

## 2. UFW Reduction Activity

### 2.1 Action Plan for UFW Reduction Activity



**SHARKIA POTABLE WATER  
AND SANITATION COMPANY  
(SHAPWASCO)**

**JAPAN INTERNATIONAL  
COOPERATION AGENCY  
(JICA)**



**THE PROJECT  
FOR  
IMPROVEMENT OF MANAGEMENT CAPACITY  
OF  
OPERATION AND MAINTENANCE FOR SHAPWASCO  
IN THE ARAB REPUBLIC OF EGYPT**

**Action Plan for UFW Reduction Activity**

**March 2007**

**Project Team  
SHARKIA POTABLE WATER  
AND SANITATION COMPANY  
(SHAPWASCO)**

## **Action Plan for UFW Reduction Activity**

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**Abbreviations**

SHAPWASCO	Sharkia Potable Water and Sanitation Company
UFW	Unaccounted-for Water
HQ	Headquarters
C/P	Counterpart
GIS	Geographical Information System
JICA	Japan International Cooperation Agency
MNF	Minimum Night Flow

## **Introduction**

In order to grasp the current situation of unaccounted-for water (UFW) in Sharkia Governorate and formulate an action plan for UFW reduction activity, UFW/HQ Team conducted site surveys with Expert Team from December 2006 to January 2007. For the formulation of Action Plan for UFW reduction activity, SHAPWASCO nominated UFW teams from the whole SHAPWASCO branches and held workshops on February 24 to 25, 2007. The attendants participated in the workshops are listed below. Actions to be taken to achieve the purpose of the project have been discussed actively including the selection of pilot project sites for the activity and results were compiled as “Action Plan for UFW Reduction Activity”.

### UFW Teams for Action Plan formulation

City/Markaz	Name
SHAPWASCO Headquarters (HQ)	Mr. Alae El Din Mohamed (E)
Zagazig City - West	Mr. Salama Mahmoud Abd El Aal (E) Mr. Mohamed Mohamed BakrSupervisor (S)
Zagazig City – East	Mr. Samir Mahmoud Abd El Hameed (E) Mr. Mahmoud Mohamed El Hariry (S)
Zagazig Markaz	Ms. Asmaa Mohamed Farag (E) Mr. Mohamed Mohamed Sabry (S)
Hihya Markaz	Mr. Mahdy Fathy Ahmed (E) Mr.Amin Sedeek Amin (S)
Ibrahimiya Markaz	Mr. Abdou Mohamed Ahmed (E) Mr. Abd Allah Abd El Mgeed (S)
Diarb Nigm Markaz	Mr. Adel Salah Sadek (E) Mr. Mohamed Abbass (S)
Awlad Saqr Markaz	Mr. Emad Ahmed Abd El Kader (E) Mr. Bendary Hassan Bendary (S)
Kafr Saqr Markaz	Mr. Fahmy Mohamed Khalaf (E) Mr. Mohamed Ibrahim Mohamed (S)
Menia Al Qamah Markaz	Mr. Mohamed Mohamed Nour (E) Mr. Adel Saleh (S)
Mashtool El Sooq Markaz	Mr. Saeed Abd El Rahman Hefni (E) Mr. Mohamed Ahmed Ali Hozayen (S)
Bilbais Markaz	Mr. Bendary Abd El Kader Sharawy (E) Mr. Reda Abd El Hameed Abd Allah (S)
Faqus Markaz	Mr. Sebaey Mohamed Aly Rabea (E) Mr. Mostafa Mohamed Sobeeh (S)
Abu Kabier Markaz	Mr. El Saied Abd El Reheem (E) Mr. Abd El Wahab Mohamed Aly (S)
Abu Hamad Markaz	Mr. Mostafa Abd Allah Ghanaiem (E) Mr. El Saied Hamed Hemdaan (S)
El Husseinia Markaz	Mr. Salah Abd El Haq (E) Mr. Mohamed Abd El Monem (S)

Note : (E) stands for engineer and (S) for supervisor

JICA Expert Team

Mr. Masahiro Takeuchi	Chief Advisor/Water Supply Planning
Mr. Masatoshi Seno	Expert/Unaccounted for Water Reduction
Mr. Noboru Saeki	Expert/SOP Activity for Water Supply Facilities
Mr. Keizo Kimura	Expert/SOP Activity for Water Supply Facilities
Mr. Mitsuhiro Omori	Coordinator/Hydraulic Analysis for Network
Mr. Mohamed Nagi	Project Facilitator
Mr. Mohamed Sobhy	Expert/Unaccounted for Water Reduction
Mr. Mahmoud Khalaf	Expert/SOP Activity for Water Supply Facilities
Ms. Reem Abd El Rahman	Interpreter

## **Chapter 1. Pilot Project Sites**

### **1.1 Method for Selecting Pilot Project Sites**

#### (1) Size of Pilot Project Sites

Six pilot project sites in total shall be selected, three sites each from Pilot Area 1 (Zagazig City and Zagazig Markaz) and Pilot Area 2 (Hihya, Diarb Nigm and Ibrahimiya Markaz), where UFW reduction activities shall be carried out.

After leakage survey (or minimum night flow measurement) of the candidate areas for pilot project sites, the pilot project site shall be selected in each pilot project area as shown in Table 1-1.

Policies for setting the size of each pilot project site, including the number of house connections to be covered and the size of districts, are as provided in Table 1-1. The locations of the pilot project sites shall be selected after the minimum night flow (or leakage) survey for the candidate sites for the pilot project sites. The candidate area shall be determined based on the study of the existing drawings and a field survey to be conducted in cooperation with the C/P, considering the feasibility of measuring effects as a pilot project.

**Table 1-1 Number of Pilot Project Site in each Pilot Project Area**

Pilot Area No.	Pilot Project Area	Number of Pilot Project Site	Size of Pilot Project Site (House Connection)
1	Zagazig City-East	1	500 - 1,000
	Zagazig City-West	1	500 - 1,000
	Zagazig Markaz	1	1,000 – 3,000
2	Hihya Markaz	1	1,000 – 3,000
	Diarb Nigm Markaz	1	1,000 – 3,000
	Ibrahimiya Markaz	1	1,000 - 3,000

Note : The number of house connection shown above is the preferable number. It is subject to change according to the situation of the area.

#### (2) Criteria for Selecting Candidate Areas

The basic parameters to be considered in the selection of the pilot project site shall be:

1. The pilot project site should have control valves so that the district could be isolated from the network with just one inlet point. At this inlet point, a flow meter shall be installed to measure the minimum night flow rate. In rural areas in markaz, we can identify some isolated regions with tree system of distribution networks.
2. Preferably, the used water billing method is computerized on a database.
3. The isolation valves should be in good working conditions.
4. Size and type of the area: the size should be limited to enable proper monitoring of the network and water connections.

5. Size and type of customers: the area should have a good mix of type of customers, i.e. sewer, non-sewer, private and governmental. The number of customers should be limited to manage the customer validation process.
6. The pilot project site shall have a high visible water leakage points and operating water pressure of 1-2 bars.
7. It is preferable to select an area with asbestos cement pipe. It is assumed that asbestos cement pipes have the oldest age.
8. The district shall be provided with water meters for each house connections. No unauthorized or un-metered connections are allowed. If any connections without water meters, these shall be provided with new water meters by SHAPWASCO before the commencement of the pilot project.
9. All water meters shall be registered and regularly read and documented in the billing database.
10. If fire hydrant exists in the pilot project sites, monitoring of fire fighting shall be taken into consideration to account the fire fighting water as legal losses during study period.
11. Preferably, no public taps exist in the pilot project site. If any exists, a water meter shall be installed at the public tap.
12. The area of the pilot project site shall be around 2 to 3 km<sup>2</sup> or as per the conditions of the candidate site.
13. In order to minimize the cost for repair works, wide road, roads with heavy traffic, paved road and so forth shall be avoided.
14. Appropriate network drawing shall be available indicating the location of control valves and how to raise the pressure inside the area, if required.

## **1.2 Candidate Areas for Pilot Project Sites**

The pilot project sites in each pilot area shall be determined by the results of leakage survey (or minimum night flow survey) for the candidate areas for pilot project sites. The candidate areas for pilot project sites have been nominated in Phase-1 as shown in Table 1-2 and the maps attached as Attachment-1.



**Table 1-2 List of Nominated Candidate Areas for Pilot Project Sites**

City/Markaz Name	Candidate Area		Number of House Connection
Zagazig City - East	Aera-1	El Zend	501
	Area-2	El Husienia	900
	Area-3	Manshiat El Husienia	1,200
	Area-4	El Henawy	962
	Area-5	Hai Mubarak	489
Zagazig City - West	Aera-1	Hai El Salam	365
	Area-2	Abu Areiba	546
	Area-3	El Zagazig El Buhari	600
	Area-4	Hassan Saleh	450
	Area-5	Manshiet El Sadat	1,062
Zagazig Markaz	Aera-1	Kafr El Hamam	2,012
	Area-2	Bana Yous	2,410
	Area-3	El Messalamia	1,000
	Area-4	Sharwida	900
	Area-5	Tahlet Bordain	850
Hihya Markaz	Aera-1	Southern Western of Hihya City	4,000
	Area-2	Southern Eastern of Hihya City	2,000
	Area-3	El Shbraween	1,300
	Area-4	El Mosalami	541
	Area-5	El Mahdiah	2,062
Ibrahimiya Markaz	Aera-1	Ibrahimiya City	1,025
	Area-2	El Halawat	1,097
	Area-3	El Seds	584
	Area-4	Kafr Abo El Deeb	697
	Area-5	El Habsh	1,126
Diarb Nigm Markaz	Aera-1	Diarb Nigm City (El Kosailah El Bahryiah)	1,500
	Area-2	Bahnya	1,800
	Area-3	Gemezot Bani Amr	2,000
	Area-4	Sahbarah	1,030
	Area-5	Taha El Marg	1,430

Note : The number of house connection above is for reference only and the approximate number will be confirmed before making field survey of the candidate area.

## Chapter 2. Actions to be taken for UFW Reduction Activity

During the UFW reduction activity in Phase-2 to 4 of the Project, following actions shall be taken.

**Table 2-1 Actions to be Taken in UFW Reduction Activity in Phase-2 to 4**

Action	Title	Contents	Remarks
1	Conducting training of C/P staff at Mostrod Training Center	➤ Conducting training of counterpart staff (UFW teams for HQ, Zagazig City and each Markaz) at Mostrod Training Center	
2	Conducting leakage (or minimum night flow : MNF) survey for candidate sites	➤ Conducting MNF survey for 30 candidate areas for Pilot Area-1 and Pilot Area-2 in total.	
3	Determining pilot project site for each pilot project area	➤ Pick up one (1) candidate area as the pilot project site for Zagazig City (East and West) and 4 Markazes	
4	Preparing GIS drawings	➤ Preparing GIS drawings for distribution pipelines of the pilot project areas using the base maps prepared in Phase-1	
5	Learning experiences of similar UFW reduction project in Jordan	➤ Visiting Jordan and learning outputs of UFW reduction project	One Japanese expert and five members of UFW teams
6	Making field survey of distribution network	<ul style="list-style-type: none"> <li>➤ Detection of visible leakage (including service pipes) in the pilot project sites</li> <li>➤ Recording the leakage points on the maps</li> </ul>	
7	Surveying installation conditions of water meters in the pilot project sites	<ul style="list-style-type: none"> <li>➤ Collection and sorting-out of customers' data in the pilot project sites</li> <li>➤ Check of the installation conditions of water meter</li> <li>➤ Replacement of non-working water meters with new meters</li> <li>➤ Conducting meter reading (approx. for one week) of the customers in the pilot project site in parallel with the leakage survey</li> </ul>	<ul style="list-style-type: none"> <li>➤ Identifying non-working meters</li> <li>➤ Procurement of new water meters and preparation of installation</li> </ul>
8	Measuring metering error for working meters and waste in the house	➤ Measuring metering error for water meter of at 20 to 30 customers selected at random in the pilot project site	
9	Conducting leakage (MNF) survey	➤ Conducting MNF survey of the selected pilot project sites (6 sites)	

<b>Action</b>	<b>Title</b>	<b>Contents</b>	<b>Remarks</b>
<b>10</b>	Making Water balance analysis before repair works	<ul style="list-style-type: none"> <li>➤ Checking current leakage by minimum night flow (MNF)</li> <li>➤ Measuring total distributed water flow consumed in the pilot project site in 24 hours</li> <li>➤ Calculation of UFW ratio before leakage repair</li> </ul>	<ul style="list-style-type: none"> <li>➤ Obtaining MNF by conducting 24-hour water flow measurement</li> </ul>
<b>11</b>	Conducting leakage detection survey in the pilot project sites	<ul style="list-style-type: none"> <li>➤ Detecting invisible (or underground) leakage</li> <li>➤ Sorting-out the repairing items</li> <li>➤ Estimating required cost for repair</li> </ul>	<ul style="list-style-type: none"> <li>➤ Reporting SHAPWASCO required cost estimate</li> </ul>
<b>12</b>	Repairing leaking parts	<ul style="list-style-type: none"> <li>➤ Acquiring construction permits from the authorities concerned</li> <li>➤ Inspection by the authority concerned, if necessary</li> </ul>	
<b>13</b>	Conducting leakage survey after repair works	<ul style="list-style-type: none"> <li>➤ Checking the leakage after the repair by MNF survey</li> <li>➤ Calculation of UFW after the leakage repair</li> </ul>	
<b>14</b>	Making water balance analysis after repair works and evaluation	<ul style="list-style-type: none"> <li>➤ Sorting out the contents of UFW</li> </ul>	By using the following results : - Distributed water flow - Water consumption by water meter reading - MNF - Metering error
<b>Activities related to UFW reduction activity</b>			
<b>1</b>	Holding UFW workshops and seminars for presenting the activity results	<ul style="list-style-type: none"> <li>➤ Holding internal workshops and open workshops</li> <li>➤ Holding open seminars</li> </ul>	
<b>2</b>	Conducting water conservation campaign	<ul style="list-style-type: none"> <li>➤ Distributing leaflet to the customers, making lecture in school, etc.</li> </ul>	

