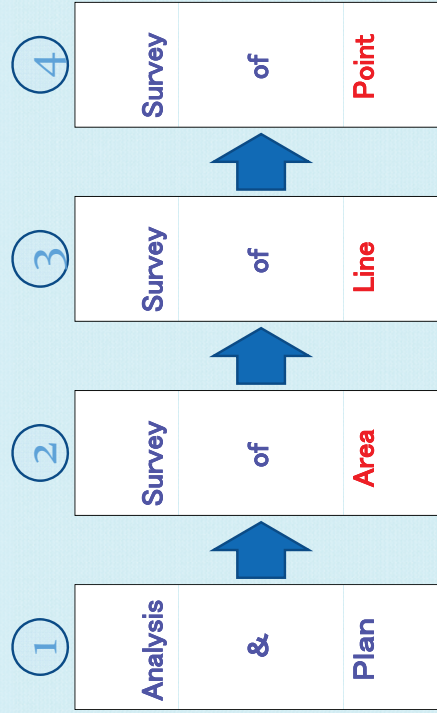


Leakage of Visible

: Patrol , Inform from inhabitant

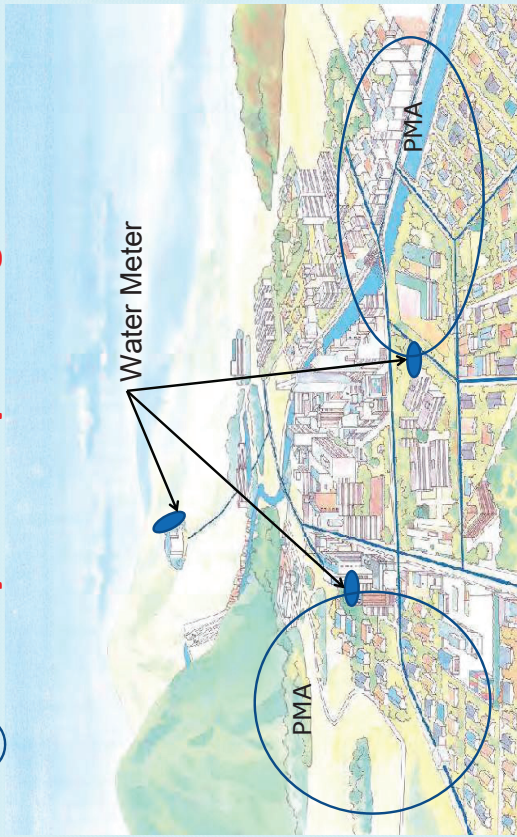
Leakage of Under ground : Survey of Using the equipment

Procedure of Leak Detection

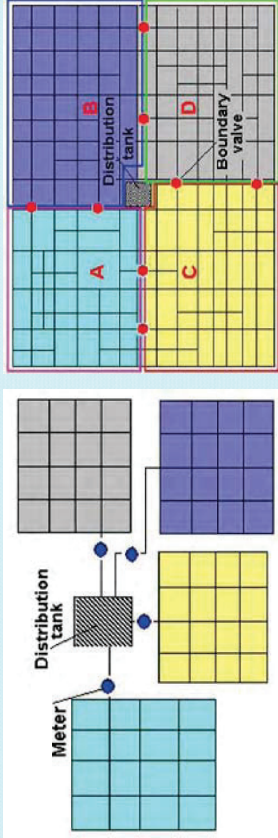


Water Leakage detection is that narrow the range gradually.

1 Analysis and planning



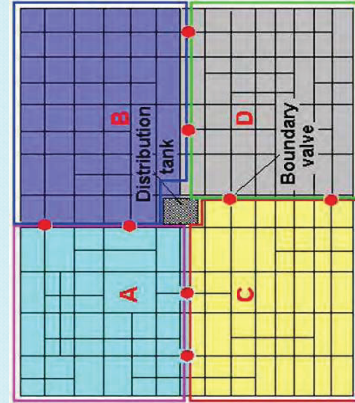
For Water Leakage Survey Calculate of NRW or Leakage Ratio



Calculate NRW ratio by inflow data and monthly customer consumption.

Each inlet point of isolated area and each house must install meter .

Prioritization for Water Leakage Survey



Area	Pipe length (m)	Number of Connection	MNF (m ³ /h)	MNF /Km (m ³ /h)
A	19,000	1,425	7.8	0.41
B	17,000	1,270	15.8	0.88
C	15,000	1,120	22.1	1.47
D	13,000	980	4.0	0.30

Preparation Work for the Leak Detection



Check the location of boundary valve for Isolation area.

