

添付資料 4.28

2018 年春期研修「Leakage Detection」の教材



In the Name of Allah the Most Beneficent,
the Most Merciful



Current Scenario of Leak Detection at WASA's

By
Zia Mustafa
Water Specialist

April 2018

Course Team



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What are your Training Expectations?

Course: Leakage Detection and Repair-W 7231

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Outline of Presentation

- Basic knowledge of Leak Detection
- Water Network Maintenance and Leakage Detection
- Types and Sounds of Leakage
- Factors causing Leakages
- Existing Situation of Five WASA's for Leakage Control
- House Connection Assembly

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Basic Knowledge of Leakage Detection

Day 1

- Current Scenario of Leak Detection
- Countermeasures for Leakage Control
- Leakage Survey Equipment
- Repairing of Burst Pipeline
- Illegal Connections
- Case Study

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Water Network Maintenance & Leakage Detection (OJT)

Day 2

- On Site Leakage Detection
 - Acoustic Leak Detector
 - Acoustic Bar
 - Non Metal Pipe Locater
- Visit of Leakage Repairing Site (Green Town, WASA Sub Division)

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Installation & Operation of Leakage Detection Equipment (OJT)

Day 3

- Equipment Installation & Operation
 - Metal Pipe Locator
 - Ultrasonic Flow Meter
 - Pressure Recorder

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Site Visit and Leak Detection Action Plan

Day 4

- Preparation of Leak Detection Action Plan by Training Participants

Learning Outcomes

- Build Basic Knowledge of Leak Detection through use of the Leakage Detection Equipment
- Understand Installation and Operation of Equipment(Pressure Recorder, Ultrasonic Flowmeter etc.)
- Develop Leak Detection Action Plan

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Current Scenario of Leakage Detection

- Introduction to Leakage
- Types and Sounds of Leaks
- Factors Causing Pipe Leakages
- Situational Analysis of Leakage Detection in Five WASAs



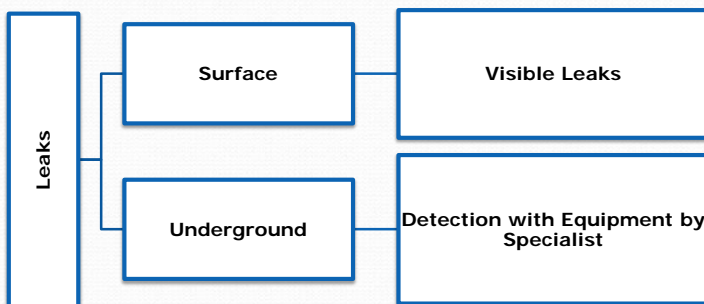
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Water Balance

System Input Volume	Authorised Consumption	Billed Authorised Consumption	Billed Metered Consumption	Revenue Water	
			Billed Unmetered Consumption		
	Water Losses	Unbilled Authorised Consumption		Unbilled Metered Consumption	Non- Revenue Water (NRW)
				Unbilled Unmetered Consumption (e.g. flat rates not billed)	
		Commercial (Apparent Losses)		Unauthorised Consumption (e.g. illegal connections)	
				Metering Inaccuracies	
		Physical (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 use				

Types & Sounds of Leakage



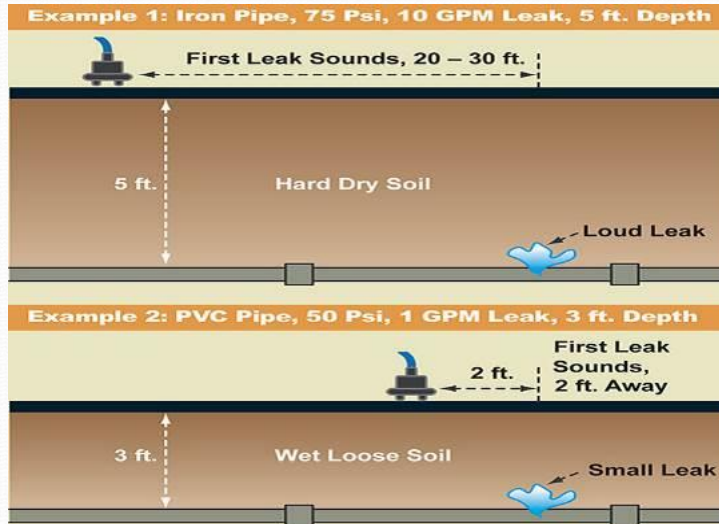
Leak Sound Depending on:

- Pipe Diameter
- Material
- Kind of Joints
- Leakage Flow
- Depth
- Soil Density

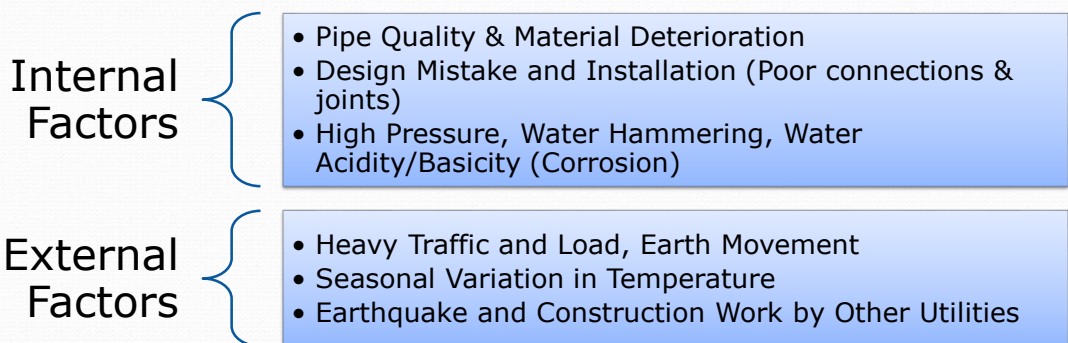
False Leak Sound:

- Water Flow Sound
- Sewage Flow into Manhole
- Breeze Sound
- Driving Vehicles Sound
- Urban Noise

Types & Sounds of Leakage



Factors Causing Leakage



Existing Situation of Five WASA's for Leakage Control

Items	Lahore	Faisalabad	Gujranwala	Multan	Rawalpindi
No. of leakage survey teams	52	2	0	9	15
No. of person in one team	3	8	0	4	2-3
No. of days of leakage survey (person*days/year)	62	8*150=1200	0	4*1=4	Every day
No. of hours of leakage survey (person*hours/month)	9.6	8*250=2000	0	24	Office hour
Length of leakage survey (km/year)	9.1	750	0	0	300
No. of surface leakage detection (number/year)	2700	68	0	576	640
No. of underground leakage detection (number/year)	300	427	0	2880	Nil
How to detect underground leakage	Manual detect	Helium gas	Manual detect	Manual detect	N/A

(Source: JICA Quarterly Report, January 2016)

Module 1: Basic Knowledge of Leakage Detection

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Existing Situation of Five WASA's for Leakage Control

Items	Lahore	Faisalabad	Gujranwala	Multan	Rawalpindi
No. of repairing leakage	3,000	672	1,137	3,456	Nil
No. of leakage per kilometer of distribution pipeline	0.389	0.456	3.056	3.294	0.556
No. of leakage report from citizens	2,950	1,737	1,137	3,110	225
Done the Minimum Flow Measurement	N/A	Yes	N/A	N/A	N/A
Equipment : Acoustic Rod	0	0	0	0	0
Equipment : Correlative leak detector	0	0	0	0	0
Equipment : Leak noise correlator	1	5	0	0	0

(Source: JICA Quarterly Report, January 2016)

Module 1: Basic Knowledge of Leakage Detection

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Existing Situation of Five WASA's for Leakage Control

Items	Lahore	Faisalabad	Gujranwal a	Multan	Rawalpindi
Equipment : Metal Pipe Locator	1	0	0	0	0
Equipment : Non-Metal Pipe Locator	0	0	0	0	0
Equipment : Other Leakage Detector	0	Helium gas	0	0	0
Metering Ratio (%)	1	18	0	0	0
NRW (%)	41	32.9	35	22	31
Mapping System / DMA	(GIS/DMA)	Yes(Mapping/DMA)	Yes (Mapping)	Mapping	(GIS)

(Source: JICA Quarterly Report, January 2016)

Module 1: Basic Knowledge of Leakage Detection

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Leak Detection Equipment (JICA)

Equipment	Lahore	Faisalabad	Gujranwala	Multan	Rawalpindi
Metal Pipe Locator	1	1	1	1	1
Non-Metal Pipe Locator	1	1	1	1	1
Acoustic Leak Detector	1	1	1	1	1
Acoustic Bar	1	1	1	1	1
Ultrasonic Flow Meter	1	1	1	1	1
Pressure Recorder	1	1	1	1	1
Metal Detector	1	1	1	1	1

Module 1: Basic Knowledge of Leakage Detection

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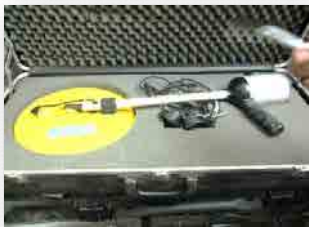
Leak Detection Equipment at WASA Lahore



Old Type Leak Correlator



Acoustic Leak Detector



Metal Pipe Locator



Electromagnetic Flow Meter

Leak Detection Equipment at WASA Faisalabad



Helium Gas Leak Detector



Acoustic Leak Detector



Leak Detector



Metal Detector

Installed Pipe Network by Material & Length

Pipe Material	Faisalabad	Gujranwala	Lahore	Multan	Rawalpindi
Cast Iron Pipe (CI), km	4		449	38	4
Asbestos Cement Pipe (ACP), km	1,200	209	3,567	1,176	225
Polyvinyl Chloride (PVC), km	8	241	254	62	116
High Density Polyethylene (HDPE), km	7	-	802	10	186
Concrete (Hume) Pipe, km	-	16	-		14
Ductile Iron Pipe (DIP), km	-	-	326		4
Steel Pipe, km	-	-	-		35
Galvanized Iron (GI) pipe, km	-	29	-	162	29
Total	1,219	495	5,398	1,149	613

Module 1: Basic Knowledge of Leakage Detection

(Source: JICA Quarterly Report, January 2016) 23

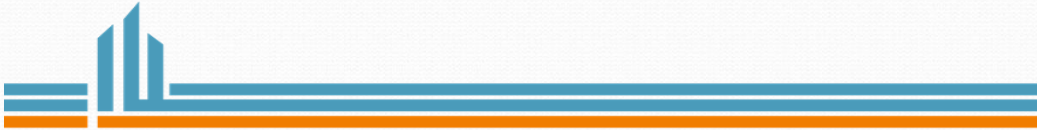
Components of House Connection Assembly

- Clamp
- Rubber Pad
- Ferrule
- Elbo
- Union
- Non Return Valve
- Pipe (HDPE/GI)



Joining Procedure of House Connection

- Adjust the clamp over the main water supply line
- Install Elbo and Union
- Install Non Return Valve between main water supply line and house connection pipe
- Connecting the house connection pipe to the fittings



House Connection Assembly at WASA Lahore

- Clamp Adjustment on HDPE Pipe for House Connection



House Connection Assembly at Multan

- Clamp Adjustment on AC Pipe for House Connection

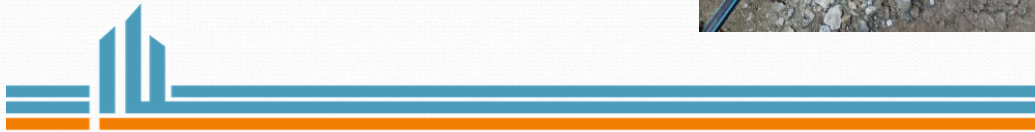


House Connection Assembly at Faisalabad

- HDPE Clamp adjustment on AC pipe



House Connection Assembly at Rawalpindi



Contact Information

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the Most Merciful

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ALJAZARI
— ACADEMY —

Counter Measures for Leakage Control

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April 2018

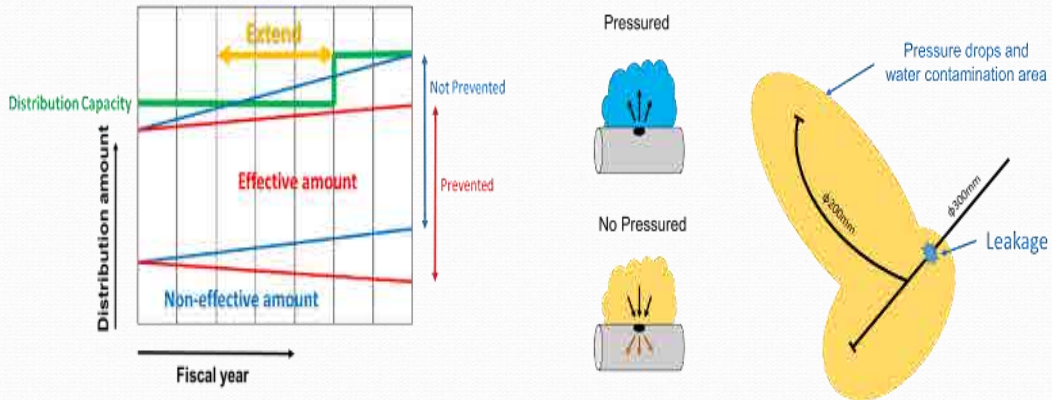
Outline of Presentation

- Leakage Survey Methods
- Water Quality Based Leakage Detection
- Leakage Prevention Work

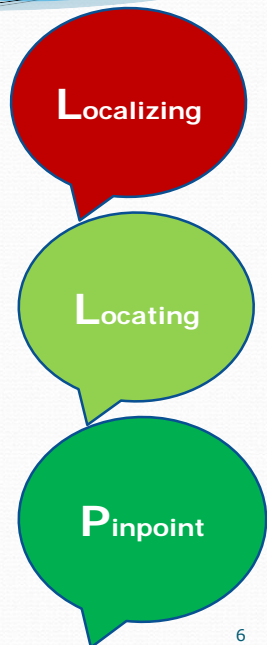
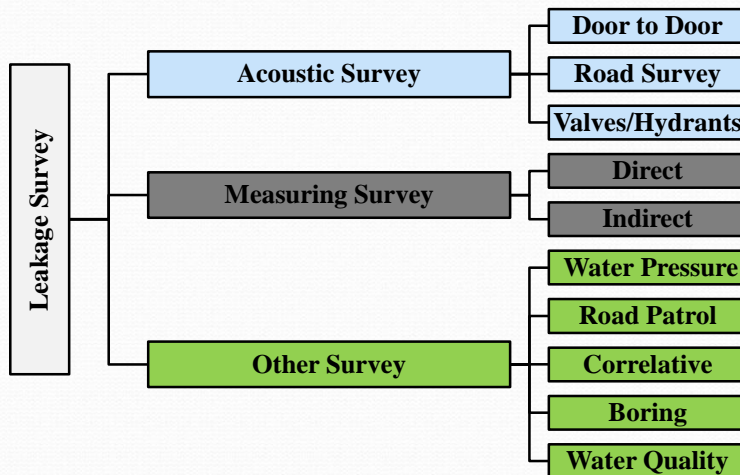
Objectives of Leakage Control

- To Maximize Utilization of Limited Water Resources
- To Maintain Water Pressure in the Network
- To Prevent Water Contamination
- To Prevent Potential Accidents Leading to Leakage

Importance of Leakage Prevention Work



Leakage Survey Methods



Acoustic Survey

Detection from Valves



Detection from Water Meter



Acoustic Survey with Leak Detector



Module 1: Basic Knowledge of Leakage Detection

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Measuring Survey

- A Service Area (Block) is Isolated by Closing the Valves
- Water can be supplied temporarily by Pipe or with a Hose connected with Fire Hydrant
- Water Lost due to Leakage in Area is Determined by Using Electromagnetic or Ultrasonic Flowmeter
- Minimum Flow is Recorded at Midnight with Continuous Supply of Water
- Process is Repeated Several Times to Find Accurate Leakage Flow Value

Module 1: Basic Knowledge of Leakage Detection

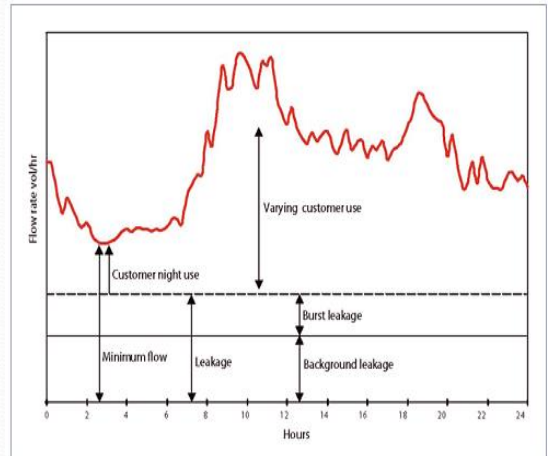
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Measuring Survey

1. Minimum Night Flow or Bottom-Up Approach

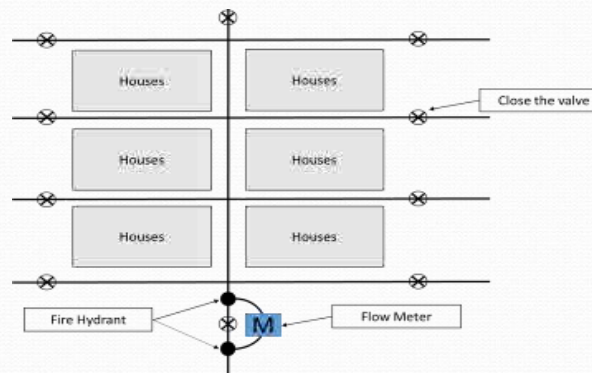
[Net Night Flow] = [Minimum Night Flow] - [Minimum Night Consumption]

- Customer Demand is Minimum at Night, Water Operators have to account for the Minimum Night Consumption (MNC), i.e. the Night-time Customer Demand, such as Toilet Flushing, Washing Machines, etc.



Measuring Survey

- In a system with 100% Metering, MNC is calculated by Measuring the Hourly Night Flow for all Non-Domestic Demand and a portion (e.g. 10%) of Domestic Meters within the DMA
- Measured Directly from the Data Logging Devices or the Flow Graph



Measuring Survey

2. Integrated or Top Down Approach

Leakage = Distribution Input – Consumption

- Leakage is the remaining amount of the Annual Water Balance
- Consistent Approach is used to Estimate Leakage using this Method

Distribution Volume Analysis (WASA Faisalabad)

System Input Volume 93.5 MGD	Authorized Consumption 62.7 MGD	Billed Authorized Consumption 61.7 MGD	Billed Metered Consumption (including water exported)	0%	Revenue Water 64.6%
			Billed Non-metered Consumption	64.6%	
		Unbilled Authorized Consumption 0.94 MGD	Unbilled Metered Consumption	0%	Non- Revenue Water (NRW) 35.4%
			Unbilled Non-metered Consumption	1.5%	
	Water Losses 30.8 MGD	Apparent Losses 14.76 MGD	Unauthorized Consumption	13%	
			Metering Inaccuracies	1%	
		Real Losses 16.1 MGD	Leakage on Transmission and/or Distribution Mains	5%	
			Leakage and Overflows at Utilities Storage Tanks	0.2%	
		Leakage on Service Connections up to Customers' Meters	14.7%		
				Total	93.5 MGD/100 %

Index of International Water Association (IWA)

$$ILI = CAPL/MAAPL$$

- ILI = Infrastructure Leakage Index
- CAPL (liters/day): Current Annual Volume of Physical Losses
- MAAPL (liters/day): Minimum Achievable Annual Physical Losses

- MAAPL (liters/day) = $(18 \times L_m + 0.8 \times N_c + 25 \times L_p) \times P$
 - MAAPL (liters/day): Minimum Achievable Annual Physical Losses
 - L_m : mains length (km)
 - N_c : number of service connections
 - L_p : total length of private pipe, property boundary to customer meter (km)
 - P : average pressure (m)

Infrastructure Leakage Index (ILI)

Ratio of the CAPL to MAAPL, or the ILI, is a Measure of How Well the Utility Implements the three Infrastructure Management Functions:

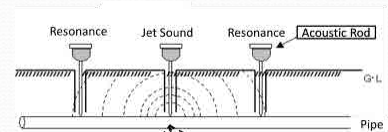
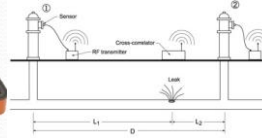
- Repairs
- Pipelines and Asset Management
- Active leakage control

- ILI is particularly useful in networks where NRW is relatively low, below 20%.



Other Survey

- Water Pressure Recording Survey
- Road Surface Survey
- Correlative Survey
 - Leak sound correlator installed at two points
 - at divide valve and fire hydrant - between a stop valve and a meter.
 - Leaks are detected by moving the device point to point above the pipeline
- Boring Survey
 - Leak point detection is easy by the use of bore survey in combination with Acoustic Rod
- Residual Chlorine Based Survey



-Inject sample water & switched on "ZERO"

-Inject A&B, drop by drop

-Inject sample water 2mL by syringe

-"READ" switched on

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Module 1: Basic Knowledge of Leakage Detection

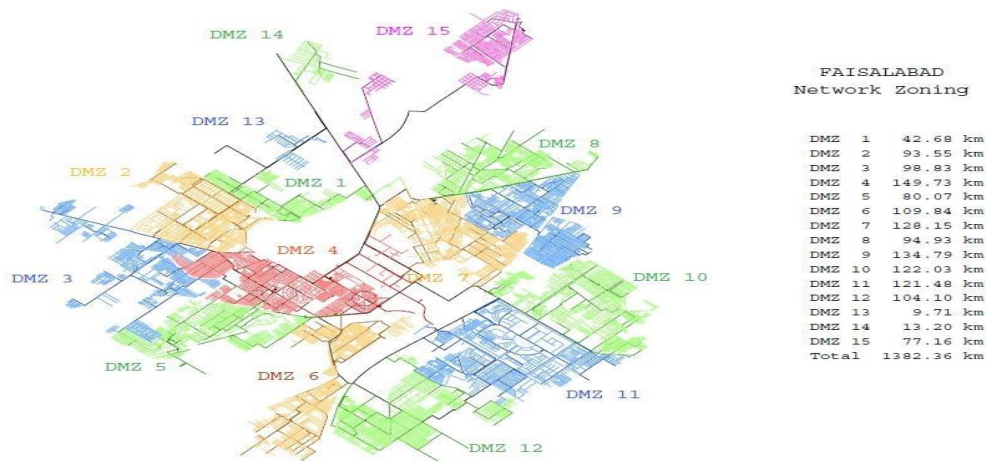
District Metered Area (DMA)

- Water Network Area is divided into Zones to Minimize Physical Losses
- Zones can be Further sub divided into a series of small sub-systems to make easy for losses calculation, often referred to as District Metered Areas (DMAs)
- Each DMA should be hydraulically isolated to calculate volume of water lost within that area
- Purpose of this Division is:
 - To Reduce NRW,
 - Minimize the Water Quality Problems, and
 - To Sustain Water Pressure in the lines to Supply Uniform Quantity of Water

Module 1: Basic Knowledge of Leakage Detection

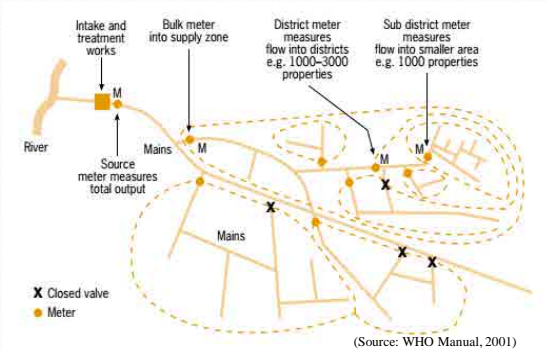
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District Metered Area Zones



DMA Establishment

- Size of DMA (Number of Connections - Generally Between 1,000 and 3,000)
- Number of Valves that must be closed to isolate the DMA – should be kept to a minimum – Natural Boundaries should be used wherever possible to Reduce Cost
- Topographic Features that can serve as Boundaries for the DMA, such as Rivers, Drainage Channels, Railroads, Highways, etc.
- Number of Flow Meters to measure Inflows and Outflows, Minimum Meters Required
- Flat Area Selection, more easy to Control Pressure Fluctuation
- Ensure all Pipes within and out of the DMA are either Closed or Metered



Water Quality Based Leakage Detection

- Residual Chlorine
- PH judgment
- Conductivity Based Judgment

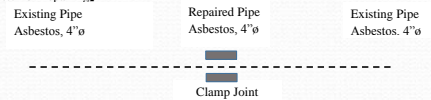
Water Source	pH value	Conductivity ($\mu\text{s}/\text{cm}$)
Drinking water	Approx. 6.7~7.5	Approx. 100~300
Rain water	Under 6.0	Approx. 40~90
Groundwater	Approx. 6.4~7.5	Approx. 300~1000
Sewage	Over 7.0 (High)	Over 500 (High)

Site Record Sheet



Date and Time	10:50 am; 11 February, 2016
Address	Civic Centre Near Cine Star Cinema
Person in charge	Mr. Shamas Ayoub Gujjar – SDO Green Town
Organization of repairing team	Pipe fitter x 1, Helper x 2
Diameter(mm)	4"
Material and Kind of Joint	Asbestos, wooden cork inserted into the hole and metal clamp along-with water proof sponge was used
Age (installation year)	45
Shape of leak point	Hole of 0.5" diameter
Pressure (kg/m ²)	Low
Depth(m)	4.5'
Soil around the pipe	Rough soil and garbage
Traffic density	Medium
Supply Hour	14
Cause of the leak	
Quantity of leak (m ³ /min)	
Time of Repairing (Hour)	3

[Sketch of Repairing]



[Picture of Repairing]

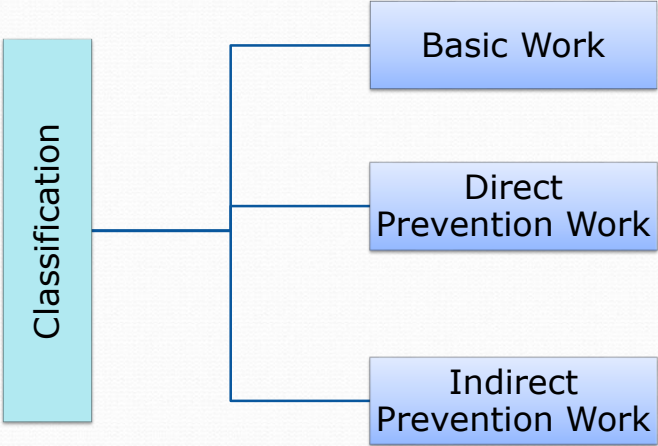


Location on the Map

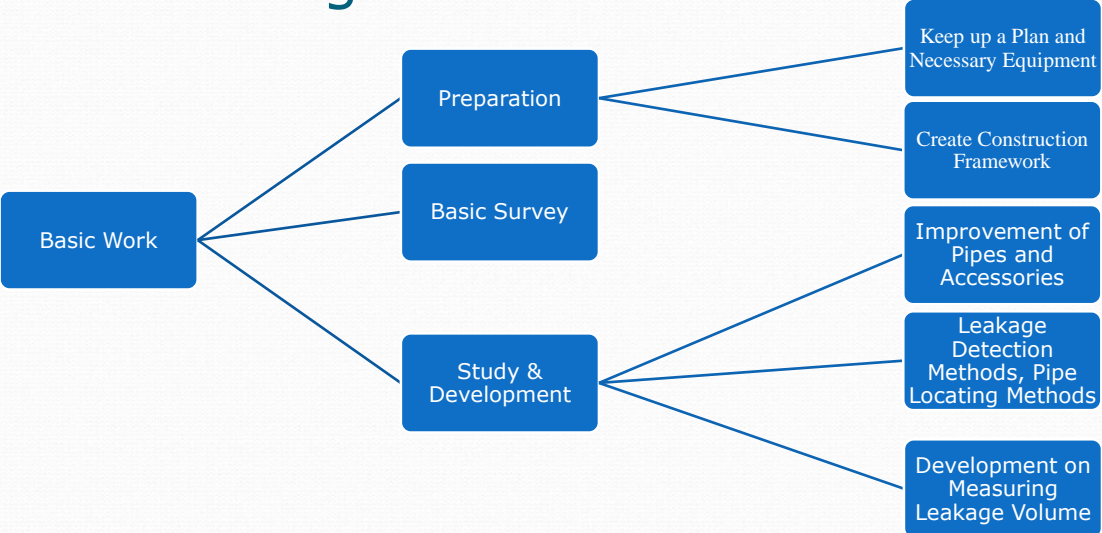
Coordinates: 31.450828 N, 74.310791 E



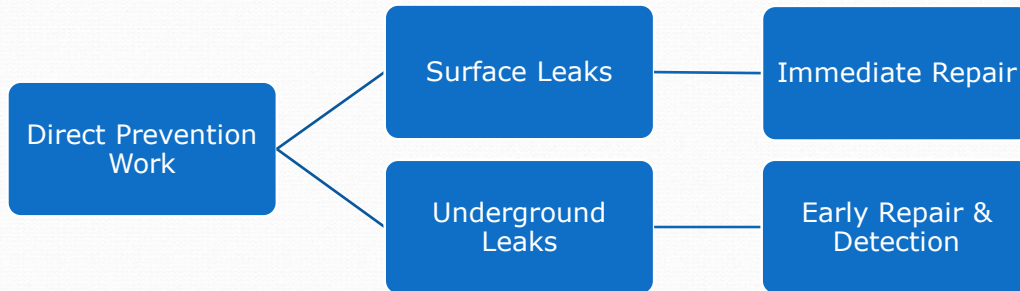
Leakage Prevention Work



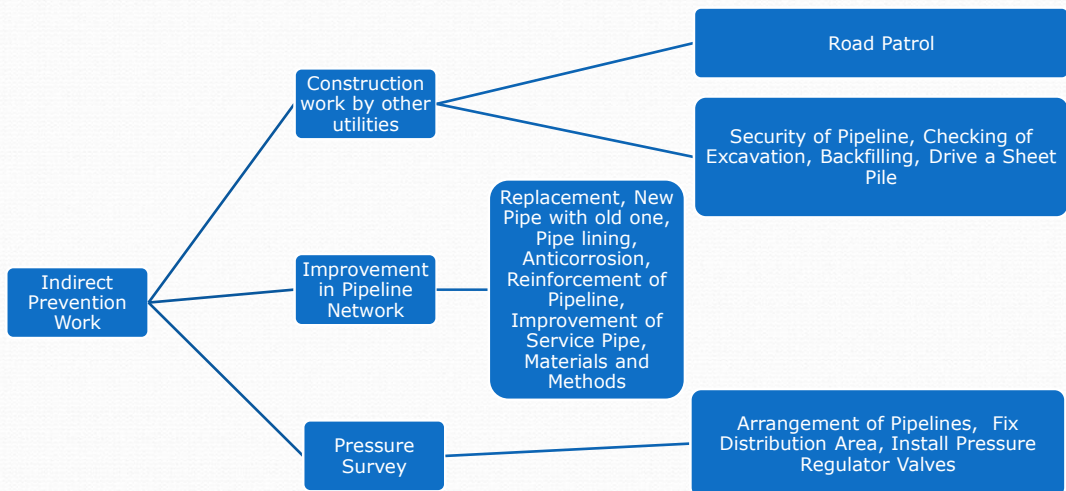
Leakage Prevention Work



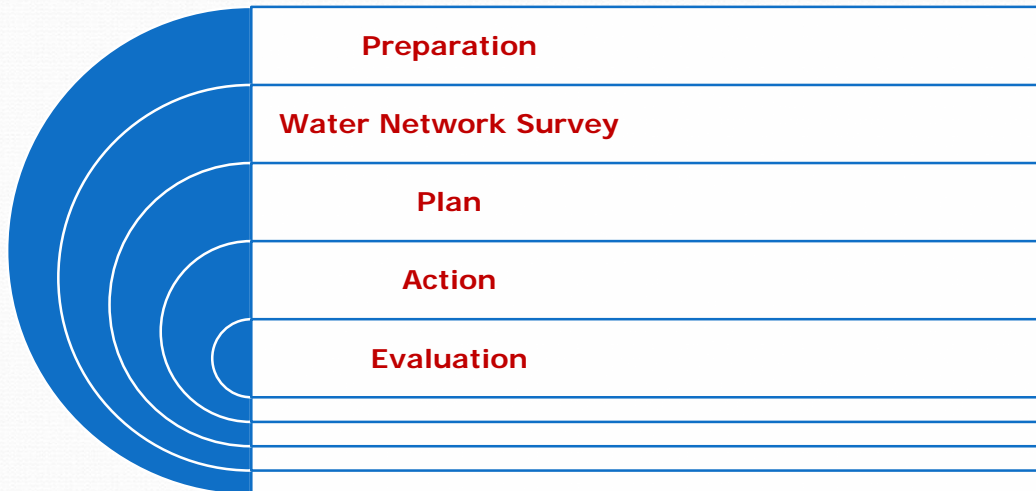
Leakage Prevention Work



Leakage Prevention Work



Leakage Prevention Procedure



Procedure For Leakage Prevention

- **Preparation**
 - Establishment of Leakage Detection Cell and Team
 - Procurement of Equipment
 - Preparation of Maps for Water Distribution
- **Water Network Survey**
 - Distribution Analysis and Analysis of Water Volume Error
 - Analysis and Distribution of Groundwater, Cause of Leakage Volume