### Chapter 3. Flow of Actions for UFW Reduction Activities

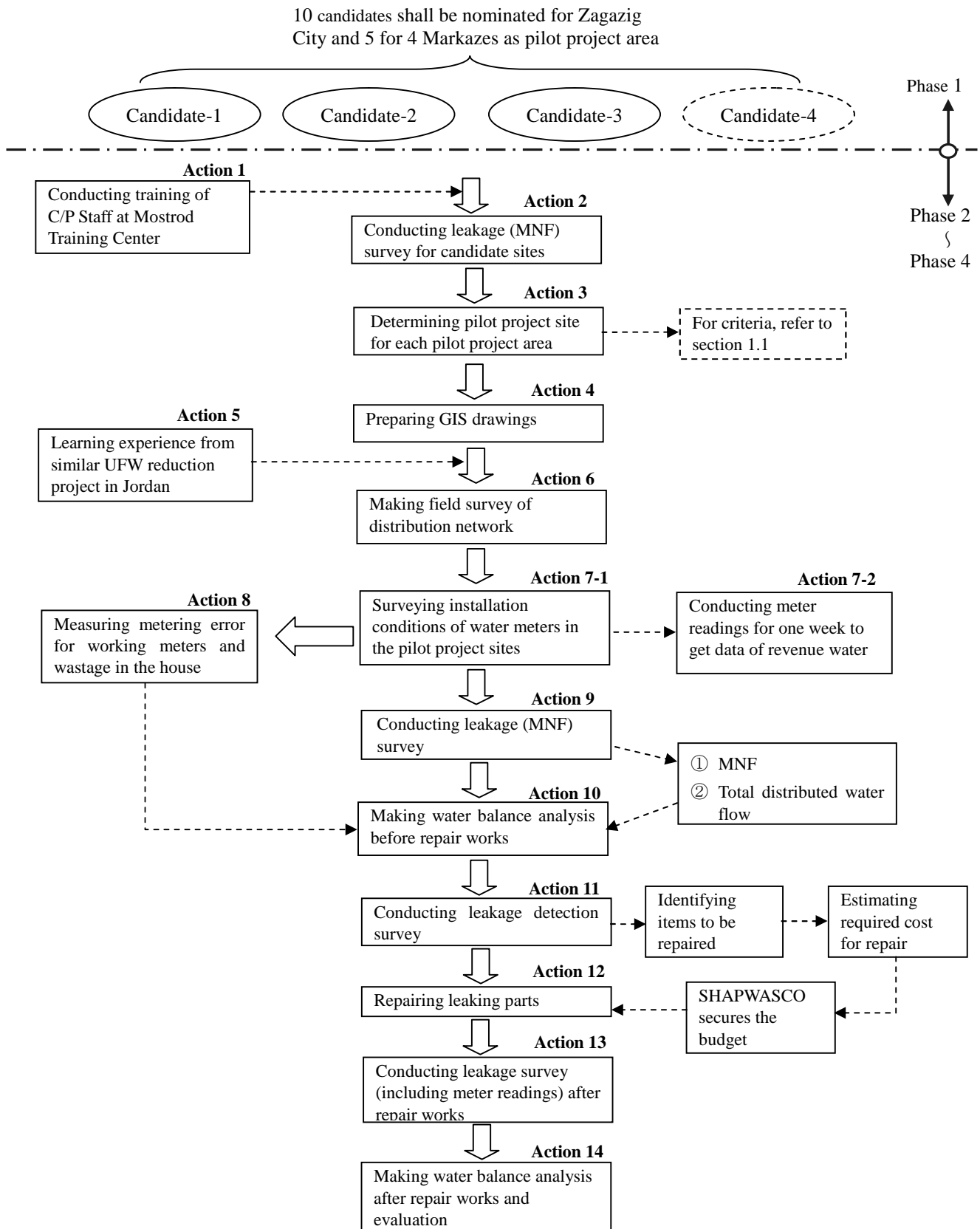


Figure 3-1 Flow of Actions for UFW Reduction Activity

## Chapter 4. Description of Each Action

Actions listed in Table 2-1 are described in details as follows:

### Action 1 Conducting Training of C/P Staff at Mostrod Training Center

UFW teams have been organized for the Pilot Project Areas : Pilot Area 1 (Zagazig City and Zagazig Markaz) and Pilot Area 2 (Hihya, Ibrahimiya and Diarb Nigm Markazes).

The UFW team of Zagazig City and each Markaz of SHAPWASCO consists of one (1) engineer, three (3) supervisor and two (2) workers. The names of engineer and supervisors are mentioned in Table 4-1.

**Table 4-1 List of UFW Team Member**

City/Markaz	Name
SHAPWASCO Headquarters	Mr. Alae El Din Mohamed
Zagazig City - East	Mr. Salama Mahmoud Abd El Aal (E) Mr. Mohamed Mohamed Bakr (S) Mr. Medhat Moneir Mahmoud (S) Mr. Mohamed Hafez Lotfy (S)
Zagazig City - West	Mr. Samir Mahmoud Abd El Hameed (E) Mr. Mahmoud Mohamed El Hariry (S) Mr. Nabil Fathy El Sayed (S) Mr. Gorge Abd El Maseeh (S)
Zagazig Markaz	Ms. Asmaa Mohamed Farag (E) Mr. Mohamed Mohamed Sabry (S) Mr. El Sayed Farag Ahmed (S) Mr. Ibrahim Bayoumi Mohamed (S)
Hihya Markaz	Mr. Mahdy Fathy Ahmed (E) Mr. Amin Sedeek Amin (S) Mr. Gamal Mohamed Hussein (S) Mr. El Hady Ahmed El Taher (S)
Ibrahimiya Markaz	Mr. Abdou Mohamed Ahmed (E) Mr. Abd Allah Abd El Mgeed (S) Mr. Samir Mohamed Ahmed Farag (S) Mr. Ramadan Abd Allah (S)
Diarb Nigm Markaz	Mr. Adel Salah Sadek (E) Mr. Mohamed Abbas(S) Mr. Mohamed El Sayed El Killany (S) Mr. Mohamed Megahed Abd El Aziz (S)
Awlad Saqr Markaz	Mr. Emad Ahmed Abd El Kader (E) Mr. Bendary Hassan Bendarhy (S) Mr. Hegazy El Sayed Ali (S) Mr. Saeed Abd El Salam Ahmed (S)
Kafr Saqr Markaz	Mr. Fahmy Mohamed Khalaf Allah (E) Mr. Mohamed Ibrahim Mohamed (S) Mr. Mohamed Ibrahim Desouky (S) Mr. Fahmy Mohamed Khalaf Allah (S)

City/Markaz	Name
Menia Al Qamah Markaz	Mr. Mohamed Mohamed Nour (E) Mr. Adel Saleh (S) Mr. Ibrahim Fathy El Sadany (S) Mr. El Sayed Abd El Habet Ghamry (S)
Mashtool El Sooq Markaz	Mr. Saeed Abd El Rahman Hefny (E) Mr. Mohamed Ahmed Ali Hozayen (S) Mr. Abd El Baset Mostafa Mohamed (S) Mr. Soliman Hassan Soliman (S)
Bilbais Markaz	Mr. Bendary Abd El Kader Sharawy (E) Mr. Reda Abd El Hameed Abd Allah (S) Mr. Salah Mohamed Kamel (S) Mr. Mahmoud Salem Ibrahim (S)
Faqus Markaz	Mr. Sebaey Mohamed Rabee (E) Mr. Mostafa Mohamed Sobeeh (S) Mr. El Sayed Abd El Aziz Soliman (S) Mr. Salah El Dien Abbas Farah (S)
Abu Kabier Markaz	Mr. El Saied Abd El Reheem (E) Mr. Abd El Wahab Mohamed Ali (S) Mr. Mahrous Gergis Romees (S) Mr. Mahmoud Mohamed Gebaly (S)
Abu Hamad Markaz	Mr. Mostafa Abd Allah Ghanaieem (E) Mr. El Saied Hamed Hemdaan (S) Mr. Mohamed Mahmoud Radwan (S) Mr. Youssry Abd El Monem Hassan (S)
El Husseinia Markaz	Mr. Salah Abd El Haq (E) Mr. Mohamed Abd El Monem (S) Mr. El Sayed Ibrahim Ali (S) Mr. Mohamed Abd El Aal Mohamed (S)

Note : (E) stands for engineer and (S) for supervisor

Members of UFW teams will receive training for learning leakage survey technology at Mostrod Training Center in Cairo. This training will be completed before commencement of pilot project (by the end of April 2007).

UFW teams organized in the pilot project areas and other Markazes will work together in cooperation with other teams as proposed in Table 4-2.

Tentative arrangement of UFW teams in minimum night flow (leakage) survey for selecting pilot project sites is proposed as shown in Attachment-2 and tentative arrangement of UFW teams in pilot project for the selected pilot project site (for Zagazig City-East) is mentioned as shown in Attachment-3.

**Table 4-2 UFW Team Distribution During UFW Reduction Activity**

City/Markaz (Pilot Project Area)	Core Team	Cooperating Team	Auditing Team
Zagazig City	Zagazig-East	Zagazig-West	Bilbais Menia Alqamah
Zagazig Markaz	Zagazig-East	Zagazig Markaz	Mashtool Alsooq Abu Hamad
Hihya Markaz	Hihya	Ibrahimiya Diarb Nigm	El Huseinia Faqus
Ibrahimiya Markaz	Hihya	Ibrahimiya	Abu Kabier
Diarb Nigm Markaz	Hihya	Diarb Nigm	Kafr Saqr Awlad Saqr

**Action 2 Conducting leakage (or MNF) survey for candidate sites**

In order to select 6 pilot project sites from Pilot Area-1 (Zagazig City and Zagazig Markaz) and Pilot Area-2 (Hihya, Ibrahimiya and Diarb Nigm Markazes), leakage (or minimum night flow : MNF) survey shall be conducted in the candidate areas as follows:

- 10 areas for Zagazig City (5 from east part and 5 from west part of the city)
- 5 areas for Hihya Markaz
- 5 areas for Ibrahimiya Markaz
- 5 areas for Diarb Nigm Markaz

Average leakage ratio obtained in the MNF survey shall be assumed as the representative leakage ratio for Zagazig City and each Markaz.

**Action 3 Determining pilot project site for each pilot project area**

Pick up one (1) candidate area as the pilot project site for the pilot project areas of Zagazig City (East and West), Zagazig, Hihya, Ibrahimiya and Diarb Nigm Markazes.

The selected candidate area shall have the nearest leakage ratio to the representative leakage ratio of the city and Markaz.

**Action 4 Preparing GIS drawings**

GIS drawings (the scale of 1 to 5,000) for pilot areas shall be prepared according to the schedule shown in Figure 6-1. In preparation of GIS drawings, priority shall be put on the candidate areas for pilot project sites.

**Action 5 Learning experiences of similar UFW reduction project in Jordan**

In Jordan, a project for capacity improvement of UFW control by JICA has been implemented

since 2005. The outcomes of Jordan project will be useful for this project. A representative of JICA expert team and representatives of SHAPWASCO UFW teams will visit the project sites in Jordan and learn their experience.

#### **Action 6 Making field survey of distribution network**

Field survey shall be executed for the selected pilot project sites as follows:

- Detecting visible leakage and making record in the map
- Confirming location and conditions of valves at site and recording in the map
- Confirming location of public taps, fire hydrant and governmental buildings, if any

#### **Action 7 Surveying installation conditions of water meters**

Conditions of the existing water meters shall be checked at site to clarify non-working meters and the customers without water meters. In case non-working meters or the connection without water meters are found, new water meters shall be replaced or installed.

#### **Action 8 Measuring metering error of water meter and wastage in the house**

Metering error (or meter insensitive water volume) shall be estimated by the method shown in Figure 4-1 below. Work for measuring metering error will be conducted in parallel with the activities in item (6) to (11) mentioned in Table 2-1. In order to measure the metering error more accurately, wastage of water in the house (leakage at taps, toilet equipment, etc.) will also be measured.

Procedures for measuring metering error and wastage in the house are as follows:

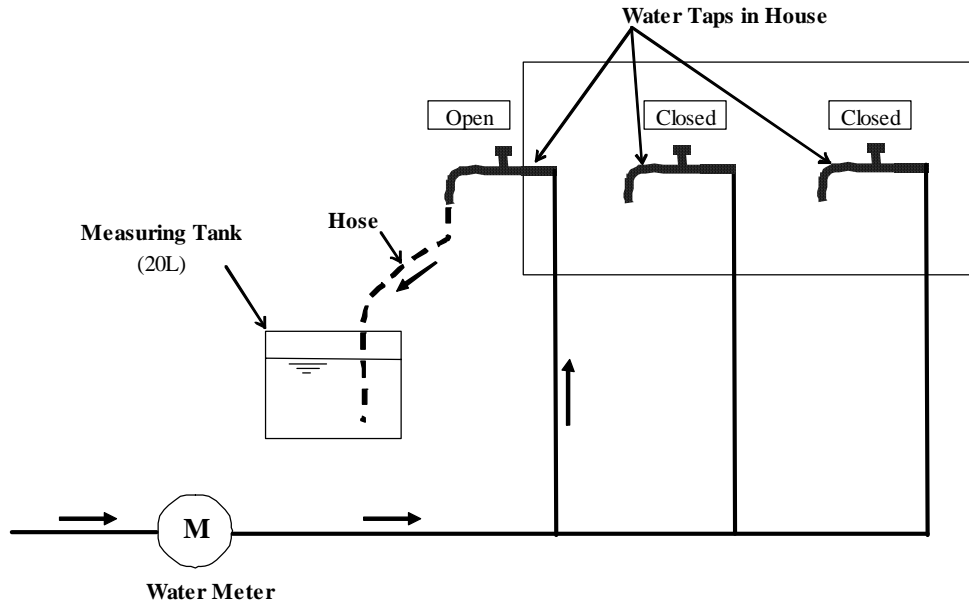
##### **[1<sup>st</sup> Step : Measuring metering error]**

1. Select 20 to 30 working meters randomly in the pilot project site.
2. Close all the taps in the house.
3. Set the hands of the water meter at zero point.
4. Open one tap and close all other taps in the house. Measurement shall be done by the following three cases for the degree of tap opening:
  - Case 1 : Full opening
  - Case-2 : Half opening
  - Case-3 : Quarter opening
5. Keep running water into the measuring tank for one minute and close the tap.
6. Reopen the tap for one minute and close.
7. Repeat items 5 and 6 until water level shows 20L or other readings (10L and 15L which will be determined taking into account the work progress at site and situation of the house).
8. Close the tap and read the meter.
9. Record the time of the measurement (from item 3 to 5)
10. Repeat the procedure from item 3 to 6 for all cases.



**[2<sup>nd</sup> Step : Measuring wastage of water in the house]**

1. Close all the taps in the house.
2. Set the hands of the water meter at zero point again.
3. Wait until the time recorded in item 7 above has elapsed.
4. Read the meter.

