S.No.	Name of WTP with Capacity	Name & size	Length of Rising Main
4	Chandrawal Phase-II	Old C.I. main 1200mm New C.I. main 1200mm New C.I. main Patel Road. 900mm	33 kms
5	Haider Pur I 100 MGD	N. West main 1100mm West delhi main 1100 mm Pitampura main 1200mm Khayala main 900mm Mangolpuri main 1000mm Kirari main 1600 mm	105 kms
6.	100 MGD Bhagirathi WTP	Jal Vihar main 1200mm G.K Main 1200mm Shahdara main 1200mm	65 kms
7.	140 MGD Sonia Vihar WTP	south Delhi main 1900mm Brahm Puri main 1200mm Tahir pur main 1200mm	36 kms
8.	100 MGD Haiderpur Phase-II	South Delhi Main 1500mm South Delhi Main 1000mm West Delhi Main 1500mm Rohini Main 1100/800 mm Rural Water Supply 1000mm	93 kms
9.	40 MGD Nangloi	Papan kala main 1200mm Najfgarh main 1000mm Nangloi main 900mm	33 kms
		TOTAL LENGTH OF TRANSMISSION MAIN	603 KMS

17

Detail of Water Mains in DJB

S. No.	Type of Mains	Size	Length of Main
1.	Transmission main	600mm to 1600mm	603 kms
2	Peripheral mains	450mm to 900mm	
3.	Distribution main	100mm to 450mm	

18

MONTHLY LEAKAGE REPORT 01.04.14 TO 30.04.14.

S.NO.	ZONES / WTP	TOTAL LEAKAGES			LEAKAGES REPAIRED	BALANCE LEAKES	REMARKS
		PRESENT	PREVIOUS BALANCE	TOTAL			
1	North East - I	1	....	1	1	....	
2	North East - II	....	1	1	....	1	
3	South-II	13	....	13	9	4	
4	Haiderpur (E&M) WW Ph-I	4	....	4	....	4	
5	Wazirabad (E&M)WW	5	....	5	2	3	
6	Chandrawal (E&M) WW	3	....	3	....	3	
	TOTAL	**26**	**1**	**27**	**12**	**15**	

19

LEAKAGE REPORT SENT TO CONCERNED DIVISIONS

S.No.	Location of Leakage	Qty.(W) G/H
1	Leakage opp. Electric Pole no. 28 back side Chandrawal WW Mahatma Gandhi Road.	100
2	Leakage Nigham Bodh Ghat near gate main road Mahatma Gandhi Road.	100
3	Leakage near Police Both Raj Ghat Mahatma Gandhi Road.	100
4	Leakage near Shanti Van Pull leakage in Chamber Mahatma Gandhi Road.	100
5	Leakage near Electric Pole no. 22 opp. Chandrawal Gate no. 2 leakage in Scover Valve.	1000

20

SUBJECT: - ANNUAL LEAKAGE REPORT FOR THE YEAR 2013-2014

S. No.	ZONE/WTP	LEAKAGE DETECTED	LEAKAGE REPAIR	LEAKAGE BALANCE	REMARK
1	CENTRAL -I	3	3	....	
2	CENTRAL -II	3	3	....	
3	EAST-I	14	12	2	
4	EAST -II	....	....	....	
5	NORTH -I	....	....	....	
6	NORTH EAST-I	10	10	....	
7	NORTH EAST-II	6	3	3	
8	NORTH EAST-III	3	3	....	
9	WEST- I	7	7	....	
10	WEST -II	....	....	....	
11	WEST -III	17	3	14	
12	NORTH WEST -I	3	3	....	
13	NORTH WEST -II	14	14	....	
14	NORTH WEST -III	17	17	....	
15	NORTH WEST -IV	24	21	3	
16	SOUTH -I	4	4	....	
17	SOUTH -II	36	33	3	
18	SOUTH -III	19	19	....	
19	SOUTH -IV	74	74	....	
20	SOUTH WEST-I	....	....	....	
21	SOUTH WEST -II	11	11	....	
22	SOUTH WEST -III	15	15	....	
23	HAIDERPUR -I	3	3	....	
24	HAIDERPUR -II	12	12	....	
25	WAZIRABAD -WW	6	5	1	
26	CH. WW	4	4	....	
27	NANGLOI PLANT	10	10	2	
28	PROJECT W-I	2	2	....	
	TOTAL	**317**	**289**	**28**	

21

LIST OF LEAK DETECTION EQUIPMENTS

S.No.	Name of Item	Qty. Exist	Working	Non working	Year/Make	Type	Remarks
1	Leakage loggers (Z-Core)	04	04	------			
2	Potable leak detector with complete accessories (Flow Matrix) (G.M Phone)	01	01	------			
3	Note book computer (IBM make)	04	-----	04			
4	Sounding Rod	11	11	------			
5	Measuring wheel	08	6	2			
6	Metal Detector	02	00	02			
7	Leak noise co-realtor DG-Core-III	1	1	------			
8	Potable leak detector with complete accessories	04	02	02			

22

LIST OF EQUIPMENTS SUPPLIED BY JAICA

S.No.	Name of Item	Qty. Exist	Working	Non working	Year/Make	Type	Remarks
1	Leakage loggers (Z-Core)	04	04	------			
2	Potable leak detector with complete accessories (Flow Matrix) (G.M Phone)	01	01	------			
3	Note book computer (IBM make)	04	-----	04			
4	Sounding Rod	11	11	------			
5	Measuring wheel	08	6	2			
6	Metal Detector	04	04	-------			
7	Leak noise co-realtor DG-Core-III	1	1	------			
8	Potable leak detector with complete accessories	04	01	03			

23

FUTURE PLAN & RECOMMENDATIONS

LD&I is a specialized cell (it is one of most important as well as most ignored division). It's objective is not very much achieved due to various reasons, such as constraint scope of work poor infrastructure, insufficient & untrained staff and use of old technology. For increasing efficiency and optimum use of this cell some administrative and police decision will have to taken.

Recommendations for improvement

A. Up gradation of Infrastructure

1) Provision of vehicle for field staff.
2) Reimbursement of all route DTC to fitters & Beldars
3) AMC & purchasing of required leak detection equipment/ Laptop etc.

B. DEPLOYEMENT AND UP GRADATION OF SKILL OF STAFF

1) Sufficient no. Of staff should be provided.
2) Seminars/ Training should be provided to staff.
3)Specialized & Trained field staff like JE/Fitter/Beldar be deployed at LD&I should not be transferred

TECHNOLOGY UP GRADATION

The training and regular updating leak detecting equipment.

24

NRW Reduction Measures by Management Improvement

The 3rd Seminar in Delhi
27th August, 2014

Kenji OZAWA
Manager of Shinjuku Service Station,
Tokyo Metropolitan Government, Bureau of Waterworks

Outline of Tokyo Waterworks

Start of water supply	December 01,1898 (116 years ago)

Service area	1,235 sq km
Population served	12,878,752 people
Number of service connections	7,062,148 cases
Pervasion	100%
Total length of distribution pipes	26,490 km
Total capacity of facilities	6,859,500 m^3/day
Max. distribution amount per day	4,589,700 m^3/day

Number of staff	3,865 persons
Annual revenue on water supply(FY2012)	USD 2,882 million

As of FY 2012

The IWA Standard Water Balance

System Input Volume	Authorized Consumption	Billed Authorized Consumption	Billed Metered Consumption	Revenue Water
			Billed Unmetered Consumption	
		Unbilled Authorized Consumption	Unbilled Metered Consumption	Non Revenue Water
			Unbilled Unmetered Consumption	
	Water Losses	Apparent Losses	Unauthorized Consumption	
			Customer Metering Inaccuracies	
		Real Losses	Leakage on Transmission and/or Distribution Mains	
			Leakage and Overflows at Utility's Storage Tanks	
			Leakage on Service Connections up to Point of Customer Metering	

Today's Topic

1 Installation and Proper Maintenance of Water Meters

2 Billing of Charges Based on Accurate Customer Information

3 Credit Management and Demand for Unpaid Bills

1 Installation and Proper Maintenance of Water Meters

1.1 Purpose of Installation of Water Meter

Accurate Metering

. Accurate metering of water consumption
. Allows for in-depth NRW analysis

Fair Billing

. Allows for fair billing based on a benefit principle

Water Conservation

. Billing based on metered consumption provides incentives to water conservation.
. Reduces investments to keep pace with demand from increasing population.

1.2 Installation of Water Meter in Tokyo

Water meters have been installed for all customers at the expense of Tokyo Waterworks.

Performance Standards

By national law
- Type approval by national authorities
- Allowed error, materials, structure, test method etc.

Installation Standards

By ordinance of TMG

Site of meter installation
- Nearest point from distribution pipe
- To allow meter reading and replacement easily
- One meter per a building etc.

1.3 Status of Meter Installation and Costs

Number of Meter	7,064,792	Number of Service Connections 7,062,148
Number of Purchase	1,269,196	Including repair
Cost of Purchase	27,716,000 $	Including repair
Cost of Replacement	30,605,000 $	
Total	58,321,000 $	1.9% of Water Revenue

As of FY 2012

1.4 Progress of Installation of Meters in Tokyo

Year	Characteristics
1898	First water charge system 1) Both fixed charge system and meter charge system. 2) Set a lower charge for customers using shared water taps.
1921	Six year plan of installation of meters to all water taps → Stopped because of the Great Kanto Earthquake in 1923.
1947 to 1954	Installation of meters to all water taps
1956	Because all water taps had meters, fixed charge system was abolished.
1966	According to the changes in our life style and increased demands, the water charge system was reviewed drastically: 1) Charge system according to the diameter 2) Gradually increasing commodity charge system

1.5 Key Points of Meter installation and maintenance

Installation on all water taps

- Introduce a meter charge system based on water consumption to ensure fairness among customers.

