

(5) Handout Materials for Field Workshop
Held on 5th July 2010, 18th October 2010
and 25th October, 2010

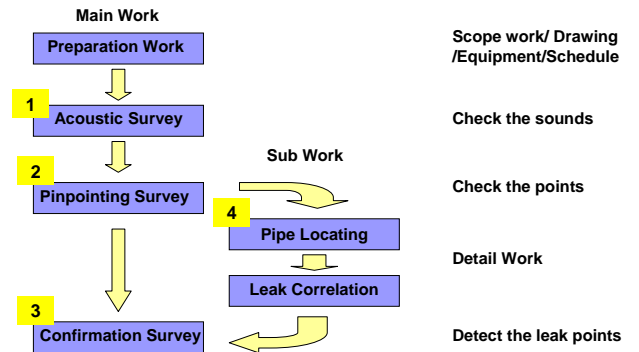
Leak Detection

JULY, 2010

JICA Experts Team

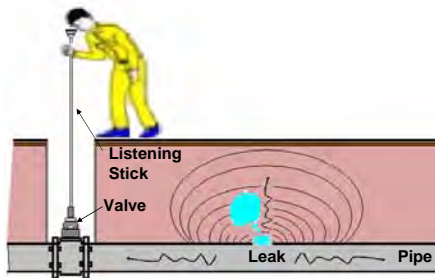
1

1 Procedure of Water Leak detection



2

1 Acoustic survey (1/6) 1-1 Listening Stick (1/3)



With the listening stick, check the Leak sound which is transmitted from leak point to the valve or other fittings.

3

1 Acoustic survey (2/6) 1-1 Listening Stick (2/3)



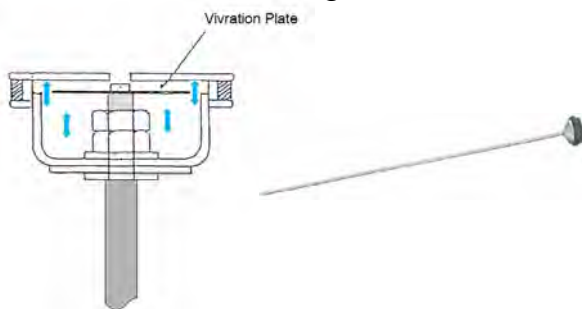
Listen to the noise at the Valve



Listen to the noise at the customer meter

4

1 Acoustic survey (3/6) 1-1 Listening Stick (3/3) Structure of Listening stick



5

1 Acoustic survey (4/6) 1-2 Electrical Acoustic Rod (1/3)

Acoustic Survey using Electrical Acoustic rod

- Leak sound decreases in PVC and non-metallic pipelines drastically.
- Electrical acoustic rod can amplify the small sound.

6

1 Acoustic survey (5/6)

1-2 Electrical Acoustic Rod (2/3)

Acoustic Survey using Electrical Acoustic Rod



Contact the rod to the water tap



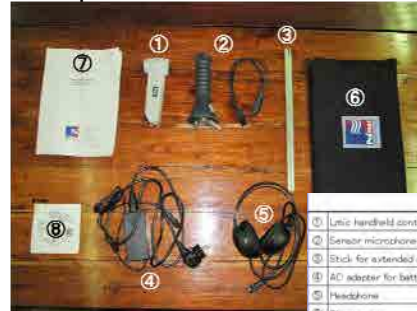
Contact the rod to the water meter

7

1 Acoustic survey (6/6)

1-2 Electrical Acoustic Rod (3/3)

Components of Electrical Acoustic Rod



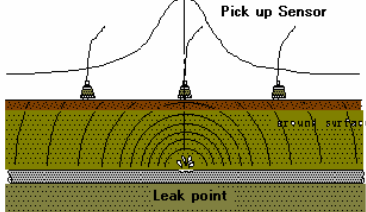
System Components	
① Lotic handheld control unit	1pc
② Sensor microphone unit	1pc
③ Stick for extended connection	2pcs
④ AC adapter for battery charger	1pc
⑤ Headphone	1pc
⑥ Storage case	1pc
⑦ Instruction manual (English)	2pcs
⑧ Instruction manual CD (English)	1pc

2 Pinpointing survey (1/2)

~ Principle ~

Maximum Sensitivity

Pick up Sensor



Find a loudness point



2 Pinpointing survey (2/2)

~ Components of Electric Leak Detector ~



System Components	
① Main unit	1pc
② Pick up sensor	1pc
③ Headphone	1pc
④ Steel probe rod set	1pc
⑤ Disk plate for acoustic of road surface	1pc
⑥ Storage case	1pc
⑦ Instruction manual (English)	2pcs
⑧ Dielectric Grease	1pc

3 Confirmation Survey

Generator & Drill

Confirmation Survey finds the leak point correctly.

①Drilling



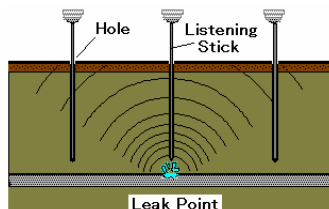
Boring Bar

②Boring



Listing Stick

③Confirming



Boring bar 1m type

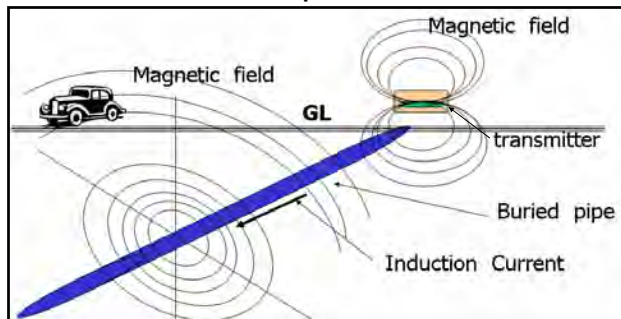
11

4. Pipe Locators

- Pipe locator (Metallic)
- Pipe locator (Non-Metallic)
- Magnetic locator (Valve)

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4-1 Pipe Locator (Metallic Pipe) (1/3) ~ Principle ~



13

4-1 Pipe Locator (Metallic Pipe) (2/3) ~ Practical Use ~



Moving the receiver for the pipe detection



Set the transmitter on the pipe line

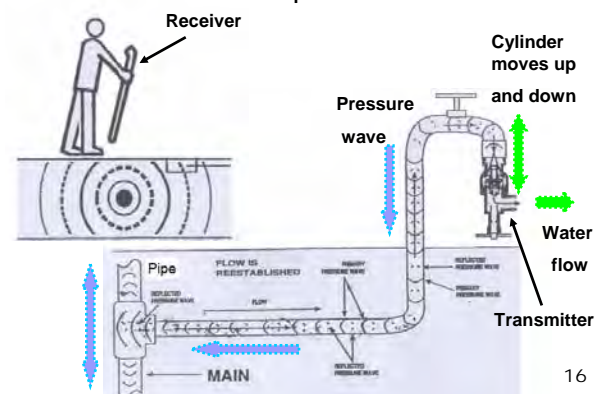
14

4-1 Pipe Locator (Metallic Pipe) (3/3) ~ Components ~



System Components	
1 Receiver	1 pc
2 Transmitter	1 pc
3 Strong connection cable (with clip, 15m/50ft)	1 pc
4 Transmitter manual (English)	1 pc
5 Accessory bag / Transporter case	1 pc
6 AC adapter	1 pc
7 Battery box	1 pc
8 Disposable AA (batteries) with battery charger	1 set
9 Transforming plug (C type to B type)	2 pcs
10 Spare tire	1 pc
11 Battery cover	1 pc

4-2 Pipe Locator (Non-Metallic) (1/2) ~ Principle ~



16

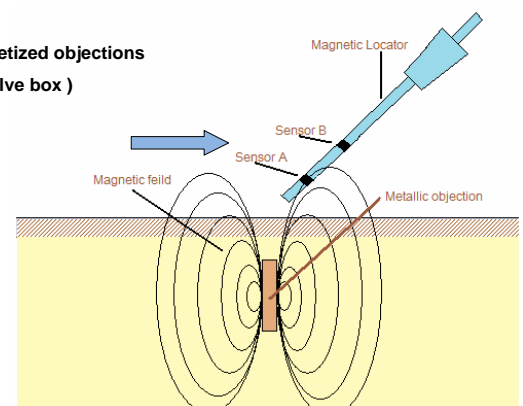
4-2 Pipe Locator (Non-Metallic) (2/2) ~ Components ~



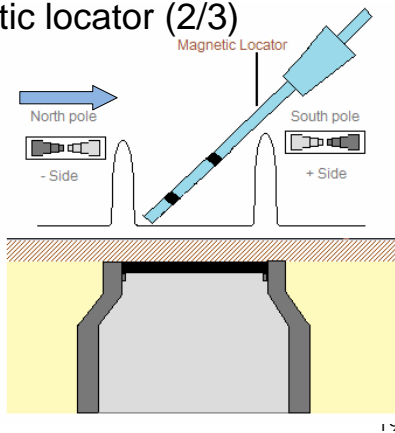
System Components	
1 Receiver	1 pc
2 Headphone	1 pc
3 Cable pin	1 pc
4 Surface plate	1 pc
5 Carrying case	1 pc
6 Instruction manual	1 pc
7 9VPP battery (DC9V) (for receiver)	2 pcs
8 Transmitter/Water pressure wave generator (with connection cable) for fire hydrant (red)	1 pc
9 Transmitter/Water pressure wave generator (with connection cable) for meter base (yellow)	1 pc
10 Transmitter/Water pressure wave generator (with connection cable) for tap (green)	1 pc

4-3 Magnetic locator (1/3)

Find magnetized objections
(Buried valve box)



4-3 Magnetic locator (2/3)



Magnetic locator detect the size of buried objection to distinguish the North(-) or South pole (+) side function.

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4-3 Magnetic Locator (3/3) ~ Components ~



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THE CAPACITY DEVELOPMENT PROJECT FOR NRW REDUCTION IN COLOMBO CITY

~ SERVICE PIPE REPAIR ~

JULY,2010
JICA EXPERT TEAM

① Marking



- Heat joint



- After cooled, put I-mark to the pipe

② Chamfer



- chamfer the inside of pipe
 - It is easy to insert pipe after heating
- chamfer the outside of pipe
 - without chamfer, the corner of pipe scratch the adhesive off the pipe

③ Cleaning the pipe

- Cleaning the inside of pipe
- Cleaning the outside of pipe

(Method)

- wipe by dry cloth

(Reason)

- When mud, sand, oil or moisture sticks on the surface, enough strength of bond is not obtained.

④ Adhesive Application



- The adhesive shall be uniformly spread on the inside of the pipe of receiving mouth side
- The adhesive shall be uniformly spread on the outside of pipe

④-1

Quantity consumed of PVC solvent cement

- The proper quantity is painted thinly, and uniformly (Reason)
- a) Too much solvent cement
 - causes that reduction of inside diameter of pipe
 - causes the nasty smell of tap water
 - takes time until enough strength of solvent cement goes out
 - causes a possibility of damaging the vinyl chloride
- b) Uniformly
 - when the painting is not uniformly, it causes the water leak

④-2

Management of adhesive

- The fire shall be avoided and keeps in the cool dark place
- Keep free from earth, sand and water
- Not use the adhesive that becomes old and started hardening. (even if thinned with thinner)
- The different kind of adhesive shall not be mixed
- An old adhesive shall not be mixed with the new one.