Leakage Prevention Procedure

- Plan
 - Set the Target Value
 - Set the Planning Year
 - Decide the Survey Method
- Action
 - Leakage Survey
 - Analysis of Cause of Leakage
 - Measuring of Prevention Volume
 - Preventive Work
 - Countermeasures of Leakage
- Evaluation
 - Analysis of Results
 - Compare the Plan and Action

Contact Information

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In the Name of Allah the Most Beneficent,
the Most Merciful

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Leakage Survey Equipment

By
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April 2018

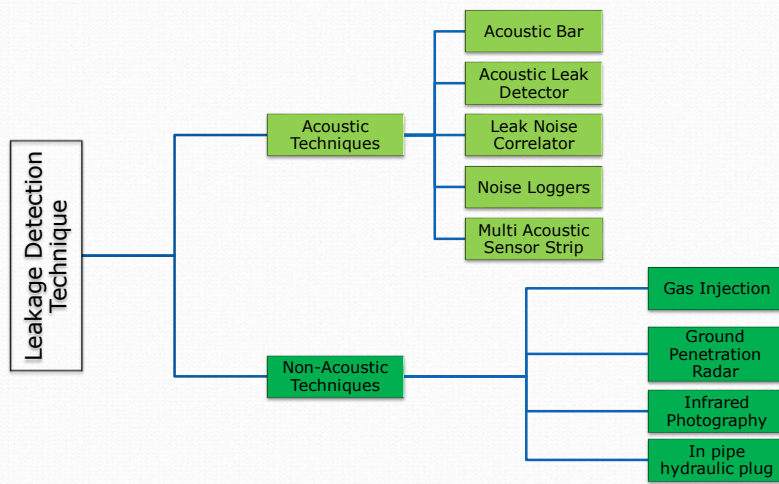
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Outline of Presentation

- Leakage Detection Techniques
- Working Principle of Leakage Detection
- Types of Leak Detector

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Leakage Detection Techniques

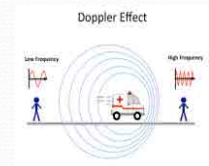
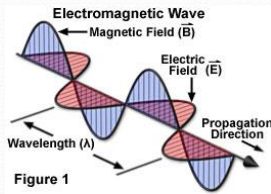
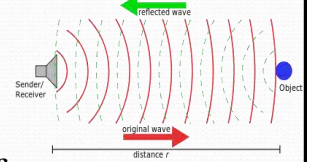


Module 1: Basic Knowledge of Leakage Detection

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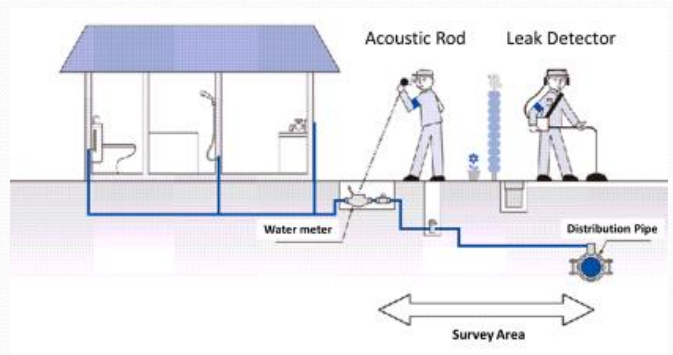
Working Principle of Leakage Detection

- Based on Multiple Scientific Information
- Vibrations and Noise caused by the leak & Electromagnetism Contributing in Amplifying Sound Effects



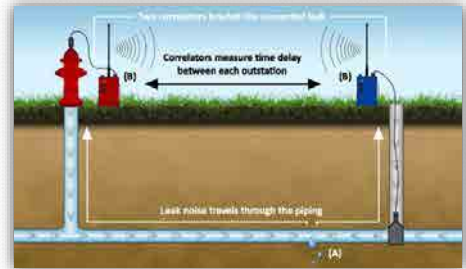
Acoustic Rod & Electronic Leak Detector

- Sound is Amplified and Transmitted to Headphones
- High Sound on Leak Point



Leak Correlator

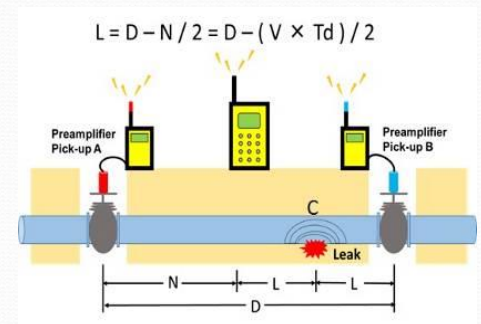
- Water Leakage in Pipelines Produce Noise
- Noise Travels by Two Routes:
 - Travels through the ground to the surface
 - Travels through wall of the pipe & water
- Correlator Detects noise sound transmitted in the wall of the Pipe and Water
- Pipe Fittings, Flow Meters, Valves & Hydrants are used as Access Points
- Leak Position is pinpointed by selecting two approximate location around the leak



Leak Correlator

Leak sound is transmitted through the pipe to either side of leakage. At randomly selected points on both sides of the leak, it shows "noise travel time difference or time delay" due to difference in distance from the leak, represented by "Td"

- When this time delay (Td) is multiplied by the sound velocity (V) through the pipeline, the distance (N) between points A and C is calculated
- Subtracted "N" from the distance (D) between A and B, and divided by 2 to determine the distance (L) to the leak point



Acoustic Rod/Bar

Specification				
Type	Cap dia.* Thickness (mm)	Total Length (mm)	Dia. of Iron Bar (mm)	Material
LSP-1	ø 67x29	1,013	7	Stainless Steel

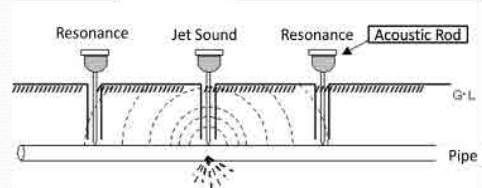


Use:

- Place the tip of Acoustic Rod at the point where doubt of leakage is evident
- Catch the stick below the listening cap and place ear on the cap of acoustic rod
- Hear the sound of leaked water, if no leakage at that place repeat the same procedure aside this place
- Very useful to listen leaks sound at hydrants and valves

Factors Affecting Performance:

- Pressure
- Depth



Leak Detector

Operation:

- Use head phones remembering Left and Right direction
- Turn volume up to half using the dial on the headphone cable
- Ensure good contact of microphone and surface area
- Press and hold silver button to listen sound
- With every press and release of the silver button, the noise level will be recorded in the memory
- To see memory data for the last eight soundings, press and hold the pink "M" button on the amplifier
- To turn filter on, press and hold the green + & - filter buttons simultaneously. The filter bandwidth is +/- 100Hz



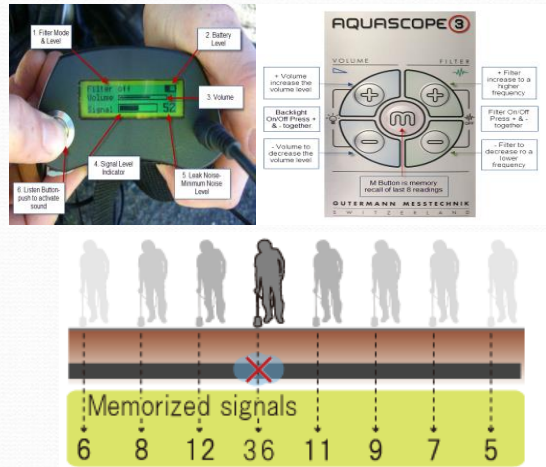
Components:

- Amplifier with waist belt
- Hand probe microphone
- Ground microphone plate
- Probe rods
- Stereo headphones
- Connecting cable



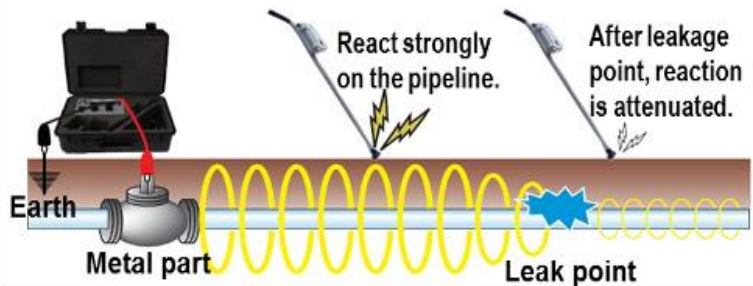
Leak Detector Important Points & Precautions

- Use filter in case of high background noises
- Leakage sound depends upon,
 - Water pressure
 - Crack or hole size
- Operator should stay stable during its use
- Required practice to pinpoint or identify leaks.
- Don't use in rainy days
- Sensors are water resistant, but control unit and head phones are not resistive, Keep them away from water



Non-Metal Pipe Locator

- Works on electrical insulation properties of the non-metal pipes
- Does not require "leak noise"
- Pass a high frequency electromagnetic waves through the "water" in the pipe
- Plastic pipe' electrical insulation properties creates a boundary with the earth, making the tracing of pipe routes easy using the same essential idea as a buried cable detector

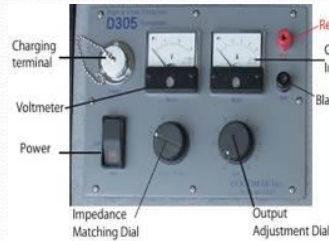


Non-Metal Pipe Locator

Installation

Components:

- Transmitter with current meter and voltmeter
- Receiver
- Cord with alligator clips
- For earth 25 m extension cable with drum Earth rod
- Charger for transmitter
- Charger for receiver
- Locking Plier

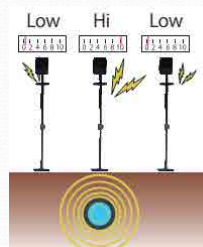
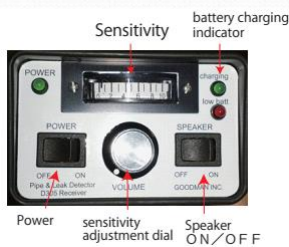


Module 3: Installation and Operation of Equipment

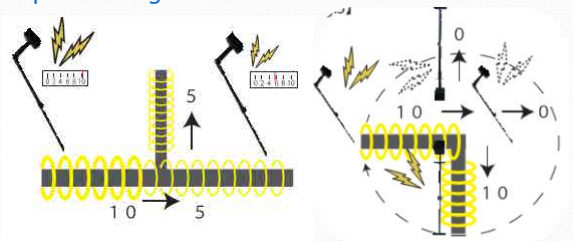
13

Non-Metal Pipe Locator Operation:

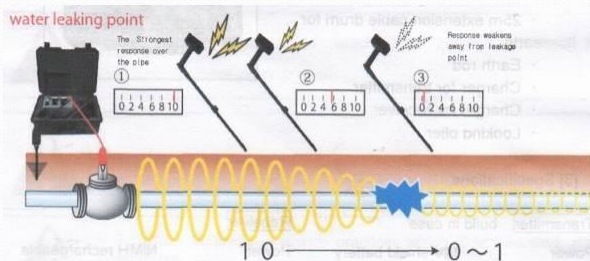
Move Receiver like a Pendulum



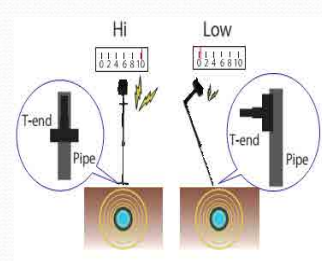
Pipe Routing



Sudden drop in signal, Indication of leak



Identification of Buried Apertures



Module 3: Installation and Operation of Equipment

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Metal Pipe Locator

Operation:

Direct Method

- Battery test for transmitter and receiver
- Use cords inside the box, attach one alligator clip to the coupler clamp and the second with rod for grounding. Attach the plugs in transmitter
- Put coupler clamp on valve or house meter that is above the pipe line
- Use receiver and walk on the surface with receiver similar as like pendulum motion
- High value on the meter of receiver and high pitch of the sound identifies the location of buried pipe line

Indirect Method

No clamping & no grounding



Components

- Transmitter
- Receiver
- Carrying Case with Inductive Antenna
- Chord Set
- Inductive Coupler
- Optional Headset

Module 3: Installation and Operation of Equipment

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Metal Pipe Locator

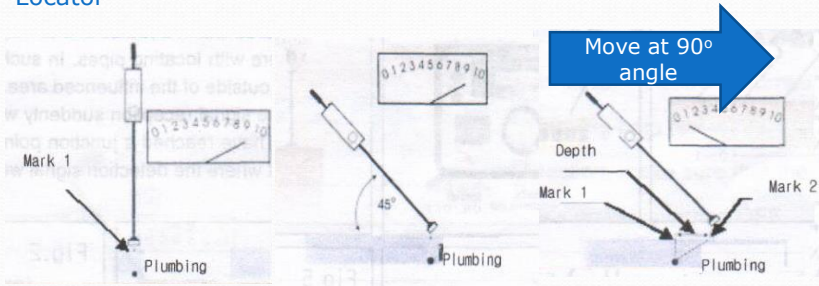


Module 1: Basic Knowledge of Leakage Detection

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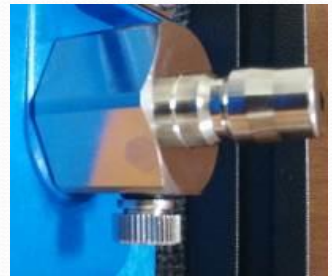
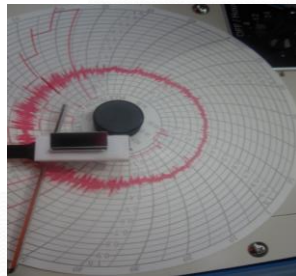
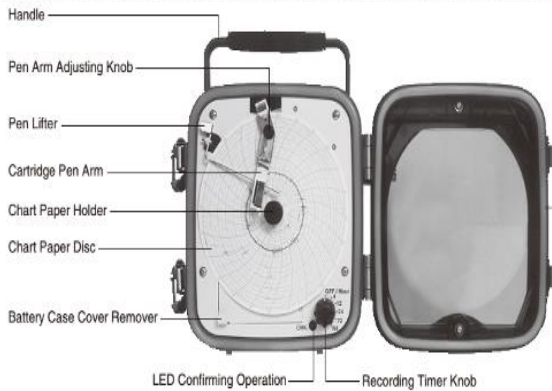
Determining Pipe Depth

Using Both Non-Metal Pipe Locator and Metal Pipe Locator



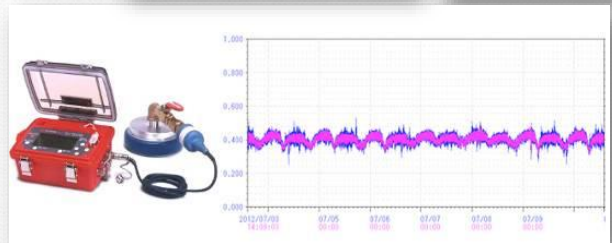
Depth= approx. 4 ft. etc.

Pressure Recorder



Pressure Recorder

- Develop the pressure charts to check fluctuation of water flow in distribution system
- Can be used for pressure testing of new pipelines
- Installation can be made in the chamber, at pumping station, at fire hydrants and at the valves in water networking system



Module 1: Basic Knowledge of Leakage Detection

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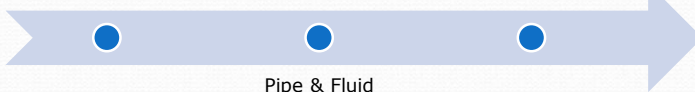
Ultrasonic Flowmeter

Components

- Device Setting:

Configuration Menu (SIMPLE)

Probe Distance



Pipe & Fluid Setting (Outside diameter & thickness)



- Installation:



Module 2: Basic Water Network Maintenance & Leakage Detection

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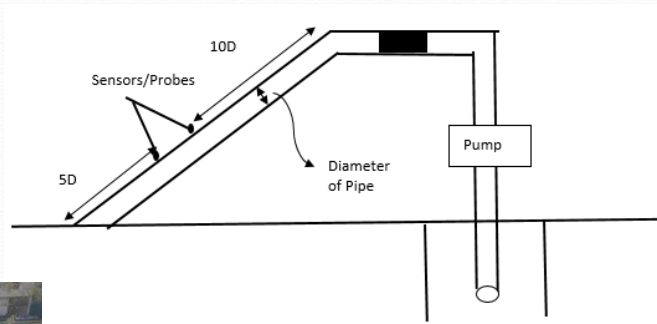
Ultrasonic Flowmeter



Installation Procedure

Data Required

- Pipe Diameter
- Pipe Material
- Probes ID Number
- Pipe Thickness



Gas-Permeation Inspection Method

- Identify the leaks by injecting gas having less specific gravity
- *Helium gas* due to its high cost is replaced with the *gas mixture* (5% hydrogen, 95% Nitrogen).
- Mixture is non-soluble in water, compliance with ISO 10156 standard and its safety is globally recognized
- In areas where "acoustic type leak detection" is difficult due to surrounding noise (traffic area, congested area and factory area), gas injection method is used



Leakage Detection Video

Localizing, Locating & Pinpointing



Contact Information

Zia Mustafa
Water Specialist



In the Name of Allah the Most Beneficent,
the Most Merciful

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Repairing of Leakage & Burst Pipe Line (OJT)

By
Zia Mustafa
Water Specialist

April 2018

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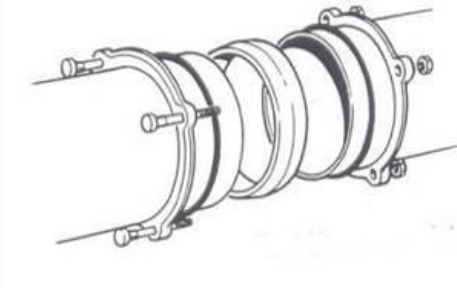
Outline of Presentation

- Repairing Materials
- Repairing Procedure at Site (AC Pipe)
- On Site Leakage Repairing
- Repairing Tools and Machinery
- Pipe Jointing
- Comparison of Materials and Methods of AC Pipe

3

AC Pipe Repairing Material

- Gibault Joint Material



AC Pipe Repairing Material

- Clamps & Water Proof Rubber



AC Pipe Repairing Material

- Rubber Tube & Wooden Piece/Cork



- Tire Tube Rubber



AC Pipe Repairing Material

- Socket & Socket Ring

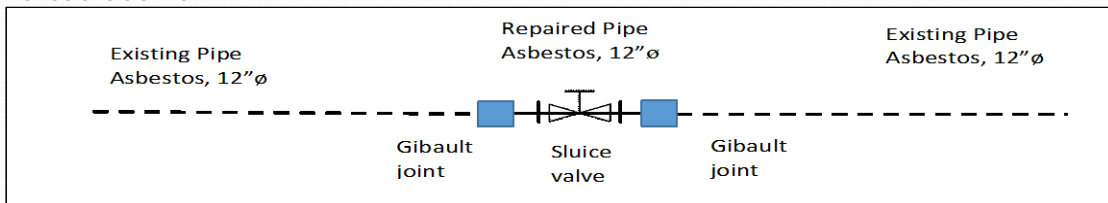


- Flange



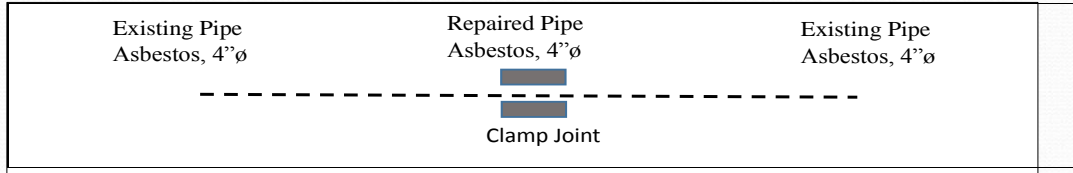
Repairing Procedure at Site

Gibault Joint



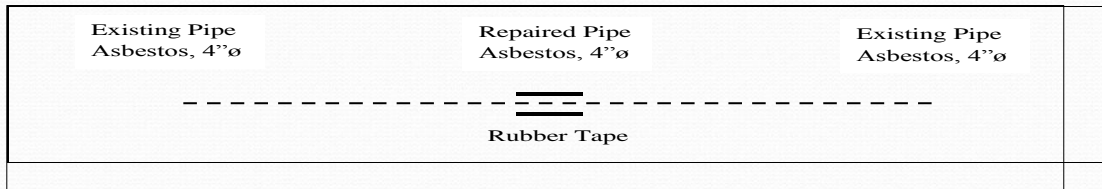
Repairing Procedure at Site

Clamp Joint



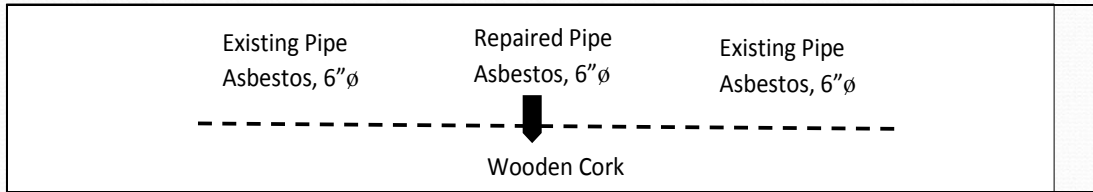
Repairing Procedure at Site

Rubber Tube



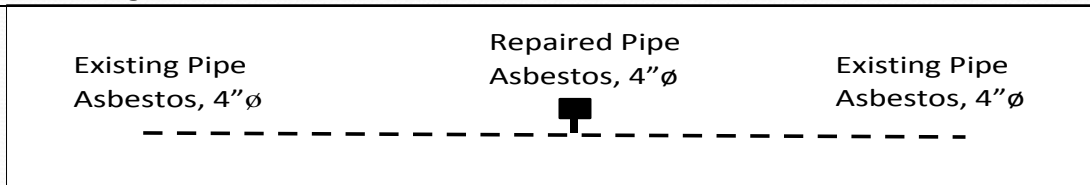
Repairing Procedure at Site

Wooden Piece or Cork

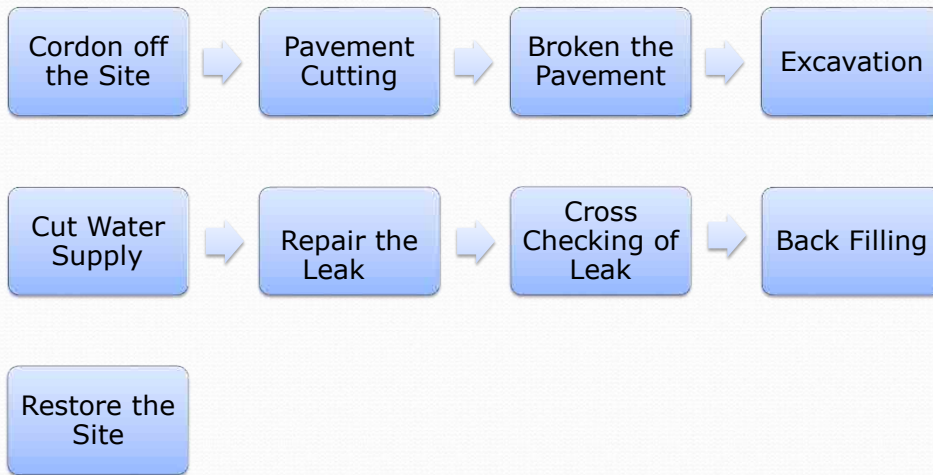


Repairing Procedure at Site

End Plug



On Site Leakage Repairing



Cordon off Site

- Cones
- Reflection Tape
- Diversion Board



Personal Protective Equipment

- Mask
- Gloves
- Shoes
- Hamlet
- Goggles (Eye Wear)



Repairing Tools & Machinery

- **Hand Tools**
 - Adjustable Wrench
 - Screw Driver
 - Hammer & Maul
 - Hand Saw
 - Bucket
- **Cutting Tools**
 - Snap Cutter
 - Pipe Cutter
- **Excavation Tools**
 - Shovel
 - Grape Hoe
 - Pick Axe
- **Excavation Machinery**
 - Pavement Breaker
 - Sucker Machine
 - Excavator
 - Portable Soil Compactor

Site Data Recording

Date and time	10:20 am, 11 February, 2016
Address	Hamdard Chowk, Ali Road
Person in charge	Mr. Shamas Ayoub Gujjar – SDO Green Town
Organization of repairing team	Pipe Fitter x 2, Helper x 2, Worker x 2 (Sucker Machine)
Diameter(mm)	12"
Material and Kind of joint	Asbestos, a sluice valve is installed after removing the cracked portion
Age (installation year)	45 years
Shape of leak point	5" long crack
Pressure (kg/m2)	High
Depth(m)	4.5"
Soil around the pipe	Rough mud, but after repairing a cemented valve chamber will be formed to operate valve in the future
Traffic density	High
Supply Hour	18
Cause of the leak	Old pipe and high Pressure (main transmission line connected with four tube wells)
Quantity of leak (m3/min)	
Time of Repairing (Hour)	4.5
Other Information	Sucker machine is used to remove water for repairing
Figure of repairing	
Picture of repairing	
Location on Map	

Date and time	10:50am 11 February, 2016
Address	Civic Centre near Cine Star Cinema
Person in charge	Mr. Shamas Ayoub Gujjar – SDO Green Town
Organization of repairing team	Pipe fitter x 1, Helper x 2
Diameter(mm)	4"
Material and Kind of joint	Asbestos, wooden cork inserted into the hole and metal clamp along-with water proof sponge was used
Age (installation year)	45
Shape of leak point	Hole of 0.5" diameter
Pressure (kg/m2)	Low
Depth(m)	4.5"
Soil around the pipe	Rough soil and garbage
Traffic density	Medium
Supply Hour	14
Cause of the leak	
Quantity of leak (m3/min)	
Time of Repairing (Hour)	3
Figure of repairing	
Picture of repairing	
Location on Map	

Module 2: Water Network Maintenance & Leakage Detection

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Polyethylene Pipe

- Polyethylene (PE) is fast replacing conventional material in piping for Water supply system. HDPE Pipe Size range from 20mm to 500mm

- Clamp Pipe and Fitting
- Align in Axial Direction
- Joint end Cleaning
- Facing
- Fusion Pressure Adjustment
- Time & Voltage Adjustment
- Insert Heat Plates or Wire Connection
- Pipe Fusion

Module 2: Water Network Maintenance & Leakage Detection

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Thermal Electrofusion Jointing

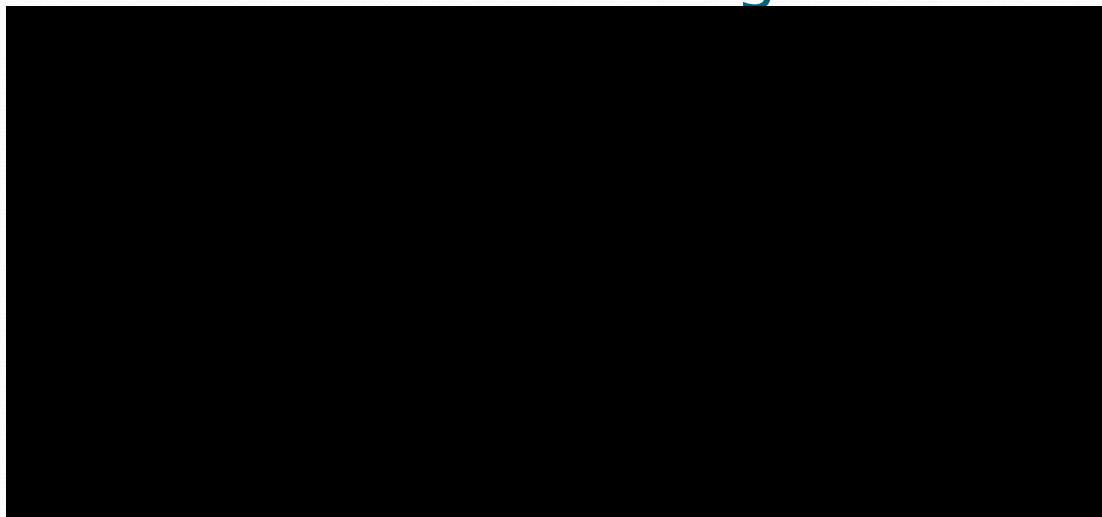
Butt Fusion Video



Module 2: Water Network Maintenance & Leakage Detection

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Butt Fusion Jointing Videos



Module 2: Water Network Maintenance & Leakage Detection

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Pipe Jointing

- Jointing of AC Pipe with HDPE through Use of Flanges and Bolts



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Comparison of Materials and Methods of AC Pipe

Method	Cost	Life	Availability	Skill Level Required	Time to Repair	Pressure of Line	Remedy	Shape of Leakage Point	Remarks
Rubber Tube	Low 25 PKR/piece	Short ~ 1 year	Easy	No	Short ~ 40 minutes	Low ~ 4 bar	Temporary	Hole /Crack	Only Recommended in the case of emergency but not a permanent remedy. Clamps should be used to increase the joint life.
Cork	Low 100 PKR/piece for 3" dia. Pipe 1000 PKR/piece for 12" dia pipe	Short ~ 1 year along with tube	Easy	No	Medium ~ 1.5 hr	Low ~ 4 bar	Temporary	Hole	Recommended only in case of emergency along with rubber tube. The piece of cork should be accurate, do not put extra size cork in hole of the pipe that results in the biological contamination of water. Not a permanent method, use it with clamps.