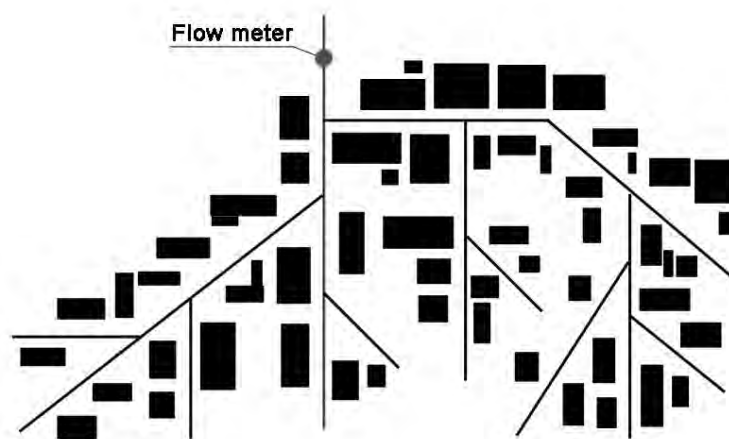


**Figure 4-1 Method of Measuring Metering Error**

**Action 9 Conducting leakage (MNF) survey**

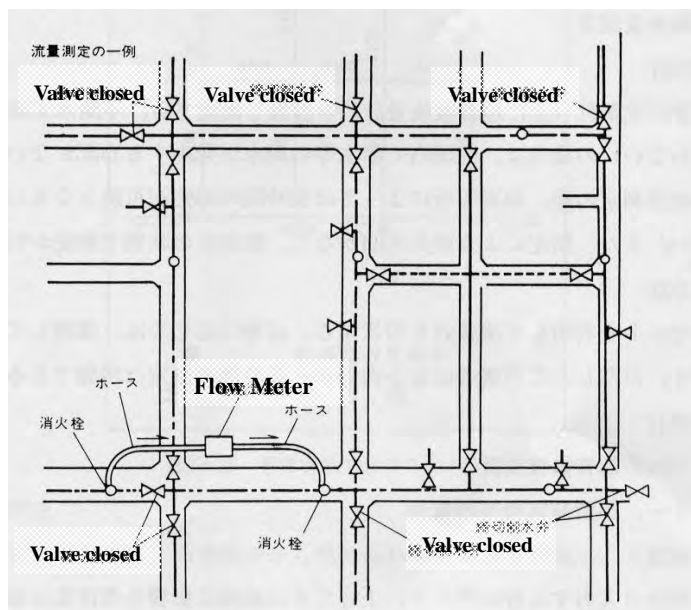
**(1) Method of Minimum Night Flow Measurement**

When the network is formed in the tree shape and it has only one distribution pipeline supplying to the area, one (1) flow meter will be installed as shown in Figure 4-2.



**Figure 4-2 Flow Meter Installation for Tree Shape Network**

When the network is located in the highly-populated area, one flow meter will be installed after isolating the area by closing all the valves as shown in Figure 4-3.



**Figure 4-3 Flow Meter Installation for Network in Highly-Populated District**

(2) Type of Flow Meter

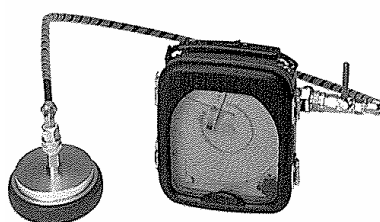
The minimum night flow shall be measured by ultrasonic flow meter (refer to Figure 4-4). The ultrasonic flow meter can measure flow in pipes by catching variation in the velocity of ultrasonic waves, as they exactly depend on the rate of flow in the pipeline. It can be installed on/around water pipe without interrupting water supply.



**Figure 4-4 Ultrasonic Flow Meter**

(3) Measurement of water pressure

This device is used for recording water pressure for 24 hours (refer to Figure 4-5). It will be installed at the inlet point of the pilot project site and highest point of the site (at taps or hydrants) to measure average water pressure in the site.



**Figure 4-5 Water Pressure Recorder**

### Action 10 Making Water balance analysis (before repair works)

Water balance analysis is essential in preliminary work for UFW reduction activity. Following data shall be collected for the analysis.

- Water production volume
- Water distribution volume
- Authorized water consumption
  - Billed authorized consumption
  - Unbilled authorized consumption
- Water losses
  - Apparent losses (consumption by illegal connection, metering error, etc.)
  - Real losses (leakage in the water supply system)

The example of the water balance analysis is shown in Table 4-3.

**Table 4-3 Water Balance Analysis Sheet (Example)**

No.	Item	Description	Volume (m <sup>3</sup> /year)	
<b>1</b>	<b>Raw Water Intake [1.1] + [1.2] + [1.3] + [1.4]</b>		1,900	
1.1	- Water Treatment Plant		1,000	
1.2	- Production Wells		700	
1.3	- Fe/Mn Remoral Facility		100	
1.4	- Compact Unit		100	
<b>2</b>	<b>Treatment Losses</b>	Backwash, Evaporation, etc.	70	
2.1	- Water Treatment Plant		30	
2.2	- Production Wells		20	
2.3	- Fe/Mn Remoral Facility		10	
2.4	- Compact Unit		10	
<b>3</b>	<b>Water Produced in Markaz [1 - 2]</b>	Raw Water Intake – Treatment Losses	1,830	
3.1	- Water Treatment Plant		970	
3.2	- Production Wells		680	
3.3	- Fe/Mn Remoral Facility		90	
3.4	- Compact Unit		90	
<b>4</b>	<b>Water Exported to or Imported from Other Markaz(es)</b>		-10	
4.1	- Water Exported to Other Markaz(es)		30	
4.2	- Water Imported to Other Markaz(es)		20	
<b>5</b>	<b>Effective Water Distribution inside the Markaz [3] + [4]</b>		1,820	
<b>6</b>	<b>Authorized Consumption [6.1] + [6.2]</b>		1,120	
<b>6.1</b>	<b>Billed Authorized Consumption</b>		1,100	
6.1.1	- Billed Metered Consumption	Including uncollected consumption	1,000	
6.1.2	- Billed Unmetered Consumption	Estimated consumption	100	
<b>6.2</b>	<b>Unbilled Authorized Consumption</b>		20	
6.2.1	- Unbilled Metered Consumption	Water for fire hydrant	0	Revenue Water
6.2.2	- Unbilled Unmetered Consumption	Water used for flushing of pipes, etc.	20	<b>[6.1]</b>
<b>7</b>	<b>Water Losses [7.1] + [7.2] (or [5] - [6])</b>		700	1,100
<b>7.1</b>	<b>Apparent Losses</b>		90	60.4%
7.1.1	- Unauthorized Consumption	Illegal connection, etc.	30	Unaccounted-for Water (UFW)
7.1.2	- Metering Inaccuracies	Metering errors	60	
<b>7.2</b>	<b>Real Losses</b>		610	<b>[6.2] + [7]</b>
7.2.1	- Leakage on Transmission and or Distribution Mains		500	<b>(or [5]-[6.1])</b>
7.2.2	- Leakage and Overflows at Utility's Storage Tanks		10	720
7.2.3	- Leakage on Service Connections up to point of Customer Metering		100	39.6%

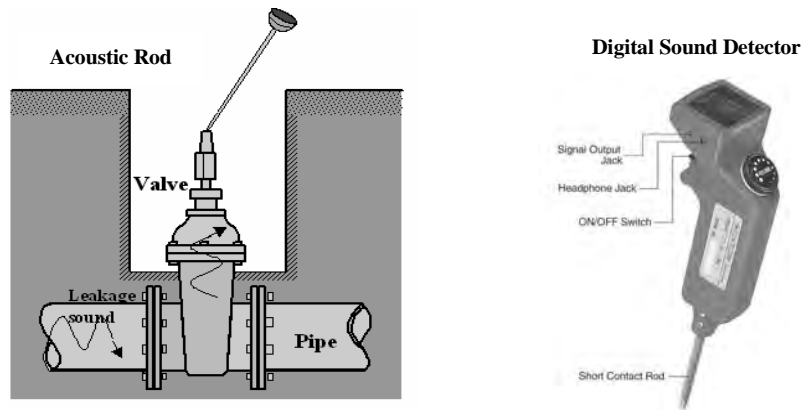
Note : When the required data above is not available, "N/A" shall be mentioned in the columns.

### Action 11 Conducting leakage detection survey

Leakage detection survey shall be conducted by means of the following methods:

- (1) Detection of leaking sound by Acoustic Rod or Digital Sound Detector

When leakage occurs, leaking sound spreads through the pipe. At the point where valves are available, acoustic rod or digital sound detector will be useful for detecting the sound. The method of leaking sound detection is shown on Figure 4-6.



**Figure 4-6 Detecting by Acoustic Rod or Digital Sound Detector**

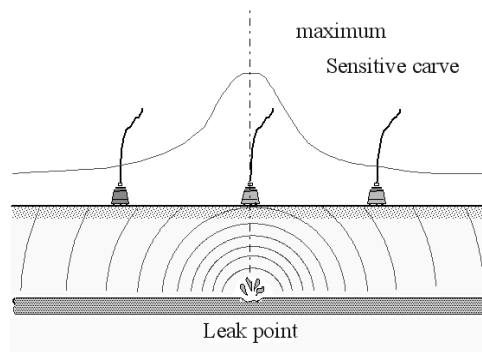
(2) Detection of leaking points by Leak Detector

The location of the leaking points will be identified by Leak Detector. The detection work by Leak Detector is shown in the picture.



**Detection Work by Leak Detector**

The mechanism of detecting leaking point is explained in Figure 4-7.



**Figure 4-7 Mechanism of Detecting Leaking Point**

The typical leak detector is as shown in Figure 4-8.



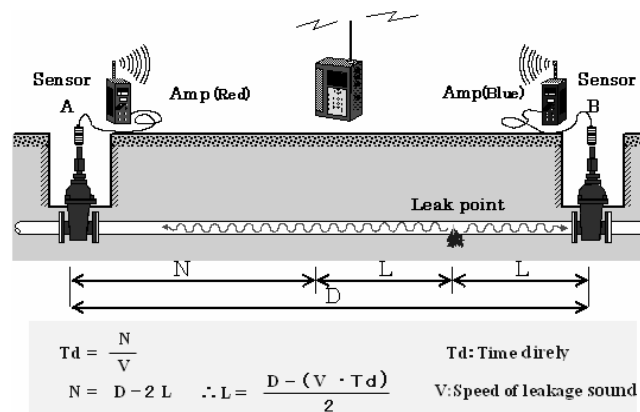
**Figure 4-8 Typical Leak Detector**

(3) Detection by Leak Sound Correlator

Leak Sound Correlator will be applied to confirm the leaking point when leak sound is detected in two points. This equipment identifies the location of leaks by intercepting leak noise that is caught by a sensor at two valves or hydrants (refer to Figure 4-9). It measures the difference in transmission time between two points, and processes the data by computer. Thus, it exactly shows the leaking point.



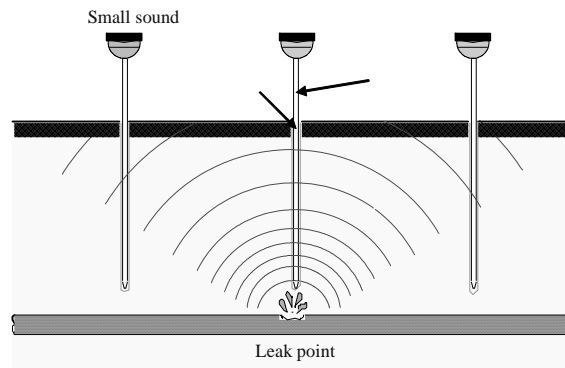
**Figure 4-9 Leak Sound Correlator**



**Figure 4-10 Method of Detecting Leakage by Leak Sound Correlator**

(4) Confirmation of Leak Point by Acoustic Rod

After detecting leak point, some holes are drilled at the detected leak points and acoustic rod will be inserted in the hole to confirm the exact location of the leak point (refer to Figure 4-11).



**Figure 4-11 Method of Confirming Exact Location of Leak Point**

(5) Pipe Locating Devices

When the buried pipes are not identified, following devices will be applied.

Pipe & Cable Locator

This device is used for locating pipes and cables under the ground.



**Figure 4-12 Pipe & Cable Locator**

Metal Locator

A sensor of this device detects the location of hidden iron-made structures such as valve boxes and stop valves. As iron creates a magnetic field, the suitable sensors can detect it.



**Figure 4-13 Metal Locator**

**Action 12 Repairing leaking parts**

After leak detection work, items to be repaired for stopping leakage shall be listed with priority and the cost estimation shall be done. The repairing work will be executed for the leakage parts according to the priority within the budget of SHAPWASCO.

**Action 13 Conducting leakage survey (after repair works)**

In order to confirm the effectiveness of the repairing work (or reduction percentage of leakage ratio), MNF survey shall be carried out after the repairing work of the leaking parts. Before conducting MNF survey, meter readings for one week shall be conducted.

**Action 14 Making water balance analysis after repair works and evaluation**

Water balance analysis shall be conducted using data obtained after the repairing works of the leak points and evaluation the effects of the reduction works.

## **Chapter 5. Other Activities related to UFW Reduction Activity**

### **5.1 Holding UFW workshops and Seminars for presenting the outcomes of activity**

JICA expert team and C/P UFW teams together with C/P SOP teams will hold workshops and seminars to present the outcomes of UFW reduction activity. The workshops and seminars will be held in the following schedule:

#### **[Open Workshop]**

- 1<sup>st</sup> Workshop : October 2007 in Phase-2
- 2<sup>nd</sup> Workshop : February 2008 in Phase-2
- 3<sup>rd</sup> Workshop : October 2008 in Phase-3
- 4<sup>th</sup> Workshop : February 2009 in Phase-3

#### **[Internal Workshop]**

- 1<sup>st</sup> Workshop : May 2007 in Phase-2
- 2<sup>nd</sup> Workshop : May 2008 in Phase-3

#### **[Open Seminar]**

- 1<sup>st</sup> Seminar : June 2007 in Phase-2
- 2<sup>nd</sup> Seminar : May 2009 in Phase-4

### **5.2 Conducting water conservation campaign**

In parallel with the pilot project for UFW reduction, water conservation campaign shall be conducted. Action program for water conservation including leaflet and other tools will be proposed.