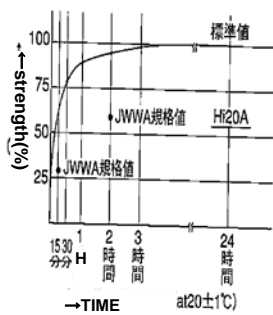
⑤ Pipe Insert



- Insert the pipe in the receiving mouth and match the I-mark
- Keep the position about 30 second

⑤-1

Curing



- The state of inserting the pipe has to be maintained for about 30 second
- Relation between the time of curing of adhesive and strength of bond

(6) Presentation Materials for Seminar/Workshop

Held on 25th January, 2011

List of Materials

- ①: Briefing of the Project (AGM (NRW))
- ②: Briefing of the Seminar (JICA Expert Team)
- ③: Findings in Technical Exchange Program in Jordan (Engineer (O&M))
- ④: Findings in Technical Exchange Program in Jordan (Engineer (O&M))
- ⑤: Results of the Pilot Activities in Kotahena (AE Colombo North -Kotahena)
- ⑥: Results of the Pilot Activities in Borella (AE, Colombo East - Borella)
- ⑦: Results of similar activities in Other areas (AE Colombo South)

WORKSHOP / SEMINAR
FOR
THE CAPACITY DEVELOPMENT PROJECT
FOR NON REVENUE WATER (NRW) REDUCTION
IN COLOMBO CITY

Time and Date: At 9:00HR on Tuesday 25 January 2011

Place: Conference Room at Berjaya Mount Royal Hotel

Agenda

- | | |
|--------------|--|
| 9:30-9:40 | Opening Address (Addl. GM) |
| 9:40-9:50 | Briefing of the Project (AGM (NRW)) |
| 9:50-10:00 | Briefing of the Seminar (JICA Expert Team) |
| 10:00-10:20 | Findings in Training Program in Japan (AGM (O&M)) |
| 10:20-10:40 | Findings in Technical Exchange Program in Jordan (Engineer (O&M)) |
| | |
| 10:40-11:00 | Break |
| | |
| 11:00-11:20 | Results of the Pilot Activities in Kotahena (AE Colombo North -Kotahena) |
| 11:20-11:30 | Q&A |
| 11:30-11:50 | Results of the Pilot Activities in Borella (AE, Colombo East - Borella) |
| 11:50-12:00 | Q&A |
| 12:00-12:15 | Results of similar activities in Other areas (AE Colombo South) |
| 12:15-12:30 | Results of similar activities in Other areas (OIC Maligawatte) |
| | |
| 12:30- 12:50 | Questionnaire |
| | |
| 12:50-13:00 | Closing Address (DGM) |

THE CAPACITY DEVELOPMENT PROJECT FOR NRW REDUCTION IN COLOMBO CITY

NRW Components

- ▶ Leaks
- ▶ Unauthorized consumption
- ▶ Administrative losses
- ▶ Free water



Who is Responsible?

- ▶ NRW Section Staff
- ▶ O&M Section Staff
 - Commercial Staff

Strategic Approach for NRW reduction in CMR

- ▶ Action path
 - Replacement of pipes which are beyond economical repairs in a planned manner
 - Reorganize Colombo City Management
 - Implementation of planned preventive approach
 - Implement pilot projects to enhance Capacity Building and Create awareness among staff
 - NRW section to play a role of NRW Management
 - Review specification of materials to maintain Quality
 - Strength Legal Section for NRW control and speed up court cases
 - Review Present Incentive Scheme

Projected Target

- ▶ Reduce NRW in Colombo City to 32% by year 5

Capacity Development Purpose of the Project

- ▶ NWSDB Capacity to implement NRW reduction activity in Colombo City is Strengthened

- ▶ Management Capacity of Senior Officers of RSC (W-C) to Plan and Supervise NRW Reduction Activities is Enhanced
- ▶ Technical and Operational Capacity to Conduct NRW reduction activities by officer / Staff of RSC (W-C) is Developed

- ▶ Chief Advisor
- ▶ Leaks Detection Advisor
- ▶ Arrangement of pipeline drawing and Customer Data Advisor
- ▶ Service pipe connection Advisor

Name	Quantity
▶ Valves for isolating pilot areas (ϕ 100–200mm)	60
▶ Portable ultrasonic flow meters	10
▶ Data loggers with pressure inducers	8
▶ Pipe detectors (metal)	4
▶ Pipe detectors (non-metal)	3
▶ Acoustic rods (Listening bars) – digital type	5
▶ Electronic leak detectors	5
▶ Correlation leak detectors	2
▶ Plastic customer meter assembly	200
▶ Lap top computers	2
▶ Crew CABs (Double cabin trucks)	2
▶ Pickup trucks	2
▶ Micro excavators	2

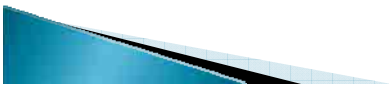
Name	Quantity
▶ Metal locator (Valve locator)	5
▶ Listening stick	6
▶ Boring bar	2
▶ Drill bit	30
▶ Hammer drill	2
▶ Pressure gauge for house connection	6
▶ Generator	2
▶ Projector	1

- ▶ Weekly Meeting



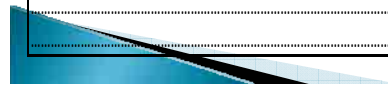
On going Pilot Zones

- ▶ Under the guideline of Experts 5 zones having 2,330 connections
- ▶ Voluntarily selected 3 nos Zones 963 connections

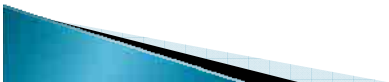


Monitoring Form

Daily & Weekly Work Done - Mr/Mrs.			
Date	<input type="text"/>	Weather - Good / Fair / Raining	
Nature of Work - Randiya / Illegal / Survey / Leak Detection / Flow Measurement / Permission / Office/.....			
Team	<input type="text"/> Fitter / Labour	Vehicle	<input type="text"/> Board / Hired <input type="text"/> hrs
Working hrs	<input type="text"/> Morning	<input type="text"/> Afternoon	<input type="text"/> Night
Work Done / Locations			
.....			
.....			
.....			



Thanks



Briefing of the Workshop / Seminar




1

Findings in Overseas Training

- In JAPAN (Management Level)
- In a Third Country (NRW Reduction Team)

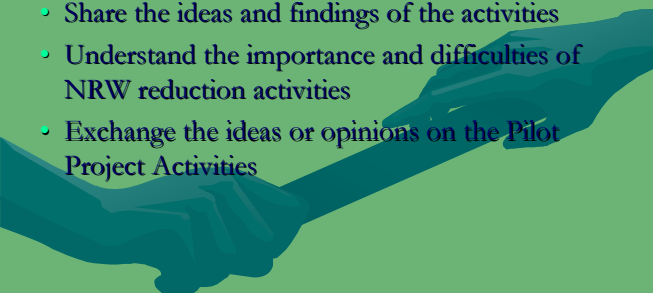
A chance to Share the findings and ideas among
NWSDB



2

Pilot Project Activities

Aim to

- Share the ideas and findings of the activities
 - Understand the importance and difficulties of NRW reduction activities
 - Exchange the ideas or opinions on the Pilot Project Activities
- 

3

Questionnaire

- Welcome any comments
on and suggestions to the
Project Activities !!
- 

4

Outcome of the Training Course in Tokyo, Japan on NRW Reduction

8th to 16th September, 2010
NWSDB, Sri Lanka

1

0. Schedule

- 10/Sep (Fri)
 - AM: JWWA
 - Lecture on history of water supply system development and on strategy of future development in Tokyo
 - PM: Tokyo Metropolitan W'Works
 - Lecture on NRW Reduction Measures at Training Center
- 13/Sep (Mon)
 - AM: NSC
 - Lecture on Commercial Activities for NRW reduction in Japan
 - PM: Tokyo Metropolitan W'Works
 - Importance of integrated controlling / monitoring water conveyance system
 - Water History Museum
- 14/Sep (Tue)
 - AM: Tokyo Metropolitan W'Works
 - PR activities by waterworks bureau
 - PM: NSC
 - Summarizing work

2

1. Impression/Findings (difference between CMB & Tokyo) (1/2)

- Organization
 - NWSDB: National organization (semi-govt.)
 - JPN: Municipal operated (public enterprise)
- NRW Rate
 - 50% in CMB (leakage, illegal use, estimated bill, administrative loss, free water)
 - 3% in Tokyo (leakage)
- Free Water
 - Very high in CMB due to 1,600 Tenement Gardens
- Distribution Pressure
 - Tokyo: minimum 15m
 - CMB: very low due to aged CI pipes (scale, leakage, etc), high number of public stand post (4,000)
- Operation & Maintenance
 - Tokyo: Highly computerized, centralized and automated

3

1. Impression/Findings (difference between CMB & Tokyo) (2/2)

- Quality of Material
 - Tokyo: very high (eg. stainless connection pipe, DI Pipe in distribution pipes)
 - SLK: poor quality
- Office Environment
 - Good for working
- Tariff
 - SLK: covers only O&M
 - JPN: covers O&M + investment
- Mapping for water transmission / distribution
 - Tokyo: highly-established
 - CMB: lacks due to unavailability of resources

4

2. What we would like to tell/disseminate to our colleagues / What we would like to do after going back

- Training Center
- PR Activities
- Planned Activities
- Improvement of Meter-reading Activities
- Establishment of New Water Supply Operation Center

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2-(1) Training Center

- Highly organized
- Importance of equipped/centralized training center (OJT)

6



2-(2) PR Activities

- Response method (highly attended, customer focused)
- Improvement of call center with the facilities and personnel
- Museum

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2-(3) Planned Activities

- Continuation of on-going activities on reduction of administrative losses (defective meters, unreadable meters, estimated bills etc), illegal use, number of stand posts, free water in Tenement Gardens
- Pipe replacement program (delay due to lack of funds)
- Improvement of transmission pipes (capacity, etc)

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2-(4) Improvement of Meter-reading Activities

- Promotion of awareness of their role / discipline
- Bi-monthly: to save cost
- Make use of private sector (outsource)

12

2-(5) Establishment of New Water Supply Operation Center

- To maintain pressure/ residual chlorine/ adequate quality

13

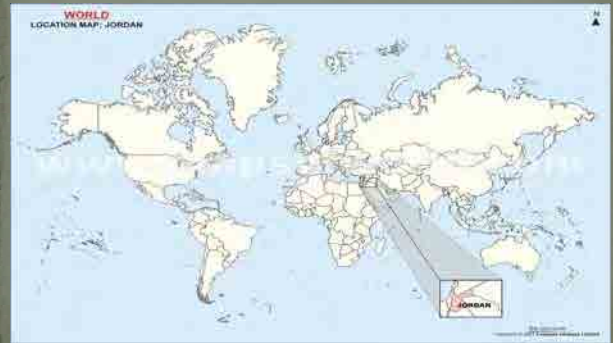
Thank you

14

What we have gained through the Jordan Tour



Where is JORDAN ?