If objective valve or line are missing at site.

Survey of Buried Valve (box) at Site

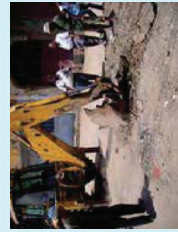
Metal Locator detects the position of the valve buried underground.



Metal Locator F-90M



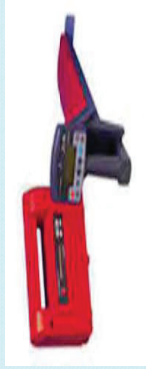
Valve Locating at Site



Survey of Metal Pipe at Site



Pipe & Cable Locator Series



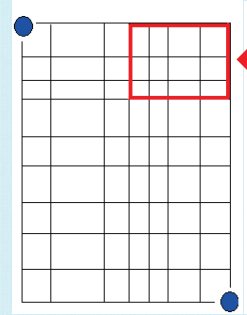
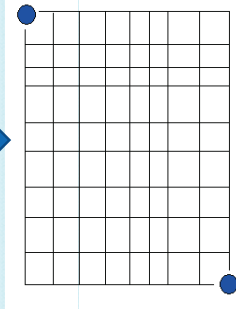
PL-960

Advantage for Urban Site

27KHz/ 89KHz/ 334KHz

② Method of Detection for Leak Area

Water distribution management area



Leakage management area

Leak point should be narrowed down from large area.

Survey of Minimum Night Flow (24h) (Leakage Volume)



Ultrasonic Flow Meter

&

Water Pressure Recorder



In

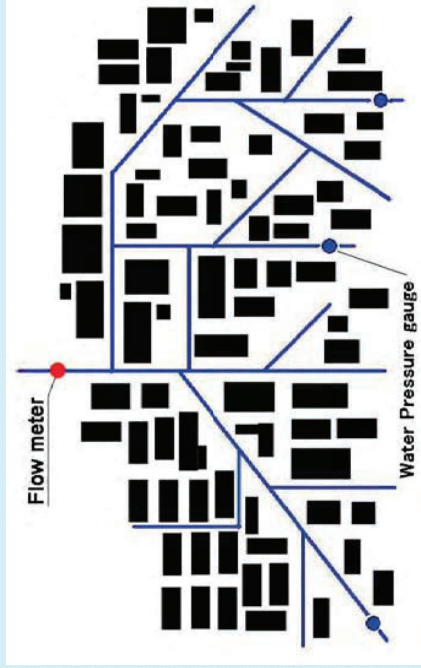
Chamber



Flow Measurement 24h (Model Block)



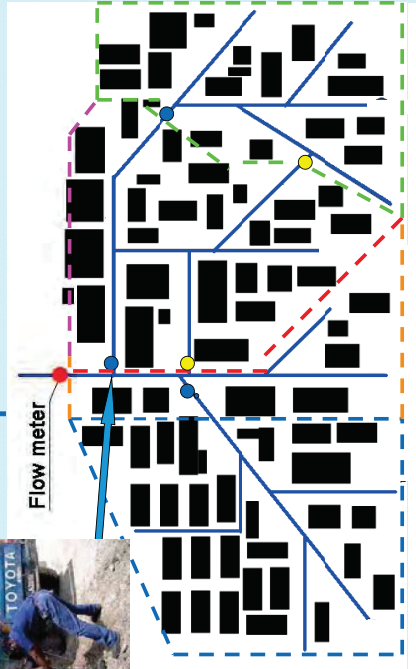
Image of Flow Measurement Survey



Install the flow meter and water pressure recorder at the inlet point of Isolated area.



