Islamic Republic of Iran
Ministry of Energy
National Water and Wastewater Engineering Company

THE DATA COLLECTION SURVEY ON WATER SUPPLY SECTOR IN THE ISLAMIC REPUBLIC OF IRAN

FINAL REPORT

SEPTEMBER 2016

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

NIHON SUIDO CONSULTANTS, Co., Ltd.
ExeIdea LTD.

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JR
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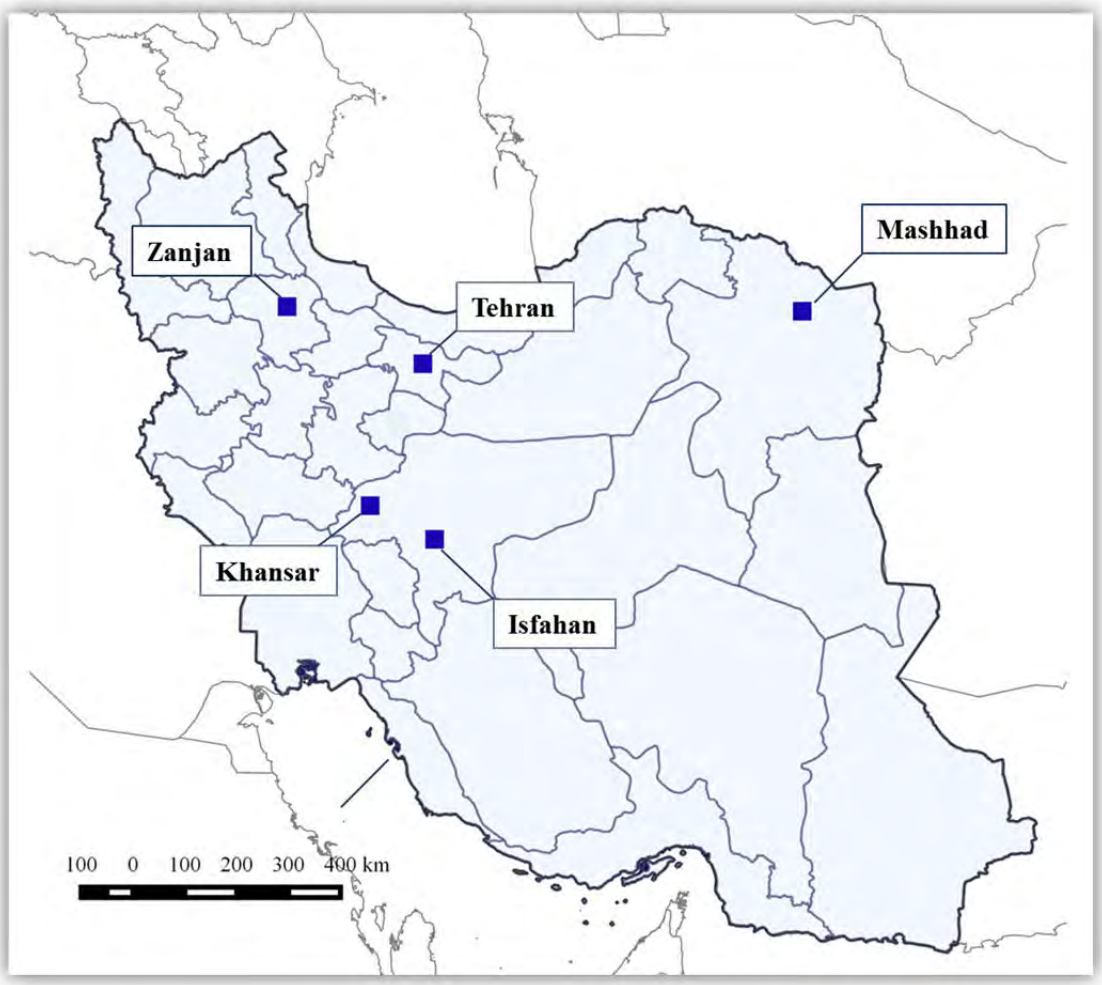

Map showing the Cities in Iran Covered by the Survey

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NWWEC (National Water and Wastewater Engineering Company)

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Meeting with NWWEC

Meeting with NWWEC

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Jalaiaeh Water Treatment Plant

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Meeting with ZPWWC

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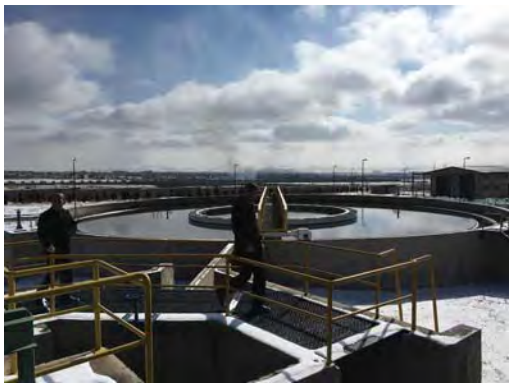
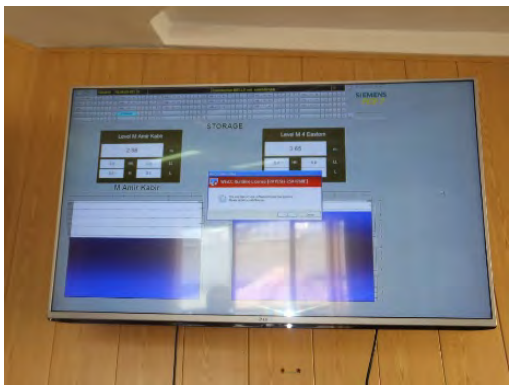


Zanjan Water Treatment Plant



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Housing Complex Water Meters
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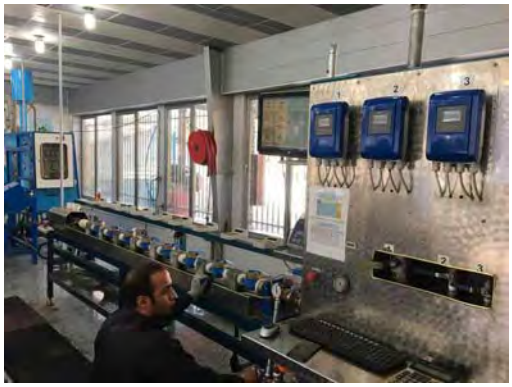
Meeting with IPWWC



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Meeting with KWWC

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Water Treatment Plant No. 2

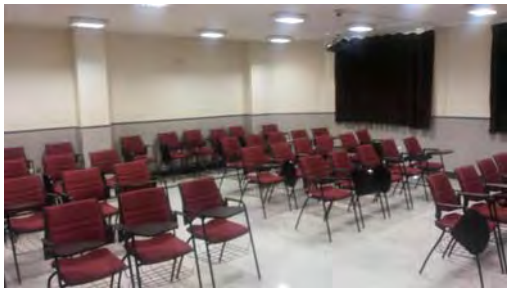
<u>IHEARI (Isfahan Higher Education and Research Institute)</u>

Water Quality Test Laboratory

Pump Operation Training Equipment

Pipe for Saddle Installation Training

Valve Samples



Lecture Room

Dormitory

List of Abbreviations

Abbreviation	English
ACP	: Asbestos Cement Pipe
BOO	: Build Own Operate
BOT	: Build Operate Transfer
CIP	: Cast Iron Steel Pipe
C/P	: Counter Part
DIP	: Ductile Cast Iron Pipe
DMA	: District Metered Area
EU	: European Union
GIP	: Galvanized Iron Pipe
GIS	: Geographic Information System
GPS	: Global Positioning System
GRP	: Ground Penetrating Rader
IHEARI	: Isfahan Higher Education and Research Institute
IPWWC	: Isfahan Provincial Water and Wastewater Company
IRR	: Iranian Riel
JCCME	: Japan Cooperation Center for Middle East
JICA	: Japan International Cooperation Agency
KWWC	: Khansar Water and Wastewater Company
1l/sec	: Liter per second
1lpcd	: Liter per capita day
MLD	: Million Litter per Day
MNF	: Minimum Night Flow
MOE	: Ministry of Energy
MPO	: Management Planning Organization
MWWC	: Mashhad Water and Wastewater Company
NDP	: National Development Plan
NRW	: Non-Revenue Water
NWWEC	: National Water and Wastewater Engineering Company
PE	: Polyethylene

PMO	: Project Management Office
PPP	: Public Private Partnership
PR	: Public Relations
PTC	: Professional Training Center
PVC	: Polyvinylchloride
RCUWM	: Regional Centre on Urban Water Management
SCADA	: Supervisory Control and Data Acquisition
TPWWC	: Tehran Provincial Water and Wastewater Company
UN	: United Nations
The USA	: the United States of America
USD	: United States Dollar
WaterGEMS	: Name of software for hydraulic network analysis
WB	: World Bank
WTP	: Water Treatment Plant
WWC	: Water and Wastewater Company
WWTP	: Waste Water Treatment Plant
ZPWWC	: Zanjan Provincial Water and Wastewater Company

CHAPTER 1 OUTLINE OF THE SURVEY

1-1 Background of the Survey

In the Islamic Republic of Iran, the National Water and Wastewater Engineering Company (NWWEC) controls the administration of the water supply. As a measure to mitigate water shortages, it encourages the reduction of non-revenue water (NRW) using its own technologies. However, due to the deterioration of aging facilities, the average percentage of NRW is still in excess of 25%.

The Government of Iran requested Japanese technical cooperation to deal with NRW in Khansar City in Isfahan Province. A survey was implemented to gather and analyze background information relating to the water supply sector in Iran, and to identify the issues and consider the appropriate assistance the Japan International Cooperation Agency's (JICA) can provide.

1-2 Objectives of the Survey

The Survey was implemented for the objectives listed below.

(1) To investigate the policies, present state and issues relating to the water supply sector in Iran.
(2) To verify the status and issues of the water supply projects in the areas covered by the Survey, namely, Tehran City in Tehran Province, Isfahan City and Khansar City in Isfahan Province, Zanjan City in Zanjan Province and Mashhad City in Razavi Khorasan Province.
(3) To sort and categorize the issues so that JICA can use the information to formulate the appropriate assistance to be offered.

1-3 Survey Areas

The cities covered by the Survey are described in Table 1-3-1 and their choice is briefly discussed below.

Tehran City is the capital of Iran and Isfahan City is the capital of the central region. Khansar City is the target area requested by the Iranian side for a pilot project. Zanjan City was the focus for the JICA Integrated Water Resources Management for the Sefidrud River Basin Survey (August 2007 to December 2008), which confirmed the lowering of groundwater levels and therefore the city has a high awareness of the need to reduce NRW. Mashhad City is Iran's second-largest city after Tehran

and the central city in eastern Iran.

Table 1-3-1 Cities covered by the Survey and their Respective Water and Wastewater Companies (WWCs)

Area	WWCs
Tehran City	Tehran Provincial Water and Wastewater Company (TPWWC)
Isfahan City	Isfahan Provincial Water and Wastewater Company (IPWWC)
Khansar City	Khansar Water and Wastewater Company (KWWC)
Zanjan City	Zanjan Provincial Water and Wastewater Company (ZPWWC)
Mashhad City	Mashhad Water and Wastewater Company (MWWC)

1-4 Survey Team Members

The members of the survey team are shown in Table 1-4-1

Table 1-4-1 Composition of the Survey Team

Name	Position
Takemasa MAMIYA	Water Supply Planning Specialist (Chief Consultant)
Hiroshi NISHIMAKI	Organization System / Problem Analysis
Akihiko OKAZAKI	Non-Revenue Water Expert
Yuya KAWAHARA	Operational Coordinator

Personnel from JICA headquarters who participated in the 3rd Field Work are shown in Table 1-4-2 below.