Neighboring Countries

Palestine

Syria

Jordan

Iraq

Yemen

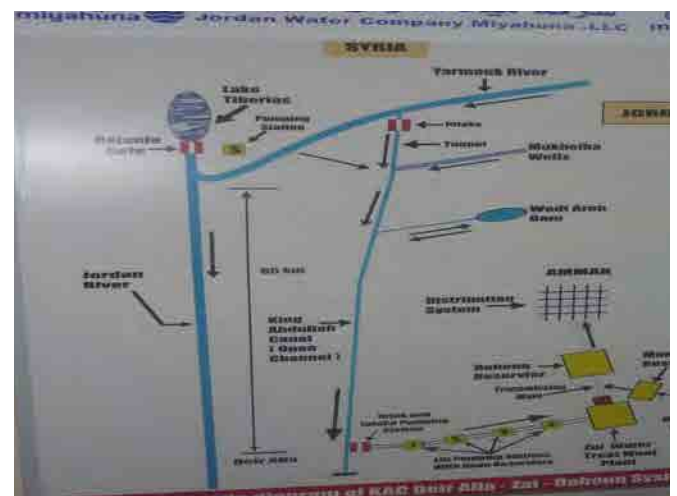
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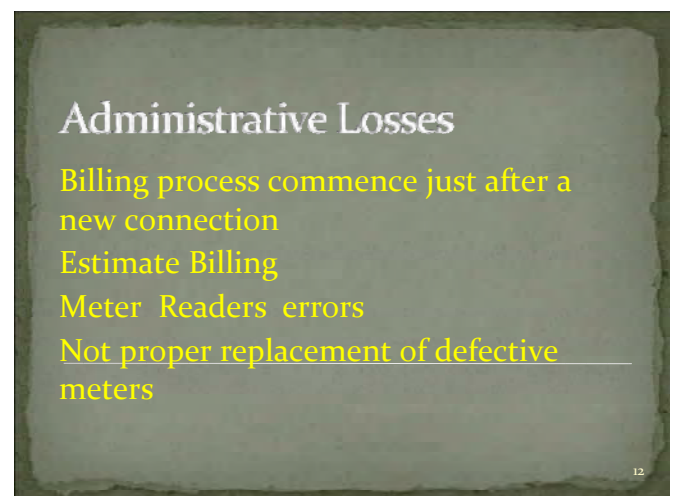
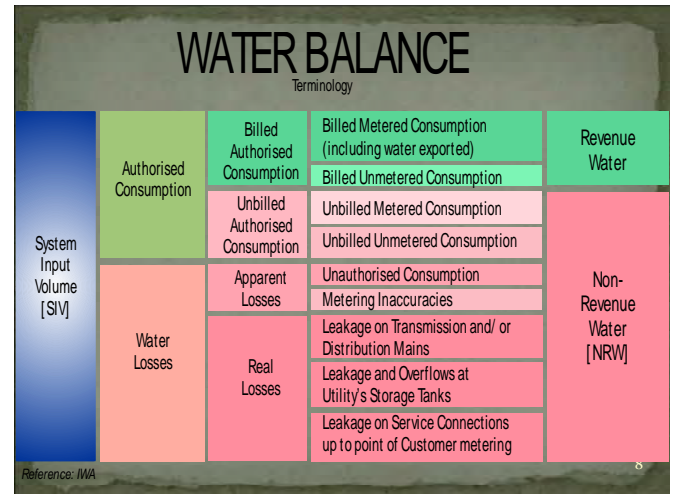
OUR TEAM



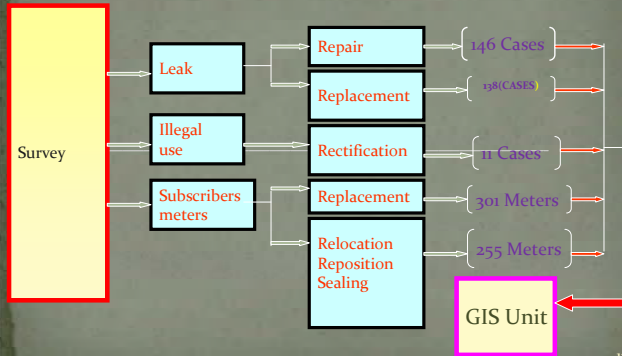
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Introduction





How They Reduce the NRW



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Selected Pilot Areas

Thafilah

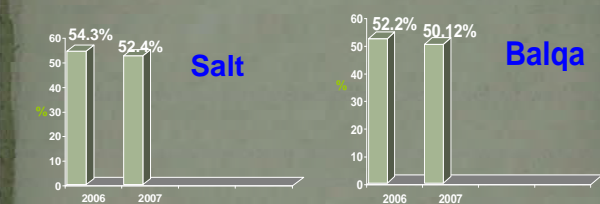


Balqa



14

The Benefit of NRW Reduction



One Of The Main Reasons For This Reduction Is
(Our Activities In The Pilot Area During The Year 2007)

Glance at Similarities and Differences in Jordan & Sri Lanka

Description	Sri Lanka	Jordan
Rainfall per year	5000-6000 mm	<300 mm
Water service	Uninterrupted	Once a week
NRW	52.1 % in 2010	52% in 2002
Pilot Area	Kotahena and Borella	Balqa and Thafilah
No of consumers per zone officer	> 6000	< 2500
Population	20 million	6.0 million
Water Source	Many	Only one
Pressure	Low 0.1 m-10m	High 250m - 350m
Charging System	Only water	Water, Waste water and Irrigation
No of days for new connections	7 to 14 days	7days

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Glance at Similarities and Differences in Jordan & Sri Lanka

Description	Sri Lanka	Jordan
Billing	monthly	quarterly
Documentary work	More	Less
Inter cooperation with other institutions	To be developed	Excellent
Transition for GIS	-	01 year
No of team members	4 to 5	10
Private participation	To be developed	Satisfied
Public awareness	To be developed	Satisfied
Leak, Valve, Line detections	Same	Same
Preventive maintenance	To be developed	Once a six months

Sophisticated Tools



Phocus2



Ultrasonic Flow Meters

18

SOPHISTICATED TOOLS



Pressure Loggers



Noise Loggers



Flow meters / data Loggers

19

LEAKE DETECTORS



20

Leakage Van



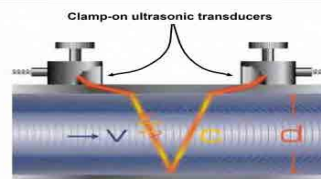
PIPE LOCATER



NOISE LOGGER



FLOW METERS



FLOW METERS



Sophisticated Tools



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GIS Applications



27

Water networks and customers survey



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Map Preparation



What to do in Sri Lanka

- Introduce GIS System
- Several data are available in Sri Lanka but not used.
- Develop the analysis of problems related to water supply and share the outcomes with other offices through the periodicals or a easy way.
- Can introduced the pressure reducing valves to hilly areas like Kandy Region.
- Introduce the High Density Poly Ethylene (HDPE) Pipe. But very cost it.
- Provide the IT facilities and Improve the Computer Literacy of the officers .
- To be developed the Call Centre with modern facilities and skilled Officers.
- More attention to be paid for preventive maintenance and corrective maintenance.
- Better Co ordination with Police, CMC and other utility servicers such as Telecom, CEB, RDA Survey department & Trade Unions Etc.
- Improve the bill money collection systems with parallel to

30

EXCHANGING SOUVENIR



31

Not only that...We enjoyed

Ajlun Castle Archaeological site @ Erbith



32

Petra – A World Wonder.....



33

Petra – A World Wonder.....



34



Dead Sea.....



37



Olive Oil Factory.....



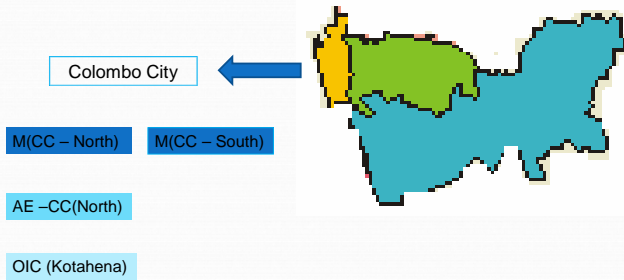
39

*CAPACITY DEVELOPMENT ?
REDUCTION OF NRW ?*

YES WE CAN

*THANKS
JICA, WAJ, NWSDB, & U*

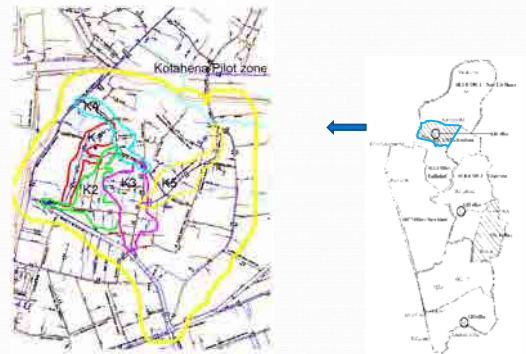
Western Central Region



1

Pilot Zone - Kotahena

Introduction – Pipe born system commence in 1886 which is one of the oldest pipes lines in CC.

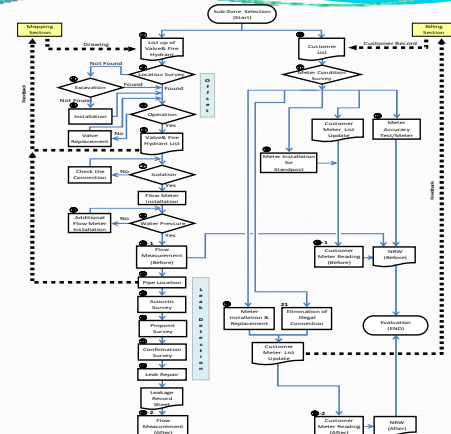


2

Activities Implemented Under JICA Project in Kotahena Pilot Zone

3

Work Flow of Activities



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Main Work Flow of Activities

- Sub Zone Isolation
- Map Updating
- Consumer Survey
- Leakage Management
- Development of Further Sub Zones

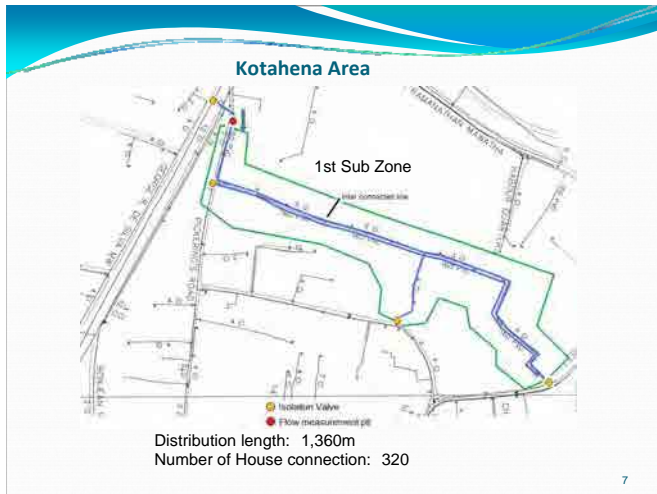
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Sub Zone Isolation in Kotahena

- Identification of Pipe Lines and Valve
 - Valve Tracing
 - Valve Condition Survey
 - Valve Repair if Any or New Valve Installation
- Bulk Meter Installation
- Isolation Confirmation Test



6



Map Updating

- Size and Material of Pipe line
- Side of the Pipe Lines
- Location of Valve
- Insert New Valves & Pipes

Consumer Survey

- Meter Condition
- Meter Accuracy Test
- Collection of Consumer details
- Acoustic Survey for service leak detection
- Checking and Legalizing of Illegal connections
- Metering of Unmetered Connections
- Defective meter replacement

Customer list

Customer meter check list					Name of Plot and Name of Sub zone			Remarks
No.	Customer name	Customer ID	Road name (House No.)	Previous month consumption (m3)	Meter condition (W, N, U, I, NA, O)	Family's Number	Number of tap	
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

W: Working
N: Non-working
U: Unmetered
I: Illegal Connection
NA: Not Access
O: Other

Customer list should be prepared and all meter condition should be checked.