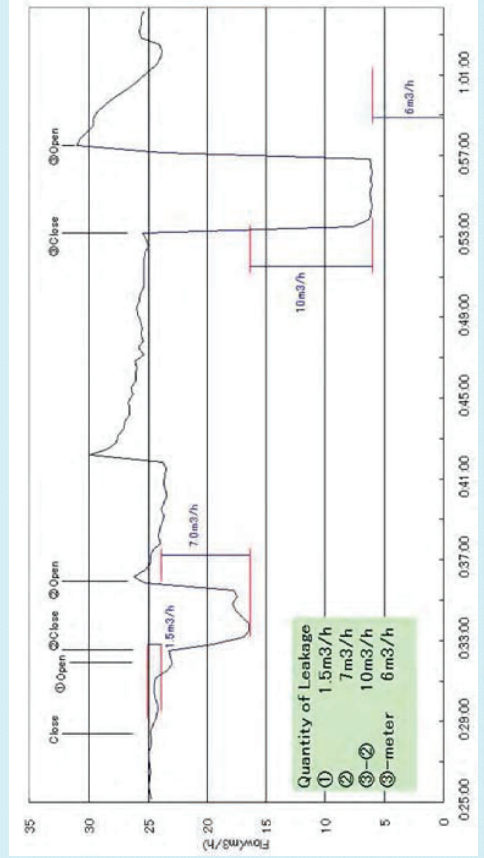
Step Test Method



Leak volume in the respective areas should be proved by the valve operation

- Closed valve
- Operating valve

Image graph of Step Test



Compare the flow volume before and after valve operation.

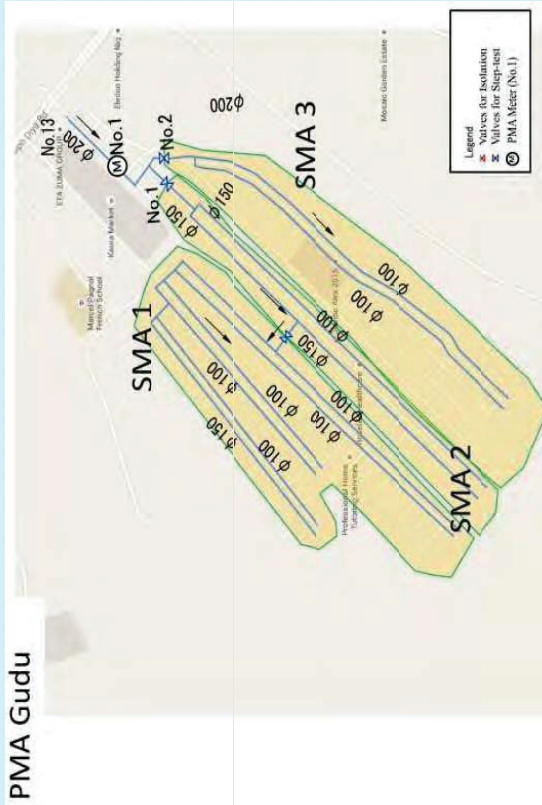
Creation of Pilot Metering Areas

PMA Garki 1



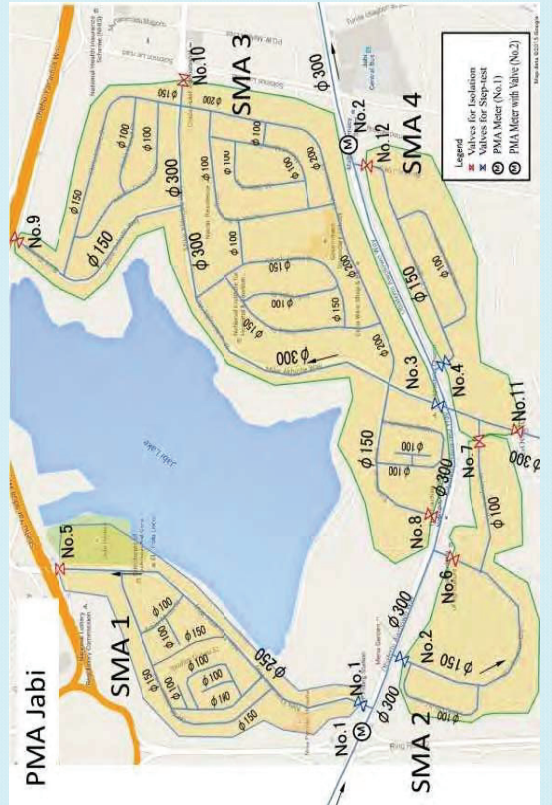
Creation of Pilot Metering Areas

PMA Gudu

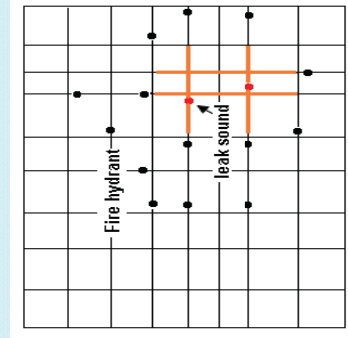
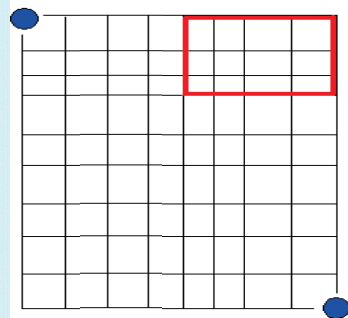