Module 2: Water Network Maintenance & Leakage Detection

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Comparison of Materials and Methods of AC Pipe

Method	Cost	Life	Availability	Skill Level Required	Time to Repair	Pressure of Line	Remedy	Shape of Leakage Point	Remarks
Clamp	Medium 125-150 PKR/kg for 4" dia. pipe e.g. Clamp for 4" dia pipe 2 kg iron plate is used.	Medium ~ 8-10 years	Easy	Basic	Medium ~ 1-1.5 hr	High ~ 7-8 bar	Permanent	Hole/ crack	Used where cracks or hole sizes are not so large. (e.g. Ø 4"~ 10.16 cm Ø 6"~ 15.24 cm). Use clamps with at least length of 2 inch more than the crack or hole diameter to cover it safely. It has long life as compare to rubber tube and cork. Can be used at shallow depth with low pressure but in case of high pressure we recommend to use Gibault joint. Clamp joint considered as a permanent remedy with maximum durability.

Module 2: Water Network Maintenance & Leakage Detection

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Comparison of Materials and Methods of AC Pipe

Method	Cost	Life	Availability	Skill Level Required	Time to Repair	Pressure of Line	Remedy	Shape of Leakage Point	Remarks
Gibault Joint	High 1200 PKR/piece for 6" dia. pipe	Long ~ 15 years	Medium	Skilled	Medium ~ 2 hr	High ~ 9 bar	Permanent	Burst /Replace of line	It is an expensive but permanent method for repair. Used where we have to repair the burst line or replace a pipe with another pipe of 5-7 feet of length. The rubber ring of Gibault joint becomes hard with the passage of time (duration 4-5 years), cracks are formed on it that lead to the leakage of water. Check the rubber ring before using Gibault joint. Replace the rubber ring after 4-5 years of usage, to prevent leakage.

Module 2: Water Network Maintenance & Leakage Detection

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Comparison of Materials and Methods of AC Pipe

Method	Cost	Life	Availability	Skill Level Required	Time to Repair	Pressure of Line	Remedy	Shape of Leakage Point	Remarks
Socket Joint	High 450 PKR/ piece for 4" pipe. 550 PKR/ piece for 6" pipe.	Long ~ 20 years	Medium	Skilled	Medium ~ 2 hr	High ~ 9 bar	Permanent	Burst/ replace of line	It is a little bit expensive compared with clamp joint but a permanent method for repair. . Used only in AC pipe only where we have to repair the burst line or replace pipe with another pipe of 5-7 feet of length. This method is not mostly used in routine repairs, used where new pipe line is being laid. It is a time taking process, and very inconvenient in presence of water.

Contact Information

Zia Mustafa
Water Specialist

Group Activity

“A City” Water Supply Authority Case Study

The “A City” Water Supply is the municipal water utility that serves the “A City” area and surrounding areas. Recent data reveals that utility provides low-quality piped water at very low pressure (6 psi) for only 06 hours per day to only 20% of the city's residents. Non -Revenue Water (NRW) is extremely high at 72% due to illegal connections, manipulation of bills and physical leakage. Tariffs are extremely low, there are no metering and less than half of the amounts billed are collected. Staff are underpaid and demoralized and most of them are engaged in corrupt activities.

Instructions:

In your groups please analyze the case using the systematic approach and present it.

- 1) What is the issue?
- 2) What is the context of the problem?
- 3) What key facts should be considered?
- 4) What alternatives are available to the decision-maker?
- 5) What would you recommend — and why?

Group Assignment 1

Current Practices of Leakage
Detection & Repair in all WASAs

Acoustic Leak Detector

The Acoustic Leak Detector is used to diagnose and localize the underground leak to a specific area of a property. The equipment consists of;

- Control Unit
- Headphones
- Connection wire
- Electromagnetic micro sensors
- Handle



Procedure:

- At first, connect the connection wire with headphones & the control unit.
- Volume of the sound detected by headphones can be increased or decreased by the buttons on the control unit.
- Filter can also be turned ON or OFF by simultaneously pressing the two buttons (+ & -) on control unit.



- Now connect the electromagnetic micro sensor with the control unit. The equipment will be turned ON as soon as you connect the electromagnetic sensor.
- Now wear the headphones, place the electromagnetic sensor on the ground with care and grab the handle in your hand.



- Move the sensor on ground at the offset of 1 ft and keep focusing the different sounds that you hear on the headphones.
- Meanwhile, keep noticing the signal on control unit having readings from 0 to 99. The maximum value at that reading indicates the leakage point.



Closing of Equipment:

Disconnect the Electromagnetic sensor from the control unit. Disconnect the connection wire from the control unit and the headphones. Place back all the things in the equipment casing with care.

Check List of using Acoustic Leak Detector

Following steps should be performed while using the device in Field:

- Check the battery on the control unit
- Connect the connection wire with the control unit & headphones
- Connect the electromagnetic sensor with the control unit
- Wear headphones and place the electromagnetic sensor on ground with care
- Concentrate on different sounds detected on headphones and keep noticing the signals on the control unit

Closing of the equipment:

Following points must be taken into account while packing up the equipment after use:

- Disconnect the connection wire from control unit & headphones
- Disconnect the Electromagnetic sensor from the control unit
- Keep all the things back in the equipment casing with care

Note: Use the Acoustic Leak Detector when there is a flow of water through pipeline.

Leak Frequency in Different Pipes

Acoustic Leak Detection

Aquascope

Pipe Material	Frequency Range (Hz)	Normal Frequency (Hz)
Steel	400 – 1500	800
Iron	300 – 1200	700
Copper	700 – 2500	1800
AC	300 – 800	500
Lead	200 – 700	400
PVC	200 – 500	300
Polyethylene	100 – 400	250

DATA RECORDING SHEET FOR LEAKAGE & PIPE REPAIRING

Date and Time	
Address	
Person in charge	
Organization of repairing team	
Diameter(mm)	
Material and Kind of Joint	
Age (installation year)	
Shape of leak point	
Pressure (kg/m ²)	
Depth(m)	
Soil around the pipe	
Traffic density	
Supply Hour	
Cause of the leak	
Quantity of leak (m ³ /min)	
Time of Repairing (Hour)	
<p>【Signature】 Supervisor _____ Sub Engineer _____</p>	



Non Metal Pipe Locator

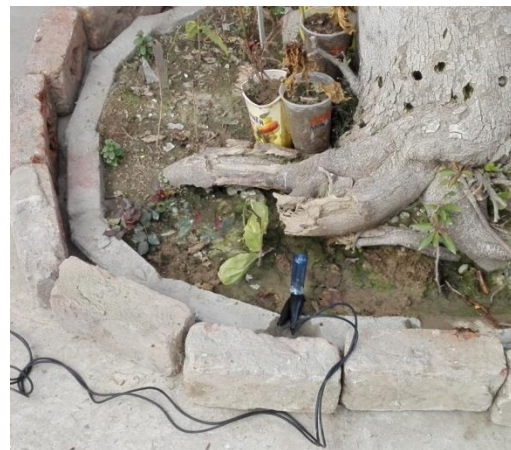
Non metal pipe locator is used to locate the underground water pipe and to indicate the underground leakage point by developing electromagnetic field around the pipe.

Procedure:

- First of all, check that knobs of 'impedance' & 'power' should be at zero before switching ON the equipment.
- Red probe should be connected to valve of the underground pipe in a chamber & is considered as positive.



- Black probe is treated as negative & should be grounded with the help of a screw driver.



- Grounding should be done at 45° to the opposite direction of identifying pipe.
- Now, switch on the equipment.
- At first, keep the impedance & power at 1 or 2. Then, keep on increasing the values as you move away from the starting point.
- Move the receiver along the direction of pipe & keep noticing the needle on device.
- Also note that while moving the receiver, its distance above the ground should at least be 2 or 3 cm.
- Set the impedance & power such that at the starting point where you know that there is a pipe, the value should be from 8 to 10.
- As you move away, keep setting the impedance & power so that the value should be between 8 to 10,
- If you notice any sudden fall in the reading of the needle (For example, if the needle comes suddenly to 1 or 2 from 8 or 10) it means that either there is a sharp bend or there is a leakage at the point.

Closing of Equipment:

Turn off all the knobs. Remove the red probe from the valve. Also, remove the black probe from the grounding and clean the screw driver with tissue paper. Place back equipment along with its accessories in casing with care.

Check List of using Non Metal Pipe Locator

Following steps should be performed while using the device in Field:

- Check the knobs (Impedance & power knobs should be zero before starting)
- Red probe should be connected to valve in the chamber
- Black probe should be grounded in soil
- Grounding should be done at 45° to the opposite direction of identifying pipe
- The distance of receiver while moving should not be more than 2 or 3 cm from the ground surface
- Keep on increasing the impedance & power as you move away from the starting point
- The needle lying between 8 or 10 indicates the underlying pipe
- Any reading lying between 2 or 3 indicates the absence of pipe

Closing of the equipment:

Following points must be taken into account while packing up the equipment after use:

- Turn off the knob of the recording device after use
- Turn off the knobs of the impedance & power
- Remove the red probe from the valve
- Remove the black probe from the grounding and clean the screw gauge with the help of tissue paper
- Keep all the things back in the equipment casing with care

Group Assignment 2

Site Visit Reflection Report

Metal Pipe Locator

The Metal Pipe Locator consists of the following components:

- Transmitter
- Receiver
- Inductive Coupler
- Inductive Antenna
- Connecting Wires

Checklist

- Check the battery of the transmitter before using it.
- Connect the wires carefully onto the pipe before carrying out the procedure.
- External metal interruptions and electromagnetic field should be minimum for better results.
- Handle the equipment parts carefully during the procedure.
- Clean the equipment before closing it and place into the box according to the previous configurations.
- Beware of the surroundings while carrying out the procedure.

Procedure

There are two methods of doing this procedure

1. Direct Method
2. Indirect Method

Direct Method

For direct method, we have to first establish the transmitter connection. Connect the first lead to the pipe and the other to the ground via screwdriver. After the connection has been completed, switch on the transmitter and first adjust the impedance/frequency to the lowest and increase it along with the distance. Hold the receiver with T end perpendicular to suspected path of metal pipe. The frequency both at the transmitter and receiver has to be adjusted according to the distance from each other. The noise and the peak value (varies between 0 to 10) at the receiver end will show the location of the metal pipe, where higher value indicates the presence of metal.





Indirect Method

In the indirect method, we do not establish the ground connection, rather we move both the receiver and transmitter simultaneously 6 inch above the ground in the similar suspected path to locate the metal pipe.

This method is rather easy, quick but inaccurate as compared to the direct method.



Ultrasonic Flowmeter Device



Checklist:

- Place the containing box carefully before opening as the equipment is sensitive and expensive.
- Remember the placed configuration of different parts of the equipment like connecting wires, portable device, gel bottle and transducers.
- Use the correct port of the device while connecting the transducer wires.
- Place the transducers carefully on the pipe and then use the screws to adjust the probe distance.
- Apply the optimum quantity of gel onto the transducers and after using it remove it.
- After carrying out the procedure remove the cables carefully with minimum force both from the device and transducers.
- Clean the gel from the transducers and pipe and separate them carefully.
- Assemble the equipment in order carefully and close the containing box.

*Note: Tube well must be working to carry out the procedure.

Introduction

The ultrasonic flowmeter uses the ultrasonic pulse transit time difference to measure the flow of a fluid. It is a portable device to carry the on field flow measurements. The equipment consists of

- Ultrasonic Portable Device
- Two Transducers/Probes (One for the large probe distance and other for relatively small distance, probe selection also depends upon the pipe conditions etc.)
- Two chords connected from device to the probe other than charging and computer connecting device.
- Ultra flux Gel

Procedure:

After selecting the pipe location, the first step is to check the external surface of the pipe as it should be smooth before carrying out the procedure for flow measuring. Check the condition of all the equipment

before proceeding. First check the battery condition of device by turning on the device. After this press the “F” button and select the flow measurement option. By selecting this option, you have to put the required data in the device which includes the following

1. Perimeter of Pipe
2. Diameter (Which would be based on perimeter of the pipe calculated manually)
3. Thickness of the Pipe
4. Type of the Material E.g. Cast Iron, Stainless Steel, PVC etc.
5. Type of the ultrasonic pulse velocity pattern i.e. V, W, N etc. (Which depends upon the pipe length available and accuracy desired)
6. Select the Unit of flow measurement i.e. m^3/hr . etc.

After selecting these values, the ultra-flux device will show the probe distance which depends upon the factors mentioned above, also you can select the different unit for the flow measurement. Before proceeding further, we have to apply the ultra-flux gel which will smooth the movement of ultrasonic pulse in the pipe. The transducer should be placed at distance “5D” where “D” is the diameter of Pipe.



After the gel application on the transducers' magnet portions we can assemble the probes/transducers to the distance provided by the device. After the distance is adjusted then we connect the chords to the probes/transducers and by pressing the “F” we can have the flow measurement of the fluid in the pipe.

After the field measurement we can transfer the data to the computer through connecting with the ultra-flux device.

Ultrasonic Flow meter

Ultrasonic Velocities in Common Pipe Materials

Sr. No	Material Type	Velocity (meter/sec)
1	GI (Iron Electrolytic)	3240
2	PVC	2400
3	Asbestos Cement	2200
4	Mild Steel	3235
5	Cast Iron	3230
6	Ductile Iron	3000
7	HDPE	2310

Pressure Recorder (FJN-501)

Procedure:

- First of all, install the battery (Dry cells).
- Fully rotate the knob (Indicating hours) to test the battery; if the red light starts blinking then it means that battery is in working condition.
- Now, place the graph paper at its place & plug in the cap.
- Install the pen in pen holder.
- Keep the knob at that hour of which the graph paper is installed.
(e.g. 4, 12, 24, 72, 168 hr).
- Set the graph paper & pen holder in such a way that pen needle is at zero of pressure axis & the time axis (at specified hour) by adjusting the movement of the screw of pen holder.
- Do not press the pen needle hard because in that case, pen ink will get spread on graph paper.



- Now, drain the air from the pipe installed at tube well by slowly opening the valve.
- Also, drain the air by opening the screw attached with nozzle of the Pressure Recorder.
- After completion of all these above steps, place the instrument on ground for recording of pressure for specific duration.



After using the equipment, remove the hose pipe from the tube well and pressure recorder. Take out the graph paper and the pen from the pen holder. Keep all the things back in the equipment casing with care.

Note: Use the Pressure Recorder when the tube well is in working condition and flow of water is passing through pipeline.

Check List of using Pressure Recorder

Following steps should be performed while using the device in Field:

- Check the battery status of equipment by fully rotating the knob. If red light blinks for a minute then equipment is ready for its use
- Place the graph paper on specified portion of pressure recorder
- Install the pen in pen holder properly
- Set the graph paper & pen needle as per requirement by adjusting the movement of the screw of pen holder
- Do not press the needle hard
- Drain the air from the hose pipe by opening the valve of tube well
- Drain the air from pressure recorder by opening the screw attached with pressure recorder
- Attach the hose pipe properly with nozzle at tube well and pressure recorder

Closing of the equipment:

Following points must be taken into account while packing up the equipment after use:

- Remove the hose pipe properly from the nozzle of tube well and pressure recorder
- Pen holder should be lifted up properly so that the pen and the graph paper can be removed safely
- Put on the cap of the pen
- Keep all the things back in the equipment casing with care

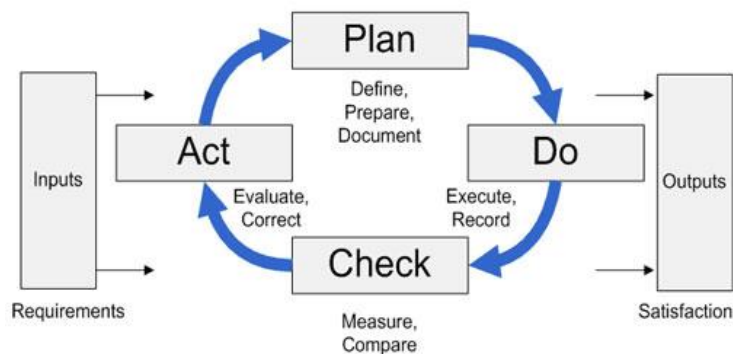
Note: Use the Pressure Recorder when the tube well is in working condition and flow of water is passing through pipeline.

Group Assignment 3

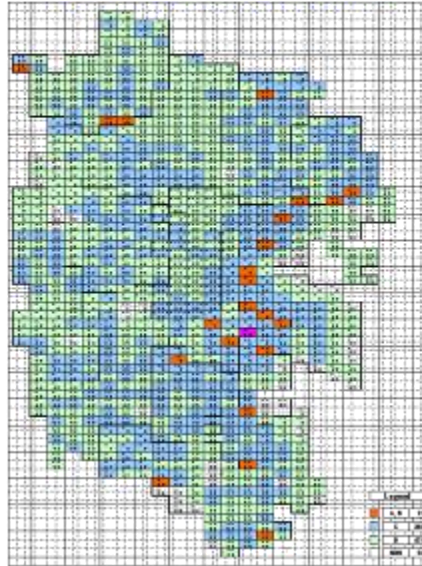
Site Visit Reflection Report

STEP BY STEP PROCEDURE FOR LEAKAGE PREVENTION PLAN

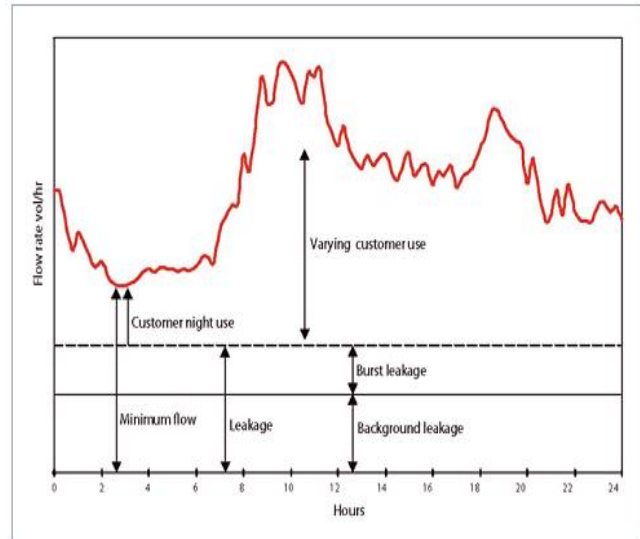
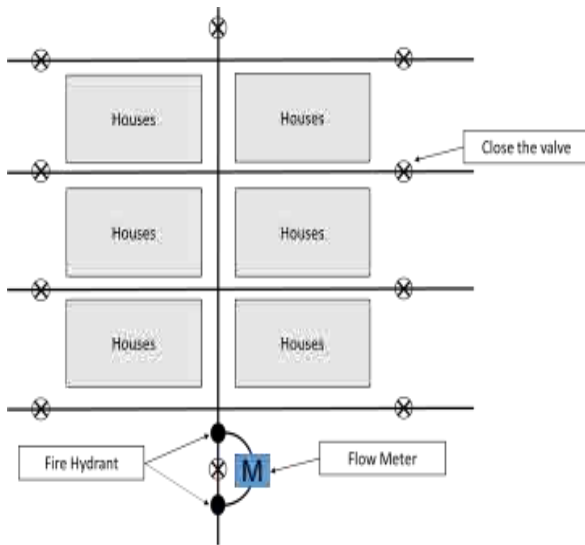
Sr. No.	Guideline	
1.	Preparation	<ol style="list-style-type: none"> 1. Establishment of Leakage Detection Cell and Team 2. Preparation of Water Distribution Network Maps and Drawings 3. Procurement of Equipment
2.	Basic Survey	<ol style="list-style-type: none"> 1. Analysis of Water Supplied and Pressure 2. Divide the City into Blocks 3. Study of Pipe Age, Material and Quality 4. Preventive Works
3.	Plan	<ol style="list-style-type: none"> 1. Set the Target Value 2. Set the Planning year 3. Decide the Survey Methods
4.	Action/ Implementation	<ol style="list-style-type: none"> 1. Leakage Survey 2. Analysis of Causes of Leakage 3. Leakage Volume Calculation 4. Quick Repairs (Surface Leakage) 5. Systematic Detection and Repair (Underground Leakage) 6. Countermeasures for Leakage
5.	Evaluation	<ol style="list-style-type: none"> 1. Analysis of Results 2. Compare Plan with Action

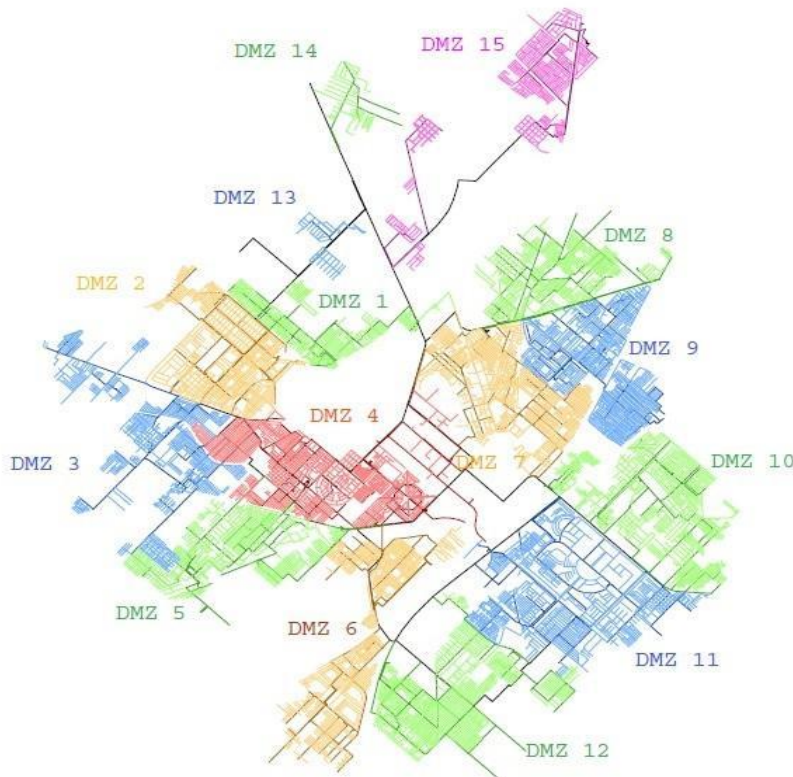
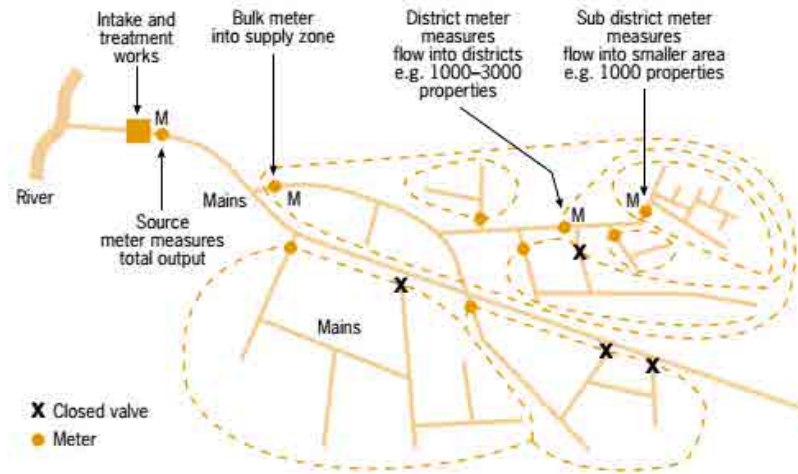


**Survey Block 0.5km × 1km
915 (865) Blocks**



- A** More than 10
- B** 5 to 9
- C** 1 to 4
- D** 0
- Non pipeline

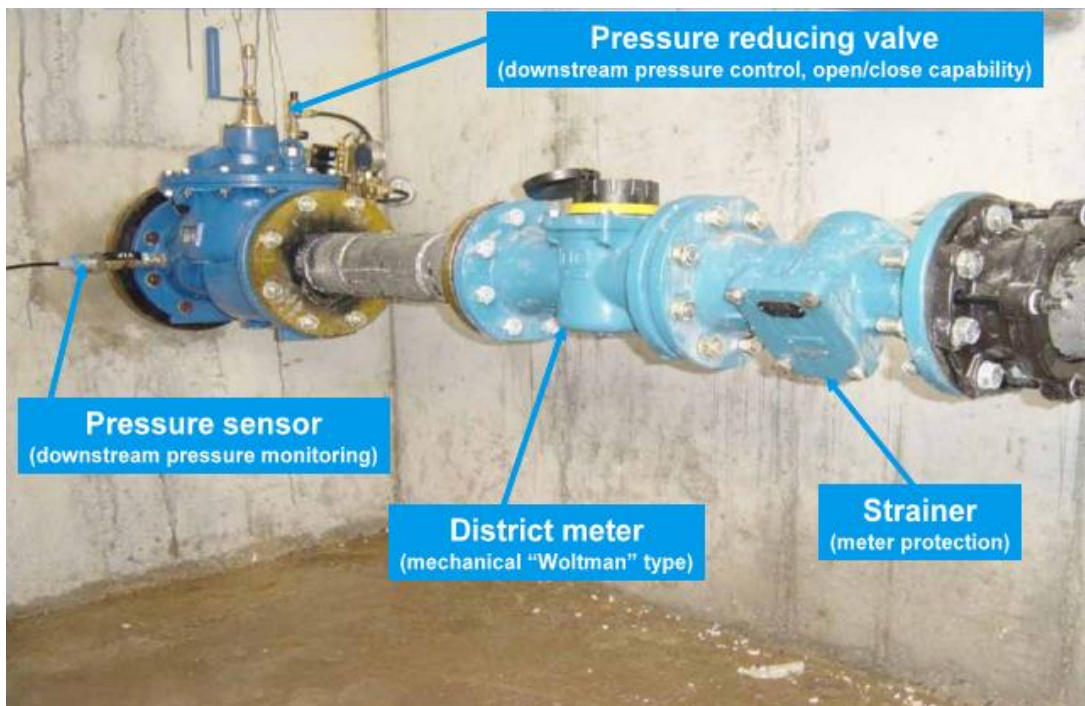
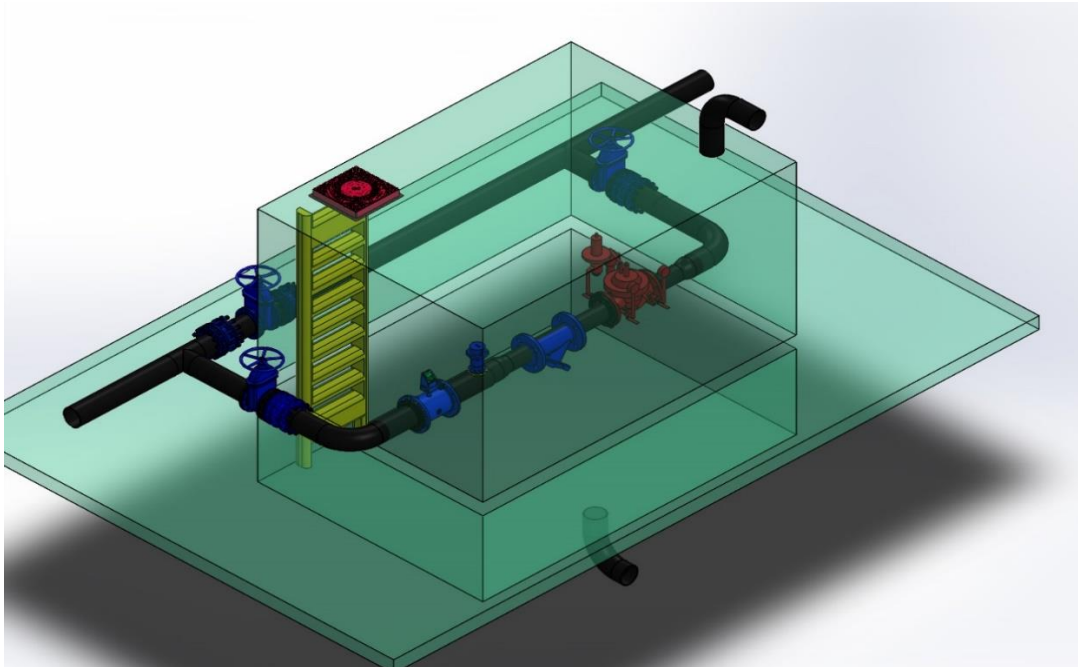




FAISALABAD
Network Zoning

DMZ 1	42.68 km
DMZ 2	93.55 km
DMZ 3	98.83 km
DMZ 4	149.73 km
DMZ 5	80.07 km
DMZ 6	109.84 km
DMZ 7	128.15 km
DMZ 8	94.93 km
DMZ 9	134.79 km
DMZ 10	122.03 km
DMZ 11	121.48 km
DMZ 12	104.10 km
DMZ 13	9.71 km
DMZ 14	13.20 km
DMZ 15	77.16 km
Total	1382.36 km





Group Assignment 4

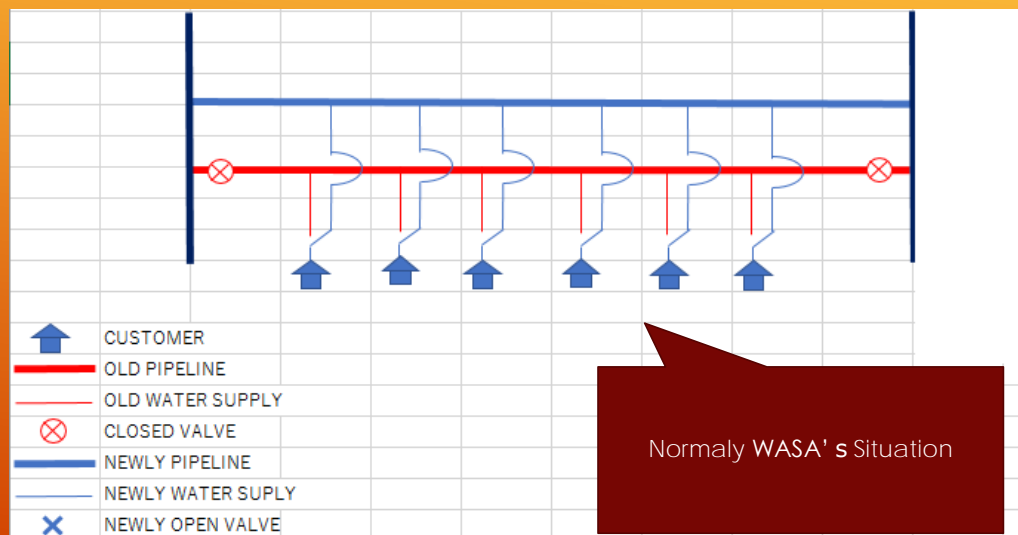
Preparation of Leak Detection
Action Plan

TO PREVENT LEAKAGE

- WHEN INSTALL NEWLY DISTRIBUTION PIPE
- WHEN INSTALL NEWLY WATER SUPPLY HOUSE CONNECTION PIPE
- EDUCATE CUSTOMER (FOR PREVENT ILLEGAL CONNECTION, IMPROVEMENT OF WATER SUPPLY)

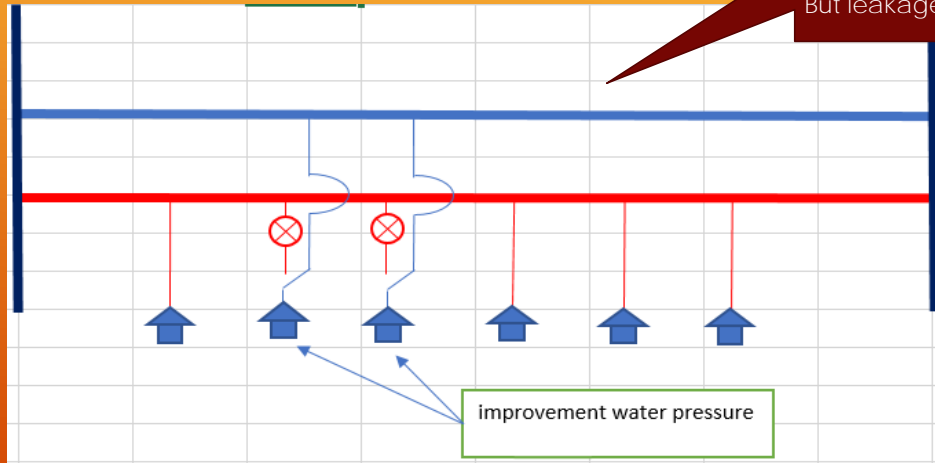
FOR PREVENT LEAKAGE

CASE1



FOR PREVENT LEAKAGE

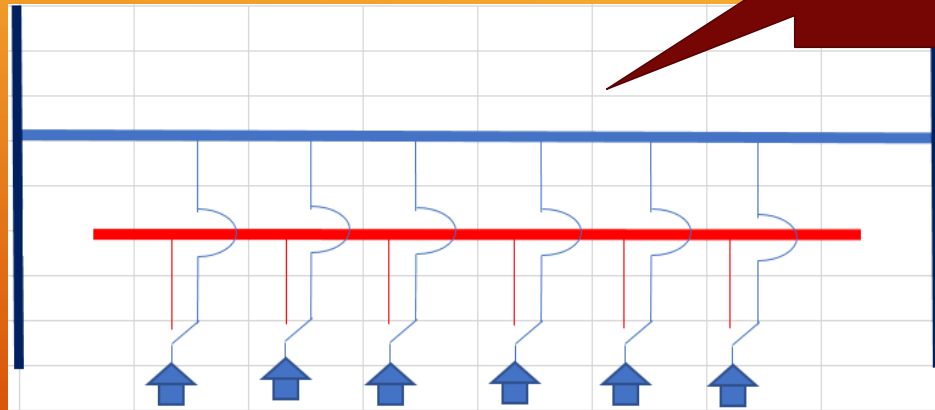
CASE-2



We improved the water situation of only two houses. Other houses have no problem. Cost is low. But leakage is...