Water supplier needs to purchase meters at their own expense

- Meters serve as the basis for calculating water charges.
- Water supplier needs to make sure that charging is accurate and fair.

Meters need periodic replacement

- Meters must stay accurate and reliable
- In Japan, meters shall be replaced every 8 years.

2 Billing of Charges Based on Accurate Customer Information

2.1 Necessity to obtain accurate customer information

Accurate Customer information = **Prerequisite for billing**

Identify obligors (contracted customers)

. Do we keep track of service start/end dates, change of ownership, etc.?
. Is our system able to check if someone starts or ends using service without notifying us?

Calculate accurate charges for each customer

. Are water charges calculated based on elements for each customer?

Correct information for billing

. Is the information, such as mailing address on the bill, bank account for withdrawal, correct?

2.2 Customer Information Management in Tokyo

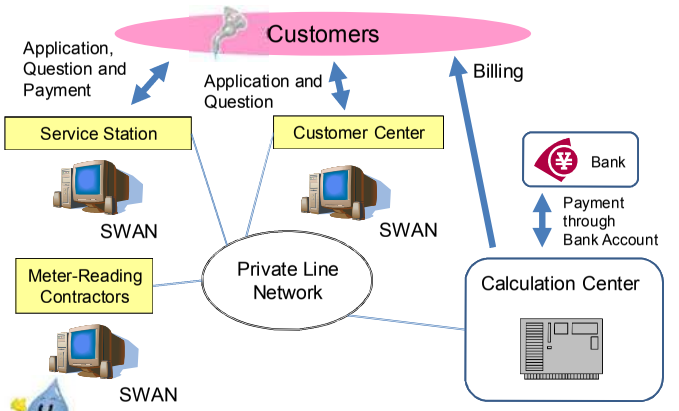
Database System

SWAN（Suido Wide Area Network)
Database of customer information, calculating and billing system

Review of Information

- Application from customers
- Investigation while meter reading　etc.

2.3.1 SWAN's Concept Map

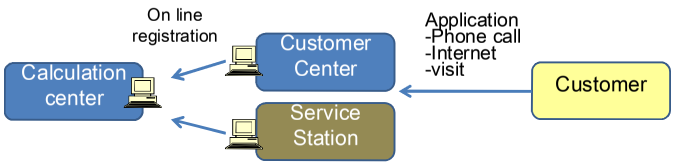


2.3.2 SWAN

2.3.3 Main Information in SWAN

Basic information	Meter-related information	Meter reading information	Billing information
Customer number	Meter type	Meter reading date	Months
Address	Meter diameter	Notes for meter reading	Amount billed
Name of customer	Meter number	Meter location	Due date
Phone number	Expiration date	Indicator	Amount unpaid
Payment method	Notes for installation	Amount consumed	Date received
Use Application	Installation date	Water charge	Way of payment
Other customer information	Notes for uninstallation	Sewerage charge	
	Uninstallation date		

2.4.1 Update of Information -1



Customers need to contact us Obligations of customers!

- when a customer wants to install a new water supply equipment
- when a customer wants to start and stop water services
- when the owner of water supply equipment is changed, etc.

2.4.2 Update of Information -2

Following checks are carried out when reading a meter.

What to check

- Nameplate, mailbox of the premise
- Unusually low use
  - Customer may have moved out without notifying.
- Unusually high use
  - There might be a leak, notify the customer.
  - Customer may have changed.
- If water is used in an empty house, find out who is using water.

3 Credit Management and Demand for Unpaid Bills

3.1 Importance of Collection of Bill Payments

- To ensure fairness
- To prevent wasteful use
- To ensure sound management

→ It is essential to collect bill payments surely.

Complete Credit Management	by SWAN
Standardization of Demand Process	Mentioned later
Complete Management of Demand Process	by SWAN
Standardization of Suspension of Demanding Payments	Mentioned later

3.2 Billing and Demand Process in Tokyo

Meter Reading	
Sending Bill	4 days after
Sending Bill with Notice of Suspension	60 days after
Handing or Posting Letter of Demand	90 days after
Handing or Posting Notice of Suspension	110 days after
Suspend Water Supply	120 days after
Remove the Meter and Terminate the Contract	
Judicial Proceedings	

21

3.3 Demand System of Tokyo Waterworks

Handing or Posting Letter of Demand	90 days after	Outsourced
Handing or Posting Notice of Suspension	110 days after	

Suspend Water Supply	120 days after	

Allocate about 150 specialized staff at 21 service stations

One staff handles about 200 cases per month

Number of collected after demand process	246,750	(141 cases per staff)
Number of suspension of demand process	57,175	(33 cases per staff)
Total	303,925	

(As of FY 2013, only in the metropolitan area)

22

3.4 Suspension of Demanding Payments

We may not demand payments if further collection is impossible or inefficient.

Example

- We cannot find where customers have moved to.
- Customers have moved into a place extremely far.

These are exceptional cases

- We do our best to search residence registry, etc.
- Send letters of demand, make phone calls, etc.
- A standard should be set for due amounts and locations of customers.

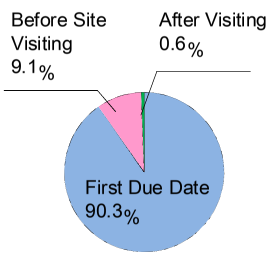
Benefits

- Appropriate accounting
- Improvement of efficiency of demand activities

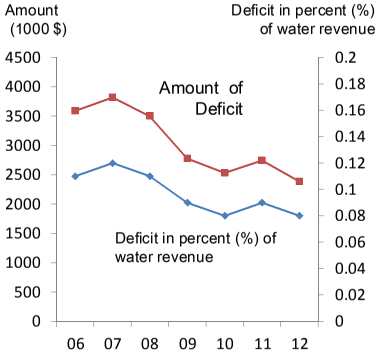
23

3.5 Status of Unpaid Bills in Tokyo

Time of Payment



Status of deficit by uncollectible accounts



24

Conclusion

1 Installation and Proper Maintenance of Water Meters

- Accurate Metering
- Fair Billing
- Water Conservation

→ Important for water supplier to install reliable water meters

2 Billing of Charges Based on Accurate Customer Information

- Accurate Customer Information
- Update of Information

→ Prerequisite for calculation of charges and bills

3 Credit Management and Demand for Unpaid Bills

- Standardization of Demand Process
- Management of Demand Progress

→ Improve business performance by collecting unpaid bills

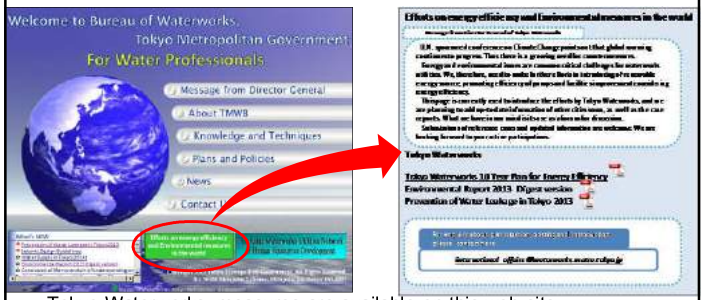
25

PR from Tokyo Waterworks

Introduction of Information board

"Efforts on energy efficiency and Environmental measures"

(http://www.waterprofessionals.metro.tokyo.jp/index.html)



- Tokyo Waterworks' measures are available on this web-site.
  ex.) "Environmental Report" , "10 year Plan for Energy Efficiency"
- Overseas Waterworks' measures will be uploaded.

26

Kabuki-cho

Shinjuku Gyoen Park

When you will come to Tokyo this Autumn, please visit Shinjuku!

27

Thank You for Your Attention!

28

Prevention of water leakage in Tokyo

Tomoyuki TANIMOTO

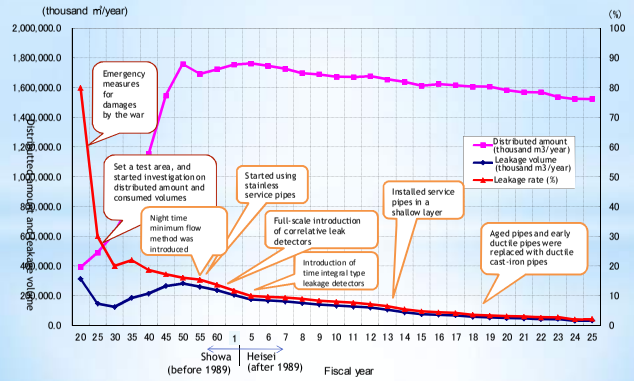
Director
Water Supply Section
East Area 1st Branch Office
Tokyo Waterworks

History of leakage prevention in Tokyo (overview)

Spent 4.5 years from Feb 1913 to July 1917 to measure the leakage volume in 15 districts
Leakage rate: 12.3 %

- Around 1926 (early in Showa period), the service area was expanded due to mergers of towns and villages
  Leakage rate: approx. 25 %
- From 1945 to 1949, bent lead pipes to stop leakage in the ruins of war
  Leakage rate: approx. 80%
- In April of 1969, a division responsible for leakage prevention was established, and a full-scale leakage prevention system similar to the current one was introduced.
  Leakage rate: approx. 25%
- End of FY 2012 (as a result of various measures)
  Leakage rate: 2.0 %

Transitions of distributed amount and leakage volume, and leakage rate in Tokyo after World War II



Definition of non-revenue water by IWA

Distribution total	Authorised Consumption	Billed Authorised Consumption	Billed Meterd Consumption
			Billed Unmeterd Consumption
		Unbilled Authorised Consumption	Unbilled Meterd Consumption
			Unbilled Unmeterd Consumption
	Water Losses	Apparent Losses	Unauthorised Consumption
			Metering Inaccuacies
		Real Losses	Leakage of Pipe Networks