Table 1-4-2 Participant from JICA headquarters

Eriko TAMURA	Director, Water Resources Team1, Global Environment Department (Team Leader)
Sadanobu SAWARA	Senior Advisor (Urban Water Supply)
Mayu OMURA	Technical Advisor, Water Resources Team1, Global Environment Department

1-5 Survey Schedule

Three field surveys were carried out and their schedules are shown in Table 1-5-1 and the detail schedules of each field work are shown in Table 1-5-2, Table 1-5-3 and Table 1-5-4.

Table 1-5-1 Survey Schedule

1st Field Work	22nd January 2016 ～12th February 2016
2nd Field Work	8th April 2016 ～1st May 2016
3rd Field Work	14th July 2016 ～28th July 2016

Table 1-5-2 Detail Schedule of 1st Field Work

Date		Consultants		
		Water Supply Planning (Chief Consultant)	Organization System/ Problem Analysis	Non-Revenue Water Expert
		Takemasa MAMIYA	Hiroshi NISHIMAKI	Akihiko OKAZAKI
2016/1/22	Fri	Depart for Iran		
2016/1/23	Sat	Arrive at Tehran		
2016/1/24	Sun	Meeting at RCUWM		
2016/1/25	Mon	Meeting with NWWEC		
2016/1/26	Tue	Meeting with TPWWC		
2016/1/27	Wed	Meeting with TPWWC、Field Investigation in Tehran		
2016/1/28	Thu	Move to Zanjan Meeting with ZPWWC Move to Tehran		
2016/1/29	Fri	Move to Isfahan		
2016/1/30	Sat	Meeting with IPWWC, IWWC,		
2016/1/31	Sun	Move to Khansar, Meeting with KWWC,		
2016/2/1	Mon	Move to Tehran Move to Mashhad		
2016/2/2	Tue	Meeting with MWWC、Field Investigation		
2016/2/3	Wed	Move to Tehran		
2016/2/4	Thu	Vacant day for additionally required activities in Tehran		
2016/2/5	Fri			
2016/2/6	Sat	Meeting with NWWEC, Report to JICA Iran Office		
2016/2/7	Sun	Depart for Tokyo	Meeting with JICA Expert in NWWEC Visit Power and Water University of Technology	
2016/2/8	Mon	Arrive at Tokyo	Visit Regional Center on Urban Waer Management Visit Iran Waterworks Association	
2016/2/9	Tue	-	Meeting with NWWEC (Preliminary survey results and schedule) JICA Iran Office	
2016/2/10	Wed	-	Depart for Tokyo	
2016/2/11	Thu	-	Arrive at Tokyo	

Table 1-5-3 Detail Schedule of 2nd Field Work

Date		Consultants	
		Water Supply Planning (Chies Consultant)	Non-Revenue Water Expert
		Takemasa MAMIYA	Akihiko OKAZAKI
2016/4/8	Fri	-	Depart for Tehran
2016/4/9	Sat	-	Arrive at Tehran
2016/4/10	Sun	-	JICA Iran Office Meeting with RCUWM
2016/4/11	Mon	-	Meeting with TPWWC .
2016/4/12	Tue	-	Field servey at TPWWC
2016/4/13	Wed	-	Meeting with Janjarn
2016/4/14	Thu	-	Field servey at ZPWWC
2016/4/15	Fri	-	Move to Isfahan
2016/4/16	Sat	-	Meeting with IPWWC
2016/4/17	Sun	-	Field survey at IPWWC
2016/4/18	Mon	-	Meeting with KWWC Field survey at KWWC
2016/4/19	Tue	-	Field survey at KWWC
2016/4/20	Wed	-	Field survey at KWWC Move to Tehran
2016/4/21	Thu	-	Meeting with JICA Iran Office
2016/4/22	Fri	-	Move to Mashhad
2016/4/23	Sat	-	Meeting with Mashhad
2016/4/24	Sun	-	Field Survey MPWWC
2016/4/25	Mon	Depart for Tehran	Move to Tehran
2016/4/26	Tue	Arrive Tehran	
2016/4/27	Wed	Meeting with NWWEC	
2016/4/28	Thu	Report to JICA Iran Office	
2016/4/29	Fri	Depart for Tokyo	
2016/4/30	Sat	Arrive at Tokyo	Depart for Tokyo
2016/5/1	Sun		Arrive at Tokyo

Table 1-5-4 Detail Schedule of 3rd Field Work

Date		JICA	Consultants		
		Eriko TAMURA Sadanobu SAWARA Mayu OMURA	Water Supply Planning (Chief Consultant)	Organization System/ Problem Analysis	Non-Revenue Water Expert
			Takemasa MAMIYA	Hiroshi NISHIMAKI	Akihiko OKAZAKI
2016/7/14	Thu	-	Depart for Tehran		
2016/7/15	Fri	-	Arrive at Tehran		
2016/7/16	Sat	-	Meeting with NWWEC (Explanation of DFR)		
2016/7/17	Sun	-	Information collection and discussion		
2016/7/18	Mon	Depart for Tehran	Information collection and discussion		
2016/7/19	Tue	(JICA Team: Arrive at Tehran) Initial meeting with NWWEC, RCUWM to explain DFR			
2016/7/20	Wed	Professional Training Center (PTC), Shahid Beheshti University			
2016/7/21	Thu	Move to Isfahan			
2016/7/22	Fri	Information collection and Document Making			
2016/7/23	Sat	Discussion with IPWWC Isfahan Higher Education and Reserch Institute (IHEARI)			
2016/7/24	Sun	Move to Khansar Meeting with KWWC, Filed Investigation			
2016/7/25	Mon	Move to Tehran Meeting with RCUWM			
2016/7/26	Tue	Meeting with NWWEC			
2016/7/27	Wed	Meeting with NWWEC, RCUWM, signing on M/M Leave Tehran			

1-6 Survey Policy

The basic policies for the implementation of the Survey are as follows:

【Basic policy for the implementation of the survey】

Policy-1: Information collection/sorting/analysis, taking into account the general characteristics of the water supply sector in Iran as well as the regional differences.

Policy-2: Confirmation of the content of the project proposed by the Iranian side and the means of sharing technologies/experiences gained with the rest of the country.

Policy-3: Survey of the relevant organizations/institutions and problem analysis.

【Policy 1】Information collection/sorting/analysis, taking into account the general characteristics of the water supply sector in Iran as well as the regional differences.

There is only limited information regarding the overall situation of the water supply sector in Iran. More information is needed for JICA to determine the assistance it can provide. Information from water policy advisors and on relevant organizations in the water supply sector will be collected to identify the needs and pertinent issues.

【Policy 2】Confirmation of the content of the project proposed by the Iranian side and the means of sharing technologies/experiences gained with the rest of the country.

A project to promote the systematic learning of elementary skills would not be appropriate for NWWEC and the Tehran Provincial Water and Wastewater Company (TPWWC) which already have high technical capability. The Isfahan Provincial Water and Wastewater Company (IPWWC) has difficulties with detecting leaks in its large diameter pipelines and has requested the introduction of effective leak detection technology. Thus, the difference in technical level has to be taken into consideration in determining the appropriate support measures.

【Policy 3】Survey of the relevant organizations/institutions and problem analysis.

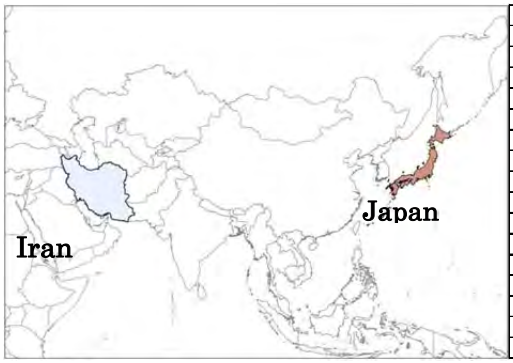
The management issues of the WWCs sometimes stem not only from how they are organized, but also factors including responsibility sharing among the organizations, legislative frameworks and standards, human resource plans and capacity development and political situations. Thus, a study of the roles and authority of the Ministry of Energy (MOE) and NWWEC in addition to the WWCs, which manage the water supply in each region, will be carried out to clarify the organizational problems facing the water supply administration.

CHAPTER 2 PRESENT STATUS IN IRAN

2-1 General Information

2-1-1 Background Data

Iran is located in the Middle East and has an area of about 1.65 million km^2 (about 4.4 times that of Japan). In the east it shares borders with Turkmenistan, Afghanistan, and Pakistan, and in the west with Azerbaijan, Armenia, Turkey, and Iraq (Figure 2-1-1).



No.	Name of Provinces
1	Alborz
2	Ardebil
3	Bushehr
4	Chahar Mahall and Bakhtian
5	East Azarbaijan
6	Isfahan
7	Fars
8	Gilan
9	Golestan
10	Hamadan
11	Hormozgan
12	Iliam
13	Kerman
14	Kermanshah
15	Khuzestan
16	Kohgiluyeh and Buyer Ahmad

No.	Name of Provinces
17	Kordestan
18	Lorestan
19	Markazi
20	Mazandaran
21	North Khorasan
22	Qazvin
23	Qom
24	Razavi Khorasan
25	Semnan
26	Sistan and Baluchestan
27	South Khorasan
28	Tehran
29	West Azarbaijan
30	Yazd
31	Zanjan

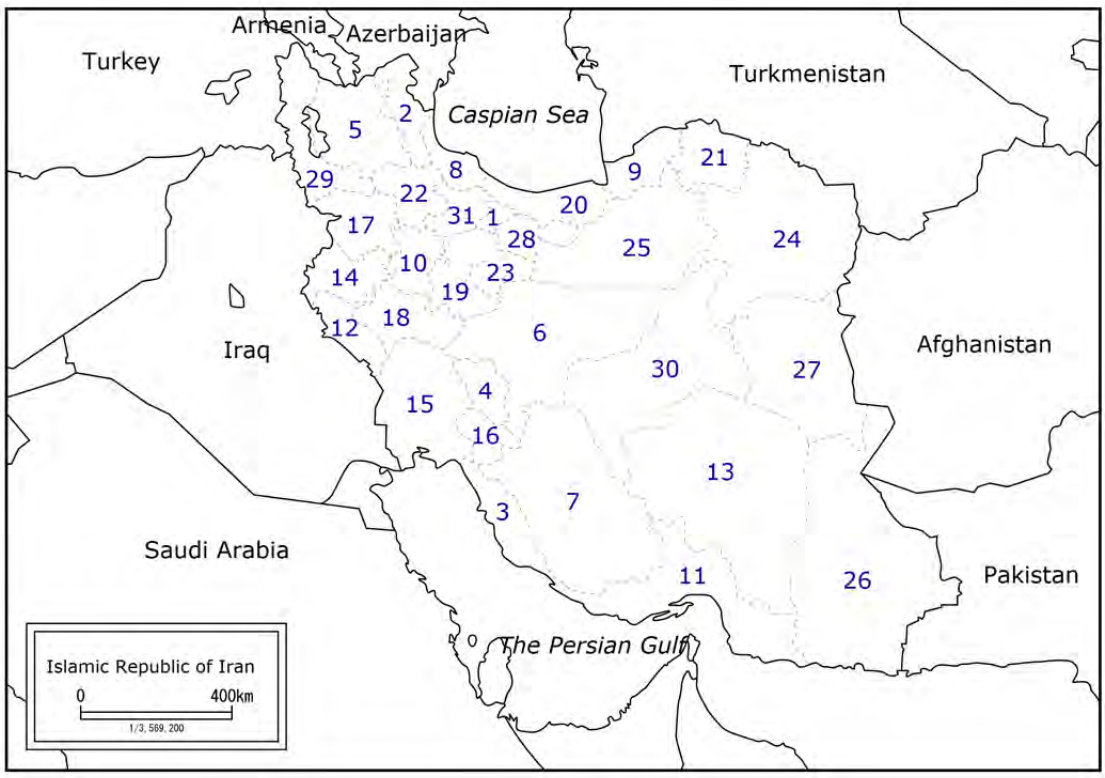
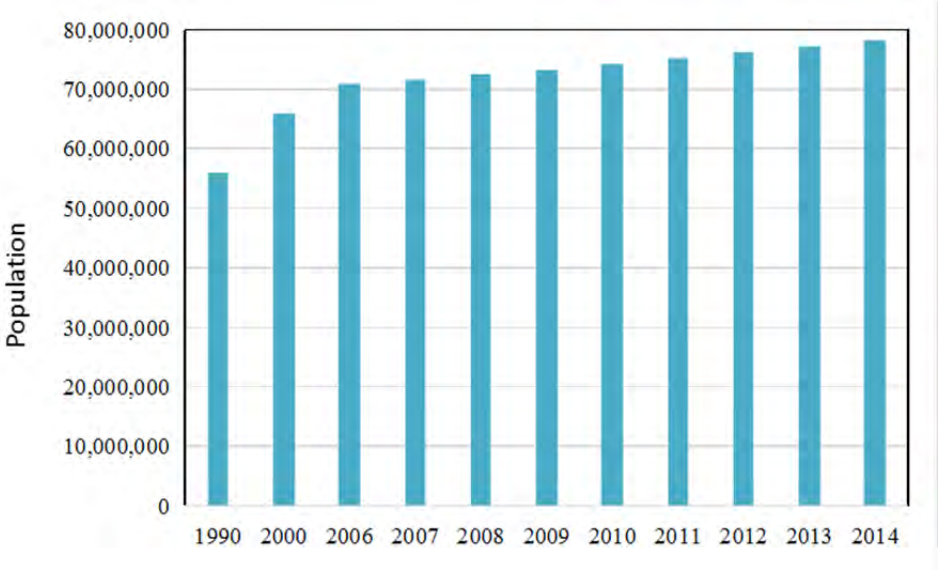