FOR PREVENT LEAKAGE

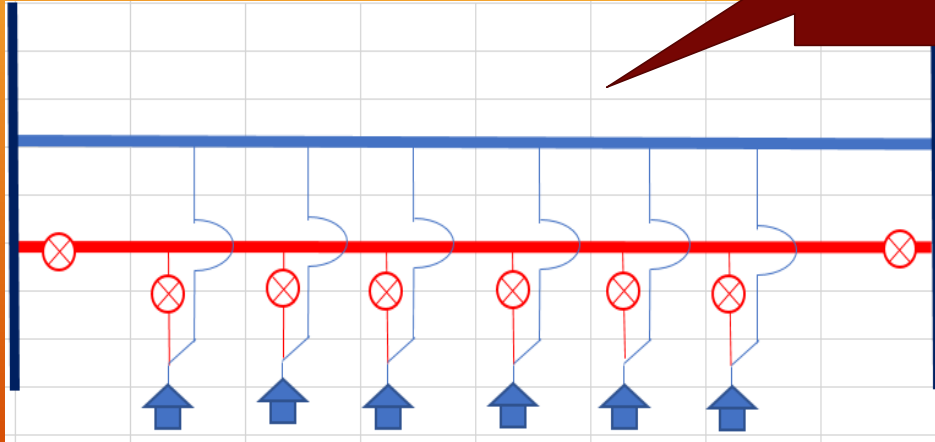
CASE-3



Old Pipeline remove two point. Leakage risk is low. Cost is high

FOR PREVENT LEAKAGE

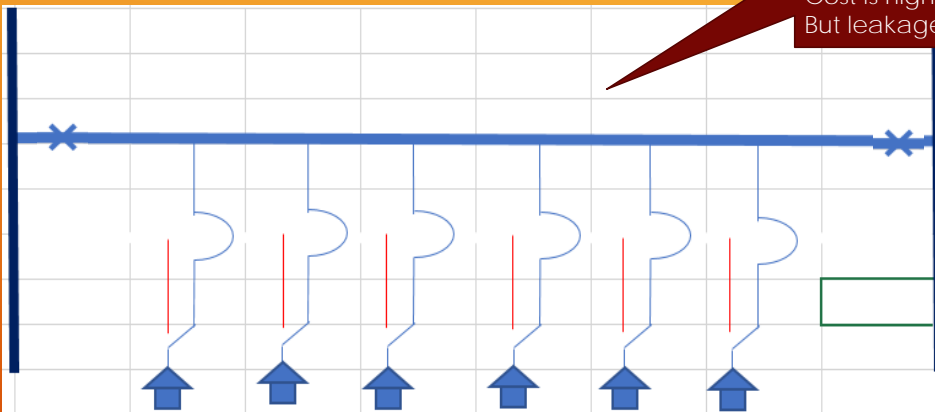
CASE-4



Old pipe do not remove.
Cost is very low.

FOR PREVENT LEAKAGE

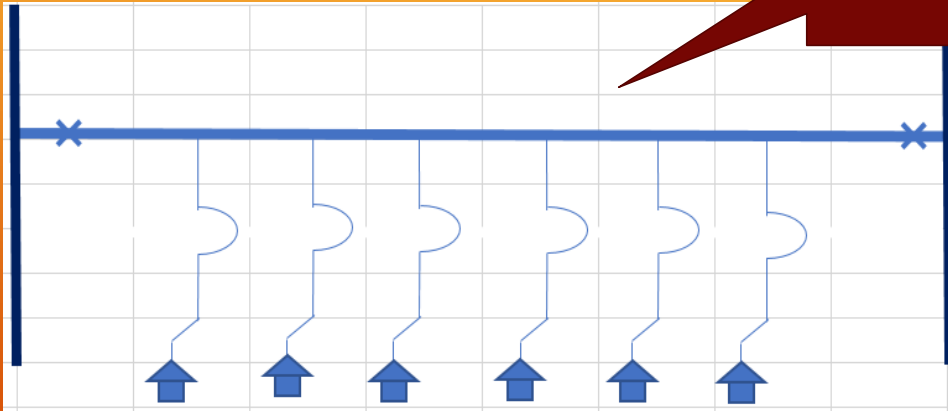
CASE-5



Japanese situation
Old distribution pipe only remove
But water supply pipe do not
remove completely.
Cost is high
But leakage risk is low

FOR PREVENT LEAKAGE

CASE-6



Old pipeline remove completely.
Leakage risk is very low
But cost is highest.

FOR PREVENT LEAKAGE
PLEASE TELL ME YOUR OPINION.

添付資料 4.29

2018 年春期研修「O&M of Sewer and Storm Water Drainage」の教材



In the name of Allah, the most Gracious and ever Merciful



Introduction

Welcome To Al-Jazari Academy

2/20



Welcome To All Stakeholders

Course Team



Mr. Ryuta Kudo

JICA Expert



Mr. Muhammad Irfan

Course Leader



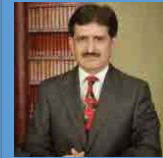
Mr. Rizwan Qazi

JICA Coordinator



Mr. Syed Fahad Hussain

Young Professional



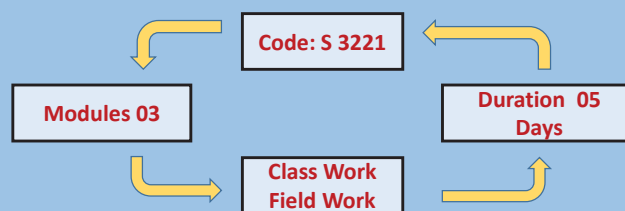
Course Reviewer

Prof. Dr. Sajjad Haider (UET), Lahore

Introduction

5/20

Operation and Maintenance (O&M) of Sewerage and Drainage System including Safety Precautions



Introduction

6/20

Modules



- Module 1**
 - Safety Control and Measures for Sewerage and Drainage Works
 - 01 Days
- Module 2**
 - Operation and Maintenance (O&M) of Storm Water Drainage System
 - 01 Days
- Module 3**
 - Operation and Maintenance (O&M) of Sewerage System
 - 02 Days + Action Plans

HOW WE WILL PROCEED . . .



- Module Introduction
- Expected Learning Outcomes
- Lectures
- Tea Break
- Field Work
- Lunch Break
- Presentation by Participants
- Comments by Participants
- Day Work Conclusion

1



2



3



4



5



6

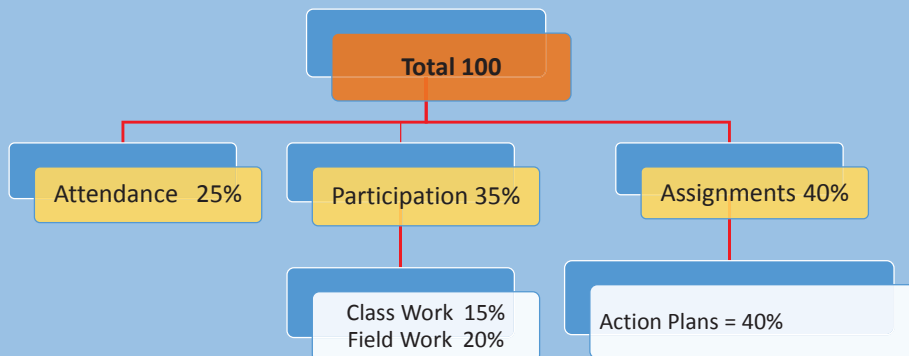


Sign off

WHAT WILL ANIMATE THE TRAINING SESSION. . .



Course Evaluation Criteria



Please Note:

Participants with active participation, maintaining 80% attendance and passing their exam with at least 70% score will be awarded certificates

Reference Material

- Book :** Operation & Maintenance of Wastewater Collection Systems (Vol. 01)
By: Kenneth D. Kerri & John Brady (California State University, USA)
- O&M Manual :** Water Born Sanitation Operations and Maintenance Guide
By: S J van Vuuren & M van Dijk (University of Pretoria, South Africa)
- Operation Manuals :** (1) Portable Gas Monitor (GX-8000)
RIKEN KEIKI Co., Ltd. Japan
- (2) Valve Box Locator M130
SEWERIN, UK



WHY O&M TRAINING IS ESSENTIAL . . .

Open Drain



Open Drain is Silted Badly

1. Solid waste
2. Bushes & weed growth

Covered Drain



Covered Drain is Choked

1. Root growth
2. Solid waste



Pump Replacement Operation at Disposal Station

1. Metallic boom contacting electricity conductors
2. No traffic management exercised



WHY O&M TRAINING IS ESSENTIAL . . .



Manhole Lid Missing

1. Tree branch is used as replacement (Self help)



Uncovering Manhole

1. Non-standard method applied



Kerb Grating Missing

1. Solid waste entry is evident



WHY TRAINING IS MANDATORY . . .



1. Poor screening may cause damage to pump internal parts.



1. Non-hygienic conditions
2. PPE no-where



No Compliance with SOP



WHY TRAINING IS MANDATORY . . .



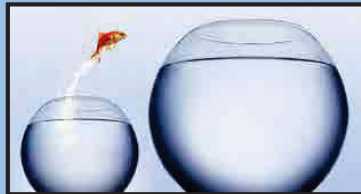
1. Proper care & maintenance is ignored

Non-Functional Bucket Machine (Winch Machine)

WHY TRAINING IS MANDATORY . . .



O&M Training is Essential Every Where



ADVANTAGES OF AN EFFICIENT (O&M) SYSTEM

- Full use of the system over its intended design life will be achieved.
- It will result in high reliability of equipment and facilities as designed.
- It will ensure that facilities and equipment are available as intended.
- It will maintain the value of the infrastructure investment.
- There will be a collection of accurate information and data on which the operation and maintenance can be planned and budgeted for.
- It will reduce costs since planned maintenance and repairs are much more cost-effective than late-night emergency repairs.



Q & A

Ideas

Comments

Contacts:

Name	Designation	Contact No.	E-Mail
Mr. Dr. Nobuyuki Sato	JICA Expert		
Mr. Muhammad Irfan	Course Leader		
Mr. Rizwan Qazi	JICA Coordinator		
Mr. Syed Fahad Hussain	Young Professional		



In the name of Allah, the most Gracious and ever Merciful

Operation and Maintenance of Sewer & Storm Water Drainage System including Safety Precautions
S 3221

Module 01
Safety Control and Measures for Sewerage and Drainage Works

01 Days

Module 02
O&M of Storm Water Drainage System

01 Days

Module 03
O&M of Sewer System

02 Days

Module 01 (An Overview)

Safety Control and Measures for Sewerage and Drainage Works

No. of Topics 06

No. Lectures 09

Theory 04

OST 03

DAY 01	<input type="checkbox"/> Risks and hazards associated with sewers & drains	<input type="checkbox"/> Risks and hazards	Theory
		<input type="checkbox"/> Control measures	Theory
	<input type="checkbox"/> Safety practices for sewers & drain O&M	<input type="checkbox"/> Current safety practices in WASA & Visit to WASA Training Center	OST
	<input type="checkbox"/> Use of safety gears	<input type="checkbox"/> Concept of PPEs	Theory
	<input type="checkbox"/> Best safety practices	<input type="checkbox"/> Working in confined spaces	OST
		<input type="checkbox"/> Tests for hazardous gases	
	<input type="checkbox"/> First aid	<input type="checkbox"/> Arrangements for medical treatment	Theory
	<input type="checkbox"/> Traffic control practice	<input type="checkbox"/> Identification of a specific manhole	OST
		<input type="checkbox"/> Traffic control plan	

3/15

Module 01

Safety Control and Measures for Sewerage and Drainage Works

Topic No. 01

Risks and Hazards Associated with Sewers & Drains

Lecture No. 01

Risks and Hazards

Theory

Lecture Breakdown	Duration
Objectives	 15 Min.
Important Definitions	
Hazards & Risks related to Sewer & Drainage Works	
Risk Assessment	
Summary	
Q&A	



Module-1 Lecture-1 Risks and Hazards

4/15

Objectives:

- To Give an overview of job related hazards & risks
- Assessment of risks at WASA work sites during O&M



Important Definitions

Hazard



A Hazard is a potential source of harm.

Risk



Risk is the likelihood that a person may be harmed.

Assessment



Identify hazards + Analyze or evaluate risk + Determine methods to control

Prioritization



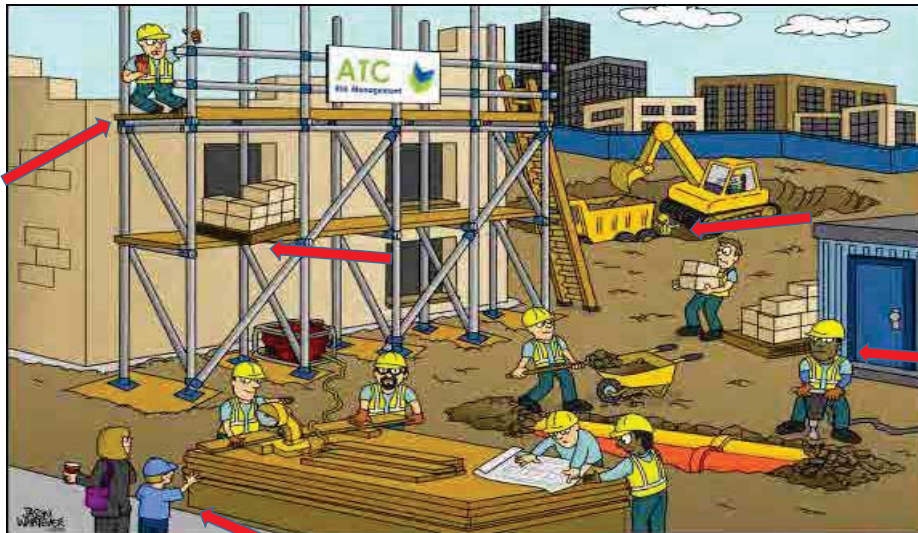
Evaluating risks and ranking them in their order of severity.



Find out the Hazards in office...



Find out the Hazards at Work Site...



Comprehension of Hazard and Risk: (Video Clip...Duration: 0:2:45)



Target	Steps
Determine Risk	1
Decide if the Risk is Tolerable	2
Review the Risk	3
Develop Control Measures	4



Severity of Harm

Likelihood of Harm	Severity of Harm		
	Slight Harm	Moderate Harm	Extreme Harm
Very unlikely	Very low risk	Very low risk	High risk
Unlikely	Very low risk	Medium risk	Very high risk
Likely	Low risk	High risk	Very high risk
Very likely	Low risk	Very high risk	Very high risk





Manhole De-Silting Operation (Night)
-near Ferozpur Road, Lahore

Hazards are always present at & around WASA work sites

Risk Assessment is no doubt utmost **necessary** before commencing O&M works

O&M Works can be done **safely** if best practices & **Control Measures** are adopted

Q. 01:

What are the major hazards present at & around the manhole?

Q. 02:

How the hazards transform into various types of risks at & around the manhole?

Q. 03:

Can you make a list of hazards and related risks at WASA drain dredging site?

Name	Designation	Contact No.	E-Mail
Mr. Dr. Nobuyuki Sato	JICA Expert		
Mr. Muhammad Irfan	Course Leader		
Mr. Rizwan Qazi	JICA Coordinator		
Mr. Syed Fahad Hussain	Young Professional		





In the name of Allah, the most Gracious and ever Merciful



Safety Control and Measures for Sewerage and Drainage Works



Lecture Breakdown	Duration
Objectives	 15 Min.
Important Definitions	
Various Control Measures	
Brainstorming Session	
Summary	
Q&A	



Module-1 Lecture-2 Control Measures

2/16



Objectives:

To aware participants about various control measures to be adopted to avoid risks during O&M



Important Definitions



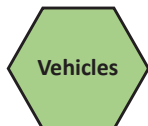
- **Control Measures** Actions that reduce the potential of exposure to hazard
- **Elimination** Remove hazard from the workplace
- **Substitution** Replace hazardous materials or machines with less hazardous ones
- **Engineering** Design modifications to reduce the hazard
- **Administration** Procedure changes, employee training, signs, labels & exercise breaks
- **PPE** Protective clothing, helmets, goggles & equipment etc.

Module-1 Lecture-2 Control Measures

3/16

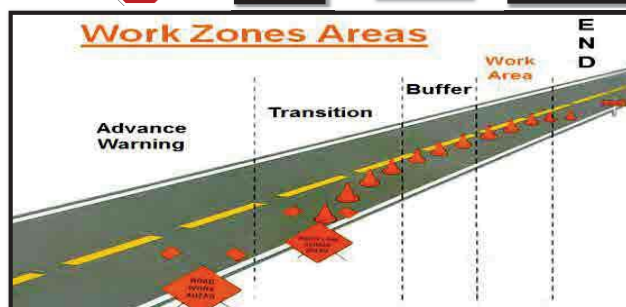


Control Measures during O&M:



Routing Traffic around Job Site

- Advance Warning Area
- Transition Area
- Buffer Space
- Work Area
- Termination Area



Module-1 Lecture-2 Control Measures

6/16



Any space where:

- Existing ventilation is insufficient
- Oxygen is deficient
- Access is difficult
- Getting out is difficult
- Not designed for permanent dwelling

Atmospheric Hazards:

Explosive	Toxic	Deficiency
Methane - CH ₃	Hydrogen Sulfide - H ₂ S Carbon Monoxide - CO	Oxygen - O ₂

Control Measures:

- Use gas detector/monitor
- Continuous Ventilation
- Continuous Testing
- Self Contained Breathing Apparatus (SCBA)



Hazards:

- Uneven Footing
- Poor Balance
- Awkward Position
- Ladder Drop
- Weak Manhole Rungs
- Dropping Tool
- Sharp Objects

Risks:

- Strained Muscles
- Torn Skin
- Abrasion
- Swelling
- Puncture
- Fracture



Control Measures:

- Correct Position/Orientation
- Correct SOP
- Light Weight Ladder
- Avoid Tool Drop & Throw/Toss
- PPE (Helmet + Goggles + Gloves + Safety Shoes)



Infections & Diseases



Hazards:

- Parasite
- Virus
- Infection
- Illness
- Urine & Feces of Rat

Risks:

- Fever
- Headaches
- Nausea
- Muscular Pain
- Tetanus
- Polio
- Typhoid



Control Measures:

- Personal Cleanliness
- Keep & Wash Cloths Separately
- No Eating/Drinking at Job Site
- Disinfect the Manhole
- Prevent Infectious Discharge Entry
- PPE (Goggles + Gloves + Wader+ Safety Shoes)



Insects- Bugs- Rodents



Hazards:

- Black Widow Spider
- Violin Spider
- Scorpions
- Rat
- Mosquito
- Cockroaches

Risks:

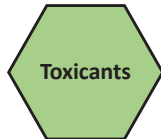
- Allergy & Fever
- Infections
- Poisoning
- Rat Bite
- Rabies
- Malaria



Control Measures:

- Spray Insecticide
- Ventilate Manhole
- Wash Manhole
- PPE (Gloves + Wader)
- Get Medical Attention





Hazards:

- Acids
- Bases
- Poisons
- Hazardous Liquids
- Solid Chemicals

Risks:

- Inhalation
- Dermal Contact (Absorption)
- Ingestion
- Splash



Control Measures:

- Avoid Accidental Spill
- Avoid Deliberate Action
- Implement Law
- PPE (Gloves + Gums)
- Get Medical Attention

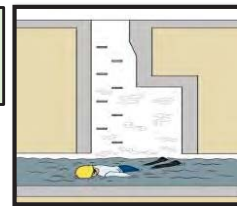


Hazards:

- Large Sewage Flow
- Accidental Slip
- Fall
- Uneven Base
- Weak Eyesight

Risks:

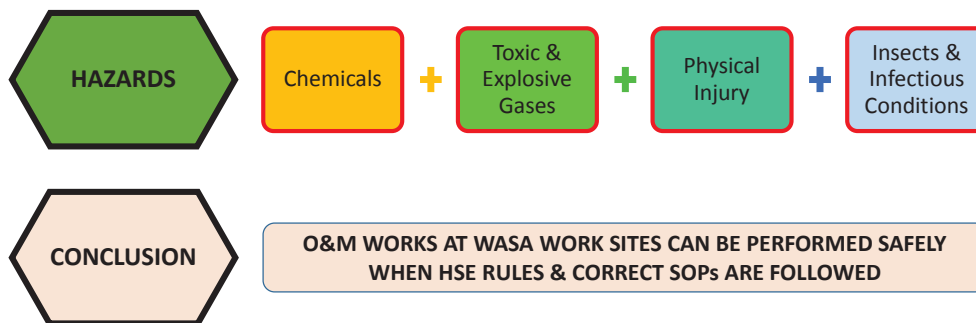
- Drowning
- Injury
- Death



Control Measures:

- Watch Your Steps
- Wear Life Jackets
- Use Life Line
- Get Medical Attention





Q. 01:

How can you protect yourself from diseases when working at WASA work sites?

Q. 02:

How can you protect yourself from insects when working in a manhole?

Q. 03:

How can you protect yourself from drowning when working in a manhole?



Contacts:



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Mr. Syed Fahad Hussain	Young Professional		



THANK YOU!





In the name of Allah, the most Gracious and ever Merciful

Module 01

Safety Control and Measures for Sewerage and Drainage Works



Lecture Breakdown	Duration
OJT	 15 Min.
OJT Cycle for WASA Site	
OJT Success at WASA Site	
Current Safety Practices in WASA	
Pictorial...	
Q&A	



OJT...Dates Back



On-the-Job (OJT) Training:



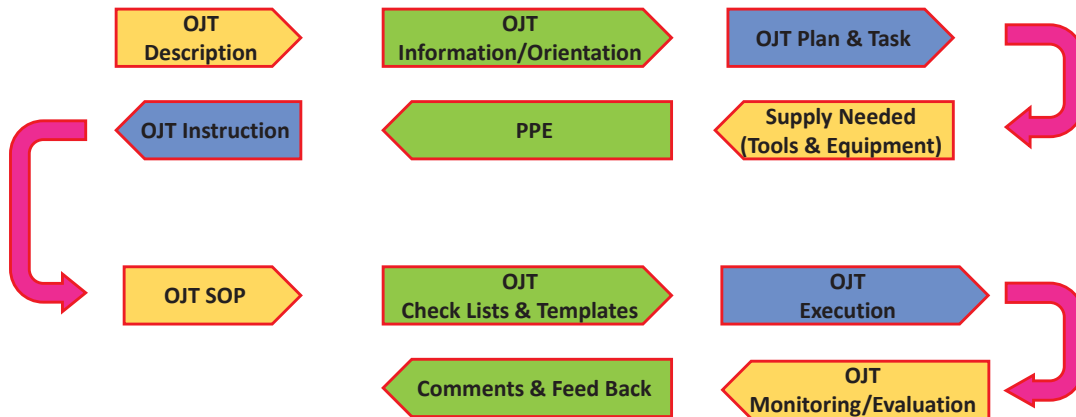
1	Training where the “Trainer” instructs the new “Trainees” on the skills needed to perform his/her new job effectively
2	Either the Trainee performs the job while the Trainer instructs Or
3	The Trainer performs the job while the Trainee observes.
4	On-the-Job training should take place mostly in the field ; however, some classroom training is also permissible.





On-the-Job (OJT) Training:

‘Training at a site away from the actual work environment’ (00:00:42)





- 


 - 1) Understand the need of OJT
 - 2) Comprehend the aim & plan
 - 3) Read through the templates (for filling in the observations during OJT)
 - 4) Travel towards WASA work site
 - 5) Get the orientation
 - 6) Wear the requisite PPE
 - 7) Chose safe position for observation
 - 8) Remain as close to the normal working position as possible
 - 9) Follow the directions of Trainer
 - 10) While performing OJT keep in mind the WASA policies and local rules
 - 11) Use the accompanying equipment & tools with care
 - 12) Fill in the templates with accurate data
 - 13) Write a concise report after return

IMPORTANT: TRAINER WILL EVALUATE THE TRAINEES' PERFORMANCE DURING OJT

OJT Description

Current Safety Practices in WASA

OJT Plan & Task

- To visit various WASA work sites where O&M works are in progress
- To observe that up to which level the HSE standards are being adopted during O&M works

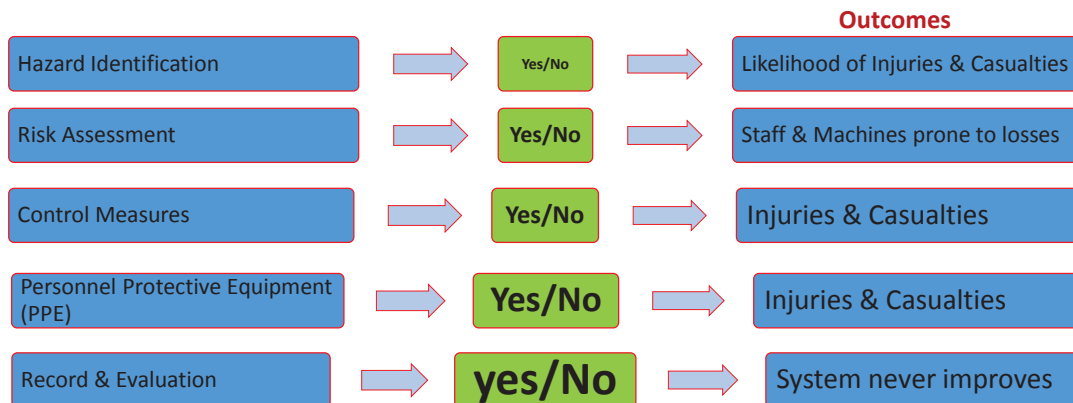
OJT Information

De-silting & Cleaning operation at a Manhole affected by Chronical Blockages WASA Lahore (Green Town Sub-Division)

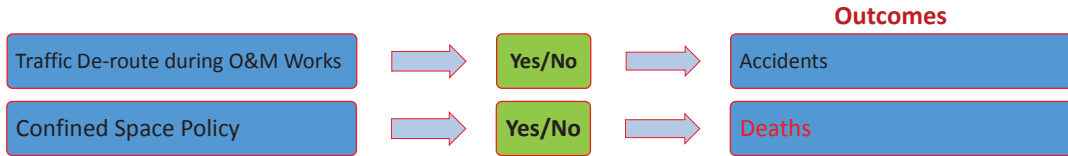
Supply Needed

HSE related check lists

PPE



➤ Current Safety Practices in WASA



Q. 01:

How you assess the implementation of HSE rules in **WASA** during various O&M jobs?

Q. 02:

What are the reasons behind non-implementation of HSE practices at WASA work sites?

Q. 03:

What are your suggestions to improve & implement the HSE policies during O&M jobs?

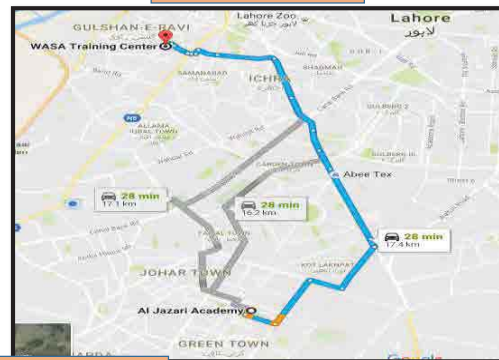
**WASA Training Directorate
Gulshan-e-Ravi
LAHORE**

OBJECTIVE:

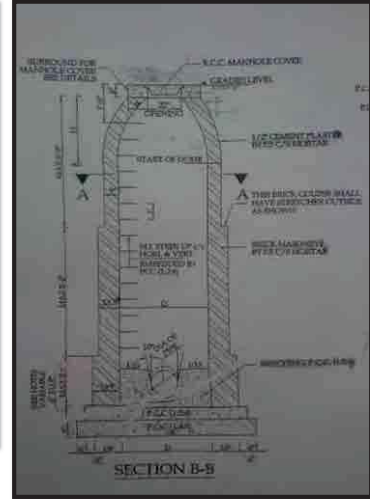
- To observe training facilities & infrastructure at the directorate
- Preparation of visit report on return

Remember: PPE are necessary

Road Map



17 Km – 30 Min.



Manhole Structural Details

13/16



Trunk Sewers

14/16



Contacts:



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THANK YOU!