Creation of Pilot Metering Areas

PMA Jabi

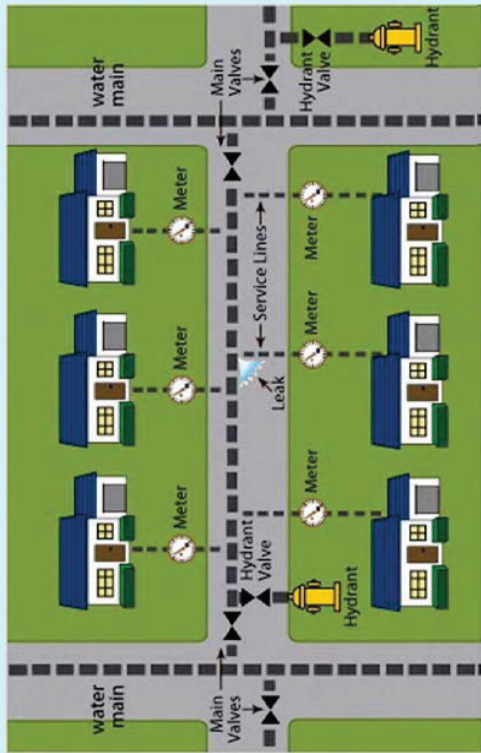


3 Method of Detection for Leak Line



Check a leak sound in valve, water meter and other fittings.

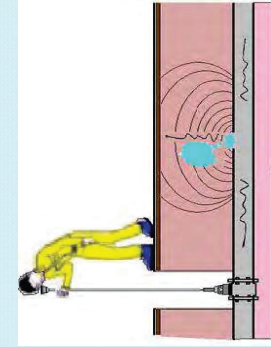
Acoustic Survey



Leak sound is transmitted to water main or service pipe lines from leak point.

Listening stick

LSP-1.0m, 1.5m



Leak

Listening stick is touching of valves and water meters for confirmation of leakage sound

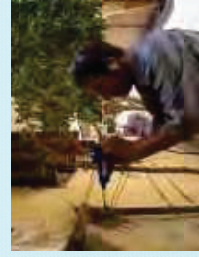
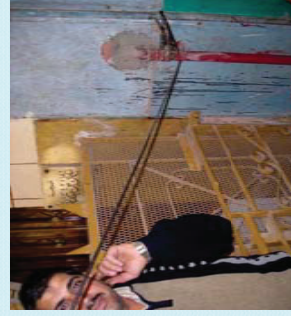


Water Leak Survey on the Meter



Check the Leak sound to listening stick which is transmitted from leak point at the meters and other fittings.

Acoustic Survey at Site



Listening Stick LS-1.5

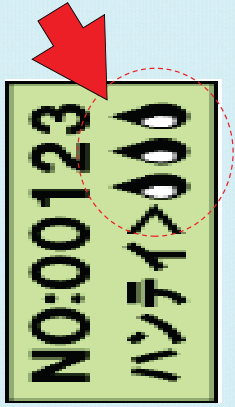
Digital Sound Detector FSB-8D

Time Integration Type Leakage Detector

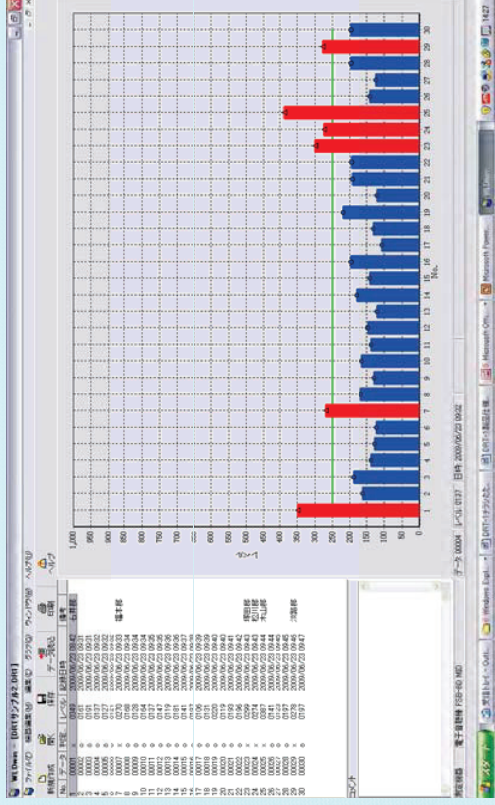
Just press the button
(Measured in 3 seconds)