Figure 2-1-1 Location of Iran and Names of Each Province

The population of Iran as of 2014 is about 78 million, with an annual increase of about 1.3% in recent years (Figure 2-1-2). The population of the capital Tehran was 8.15 million in 2013, or about 10% of the total population of Iran[1].98 percent of the population is Muslim (of which 90% is Shiite), and the official language is Persian[2].



Source: The World Bank, Population Total (http://data.worldbank.org/indicator/SP.POP.TOTL)

Figure 2-1-2 Population Trend in Iran

2-1-2 Political System

Iran is an "Islamic Republic" based on the teaching of Islam. The Supreme Leader commands the army and presides over security agencies above the three arms of government (legislative, executive and judicial). The current Supreme Leader is Grand Ayatollash Sayyid Ali Khamenei, who was elected in 1989. The Iranian Assembly is a unicameral system with the President as the head of the Executive Branch that has the administration authority, except for the exclusive prerogative of the Supreme Leader.

2-1-3 Economic Status

Economically, the nominal GDP of Iran in 2015 was about 387.6 billion USD, which is among the highest in the Middle East (Table 2-1-1). The trend in real GDP (Figure 2-1-3) shows that growth

[1] UN Data (http://data.un.org/Data.aspx?d=POP&f=tableCode%3A240)

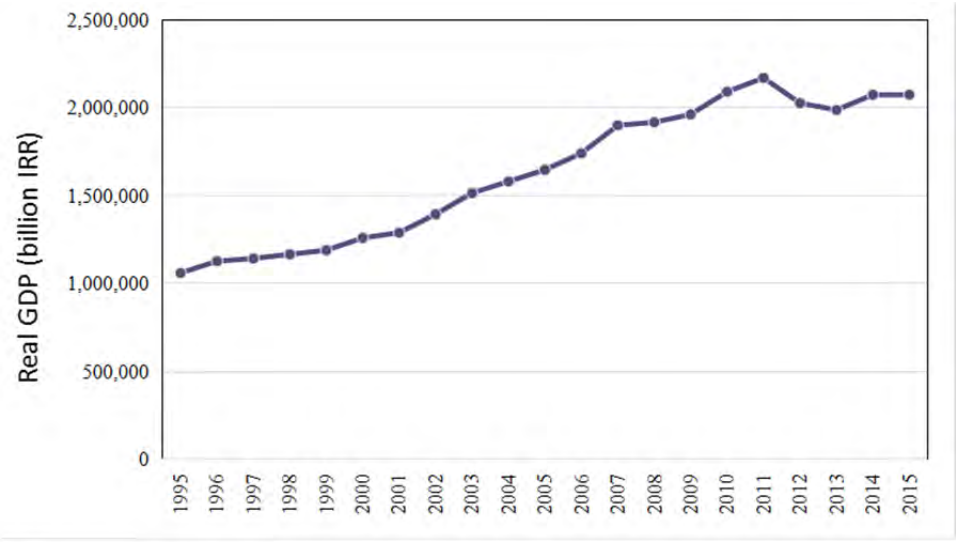
[2] Iran Overbview, 2016/JETRO (https://www.jetro.go.jp/world/middle_east/ir/basic_01.html)

was strong until 2011, and thereafter the real GDP stagnated due economic sanctions which are discussed later.

Table 2-1-1 Comparison of 2015 Nominal GDP among Top 5 Middle Eastern Countries

Rank	Countries	Nominal GDP in 2015 (billion USD)
1	Turkey	733.64
2	Saudi Arabia	653.22
3	**Islamic Republic of Iran**	**387.61**
4	UAE	345.48
5	Israel	296.07

Source: World Economic Outlook Database, 2015/IMF



Source: World Economic Outlook Database, 2015/IMF

Figure 2-1-3 Trend of Real GDP in Iran

Iran is a major producer of natural resources, being number 4 in the world for reserves of crude oil and number 1 in natural gas[3]. New oil and gas development had been difficult when economic sanctions were imposed by the international community after Iran refused to suspend its uranium enrichment program. But after the sanctions were lifted, the expectations for resource development are increasing. Iran ranks the 6th as a supplier of crude oil to Japan[4].

[3] The current status and the future opportunity of the oil and natural gas development in Iran – The Affair Analysis of the Middle East Countries, 2015/ Kouichi IWAMA

[4] Financial Statistics, 2014/Ministry of Finance, Japan

Iran's exports and imports are typical of a resource rich country, with the petroleum sector accounting for 70% of total exports (Table 2-1-2); the remainder being mainly iron ore and liquefied propane. The main imports include grains, automobiles and electrical goods (Table 2-1-3). Hassan Rouhani, the President of Iran who came to power in 2013, aims to strengthen the relationship with neighboring countries while advocating the need for building and preservation of good relations with the rest of the world. As a result of this, seven of the top 10 export partners of Iran are neighboring countries[5] (Table 2-1-4).

Table 2-1-2 Value of Iran's Trade (2013[6])

Items		Amount (million USD)
Exports	Petroleum sector	68,135
	Non-petroleum sector	29,899
	Total amount	98,033
Imports	Total	67,058

Source: JETRO Global Trade and Investment Report, 2015/JETRO

Table 2-1-3 Main Exports (Excluding the Petroleum Sector) and Imports (top 10 items, 2014)

Rank	Exports Items	Amount (million USD)	Rank	Imports Items	Amount (million USD)
1	Liquefied propane	2,279	1	Wheat	2,289
2	Methanol	1,477	2	Passenger auto	2,001
3	Butane	1,468	3	Feed corn	1,751
4	Polyethylene (less than a specific gravity of 0.94)	1,418	4	Polished rice	1,409
5	Petroleum asphalt	1,324	5	Soybean meal	1,239
6	Iron or non-alloy steel flat-rolled products	902	6	TV Display module	810
7	Pistachio	778	7	Iron or non-alloy steel flat-rolled products	757
8	Urea	733	8	Auto parts (except tires)	644
9	Manufactures of oil and bituminous oil	677	9	Cellphone parts	533
10	Polyethylene (more than a specific gravity of 0.94)	662	10	Barley	499

Source: JETRO Global Trade and Investment Report, 2015/JETRO

[5] JETRO Global Trade and Investment Report , 2015/JETRO

[6] Data in 2014 is not available; so the one in 2013 is applied.

Table 2-1-4 Major Trading Partners of Iran

Rank	Exporters	Amount (million USD)
1	China	9,159
2	Iraq	6,183
3	UAE	3,932
4	India	2,441
5	Afghanistan	2,388
6	Turkey	2,159
7	Turkmenistan	974
8	Pakistan	946
9	Italy	618
10	Egypt	578

Rank	Importing country	Amount (million USD)
1	China	12,561
2	UAE	12,164
3	Korea	4,310
4	Turkey	3,822
5	India	3,730
6	Switzerland	2,343
7	Germany	2,331
8	Italy	1,059
9	Netherlands	1,026
10	Taiwan	702

Source: JETRO Global Trade and Investment Report, 2015/JETRO

2-1-4 Social Situation

As mentioned above, Iran's diplomatic policy is "to construct a fair and mutual relationship with all nations and people"[7]. Although it is an influential voice among the OPEC hardline group, in recent years it has also undertaken cooperative actions with moderates, such as Saudi Arabia.[8]

Since the Iran Islamic Revolution in 1979, Iran has not had a good relationship with the international community, in particular the USA. In 1995 the USA prohibited US companies from engaging in trade, investment, and financial transactions with Iran, and in 1996 the Iran and Libya Sanctions Act (ILSA) was enacted to prohibit domestic and foreign companies from investing in oil and gas developments in Iran.

In 2002 undeclared nuclear development by Iran was discovered. Two years later these activities were stopped under the Paris Agreement with the United Kingdom, France, and Germany, but uranium enrichment was restarted in 2006. As a result the United Nations Security Council imposed sanctions on Iran over several years. Thereafter as uranium enrichment by Iran intensified, the sanctions by the international community, including the USA and Europe, became more severe[8].

[7] Iran Basic Data, 2015/ Ministry of Foreign Affairs, Japan(http://www.mofa.go.jp/mofaj/area/iran/data.html)
[8] Trade Policy for Iran, 2016/Ministry of Economy, Trade and Industry, Japan(http://www.meti.go.jp/policy/trade_policy/africa/iran/)

Since the beginning of the Rouhani presidency in 2013, the situation improved. International discussions regarding Iran's uranium enrichment program progressed, and in 2014 there was a partial easing of sanctions. The Joint Comprehensive Plan of Action (JCPOA) adopted on 18th October 2015 (Japanese time) agreed that in return for a curtailment in Iran's uranium enrichment capability and acceptance of International Atomic Energy Agency (IAEA) inspections, there would be staged lifting of the sanctions imposed by the UN, the USA, and Europe[9].

The JCPOA (the final agreement) included the implementation date of 17th January 2016 (Japanese time). When the IAEA confirmed that Iran had taken the measures to partially restrict its nuclear development, the USA terminated its relevant sanctions, the EU terminated some of its sanctions and with the passage of Security Council Resolution No. 2231, the measures imposed by the past resolutions were also terminated.

The restrictions on financial transfers and transactions with Iran, establishment of branch offices of financial institutions, new investment in the petroleum and gas sector were lifted[10].

Some of the effects of the lifting of sanctions include:

- The revenue from petroleum exports in the fiscal year following the lifting of sanctions increased by 1 billion USD.
- Three to five billion USD were freed up in bank accounts where the assets were frozen.
- The GDP growth rate from 2016 to 2017 is expected to increase to 5%.
- It is anticipated that the excess costs incurred by the restrictions on trade will be reduced annually by 1.5 billion[11] USD.