### **5.3 Water balance analysis in Zagazig City and selected Markaz**

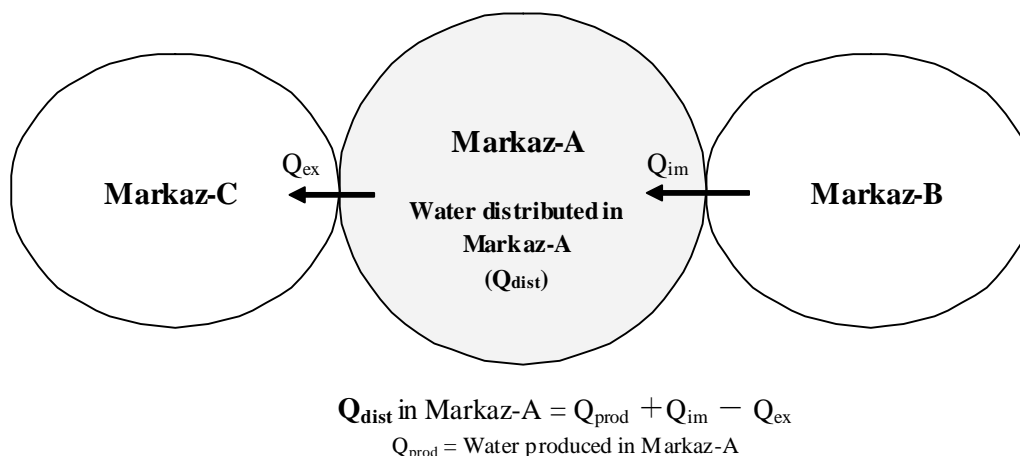
Water balance analysis is the most important work in UFW reduction activity. Therefore, in the water utility management, it is essential to conduct water balance analysis periodically on a monthly basis or quarterly basis.

In order to obtain data for the water balance of the whole SHAPWASCO, it is necessary to conduct water balance analysis in all the SHAPWASCO branches (Zagazig City and 13 Markazes).

Water distributed in each Markaz is explained in Figure 5.1.

In the Project, water balance analysis will be done for Zagazig City and selected Markazes which will be determined with C/P.





**Figure 5-1 Water Distributed in Each Markaz**

#### 5.4 Measuring water flow of inter-Markaz transmission and distribution mains

At present, there is no data for the water flow transferred between or among Markazes. Therefore, it is not possible to make water balance analysis in each branch. During the project period, water flow imported from or exported to other Markazes will be measured by portable flow meter in Zagazig City and four Markazes (Zagazig Markaz, Hihya Markaz, Ibrahimiya Markaz and Diarb Nigm Markaz) where the pilot project is done.

#### 5.5 Formulating and executing long-term pipe replacement plan for preventive works

In this Project, focus shall be put on preliminary works and on-site work, that is:

[Preliminary works]

- Organizing UFW team
- Preparing network drawings
- Conducting water balance analysis
- Analyzing causes of leakage
- Studying age of pipes

[On-site work]

- Doing quick repairs for visible (or on-the-ground) leakage
- Detecting leakage and conducting repair works

Besides the above works, in order to reduce the leakage ratio steadily year by year, the preventive works will be indispensable. Therefore, pipe replacement plan for the long term will be formulated in the Project.

## Chapter6. Implementation Schedule of UFW Reduction Activity

Proposed implementation schedule of the UFW reduction activity is described as follows:

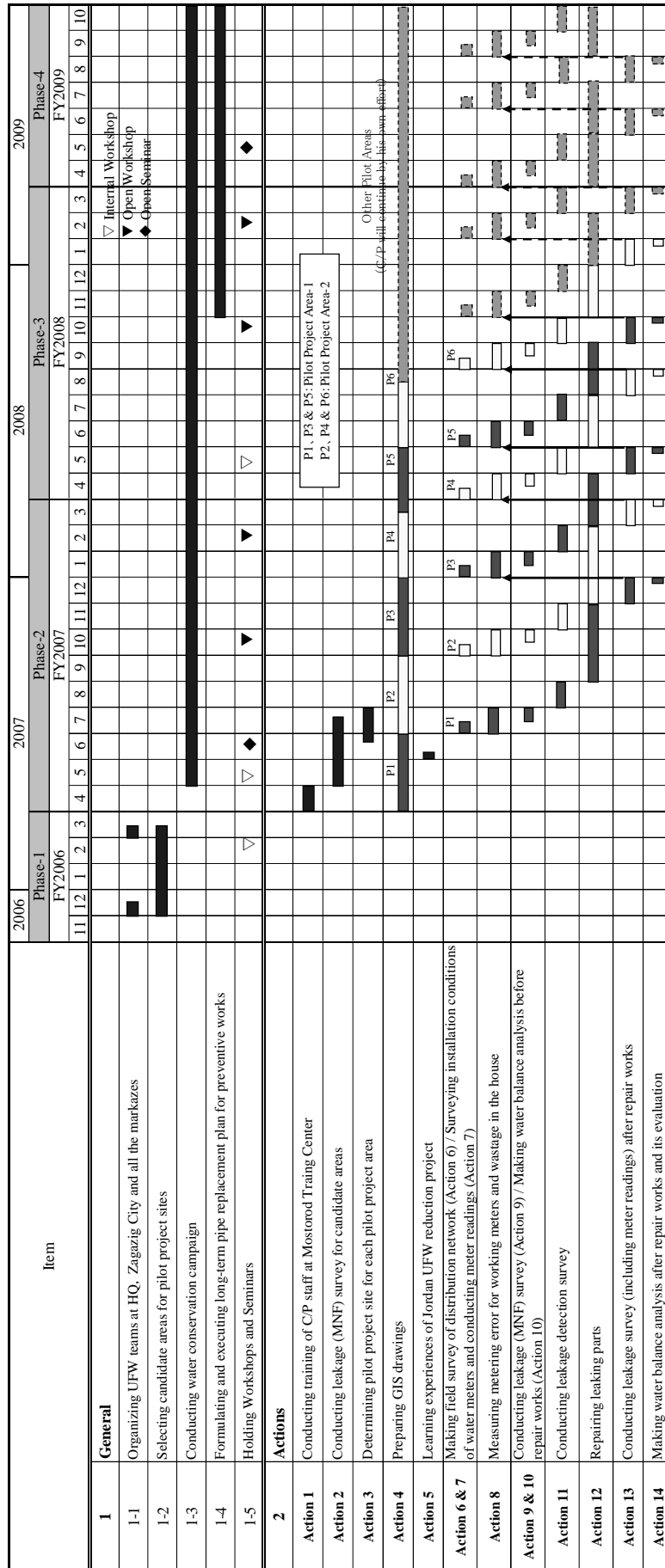
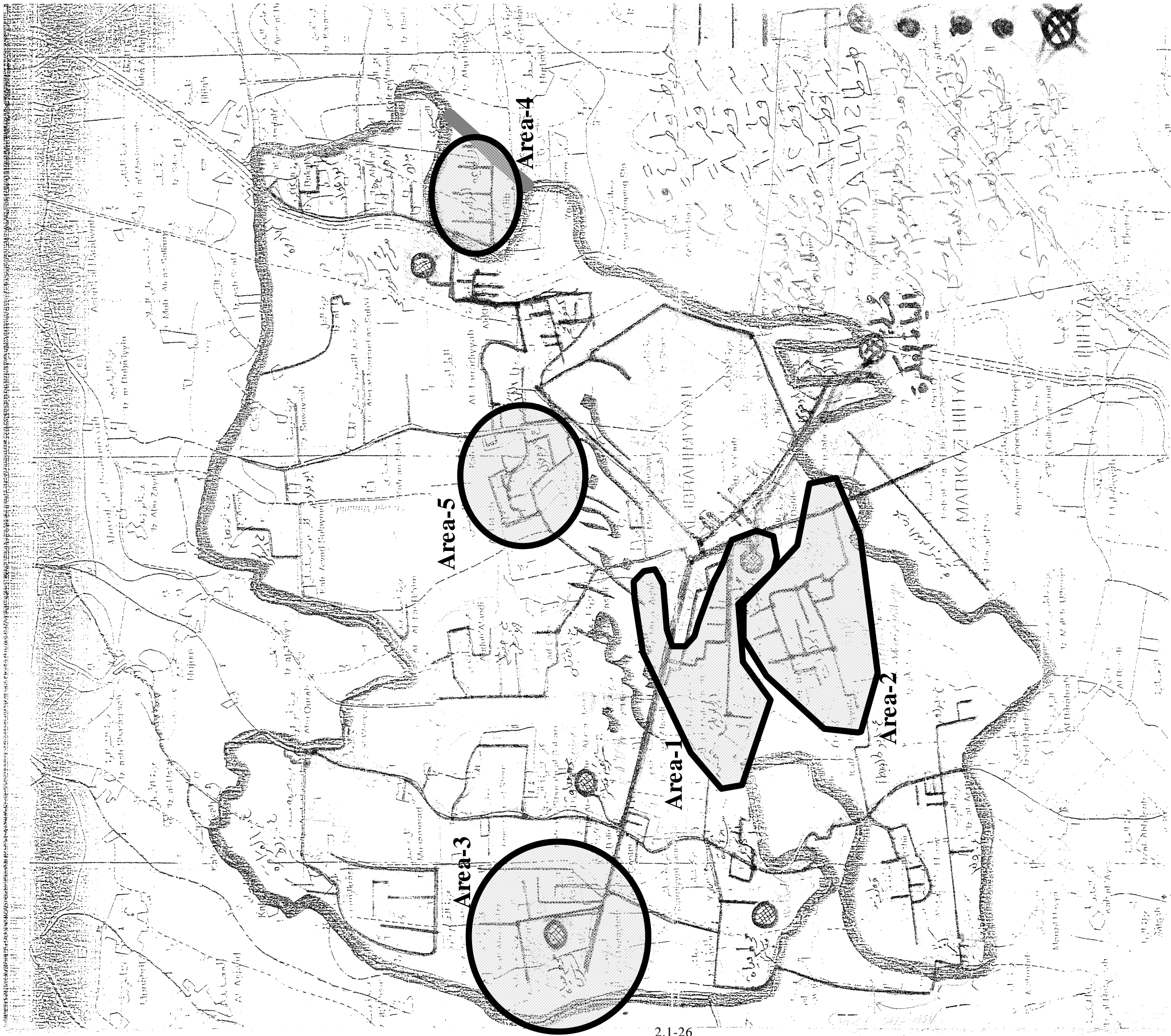


Figure 6-1 Implementation Schedule for UFW Reduction Activity



**Nominated Candidate Areas**

Area-1	Ibrahimiya City
Area-2	El Halawat
Area-3	El Seds
Area-4	Kafr Abo El Deeb
Area-5	El Hebsh

**Legend:**  : Location of Nominated Candidate Areas

**Location of Nominated Candidate Areas**

**⑥ Ibrahimiya Markaz**

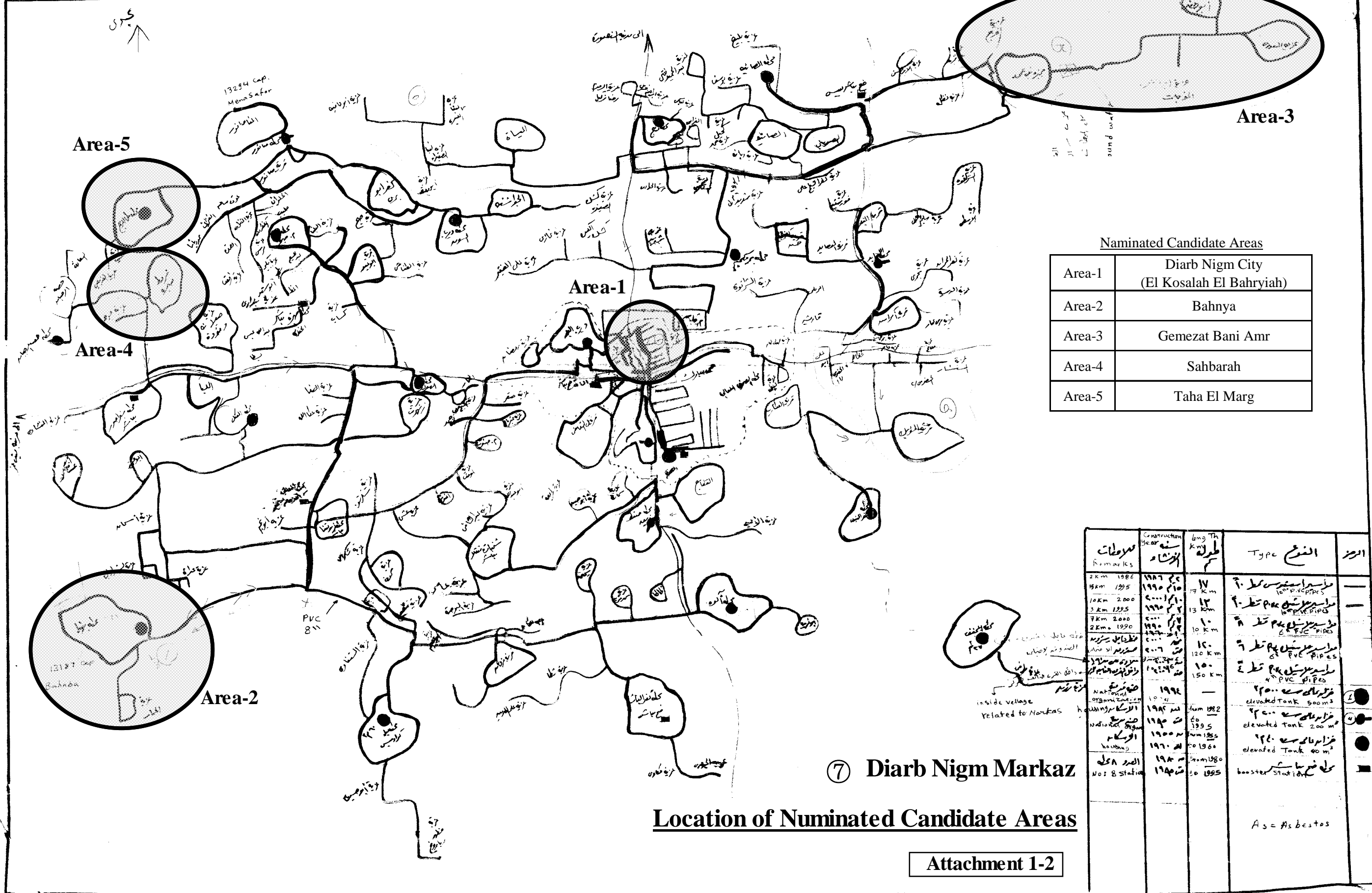
**Attachment 1-1**

Sketch.