- Easy operation
- Automatic judgment



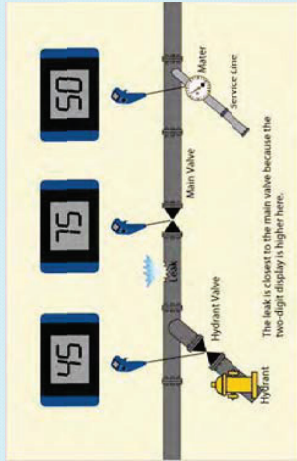
Time Integration Type Leakage Detector



Electric listening stick FSB-8D



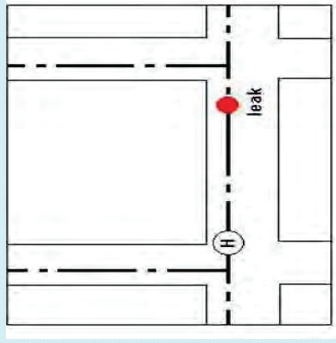
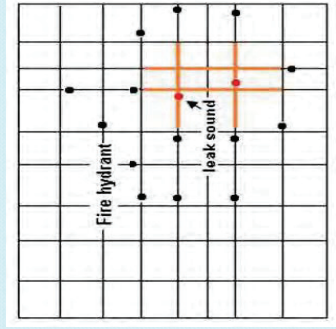
FSB-8D is effective against a PVC pipe or small sound.



Check the sound level and leak sound through the headphones.

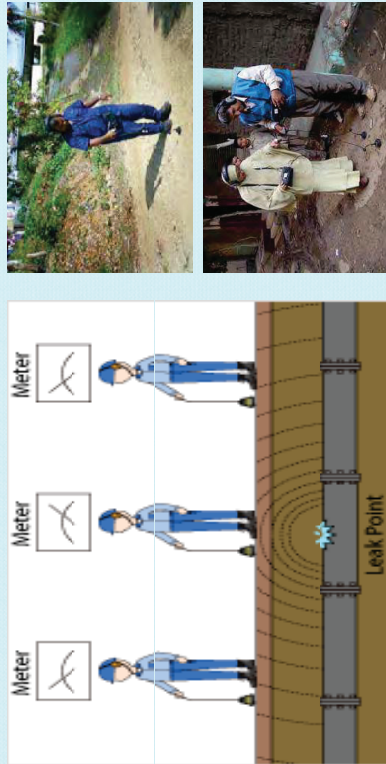


④ Method of Detection for Leak Point



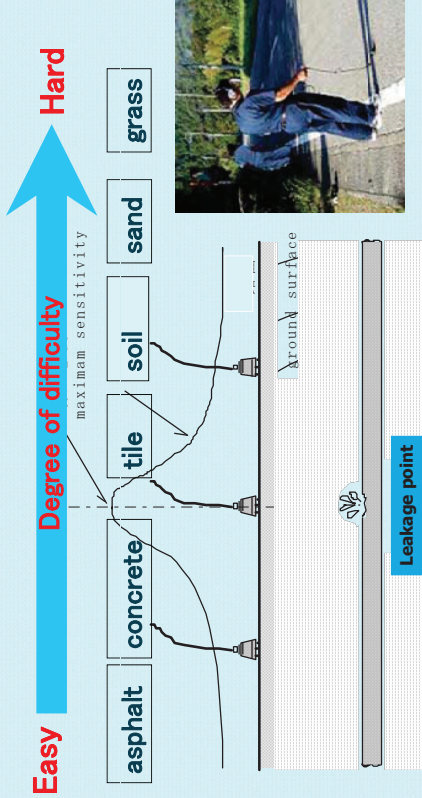
Detect the leak point

Water Leak Detect on the Ground



Detection of most large sound point.

Water Leak Detect on the Ground (Ground condition)



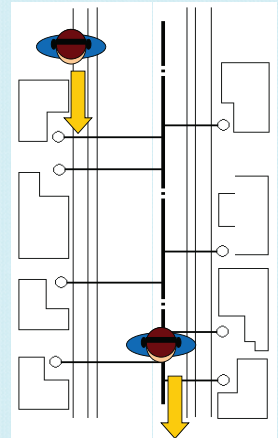
Water Leak Detect on the Ground

at **Nighttime**
effect of night time leak detection

- rise of the water pressure
- decrease of the noise



(At nighttime)



(Image)

Leak noise Correlator

LC-2500

It is not affected by the noise such as traffic and factory, survey is possible in the day.