Japanese engagement with Iran since the implementation day included the visit to Japan by the Iranian Minister of Economic Affairs and Finance and the signing of the "Agreement between Japan and the Islamic Republic of Iran on Reciprocal Promotion and Protection of Investment" (the Japan-Iran Investment Agreement) on 5th February 2016. This Agreement stipulates the treatments accorded to investment activities and assets when an investor of a Contracting Party invests in the

[9] Influence of Iran international reintegration, 2015/ Mizuho Research Institute (http://www.mizuho-ri.co.jp/publication/research/pdf/insight/eg151222.pdf)
[10] Information related to the sanction to Iran, 2016/ Ministry of Economy, Trade and Industry
[11] What lifting Iran sanctions means for world markets, 2016/BBC News

other Contracting Party[12]. In addition a memorandum of cooperation was signed between Iran, the Japan Bank for International Cooperation (JBIC), and Nippon Export and Investment Insurance (NEXI) to strengthen cooperative relationships in financial matters[13]. It is expected that investment and finance activities will steadily expand, resulting in more vigorous investment activities, including personal interactions. However, it is necessary to carry out the activities with the latest information such as the regulations by the US Office of Foreign Asset Control (OFAC).

2-2 Natural Environment

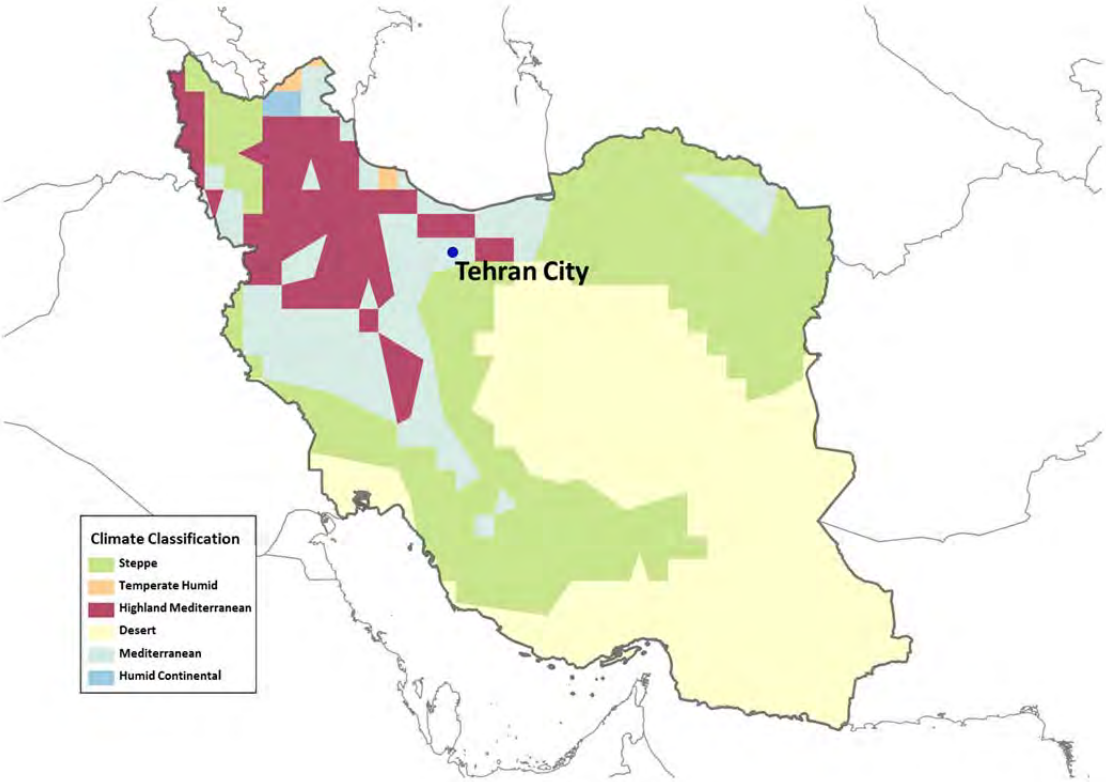
2-2-1 Topography

The Alborz Mountain Range is located in the north-west, and the Zagros Mountain Range stretches from the north-west to the south-east. Between these 2 folded mountain ranges is the Iranian Plateau at an elevation of 1,000 to 2,000 meters. Both mountain ranges belong to the Alpine-Himalayan orogenic belt, formed by folding of the earth's crust over a long period of time. The majority of the national land is on the Iranian Plateau, with low-lying areas limited to the Caspian coast in the north and the Persian Gulf in the south. The Plateau is dry, with 2 large deserts in the center, the Kavirs and Loot deserts, and there are many folded mountain ranges running parallel along the 2 edges of these deserts. In the north-west is the salt lake, Lake Urmia, and in the center are many salt lakes, one of which is Namak Lake. There are many rivers that dry up seasonally or terminate downstream in the deserts. The largest inland river is the Zayanderud River which flows through Isfahan into the Gavkhouni Swamp[14].

2-2-2 Climate

The Köppen climate classification of Iran is shown in Figure 2-2-1. There are various climate classifications in Iran, but the majority of the country has a steppe or desert, or highland Mediterranean climate (cool-temperate with little rain in the summer), and overall there is little rain in the country.

[12] AGREEMENT BETWEEN JAPAN AND THE ISLAMIC REPUBLIC OF IRAN ON RECIPROCAL PROMOTION AND PROTECTION OF INVESTMENT,2016/ Ministry of Foreign Affairs, Japan
[13] Signing of a Memorandum of Cooperation with Iran concerning Establishment of a Financing Facility and Iran's provision of sovereign guarantee,2016/ JBIC
[14] Encyclopedia "Nipponica"



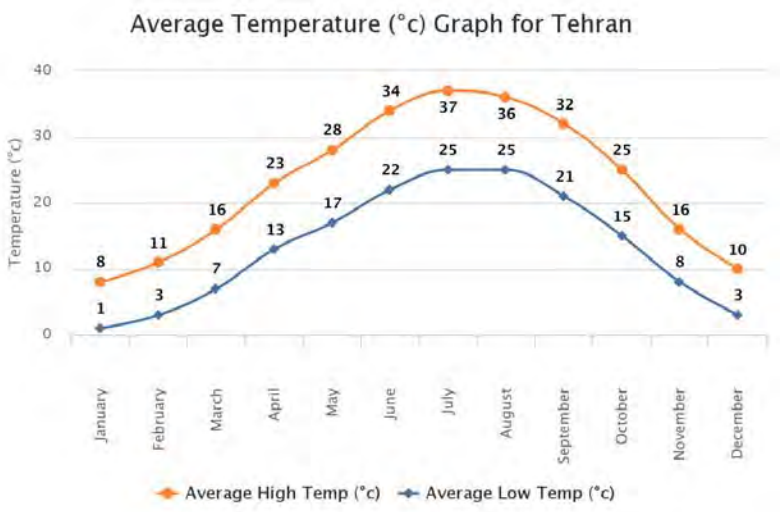
Source: WORLD MAPS OF KÖPPEN-GEIGER CLIMATE CLASSIFICATION, Institute for Veterinary Public Health

Figure 2-2-1 Climate Classifications in Iran

The monthly averages of temperature and rainfall in Tehran are shown in Figure 2-2-2 and Figure 2-2-3. The seasonal change in average temperature is large, varying between 1 degree and 37°C. Most of the rain falls between November and April. There tends to be little rainfall in the high temperature season. The amount of evapotranspiration is greater than the amount of water recharged to the water resources and during the summer water shortages occur frequently.

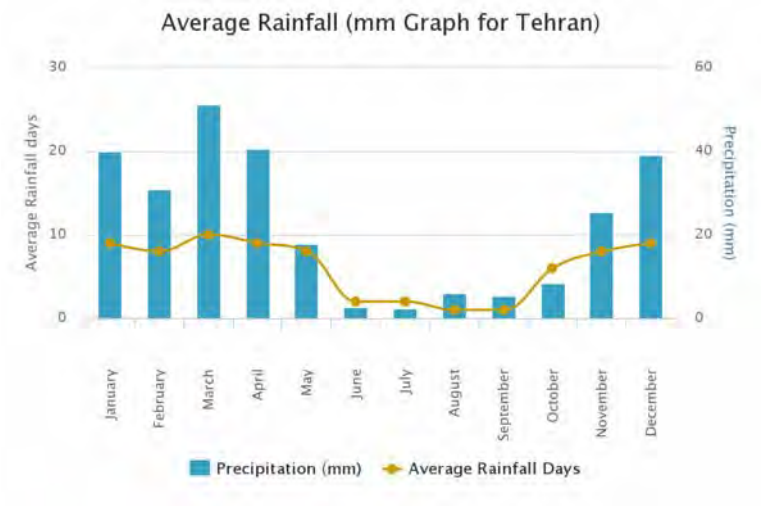
Apart from the Caspian Sea coast which sees an annual rainfall of 2,000 mm, almost all other areas have less than 50 mm per year, and most of the rain evaporates before reaching the rivers[15].

[15] Water Resources Issues in Iran, 2016/Gesuidoujouhou No. 1809



Source: World Weather Online

Figure 2-2-2 Monthly Average Temperatures in Tehran (2000 to 2012)



Source: World Weather Online

Figure 2-2-3 Monthly Average Rainfall in Tehran (2000 to 2012)

2-2-3 Water Resources

The annual average rainfall in Iran is about 230 mm, and the quantity of water that can be used per person is about 1,600 m^3/ year. There is an extreme distribution of water resources between the desert areas in the center of Iran and the warm and wet area along the Caspian Sea coast. In recent

years there has been steady expansion of agriculture and industry and significant population growth, resulting in increasing water demand[16].

The water resources in Iran and Japan are shown in Table 2-2-1. Iran's rainfall is about 1/8 of that of Japan. Underground water resources recharged by snowmelt from the mountain ranges in the north are plentiful, but the loss of surface water due to evapotranspiration is large, so in total the water resources in Iran are less than half those of Japan.

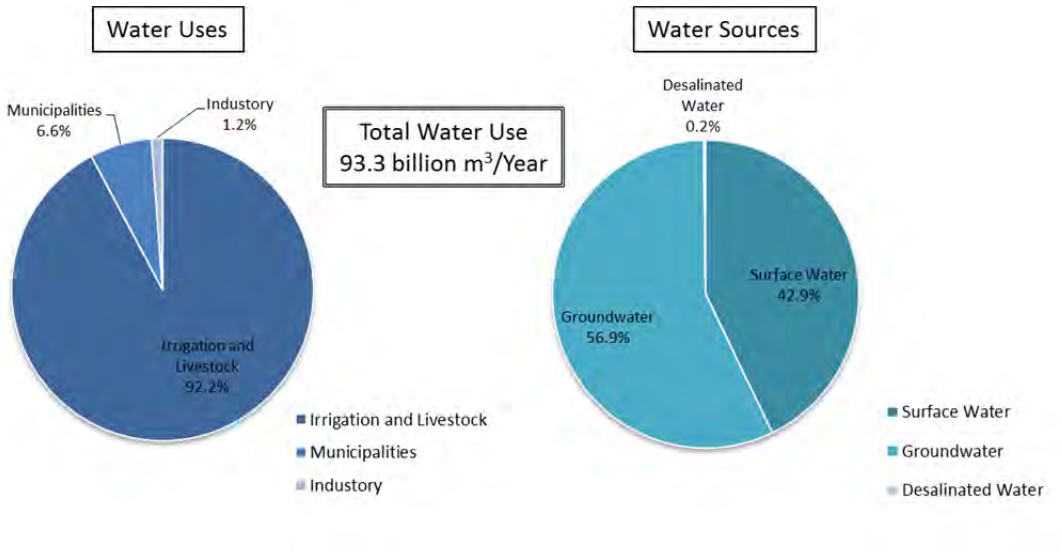
Table 2-2-1 Comparison of Water Resources in Iran and Japan

Item		unit	Iran	Japan
Annual rainfall		mm/year	228	1,668
Water resource endowment*		km^3/year	128.5	430.0
	Surface water	km^3/year	97.3	420.0
	Groundwater	km^3/year	49.3	27.0
Per capita water resources endowment		m^3/person・year	1,624	3,397

*It does not coincide with the total value for surface water and groundwater to partially overlap
Source: AQUASTAT, 2014/FAO

The quantity of water used in Iran in 2004 by source and use are shown in Figure 2-2-4. Of the total quantity of water used, 93.3 billion m^3, 56.9% was groundwater, followed by surface water at 42.9%. 92.2% of the water used was for agriculture, and the percentages for domestic and industrial uses were small by comparison.