شركة مياه الشرب والصرف الصحي بالشركة  
Shakia Potable water and sanitation company  
Diarb Nigm Markaz

by: - Eng. Mohamed Abbas  
اعداد المهندس محمد عباس  
network manager

محطات وشبكات المياه بمرکز وقرية دير نغم  
Stations and water net works for markaz diarb Nigm



Nominated Candidate Areas

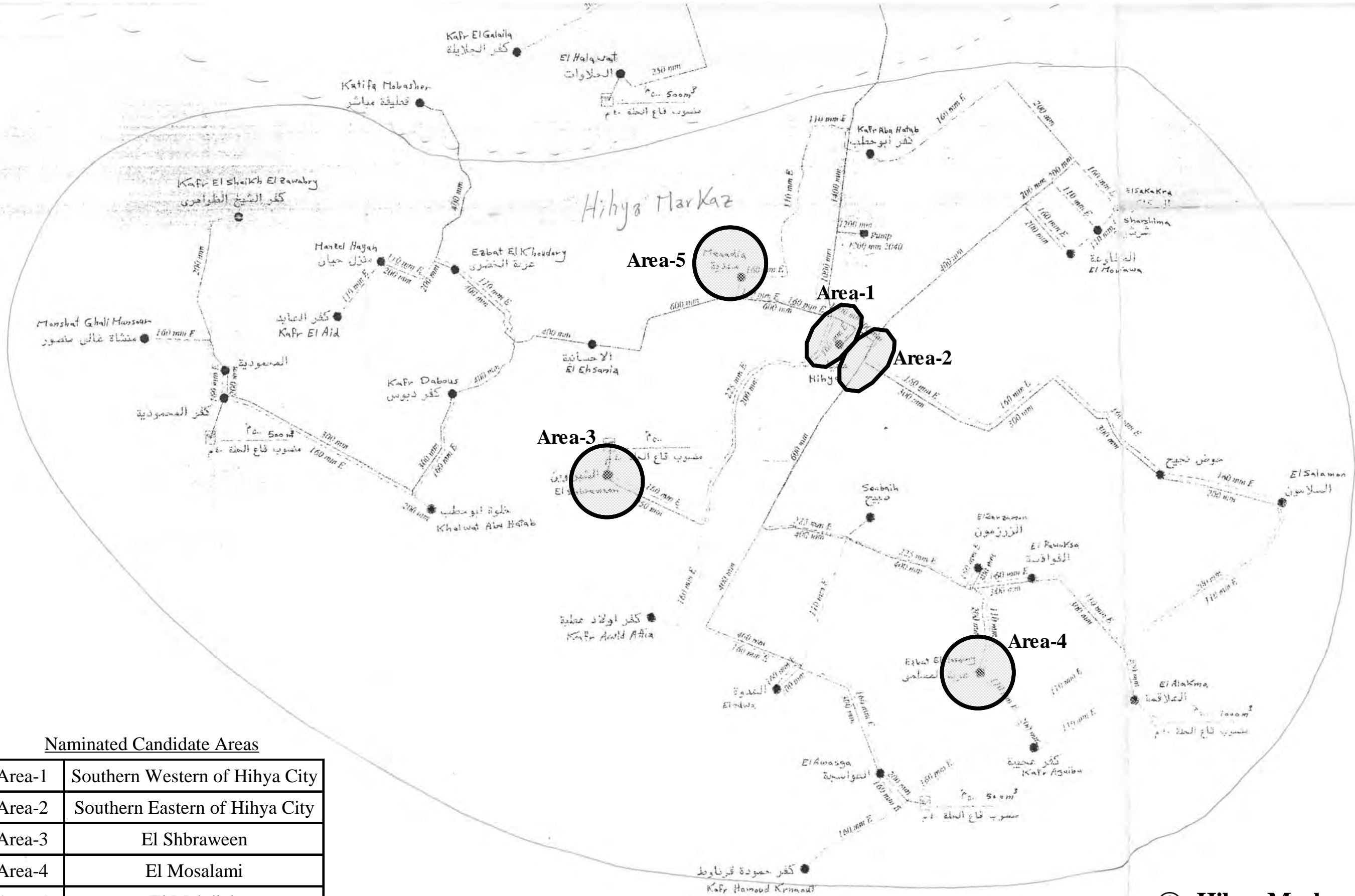
Area-1	Diarb Nigm City (El Kosalah El Bahryiah)
Area-2	Bahnya
Area-3	Gemezat Bani Amr
Area-4	Sahbarah
Area-5	Taha El Marg

ملاحظات Remarks	سنة الإنشاء Construction Year	طول خط Long Th Km	النوع Type	الوزن
2 Km 1986	1986	17 Km	مياه بستان PVC 10"	As
15 Km 1995	1995	17 Km	مياه بستان PVC 10"	PVC 10"
10 Km 2000	2000	13 Km	مياه بستان PVC 10"	PVC 10"
3 Km 1995	1995	13 Km	مياه بستان PVC 10"	PVC 8"
7 Km 2000	2000	10 Km	مياه بستان PVC 10"	PVC 8"
2 Km 1990	1990	10 Km	مياه بستان PVC 10"	PVC 8"
مطابق على مستوى مستوي الارتفاع مطابق على مستوى مستوي الارتفاع	2007	120 Km	مياه بستان PVC 10"	PVC 6"
مطابق على مستوى مستوي الارتفاع مطابق على مستوى مستوي الارتفاع	2007	150 Km	مياه بستان PVC 10"	PVC 4"
مطابق على مستوى مستوي الارتفاع مطابق على مستوى مستوي الارتفاع	1998	150 Km	مياه بستان PVC 10"	PVC 4"
National housing organization المنظمة الوطنية للإسكان	1982	100 m	elevated Tank 500 m <sup>3</sup>	●
مطابق على مستوى مستوي الارتفاع مطابق على مستوى مستوي الارتفاع	1982	100 m	elevated Tank 200 m <sup>3</sup>	●
مطابق على مستوى مستوي الارتفاع مطابق على مستوى مستوي الارتفاع	1955	100 m	elevated Tank 40 m <sup>3</sup>	●
مطابق على مستوى مستوي الارتفاع مطابق على مستوى مستوي الارتفاع	1980	100 m	elevated Tank 40 m <sup>3</sup>	●
المركز No: 8 Station	1980	100 m	booster Station	■

⑦ Diarb Nigm Markaz

Location of Nominated Candidate Areas

Attachment 1-2

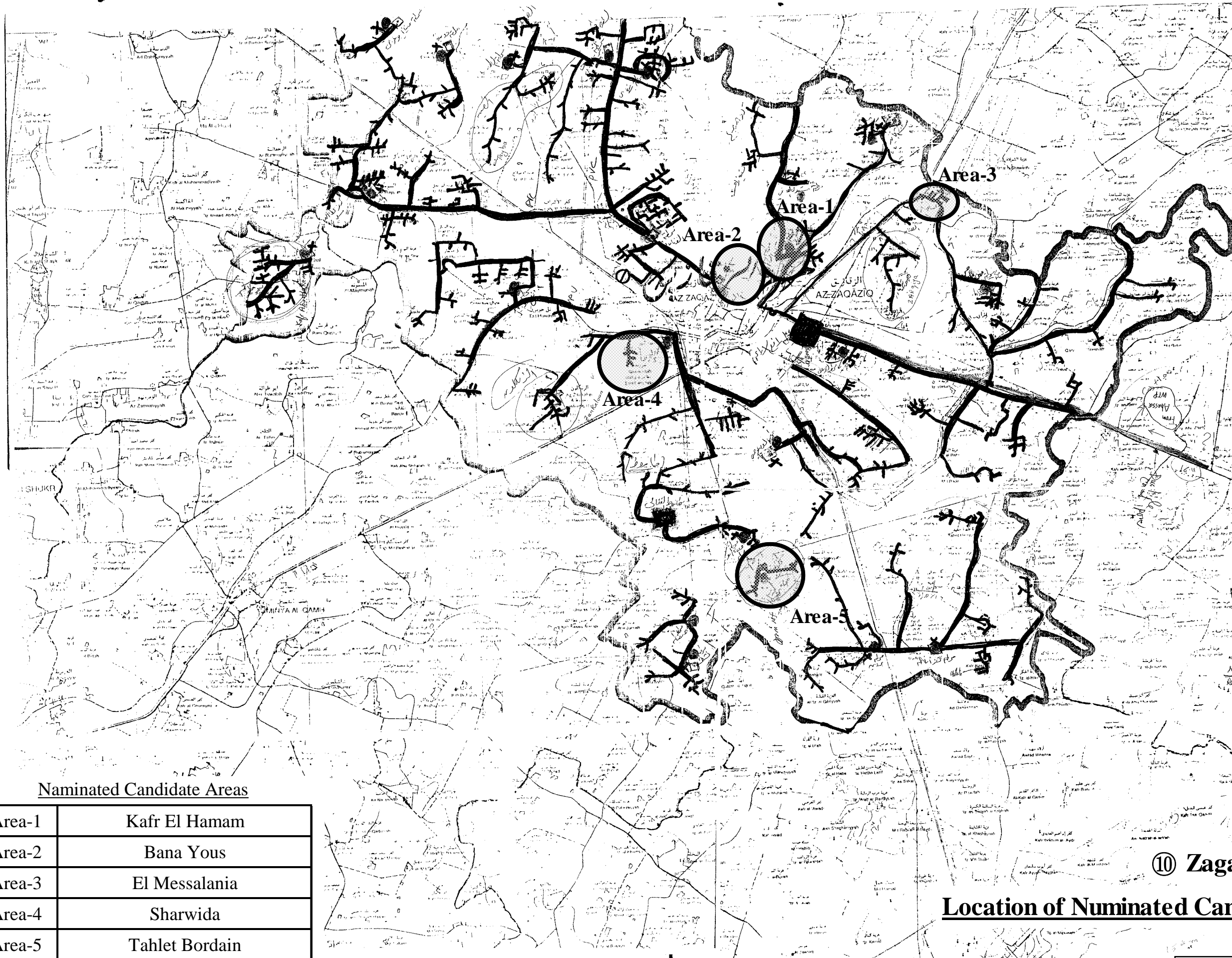


⑧ Hihya Markaz

Naminated Candidate Areas

Area-1	Southern Western of Hihya City
Area-2	Southern Eastern of Hihya City
Area-3	El Shbraween
Area-4	El Mosalami
Area-5	El Mahdiah

Location of Numinated Candidate Areas



**Naminated Candidate Areas**

Area-1	Kafir El Hamam
Area-2	Bana Yous
Area-3	El Messalania
Area-4	Sharwida
Area-5	Tahlet Bordain

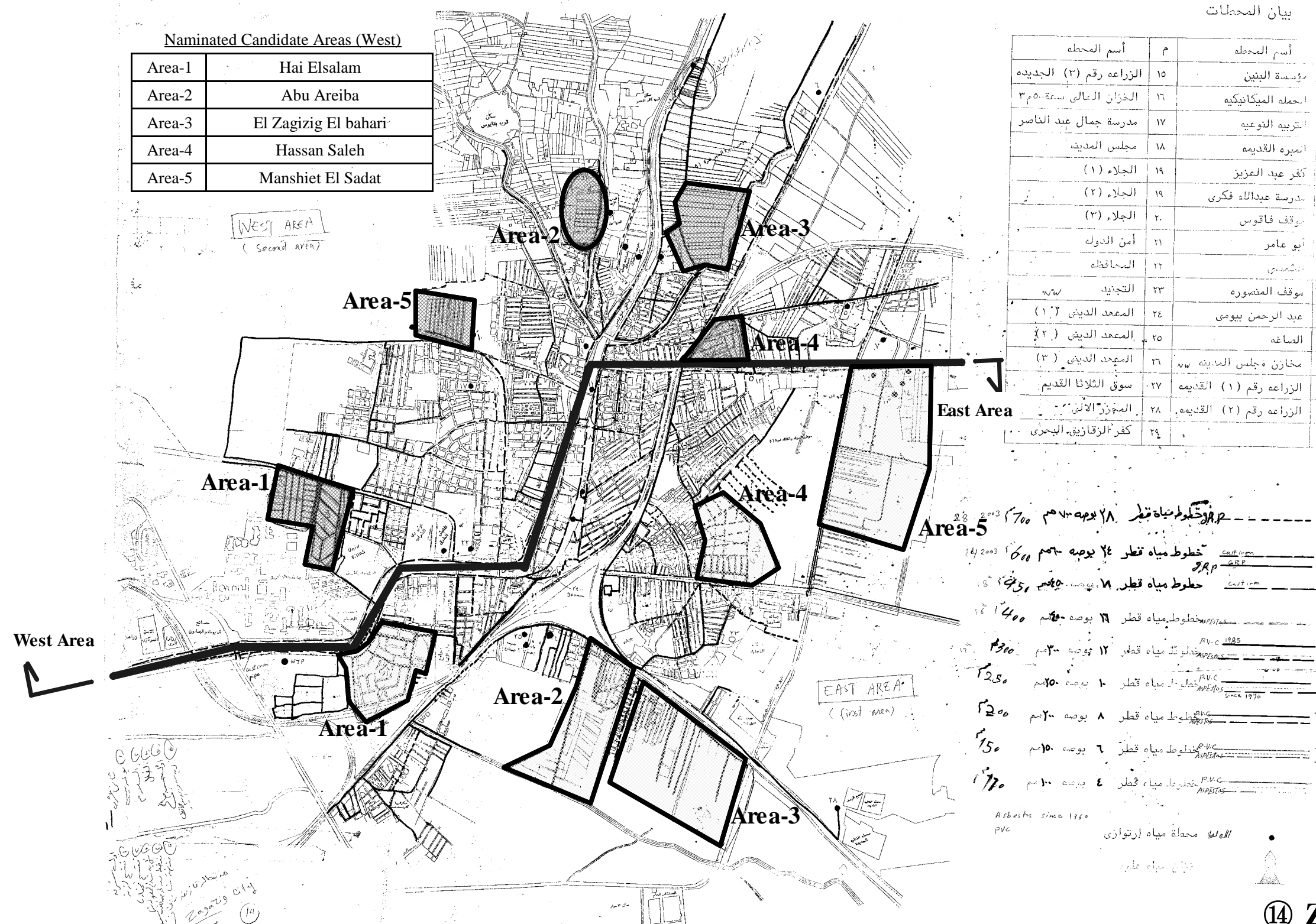
**Location of Numinated Candidate Areas**

**10 Zagazig Markaz**

**Attachment 1-4**



# شبكة خطوط المياه بمدينة الزقازيق



**Naminated Candidate Areas (West)**

Area-1	Hai Elsalam
Area-2	Abu Areiba
Area-3	El Zagizig El bahari
Area-4	Hassan Saleh
Area-5	Manshiet El Sadat