Cardiopulmonary Resuscitation (CPR)



01/07



A view of Training on CPR at RESCUE 1122 H/O (Lahore)



02/07



Students learning how to perform mouth-to-mouth breathing, an artificial respiration technique and component of cardiopulmonary resuscitation (CPR)

03/07



↓

- D** = DANGER
- R** = RESPONSE
- S** = SHOUT FOR HELP
- A** = AIRWAY
- B** = BREATHING
- C** = CIRCULATION
- D** = DEFIBRILLATION

TASK

- ✓ Artificial Respiration
- ✓ Artificial Blood Circulation

04/07



Cardiopulmonary Resuscitation (CPR) (00:03:52)



05/07



Cardiopulmonary Resuscitation (CPR) (00:01:13)



06/07



Thank You



In the name of Allah, the most Gracious and ever Merciful







Module 01

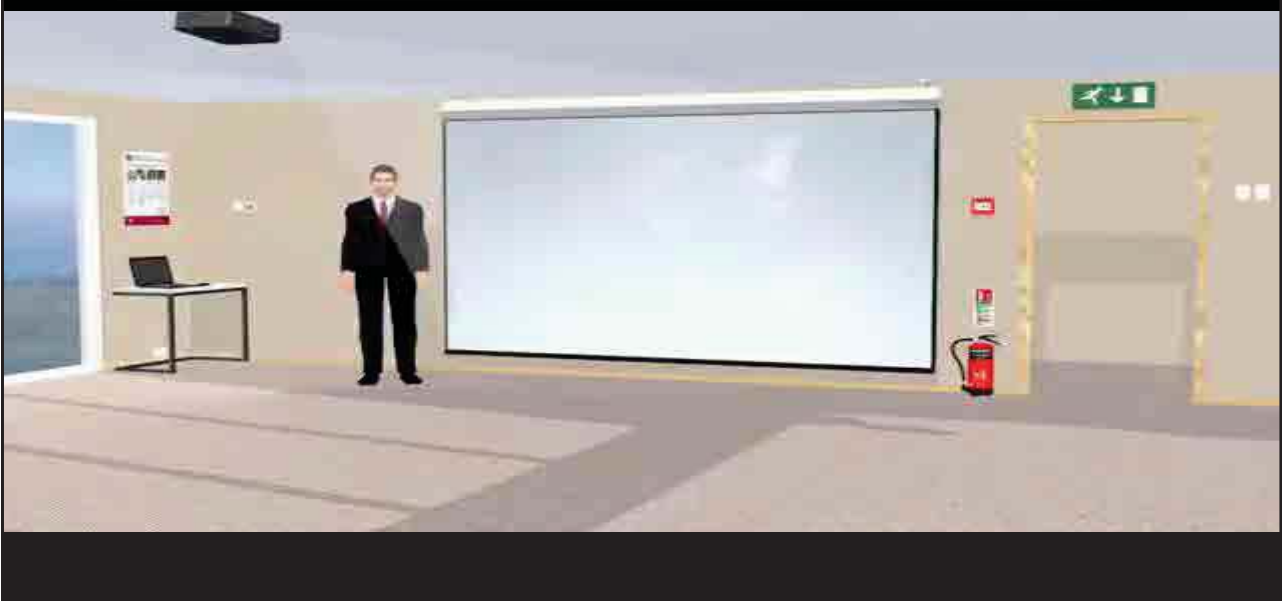
Safety Control and Measures for Sewerage and Drainage Works



Lecture Breakdown	Duration
Purpose of PPE	20 Min.
Selection of PPE	
PPE in Details	
Care & Maintenance	
Q&A	



PPE	Protective <u>clothing</u> , <u>helmets</u> , <u>goggles</u> , or other garments or equipment designed to protect the wearer's body from injury or infection.
Purpose of PPE	When controlling measures e.g. elimination, engineering, work practice and administrative controls do not provide sufficient protection against the HAZARDS & RISKS, personal protective equipment (PPE) must be used as a last resort.
Selection of PPE	The selection of appropriate PPE is based upon the <u>hazard assessment</u> and many other factors.
Care & Maintenance	<u>Clean and properly maintained PPE</u> is important to ensure the effectiveness and proper functioning of PPE and to prevent transmitting infections.
	     



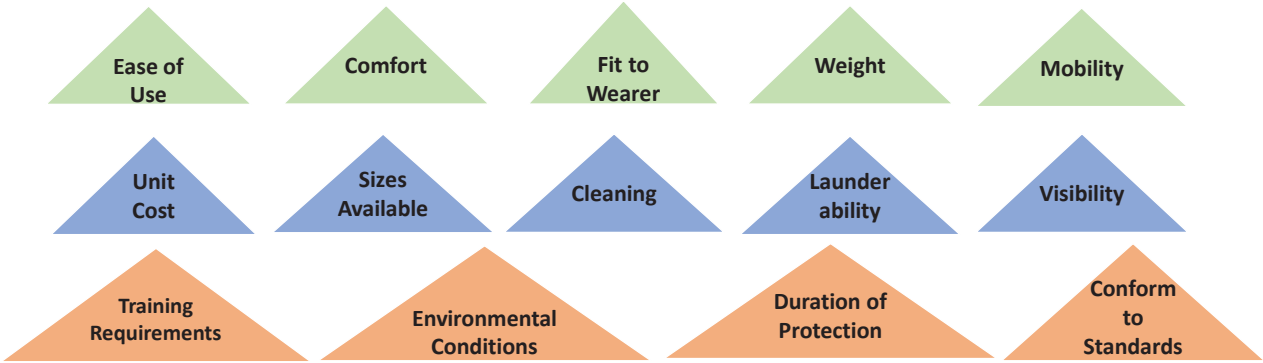
PPE Selection Criteria

Identify the Potential Hazards
Impact + Penetration + Compression + Chemical + Heat/Cold + Harmful Dust + Light + Radiation
Determine the Types of Protective Equipment Available for the Present Hazards
Evaluate the Effectiveness of the PPE
Select Appropriate Protective Equipment
Provide a Variety of Sizes to Properly Fit all Users
Select Equipment that is Compatible with other PPE

VARIOUS HAZARDS AT WORK SITE



PPE Selection Criteria



REMEMBER : PPE IS LAST LINE OF DEFENCE AGAINST ACCIDENTS & INJURIES

PPE EXAMPLES



PPE EXAMPLES

Dust/Flying Debris

Eyes	Goggles
Head + Neck + Face	Face Shield Dust Mask Helmet
Feet + Toes	Safety Shoes
Hands	Appropriate Gloves
Body: Arms + Legs	Protective Clothing

Impact/Compression

Eyes	Goggles Face Shields
Head + Neck + Face	Class G, E, or C Helmet
Feet + Toes	Hard Toed Shoes
Hands	Metal Mesh Gloves
Body: Arms + Legs	Leather Clothing

PPE EXAMPLES

Electrical Hazards

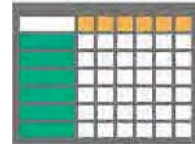
Eyes	Goggles
Head + Neck + Face	Helmet Class E
Feet + Toes	Electrical Hazard Footwear
Hands	Rubber Gloves and Insulating Sleeves
Body: Arms + Legs	Garment from Synthetic Clothing

Puncture/Cuts/Abrasions

Eyes	Goggles
Head + Neck + Face	Face Shield
Feet + Toes	Puncture Resistant Sole Shoes
Hands	Metal Mesh Gloves
Body: Arms + Legs	Clothing made of Cotton or Leather

PPE SELECTION ON THE BASIS OF HAZARD ASSESSMENT

Work Site: _____
 Sub-Division: _____
 Foreman: _____
 Date: _____



SR. NO.	JOB	HAZARDS	PPE REQUIRED

Employees Training in PPE Use

Employers are required to train each employee who must use PPE



- When PPE is necessary?
- How to properly put on, take off, adjust and wear the PPE?
- The limitations of the PPE
- Proper Care, Maintenance, Useful Life and Safe Disposal of PPE

PPE Care & Maintenance

Clean and Properly Maintained PPE is Important to Ensure the Effectiveness of PPE






Care & Maintenance Includes....

Cleaning of PPE + Storage of PPE + Examination + Testing

Repair + Replacement of Worn Components + Safe Disposal



PPE Care & Maintenance

Helmet	Clean hard hats regularly Store head protection out of the sun Check the headband Replace a hard hat if it is cracked or dented	
Goggles	Clean safety glasses and goggles regularly Store eye protection preferably in a clean dust-proof case Replace safety glasses if frames are bent	
Respirators	Clean and disinfect Check for holes & cracks Store in a safe location which is protected from dust	
Gloves	Keep gloves clean and dry Have a backup pair in case gloves get wet Replace worn or damaged gloves right away	
Safety Shoes	Wipe wet or soiled shoes with a clean cloth Have worn or damaged shoes repaired, or replace them	

Q. 01:

List the **PPE** recommended for use when operators are working at WASA work sites?

Q. 02:

Describe prominent features of **Safety Helmet**, **Safety Harness** & **Hard Toed Safety Shoes**.

Q. 03:

Illustrate self-contained breathing apparatus (**SCBA**) & explain its parts and use.

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Observations

Module-1 OST-1

Day/Date:

Name:

Visit Location:

Designation:

Observations	
1.	
2.	
3.	
4.	
5.	
6.	
Suggestions for Improving the Training Directorate Facilities	

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.

Suggestions for Improving the Training Directorate Facilities



In the name of Allah, the most Gracious and ever Merciful

Module 01

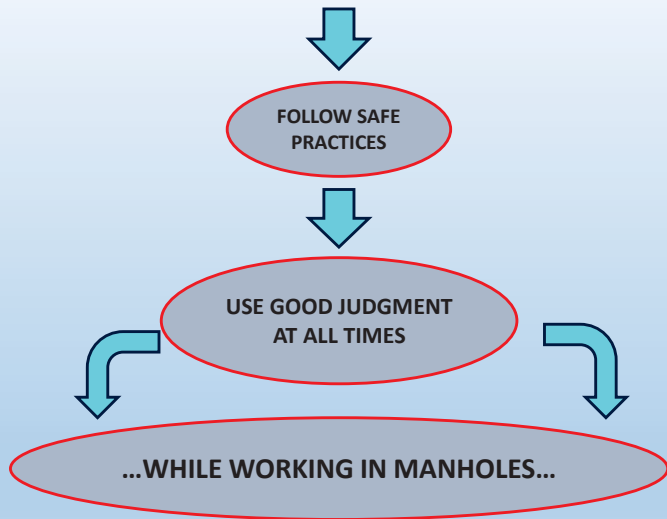
Safety Control and Measures for Sewerage and Drainage Works



Lecture Breakdown	Duration
Safety Equipment & Procedures	20 Min.
Precautions before Manhole Entry	
Procedure during Manhole Entry	
While Operator is in Manhole	
Special Problems relates with Manhole O&M	
After Leaving the Manhole	
Q&A	



Manhole – A Confined Space



Safety Equipment & Procedures

Self-Contained Breathing Apparatus (SCBA)



Ventilation Blower with Hose



Tripod



Manhole Enclosure



Portable Atmospheric Alarm Unit (Gas Monitor)



Safety Harness with Lifeline



Safety Equipment & Procedures

Winch		Hard Hats (Safety Helmet) with Removable Torch	
Ladders		Protective Clothing	
Ropes & Buckets		Cones + Barricades + High-Level Flags	

Safety Equipment & Procedures

First Aid Kit		Clean Clothes	
Fresh Water		RESCUE NO. 1122	
Soap			



Precautions before Manhole Entry

Health Conditions of Operator:

- ✓ Be in good health
- ✓ Be in sound physical condition
- ✓ Be free from alcohol or drugs



Required Tools + Materials + Equipment:

- ✓ Examine the condition of all required tools
- ✓ Arrange tools & equip. so that work must be accomplished with single entry & exit



Foreman or Crew Leader should Hold Briefing

- ✓ To explain about HSE rules
- ✓ To explain the work sequence
- ✓ To explain SOP



Manhole Entry Form

Date:	Structure Entering:	Location:
Person Entering:		
Supervisor:		
	Not Applicable	Complete
1. Unit Pumped Out		
2. Unit Ventilated		
3. Explosive Vapors Less Than 20% Of LEL		
4. Oxygen Content 19.5% Minimum		
5. H ₂ S Less Than 10 Ppm		
6. PPE and Rescue Devices		
a. Harness on Person Entering		
b. Lifeline Attached to Harness		
c. SCBA on Employee Entering		
7. Emergency Procedure Explained and Understood		
Send Original To Supervisor	Send Copy To Safety Officer	

Procedure during Manhole Entry

- Following procedure shall be adhered to:
- A confined space entry form shall be used to review the necessary precautions
 - All traffic control measures shall be taken
 - All valves or power sources shall be locked out
 - An initial test of the atmosphere must be performed
 - All persons who enter a confined space shall be instructed about hazards
 - All persons entering a confined space shall wear a rescue harness with attached lifeline
 - No smoking shall be permitted inside or within ten feet (10 ft.) of a confined space
 - At least one person shall remain outside the confined space while it is occupied
 - Atmospheric testing shall continue while the confined space is occupied
 - All persons in a confined space shall vacate immediately if the warning alarm is activated
 - A hard hat shall be worn at all times in a confined space

Operation of Manhole Entry

Following procedure shall be adhered to:

- Place the manhole safety enclosure around the manhole
- Calibrate the portable atmospheric monitor BEFORE removing the manhole cover**
- Test** the manhole from top to bottom for oxygen deficiency, explosive and toxic (hydrogen sulfide) gases
- Never use hands to remove the manhole cover**
- Open manholes** upstream and downstream from the work area
- Sweep the area before removing the manhole cover**
- Before entering the manhole start the ventilation blower
- Once the operator going into the hole confirm safety harness and lifeline is attached**
- Continue to use the atmospheric monitoring system

While Operator is in Manhole

Following procedure shall be adhered to:

- The end of the lifeline must be secured outside of the confined space
- Whenever an operator is in a manhole continuously test the atmosphere**
- The operator in the manhole must be observed continuously
- If there are any indications of trouble immediately remove the operator**



Special Problems of Manhole Work

Following problems may occur during working in manhole:

- Sharp odor or prolonged breathing of an odorous atmosphere will cause the sense of smell to be temporarily lost
- NEVER allow anyone to enter a manhole until the oxygen content tests greater than 19.5 percent oxygen**
- Victims suffering from a lack of oxygen may require artificial respiration if the case is severe



After Leaving the Manhole

Following steps should be taken after operation inside manhole:

1. Take hot shower.
2. **Put on clean clothes.**
3. Don't wear the clothing worn in manhole, at home.
4. **Never expose your family to any object which was in contact with your clothing.**
5. No clothing should be washed with the family laundry.





Questions & Answer Session:



Q. 01:

What should the **operator at the manhole** entrance be doing while another operator is in the manhole?

Q. 02:

What is the **minimum level of oxygen** in air for safe breathing?

Q. 03:

What should an operator do **after leaving a manhole**?



Contacts:



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In the name of Allah, the most Gracious and ever Merciful


Module 01

Safety Control and Measures for Sewerage and Drainage Works



Lecture Breakdown	Duration
Objectives	20 Min. 
Purpose of First Aid	
Phases of First Aid	
First Aid Rules	
Various Emergencies around Job Site	
Q&A	



Objectives

The objective of this lecture is to improve capacity of participants to render first aid in emergency situations

FIRST AID :

First aid is the assistance given to any person suffering a sudden illness or injury, with care provided to preserve life, prevent the condition from worsening, and/or promote recovery.

Purposes of First Aid

1. Prevent further injury
2. Preserve life
3. Promote recovery

Phases of First Aid

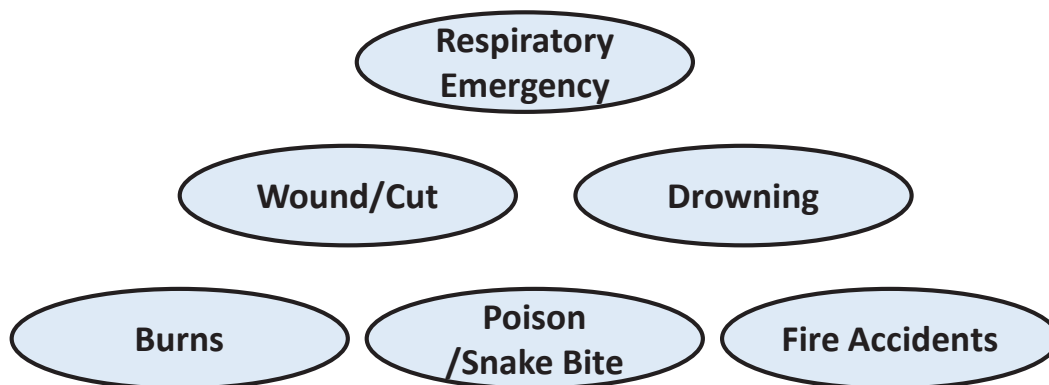
1. Self-aid
2. Assistance from a companion
3. Emergency treatment
4. Initial surgery

First Aid Rules



1. Do not get excited
2. Do not move injured victim unless it is necessary
3. Keep the victim lying down
4. Keep the victim warm and comfortable
5. Examine the victim gently
6. Avoid allowing the victim to see his own injury
7. Do not try to give any solid or liquid substance by mouth
8. Do not touch open wounds or burns with fingers or other objects
9. Seek medical attention immediately

Various Emergencies around Job Site



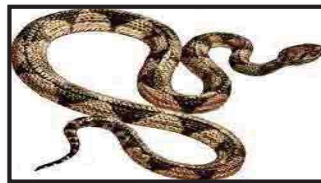
Respiratory Emergency

- Common Causes
- Signs & Symptoms
- First Aid Measures



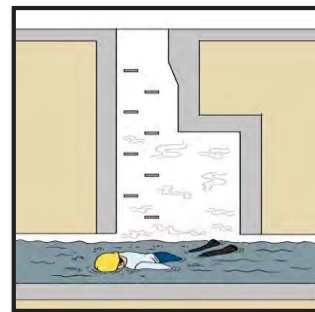
Snake Bite

- Signs & Symptoms
- First Aid Measures



Drowning

- First Aid Measures



Wound

- Common Causes
- First Aid Measures



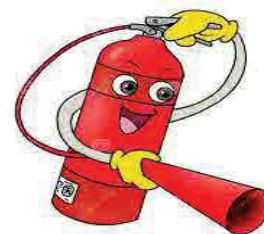
Burns

- First Aid Measures



Fire Accidents

- Fire & Causes
- Fire Suppression
- Fire Extinguisher



Q. 01:

How to provide first aid to a sanitary worker who is severely affected by **manhole gases** during desilting operation?

Q. 02:

What items should be available in **first aid kit** ?

Q. 03:

How to provide first aid to a sanitary worker who is **drowned in a manhole**?

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**Thank
You!!!**



In the name of Allah, the most Gracious and ever Merciful

Module 01

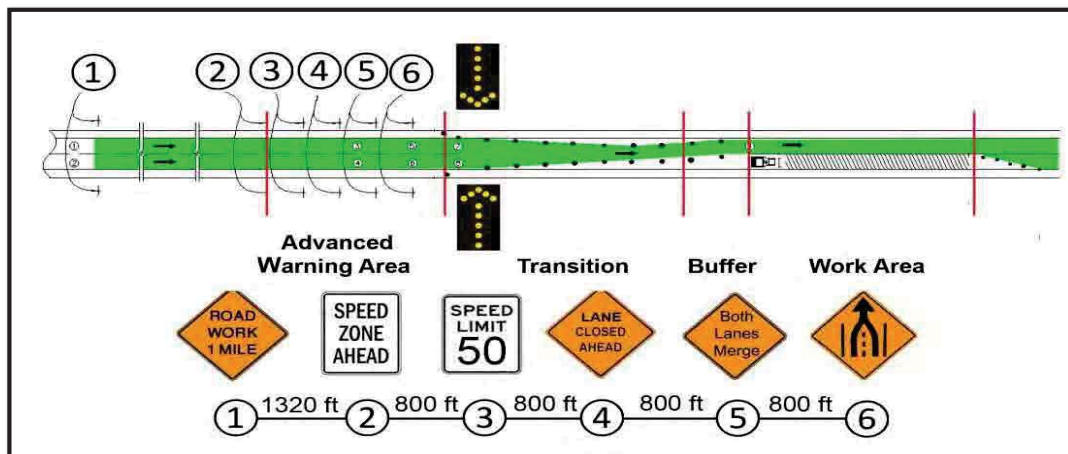
Safety Control and Measures for Sewerage and Drainage Works



Lecture Breakdown	Duration
Objectives	30 Min.
General Conditions	
Traffic Control Criteria	
Areas of Traffic Control	
Traffic Control Devices	
Q&A	



Traffic Routing Layout



Objectives of Routing Traffic Around Job Site

To Create a Safe zone for WASA Staff + Machinery + Tools & Equipment :

Who are busy at or near the roads in operation and maintenance works e.g.

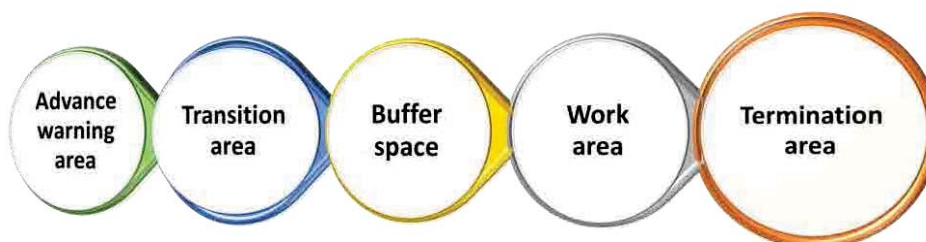
- ✓ Manhole de-silting,
- ✓ Drain dredging,
- ✓ Replacement of sewer pipe

Routing Traffic Criteria

Answers to several questions will determine traffic control criteria around the WASA work site:

- Is traffic moving at a low speed (0-60 Km/Hr.) or a high speed (60-90 Km/Hr.)?
- Is the road two-lane, one-way or two-way?
- Is it undivided four-lane?
- Is it multi-lane one-way?
- Are pedestrian walkways affected?
- Is it in a residential area?
- Will a lane closure be required?
- Will more than one lane be closed?
- Will traffic control be required during peak traffic periods or at night?

Areas of Traffic Control



1 - Advance Warning Area

- The purpose of this area is to **alert drivers** to activity ahead.
- Allow them enough time to alter their driving patterns prior to reaching the work area.

2 – Transition Area

- Traffic is channeled** from the normal traffic lane to the path required to move it around the work area

3 – Buffer Space

- This zone provides an **additional margin** of safety for both traffic and working operators

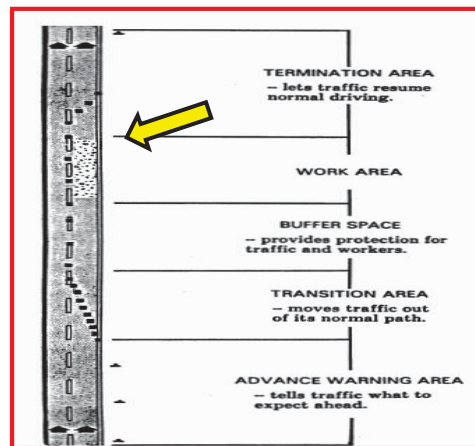
4 – Work Area

- Work area is that portion of the road which contains the **work activity** and equipment, is closed to the traffic

5 – Termination Area

- This area provides a short distance for traffic to **get clear of the work area** and to return to the normal traffic lanes

Pictorial Views of Traffic Routing

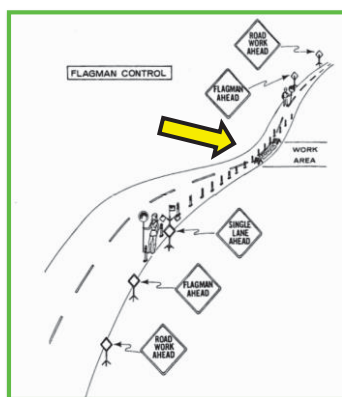


Module-1 Lecture-7 Traffic Control Plan

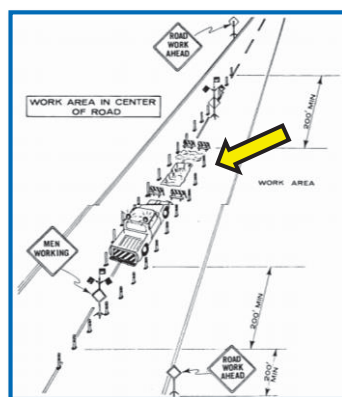
General Layout

9/16

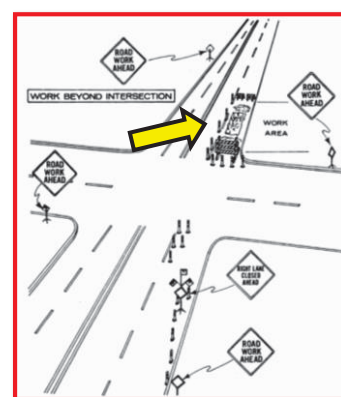
Pictorial Views of Traffic Routing



Flagman Control



Work Area in Center of Road

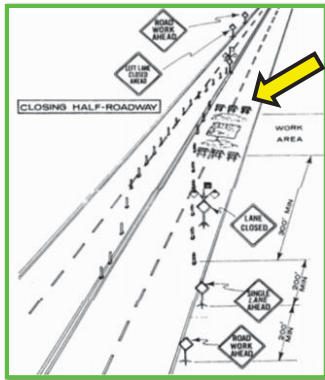


Work Beyond Intersection

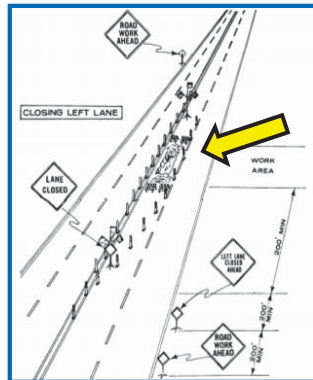
Module-1 Lecture-7 Traffic Control Plan

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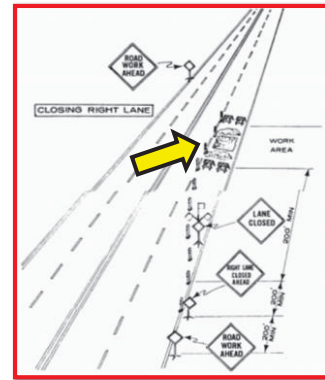
Pictorial Views of Traffic Routing



Closing Half-Roadway



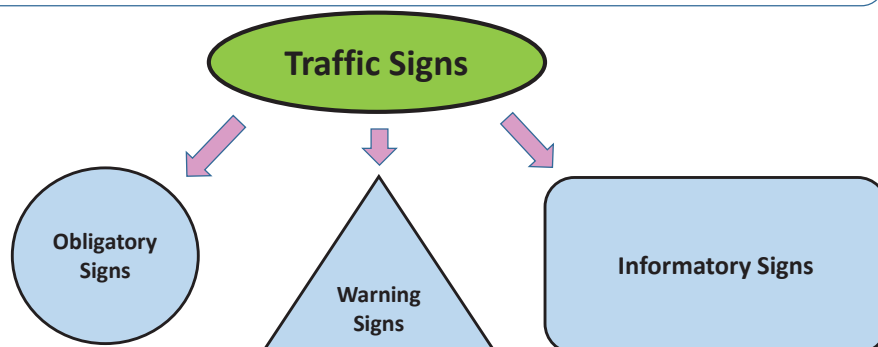
Closing Left Lane



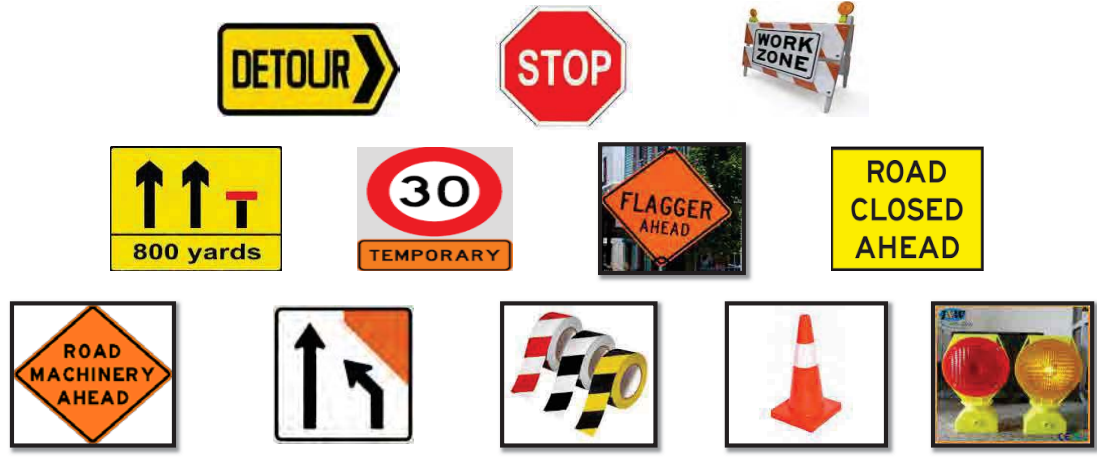
Closing Right Lane

Traffic Control Devices

Traffic control devices are **markers, signs** and **signal devices** used to inform, guide and control traffic, including pedestrians, motor vehicle drivers and bicyclists



Traffic Control Devices



Questions & Answer Session:

- Q. 01:**
Who should be **contacted** before setting up a work site at a Road?
- Q. 02:**
How can **traffic be warned** of your presence at a road?
- Q. 03:**
How can motorists be **safely routed** around a job site?



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THANK YOU!





HSE Action Plan Module 01

ACTION PLAN

A	DESCRIPTION OF PROBLEM						
1	Description of Problem						
	Date						
2	Type / Rating of Hazard		Major		Probable Outcomes		
			Moderate				
			Minor				
3	Hazard Discovered Through		Inspection	Near Miss	Accident	Any Other	

B		IMMEDIATE ACTION			
1	Date of Response	Take Immediate Action	Remove Hazard	How?	
			Isolate Hazard	How?	
			Restrict the Access	How?	
			Erect Signage	How?	
			Any Other	How?	
2	Finding Root Cause	Apply "5Whys" Methodology			
3	Contributing Reasons / Causes	Lack of Training	Un-Safe O&M Method	Ignorance	
		No Use of PPE	Lack of Proper Tools	Willful Misconduct	
		Improper House Keeping	Improper Maintenance	Any Other	

C - Action Plan Template

Sr. No.	WHAT TO DO?	HOW TO DO?	WHEN TO DO?	WHO TO DO?		DO WITH WHAT?		CHECK DONE?	WHO TO CHECK?
	Preventive Action	(Follow SOP)	(Frequency)	(Carried out By)		Materials	Tools/ Equip.	How to Check?	Effectiveness to be Checked By?
				Class of Work	Worker				

C- Action Plan Template

Sr. No.	Due Date	Date Complete	Date Verified	Any New Risk / Hazard Developed	

D- SIGNATURES			
Implementer Name		Signature	
Authority Title		Signature	

O&M of Drainage System



O&M of Drainage System

- Components
- O&M Objectives

Strategy for Improvement

- Sensitizing Senior Decision Makers
- Assessing the Existing Facilities
- Identification of Factors affecting Quality of Maintenance
- Snags in Management
- Immediate Action Plan
- Long term Action Plan



Course

Operation and Maintenance (O&M) of Sewer & Storm Water Drainage System including Safety Precautions

Module 2

O&M of Storm Water Drainage System

Lecture 1

Need for O&M of Storm Water Drainage System

1. Storm Water Drainage System and its Components
2. Current Issues
3. Sediment Deposition
4. Need for O&M
5. Maintenance of Drains



➤ Receives runoff from inlets and conveys the runoff to some point where it is then discharged into a channel, water body, or piped system

- It may be a
- closed-conduit
 - Open channel

➤ “Storm sewer” replaced with the term "storm drain" to differentiate between sanitary sewers and storm drains

- ❑ A **drainage pipe** used to convey a stream through a road or embankment
- ❑ It may carry a stream for a long distance underground to a surface discharge location
- ❑ **Short in length** and **open at both ends** and often must withstand substantial traffic loads



Ditch

- ❑ Ditches are constructed to convey water from storm runoff to an adequate outlet.
- ❑ A good ditch is shaped and lined and does not cause flooding, erosion, or sedimentation.



Gutter



- ❑ That portion of the roadway section adjacent to the curb which is utilized to convey storm water runoff.



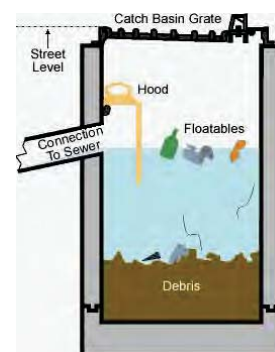
A location where storm water runoff from an open area enters the storm drain system.



Drop inlets are usually part of the public drainage system, but can sometimes be considered private.