[16] Integrated Water Resources Management for Sefidrud River Basin, 2010/JICA

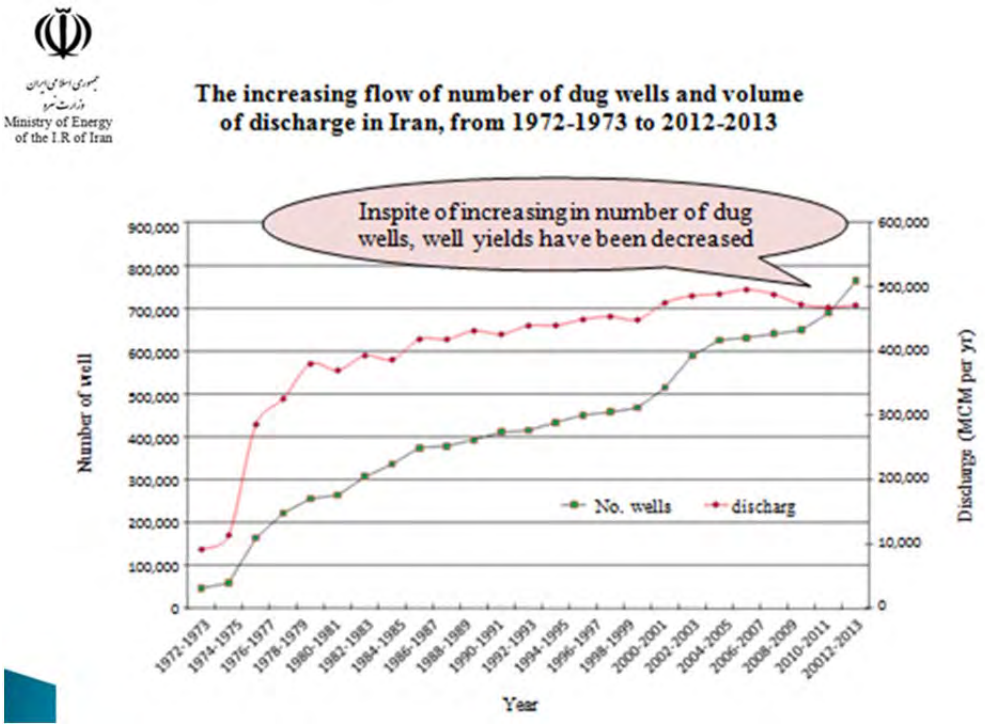


Source: AQASTAT, 2004/Food and Agriculture Organization

Figure 2-2-4 Quantity of Water Used in Iran by Source and Use (2004)

Underground water resources are plentiful in Iran, but they are gradually being depleted[16]. Each province has independent plans for the development of surface water such as bringing in water from outside areas, building dams, etc., to compensate for the uneven distribution of water resources, but there is no overall coordination[16].

According to "Groundwater Restoration and Balancing, Ministry of Energy Deputy for Water and Wastewater", although the number of new well construction is increasing year by year, total discharge of groundwater is not increasing and decreasing in recent years as shown on Figure 2-2-5.



Source: Groundwater Restoration and Balancing, Ministry of Energy Deputy for Water and wastewater

Figure 2-2-5 Number of New Well Construction and Groundwater Discharge

JICA has been implementing the "Integrated Water Resources Management for Sefidrud River Basin" project on one of the few large rivers in the country[16]. Many PPP desalination projects are in progress in the Persian Gulf and the Gulf of Oman[16], involving engineering and technical capacity development approaches for securing water resources.

CHAPTER 3 COOPERATION AND SUPPORT TO IRAN IN THE WATER SUPPLY SECTOR TO DATE

3-1 Record of Cooperation by Japan

3-1-1 Record of Cooperation by JICA

In contrast to Iran's tense relationship with the USA, ever since the establishment of diplomatic relations in 1929, bilateral relations between Iran and Japan have produced political and cultural exchanges in many areas. Visits by Prime Ministers and Presidents have been frequent. Following the Great East Japan Earthquake of 2011, in addition to messages of sympathy from high-level government officials, emergency aids were provided via the Iranian Red Crescent Society.

Furthermore, Japan has been engaged in economic cooperation with Iran ever since the signing of the Iran-Japan Economic and Technical Cooperation Treaty in 1958. Japan's support to Iran through ODA is shown in Table 3-1-1.

Table 3-1-1 Japan's Record of ODA to Iran

(100 million JPY)

Year	Loan	Grant Aid	Technical Cooperation
2009	-	0.66	7.3
2010	-	1.14	7.31
2011	-	0.95	9.56
2012	-	1.87	7.31
2013	-	0.79	6.42
2014		1.12	5.88
Cumulative	810.28	43.03	267.39

Source: ODA Country Data Book, 2015/Ministry of Foreign Affairs

Japan's policy of aid to Iran follows the priorities set forth in Iran's Five Year National Development Plan and the economic cooperation policy talks held in July 1999. Japan has provided humanitarian and development-oriented ODA focusing on technical cooperation to enable Iran to become a stabilizing force in the Middle East region[17]. The sectors in which assistance has been focused are as follows.

(1) The development of domestic industry: job creation and reducing unemployment.
(2) The narrowing of the gap between urban and rural areas: the establishment of sustainable agricultural production and increasing farmers' incomes.
(3) Environmental conservation: preservation of the natural environment, combat global warming and environmental pollution.
(4) Water resources management: promotion of comprehensive water resources management.
(5) Disaster prevention: earthquake disaster mitigation.

JICA's record of cooperation in the water sector is shown in Table 3-1-2.

[17] ODA Country Data book, 2015/ Ministry of Foreign Affairs, Japan

Table 3-1-2 Record of the Cooperation in the Water Sector by JICA

Year	Project Name	Type	Overview of the Project
2000 to 2001	The Study on Water Management in the Capital Tehran	Development Study	Establishment of the Water Resource Development and Management Plan to ensure the implementation of the water policies, indicated in the Master Plan.
2002 to 2004	Water Shortage Management in the Urban Area	Training	Training on drought management such as coordination among the organizations, allocation of water resources, and edification of citizens' consciousness.
2003 to 2005	Anzali Wetland Ecological Management Project	Development Study	Technology transfer in water quality management through establishment of Anzali Wetland Ecological Management Plan and implementation of the pilot project.
2005 to 2006	The Study on Water Supply System Resistant to Earthquakes in Tehran Municipality	Development Study	Establishment of water distribution network rehabilitation plan, including appropriate allocation of water supply district and reduction of uncertain water.
2007 to 2010	Integrated Water Resources Management for Sefidrud River Basin	Development Study	Establishment of integrated water resources management for the Sefidrud River Basin.
2007 to 2012	Assignment of Japanese experts in water policy	Assignment of Experts	Transfer of experience and technology with the implementation of the long-term water resource development plan.
2007 to 2012 2014 to 2019	Anzali Wetland Ecological Management Project Phase 1 and 2	Technical Cooperation	Technical cooperation based on the Anzali Wetland Ecological Management Plan.
2009 to 2011	Assignment of Japanese experts in water policy	Assignment of Experts	Transfer of advanced experience and technology related to sustainable water resource development.
2009 to 2014	Establishment of participatory water management system in Golestan province	Technical Cooperation	Technical cooperation for the development of water resource management structure.
2014 to 2016	The Data Collection Survey on the Hydrologic Cycle of Lake Urmia Basin	Basic Study	Development of the runoff analysis model, investigation of water circulation structure and basic data collection study in the Lake Unima Basin.
2015 to 2018	Project for Capacity Development on Integrated Water Resources Management	Technical Cooperation	Technical cooperation for the improvement of integrated water resource management capability and water use efficiency in the Sefidrud River Basin.

Source: JICA knowledge site, project information- Iran/JICA

3-1-2 Record of Cooperation by the Japan Cooperation Center for the Middle East

Japan Cooperation Center for the Middle East (JCCME) is a general incorporated foundation established in 1973 for the purpose of providing information such as the investment environment in the Middle East and North African countries, supporting Japanese firms through dispatching field survey missions and implementation of feasibility studies and supporting the promotion of mutual understanding between Japan and the Middle East and North African countries through the introductions of Japanese technologies. Before 1973, there was no appropriate support to deal with the requests and needs from the Middle East countries seeking technical assistance from Japan. JCCME provides financial support and contributes to cooperation with countries that do not have bilateral agreements with Japan. JCCME also conducts studies and surveys for the development of industrial economy and trade promotion while providing relevant information on Japan at the request of the partner countries[18].

The record of cooperation by JCCME in recent years is as indicated in Table 3-1-3.

Table 3-1-3 Record of Cooperation in the Water Sector by JCCME in Recent Years

Year	Types of Cooperation
January, 2013	Introduced to NWWEC the efforts for reducing NRW by Bureau of Waterworks Tokyo Metropolitan Government.
February, 2013	Hosted the president and the vice president of NWWEC and the president of Qom WWC.
July, 2013	Received 34 trainees to the first 6-day training program on NRW reduction, supported by Bureau of Waterworks Tokyo Metropolitan Government, providing a short course program and visit to the water supply operation center in Tokyo.
March, 2014	Hosted the vice president of NWWEC and the president of East-Azerbaijan Provincial WWC.
May, 2014	Received 42 trainees to the second 8-day training program on management of SCADA system, supported by Bureau of Waterworks Tokyo Metropolitan Government, providing a short course program and visit to the WTP in Tokyo.
June, 2014	Conducted preliminary field investigation in Khansar as requested by NWWEC.
October, 2014	Hosted the vice president of NWWEC and the president of IPWWC.
November, 2014	Received 40 trainees to the third 7-day training program on water quality management, supported by Bureau of Waterworks Tokyo Metropolitan

[18] The prospectus of JCCME,1973/ Japan Cooperation Center for the Middle East

	Government and Waterworks Bureau, City of Yokohama, providing a short course program and visit to the WTP in Tokyo.
March, 2015	Received 42 trainees to the fourth 7-day training program on management of WWTP, supported by Bureau of Sewerage Tokyo Metropolitan Government, Nagoya City Water and Sewage Bureau and some Japanese private firms, providing a short course program and visit to the WWTP in Nagoya city.
May, 2015	Hosted the president and the vice president of NWWEC and the president of IPWWC.
May, 2015	Received 41 trainees to the fifth training program on operation and maintenance of WTP, supported by Waterworks Bureau, City of Yokohama and Bureau of Waterworks Tokyo Metropolitan Government, providing a short course program and visit to the WTP in Tokyo and City of Yokohama.
November, 2015	Received 2 missions consisted of major Iranian water related companies.
February, 2016	Received 42 trainees to the sixth training program on the crisis management, supported by Kobe City Waterworks Bureau and Waterworks Bureau, City of Yokohama, providing a short course program and visit to the WWTP in Kobe City.
April, 2016	Hosted the deputy minister and the minister advisor of MOE, the president and vice president of NWWEC and the president of TPWWC.
May, 2016	Dispatched the Water Business Mission to Iran, composed of 16 officials from 9 major private water related companies in Japan.