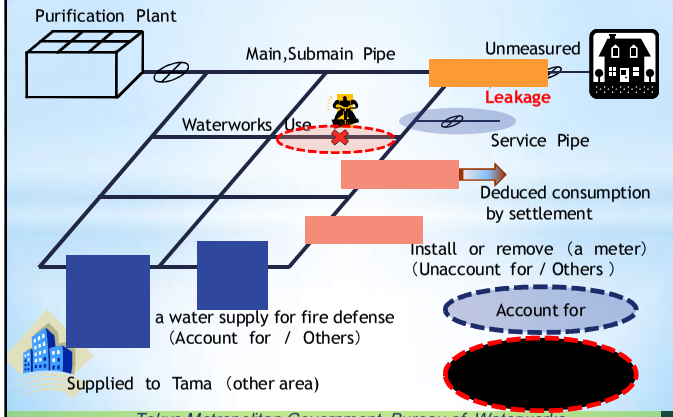
Non Revenue Water

Tokyo's annual water distributed amount and its configuration

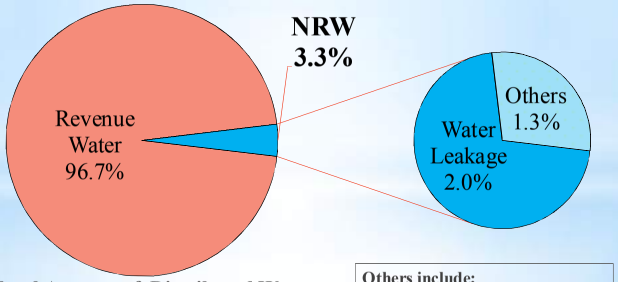
Distribution total 1,523 (100)	Effective 1,490 (97.8)	Account for 1,474 (96.7)	Charged 1,470 (96.5)	Volume of Charge
			Supplied to Tama 4 (0.2)	Distribution to unincorporated cities in the Tama area
			Others 0 (0)	Volume of compensation
		Unaccount for 16 (1.1)	Non Revenue Water	
	Ineffective 33 (2.2)			

million m^3/year (%)

Concept of distributed amount analysis in Tokyo



Non-revenue water in Tokyo



Total Amount of Distributed Water
= 1,523 million m^3/year

Others include;
- Non-Sensing of Meter [0.9%]
- Waterworks Own Use [0.1%]

Water leakage prevention measures taken by TMG

TMG's three pillars to decrease the leakage rate 2.0%

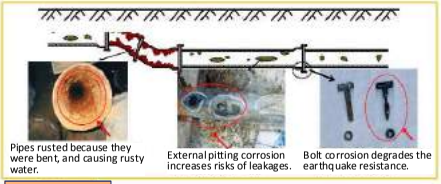
Preventive measures (scheduled replacement of water pipes, improvement of pipe materials)
- Replacement of aged pipes and early ductile pipes
- Maintenance of service pipes under private roads
- Enhancement of earthquake-resistance for large bore diameter pipes
- Improvement of service pipe materials

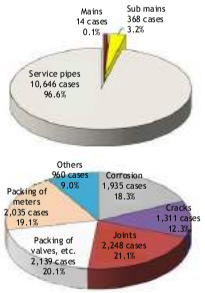
Quick response measures (leakage detection, early repair)
- Planned work (patrol investigation, leakage volume measurement, and leakage measurement investigation)
- Mobile work

Securing advanced leakage protection technique
- Training and Technical Development Center
- Accreditation of Tokyo waterworks technology experts, and super plumbers

Preventive measures

Necessity for replacement of early ductile pipes and percentages by usage and by causes against the number of leakages



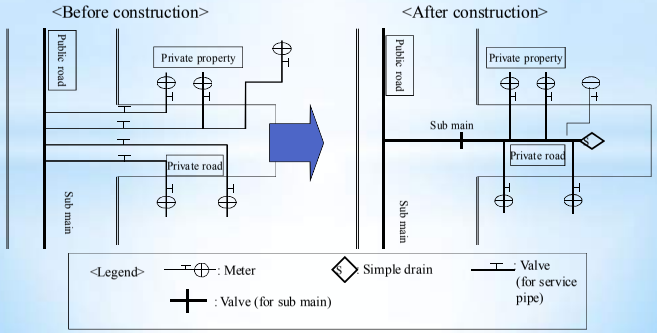


Characteristics

- Installed between the 1960s to the early 1970s
- No lining inside deformed tubes -> Causes rusty water
- Polyethylene sleeves not coated -> Causes leakage due to external pitting

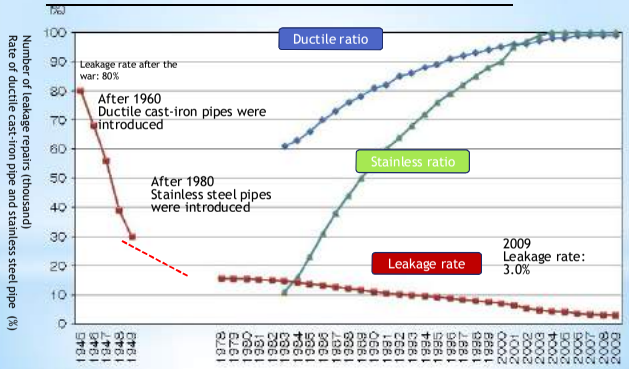
Preventive measures

Maintenance of service pipes under private roads



Preventive measures

Transitions of preventive measures and leakage rate



Quick response measures

<Planned work>

- **Patrol investigation work**
- Leakage volume measurement
- Leakage measurement investigation

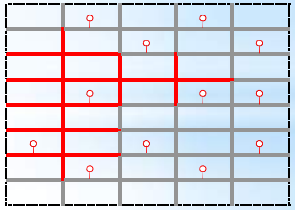
<Mobile work>

- **Leakage repair**

Quick response measures

- Patrol investigation work

Legend:
Range of a section
Sub main (subject to the work)
Meter (subject to the work)
Sub main (not subject to the work)



* To perform planned and effective leakage investigation considering recurring years, limit the area to investigate to detect and repair leakage.
* All service pipes within the section and sub mains installed before 1985 are subject to the investigation work.
* Started in 2006.

Quick response measures

- Patrol investigation work (Sample block plan)

Quick response measures

- Mobile work

Customer Service Center

Instructions for Investigation

Our Blanch Offices

Calls from Customers, Police, etc

Investigation and Repair

Secure high leakage prevention skills

- Practical training

Planning leakage prevention (Basic workflow)

1) Preparation	2) Basic investigation	3) Planning	4) Implementation	5) Evaluation
-Establish a construction organization -Maintain measurement equipment -Maintain reference documents - Others	-Analyze the distribution volume -Analyze the distribution volume (distribution, causes, etc.) - Others	- Set the target value - Set the planning period - Consider work methods - Others	- Supportive measures -Preventive counter-measures -Understand the cause of leakage -Measure the leakage prevention volume - Others	- Review the effects -Compare plans with achievements - Others

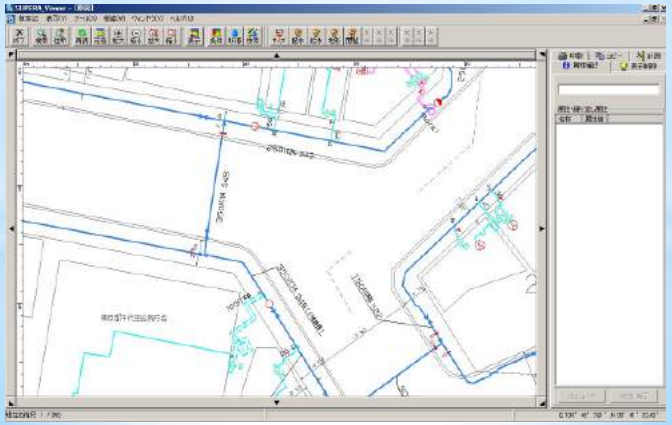
Feedback

Procedures for implementing leakage prevention countermeasures

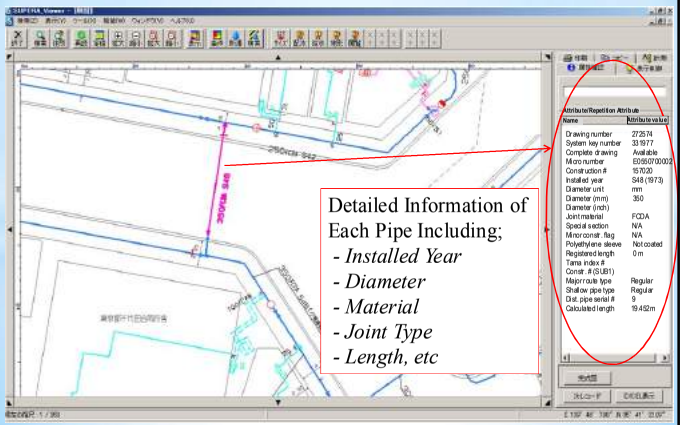
1) Database (Example: GIS DATA BASE)

How many and what kind of pipes are there ? And where?