**بيان المحطات**

أسم المحطة	م	أسم المحطة
مؤسسة البئين	١٥	الزراعة رقم (٣) الجديد
احمله الميكانيكيه	١٦	الخزان العالي سعة ٣٥٠ م <sup>٣</sup>
التربية النوعيه	١٧	مدرسة جمال عبد الناصر
امبره القديمه	١٨	مجلس المديف
كفر عبد العزيز	١٩	الجلد (١)
مدرسة عبدالك فكري	١٩	الجلد (٢)
موقف فاغوس	٢٠	الجلد (٣)
أبو عامر	٢١	أمن الدولك
شمسي	٢٢	الصحافله
موقف المنصوره	٢٣	التجديد
عبد الرحمن بيومي	٢٤	المعهد الديني (١)
المساغه	٢٥	المعهد الديني (٢)
مخازن مجلس المدينة	٢٦	المعهد الديني (٣)
الزراعة رقم (١) القديمه	٢٧	سوق الثلاثا القديم
الزراعة رقم (٢) القديمه	٢٨	المجزر الانى
	٢٩	كفر الزقازيق البحري

**Naminated Candidate Areas (East)**

Area-1	El Zend
Area-2	El Husienia
Area-3	Manshiat El Husienia
Area-4	El Henawy
Area-5	Hai Mub arak

خطوط مياه قطر ٢٨ بوصة ٧٠٠ م ٢٨  
 خطوط مياه قطر ١٤ بوصة ٦٠٠ م ٢٨  
 خطوط مياه قطر ١٨ بوصة ٤٥٠ م ٢٨  
 خطوط مياه قطر ١٢ بوصة ٣٥٠ م ٢٨  
 خطوط مياه قطر ١٠ بوصة ٣٥٠ م ٢٨  
 خطوط مياه قطر ٨ بوصة ٢٠٠ م ٢٨  
 خطوط مياه قطر ٦ بوصة ١٥٠ م ٢٨  
 خطوط مياه قطر ٤ بوصة ١٠٠ م ٢٨

Asbestos since 1960  
 PVC  
 محطة مياه ارتوازي  
 تان مياه علم

⑭ Zagazig City East & West

**Location of Numinated Candidate Areas**

Fig  
(1)

**Attachment 1-5**

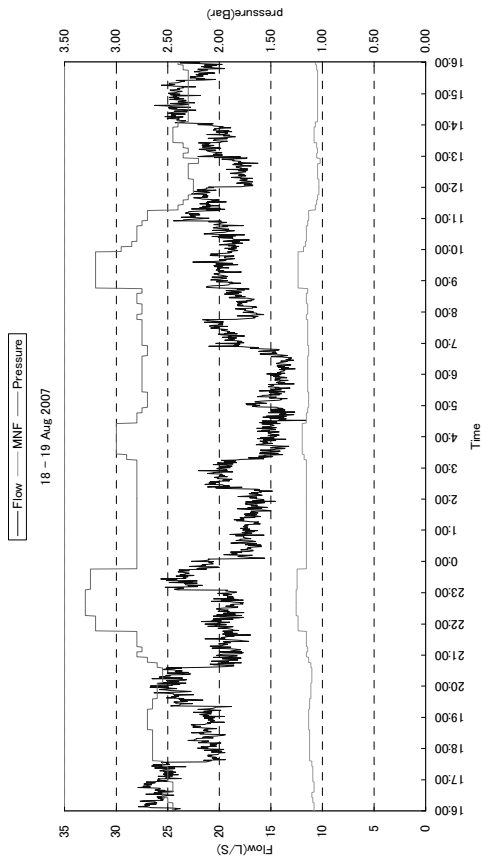




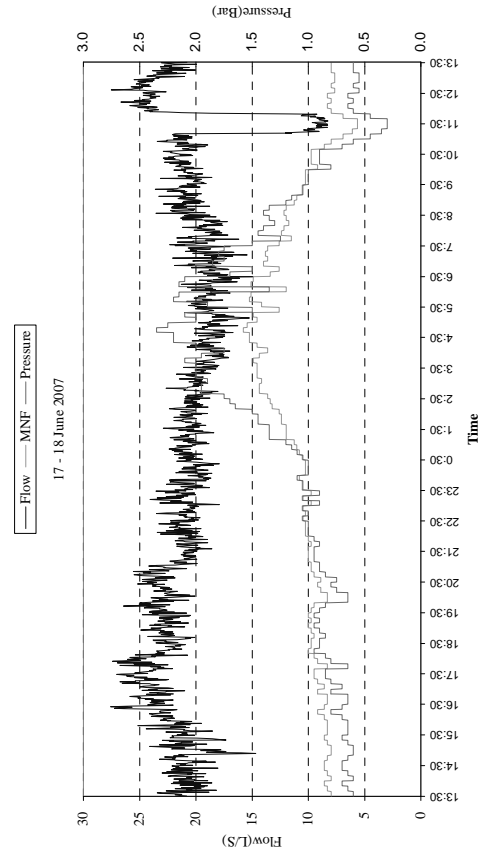


## 2.2 Result of MNF Survey for Candidate Site (Action U2)

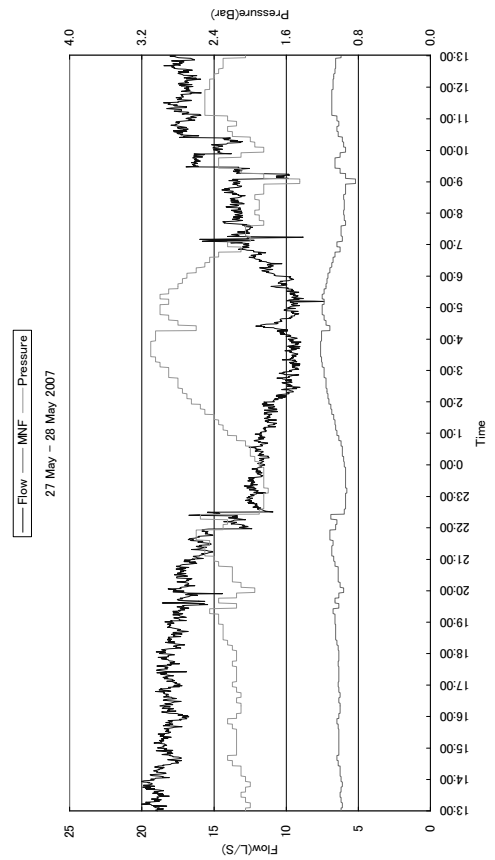
**MNF Graph for Zagazig East Area-1(18-19)**