Source: JCCME

As indicated above, JCCME has been working with NWWEC in the water sector, especially in the area related to NRW since 2013. The training programs have been conducted as a part of the "Cooperation to Promote Business Activities between Japan and Arab Countries" by the Ministry of Economy, Trade and Industry, Japan (METI) that provides financial support for airfare and accommodation for the trainees.

JCCME also conducted preliminary field investigation in Khansar City for the pilot project on NRW reduction. That investigation targets the overall status of waterworks including water related facilities, water pressure, pipeline construction status, hydrants and meters in Khansar City. The report of the investigation evaluated NRW ratio as 61.3% (Apparent Losses 8.7%, Real Losses 44.1% and Unbilled Authorized Consumption 8.5%), that is caused by over pressured and aging pipeline.

This investigation shows that it is important to identify the accurate amount of NRW and to develop a coherent strategy for NRW reduction. The Iranian side followed up the advice with the

current request.

3-2 Record of Cooperation by Other Donors

3-2-1 Record of Cooperation by the World Bank

The record of cooperation by the World Bank (WB) is as follows. (Table 3-2-1)

Table 3-2-1 Record of Cooperation in Iran by WB

Year	Name of the Project
	Contents of the Project
2004 to 2009	Ahwaz & Shiraz Water Supply and Sanitation Project
	The rehabilitation of aging waterworks and sanitation facilities in the rural areas of Ahwaz and Shiraz, through capacity building of their WWCs.
2005 to 2010	Northern Cities Water Supply & Sanitation Project
	The improvement of operation and financial management through capacity building of WWCs in 4 northern cities: Rasht, Anzali, Sari and Babol.
2005 to 2012	Alborz Integrated land and Water Management Project
	The improvement of agricultural productivity through the reduction of soil erosion and the improvement of the irrigation and drainage capacity.

Source: The World Bank Projects & Operations (http://www.worldbank.org/projects?lang=en)

There are no ongoing projects funded by the WB in Iran and no projects have been initiated since 2005[19]. There have been no new assistance strategies since the one developed for 2002 to 2005. In April, 2016 the World Bank issued Iran's Economic Outlook- Spring 2016[20] which describes the economy of Iran, including the effect of the lifting of sanctions. There are also no investments from the International Finance Corporation (IFC). The Multilateral Investment Guarantee Agency (MIGA) issued 2 investment guarantees in 2005, since then there have been no new investment guarantees issued.

3-2-2 Record of Cooperation by the Islamic Development Bank

The Islamic Development Bank's (IDB) record of cooperation in Iran as shown on its website[21], include 2 announcements in the water supply sector (construction of a water treatment plant and

[19] Iran Overview, World Bank, 2016, http://www.worldbank.org/en/country/iran/overview#2
[20] http://www.worldbank.org/en/country/iran/publication/economic-outlook-spring-2016
[21] Islamic Development Bank, http://www.isdb-pilot.org/

construction of distribution pipes in the area operated by Hormozgan Regional Water Company, December, 2014). There are 12 notices in the sewage and sanitation sector, including projects for the development of sewage system and/or construction of a wastewater treatment plant in a rural village area; water resource development project; capacity building and training project for water supply sector (October, 2015); and study on development plans and organizational assessment of WWCs (October, 2015). There are 17 announcements related to water and wastewater sector.

CHAPTER 4 PRESENT STATUS OF THE WATER SUPPLY SECTOR IN IRAN

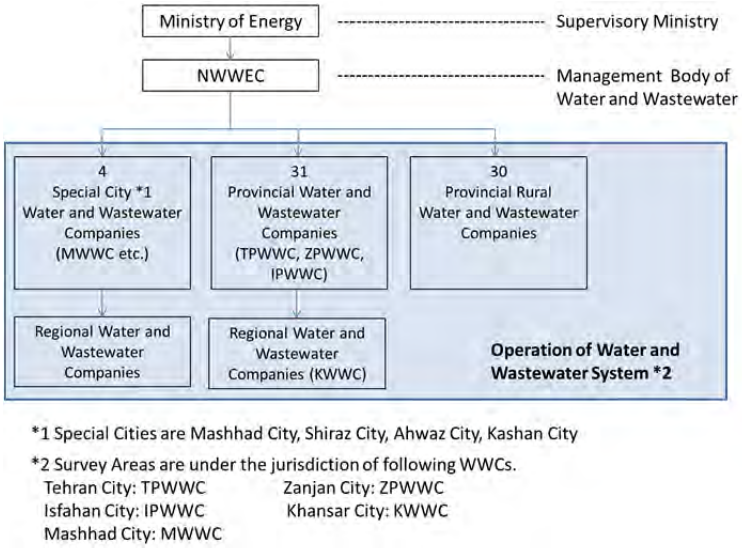
4-1 Outline of the Water Supply Sector

The water supply sector in Iran is centrally controlled by NWWEC, an organization operating under the supervision of MOE. The actual water supply service is provided by each of the provincial WWCs. As mentioned above, Iran is a country with extremely limited water resources and effective use of water is one of the country's most important policy issues (see 4-4 "Plans and Policies").

4-2 Water Supply Administration

4-2-1 Organization of the Water Sector

Water resource management and water supply and sewerage services in Iran are the responsibilities of MOE. NWWEC operates under the supervision of MOE and supervises the provincial WWCs established under it (Figure 4-2-1).



Source: Answers to the questionnaire to NWWEC, 2016/ NWWEC

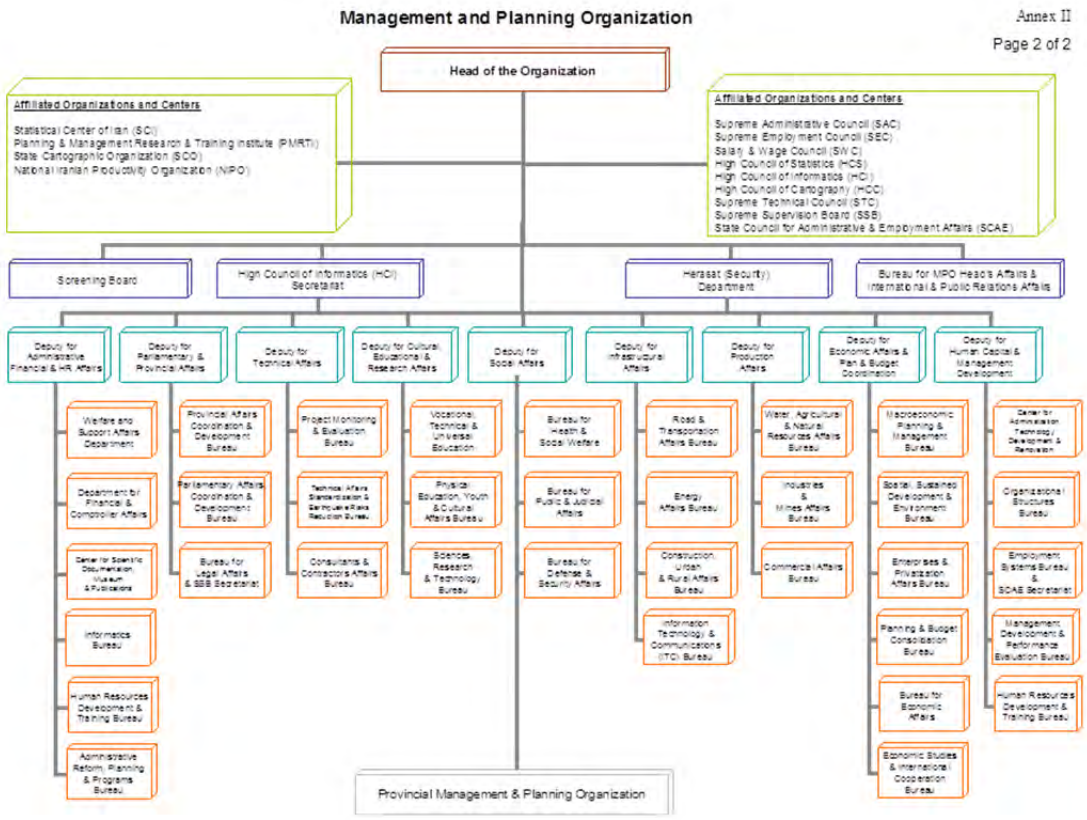
Figure 4-2-1 Structure of Administrative Organizations for Water Supply Services

Unlike many other countries where local governments are directly responsible for water services, the central government supervises the water supply sector in Iran. Under the MOE, there are 31

provincial urban WWCs, 4 municipal WWCs (Mashhad、Awhaz、Shiraz、Kashan) and 30 provincial rural WWCs. In general, provincial urban WWCs and 4 municipal WWCs manage water production and distribution systems to large urban areas, while the rural ones manage water distribution systems with wells as their water source.

Each provincial WWC is an independent state owned enterprise. There are still many state owned companies in finance, manufacturing and utilities, even though the government is moving towards large scale privatization. WWCs are still under government control because of their mandate to serve the public good.

There are many layers and duplication of responsibilities among public organizations, with double checking system at provincial and central levels. The Management Planning Organization (MPO) has ultimate control over budgetary allocation decisions, including expenditures and procurement for public works. It is one of the oldest governmental institutions established in 1948. It was abolished during the previous regime and reinstated in 2014. It is engaged in every step of public finance from planning, expenditure control, and auditing. Figure 4-2-2 shows the organizational chart of the MPO. The technical departments are divided into culture, society, public infrastructure, economic activities, and human resources. Water, Agriculture and Natural Resources Affairs Bureau under the Deputy of Production Affairs is responsible for the water and wastewater sector.