GIS DATA BASE



GIS DATA BASE

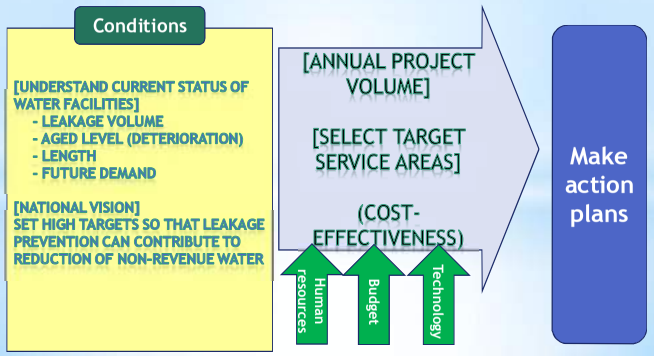


2) Basic investigation (Understanding the current status)
Example: Analyzing the distributed amount

Distribution total 1,523 (100)	Effective 1,490 (97.8)	Account for 1,474 (96.7)	Charged 1,470 (96.5)	Volume of Charge
			Supplied to Tama 4 (0.2)	Distribution to unincorporated cities in the Tama area
			Others 0 (0)	Volume of compensation
		Unaccount for 16 (1.1)	Unmeasured 14 (0.9)	Error of measure
			Waterworks use 1 (0.1)	Water works use for construction etc
			Others 1 (0.1)	Without income but effective
	Ineffective 33 (2.2)		Leakage 31 (2.0)	Volume of leakage
			Deduced consumption by settlement 2 (0.2)	Leakage in private property for cut down

million m^3/year (%)

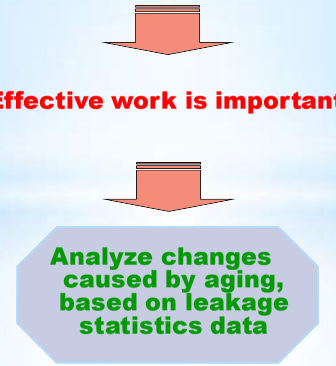
3) Planning



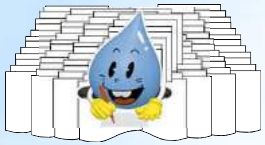
4) Implementation

Category	Item	Action plan
Supportive measures	Mobile work	▪Repair surface leakage on the same day
	Planned work	▪Find and repair subsurface leakage early
Preventive measures	Planning water projects	▪Make plans considering leakage prevention
	Designing and constructing water facilities	▪Earthquake residence, durability, corrosion resistance, and water-tightness
	Replacing aged pipes	▪Replace distribution and service pipes
	Shortening the length of distribution equipment	▪Consolidate pipes crossing roads
		▪Install water meters close to the public and private border
	Protecting public pipes	▪Reinforce corrosion proofing and deformed tubes
	Handling remaining service pipes	▪Complete handling of the branches ▪Enhance maintenance of water supply equipment
	Patrolling pipelines	▪Leading and supervising private company's constructions
	Adjusting water pressure	▪Divide distribution system, and install decompression valves

5) Evaluation



5) Evaluation



Large amounts of data

Statistical processing is required.

Electronic processing is introduced.

5) Evaluation

Leakage reason code			Diameter	Pipe type code	Installed year		Material joint code		
Part 1		Part 2	Target						
01	External damage	00: Must be input	Distribution pipe, service pipe	◎ +1	×	◎	Stainless stell pipe	1	0 SSP
02	Remaining pipes	00: Must be input							1 CSSP
15	Pipe	11: Crack, 12: Corrosion			◎ for distribution pipes and stainless × for non-stainless service		Lead pipe	2	0 LP
16	Joint (other than the following joints)	11: Crack 12: Corrosion 13: Packing 14: Rubber band 15: Gasket 16: Loosen 17: Poppes up 99: Ohters	Service pipe			◎	Plastic pipe	3	0 VP
17	SL/SV joints						Copper pipe	4	0 CP
18	Gunmetal joint (other than SLand SV)						Asbestos p	5	0 AP
19	Welded joing		Distribution pipe, service				Steel pipe	6	0 SP
30	Saddle snap tap (with anti-corrosion top)		Service pipe		◎ for stainless × for others		Cast-iron p	7	0 FC unknown
31	Saddle snap tap								1 FCC
32	Gate valve for stainless pipe								2 FCA
33	Snap tap (divesion)						Ductile cast-iron pipe	8	0 FCD unknown
34	Sluice-gate valve (ϕ30 minimum)		Sluice gate valve			×			1 FCDT
35	Stop valve (ϕ25 maximum)		Service pipe						2 FCDA
36	Plain tail type valve (ϕ13 to 25)								3 FCDK
37	Water meter (meter diameter)		Meter						4 FCDU
38	Air valve (ϕ10 to 200)		Air valve		×				5 FCD5
39	Single fire hydrant (ϕ75)		ϕ75						6 FCD5 II
40	Twin fire hydrant (ϕ100)		ϕ100						7 FCDNS
41	Section water meter		Distribution pipe						9 Other FCD
42	Fire hydrant with air valve		Fire hydrant				Poly pipe	9	0 PP
43	Drain valve		Drain pipe				Others	9	9

In Partnership with Tokyo Suido Service Co., Ltd

Core Business → Bureau of Waterworks, Tokyo Metropolitan Government

Semi-Core Business → Tokyo Suido Services, Tokyo Suido Services Co., Ltd.

Routine Business → Private Contractors

Based on our knowledge and experiences, we will offer solutions to NRW issues in your country!

Importance of NRW Improvement

- **Increase Revenue**
  - **Why?** / To Establish Financially Independent Organization
  - **How?** / By Installing and Reading Meters and Billing
- **Reduce Expenditure**
  - **Why?** / To Use Resources Effectively
  - **How?** / By Reducing Operational Costs Related to Water Leakage
- **Save Natural Resources**
  - **Why?** / To Use Natural Resources Effectively and Protect the Environment
  - **How?** / By Reducing Water Leakage

" Every Drop saved is a rupee earned"

- Profile

  Name: Hiroki Horie

  Tokyo Nishi-Shinjuku, Shinjuku-ku, 6-14-1
- Career

  I Retired from Tokyo Metropolitan Waterworks Bureau on 3 May 2006 Joined Tokyo water services (LTD) on 4 May 2006

  Starting with water pipe maintenance work of 23 wards of Tokyo I became involved in water pipe management section and leakage prevention business

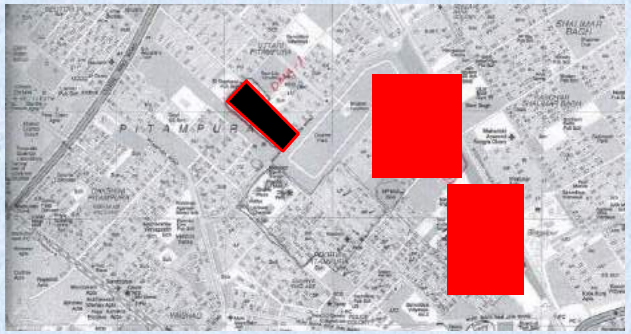
  I went for water leakage surveys in cities across Japan (Gunma, Saitama Prefecture, Tochigi Prefecture).

  I was moved to TSS TOKYO WATER Mitaka office director in April 2014.

  Currently we are engaged in business related to leakage prevention and water pipe maintenance of Tama district and 23 other wards.

Leak Detection Demonstration Execution plan

Leak demonstration location



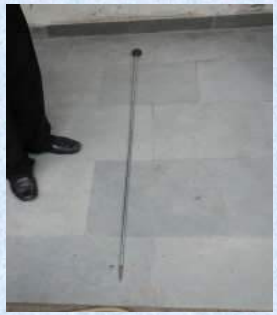
- **implementation Day date and time: 25th Aug (Mon) 6:00 - 8:30 am**
- **Implementation site Pitampura pilot project area**

leak detection instrument for acoustic leakage sound detection

Patrol with Acoustic Method

Acoustic Rod *Electronic Leakage Detector*

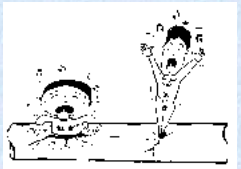
leak detection equipment owned by LDI



Acoustic Rod *Electronic Leakage Detector*

Stick-type TS leak checker

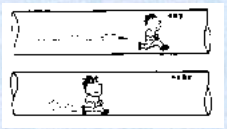
Different sounds of Leakages



The shape of leakage hole

Buried situation

Pipe diameter



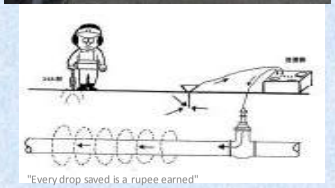
Tube species

Pipe locator

The buried pipe detection by electromagnetic waves

PL-903 type

Direct method
Other Induction methods, loop method



Issues related to leak detection at DJB

1）Low water pressure

E.G. In DMA 1 pressure is less than 1.0kg/㎠ and in DMA 2 and 3 is 0.3kg/㎠～0.8kg/㎠

(Desired water pressure for leak detection is around 2kg/㎠ or more)

2）Less number of staff engaged in leak detection and shortage of leak detection machinery

3)Time based water supply

① water supply time (5: 00 ~ 8: 00 AM 5: 30 ~ 8: 30 PM) (6 hours)
② water leakage survey is difficult
③ water can get contaminated

Low water pressure

Insufficient leakage prevention infrastructure

1. Staff engaged by LDI 9 persons

- LDI should ensure that the technology and knowledge is preserved and passed on.
- Work hand in hand with DJB maintenance staff

2. Machinery at LDI
- Yearly maintenance of machinery
- Procurement of new machinery
  - ·Acoustic rod 10 pieces
  - ·Electronic leak detector 4 machines
  - ·Pipe locator machine
  - ·Correlation equation leak Detector
  - ·Point multi-logger leak detector

Time based water supply issues

- Water contamination due to suction of impure water inside the leakage holes
- Very difficult to detect leak in pipes with low water pressure.