Water Leakage Management

- Visual Leak Repairs
 - Day and Night Appeared Leaks
 - Pin Points
 - Confirmation
- Active Leak Detection
 - Night Leak survey by Using Instruments
 - Step Testing



Problems in Leakage Management

- Defective valves
- Pervious Repairs not properly done
- Less Cover in Service Lines
- Bundle Pipes
- Poor Workmanship in Illegal tapping
- Behaviors of Other Utility Agencies in Construction

Measuring of Free Water Supply

- Identification of Out Lets

Common Outlet	14
---------------	----
- Metering of Out Lets

Common Outlet	14
---------------	----
- Details of Consumption m³

Common Outlet	4m ³ /outlet/day
---------------	-----------------------------

Development of Sub Zones

- Sub Zone K1
 - Number of Customers 369
 - Distribution Length - 3"CI 155.2 m
4"CI 253 m
5"CI 298.9 m
160 mm PVC 716.7 m
- Sub Zone K2
 - Number of Customers 410
 - Distribution Length 3"CI 61.7 m
4"CI 742.2 m
5"CI 397.3 m
63 mm PVC 245.1 m

Summary of Work Implemented

Summary of the Project

Area	Zone	Total Connection	No of Unmetered	Total Illegal	Total leak Repairing		Initial NRW	Interim NRW
					Main	Service		
Kotahena	K1	357	45	53	3	72	85.26	76.15
	K2	410	19	21	-	51	79.74	-

Problems Identification

- Deteriorated and Scaled CI Pipe Lines
- Bundle Pipes
- Defective & Buried Valves
- Defective Meters
- Wastage in Common Out Lets
- Impurities Inside the Pipe Lines

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Disconnection of CI line and transfer of Connection to PVC



Bundle pipe replacement

20

Parallel Execution



- Works in K_2, K_3, K_4 & K_5 Sub Zones were Started in Simultaneously

21

Benefits

- Familiarizing with New Technology
- Methodical approach to address Water Loss Management
- Team Work Effects
- Sharing Knowledge With Japanese Experts
- In depth information about the existing system

22

Learning

- Importance of Valve and its Workability
- Importance of Realistic Map
- Leak Repair is not effective in a deteriorated system. It need to be
 - Replaced Bundle Pipes
 - Replaced Deteriorated CI Pipes
- House to house survey gave more information for O&M activities
- Effectiveness of Weekly Meeting

23

Thank You

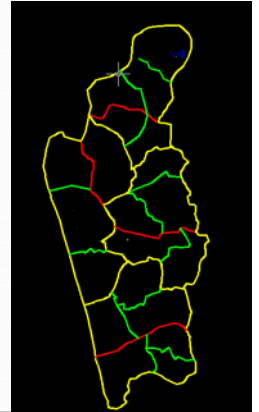
شکرا جزيلاً
 有難うございます

24

THE CAPACITY DEVELOPMENT PROJECT FOR NRW REDUCTION IN COLOMBO CITY Borella Area

Present Situation of the Colombo City

- Area 37.4 sqkm
- No of Connections as at 2010 120000
- Administrative by Two Manager office , 4 AEE & 8 OICC with 24 Zone Officers
- NRW Percentage 50%



Purpose of the Project & Project Area

- NWSDB Capacity to implement NRW reduction activity in Colombo City is Strengthened
- Borella Pilot Zone
 - Area nearly 4 sqkm
 - Total Connections 5000
 - Length of Pipe network - 32 km
 - Community consists of Domestic, Commercial & Tenement Gardens

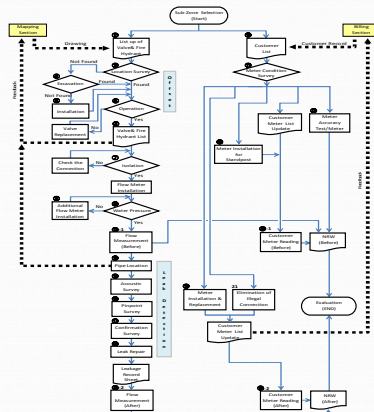


Objective of the Project

- Management Capacity of Senior Officers of RSC (W-C) to Plan and Supervise NRW Reduction Activities is Enhanced
- Technical and Operational Capacity to Conduct NRW reduction activities by officer / Staff of RSC (W-C) is Developed

Work Flow of Activities

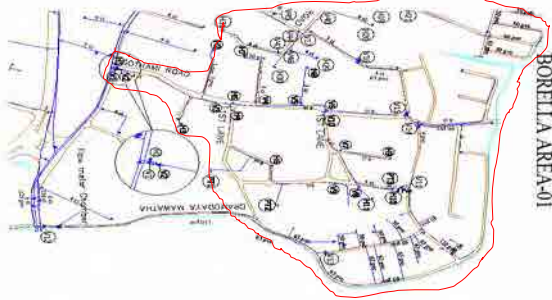
- Sub Zone **selection**
- Valve **Locating** & Sub Zone Isolation
- Initial **Inflow**
- Consumer** Survey
- Meter **Accuracy** Test
- Leak **Detection**
- Leak **Repair**
- Further **reduction** of NRW
- Observations**
- Project outcome**



Selected Pilot Zones In Colombo City Area



Zone Map-B1



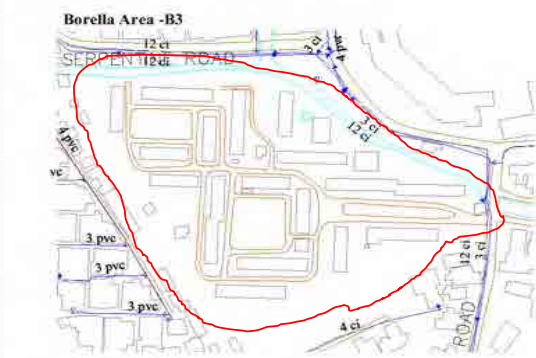
7

Zone Map-B2



8

Zone Map-B3



9

Detecting buried lines & valves by using metal locator and pipe locator



10

Identification of Valves - Borella



11

Valve condition survey

Valve condition checking list									
Name of Pilot area:									
Name of Sub zone:									
Item	No.	Size(mm)	Pipe material	Location (Existence, Buried)	Valve cover (OK, Non.)	Direction (Clockwise, Anticlockwise)	Condition		
							Operable (C, NC)	Number of rotation to be closed	Need for a replacement
Valve	V-1								
	V-2								
	V-3								
	V-4								
	V-5								
	V-6								
	V-7								
	V-8								
	V-9								
	V-10								
Fire Hydrant	H-1								
	H-2								
	H-3								
	H-4								
	H-5								
Water turbine	W-1								
	W-2								
	W-3								
Steel pipe	PT-1	Size	Material	Meter(Y, N)	Condition	Remarks			
	PT-2								
	PT-3								

All valves, fire hydrant,

12

- Condition of boundary valves which are needed for the Isolation of the sub zone were checked.
- If they cannot completely close, they were replaced.
- Installed additional valves when required.
- Data sheet shall be filled.

13

Valve Installation & Zone Isolation



14

Initial Inflow & Pressure



Bulk meter readings



Pressure measurements

15

Obtain logger measurements



16

Preparation of customer list

- Prepare the customer list of sub zone including the customer name, customer-ID, address and meter-conditions.
- Customer meter condition were checked one by one house based on the customer list.

17

Customer list

Customer meter check list					Name of Plot area		
Record					Name of Sub zone		
No.	Customer name	Customer ID	Road name (House No.)	Previous month consumption (m³)	Meter condition (W, R, U, I, NA, O)	Family's Number	Number of tap
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

W: Working
 R: Non-working
 U: Unmetered
 I: Illegal Connection
 NA: Not Access
 O: Others

Customer list should be prepared and all meter condition should be checked.

18

Customer List and Meter Condition Survey



19

Meter Accuracy test



20

Leak Detection



Acoustic survey

Pinpoint survey



Conformation survey

21

Leak map in zone B1



22

Leak Repairing



23

Leak Recording System

Leakage Record Sheet		Ref. No	27
Borella - 02			
Date of survey:	27/10/2010	Street No.	
Account No.		House No.	Infront of 17A
Main Pipe	CIP, PPH, GP, Others ()	Location	Pipe, Connection, Valve, Others
Condition			Hole, Crack, Breakage, Packing, Unknown, Others
Diameter		mm	
Cause			Corrosion, Water pressure, Deterioration (Aging), Traffic load, Unknown, Others
House Connection	PVC, GP, Others ()	Location	Pipe, Connection, Valve, Others
Condition			Hole, Crack, Breakage, Loose Connection, Packing, Unknown, Others
Diameter	19	mm	
Cause			Corrosion, Water pressure, Less Adhesive, Deterioration, Wrong Construction, Traffic load, Unknown, Vandalism, Others
Depth		cm	
Ground			Asphalt, Concrete, Gravel, Grass, Soil, Others
Leakage Size	Large, Medium, Small	Leakage Quantity (Measured)	
		Point of Leakage	
Date of Repair :	2010 Time/	Elevation Size (m x m x m)	
H0		Pipe (Dia: mm Length: m), Socket (Pto), Elbow (Pto)	
Material		Others ()	Worker ()
Other Expenses ()			

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Further Reduction of Leakages

- Step Testing
- Results
 - Minimum Night Flow(MNF)
 - Zone 01-56 l/Min
 - Zone 02-24 l/Min
 - Zone 03-108 l/Min
 - Zone 04-100 l/Min
- Observations
 - No. of leaks-06(within zone-03 & 04)
- Present Status
 - Leak Repairing work is in progress.



5

Meter Installation for Stand post



- No. of Common Outlets -2
- No. of Removal-1
- No. of New Connection Provide-10
- Average Consumption - 360 m³/month



26

Finding of buried meter



27

Recent situation of old pipes & valves



28

Out Come of the Project-B1

Physical progress

- 10 new connections given
- 8 illegal connections detected
- 47 leaks repaired (12-main/35-service)
- 10 unmetered places metered
- 15 defective meters changed
- 1 common tap removed

29

Out Come of the Project-B1

Commercial progress (using billing details)

Month	Income of the year (SL.Rs.)		Amount of increase(SL.Rs.)
	2009	2010	
November	342,947.00	383,940.00	40,993.00
December	301,937.00	342,420.00	40,483.00

30

Work summery

Borella 3	Borella 2	Borella 1	zone name	
355	617	579	no of consumers	
0	6	2	no common taps	commen tap
0		12	consumption(m3/day)	
289		543	no of working	
1		12	no of unmeter	
13		15	no of deflection	
2		0	no of difficult to read	
3		0	no of disconnections	
0		10	new connection	
47		7	house closed	
19		8	no of illegal	
16		35	no of service leake	
3		12	no of main leake	
1190.2		653.1	inflow(m3/day)	before leak repairing
106.1		312	MNF(minimum)	
279.4		564	inflow(m3/day)	after leak repairing
54.5		159	MNF(minimum)	

31

Details of NRW reduction in B1

	Initial consumption	Interim consumption	Initial NRW	Interim NRW
Metered amount(m3/day)	383.1	449.8	40.27	20.08
Estimated amount(m3/day)	7.06	1.03		
Total amount(m3/day)	390.1	450.8		

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Details of NRW reduction in B3

	Initial consumption	Interim consumption	Initial NRW	Interim NRW
Metered amount(m3/day)	179.14		84.20	32.7
Estimated amount(m3/day)	8.9			
Total amount(m3/day)	188.04	188.04		

Note- Interim NRW was calculated based on initial billing data.