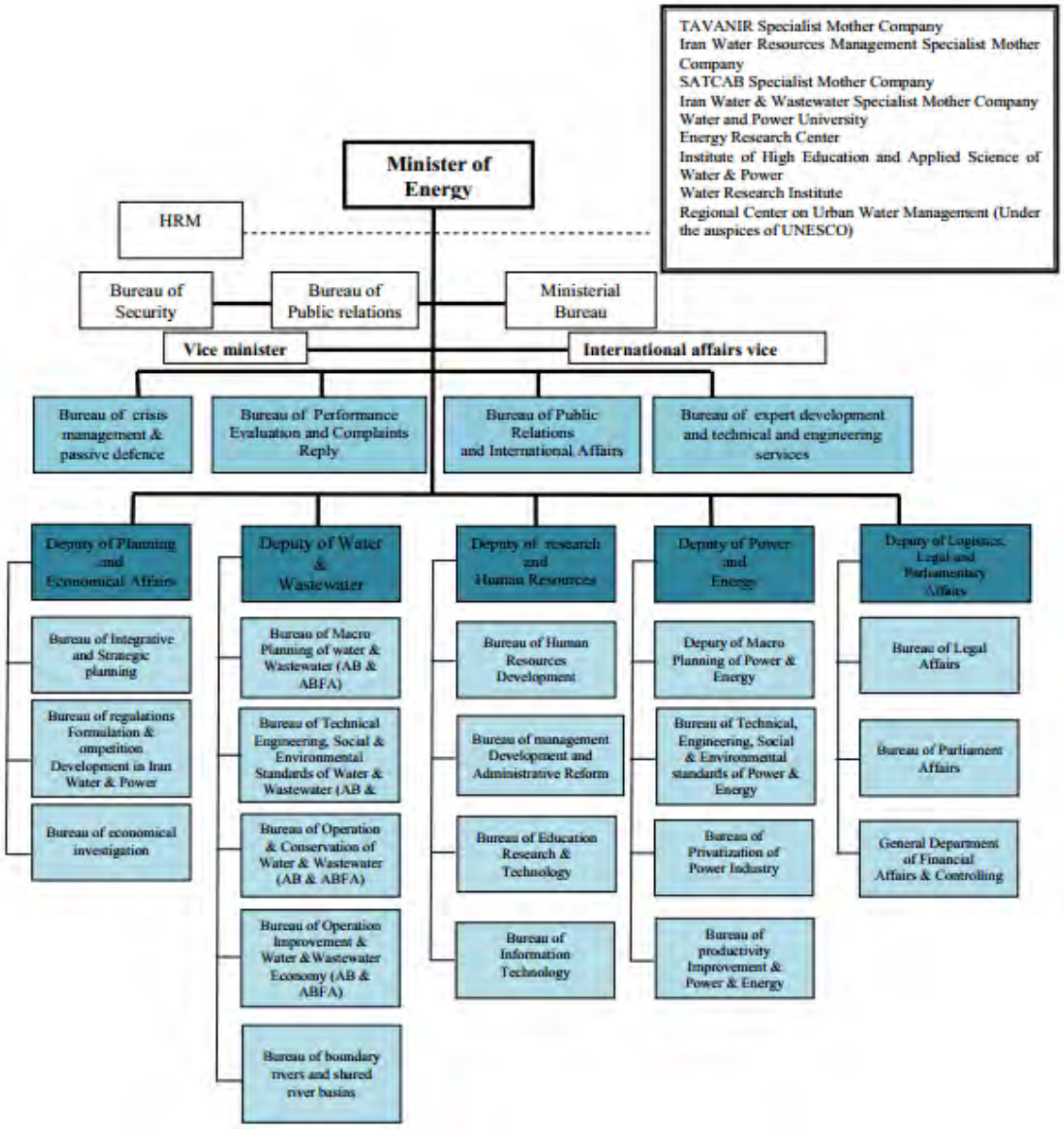


Source: Report on Public Finance, Expenditure, Procurement in Iran, 2005/the World Bank

Figure 4-2-2 Organizational Chart of MPO

Each WWC submits budget proposals and required subsidies to its MPO provincial office. These are aggregated at the provincial level and sent to the central office. NWWEC is involved with the budget and subsidy request of each provincial company and negotiates the overall budgetary allocation with MPO headquarter. The overall budgetary allocation is assessed incrementally based on the previous allocations and the decision also depends on the policy priorities of the regime and government income from oil and gas production.

MOE appoints the CEOs of provincial WWCs based on the recommendations from NWWEC. The CEO of each WWC has the staff appointment authority. The Cabinet Office controls the overall number of staff. The organizational chart of the MOE is shown in Figure 4-2-3.



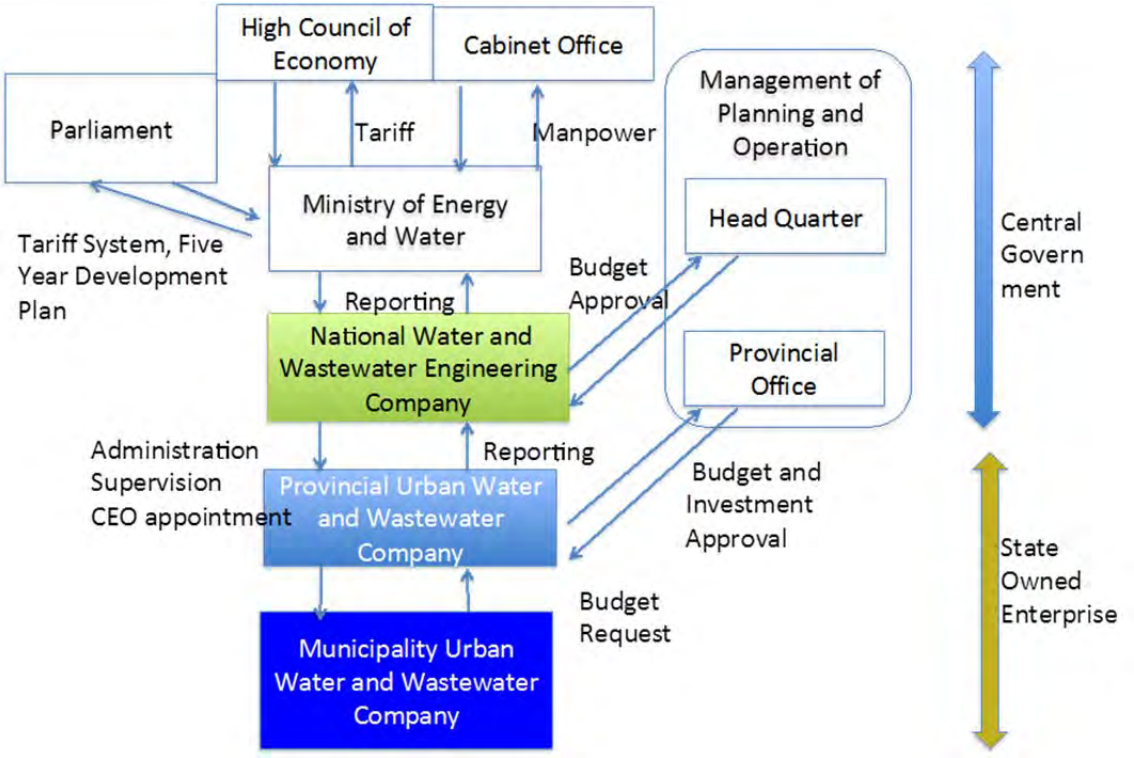
Source: MOE

Figure 4-2-3 Organizational Structure of MOE

Water tariff is nationally set. NWWEC drafts the tariff revision and MOE sends the tariff structure, the Five Year National Development Plan to the parliament for approval and annual revisions to the High Council of Economy for approval.

The next figure (Figure 4-2-4) shows the roles of each organization related to water and wastewater services in Iran. Provincial WWCs have municipal branches or affairs within their organization that manage local distribution networks. For instance, Khansar (Municipality) Water and Wastewater

Company (KWWC) is part of Isfahan Provincial Water and Wastewater Company (IPWWC). Each municipal level company has its own independent accounting books including those on profit and loss statements



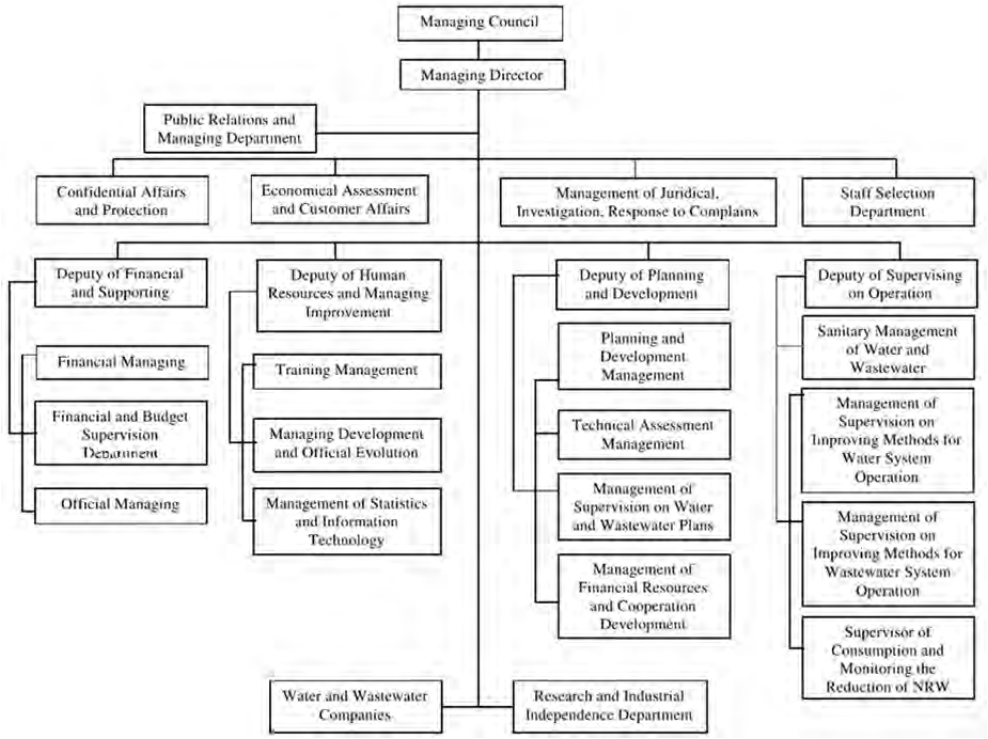
Source: JICA Survey Team, 2015

Figure 4-2-4 Organization of the Water Sector in Iran

As shown in the institutional structure of the Iranian water sector, the main responsibility for operating and managing urban water and wastewater systems, including the construction of facilities, rests with each provincial WWC(s), while NWWEC establishes policies, draft tariff revisions based on operating costs and assesses requirement for budget and subsidies.

4-2-2 National Water and Wastewater Engineering Company

NWWEC does not directly operate water supply and sewerage services such as water purification, water conveyance and water distribution. It manages these services, develops policies, examines water tariffs and reviews work programs. Construction and operation of water supply facilities and distribution to users are the responsibility of the provincial WWCs established under its supervision. The organizational chart of NWWEC is shown in Figure 4-2-5.



Source: NWWEC

Figure 4-2-5 Organizational Chart of NWWEC

4-2-3 Regional Centre on Urban Water Management

Regional Centre on Urban Water Management (RCUWM) was established jointly by MOE and UNESCO as a joint organization between MOE and UNESCO with members comprising of Iran, Oman, Germany, Bangladesh, Egypt, Kuwait, Lebanon and Syria. Therefore, it is a parallel organization to NWWEC. RCUWM and MOE signed the MOU on international cooperation and technical assistance in urban water management in 2014. RCUWM works closely with the Institute of Higher Education at UNESCO to implement public awareness campaigns, training and international conferences on urban water supply and water resource management. RCUMW is staffed with 10 regular employees and 10 contract workers.

The mission of RCUWM is to promote scientific water resource management in urban areas with the main activities centering on international exchanges, technical information dissemination, joint research, consulting etc. Table 4-2-1 shows the major workshops and trainings undertaken since 2003. The topics cover the water resource saving and rainwater harvesting to women participation ranging from technical to social issues.