Non-revenue water reduction measures

The main measures of non-revenue water reduction

1. leakage prevention measures
2. Steady implementation and development of pipeline rehabilitation plan
3. Technology development and training of staff
4. AWOL water use measures (water theft measures)
5. Normalization of water meters
6. Maintenance of the water supply pipes

第 4 回セミナー

2015 年 3 月 3 日に Indian Habitat Center にて開催された。出席者数は JICA インド事務所、東京都水道、JICA 専門家を含む約 100 人であった。発表内容は次の通りであった。

1) 本邦研修についての報告：
2) GIS の活用シナリオ：Mr. Vikram Singh, SE (Project) Water III チャンドラワール浄水場における日常点検の取組み：Mr. R.D.Yogi, AE (E & M)、JET 専門家（経営管理）　山本陽一
3) 東京都水道局のアセットマネジメントの効果について：東京都水道局東部第一支所給水課長　谷本知之
4) 堅実なマネージメントのための料金システム：東京都水道局新宿営業所長　小澤賢治
5) 図面管理について：東京都水道局東部第一支所給水課長　谷本知之
6) 施工監理について：JET 専門家（経営管理）　小島寛

上記のセミナー形式による発表の後、東京とインドにおけるパイプ布設写真を施工品質、安全面、近隣住民などの立場から比較し、施工管理及び非開削工法についてディスカッションを行った。

第 4 回セミナー
DJB の GIS 発展シナリオ

第 4 回セミナー
GIS 及びアセットマネジメント

Japan International Cooperation Agency

THE FOURTH SEMINAR UNDER "THE ASSISTANCE RELATED TO DELHI WATER SUPPLY IMPROVEMENT PROJECT"

Organized By

Delhi Jal Board AND Japan International Cooperation Agency

Date: 3rd of March 2015

Venue: Gulmohar, Indian Habitat Center Location: Delhi, India

Part. 1	
09:30 ~ 10:00	Registration & Tea
Opening Speech	
10:00 ~ 10:10	DJB *Mr. Vijay Kumar, Chief Executive Officer, Delhi Jal Board*
10:10 ~ 10:20	JICA *Mr. Shinya Ejima, Chief Representative of India Office, Japan International Cooperation Agency*
Delhi Jal Board's session	
10:20 ~ 10:50	**"Reports of Training in Japan"** *Mr. R. S. Negi, Chief Engineer (Water) Project, Delhi Jal Board*
10:50 ~ 11:20	**"GIS application scenario of DJB"** *Mr. Vikram Singh, S. E. (Project) Water III*
11:20 ~ 11:50	**"The report on the efforts of daily inspections in Chandrawal WTP"** *Mr. R. D. Yogi, A. E. (E&M)* *Mr. Yoichi Yamamoto, JICA Expert*
Bureau of Waterworks Tokyo Metropolitan Government's session	
12:00 ~ 12:30	**"Efforts of Asset Management at the Bureau of Waterworks, Tokyo Metropolitan Government ~ Database and Renewal Plan ~ "** *Mr. Tomoyuki Tanimoto, Director, Water Supply Section, East Area First Branch Office, Bureau of Waterworks, Tokyo Metropolitan Government*
12:30 ~ 13:00	**"Rate Systems for Sound Management"** *Mr. Kenji Ozawa, Manager of Shinjuku Service Station, West Branch Office, Bureau of Waterworks, Tokyo Metropolitan Government*
Discussion	
13:00 ~ 13:30	Discuss about GIS and Asset Management
Closing Speech	
13:30 ~ 13:40	DJB *Mr. Amit Satija,Addl.CEO Director (Finance & Accounts), Delhi Jal Board*
13:40 ~ 14:40	Lunch
Part. 2	
Construction Management Training	
15:00 ~ 15:10	Opening Speech *Mr. Kazufumi Momose, JICA Expert*
15:10 ~ 16:20	**"Discuss about Construction Management"** *Mr. Tomoyuki Tanimoto, TMWB* *Mr. Hiroshi Kojima, JICA Expert*
16:20 ~ 16:30	Closing Speech

The fourth semirar under "THE ASSISTANCE RELATED TO DELHI WATER SUPPLY IMPROVEMENT PROJECT"
Organised by:- Delhi Jal Board & Japan International Cooperation Agency
3rd March 2015

S.No.	Name	Designation	Phone No.	E-mail ID
1	Ashok [illegible] CHANDHAR	DE(WW) I	[redacted]	
2	Y.K. Sharma.	SE(MB)		
3	R.C. Duggal	ZE (JSK) NW-III		
4.	K.S Sharma	JE-DM Fem		
5.	V.K. BABBAR	Technical Advisor		
6	[illegible]	EE(Control)		
7	Arun Gupta	EE SO - IT		
8	M.K. Jain			
9	Mukesh Jindal	EE(OP)-II		
10.	MANISH KUMAR	EE(SW) III		
11	S P SINGH	EE PW VI		
12	Pawan Sharma	EE CSD		
13	Ramkishan	Dr (IT [illegible])		
14	V.P-Sharma	SE(SW)		
15	R.K-Singhal	EE(Vig)		
16	J.L Arora	SE (C&M) V C		
17	N.K.Tomar	SE(North)		

The fourth seminar under "THE ASSISTANCE RELATED TO DELHI WATER SUPPLY IMPROVEMENT PROJECT"
Organised by:- Delhi Jal Board & Japan International Cooperation Agency
3rd March 2015

S.No.	Name	Designation	Phone No.	E-mail D
	[illegible]	[illegible]	[redacted]	
	Bir Singh	SE (W/M) S-II		
	Sanjay [illegible]	Consultant (P-R)		
	Sanj			
	H.V. Tandon	Dir		
	Shalabh Kumar	SE(Ar) Dr N [illegible]		
	S K Bhardwaj	SE South BJB		
	Sandeep [illegible]	EE(Elec)		
	MUKUL BHARGAVA	SE(Plg) Dr.		
	V.K. Gupta	SE(Civil) IR E&NE		
	RAKESH SAMAII	SE(DR) RR W & C		
	S.K. Dubey	EE(Sewer) I		
	P.K Tyagi	EE(Proj) W-VII		
	Anil ARORA	SE(SDW) I		
	Nasib Kumar	EE (WSD) - I		
	K.C. MEENA	SE(SDW) II		

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3rd March 2015

S.No.	Name	Designation	Phone No.	E-mail D
1.	S.C. Jain	CE (Plg) Ph-I	[redacted]	
2.	A.K. Arya	EE (LDPE)		
3	R.S. Tyagi	M (WS)		
4.	Vikram Singh	SE (Plg) HQ III		
5	R.K. Gupta	EE West III		
6	DEEPMALA	EE (Hg) W-I/III		
7	ANAND PAL	EE (Tele) Dwk		
8.	I.C. Mehra	SE (East) II		
9	PANKAJ GUPTA	EE (Plg) WVIII		
10	A.K JAIN.	C.E. (C-NW.)		
11	Sanjay Prasad	JICA Expert		
12	Khan Bhim	Team Leader DJB		
13	Satpal Singh	Mapping cell		
14	K.K. HARIT	EE (NW) IV		
15	Rajesh Mittal	SE (N)		

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S.No.	Name	Designation	Phone No.	E-mail ID
1	R.S. Negi	CE (water) Projects	[redacted]	
2.	T. Tanimoto	Tokyo M.G. JWB		
3	B.M. DHAUL	Mem (Tech) DJB		
4.	R.P. VERMA	ZE (CC) C-I		
5	O.P. CHAWLA	ZE-V (C) II		
6	TORAN SINGH	ZE (H) I		
7	Chandra Jeet	ZE-IV C-I		
8	Himanshu Agarwal	EE (NW) I, DJB		
9.	Radhey Shyam.	EE (Cent) - I DJB		
10	Mayaram	ZE - Central-II		
11.	NARESH DARGAN	EE (PR) W IX		
12	Izuru Ishida	Representative JICA		

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S.No.	Name	Designation	Phone No.	E-mail ID
	DEEPAK KR. SHRIVASTAVA	EE(RPC)	[redacted]	
	P.B. Thapa	JICA Expert		
	Anil Kr. (Anil Sharma)	EE(W)II, DJB		
	V. K. Singh	EE (NW) III		
	PK Jain	SE (Proj)		
	R.S. GODBOLEY	JD (R) HQ		
	Subhash Chand	CE(S)		
	Sanjay Gupta	Sup PD (Org)		
	Y.P. Manchanda	CE(M/P)-II		
	S.L. Meena	CE (W)		

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S.No.	Name	Designation	Phone No.	E-mail ID
1	RAJEEV KR GUPTA	EE(EAST I)DJB	[redacted]	
2	J.P. Gupta	SE(Cen)I		
3	Mohd. Saleem	EE(Central)I		
4	Ahsan Kha	JICA Expn		
5	R.K. JAIN	EE (Central) II		
6	Pukhraj Singh	AE(C) PR(W)-II		
7	Jailashan	J.E(C)PR/W-II		
8	N.K. Khare	EE(South)III		
9	B.L. Kurup	EE(N)-I		

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S.No.	Name	Designation	Phone No.	E-mail ID
1	Naresh Kumar	ADR (HQ)	[redacted]	
2.	U.B. Tripathi	Secy / DJB		
3.	Bijender Kumar	EE (NS) I		
4	B.S. Rawat	EE (Proj.) W-II		
5.	Pramod Kr Jain	S.E. (Cash)		
6	S Kumar	ZE Central II		
7.	R.D Sharma	ZE Central II		
8.	Bhatt Gadekar	DM-II		
9.	Rama Gupta	HD/M		

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S.No.	Name	Designation	Phone No.	E-mail ID
	S.M.A. NAJMI	Member (Fin)	[redacted]	
	B.P. SARASWAT	EE (C) Dr. IV		
	Kazufumi Nomura	Chief Advisor JICA Study		
	R.K Bhalla	C.E. (WW)		
	Sudhir Kumar	EE (NW) II		
	V.P. Yadav	EE (Proj) W-II		
	HORENDER KUMAR	ZE-III		
	B.S. Jaglan	Director (Vig)		
	Lalit Kumar	AE (IT)		
	Devendra Giri	ZE-I		
	A.K. GUPTA	SE (NW)/SE(Proj)W-I		
	V.P. GUPTA	CE (Proj) DJB		

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S.No.	Name	Designation	Phone No.	E-mail ID
1	Bindeshwar Tewatia	EE (C) II	[redacted]	
2	V.K. Gupta	EE (E&M) I		
3	Rajiv Agarwal	AE (E&M)		
4.	R.D. Yogi	AE (E&M)		
5.	S.C. Vashishtha	SE (WW) IV		
6.	P. Bansal	EE (C) PI — SIE		
7.	Arun Verma	Project Mgr. II		