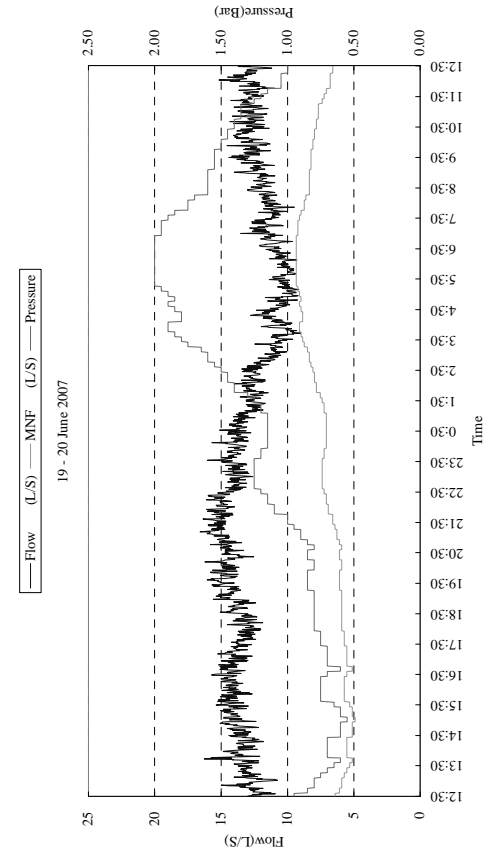
**MNF Graph for Zagazig East Area-3**



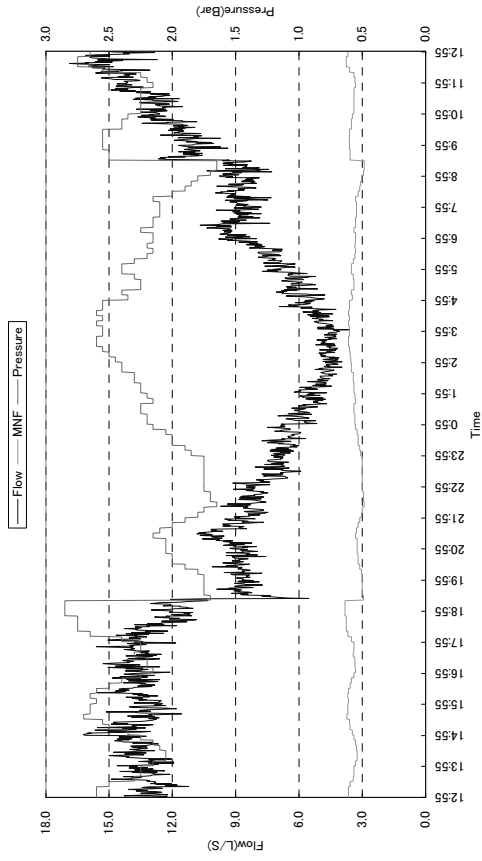
**MNF Graph for Zagazig East Area-2**



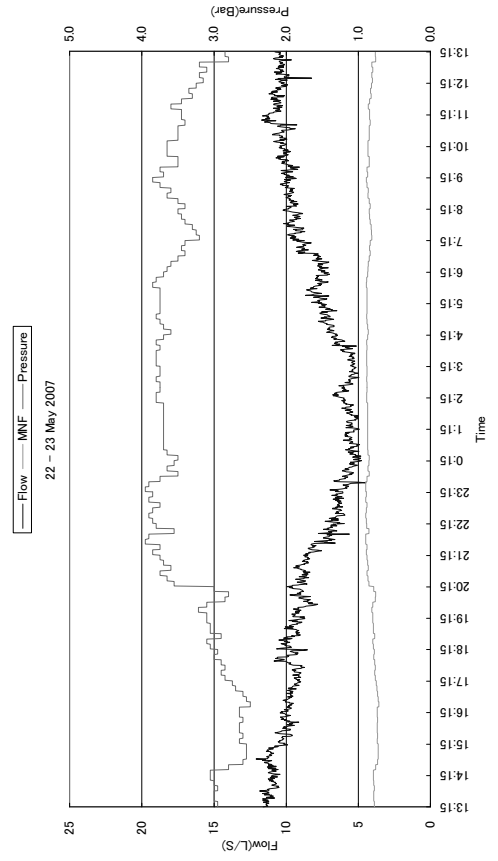
**MNF Graph For Zagazig East Area-4**



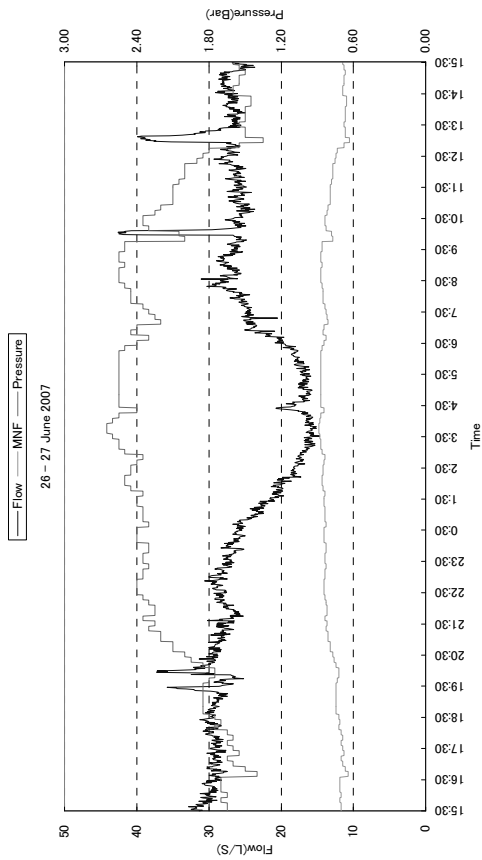
**MNF Graph for Zagazig West Area-2**



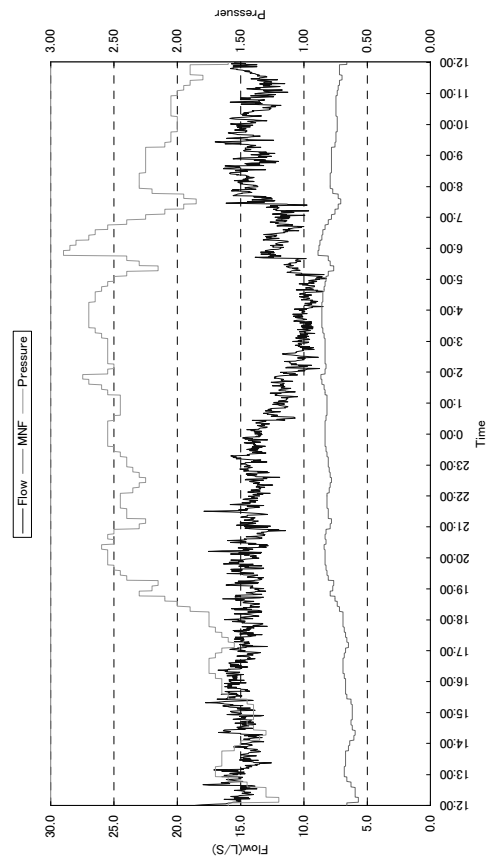
**MNF Graph For Zagazig West Area-3**



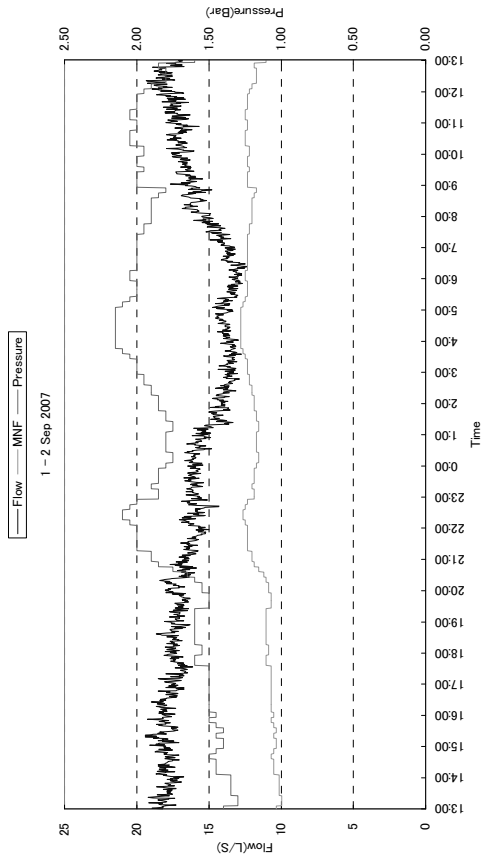
**MNF Graph For Zagazig Area-5(2)**



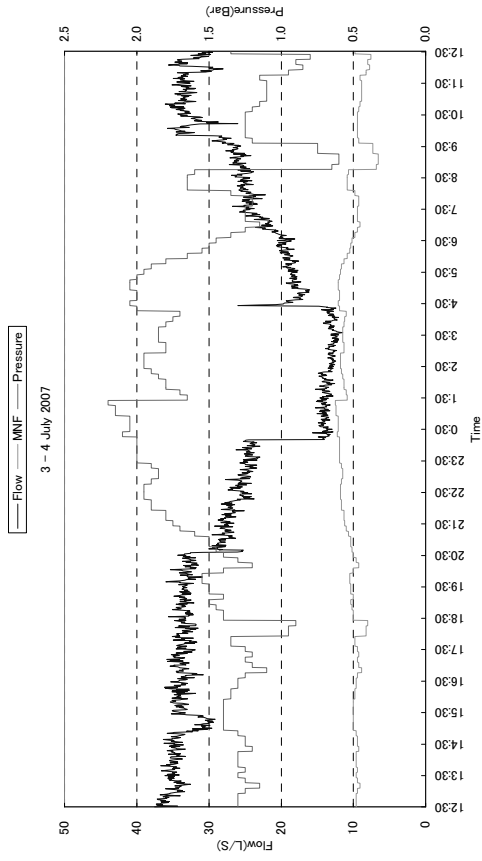
**MNF Graph for Zagazig West Area-1**



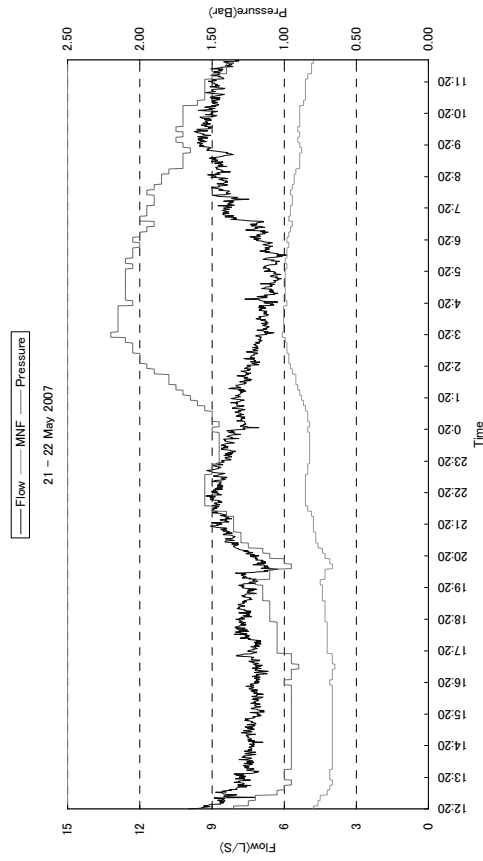
**MNF Graph For Zagazig West Area-4**



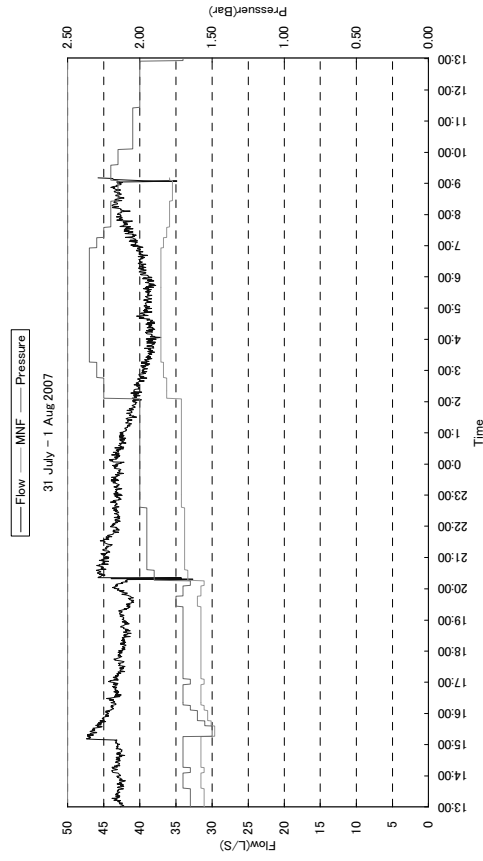
**MNF Graph For Zagazig Markaz Area-1**



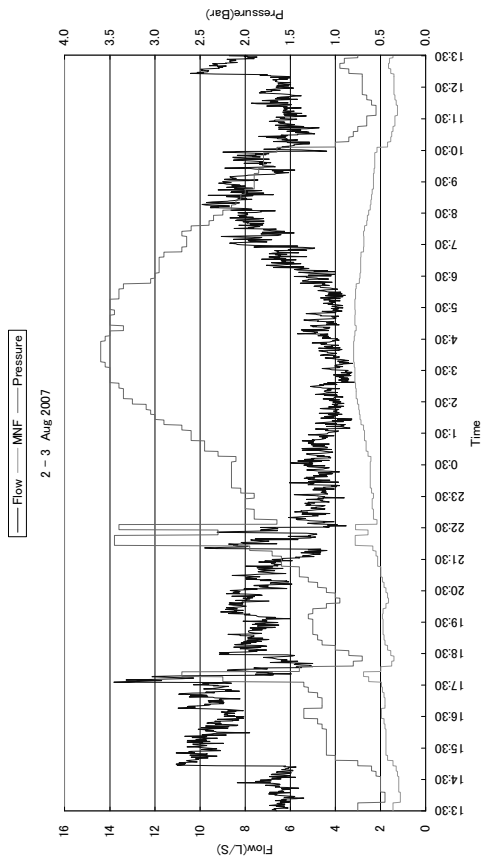
**MNF Graph For Zagazig West Area-5**



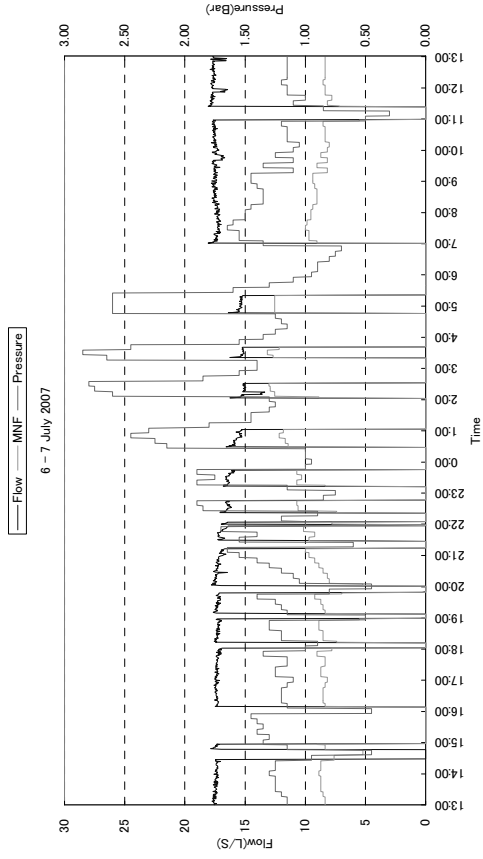
**MNF Graph For Zagazig Markaz Area-2**



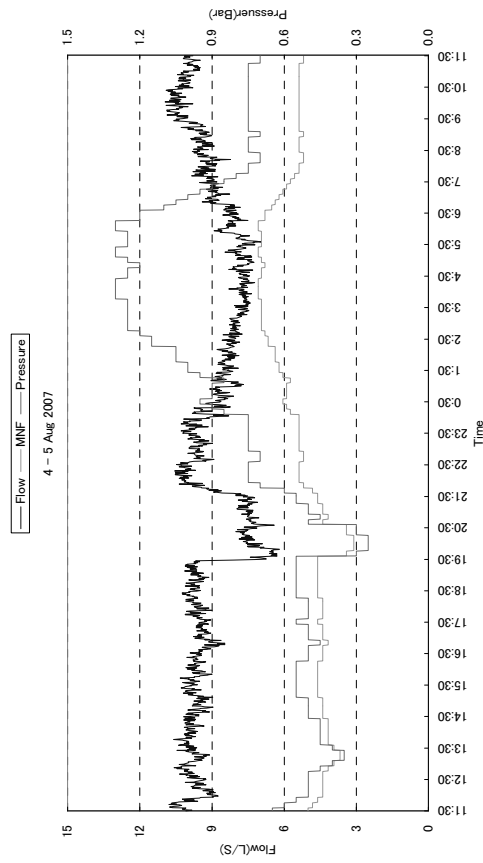
**MNF Graph For Zagazig Markaz Area-3**



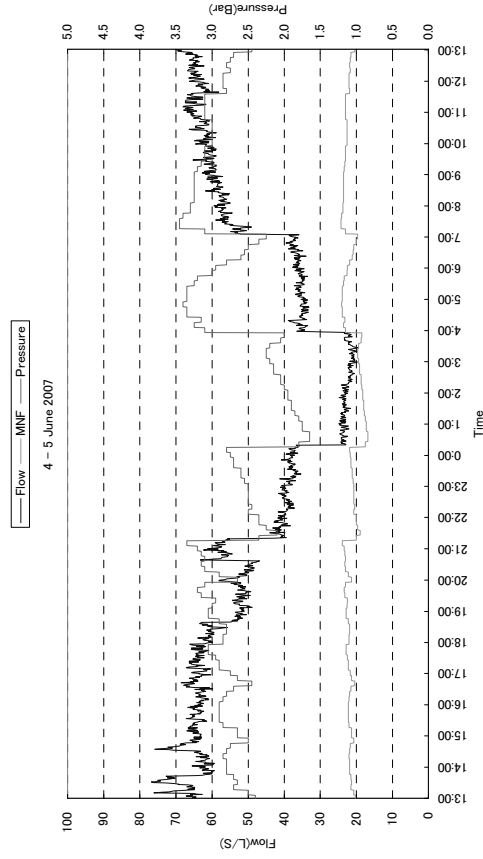
**MNF Graph For Zagazig Markaz Area-5**



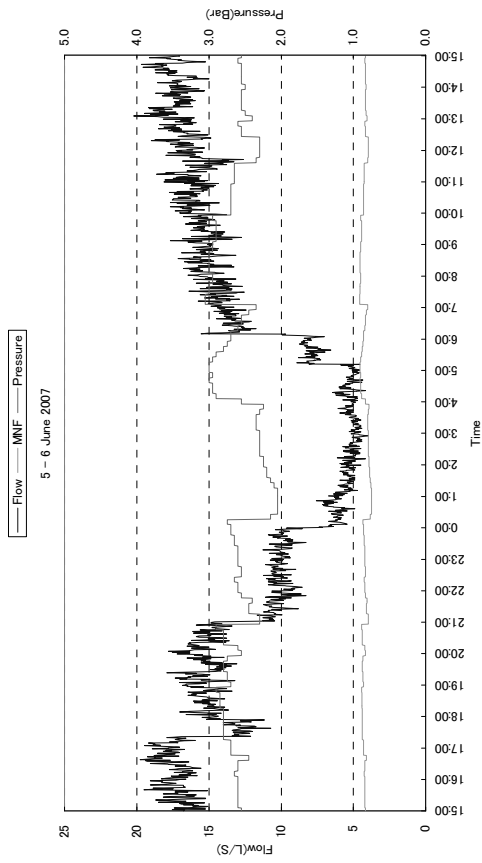