It is possible to detect the pinpoint even though leakage sound does not reach to surface.

Benefit

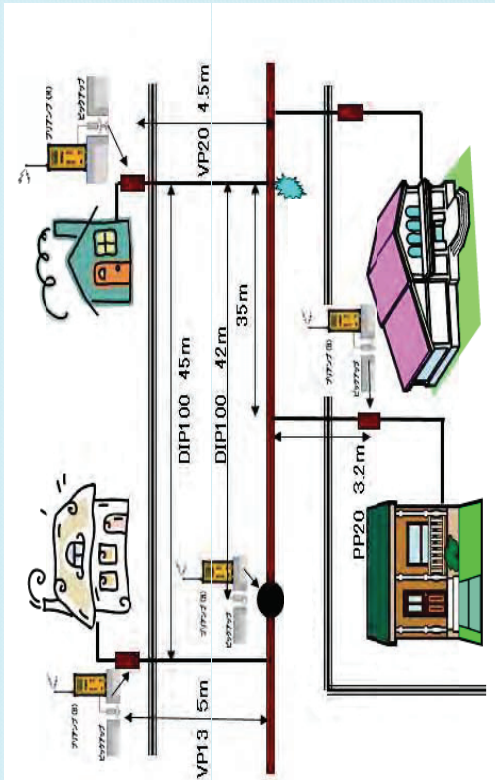


Measuring wheel



Leak Noise Correlator
LC-2500

Leak Noise Correlator Pinpointing



Pinpoint



Water Leak Detector



Leak Noise Correlator



①Drilling
Make a hole



②Boring
Insert the boring
close to the pipe.



③Confirming
Check the sound
and wet condition

Confirmation work prevents erroneous indication or misalignment error, and save the excavation cost.

Leakage Record Sheet

Leakage Record Sheet		Leak No.	4-13																												
Job No.	2012-001-13	Sanitary road	29373																												
Job Name	Sanitary road																														
Main Pipe																															
1. Pipe	2. DCP	3. PVC	4. Location																												
5. Other	6. Other	7. Meter	8. Other																												
Service Pipe																															
1. Pipe	2. PVC	3. GF	4. Location																												
5. Other	6. Other	7. Meter	8. Other																												
Leakage Site																															
1. Location	2. Medium	3. Small	4. Drop																												
Measured (150 L/Min) by flow meter																															
Leak Point																															
Hole/Crack Size (5 cm)																															
Location Map		Photo																													
<table border="1"> <thead> <tr> <th colspan="2">Information of leak repair</th> </tr> </thead> <tbody> <tr> <td>Excavation Date</td> <td>1.2.2012</td> </tr> <tr> <td>Excavation Time</td> <td>10:00</td> </tr> <tr> <td>Excavation Depth</td> <td>1.5</td> </tr> <tr> <td>Excavation Width</td> <td>1.5</td> </tr> <tr> <td>Excavation Length</td> <td>1.5</td> </tr> <tr> <td>Excavation Volume</td> <td>3.375</td> </tr> <tr> <td>Excavation Cost</td> <td>3.375</td> </tr> <tr> <td>Excavation Method</td> <td>Hand</td> </tr> <tr> <td>Excavation Material</td> <td>Hand</td> </tr> <tr> <td>Excavation Equipment</td> <td>Hand</td> </tr> <tr> <td>Excavation Condition</td> <td>Hand</td> </tr> <tr> <td>Excavation Result</td> <td>Hand</td> </tr> <tr> <td>Excavation Note</td> <td>Hand</td> </tr> </tbody> </table>				Information of leak repair		Excavation Date	1.2.2012	Excavation Time	10:00	Excavation Depth	1.5	Excavation Width	1.5	Excavation Length	1.5	Excavation Volume	3.375	Excavation Cost	3.375	Excavation Method	Hand	Excavation Material	Hand	Excavation Equipment	Hand	Excavation Condition	Hand	Excavation Result	Hand	Excavation Note	Hand
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Excavation Width	1.5																														
Excavation Length	1.5																														
Excavation Volume	3.375																														
Excavation Cost	3.375																														
Excavation Method	Hand																														
Excavation Material	Hand																														
Excavation Equipment	Hand																														
Excavation Condition	Hand																														
Excavation Result	Hand																														
Excavation Note	Hand																														