33

Accomplishment

- B1 -Initial & interim NRW determined
- B2 -Once initial NRW established then Identified shortcoming to be rectified to determined the final NRW
 - B3 -Initial & interim NRW established

Comparison with Program

- 2009 Commencement of Project Nov. 2009
- Physical Progress 25%

34

Problems Encountered

- Inaccuracy of the current drawings
- Lack of valve location details
- Buried and non function condition of the existing valves
- Difficulty of gaining approval from local authorities (Presently RDA not giving approval to excavate their roads)
- Consumer relation problems
- Old & complicated service Distribution & High Leak System
- Scaling of old Distribution network
- Work with restriction due to Motor Traffic and City Congestion

35

How to Overcome

- Use of modern equipment (used to find buried valves and leaks)
- Regular meeting helps to share the experience, gain new knowledge and change bad attitudes
- Consumer related problems minimized by acknowledging the community about NRW activities
- Initiation of a leak detection and repairs
- Team Work & Commitment
- formation of periodic work program

36

Obtain benefits

- Able to update existing drawings
- Able to implement new re-numbering system to valve network and starting to maintain valve tie-measurements system
- Pressure increasing (in B1, some area's pressure increase from 2m to 6m)
- Encourage an improved service level to consumer
- Helps to minimized billing errors
- Able to include new consumers in to the billing system (By eliminating common taps and giving new connections to surround people)
- Increasing of consumer relationship
- Control of illegal connections, vandalism and misuse of supply
- Distributed more effectively
- Increasing of consumer satisfaction

37

Lesson Learn

It is found that the major reason for the NRW is due to the leaks of the existing pipe network

○ night leak survey is very important

○ rapid engagement to leak repair works is must

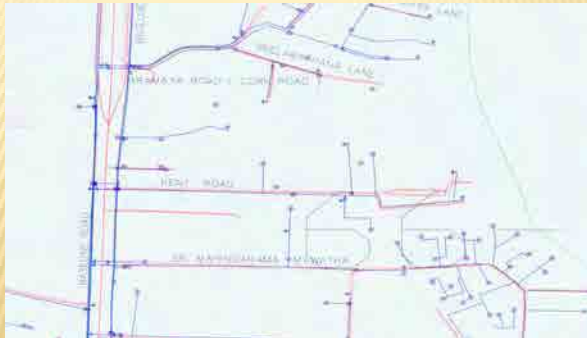
38

Thanks

For attention

39

MAP OF KENT ROAD



1

KENT ROAD

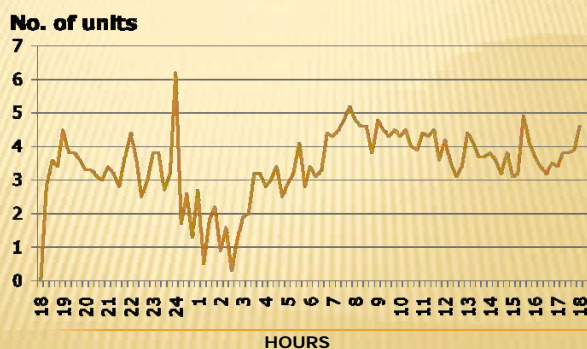
**DEMATAGODA, COLOMBO 10,
SRI LANKA.**

No. of Connection = 228 nos.
Average daily consumption (According to billing) = 158 units /24 hrs
Average daily consumption (According to bulk meter) = 334.5 units /24 hrs
Initial NRW Percentage = $\frac{(334.5-158) \times 100}{334.5}$
= 52.76%

Conducted on 01.09.2010.

2

VARIATION OF FLOW PATTERN THROUGH OUT THE DAY



3

FOLLOWING STRATEGIES WERE APPLIED TO DETECT N.R.W.

- ✗ House to house awareness programme
- ✗ Mid night survey to detect visible leaks
- ✗ Acoustic survey with listening stick
- ✗ Pinpointing survey with electric leak detector
- ✗ Conformation survey with listening stick

4

RECTIFICATION WORKS DONE

- ✗ Fixing of 90mm dia. Bulk water meter at the main
- ✗ 2 nos. of visible main leaks
- ✗ 2 nos. of invisible main leaks
- ✗ Replacing the ball valve at the sump
- ✗ 20 nos. of invisible connection leaks
- ✗ 5 nos. of visible connection leaks
- ✗ Fixing a bulk water meter at water sump of the flat
- ✗ Fixing of water meters at unmetered premises. (4 houses & 2 common taps)

5

AFTER THE ALL RECTIFICATION WORKS

Actual Consumption = 256 units / 24 hr
(According to Bulk meter)
Percentage of Present NRW = $\frac{(256-156)}{256} \times 100 \%$
= 38%

Reduction of NRW/day = $(52.76-38.00)\%$
= 14.76%

No. of units saving per year = $\frac{14.76 \times 256 \times 356}{100}$
= 13,792 units
= 13,792,000 lts.

6

PINPOINTING SURVEY



7



8



9

RECTIFICATION OF SERVICE LINE LEAK.



10



11

REPAIRING MAIN LINE LEAK



12



13

THANK YOU!

14

PROPOSED PILOT AREA

Area Engineer (CCS)

OIC (Pamankada)

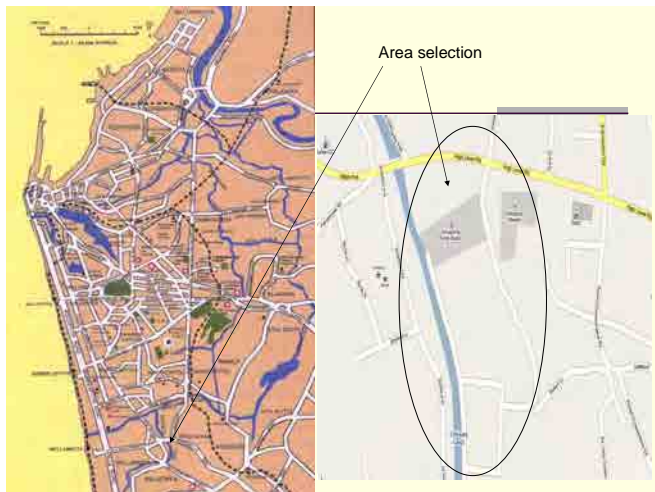
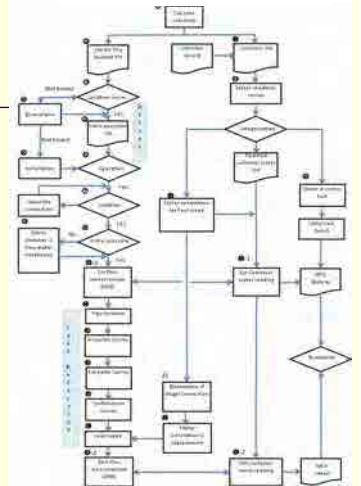
2011-01-24

Selected area

KIRULAPURA PROJECT

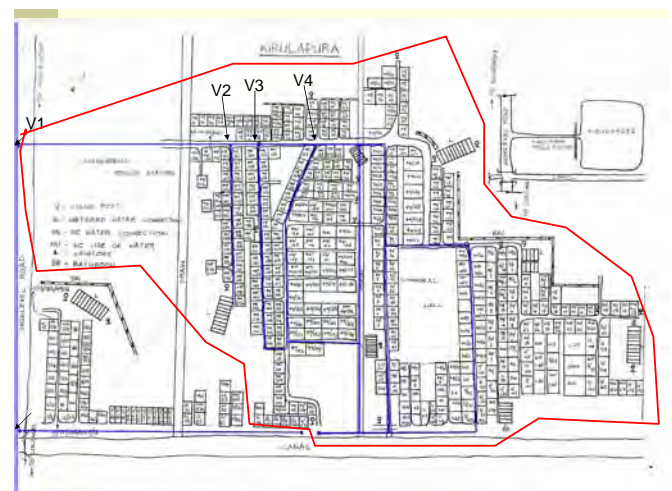
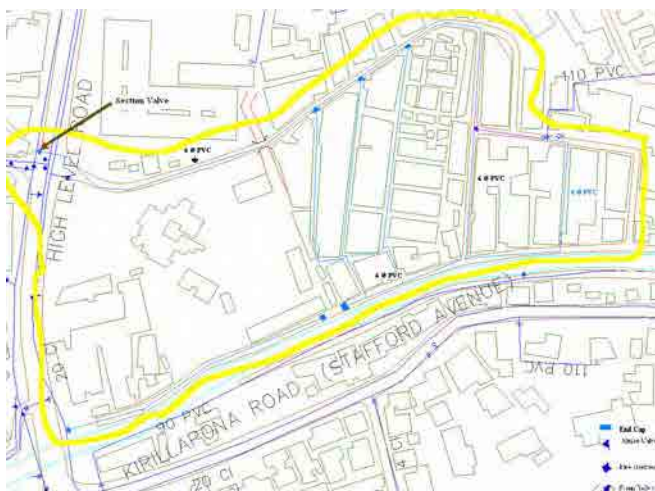
(KUBIKALE)

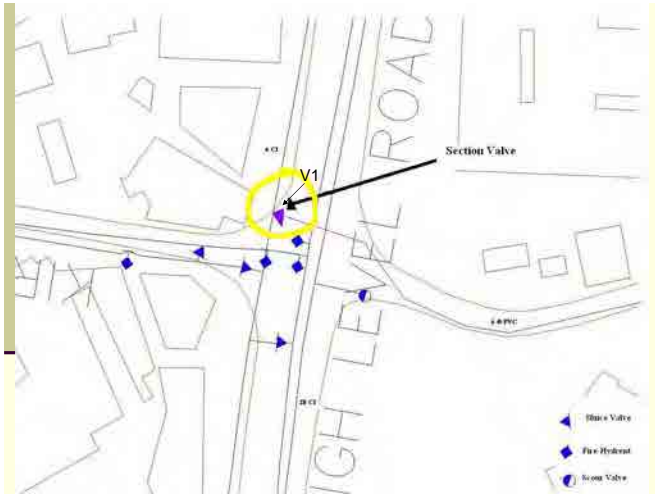
Activities to be done



Reasons for selection of the Pilot Area

- Frequent water failure in the area due to Invisible leak – March 2010.
- High-density area.
- Easy Isolation area.
- To Improve the pressure in distribution system





Valve Data Recording Sheet

Valve condition checking list								Name of Pilot area: Name of Sub zone :		
Mainline										
Date	No.	Location	Pipe material	Location (Grid/Block)	Valve cover (M, No.)	Direction (Clockwise/Anticlockwise)	Capacity (lit. per sec)	Number of meters in the street	Service replacement	Remarks
Main	V1									
	V2									
	V3									
	V4									
	V5									
	V6									
	V7									
	V8									
	V9									
	V10									
Sub	V11									
	V12									
	V13									
	V14									
	V15									
	V16									
	V17									
	V18									
	V19									
	V20									
Total	V21									
	V22									
	V23									
	V24									
	V25									
	V26									
	V27									
	V28									
	V29									
	V30									