Counterpart Training in Japan

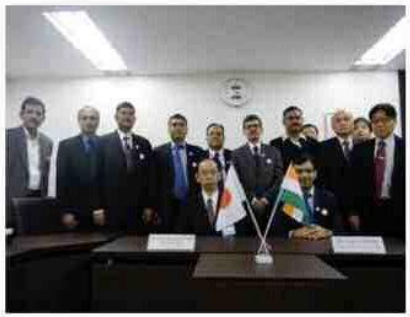
R. S. Negi
Chief Engineer(water)Project
Delhi Jal Board

- The delegation left Delhi on 09.12.2014.
- On 10th November the orientation was taken by JICA followed by Courtesy call by the President of Tokyo Water Service Co., Ltd. and lecture on Introduction summary regarding NRW, SCADA, Asset Management, Customer service etc. for the purpose of experience from their Management.
- The Date wise experience achieved during training is explained In the following slides:-

10th November

(1)Courtesy call to JWWA
(2)Courtesy call to TSS Tokyo Water Co.,Ltd
(3)Lecture &Discussion
(4)Welcome Party

Courtesy call to JWWA



Courtesy call to TSS

Discussion about realization
24×7
stable water supply in DJB

10/11/2014

- The Delhi Jal Board Team was taken to JICA head Quarter where general orientation by JICA was held on 10/11/2014.
- The delegation visited at Japan Water Works Association and held general discussion about the functioning of Association.
- In the afternoon a lecture cum discussion was held on Water Supply Management in Tokyo with Tokyo Water Works and topic like NRW, SCADA, Asset management, Customer Service etc. were covered.

5

11th November

(1)Site visit: Misono Water Purification Plant
(2)Site visit: Koemon Water Supply Station

Explaining about outline of Misono WTP

Ozone generator (site tour)

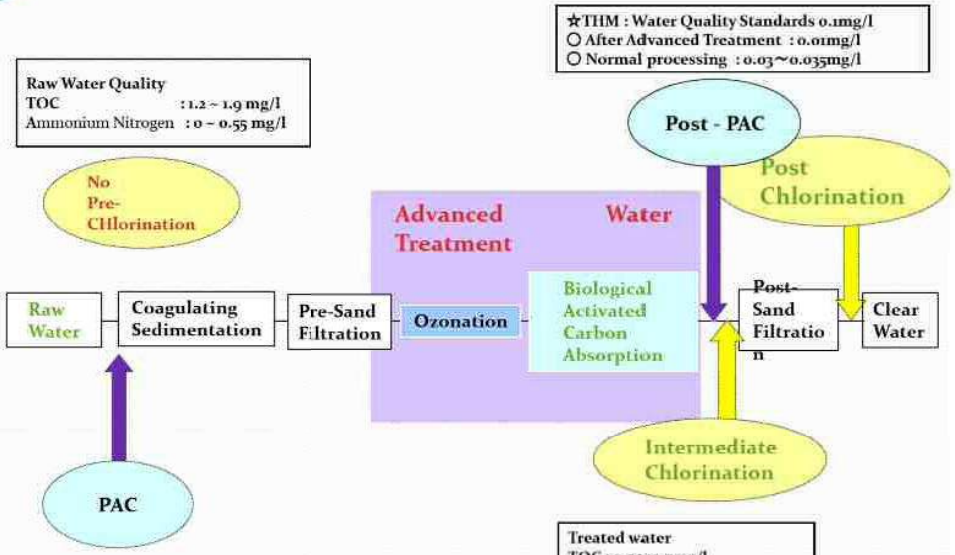
6

Near Reservoir (Site Tour)

Central Control Center (WTP SCADA)

7

Misono WTP : Advanced Water Treatment



8

A9-108

(2)Site visit: Koemon Water Supply Station

Control Center (Distribution SCADA)

Pump House

9

Water quality Management:-

- In the purification plant, the water quality for each purification process including the raw water and the tap water is managed by the water quality meters and water quality is tested by personnel.
- The water quality meters are under 24-hour observation and chemical doses are automatically controlled based on the meter readings.

10

Salient features of advance treatment:

- **Ozone contact basin:**
- Decomposition of order and organic substances.
- Increase of dissolved oxygen.
- Increase of bio degradability.
- **Biological Activated Carbon:**
- Absorbing order & organic substances.
- Eliminations of order and organic substances.
- The above two feature is very effective in removing substances that cause a Musty order and ammonia that causes a bleach order. It also removes substance that from trihalomethane.

11

<u>Lessons to be learnt by DJB</u>:

- In Delhi Jal Board we do not have any advance water treatment technology in any of our plant. Delhi Jal Board should actively consider about adopting advance water treatment technology using Ozone and Biological activated carbon in its forthcoming JICA & ADB assisted Chandrawal & Wazirabad rehabilitation/reconstruction WTP's.
- The use of Ozone and activated carbon will neutralize the effects of bad odor & formation of tri-halo-methane compounds which are health hazard. The use of Ozone will also take care of intermittent high ammonia contents which is encountered in Yamuna water.

12

Lessons to be learnt from Koemon Water Supply Station

- DJB have SCADA system in many of its BPS, but the system can be upgraded to next level where the alarms can be generated when set parameters fail.
- Further DJB can think of developing park/recreational facilities on the top of reservoirs of BPS for giving on rent for the purpose of revenue generation.

13

12th November

(1)Site Visit: Water Supply Operation Center
(2)Visit & Lecture: Customer Center
(3)Visiting: Water meter reading
(4)Visiting: Shinjuku Service Station

Control room (SCADA)

★Lecture &Site-tour

- Central Water Operation room (SCADA)
- Planning work(Daily and Monthly plan)
- Sending daily plan to WTP and WSS
- Monitoring water facilities, water flow, pressure accident and so on

14

Water meter reading

Handy Terminal

-Practice water meter reading with water meter readers
-Pay water bill

Cashier and Service window

15

13th November

(1)Lecture: NRW Reduction
(2)On the Job Training: Leak Detection Activity

Minimum night flow measurement

Correlation type leakage detector

16

A9-110

13.11.2014

- **NRW Reduction (Leakage prevention in Japan and prevention measure)**
- Detailed lecture on NRW reduction i.e. Leakage prevention and its measures in Japan and on Job training of Leak detection activity were given at Training and Development Center in TMWB. During the presentation/lecture and on job training , following methods of leak deduction were explained.
- Acoustic rod , Electronic Leak Detector , TS Leak checker
- Correlation type leakage detector
- Pipe detection (Induction method other)
- Water leakage accident first aid demonstration.

17

- The training for the day was very educative and useful in understanding the applications of SCADA which could be an effective technological tool, combined with IT enabled GIS and RMS system, for comprehensive management of water supply system for a big metropolitan city. At the same time it requires a robust water supply infrastructure system on ground to realize the full potential of these tools for comprehensive water supply management.
- On completion of the training for the day, the trainee group returned back to Tokyo.

19

14th November

(1)Lecture: SCADA System
(2)On the Job Training : SCADA operation

Presentation room

Explaining about SCADA

17th November

(1)Visiting: Ductile Iron Pipe Factory
(2)On the Job Training : Hydraulic analysis for pipeline design, O&M

Ductile Iron pipe factory

Practicing GIS operation

20

A9-111

GIS Session

- The technical presentation during GIS session was given by the firm M/s Kansuken Inc. which is a consultancy organization of Kubota Company.
- The opening speed was given by the president of Kensuken Inc. Mr. Hamada. It was highlighted that in Japan almost all water utilities were using mapping systems for water networks and there were about 20 GIS firms providing GIS services for the utilities.
- There were many software being used by water works for hydraulic analysis and assets management of water networks in Japan.

21

18th November

(1)Visiting: Construction site of Water Distribution Pipe
(2)Courtesy Call: Director General of Waterworks Bureau of Tokyo Metropolitan Government
(3)Discussion

Construction site of Water Distribution Pipe

22

Courtesy call to TMWB

Final Discussion

23

18.11.2014

- **Construction Management**
- On the last day of Training DJB Team visited construction site of Water Distribution Pipes. Integration of Service Pipes in a private road and Replacement with sub mains (distribution pipe) was being carried out. In a private road, many service pipes are laid. There were a lot of water leakages which were caused by corrosion and damage of pipes. For prevention of water leakage and for earthquake resistance of pipes the sub mains in private roads are being laid by the department and the existing service pipes are replaced with stainless steel ones. At the dead end a drain plug is provided which has the same function as a fire hydrant. At the time of an earthquake, emergency water supply can be provided from these plugs.

24

25

Lessons learnt & action points for DJB

- DJB has not been using DI pipes for larger Diameter of 1000 mm or more due to the limited manufacturing facilities of larger dia pipes in India. However, as seen in Tokyo, DI pipes up to 2600 mm dia are being manufactured and exported by Kuboto. Possibility may be explored for using larger dia DI pipes in DJB.

26

- Although, DJB has done pioneering work in the field for GIS as was also admitted by Japanese side, yet on the applications side DJB may adopt Japanese experience of using GIS data for efficient management of water networks. The Technical Assistance under JICA project is already considering introduction of all these systems in DJB.

27

- Some systematic improvements are required in DJB for laying of joints in DI pipes for various pipe line works. As seen in Japan, the pre- marking on pipes to ensure adequate insertion, use of proper chain pulley wrench and pipe lubricant can be adopted for DJB works. It will ensure leak proof joints.
- The Kubota –T technology for providing restraint joint may prove to be very useful for DJB as in some congested places, concrete thrust block may not always be possible to be constructed.