A structure in the form of a chamber which is provided along with the sewer line to admit clear rain Water free from silt, grit, debris, etc, into the combined sewer

Allows rainwater runoff to be safely collected to prevent road and property flooding





Encroachment of drains



Silting of drains due to constant blockages



Stability of drainage cross-sections dislocated and damaged old lining of the drains



Unpleasant odor of dirty water flowing in the drains

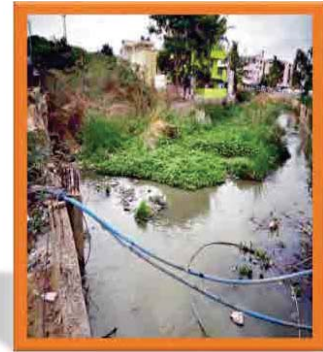
Absence of comprehensive data on storm-water drainage network

Inadequate attention to cleaning of natural drains and clearance of excess floral growth on the drains

Free access to dispose wastewater from nearby habitation

Due to the sediment deposition the problems occurred in the **open channel** includes:

- Encourages prolific weed growth
- Cause flooding of various degrees of magnitude
- Ponding of water creates breeding grounds for some disease causing agents
- Silted roadside drains produce ponding on roads



In the case of **buried or completely covered** storm channels, problems occurred are:

- Silting + Weed Growth + Bushes
- Release & accumulation of gases (that can be highly corrosive to the channel material)



Lack of regular maintenance cause the accumulation of the sediment and garbage in the drain

Extensive, regular sediment removal is a difficult and expensive process

Routine inspection and preventive maintenance are the best ways to prevent blockages and deterioration of drains

Departments should devise maintenance procedures including:

- Frequency of inspection
- Programme for dredging
- Necessary repair works
- Documentation for maintenance records





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THANK YOU!





Course

Operation and Maintenance of Sewer & Storm Water Drainage
System Including Safety Practices

Module 2

Operation and Maintenance of Storm Water Drainage System

Lecture-2

Tools and Equipment for Drain Dredging Operations

Contents

- Hydraulic Excavator
 - Excavation Buckets
 - Variations of Excavators

- Silt Pusher Boat
- Cutter Suction Dredger
- Dredge Pump



- Excavators (Hydraulic Excavators) are heavy construction equipment consisting of a boom, dipper (or stick), bucket and cab on a rotating platform known as the "house"
- All movement and functions of a hydraulic excavator are accomplished through the use of **hydraulic fluid**, with hydraulic cylinders and hydraulic motors



Digging Bucket

- Excavates materials using a pulling movement
- It is often implemented to remove thin layers of silt



Dredging Bucket

- Slightly different from standard buckets
- Characterized by holes that retain silt while allowing water to escape



Visor Bucket

- Traditional excavation bucket
- Excavate thin and very dense layers with low water content

Clamshell

- ❑ Operates using a gripping movement
- ❑ Excavate thick layers of silt and for transferring materials
- ❑ Layer thickness must be at least 0.5 m in order to achieve reasonable productivity



Environmental Grab Bucket

- ❑ An alternative type of grab bucket
- ❑ Enables an almost horizontal closing movement
- ❑ The maximum opening is circa 80% larger than a traditional grab bucket
- ❑ Relatively thin layers can also be excavated efficiently

Backhoe

- ❑ It has emerged as a suitable workhorse for soils:
 - glacial tills
 - fragmented or softish, crumbly rock
 - variety of non-rock types of soils that have stones
- ❑ May be used for dredging relatively small quantities of material that are at varying depths
- ❑ Often used for bulk dredging of a variety of sediments



A wide range of variations have been developed for hydraulic excavators over the years due to:

- Height restrictions
- Propulsion issues
- Insufficient access to the water bottom

The following variations can be encountered:

- Excavator boat
- Amphibious Excavators
- Tractor with Side-Arm



Excavator Boat



Amphibious Excavator



Tractor with Side-Arm

- ❑ A silt push boat is like a floating bulldozer, which has been developed especially for cleaning ponds, lakes and small waterways
- ❑ The machine is primarily used in situations where it is difficult to work from the water's bank



Range of Applications

- Primarily suitable for soft water bottoms (silt, clay, turf, mud, etc.)
- Effective on relatively long, straight waterways
- It can also be used for thicker layers.
- Only effective in relatively shallow waters.
- Depending on the dimensions of the machine, it is possible to work in **Depths of up to 2 m**
- Machine becomes unsuitable when depths exceed 3 m

- ❑ A cutter suction dredger is a dredging machine that is used in continuous excavation processes and is positioned using spud poles or winch cables



Range of Applications

- Generally only suitable for silt, clay and sand.
- Depending on the dredger design, be used up to **6 m deep**
- The soil type and project conditions must be known for each project
- For **harder bottoms** (i.e. sand), a cutter with larger cutting sections must be selected in order to penetrate the layer of sand

- ❑ Used to suck dredging materials from the water bottom
- ❑ The pump's suction opening is guided through the center of ditches to maximize contact with dredged materials
- ❑ Dredge pumps can be mounted to a tractor or crane, or can also be placed on a boat



Range of Applications

- Only suitable for soft water bottoms (silt, turf, etc.)
- Suited to waterways with non-polluted silt
- **Cutter** can also be attached for dredging more solid water bottoms
- Dredge pumps are **susceptible to stones** and **branches**, which could block the opening
- Less suited to dredging activities in urban settings



Dredge Pump



Observations

Module-2 Lecture-2

13/15



Module-2 Field Visit-01 (Observation of De-Silting Machinery)



Date:
Day:
Field Visit Site:
Temp.

Name:
Designation:
WASA/TMA:

Sr. No.	Machinery					Attachment(s)		Remarks
	Name/Type	Nos.	Manufacturer /Year	Capacity (Tons)	Fuel Consumption (Liters/day)	Name/Type	Capacity (Tons)	
1.								
2.								
3.								
4.								
5.								
6.								
7.								

Module-2 Lecture-2

14/15



Contacts:



Name	Designation	Contact No.	E-Mail
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Mr. Muhammad Irfan	Course Leader		
Mr. Rizwan Qazi	JICA Coordinator		
Mr. Syed Fahad Hussain	Young Professional		



THANK YOU!



Observations



Module-2 [Field Visit-01] -Observation of Drain De-Silting Machinery-



Date:
Day:
Field Visit Site:
Temp.

Name:
Designation:
WASA/TMA:

Sr. No.	Machinery					Attachment		Remarks
	Name/Type	Nos.	Manufacturer /Year	Capacity (Tons)	Fuel Consumption (Liters/day)	Name/Type	Capacity (Tons)	
1.								
2.								
3.								
4.								
5.								
6.								
7.								



In the name of Allah, the most Gracious and ever Merciful



Course

Operation and Maintenance of Sewer & Storm Water
Drainage System including Safety Practices

Module 2

Operation and Maintenance of Storm Water Drainage
System

Lecture 3

Measurement of Sludge Quantity in Drains

Class Work
Field Work

Documents
Equipment & Tools
PPE

- Presentation + Discussion on Current Practices
- Estimation of Deposited Sludge
(at Maulana Shaukat Ali Drain, Akbar Chowk, Township)
- Drain map of area + Templates
- Ranging Rod + Aluminum Staff + Distance Meter+ Road Signs + Traffic Cones etc.
- Helmet + Goggles + Hand Gloves + Safety Shoes + Gum Boots



Module-2 Lecture-3 (Measurement of Sludge Quantity in Drains)

3/19

- Need of Measurement of Sludge Quantity in Drains
- Equipment
- Procedure
- Sludge Volume Calculations
- Observations

Module-2 Lecture-3 (Measurement of Sludge Quantity in Drains)

4/19

- To **prevent** excessive sediment built-up
- No **standard method** of measuring the sediment build-up
- A **regular monitoring** programme and measurement tools will ensure that the depth of accumulated sludge is accurately measured
- Inconsistent and **inaccurate readings** of sediment accumulation could result in too frequent maintenance

1- Staff with Disc

- Consists of a rod with a flat disc (welded to its base)
- The depth of sludge is measured off the graduations on the rod
- This will then be used to find the actual sediment depth

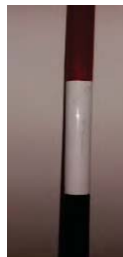


Advantages

- Portable and cheap
- Need minor maintenance
- Can be used in any type of drain



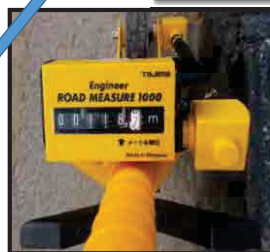
- Ranging Rod (6 feet Height)
- Colour Coded
- Each Segment is 01 Foot Long
- Metal Conical Tip for Penetration in Sludge



Step 01



Before Measurement (Reading 0-0)



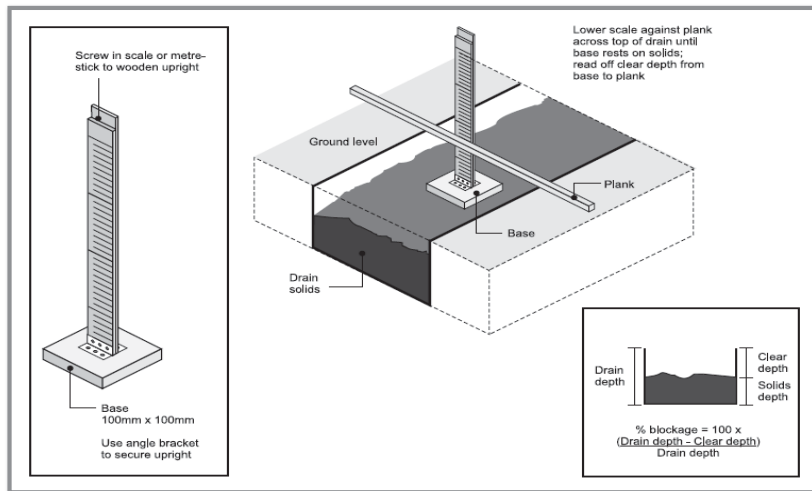
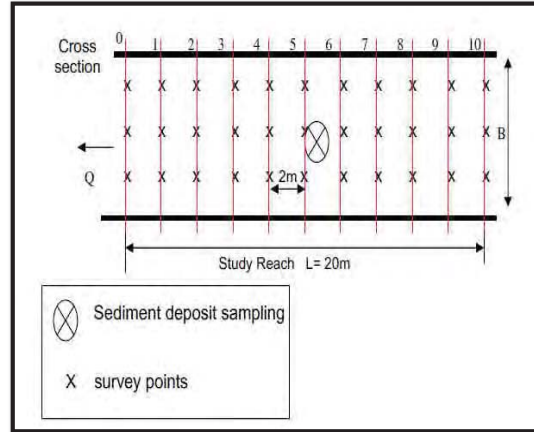
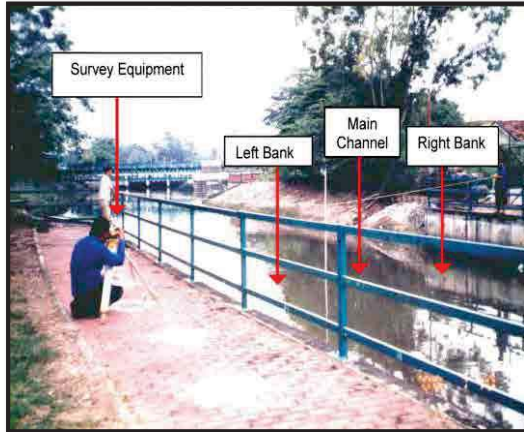
Lo = 119 m

Step 02



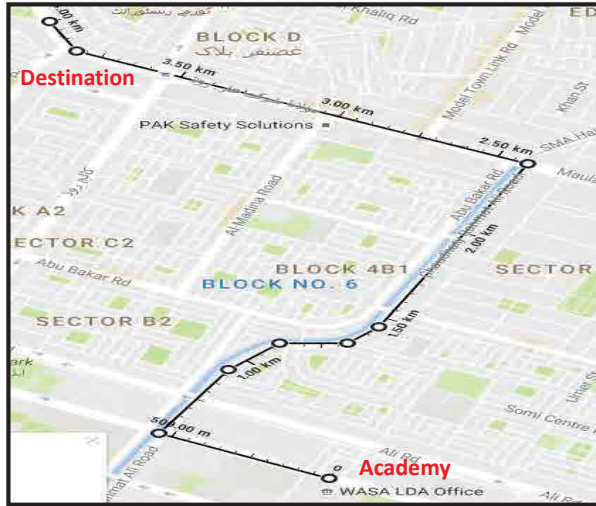
Li = 115 m

Step 03



1. First **select the venue** where you have to do dredging or sediment thickness measurement
2. Select some **culvert or bridge**
3. Properly apply **traffic control plan**
4. Ensure that each worker has worn the proper **safety gadgets**
5. Find out the **dimensions** of the drain i.e. Length Width and Depth
6. **Mark** the stations on the drain

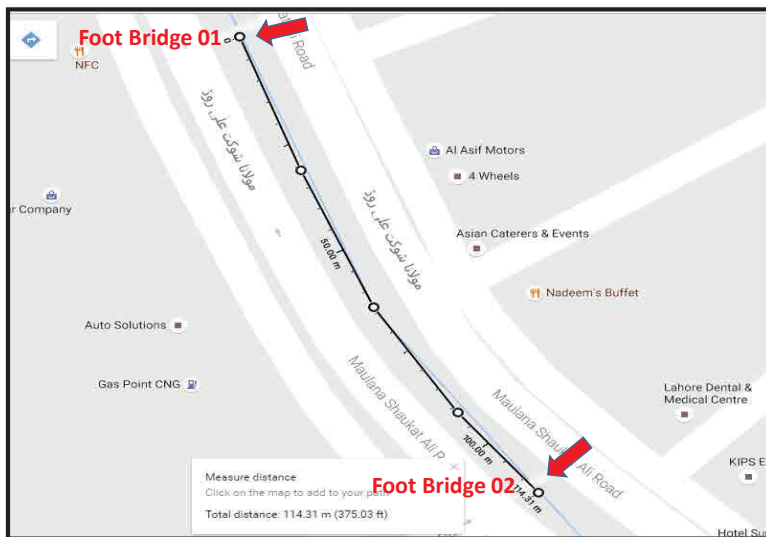
7. Two persons at both banks of the drain are required
8. **Find the depth** by using staff having graduations on it
9. Find out the **capacity of dump truck** for transporting sludge
10. **Calculate the number of trips** by dumper from dredging to disposal site
11. Also calculate the **time required by the dumper per trip** and total time for overall operation
12. If the **cleaning along the road** is required because of spillage of waste then clean that



Road Map for Sludge Measurement Site

Maulana Shaukat Ali Road (Near Shauk Chowk)

Distance: 4.0 Km
Travel Time: 10 Min.



Top View of Field Work Area (Sludge Measurement Site)

Maulana Shaukat Ali Road (Near Shauk Chowk)

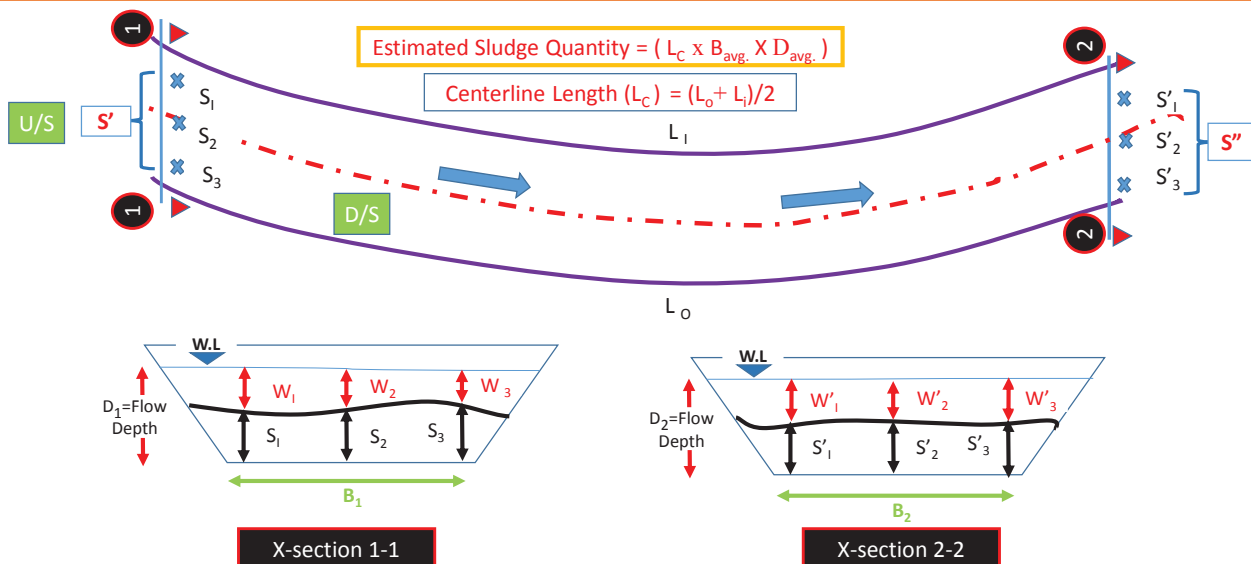
Foot Bridge 01



Foot Bridge 02



Maulana Shaukat Ali Drain (Secondary Type)



Depth at Foot 1 $s_n = (D - W_n)$	Avg. Depth at Foot 1 S_{avg}	Depth at Foot 2 $s_n = (D - W_n)$	Avg. Depth at Foot 2 S'_{avg}	Overall Avg. Depth D_{avg}	Width at Foot 1 B_1	Width at Foot 2 B_2	Avg. Width B_{avg}	Length Inner L_i	Length Outer L_o	L_c	Sludge Volume V
S_1		S'_1									
S_2		S'_2									
S_3		S'_3									

$D_1 =$	<p>Estimated Sludge Quantity (Vol.) $= (L_c \times B_{avg} \times D_{avg}.)$ <small>CUM or CFT</small></p>	<p>$L_c = (L_o + L_i) / 2$ (if drain stretch is curved) $S' = (S_1 + S_2 + S_3 + \dots) / n$ $S'' = (S'_1 + S'_2 + S'_3 + \dots) / n$ $D_{avg.} = (S' + S'' + S''' + \dots) / n$ $B_{avg.} = (B_1 + B_2 + B_3 + \dots) / n$</p>
$D_2 =$		

Sr. No.	Observations	Remarks
1.	Type of de-silted material	
2.	Flow conditions before the dredging	
3.	Flow conditions after the dredging	





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THANK YOU!





Course

Operation and Maintenance of Sewer & Storm Water
Drainage System Including Safety Practices

Module 2

Operation and Maintenance of Storm Water Drainage System

Lecture 4

Dredging and Desilting Operations

1. Small Scale Dredging

2. Critical Processes in Small Scale Dredging

3. Dredging Process

4. Dredging Techniques & Case Study

5. Selection Criteria for Dredging Techniques

6. Workplace Worksheet and Traffic Control

Small-scale dredging projects generally involve drainage channels and modified rivers in areas with artificial (pumped) drainage and smaller urban and suburban waterways, which are not used for shipping activities



- ❑ **Accessibility** along and in channels and lakes
- ❑ Logistics and transport of material in populated areas (traffic)
- ❑ **Limited space** for disposal of sediment and waste
- ❑ Sensitive project environment:
 - hinder to surroundings
 - highly visible
 - public opinion and interest
- ❑ (Old) embankments, low bridges, etc.
- ❑ **Household waste & objects**



Excavation

Process involves the:
Dislodgement;
Removal of sediments (soils) and/or rocks

Dredger – is used to excavate the material either:

- Mechanically
- Hydraulically
- By combined action

Transportation

Transportation of dredged material is achieved by:

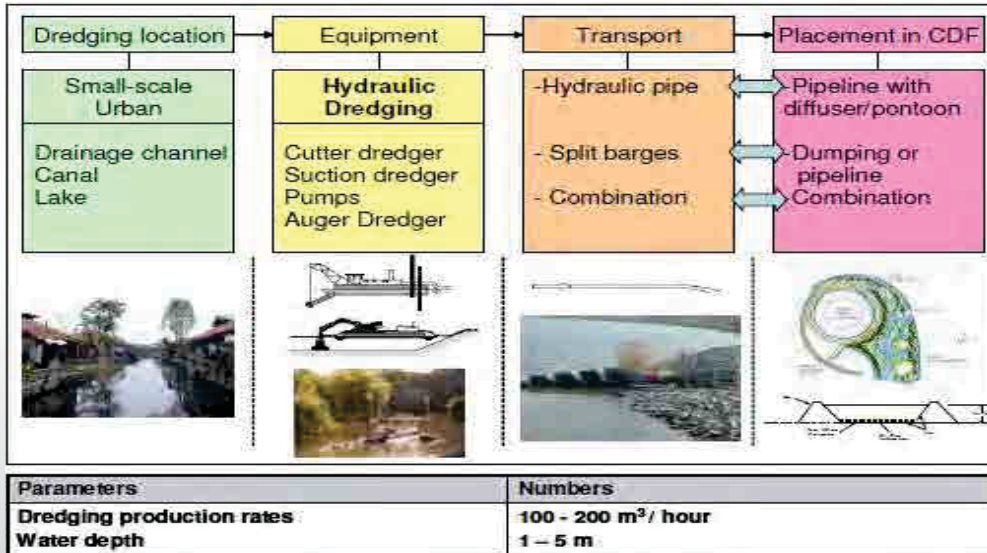
- In self-contained hoppers of the dredgers;
- In barges;

Rarely used transport methods are:

- Truck
- Conveyor belt

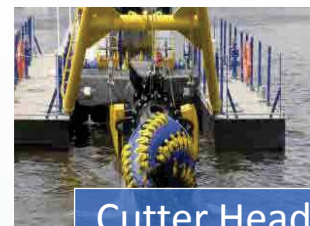
Utilization or Disposal

- In **construction projects**, dredging is driven by the demand for dredged material.
- In **navigation and remediation dredging**, the project is driven by the objective of removing the material from its original place



Hydraulic Dredging

- Used for maintenance dredging projects
- Removal of loosely compacted materials by cutter heads, dustpans, hoppers, hydraulic pipeline, plain suction, and side casters



Cutter Head

Mechanical Dredging

- Used either for maintenance or new-work projects
- Removal of loose or hard compacted materials by clamshell, dipper, or ladder dredges



Clamshell

While selection of dredging technique, the following factors must be taken into consideration:

- Composition of dredged materials
- Type and level of pollution
- Size of project
- Acceptable opacification and spillage
- Required accuracy
- Side-effects
- Ecological considerations



Work Report No: Date:

District:

Zone: Road No:

Section: From km to km

Location (s):

WORK ACHIEVED:

.....

MANPOWER USED:

Name..... Grade..... Hour Worked.....

Name..... Grade..... Hour Worked.....

Name..... Grade..... Hour Worked.....

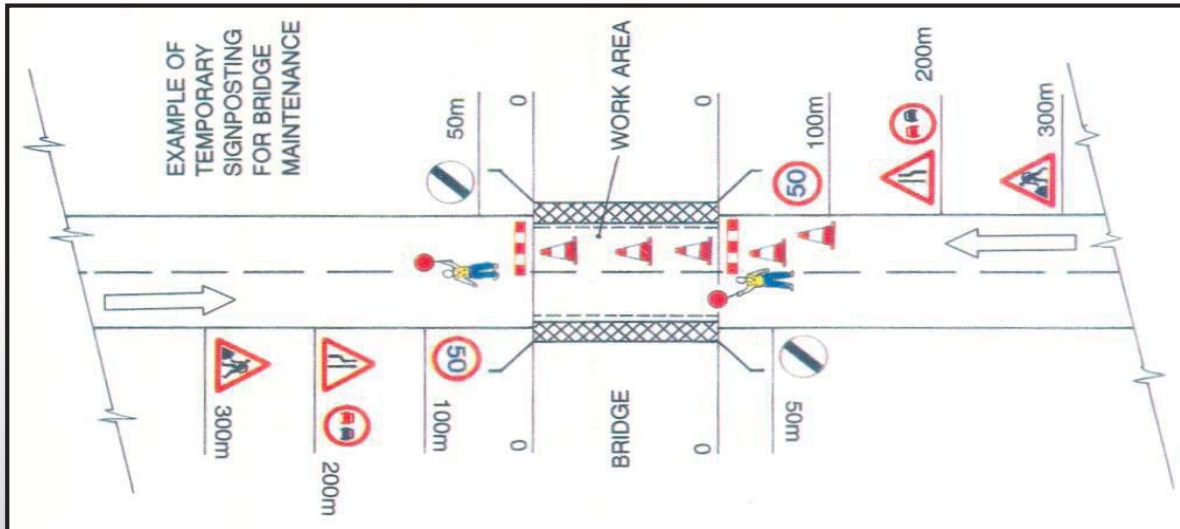
EQUIPMENT USED: DIESEL USED

Hrs..... Liters

Hrs..... Liters

MATERIALS USED:

.....



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Course

Operation and Maintenance of Sewer & Storm Water Drainage
System Including Safety Practices

Module 2

Operation and Maintenance of Storm Water Drainage System

Lecture 5

Maintenance of Storm Water Drainage System

2/22

- O & M Plan
- Maintenance Activities for Road Drainage
- BMPs for Storm Water Drainage System
- BMPs for Dredging

O & M Plan

- Define the Area to be Covered
- Identify Problem Areas
- Set an Inspection Schedule
- Assign Responsibility for Inspection
- Define What Categories of Work will be Performed Under this Program
- Identify Parties Responsible for Debris Removal
- Keep Records
- Budget



Storm water system feature	Are any of these conditions present?	Problem	Recommendation
General	Dumped yard wastes or no degradable materials (glass, plastic, Styrofoam, etc.) are present in pond	Accumulation of trash and debris	Remove trash and debris and dispose of properly.
	Undesirable vegetation is invading the pond	Nuisance, poisonous, or noxious weeds	Seek advice from the Dept. of Agriculture before applying pesticides. Certain pesticides should not be used near waterbodies.

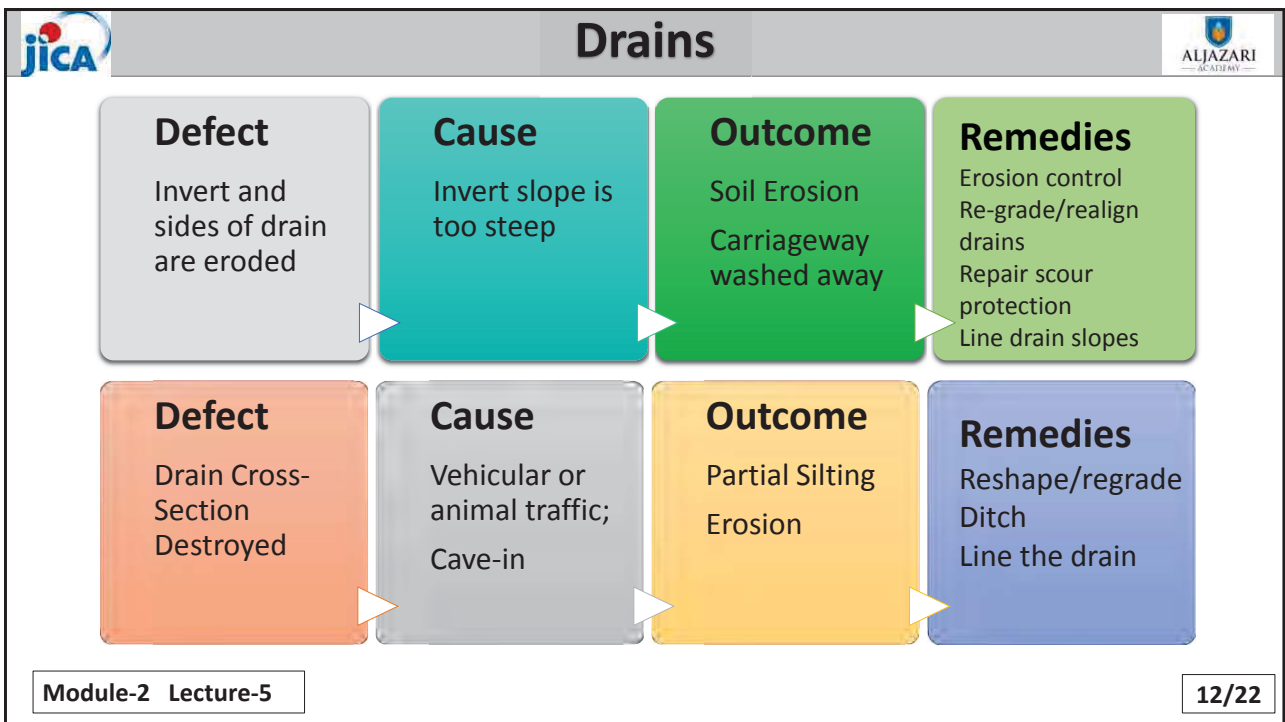
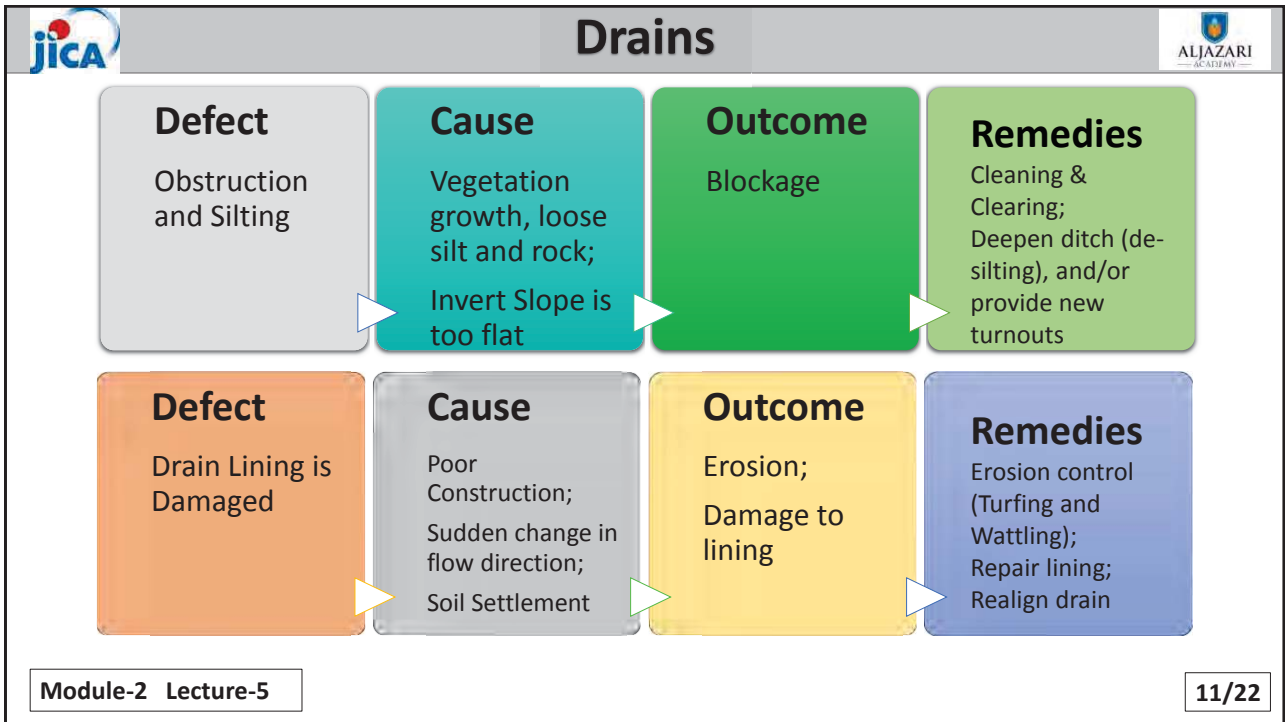
Storm water system feature	Are any of these conditions present?	Problem	Recommendation
General	Grass is taller than 10"m	Overgrown vegetation	Mow grass regularly. Grass should be mowed to a height of 4-9" for best storm water control. Avoid over-applying fertilizers. Excessive fertilizer application may compound water quality problems.
	Offensive color, odor, or sludge is present	Unknown or uncharacteristic substances	Remove substance and eliminate its source. If you don't know if the substance is hazardous, either take a sample or contact a qualified hazardous waste consultant for more information.
	Excessive mosquito population is present	Mosquitos	Install predacious bird and bat nesting boxes to control insects