MAIN VALVE



Section valve chamber



Meter Point



KIRULAPURA PROJECT

Available data

Based on MIS 2010

Year	2009	2009	2009	2009	2010	2010	2010	2010	2010
Month	September	October	November	December	January	February	March	April	May
Total Connection	536	538	538	538	538	537	539	538	538
Domestic	534	536	536	536	536	535	535	535	535
Nondomestic	2	2	2	2	2	2	4	3	3
Total Consumption	9,736	7,651	9,299	7,628	8,532	9,409	8,480	10,294	10,723
3 month Average	8,955.33	8,845.67	8,895.33	8,192.67	8,486.33	8,523.00	8,807.00	9,394.33	9,832.33
Total Revenue	245,257.65	150,939.17	217,434.39	155,733.50	195,959.55	229,479.64	198,774.50	254,420.33	271,943.80

Some Information's of this area

- | | |
|--|---------------------------------|
| 1. Mean sea level (MSL) of selected area | |
| 2. Average Population | 3500 |
| 3. Religion type | Mixed |
| 4. Land area (App) | 0.5 Km ² |
| 5. Education Level | Medium |
| 6. Income level | Medium |
| 7. Other water resources | One Dug well (Used for bathing) |
| 8. Number of Common tap | 6 (bathing areas and toilets) |
| 9. District Secretarial area | Thimbrigasyaya |
| 10. Urban Council | CMC |
| 11. Police area | Kirulapone |

Kubikale Pilot area Project Progress Report As at 2010-07-08

Number of Inspected	529
Inactive Account	12
Number of Consumers	2497
Number of Taps	1530
Over head Tank	1
Illegal Connection	4
Visible Leak	11
Disconnected	15
House Closed	10

Customer Survey Data**Measurements of Flow and Pressures****Initial Status of the Pilot Area**

Bulk consumption for 24 hrs. (m ³)	456
Bulk consumption for 30 days. (m ³)	13680
Individual consumption (Including common outlets)- (m ³)	11091.33
Therefore Initial NRW (m ³ /month)	2588.67
Initial NRW As a percentage	18.9

Average Pressure (Outlets) - 4m

Visible leaks**Final Status of the Pilot Area**

Bulk consumption for 24 hrs. (m ³)	427.4
Bulk consumption for 30 days. (m ³)	12822
Individual consumption (Including common outlets)-(m ³)	11928.13
Therefore Initial NRW m3 per month	893.87
NRW As a percentage	7



(7) Handout Materials for GIS Training from September 2011 to February 2012

List of Materials

- ①: Introduction to Coordinate System
- ②: Introduction to GPS
- ③: Introduction to GIS
- ④: Introduction to AutoCAD Map
- ⑤: Introduction to GPS (Seminar for Management Level)

① Introduction to Coordinate System

Capacity Development Project for
Non Revenue Water (NRW) Reduction
In Colombo City.

Training program on
GIS Mapping
Introduction to Coordinate Systems

Tharanga Jayamanna
GIS Analyst
JICA Expert Team for
Capacity Development Project for Non Revenue Water (NRW)
Reduction in Colombo City

Co-ordinate Systems

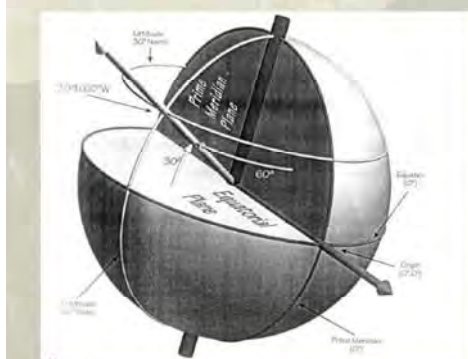
Absolute Co-ordinate Systems:

e.g. Latitude & Longitude

Relative Co-ordinate Systems:

e.g. Local Rectangular Cartesian Co-ordinate System

Latitude & Longitude



Latitude & Longitude



A Better Model for Earth

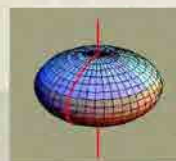
Precision of the measurements taken on the Earth has been increased tremendously. A series of gravity measurements were carried out from 1734-41. It was found that these measurements are not exactly tallying to the spherical model for the earth !

Conclusion: The earth is not an sphere ?

It is more closer to an ellipsoid !

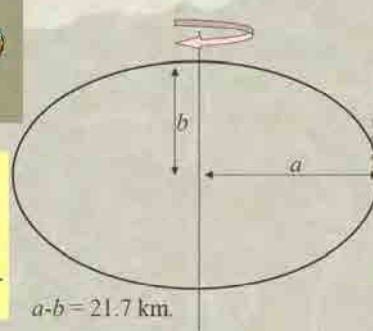


Ellipsoidal Earth



$$f = \frac{a-b}{a}$$

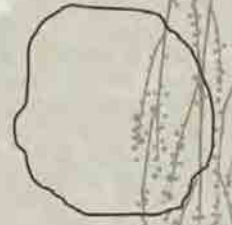
$$e^2 = \frac{a^2 - b^2}{a^2}$$



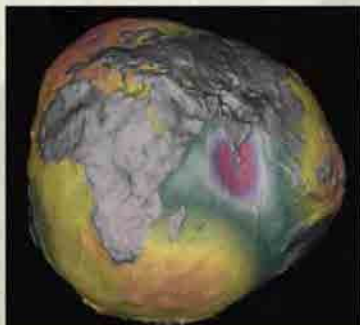
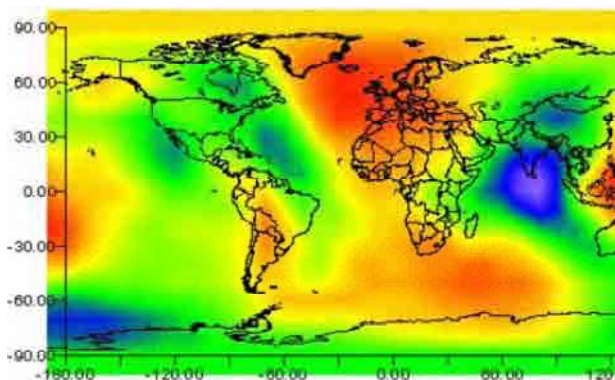
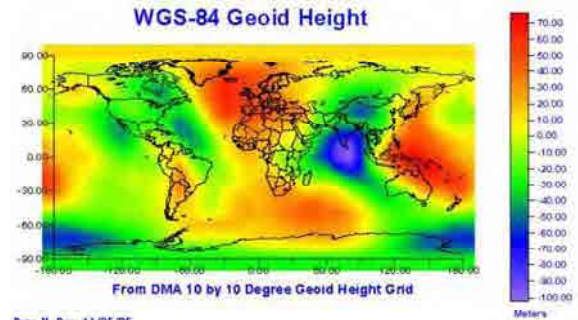
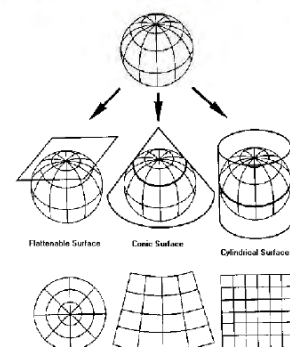
① Introduction to Coordinate System

*Reference Ellipsoid Parameters***WGS84:** $a = 6378137.000 \text{ m.}$ $1/f = 298.25722357$ **Everest:** $a = 6377276.345 \text{ m.}$ $1/f = 300.8017$ *Geoid*

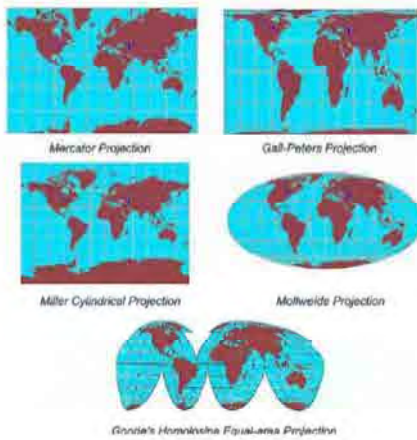
Undisturbed Sea Surface. This is considered as the shape of the Earth. It is defined as the Equipotential surface closely associated with the undisturbed sea surface.



$$V = \sum_{n=0}^{\infty} \frac{1}{r^n} \sum_{m=0}^n (A_{n,m} P_{n,m}(\cos \theta) \cos m\lambda + B_{n,m} P_{n,m}(\cos \theta) \sin m\lambda)$$

*Geoid**Colour Coded to Show Deflection from WGS84***WGS84 UNDULATION****WGS-84 Geoid Height****MAP PROJECTIONS (EXAMPLES)**

① Introduction to Coordinate System



GLOBAL COORDINATE SYSTEMS
UNIVERSAL TRANSVERSE MERCATOR (UTM)

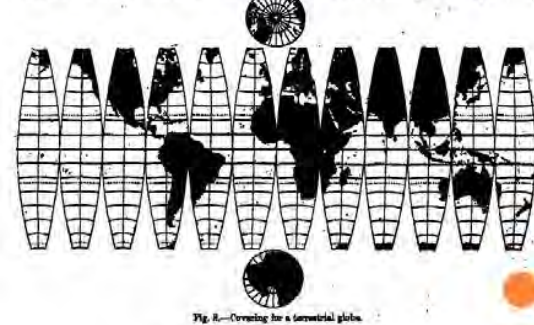
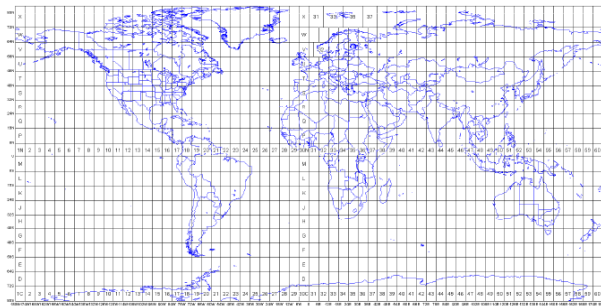
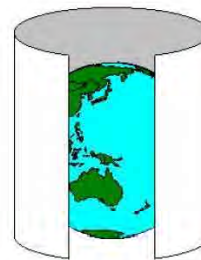


Fig. 8.—Correcting for a terrestrial globe.

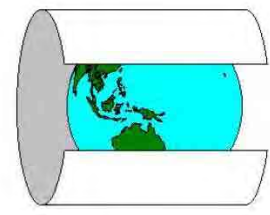


WHAT IS FOR SRI LANKA ?

- Best map projection for Sri Lanka is "Transverse Mercator"



Mercator projection



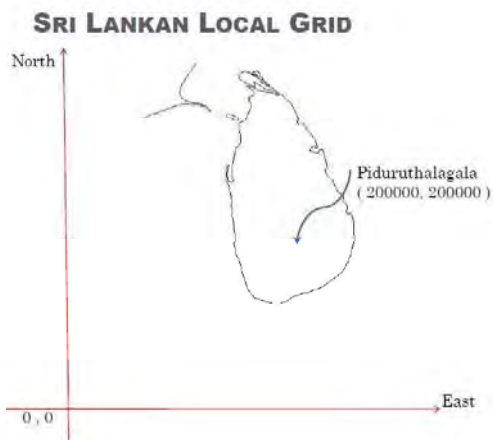
Transverse Mercator projection

MODELING THE EARTH

- Shape of the Earth (Equi-potential surface)
 - Geoid – Undulated shape
 - Modeled as a spheroid (Ellipsoid)
 - World standard spheroid – WGS84
 - Sri Lanka does not coincide with WGS84
 - Spheroid for Sri Lanka – Everest 1830



① Introduction to Coordinate System



**LOCAL COORDINATE SYSTEMS
SRI LANKAN LOCAL GRID**

- Origin at 200,000m west and 200,000m south to Piduruthalagala peak.
- Now we use 500,000 coordinate system as well.