Information of leak

Location

Pipe size

Pipe material

Pipe depth

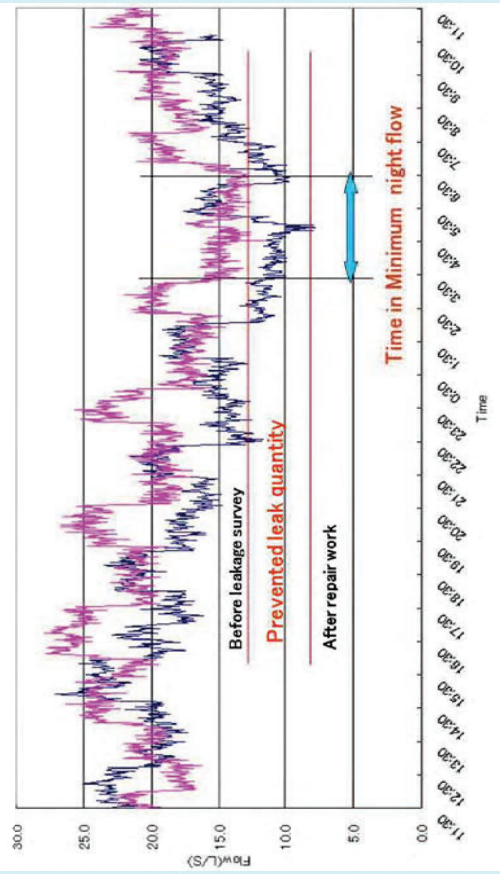
Position

Condition

Cause

Etc

Minimum Night Flow Graph



Type of Leakage (Metal Pipe)



Hole (GP)



Breakage (CIP)

Type of Leakage (Non Metal Pipe)



Crack (PVC)



Loose Joint (PVC)

Pictures of water leak quantity

Diameter: 100mm



Discharge distance: 80cm
 P: 0.2MPa, Q: 75.0m³/h
 P1: 0.3MPa, Q1: 92.0m³/h
 P2: 0.4MPa, Q2: 106.0m³/h

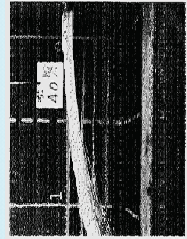


Discharge distance: 40cm
 P: 0.2MPa, Q: 40.0m³/h
 P1: 0.3MPa, Q1: 49.0m³/h
 P2: 0.4MPa, Q2: 56.5m³/h

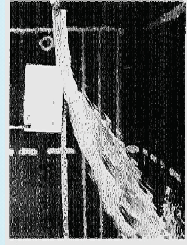


Discharge distance: 20cm
 P: 0.2MPa, Q: 25.0m³/h
 P1: 0.3MPa, Q1: 30.7m³/h
 P2: 0.4MPa, Q2: 35.4m³/h

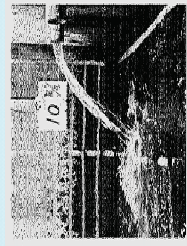
Diameter: 50mm



Discharge distance: 100cm
 P: 0.2MPa, Q: 46.0m³/h
 P1: 0.3MPa, Q1: 48.0m³/h
 P2: 0.4MPa, Q2: 56.5m³/h

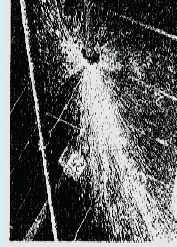


Discharge distance: 80cm
 P: 0.2MPa, Q: 20.0m³/h
 P1: 0.3MPa, Q1: 24.5m³/h
 P2: 0.4MPa, Q2: 28.5m³/h



Discharge distance: 40cm
 P: 0.2MPa, Q: 10.0m³/h
 P1: 0.3MPa, Q1: 12.2m³/h
 P2: 0.4MPa, Q2: 14.1m³/h

Diameter: 50mm (loosening of bolt and nut at joint)



P: 0.2MPa, Q: 25.0m³/h
 P1: 0.3MPa, Q1: 30.6m³/h
 P2: 0.4MPa, Q2: 35.4m³/h

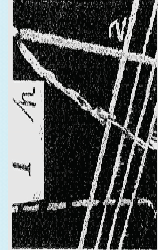


P: 0.2MPa, Q: 10.0m³/h
 P1: 0.3MPa, Q1: 12.2m³/h
 P2: 0.4MPa, Q2: 14.1m³/h

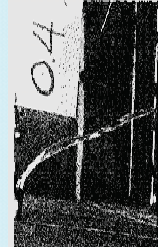


P: 0.2MPa, Q: 5.0m³/h
 P1: 0.3MPa, Q1: 6.1m³/h
 P2: 0.4MPa, Q2: 7.0m³/h

Diameter: 13mm (Service pipe)