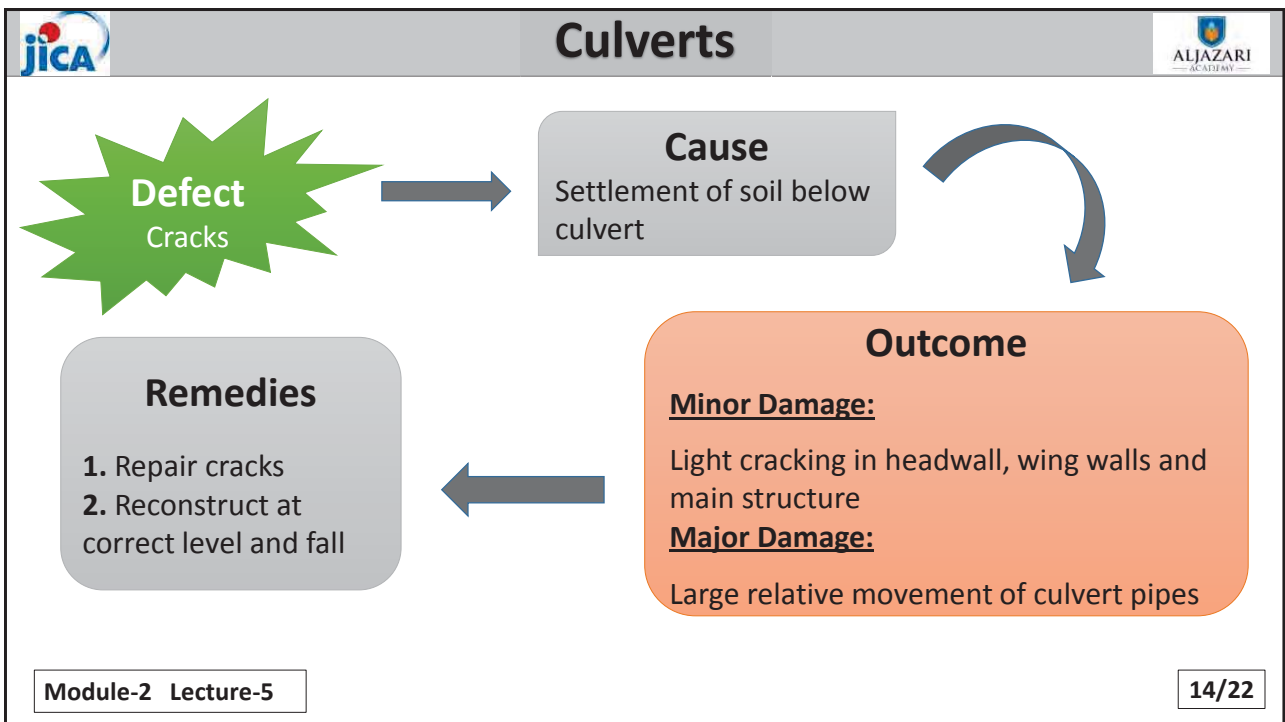
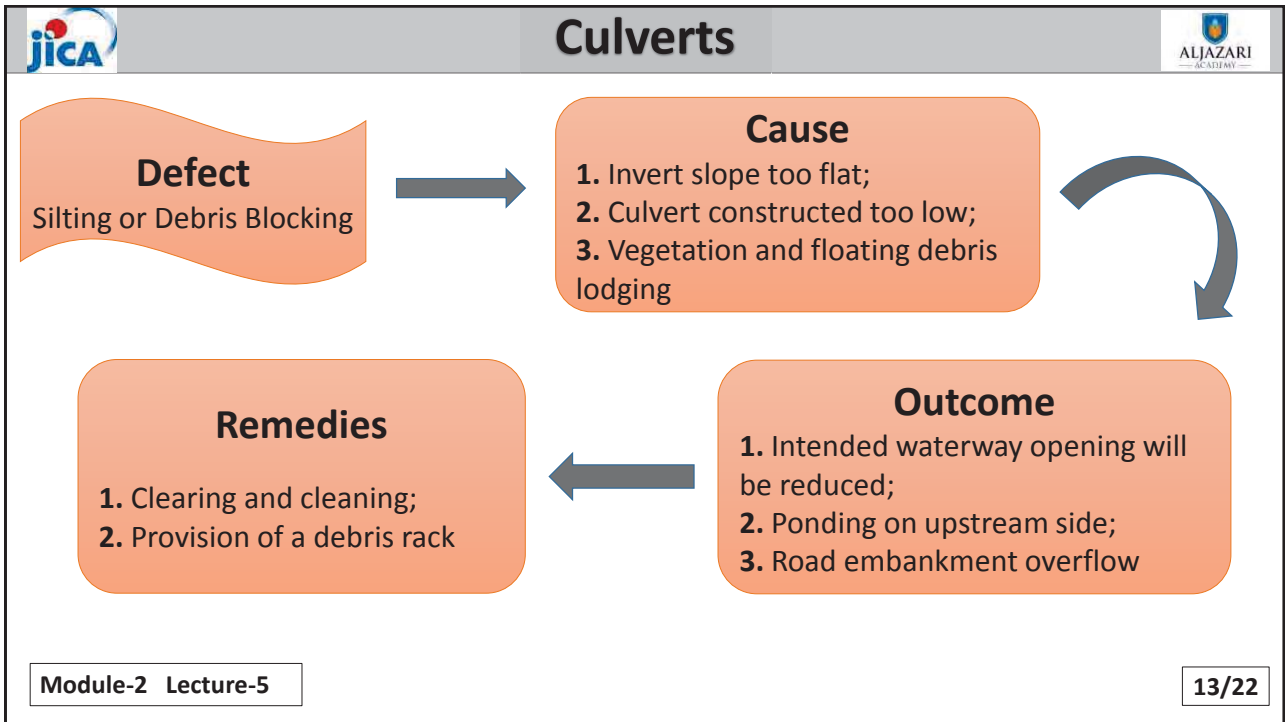
Storm water system feature	Are any of these conditions present?	Problem	Recommendation
General	Water flows through holes in dam or berm; holes are present around pond	Rodents	Destroy rodents and repair dam or berm.
	Large trees interfere with maintenance activities	Overgrown trees	Remove trees that interfere with access or maintenance activities. Preserve trees that are not a problem
	Accumulated sediment exceeds 10% of the designed pond depth	Excessive sediment	Clean out sediment to original shape and depth of the pond. Re-seed pond, if necessary, to control erosion.

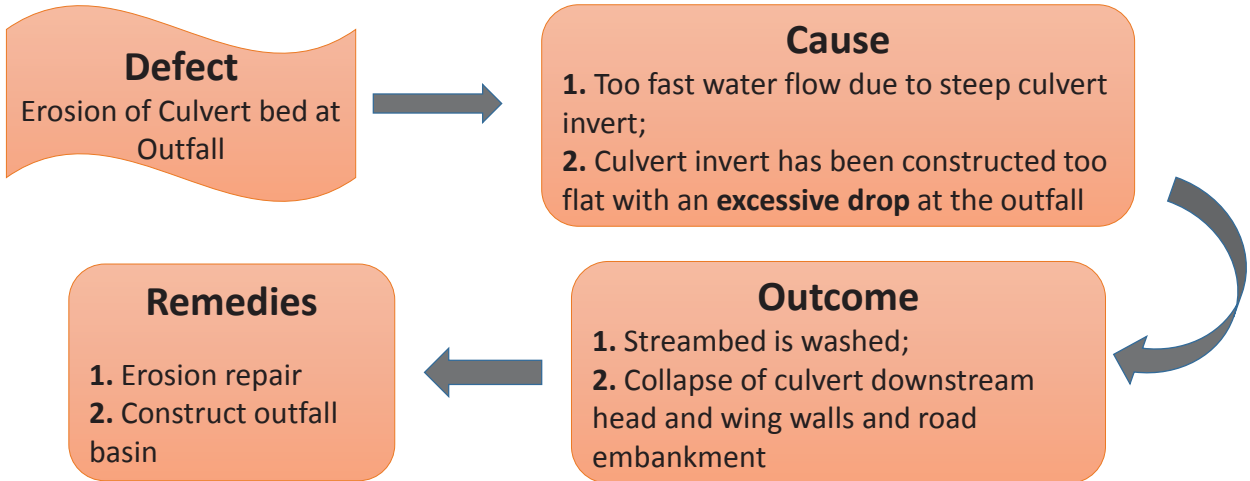
Storm water system feature	Are any of these conditions present?	Problem	Recommendation
General	Accumulated sediment or trash exceeds 20% of the diameter of the pipe	Excess accumulation of sediment or trash	Clean out sediment and trash from pipe. You can use a high pressure hose, vacuum suction, or other appropriate cleaning method.
	Vegetation is impeding water flow	Overgrown vegetation	
	Pipe is rusted; protected coating is damaged	Corroded pipe	Replace or repair pipe to original design specifications.
	Dent in pipe has reduced the pipe diameter by 20%; water flow is impeded; pipe is broken	Defective pipe	
	Water is leaking from pipe	Cracked pipe	

Maintenance Activities for Road Drainage









BMPs for Storm Water Drainage System

Municipal staff should regularly inspect facilities to ensure the following:

- Immediate repair** of any deterioration
- Cleaning before the sump is **40% full**
- Clean structures in **high pollutant load areas** just before the wet season
- Keep **accurate logs** of the number of catch basins cleaned
- Record** the amount of waste collected
- Store wastes** in appropriate containers or temporary storage sites



- ❖ Consider modification of storm channel characteristics to:
 - Improve channel hydraulics,
 - Increase pollutant removals, and
 - Enhance channel/creek aesthetic and habitat value.
- ❖ Conduct channel modification/improvement in accordance with existing laws.



- ❑ Regularly inspect and clean up hot spots
- ❑ Establish a system for **tracking incidents**. The system should be designed to identify the following:
 - Illegal dumping hot spots
 - Types and quantities (in some cases) of wastes
 - Patterns in time of occurrence
 - Mode of dumping
 - Responsible parties
- ❑ Post “**No Dumping**” signs in problem areas with a phone number for reporting



BMPs for Dredging

- Installation of **temporary silt fence**
- Fence shall remain in place for the duration of the maintenance dredging activity
- Stop the activity if watercourse flows are encountered
- Accumulated silt** shall be removed to the greatest extent possible
- Dredging shall be conducted with hand tools and/or a tracked equipment



- Dredging shall be held to the absolute minimum necessary to achieve the target channel width, depth and gradient
- The channel banks shall be sloped such that the resulting channel banks are stable
- Maintenance dredging shall not straighten or shorten the existing channel alignment
- Woody material embedded in the channel bank shall be left undisturbed and intact





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THANK YOU!



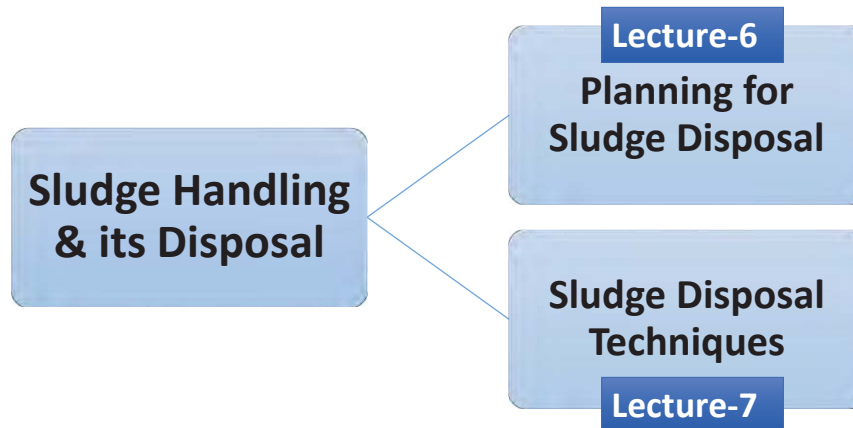


Course

Operation and Maintenance of Sewer & Storm Water Drainage System Including Safety Practices

Module 2

Operation and Maintenance of Storm Water Drainage System



Contents

- Importance of Site Selection
- Early Considerations
- Requirements for Site Selection
- Screening Process for Site Selection
- Site Selection Criteria
- Factors to be considered for Criteria



- ❑ Minimizes the future impact on public health
- ❑ Reduces the cost of:
 - Design and Construction
 - Operation
 - Maintenance



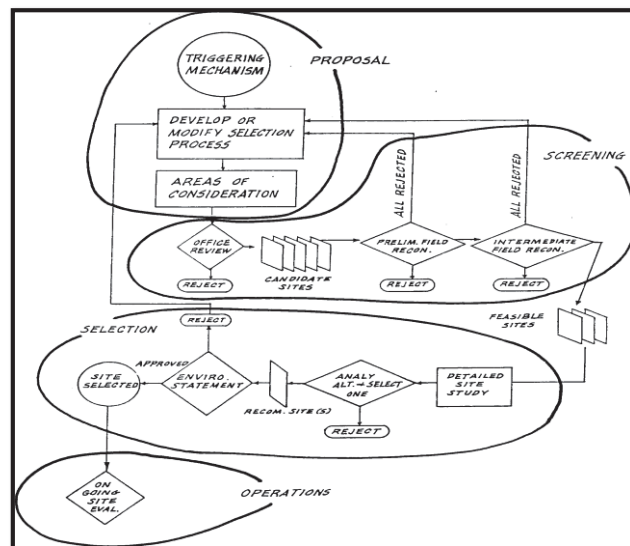
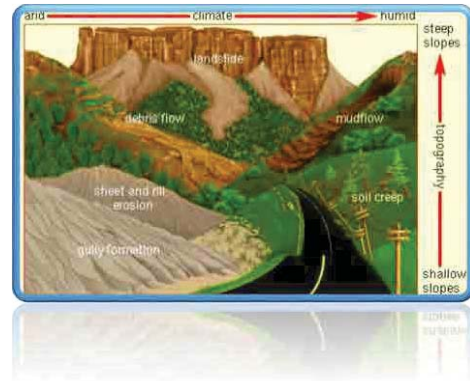
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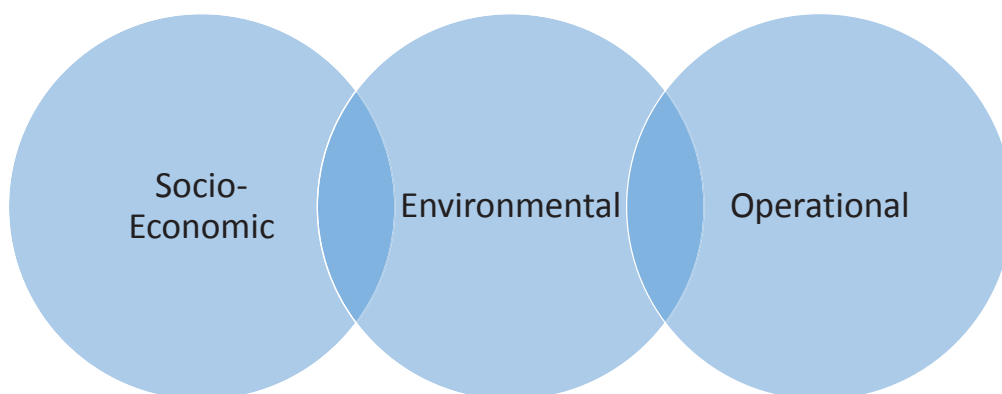
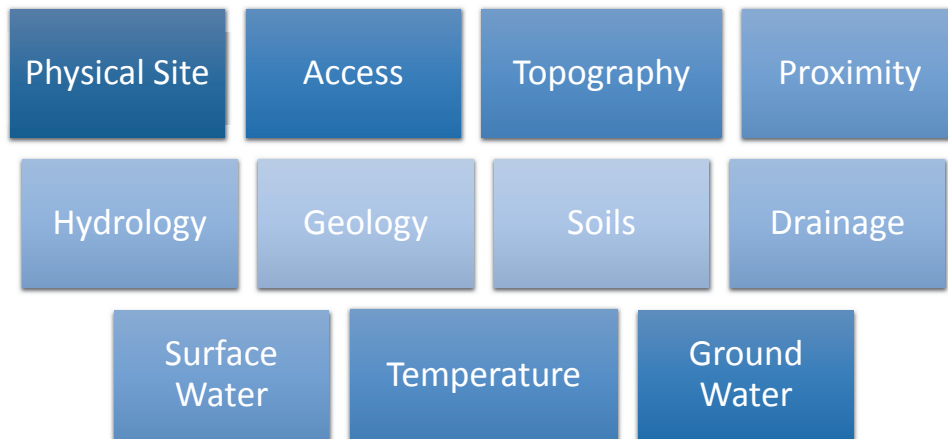
- depends on the waste stream over the predicted site life and provision for sufficient buffer zones

Strategic Location

- determined by the waste generation areas to be served and transport routes

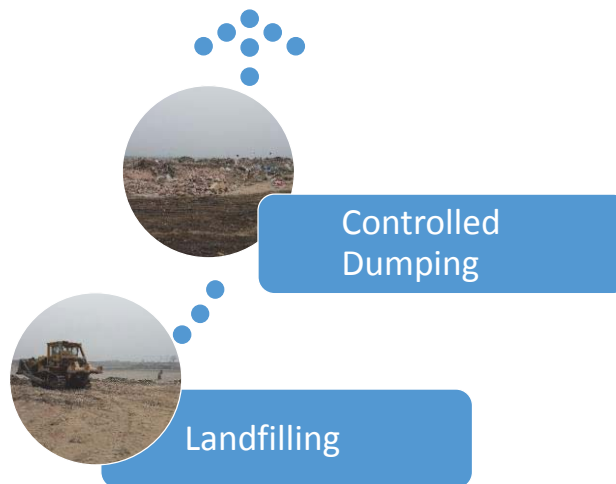
- Spatial and urban planning requirements
- Spatial and regional requirements
- Required land area
- Transportation distances
- Local site conditions
- Topography
- Climate conditions
- Hydrogeological conditions
- Geological conditions
- Geo-mechanical conditions
- Environmental protection





Contents

- ❑ Introduction
- ❑ Controlled Dumping
 - Important Considerations for Controlled Dumping
- ❑ Landfilling
 - How it Works
 - Sludge Disposal at a MSW Landfill
 - Sludge/Solid Waste Mixture
 - Sludge/Soil Mixture



- ❑ Essential burial of waste in earth on a daily basis, in an isolated and demarcated site
- ❑ An established system for rotational and organized deposit of waste
- ❑ To prepare the site to retain its waste more effectively



- ❑ Minimize its chances of contact with **humans and animals**
- ❑ Waste should be covered with a soil layer **10-15cm** deep
- ❑ If coverage with soil is not possible, **lime** may be deposited over the waste
- ❑ **Access** to these dedicated disposal areas should be **restricted**
- ❑ It would require **supervision by staff**
- ❑ Prevent scavenging

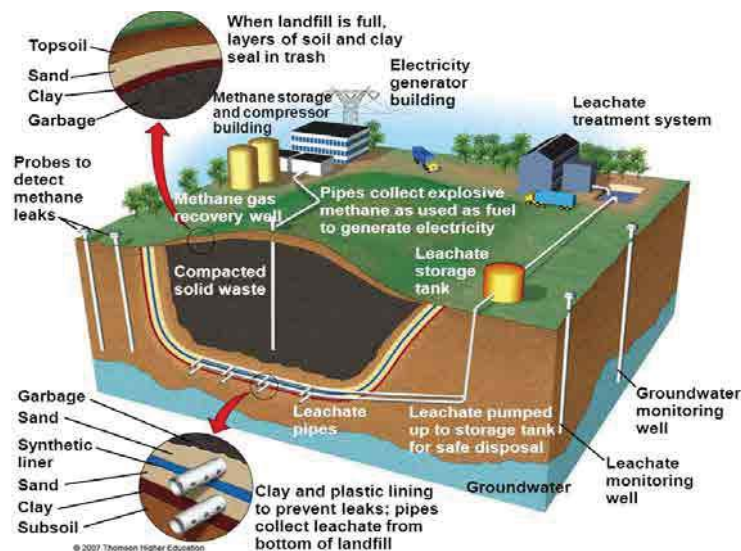


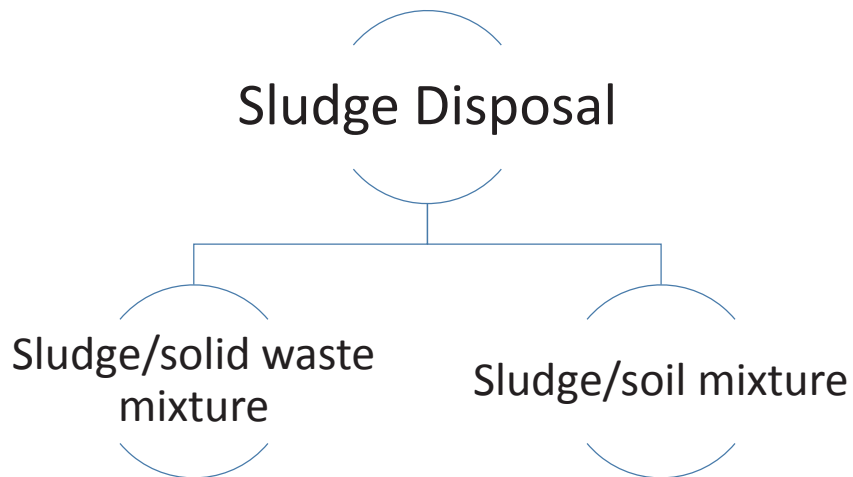
- ❑ Landfill is the site where waste is isolated from environment until it is safe
(Until completely degraded biologically, chemically and physically)



- ❑ In landfill operation, Sludge is spread and compacted in thin layers within a small area
- ❑ To allow for proper compaction, the **cell depth** should not exceed about **2 meters**
- ❑ The cell is then covered with a **layer of soil** which is spread uniformly and then compacted
- ❑ To provide an adequate **seal the cover** should normally be at least 20 cm thick

- ❑ When a number of cells reach the final desired elevation, a **final cover of about one meter** of earth is placed and it is again compacted
- ❑ Landfill must be provided with **Liners** to prevent the migration of waste out of landfill to adjacent surface soil or ground water or surface water during anytime





- Sludge is deposited atop solid waste and mixed as thoroughly as possible with the solid waste
- The mixture is then spread, compacted, and covered in the usual manner used at MSW landfills
- The minimum sludge solids content is approximately 20 percent
- The sludge is usually spread by conventional landfill operating equipment

- ❑ To provide adequate workability of the sludge/solid waste mixture, the bulking ratio for a 20 percent solids sludge should be **4 mg of solid waste to 1 wet mg of sludge**
- ❑ **Sludge application rates** for sludge/solid waste mixtures compare favorably with rates for other types of sludge disposal methods
- ❑ **Disposal rates** generally range from 500 to 4,200 yd³ of sludge per acre (900 to 7,900 m³ of sludge per ha)

- ❑ Sludge is mixed with soil and applied as intermediate or final cover over completed areas of the MSW landfill
- ❑ This is not strictly a sludge landfilling method from an engineering standpoint, because the sludge is not buried



But it is a viable and proven option for disposal of sludge at MSW landfills

Advantages

- Removes sludge from working face of landfill which may cause problems e.g. Equipment Slipping
- Sludge/soil cover promotes vegetation over completed fill areas,, hence:
 - ✓ Reduces the need for fertilizer
 - ✓ Minimizes siltation and erosion

Disadvantages

- Requires more manpower and equipment
- Odors may be more severe because the sludge is not completely buried
- Note:
For this reason, only well-stabilized sludges are recommended for use in sludge/soil mixture operations

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Storm Water Drains

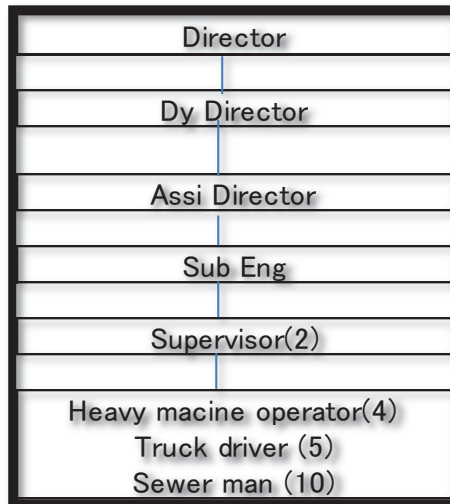
Action Plan for Desilting Operation (Example)

1. Purpose of the plan

One of the problems that WASA faces at present is the deposition of sludge in the drainages and ultimately the flow rate of the drainage system is decreased, which is causing overflowing and flooded conditions. For avoiding the flood, proper drainage cleaning plan should be made.

2. Human resources

Organization of staff is followings. The plan should be performed within staff member.



3. Equipment

We have and can use following equipment in WASA

Equipment	Quantity
Truck (8t)	1
Truck (4t)	2
Truck (2t)	3
Back Hoe (0.25m ³)	3
Back Hoe (0.40m ³)	4
Clam shell (0.4m ³)	2
Clam shell (0.7m ³)	2

4- Implementation

The plan includes following implementations

- Survey of sludge deposit quantities
- Flow rate calculation
- To make plan of the cleanings
- Implementation of the cleanings

(1) Survey of sludge deposit quantities

At first sludge deposit in drainages should be measured for making the cleaning plan.

Methodology

Same as study in the training method

Equipment

Map, Digital camera, Measuring stuff, Survey pole

Team

Two supervisors

Productivity

Visiting and surveying one place per hour per team

(2) Flow rate calculation

Methodology

From result of the survey of sludge deposit quantities, we calculate water flow rate in the all drainages, and they compare original flow rate of the drainages.

Equipment

Computers

Team

Engineers

Productivity

All calculation within a week

(3) To make plan of the cleanings

Methodology

At first, priority of cleaning place should be decided by the results of the calculation and comparison of original flow. And we make the cleaning plan considering staff and equipment.

Equipment

Computers

Team

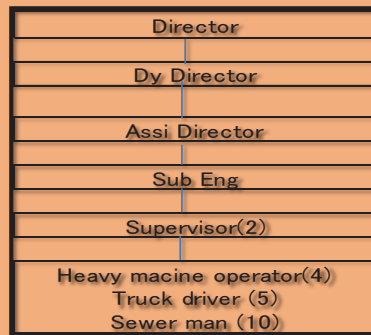
Engineers

ACTION PLAN FOR DRAIN DE-SILTING

A - Purpose of the plan

- ✓ To avoid Over Flowing & Flooded Conditions in Storm Water Drains

B - Human resources



ACTION PLAN FOR DRAIN DE-SILTING

C - Equipment

Equipment	Nos.
Truck (8t)	1
Truck (4t)	2
Truck (2t)	3
Back Hoe (0.25m ³)	3
Back Hoe (0.40m ³)	4
Clam shell (0.4m ³)	2
Clam shell (0.7m ³)	2

ACTION PLAN FOR DRAIN DE-SILTING

D - Implementation

The plan includes following implementations:

- Survey of sludge deposit quantities
- Flow rate calculation
- To make plan of the cleanings
- Implementation of the cleanings

SCHEDULES

Working items	2016		2017										Remarks	
	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct		
Survey of sludge deposit quantities	■													240places survey
Flow rate calculation			■											
To make plan of the cleanings			■											
Implementation of the cleanings				■										

SCHEDULES

DESILTING SCHEDULE OF DRAINAGE SUB DIVISION CENTRAL MONTH OF 15 NOVEMBER-2016 TO 31 DECEMBER-2016							
Sr.No	Date	Name of Drain	Reach		Total Length to be desilted per day		Machinery
			From	To	Rft	Size (ftxft)	
Schedule of Heavy Machinery							
1	15-11-2016 to 30-11-2016	Cannt Drian	Shadman Bodge	Shama Bridge	100	60 x12	01 Long boom + 05 Dump Trucks
2	15-11-2016 to 30-11-2016	Kharak Drain	Liaqat Tokay Walli Pully	WAPDA Grid Station	90	14 x7	01 Ex. + 05 Dump Trucks
3	15-11-2016 to 20-11-2016	Birdwood Drian	Jail Road	LOS Ferozepur Road	120	15 x 8	01 Clamshell + 05 Dump Trucks
6	01-12-2016 to 15-12-2016	Cannt Drian	Shera Kot	Old Babu Saou	100	90x11	01 Long boom + 05 Dump Trucks
8	01-12-2016 to 10-12-2016	Gulberg Drain-I	Railway Line	Main Boulevard Gulberg	105	30x07	01 Clamshell + 05 Dump Trucks
14	16-12-2016 to 31-12-2016	Cannt Drian	Shera Kot	Gulshan-e-Rayt	100	90x11	01 Ex. + 05 Dump Trucks
					615	187	

Note: Heavy Machinery schedule for only removal of silt.
 Back Hoe, Trolley and Wheel Loader as per requirement of Site Supervisor / Sub Engineer.
 Schedule Subject to availability of POL.
 During the Desilting for the purpose of Blockage/Daka and floating material removal, Machinery will be shifted when and where required.