**LOCAL COORDINATE SYSTEM –
PARAMETERS**

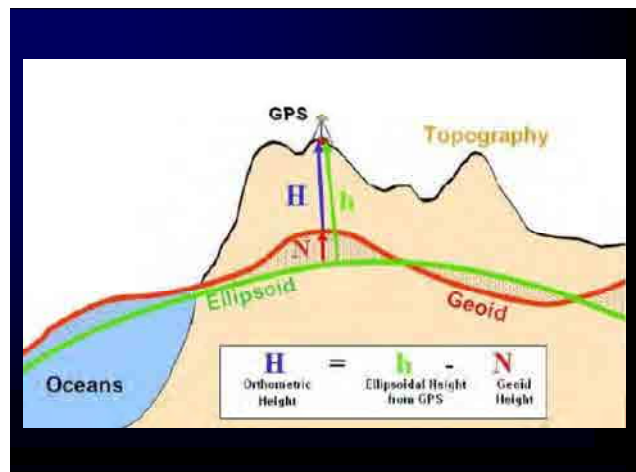
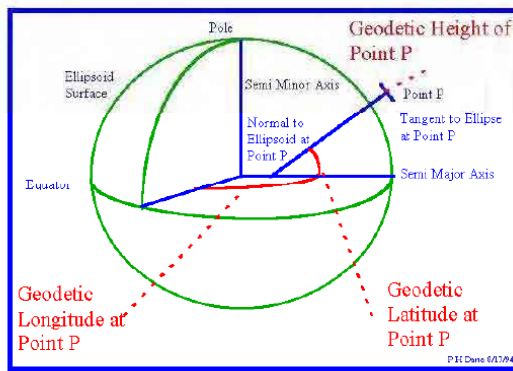
- Latitude of origin
07.00048° N
- Longitude of origin (Central Meridian)
80.77171° E
- Scale Factor
0.999923841
- False Northing
200000m
- False Easting
200000m



COORDINATE SYSTEMS

- Position is 'Relative'.
- "Coordinate Systems" are used to define "Position"
- 3D Space → 3 Parameters
 - Latitude, Longitude, Height (Global coordinates)
 - North coord., East coord., Elevation (Local coordinates)
 - X, Y, Z (Geo-centric coordinates)

GLOBAL COORDINATE SYSTEM



DATUM

- Orienting the suitable ellipsoid to fit in to the focused area is called 'Datum'
- Originally the ellipsoid is kept such that its' center coincides with the earth's center of gravity.
- Then it is moved along x, y and z axes. (3 translation parameters)
- Next it is rotated around x, y and z axes. (3 rotational parameters)
- Finally scale up or down accordingly. (1 scale parameter)
- Altogether 7 parameters are required.
- Datum used for Sri Lanka is called "Kandawala"

WHAT IS GPS

- A satellite based navigation system.
- Developed and owned by DoD – U.S.A.
- A.K.A. NavSTAR (Navigation System using Time And Ranging)
- 3 Segments
 - Space segment – Satellites
 - Control segment – Ground station
 - User segment – GPS receiver

WHY GPS

- Available around the globe
- Provide relatively accurate position data
- User can obtain coordinates without doing calculations and measurements
- Quick response
- Available in 24 / 7
- Can easily integrate with other systems
- Easy to use

DISADVANTAGES

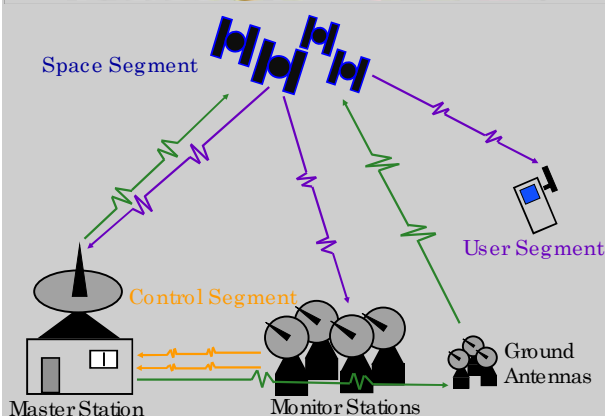
- Depended on U.S.A.
- Need for power source
- Does not work indoors

GPS AND GNSS

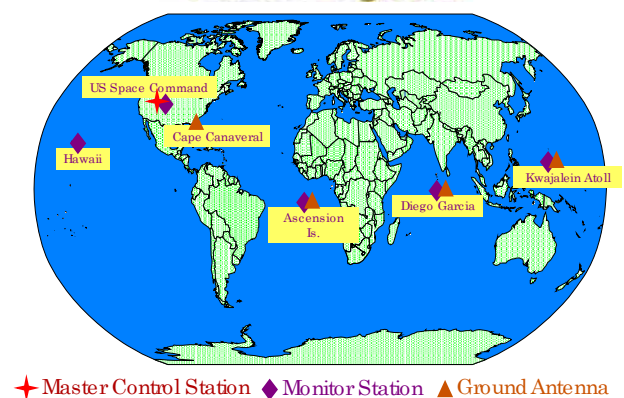
- GPS is a subsystem of GNSS
- GNSS ? – Global Navigation Satellite System
 - GPS (USA) - Global Positioning System
 - GLONASS (Russia) - Global Navigation Satellite System
 - GALILEO (Europe) - European Satellite Navigation system
 - BEIDOU (China) - Beidou Satellite Navigation and Positioning System
 - IRNSS (India) - Indian Regional Navigational Satellite System

How the GPS Works

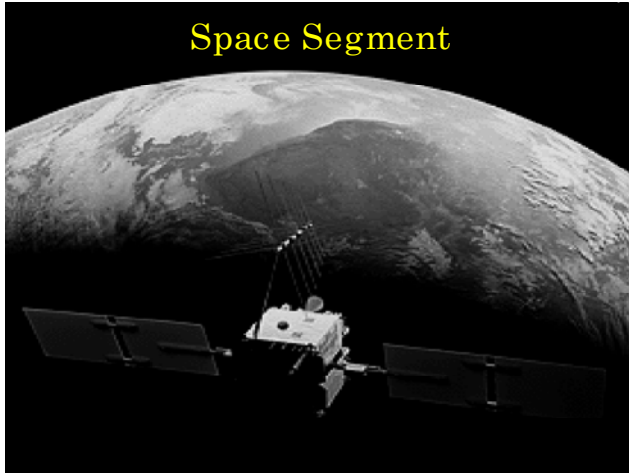
Three Segments of the GPS



Control Segment



Space Segment



MAJOR SEGMENTS - SPACE SEGMENT

- 32 satellites in 6 orbits
It was 24 Satellites, Now 32??
- Approximately 20,000km away
- Emit EM waves (travel at speed of light)
- Go around the earth approximately twice per day
- Have 4 atomic clocks on board

SPACE SEGMENT (CONT...)



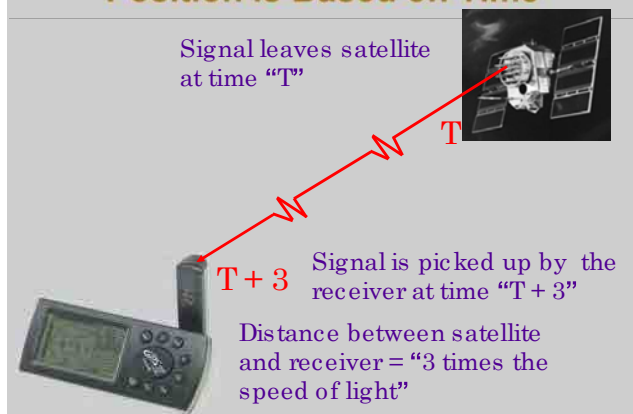
User Segment

- Military.
- Search and rescue.
- Disaster relief.
- Surveying.
- Marine, aeronautical and terrestrial navigation.
- Remote controlled vehicle and robot guidance.
- Satellite positioning and tracking.
- Shipping.
- Geographic Information Systems (GIS).
- Recreation.

Four Primary Functions of GPS

- Position and coordinates.
- The distance and direction between any two waypoints, or a position and a waypoint.
- Travel progress reports.
- Accurate time measurement.

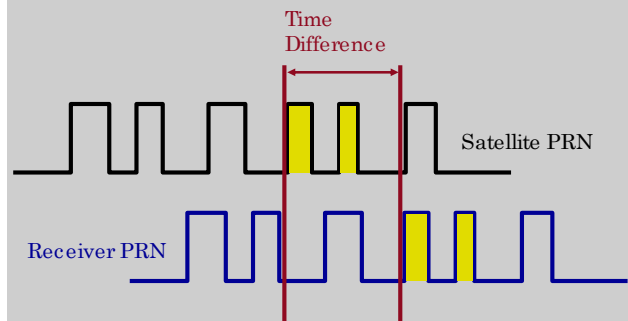
Position is Based on Time



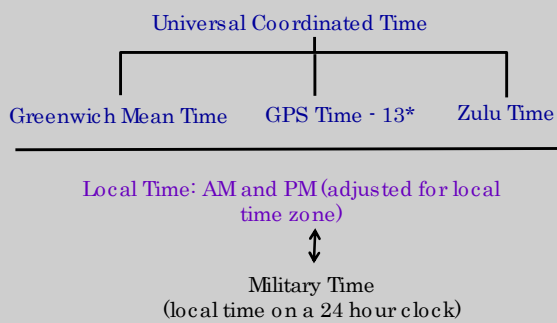
METHODS OF CALCULATING POSITION

- Pseudo Random Noise
- Carrier Phase Calculation

Pseudo Random Noise Code

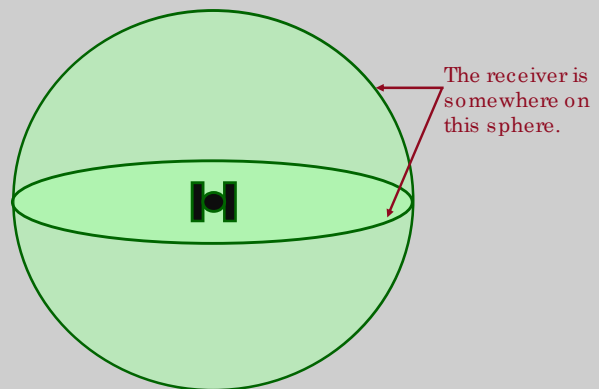


What Time is it Anyway?

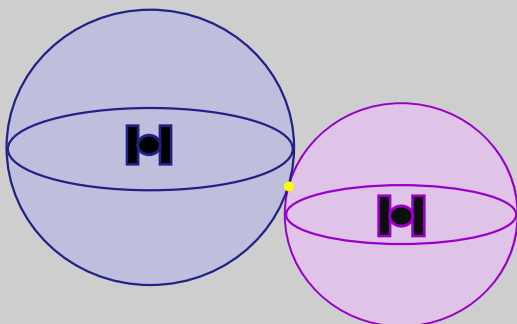


*GPS Time is currently ahead of UTC by 13 seconds.