P: 0.2MPa, Q: 1.0m³/h
 P1: 0.3MPa, Q1: 1.2m³/h
 P2: 0.4MPa, Q2: 1.4m³/h



P: 0.2MPa, Q: 0.40m³/h
 P1: 0.3MPa, Q1: 0.49m³/h
 P2: 0.4MPa, Q2: 0.57m³/h



P: 0.2MPa, Q: 0.1m³/h
 P1: 0.3MPa, Q1: 0.12m³/h
 P2: 0.4MPa, Q2: 0.14m³/h

Tap

1 2 3 4 5 6

Water drop 30/min Stringlike water 180 degree open Full open

Water drop 90/min 90 degree open

Valve

1 2 3 4

Stringlike water Splaying (in part) Splaying (half) Spatter

Pep pipe

1 2 3 4 5 6

Pin hole Crack (1cm) Crack (2cm) Crack (3,4,5cm)

	1	2	3	4	5	6	Unit:m ³ /h
Tap	0.0005	0.0015	0.004	0.129	1.65	2.36	
Stop cock	0.002	0.096	0.125	0.296			
Pe Pipe	0.001	0.113	0.64	1.18	1.83	2.86	

Dia: 13mm

Thank you for your attention!

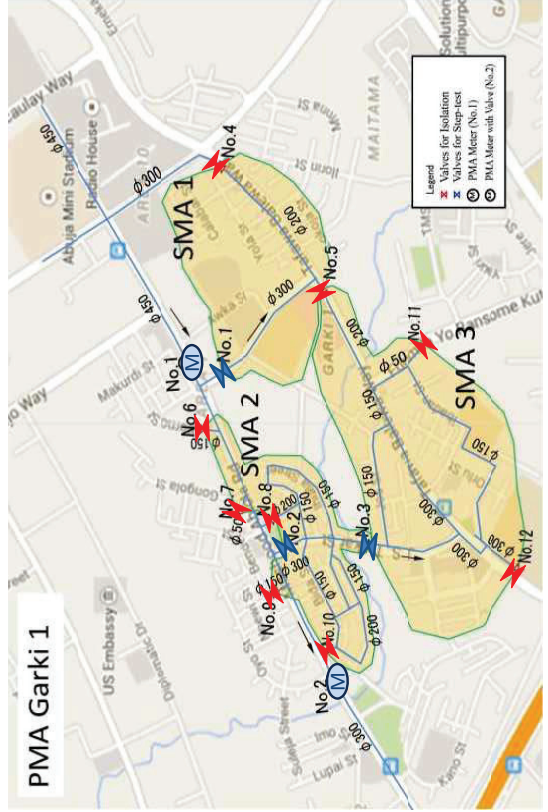
Preparation for Leakage Survey

JICA Expert Team
Jun. 2015

Until October

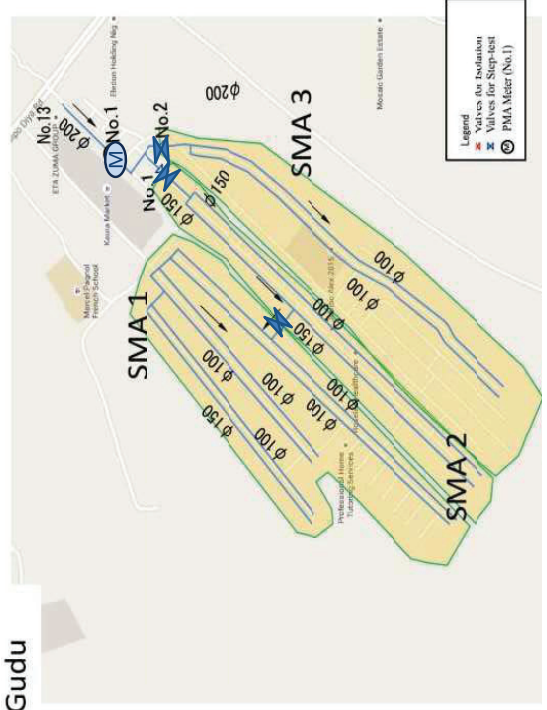
- Construction of Meter Chamber
- Install of PMA Meter at Each Pilot Area
- Install of Isolation Valve at Each Pilot Area
- Preparation of Excavation to MNF Measurement
- Confirm of Isolation at PMA and SMA

Creation of Pilot Metering Areas



Creation of Pilot Metering Areas

PMA Gudu



Creation of Pilot Metering Areas