28

- In the afternoon a courtesy call was made to Mr. Ei YOSHIDA, Director General of Water Works Bureau, Tokyo Metropolitan Government. He briefed us about progressive improvement in quality of water supply service in Japan and especially Tokyo. He also emphasized on better management of human resources for exploiting full potential of technology.
- During the wrap up session with the Representatives of JICA, Tokyo Waterworks Bureau, TSS, Kubota and Hitachi, discussions were held about the various aspects of Water purification, SCADA, GIS technology utilization and construction management. Following points came up during discussion:-

29

- Construction Management- Technology is important but management at construction site is more important. Standard of construction must be maintained. Contractors should be trained, proper supervision during construction and detailed record of execution should be maintained.
- Maintenance- all facilities should be managed and maintained properly and safely. This will keep the facility to serve for longer time and more efficiently.

30

- Planning- good manpower resources is the key to success of Tokyo Water. By outsourcing we can keep good quality of service with less staff. Special emphasis should be given to proper training and motivation to younger staff.
- DJB should start from Pilot area for 24x7 Water Supply integrating GIS, Planning and Execution. 100% metering is key to minimize the NRW. It might be difficult to include everything initially and aspects like energy saving may be included in future plans.
- Japan has taken long time in implementation of GIS. Lot of work is required to be done by field staff and GIS experts before an accurate GIS is achieved.

31

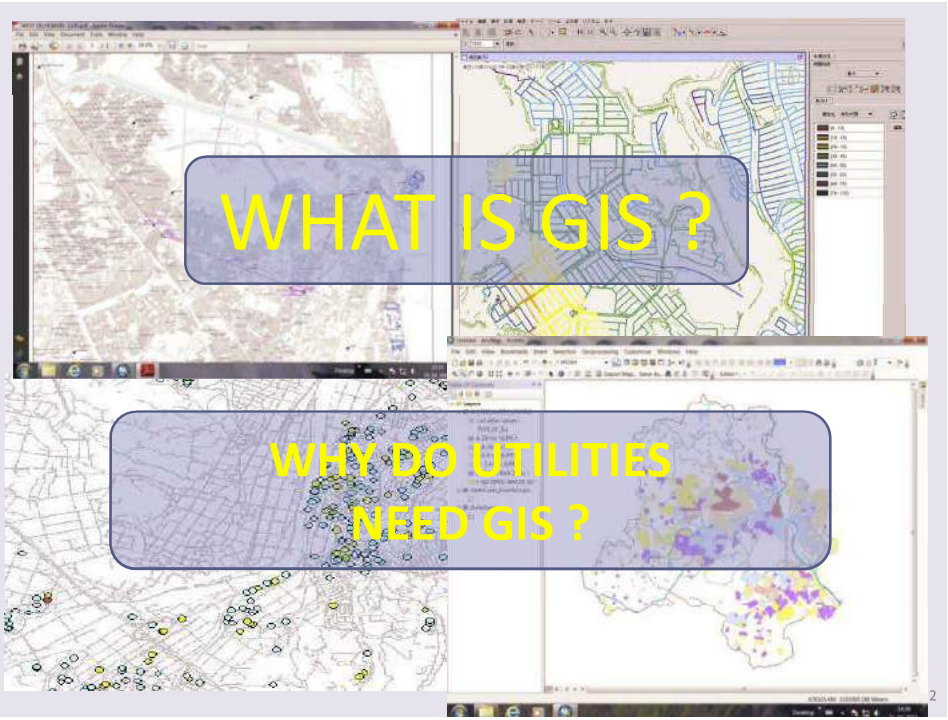
- Investment in Technology will cost very high initially but will ultimately lead to cost reduction. 5-10 years span might have to be considered.
- The various leak detection methods deliberated during training might not prove very effective, if used in isolation. The results need to be coordinated with other data. For smaller pipes Helium gas method may also used.
- The Training program ended with Thanks to all the Participants and distribution of Certificates by JICA.

32

THE ASSISTANCE RELATED TO
DELHI WATER SUPPLY IMPROVEMENT PROJECT IN
CHANDRAWAL WATER TREATMENT PLANT COMMAND AREA

GIS APPLICATION AND DEVELOPMENT SCENARIO IN DJB FOR 2021

1



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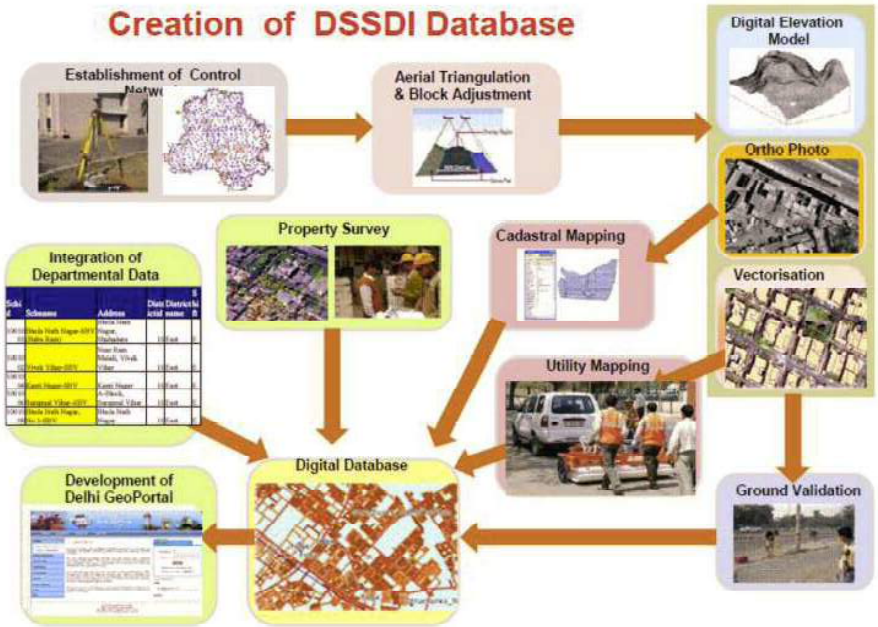


Utility Mapping System Components

Base Map

- Aerial Photography
- Reference Grid
- Photogrammetry
- Verification Survey
- Map database

Utility Map

- Water network
- Sewerage network
- Water Customers
- WTP, STP, Pumping Stations etc.

GIS Map & Applications

1

GIS Development Scenario in DJB

5

Goals for GIS development

- **To develop an enterprise GIS**
- **To develop a GIS that can be used for O&M.**
  (Leak detection/ Repair work/ Daily check/ Water distribution control)
- **To develop a GIS that can be used for asset management.**

6

Development scenario of GIS

- **Reconstruct present Database structure of GIS**
- **Update existing data in GIS**
- **Expand GIS user base in DJB**
- **Add new information to GIS and improve data accuracy**
- **Advanced application of GIS system**

7

Reconstruct present Database structure of GIS

- **Add or change layers and attribute items.**
- **Determine easy-to-understand symbols for each layer.**

8

Layers of GIS(1)

Intake～Raw water transmission			Water Treatment			Transmisson(Pump station)		
Layer	Shape	Symbol	Layer	Shape	Symbol	Layer	Shape	Symbol
Intake point	Point	R	Tank/ Basin	Polygon		Pumping well	Polygon	
Raw water pump	Point	RP	-Receiving well			Surge tank	Point	S
Gate	Point		-Grit chamber			Pipe	Polyline	
Screen	Point		-Sedimentation tank			Valve	Point	See valve table
Flow meter	Point	M	-Filter			Pump	Point	P
Pipe	Point		-Clear water reservoir			Air valve	Point	A
Valve	Point	See valve table	(Identify role of each tank by attribute)					
Air valve	Point	A	Gate	Point				
Junction well	Point		Screen	Point				
Tube well	Point		Flow meter	Point	M			
Ranney well	Point	RW	Pipe	Polyline				
			Canal	Polyline				
			Valve	Point	See valve table			
			Pump	Point	P			
			Air valve	Point	A			

9

Layers of GIS(2)

Distribution			Service			Maintenance/Customer service		
Layer	Shape	Symbol	Layer	Shape	Symbol	Layer	Shape	Symbol
Reservoir(UGR)	Point		Service pipe	Polyline		Leakage Information	Point	
Reservoir(Elevated)	Point		Meter	Point	M	Survey Information	Point	
Pump	Point	P				Complaint Information	Point	
Pipe	Polyline		Valves					
Valve	Point	See valve table	Layer	Shape	Symbol	Water supply boundary		
Air valve	Point	A	Valve	Point		Layer	Shape	Symbol
Hydrant	Point	H	Motor-operated valve	Point		WTP command area	Polygon	
Flow meter	Point	M	Check valve	Point		UGR/BPS command area	Polygon	
Pressure gauge	Point	P	Reducer valve	Point		DMA	Polygon	
Surge tank	Point	S	Scour valve	Point				
			(Symbol color correspond to the installation site)					

10

Attribute of Pipeline layer

Pipe			
No.	Item	Unit	Remarks
ATR01	ID		
ATR02	System type		Primary/Secondary/Tertiary
ATR03	Laying type		Exposed/ Buried
ATR04	Length	m	☆
ATR05	Depth	m	
ATR06	Indian standard category		IS Number
ATR07	Material		
ATR08	Joint type		
ATR09	Diameter	mm	☆
ATR10	Thickness		
ATR11	Inner surface		☆
ATR12	Installation year		
ATR13	Installation year by guess		
ATR14	Manufacturer name		
ATR15	Contractor name		
ATR16	As-built drawing No.		Link to filing data
ATR17	Velocity coefficient		☆
ATR18	Demand amount	m3/h	☆
ATR19	Added amount	m3/h	☆
ATR20	Population served		☆
ATR21	Hourly factor		☆
ATR22	Command area name		
ATR23	DMA name		
ATR24	Ground surface type		
ATR25	Presence of rehabilitation work		
ATR26	Presence of ground water		
ATR27	Soil type		
ATR28	Record of leakage		Link to filing data
ATR29	Repair work date		
ATR30	Filing document path		Link to filing data