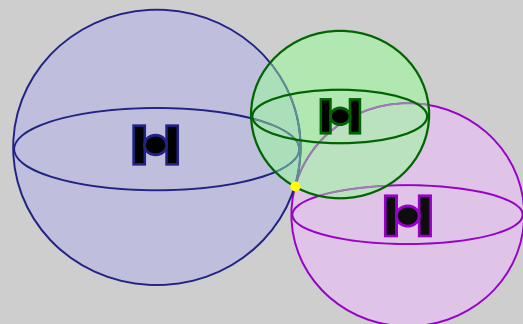
Signal From One Satellite



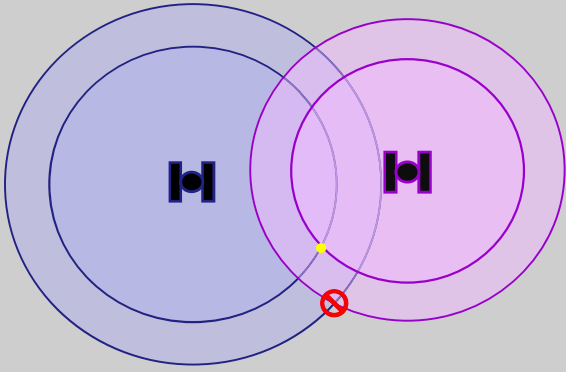
Signals From Two Satellites



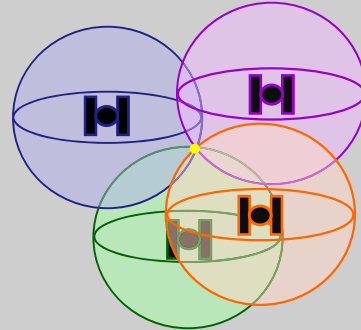
Three Satellites (2D Positioning)



Triangulating Correct Position



Three Dimensional (3D) Positioning



Sources of GPS Error

Standard Positioning Service (SPS): Civilian Users

Source	Amount of Error
> Satellite clocks:	1.5 to 3.6 meters
> Orbital errors:	< 1 meter
> Ionosphere:	5.0 to 7.0 meters
> Troposphere:	0.5 to 0.7 meters
> Receiver noise:	0.3 to 1.5 meters
> Multipath:	0.6 to 1.2 meters
> Selective Availability	(see notes)
> User error:	Up to a kilometer or more

Errors are cumulative and increased by PDOP.

ERROR CORRECTION

• Satellite Based Augmented Systems (SBAS)

- WAAS
- EGNOS
- GAGAN
- MSAS

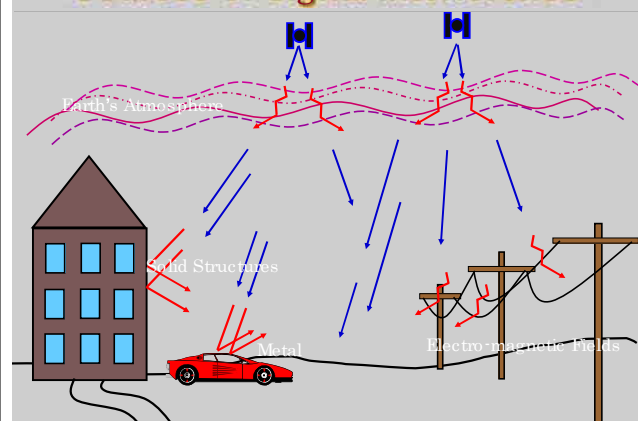
• Differential GPS

- Based station & Rover station
- UHF transmitter at base & receiver at rover
- Up to mm level accuracy

GPS ERRORS

	Standard GPS	Differential GPS
Ionosphere	5.0	0.4
Troposphere	0.5	0.2
Ephemeris	2.5	0
Satellite Clock	1.5	0
Receiver Noise	0.3	0.3
Multipath	0.6	0.6

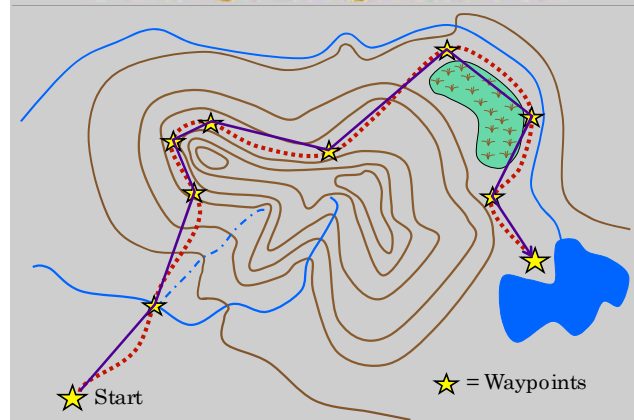
Sources of Signal Interference



Waypoint

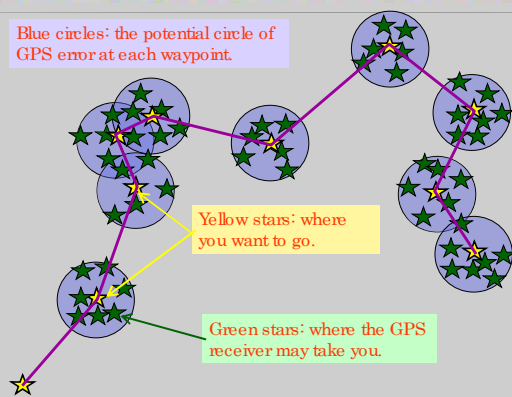
- A waypoint is based on coordinates entered into a GPS receiver's memory.
- It can be either a saved position fix, or user entered coordinates.
- It can be created for any remote point on earth.
- It must have a receiver designated code or number, or a user supplied name.
- Once entered and saved, a waypoint remains unchanged in the receiver's memory until edited or deleted.

Planning a Navigation Route



How A Receiver "Sees" Your Route

Blue circles: the potential circle of GPS error at each waypoint.

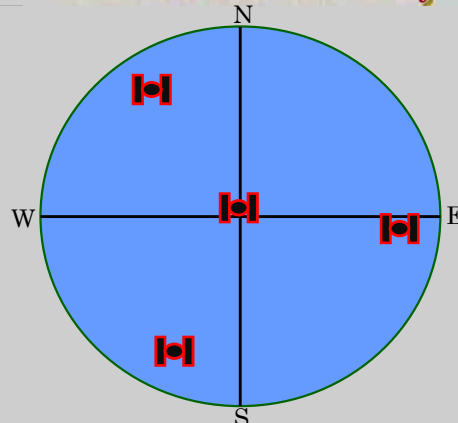


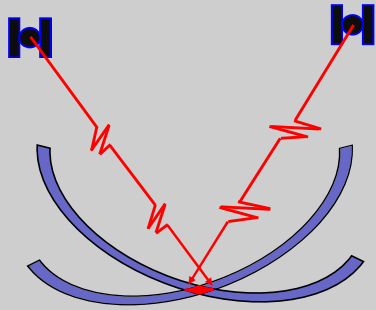
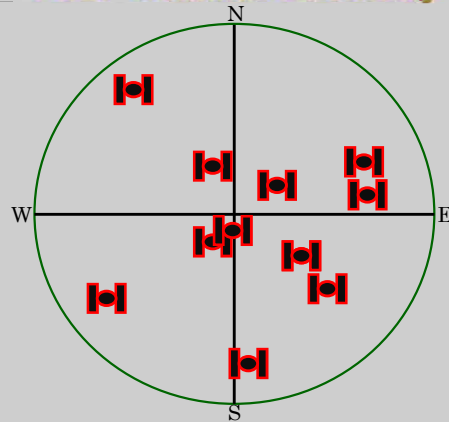
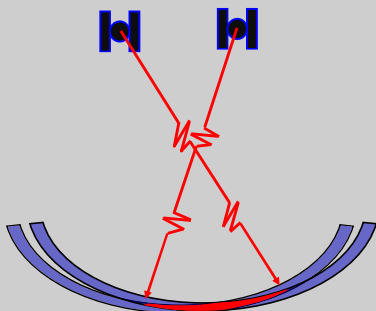
GPS Dilution of Precision and Its Affects On GPS Accuracy

GPS Satellite Geometry

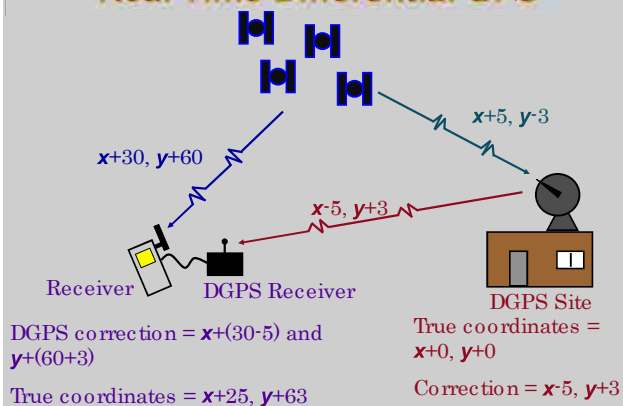
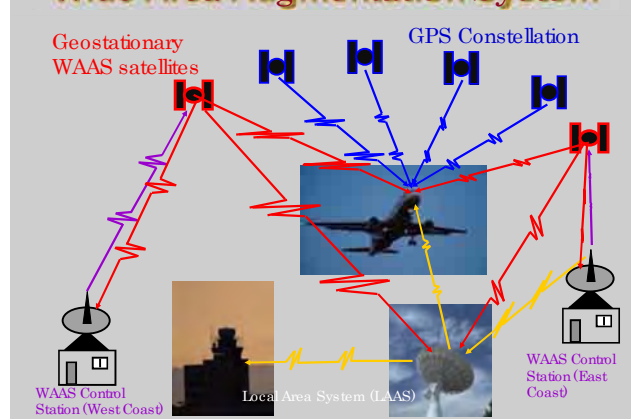
- Satellite geometry can affect the quality of GPS signals and accuracy of receiver trilateration.
- Dilution of Precision (DOP) reflects each satellite's position relative to the other satellites being accessed by a receiver.
- There are five distinct kinds of DOP.
- Position Dilution of Precision (PDOP) is the DOP value used most commonly in GPS to determine the quality of a receiver's position.
- It's usually up to the GPS receiver to pick satellites which provide the best position triangulation.
- More advanced GPS receivers can filter out poor DOP values.

Ideal Satellite Geometry



Good Satellite Geometry**Poor Satellite Geometry****Poor Satellite Geometry****Differential GPS**

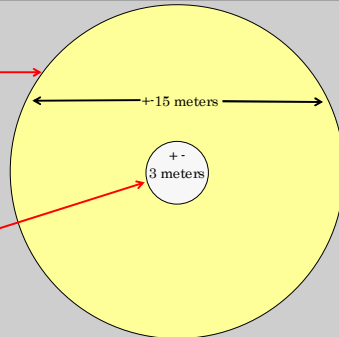
- Realtime
- Post process

Real Time Differential GPS**Wide Area Augmentation System**

How good is WAAS?

With Selective Availability set to zero, and under ideal conditions, a GPS receiver without WAAS can achieve fifteen meter accuracy most of the time.*

Under ideal conditions a WAAS equipped GPS receiver can achieve three meter accuracy 95% of the time.*



* Precision depends on good satellite geometry, open sky view, and no user induced errors.