SCHEDULES

Monthly Desilting Schedule with Labour for the Month of April-2016									
Drainage Sub Division (Central) WASA, LDA, Lahore.									
Date	Name of Drain	Locations	Total Length (Rft)	Length to be Desilted (Rft)	Labour Deployed	Name of Sub Engineer	Name of Supervisor	Remarks	
01-04-2016 to 30-04-2016	Nagra Drain	Ghugian Nagra	3000	11	8	Mirza Kashif	Hamida	3rd Shift	
01-04-2016 to 30-04-2016	Abu Bakar Saddique Colony	In Colony	2500	10	8	Ayaz Hanif	Ashiq	1st Shift	
01-04-2016 to 30-04-2016	Open Nagra Drain, G-Block Sabzazar & Line-B Sabzazar	-----	2500	12	8	Mirza Kashif	Idhaque	1st Shift	
01-04-2016 to 30-04-2016	Cannt Drian	Shama Bridge	250	25	12	Umair Raza	Khusi	1st Shift	
	Sub Engineer-I	Sub Engineer-II	Sub Engineer-III					SDO Drainage Central	



O&M of Drainage System Module 02

Action Plan Template



Sr. No	WHAT TO DO?	HOW TO DO?	WHEN TO DO?	WHO TO DO?		DO WITH WHAT?		CHECK DONE?	WHO TO CHECK?
	(Define O&M Task)	(Follow SOP Ref.#)	(Frequency)	(Carried out By)		Materials	Tools/ Equip.	How to Check?	To be Checked By?
			Class of Work	Worker					



In the name of Allah, the most Gracious and ever Merciful

WELCOME BACK TO AL-JAZARI ACADEMY





3rd Module Training

Operation and Maintenance of Sewerage System

Introduction

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3rd Module

Operation and Maintenance of Sewerage System

Start Date	Closing Date	Duration (Days)	Participants
21 February, 2018 (Wednesday)	23 February, 2018 (Friday)	03	<ul style="list-style-type: none"> ▪ Engineers ▪ Sub-Engineers

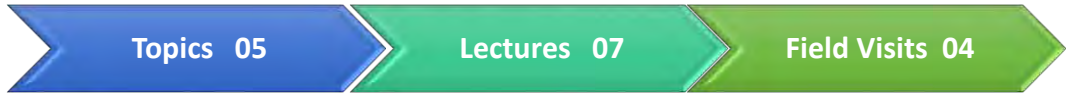


Introduction

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Module 03 (An Overview)

Operation and Maintenance of Sewerage System



DAY 03	<input type="checkbox"/> Inspection & Testing of Sewers & Manholes	<input type="checkbox"/> Inspection of Manholes & Sewer Lines <input type="checkbox"/> Testing Techniques	02 Lectures + 01 Field Visit
	<input type="checkbox"/> Machinery, Tools & Equipment for Cleaning Sewer Lines & Manholes	<input type="checkbox"/> Machinery, Tools & Equipment <input type="checkbox"/> Cleaning Techniques	02 Lectures + 01 Field Visit
DAY 04	<input type="checkbox"/> O&M of Disposal Station	<input type="checkbox"/> Disposal Station Introduction & O&M	01 Lecture + 02 Field Visits
	<input type="checkbox"/> Maintenance & Rehabilitation <input type="checkbox"/> Emergency Response Planning	<input type="checkbox"/> Repair & Rehabilitation <input type="checkbox"/> Emergency Planning for Rainy Season	02 Lecture

Introduction

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Course Team



Mr. Ryuta Kudo
JICA Expert



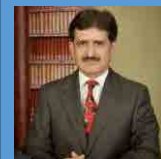
Mr. Muhammad Irfan
Course Leader



Mr. Rizwan Qazi
JICA Coordinator



Mr. Syed Fahad Hussain
Young Professional



Course Reviewer
Prof. Dr. Sajjad Haider (UET),
Lahore

Introduction

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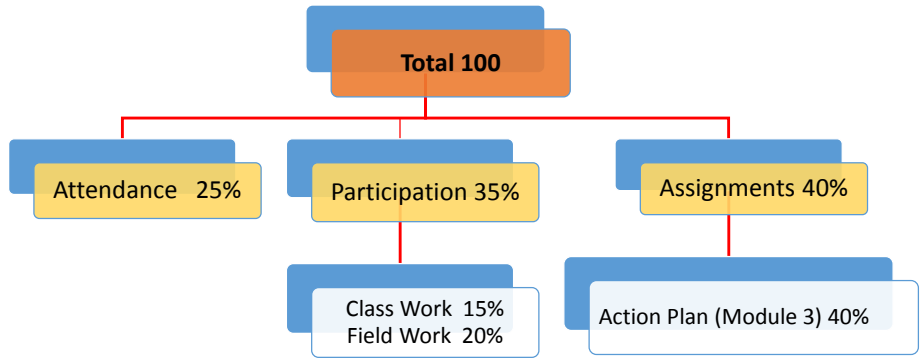
WHAT WILL ANIMATE THE TRAINING SESSION. . .



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Module Evaluation Criteria



Please Note:
 Participants with active participation, maintaining 80% attendance and passing their exam with at least 70% score will be awarded certificates.

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Introduction

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Sewerage System

Definitions

Sewerage System

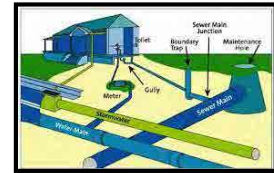
- ✓ An underground infrastructure that conveys liquid waste.
- ✓ It is the system of pipes, manholes and disposal stations etc.

Sewage

- ✓ Its liquid waste originating from homes, commercial buildings and industrial establishments.

Sewer

- ✓ An underground conduit through which sewage is carried to a point of discharge or disposal.



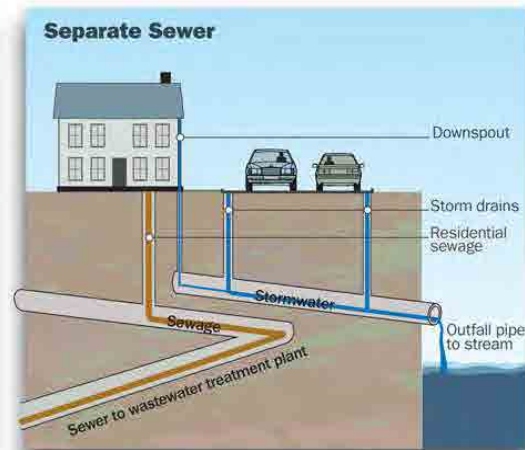
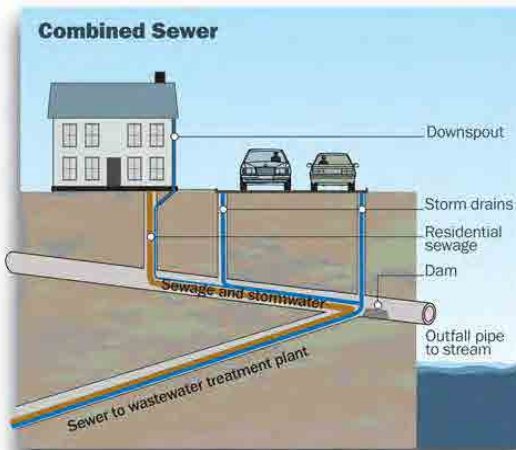
Introduction

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Sewerage System

1 - Combined Sewerage System

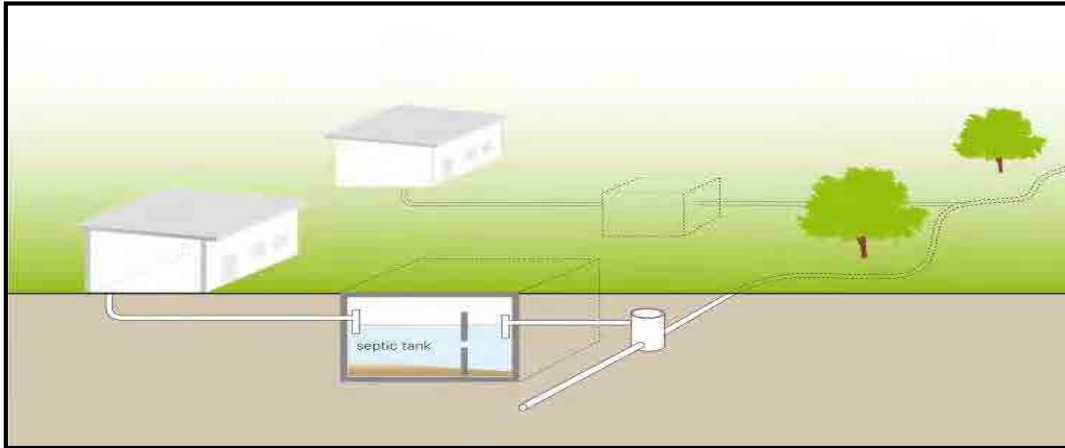
2 - Separate Sewerage System



Introduction

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3 - Effluent Sewerage System



Introduction

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- 1) Components
- 2) O&M Objectives

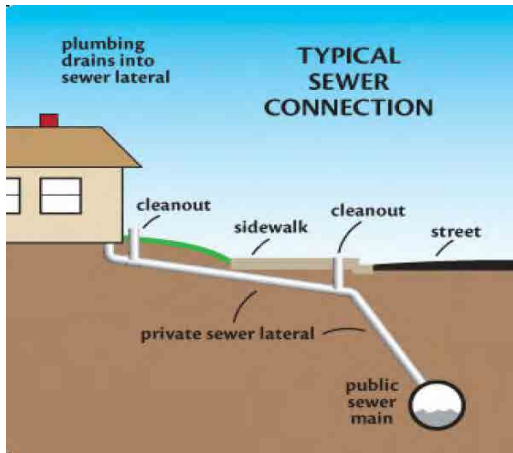
Strategy for Improvement

- 1) Sensitizing Senior Decision Makers
- 2) Assessing the Existing Facilities
- 3) Identification of Factors affecting Quality of Maintenance
- 7) Snags in Management
- 8) Immediate Action Plan
- 9) Long term Action Plan

Introduction

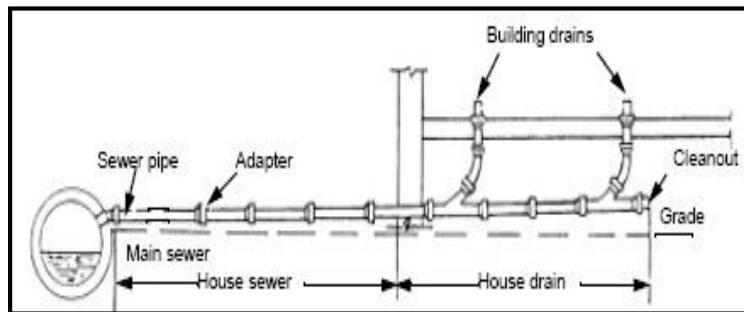
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Components of Sewerage System



Introduction

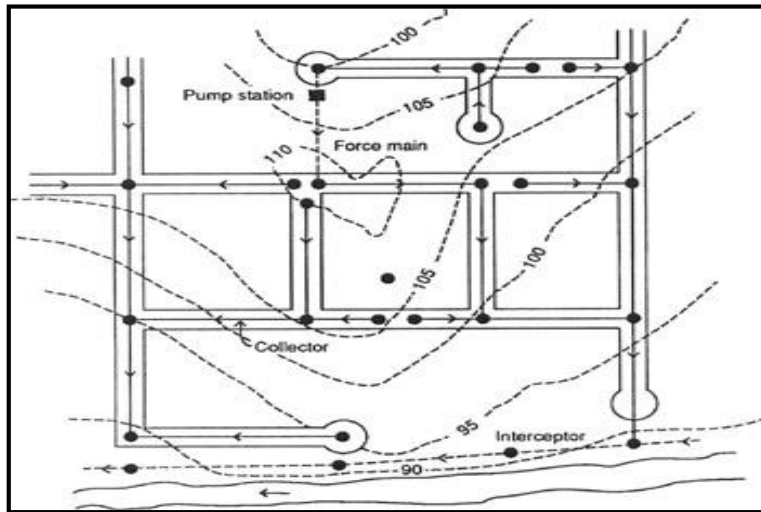
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Sewerage System (Profile View)

Introduction

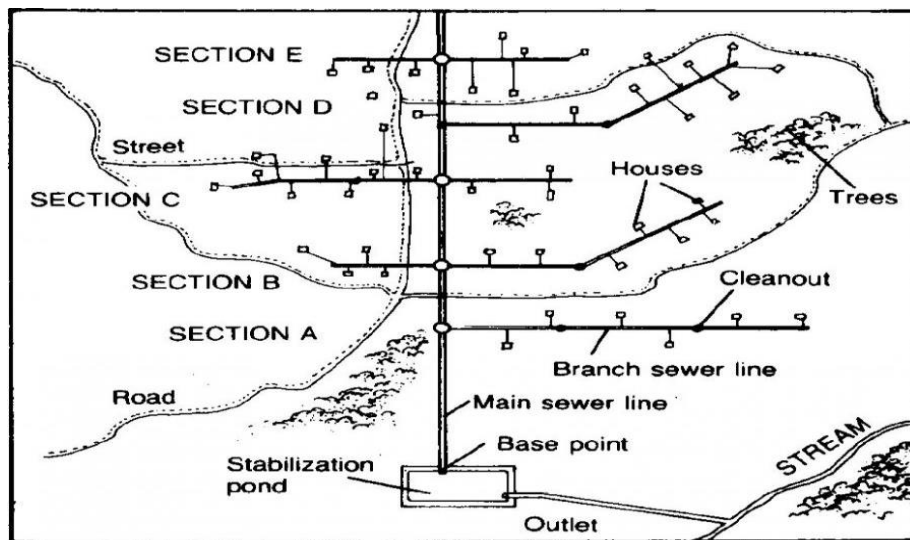
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Sewerage System Layout - 1

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Sewerage System Layout - 2

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1. Disposal Station 2. Lift Station 3. Sewer Lines 4. Manholes

Sewerage System Layout - 3

Components of Sewerage System

1. Lateral Sewer
2. Sub-Main Sewer
3. Main Sewer
4. Trunk Sewer
5. Sullage Carrier or Outfall Sewer
6. Pumping Station (Disposal/Lift Station)



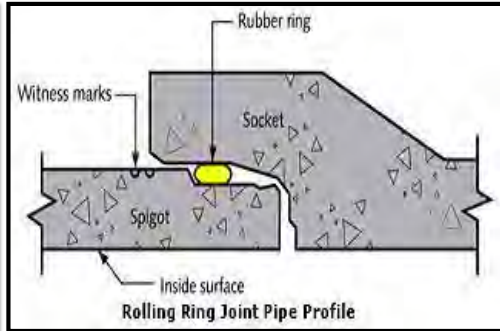
RCC SEWERS

Dia. Ranges

6" 9" 12" 15" 18" 24" 30" 36" 42" 48" 54" 60" 66" 68" 72"



Sewer Pipe Joining Works



RCC Sewer Pipe Joint
(X-Section)

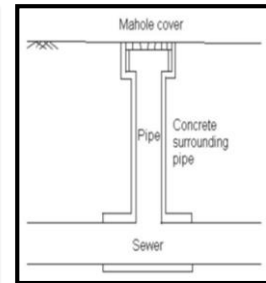
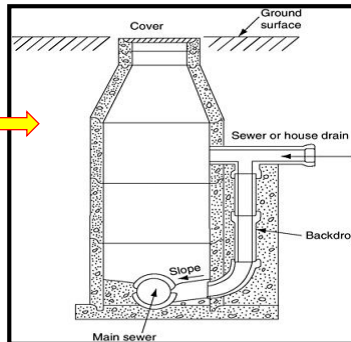
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Components of Sewerage System

SEWER APPURTENANCES

1. Manhole
2. Catch Basin
3. Clean out
4. Lamp hole
5. Inlets
6. Traps
7. Vent Shaft
8. Flushing Tanks
9. Inverted Siphon



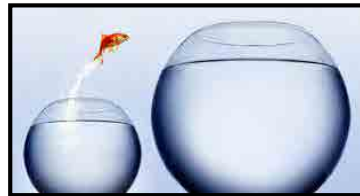
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Now What are your...

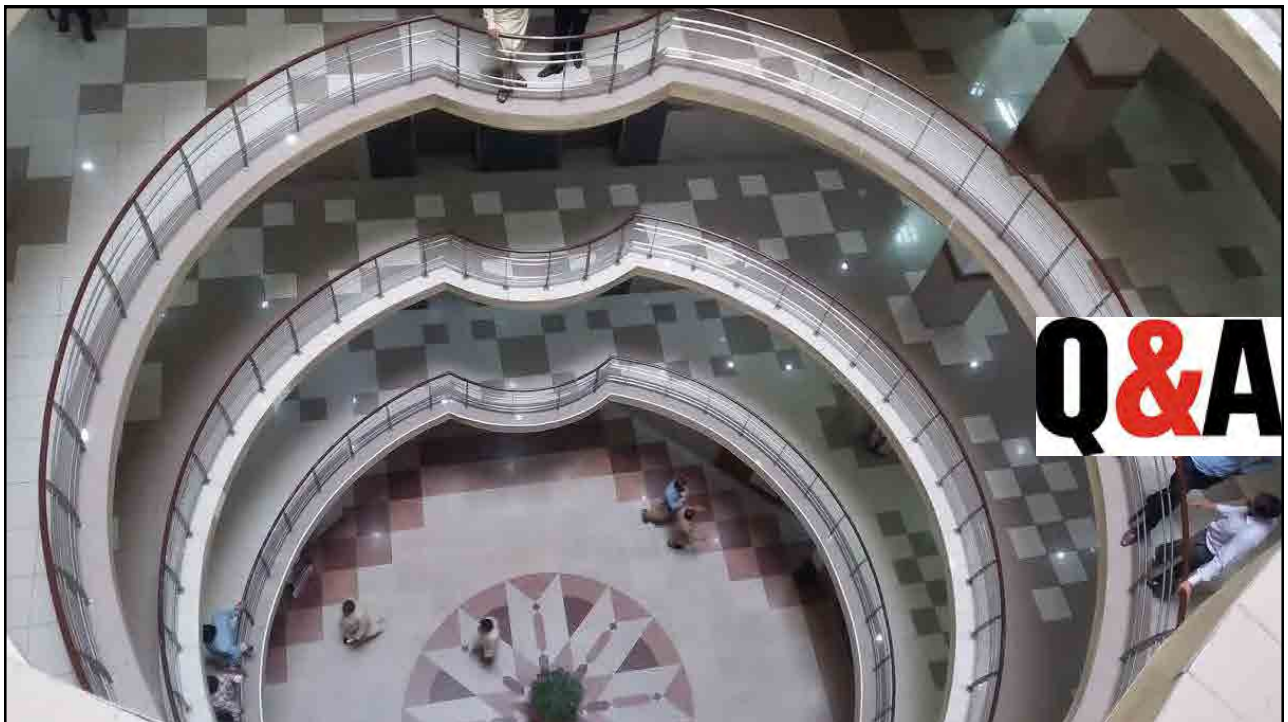


About Module & Training



Introduction

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Contacts:



Name	Designation	Contact No.	E-Mail
Mr. Dr. Nobuyuki Sato	JICA Expert		
Mr. Muhammad Irfan	Course Leader		
Mr. Rizwan Qazi	JICA Coordinator		
Mr. Syed Fahad Hussain	Young Professional		





In the name of Allah, the most Gracious and ever Merciful

Module 03

Safety Control and Measures for Sewerage and Drainage Works



Lecture Breakdown	Duration
Objectives	1 Hour
Reasons for Identifying a Specific Manhole	
Early Metal Locator	
Manhole Cover Locator	
Parts with Labels	
Working Principle	



Objectives

The objectives of this lecture are:

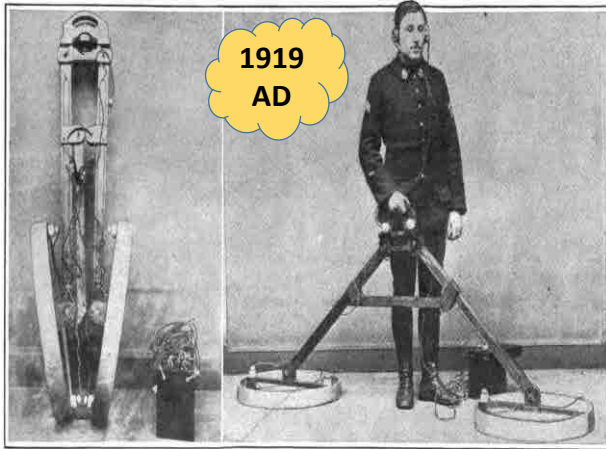
- To understand the need of locating a buried manhole
- To comprehend the working principle of metal locator device
- To identify the buried manhole with the help of metal locator

Reasons for Identifying a Specific Manhole

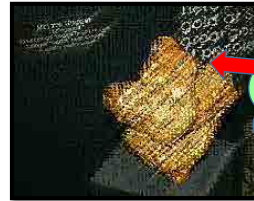
The reasons are:

- To conduct an inspection survey against the sewer system related complaint
- To initiate operation and maintenance work at the rightly identified manhole for redressing the complaint received

Early Metal Locator



1919
AD



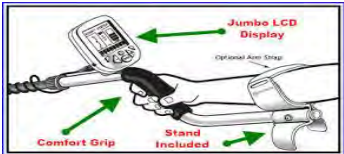
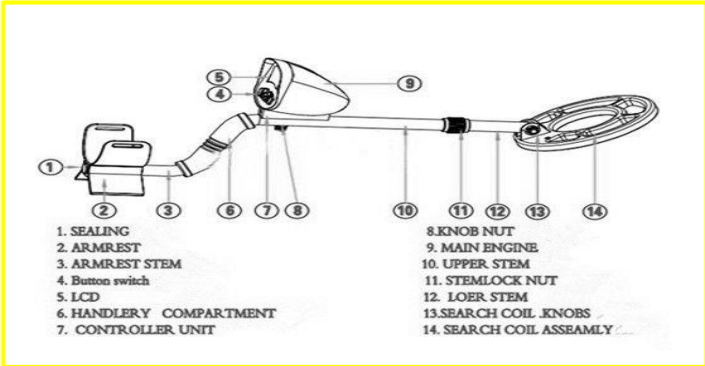
4.9 Kg
Gold
Found in
California



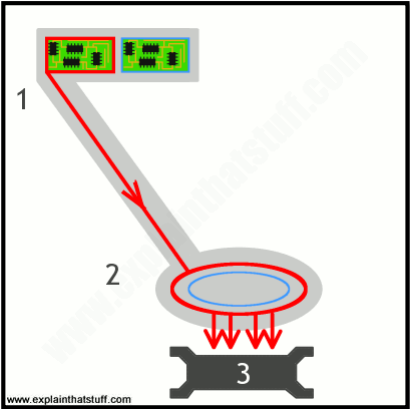
Manhole Cover Locator



Manhole Cover Locator (Parts with Labels)



Working Principle of Manhole Cover Locator (Al-Jazari Apparatus)



Working Principle of Manhole Cover Detector

1. A battery in the top of the metal detector activates the **transmitter circuit** (red) that passes electricity to the **transmitter coil**
2. When electricity flows through the transmitter coil, it creates a **magnetic field** all around it.
3. If you sweep the detector above a **metal object** electric current flow inside the metal object.
4. This flowing electric current creates a loudspeaker buzz and alerting you you've found something.





Contacts:



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Mr. Syed Fahad Hussain	Young Professional		






In the name of Allah, the most Gracious and ever Merciful

Module 03

Safety Control and Measures for Sewerage and Drainage Works



Lecture Breakdown	Duration
Various Gas Monitors	<div style="text-align: center;">1 Hour</div> 
Purpose of Use	
Portable Gas Monitor GX-8000	
Names & Functions for Each Part	
Start the Gas Monitor	
LCD Display, Features & Cautions	
Q&A	



Gas Monitoring at Manhole

Various Gas Monitors



Purpose of Use

Gas monitor enables simultaneous monitoring of the following four types of gases in Manholes:

- | | | | |
|---------------------|--------|---|-----------------|
| 1- Oxygen | O_2 | } | COMBUSTIBLE GAS |
| 2- Methane | CH_4 | | |
| 3- Carbon Monoxide | CO | } | TOXIC GASES |
| 4- Hydrogen Sulfide | H_2S | | |



Al-Jazari Apparatus

**Portable Gas Monitor
GX-8000**



Make:
**RIKEN KEIKI
Co. Ltd Tokyo
Japan**

Accessories:

1. Li-ion battery unit
2. AC powered charger
3. Shoulder strap
4. Gas sampling probe

Portable Gas Monitor GX-8000 - Accessories

<Main Unit>

GX-8000
main unit



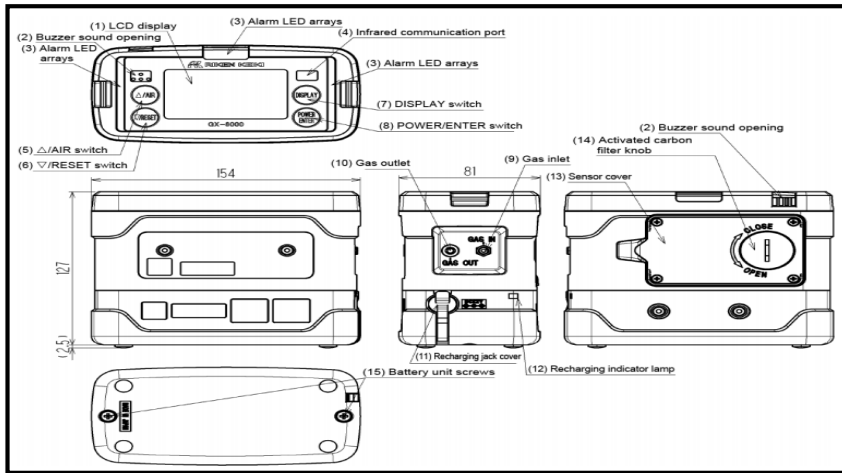
Battery unit: Li-ion or dry

<Standard Accessories>

- AC powered charger: 1
OR
AA alkaline battery: 3
- Gas sampling probe and
gas sampling hose: 1
- Shoulder strap: 1
- Operating manual
- Product warranty



Names & Functions for Each Part (Various Views)



Starting 'Gas Monitor'

<<Start-up Procedure>>
 Keep the POWER switch pressed for three seconds or more.

↓

All LCDs light up.

LCD

Alarm lamp lights up. Buzzer sounds once. (Beep)

Date/Time Display

Battery Voltage Display

1

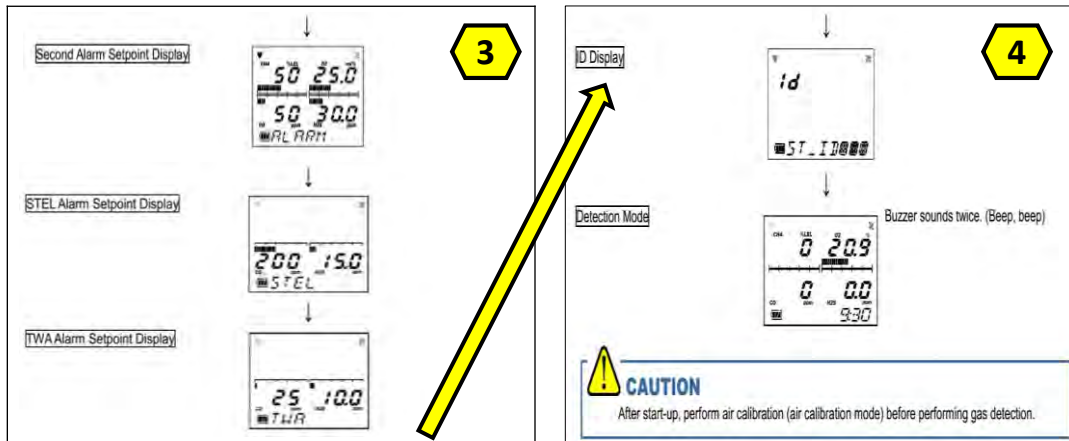
Gas Name Display

Full Scale Display

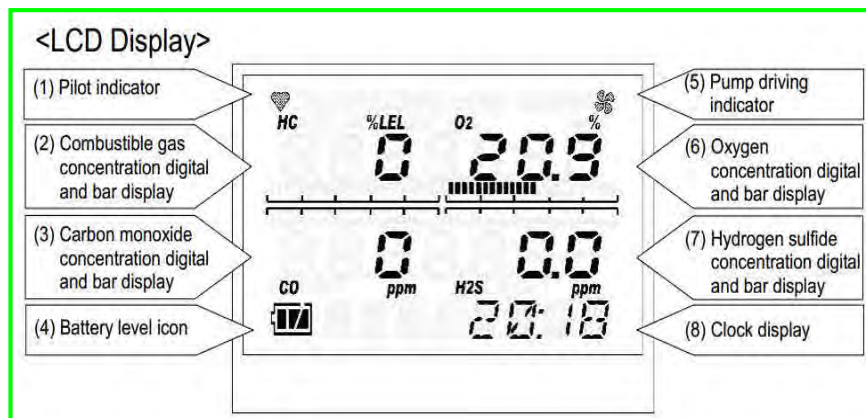
First Alarm Setpoint Display

2

Starting 'Gas Monitor'



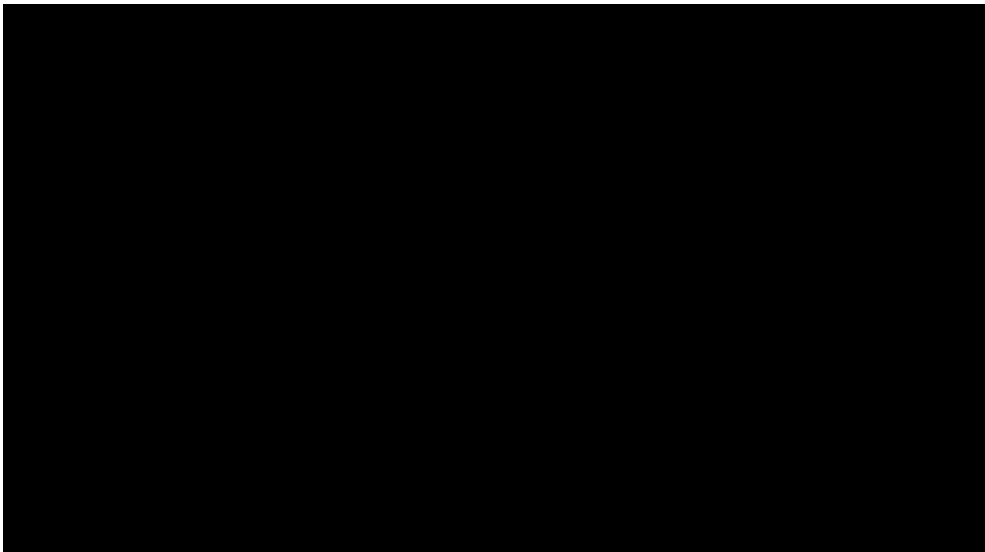
LCD Display [Home]



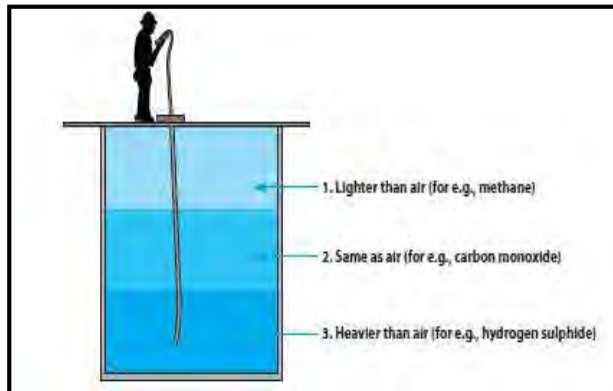
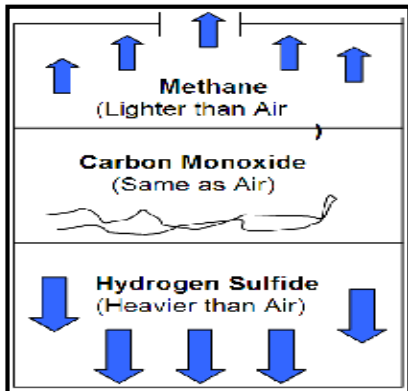
Features of Portable Gas Monitor GX-8000

- Portable and battery operated
- Continuously and simultaneously monitor for toxic and flammable gases
- Audible and visible **ALARMS**
- Small enough and light enough to be worn by an operator
- Over 10 hours of continuous operation on one full battery charge
- Automatic audible and visible low battery alarm
- Remote sample hose

Basic Functions & Operation (5:23)



Physical Appearance of Gases in Manhole



Cautions regarding Gas Monitor

- Do not drop or give shock to the gas monitor.
- Pressing buttons unnecessarily may change the settings.
- Do not use the gas monitor in a place where the temperature drops below -20°C or rises over 50°C .
- Do not use the gas monitor where it is exposed to oil, chemicals, etc.
- Verify that the pump driving indicator is rotating before using the gas monitor.
- Do not forget to perform a regular maintenance.

Q. 01:

Describe the **most important features** of a gas detection device that would be used when entering a manhole.

Q. 02:

What gas do you use for **calibration** & when to perform calibration of the device?

Q. 03:

What **toxic gas** is commonly found in wastewater collection systems?

Name	Designation	Contact No.	E-Mail
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Mr. Syed Fahad Hussain	Young Professional		



**Thank
You!!!**