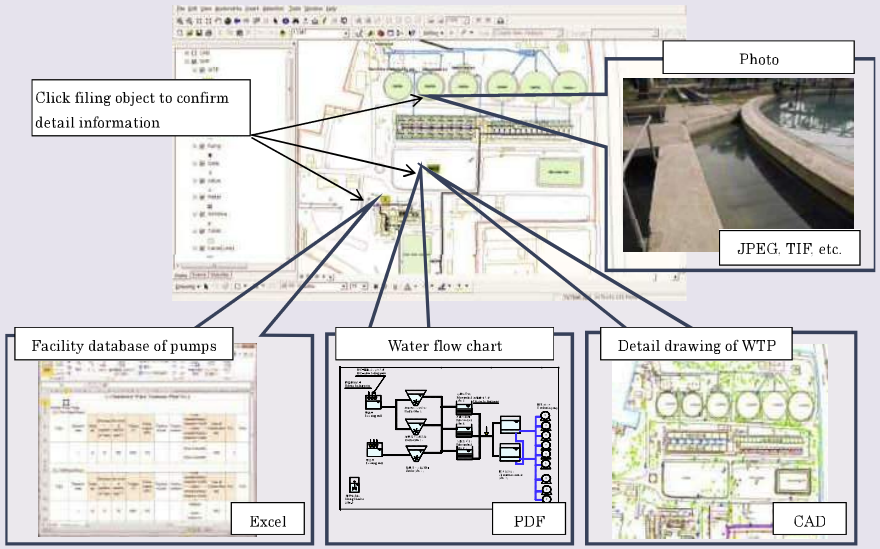
11

Update existing data in GIS

- **Add missing information related to water facilities.**
- **Convert NIC & JICA Study data to DSSDI**
- **Install GIS filing system**

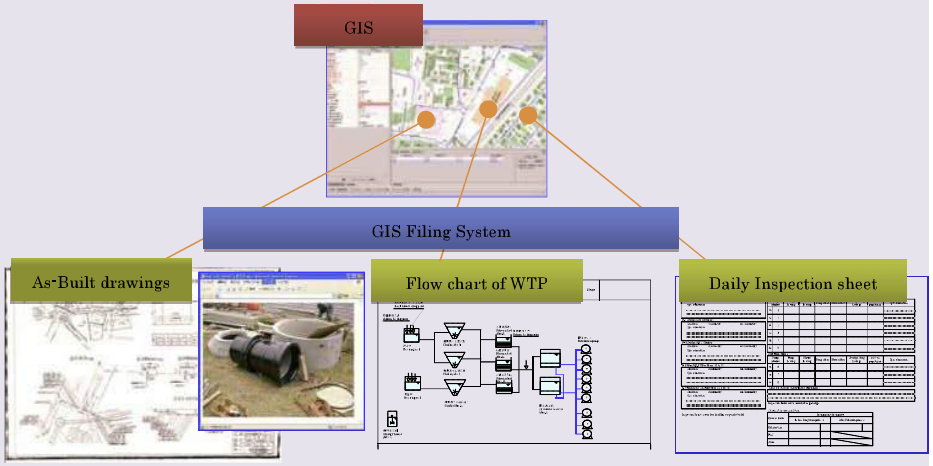
12

GIS filing system



13

Utilization of the filing system



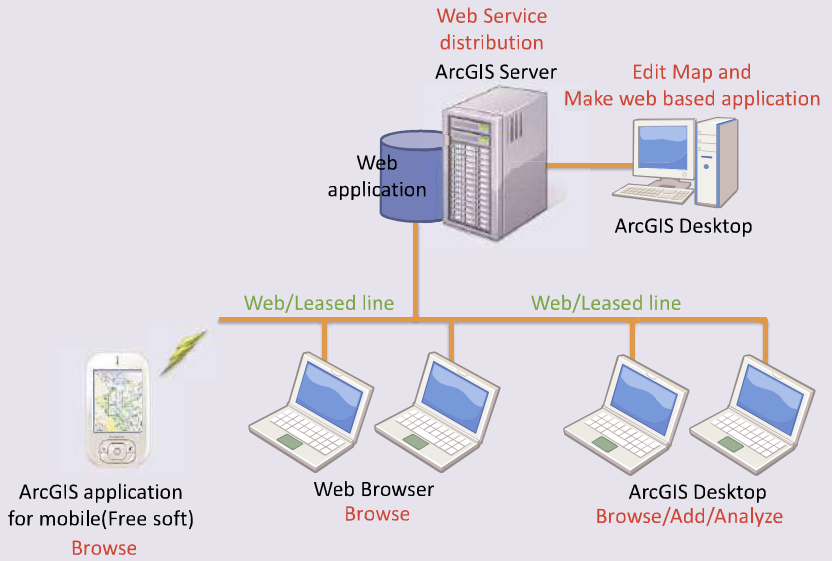
14

Expand GIS user base in DJB

- **To share the GIS data in all division of DJB.**
- **To improve data updation workflows.**
- **To utilize GIS at field for construction and maintenance works.**

15

Web-GIS and Mobile-GIS



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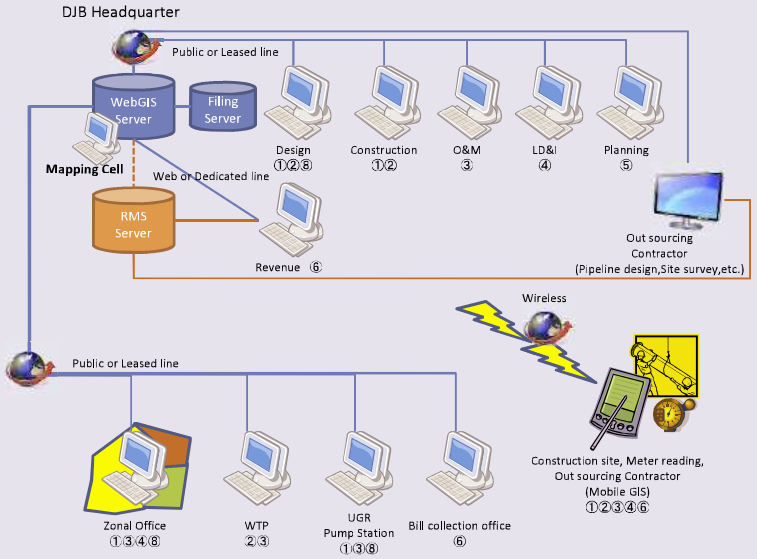
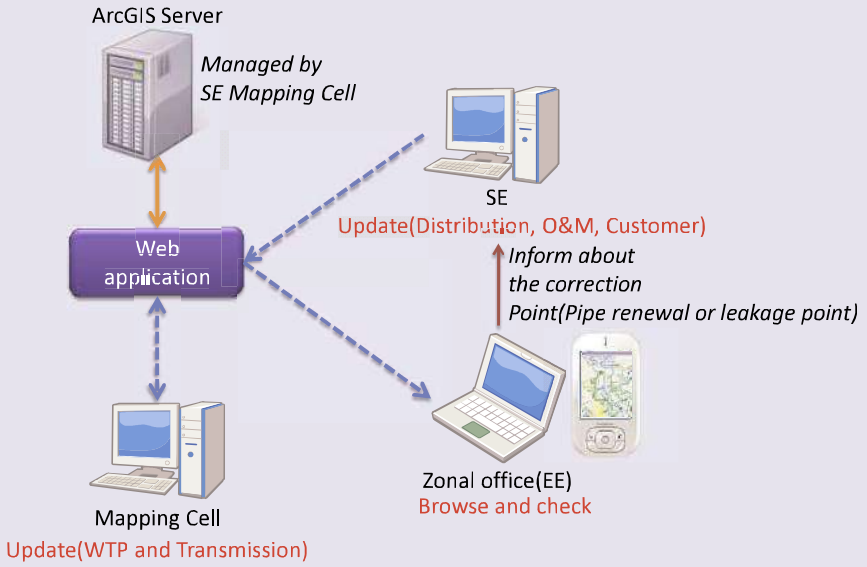
Configuration of Web-GIS and Mobile-GIS in DJB



17

To establish more efficient updation workflow



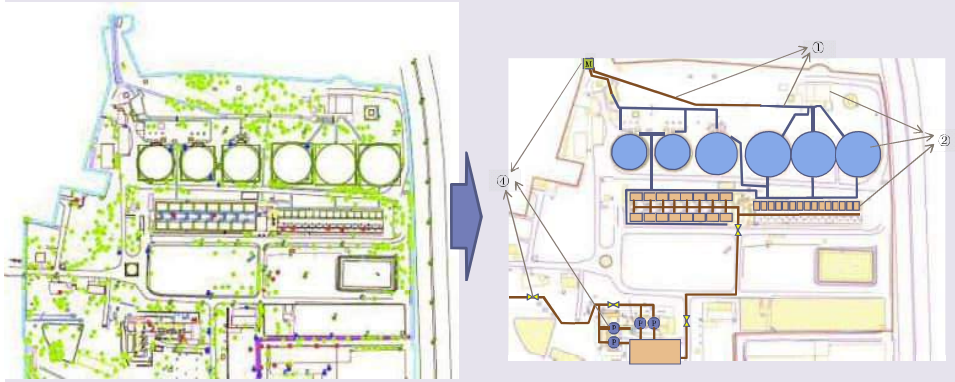
18

Add new information to GIS and improve data accuracy

- **Survey and GIS mapping of WTPs, UGRs/BPSs and TubeWells in Delhi (Detail information such as Drawings, Flow diagram, Facility database, etc. to GIS filing system). This information is used for asset management.**
- **Feed customer meter and service pipe information to the GIS**
- **Improve the accuracy of customer information by utilizing the meter reading work**
- **Update existing pipeline data from digging information.**
- **DMAs and other NRW management related information**

19

Simplification and standardization for WTP and BPS



20