**MNF Graph For Zagazig Markaz Area-4**



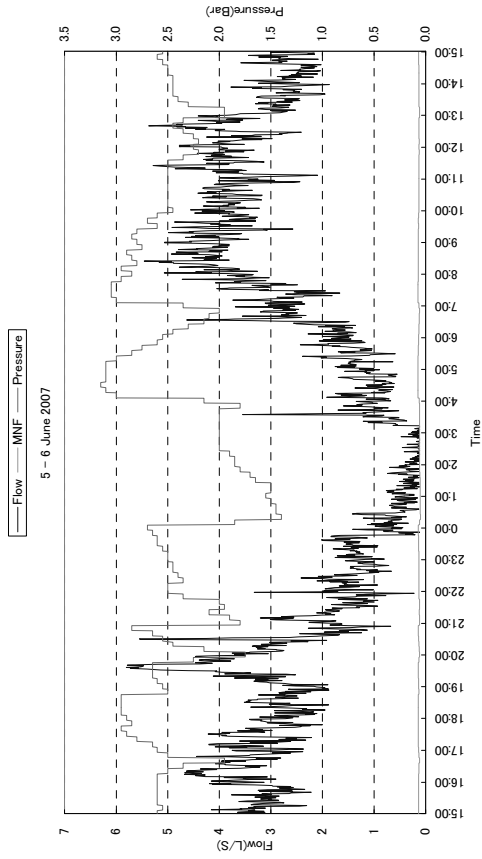
**MNF Graph For Hiniya Area-1**



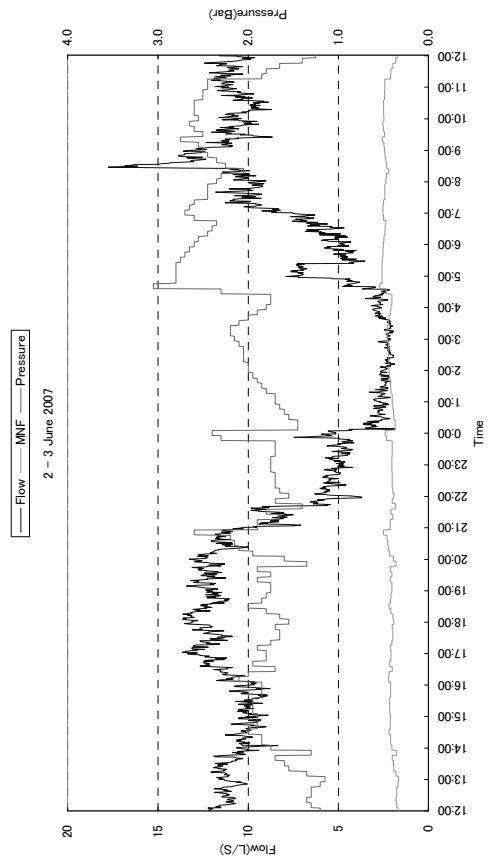
**MNF Graph For Hihiya Area-2**



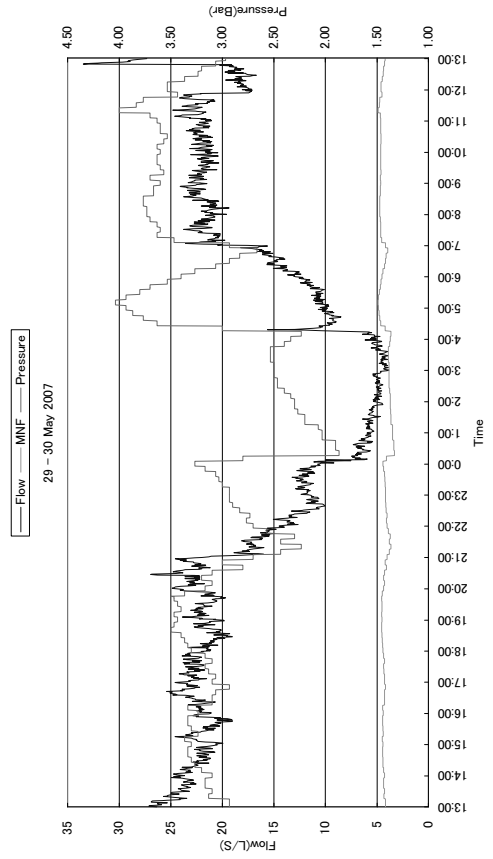
**MNF Graph For Hihiya Area-4**



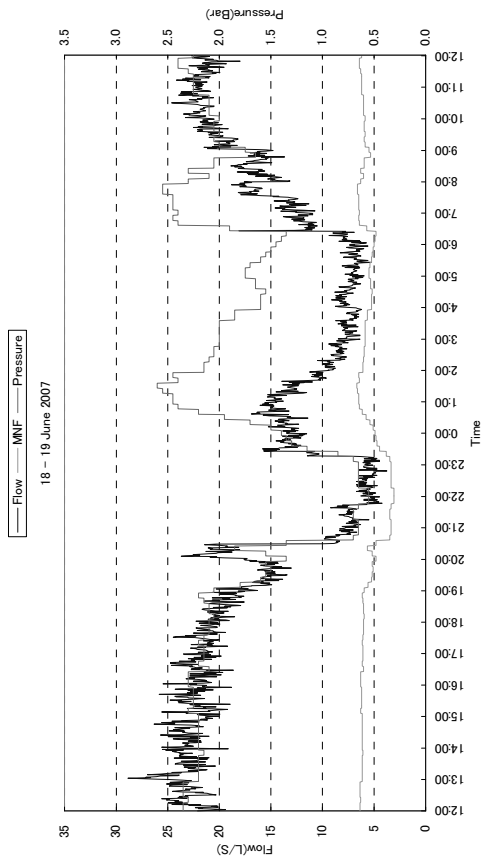
**MNF Graph For Hihiya Area-3**



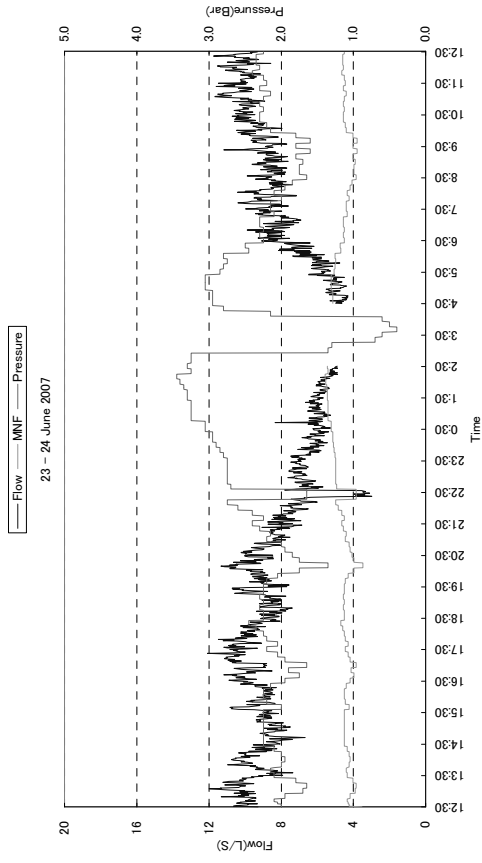
**MNF Graph For Hihiya Area-5**



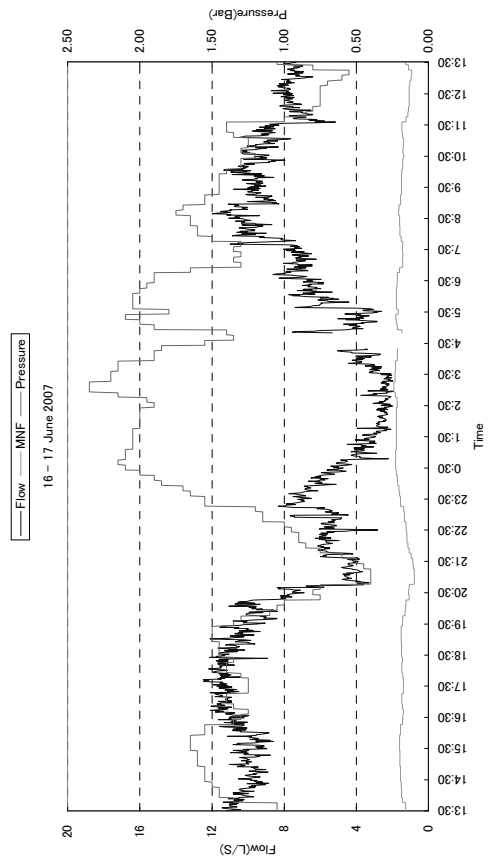
**MNF Graph For Ibrahimiya Area-1**



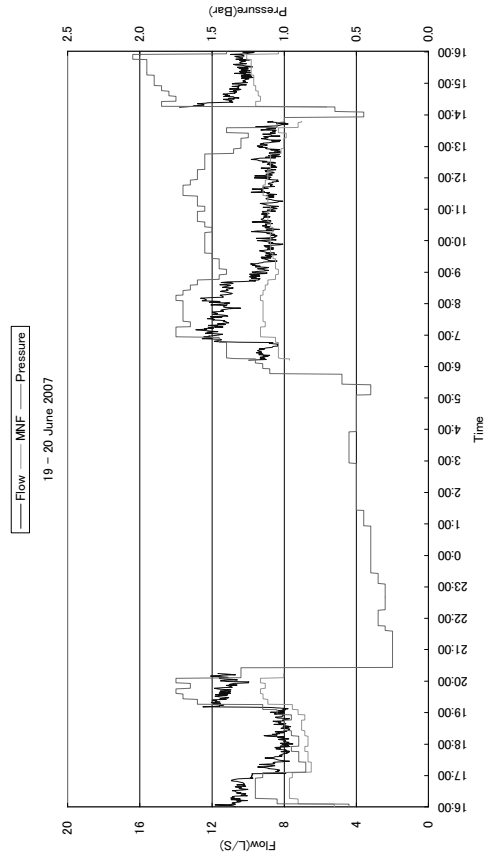
**MNF Graph For Ibrahimita Area-3**



**MNF Graph For Ibrahimiya Area-2**

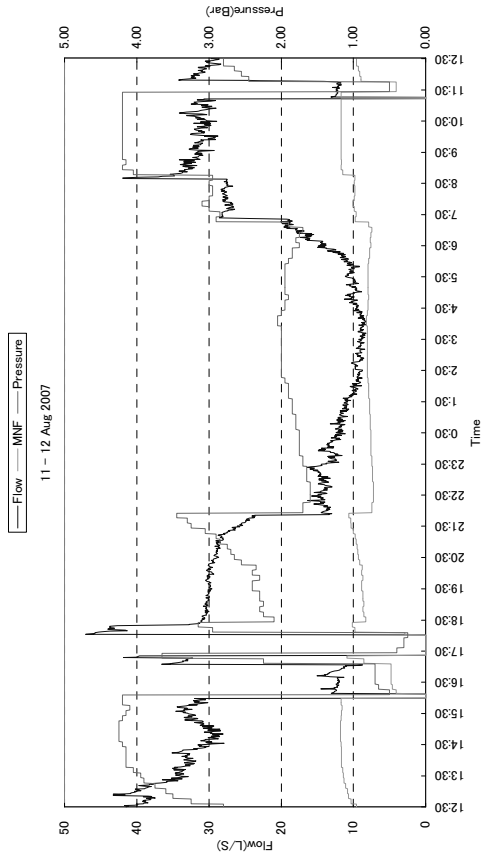


**MNF Graph For Ibrahimiya Area-4**

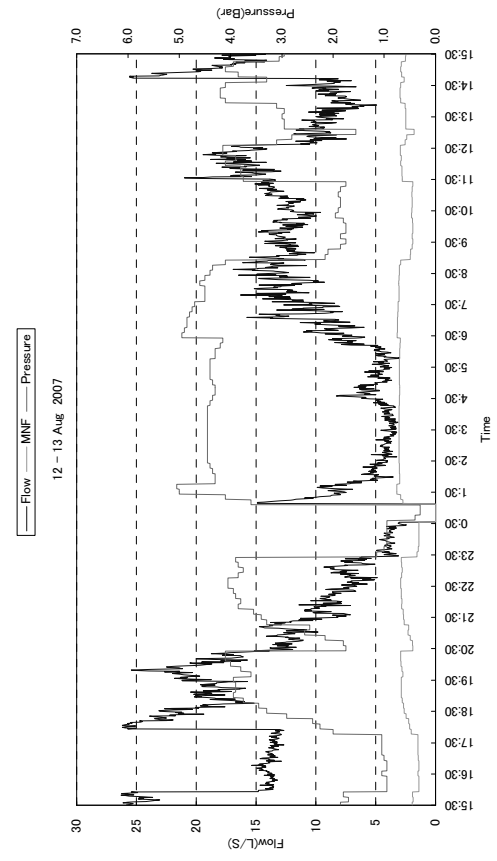




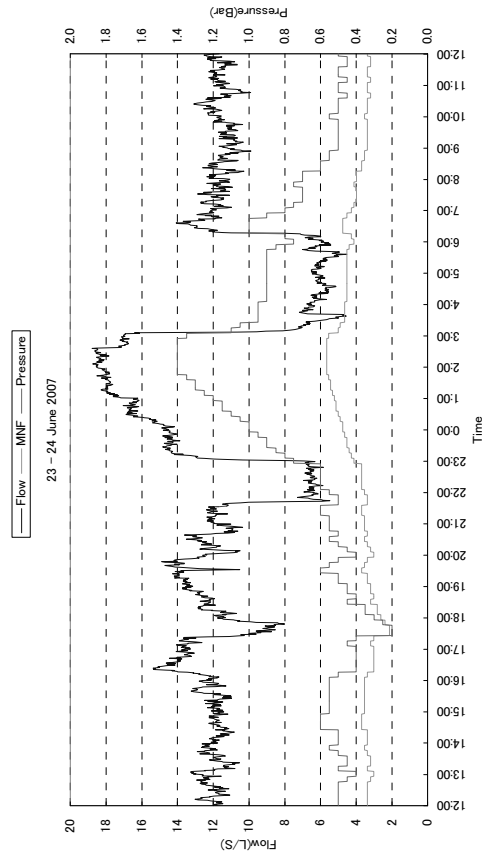
**MNF Graph For Diarb Nigm Area-2**



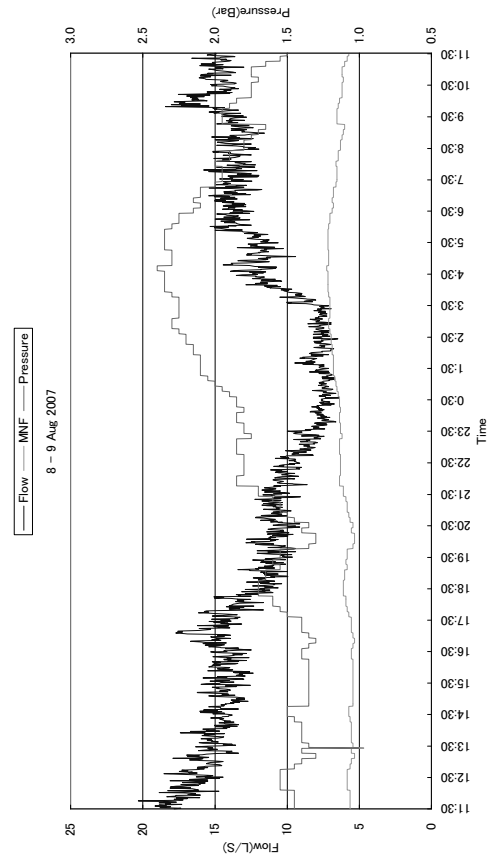
**MNF Graph For Diarb Nigm Area-3**



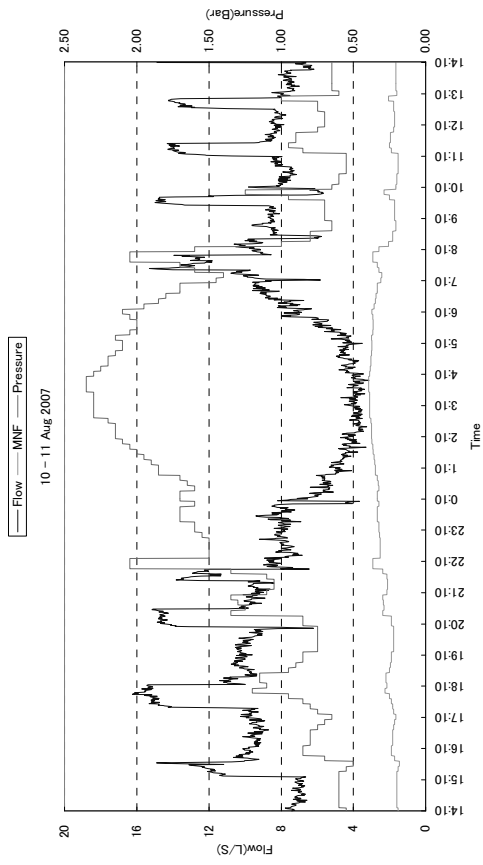
**MNF Graph For Ibrahimiya area-5**



**MNF Graph For Diarb Nigm Area-1**



MNF Graph For Diarb Nigm Area-4(Fn)



MNF Graph For Diarb Nigm Area-5