Table 4-2-1 Workshops and Training by RCUWM

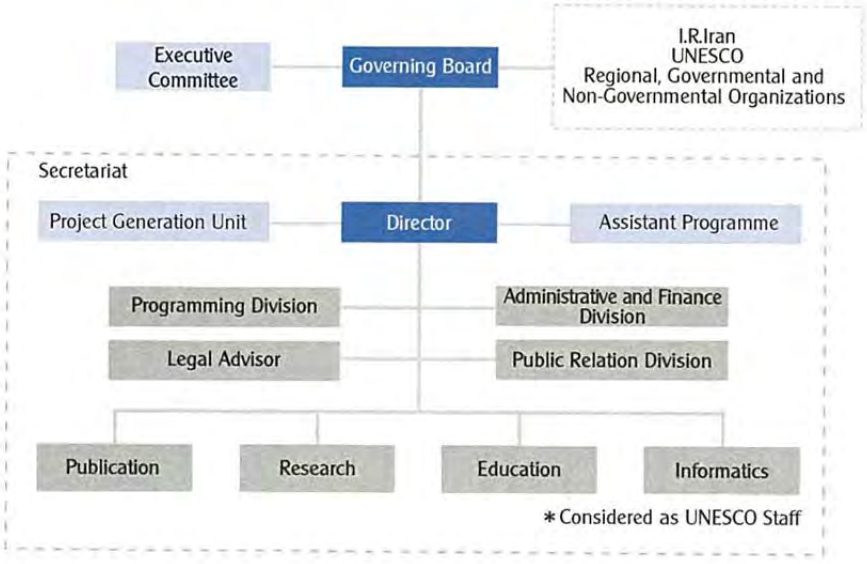
Date and Place	Workshops and Trainings	Nos. of Participants
2003		
7th - 9th May 2003 Venue: Tehran	Promotion of Public Awareness on Water Conservation'	42
30th August- 3rd Sep 2003 Venue: Tehran - Iran	Water and Wastewater Technology	24
15th - 16th Dec 2003 Venue: Tehran – Iran	Policies and Strategic Options for Water Management in the Islamic Countries·	38
2004		
27th Nov - 1st Dec 2004 Venue: Yazd, Iran	Management of Aquifer Recharge and Water Harvesting in Arid and Semi-Arid Regions of Asia	52
2005		
23rd - 24th Feb. 2005 Venue: Tehran- Iran	Promotion of Women's Participation in Water Management"	85
28th Nov -1st Dec 2005 Venue: Berlin and Dresden, Germany	Innovations in Water and Wastewater Technology•	48
2006		
21st - 23rd Feb 2006 Venue: Tehran	Innovations in Water Conservation·	57
4th - 6th September 2006 Venue: Muscat Oman	Flash Floods in Urban Areas and Risk Management'	63
29th - 31st October 2006 Venue： Tehran - Iran	Groundwater for Emergency Situations	
2007		
3rd - 5th May 2007 Venue： Lahore, Pakistan	Integrated Urban Water Management	
27th - 28th August 2007 Venue: Muscat	"Water Demand Management in Urban Areas in Light of Tourism Development	77
26th - 28th November 2007 Venue: Tehran	"Capacity Development for Water Journalists	40
2008		
5th May 2008 Venue: Tehran, Iran	Wastewater Reclamation and Water Reuse	150
13th -16th October 2008 Venue: Damascus, Syria	Impacts of Climate Change on Water Resources Management in the Region	30
2009		
11th - 14th May 2009 Venue: Tehran, Iran	Integrated Flood Management	40
10th -13th August 2009 Venue: Kuala Lumpur, Malaysia	Risk Assessment & Flash Flood Mitigation Strategies	40
19th - 22nd October 2009 Venue: Tehran, Iran	Reservoir Dams Sedimentation Control	30
28th Sep.-1st Oct 2009 Venue: Tashkent, Uzbekistan	Challenges of Sustainable Water Use in Arid and Semi-arid Regions under the Condition of Climate Change	50
9th -12th November 2009 Venue: Tehran, Iran	Development of Hydropower Plants	20
2010		
9th - 12th May 2010 Venue: Kish- Iran	First National Workshop on Capacity Development for Farm Management Strategies to improve Crop Water productivity using Aquacrop	20
3rd - 8th July 2010 Venue: Tehran- Iran	Training Workshop for Iraqi Experts	15
9th -12th May 2010 Venue: Kish, Iran	Workshop on Capacity Development for Farm Management Strategies to Improve Crop – Water Productivity Using Aqua-Crop	16
2nd - 4th August 2010 Venue: Dushanbe, Tajikistan	Training Workshop on Urban Water Management	35
9th - 14th October 2010	Technical Workshop on Iran's Achievement in the Field of Water	20

Venue: Tehran, Mazandaran, Khorasan, Iran	Industry for the Iraqi General Managers	
2011		
18th - 21st January 2011 Venue: Mascut, Sultanate of Oman	International Workshop on Application of GIS and RS in Water Resource Management	40
12th - 16th February 2011 Venue: Ahwaz, Iran	National Workshop on Capacity Development for Farm Management Strategies to Improve Crop – Water Productivity Using Aqua-Crop	18
10th - 13th April 2011 Venue: Kish, Iran	Training Workshop on International Water Laws & Trans Boundary Issues	60
30th May - 1st July 2011 Venue: Kish, Iran	International Training Workshop on Water and Sanitation Facilities in Disaster Situations	35
25th - 27th July 2011 Venue: Izmir, Turkey	International Training Workshop on Sustainable Water Use in Conditions of Climate Change	33
23rd - 26th November 2011 Venue: Beirut, Lebanon	Regional Training Workshop on Climate Change and its Impacts on Water Resources	40
2012		
12th - 13th April 2012 Venue: Tehran, Iran	Workshop on Promotion of Public Awareness on Drought	30
9th June 2012 Venue: Tehran, Iran	Training workshop for Water Journalists	22
12th July 2012 Venue: Kish, Iran	International Seminar on Water and Wastewater Technologies in I.R.Iran	56
2013		
14th - 15th May 2013 Venue: Tehran, Iran	International Workshop on Drought Management	25
20th - 21st August, 2013 Venue: Dushanbe - Tajikistan	Conference on Water Cooperation	35
22th - 24th November 2013 Venue: Grine, Northern Cyprus - Turkey	International Conference on Water and Food Security in Member Countries of the Organization of Islamic Countries (OIC)	40
2014		
24th - 26th February 2014 Venue: Muscat, Sultanate of Oman	International Seminar on Use of Unconventional Water in Urban Water Management	40
19th - 21st November 2014	International Expert Symposium on Coping with Droughts	90
25th November 2014	Workshop on Urban River Management	35
2015		
25th - 26th May 2015 Venue: Tehran, Iran	Workshop on Advances in Integrated Hydro-Electric Reservoirs Operation	70
1st July 2015 Venue: Tehran, Iran	Training Workshop on Pressure and Vacuum Sewer Systems for NWWEC	50
August, 2015 Venue: Tehran, Iran	Series of Lecture on International Experiences on River Restoration Projects	120
18th October, 2015 Venue: Tehran, Iran	Symposium of Urban River Management	264
16th - 19th November 2015 Venue: Tehran, Iran	Training Workshop on Water and Media	150
22nd - 25th November 2015 Venue: Tehran and Isfahan, Iran	Regional Workshop and Roundtable Discussion on Exploring Different Approaches aimed at Overcoming Environmental Sustainability Challenges	40

2016		
23rd - 24th January 2016 Venue: Tehran, Iran	Workshop on Value Engineering and Planning of Ecological Buffer in Urban Rivers	60
9th May 2016 Venue: Tehran, Iran	The 1st National Conference on Urban River Restoration	632
10th May, 2016 Venue: Tehran, Iran	Workshop on Urban Surface Water Quality	45
5th - 9th June 2016 Venue: Kyoto, Japan	Flood and Drought session in The 7th International Conference on Water Resources and Environment Research (ICWRER 2016)	35
27th - 28th June 2016 Venue: Vienna, Austria	Workshop on Drought Management in World's Large Rivers	37
11th - 16th July 2016 Venue: Singapore	Technical Workshop and Filed Visit on Water and Wastewater Facilities of PUB Singapore for PR officers in NWWEC	20

Source: RCUWM

The organization structure of RCUWM is shown in Figure 4-2-6 below.



Source: RCUWM

Figure 4-2-6 Organization Structure of Regional Centre for Urban Water Management

The governing board consists of the representatives from the Iranian government, UNESCO, and member countries. The organization is divided into publication, research, education and informatics.

4-2-4 Related Laws and Regulations

Laws and regulations related to water supply service are shown in Table 4-2-2

Table 4-2-2 Legal and Administrative Frameworks Related to Water Supply Administration

Title of Law	Year of Approval/ Approval Authority	Note
Fair Water Distribution Law	1983, Iranian Assembly	It stipulates that public water belongs to the Government of Islamic Republic of Iran under the Iranian Constitution Clause No.45.
Water Allocation Law	1983, Iranian Assembly	It defines the water rights of respective users in Iran.
Act of the Establishment of Water and Wastewater Companies	1983, Iranian Assembly	The law defines the establishment of provincial WWCs. It mandates the compliance of the companies to commercial laws of Iran. Private sector participations are permitted as approved by MOE. It also defines the transfer of assets and personnel belonging to the water companies which existed prior to the enforcement of the law.
The Law of Promotion of investment in Water Projects in Iran and Enforcing By law	2002, Iranian Assembly	Investments in assets and operational management of the dam projects or water supply systems are licensed with consideration of public or private sector's water right, based on the Iranian Constitution Clause No.44
The Fifth Five Year National Development Plan (2011-2016)	2010, Iranian Assembly	It stipulates that water management is to be enforced according to basin or state levels. Article 140- Industry, animal husbandry or manufacturing generate a much larger amount of sewerage than other sectors and are required to develop systems for sewage collection and treatment. Fines shall be levied on non-compliance.
Design Criteria for Urban and Rural Water Supply and Distribution Systems	2013, MOE, Bureau of Engineering and Technical Criteria for Water and Wastewater	The scope of application of the criteria includes the research related to water supply and the design of the water supply projects.
An addendum to government financial regulations, Article 37	2005, Management and Planning Organization (MPO)	Water, electricity and fuel costs in the public or private educational institutions are calculated on the basis of the educational expenses of the institution.
Drinking Water; Physical and Chemical Specifications	2010, Institute of Standards and Industrial Research of Iran (ISIRI)	The specifications define the physical and chemical characteristics for drinking water.
Quality Control Manuals for Water Treatment Plants	2006, Management and Planning	The documents set out the water quality test measures required for the monitoring and the optimal water treatment process in the WTP.

Source: Questions to and responses of MOE, JICA Survey Team, 2016

MOE approves all the policy matters included in the National Development Plans. In reality NWWEC drafts and proposes much of the policy matters to the ministry for their consideration. In the Fifth Five Year National Development Plan (target year: 2011-2016), the annual reduction of NRW of 1.5% was proposed by MOE but the next target in the Sixth Five Year National Development Plan (target year: 2016-2021), 2.5% over five years, was proposed by NWWEC.

Respective WWC approves design of new facilities. There is a design review section in WWC and it reviews the design referring to a standards, guidelines, etc. These standards and guidelines were prepared by NWWEC. The Standard office in NWWEC prepares manuals and guidelines by itself except standards which are required to have an approval from the MOE.

4-3 Present Status of Water Supply Services

4-3-1 Background Information on the Water Supply Sector

Water supply is provided by provincial WWCs operating under the supervision of NWWEC as shown in Table 4-3-1. The coverage of the water supply in urban areas is 99% and the service is available 24 hours a day, throughout the year, with a NRW ratio of 26% (the national average of NRW in Japan is around 10%[22]).

[22] Water Supply Statistics for 2013, 2014/Japan Water Works Association

Table 4-3-1 Background Information on Water Supply Sector under the Supervision of NWWEC (2014)

	Indicators & Information	Figure/Information	Unit	Resource/ Calculation basis
Sector Information				
1	Total Population of the country	60,435,444	people	(urban areas) data from NWWEC April 2015
	GDP per capita	5,443	USD／capita	World Bank (2014) http://data.worldbank.org/indicator/NY.GDP.PCAP.CD
2	Annual rainfall	195	mm／year	Water Resources Management 2014-2015 (years)
	Climatic zone	Arid and semi-arid	_	Water Resources Management
3	% of access to improved water sources	99.1	%	NWWEC (MIS) Management Information System
4	Governance of the water sector	Ministry of Energy / National Water & Wastewater Engineering Company (NWWEC) / Province Water & Wastewater Company	_	NWWEC
5	Main development strategies and challenges (National strategies, master plan, relevant regulations, structural reform plans, etc.)	main challenge: shortage of water resources	_	NWWEC

Source: shown in the table

Table 4-3-2 State of Water Supply Operated by Provincial Water and Wastewater Companies under the Supervision of NWWEC (Actual State in April 2015)

An Overview to Population Coverage and other General Information of Water and Wastewater Engineering Companies at Province Level (as of April 2015)

Row	Name of Company (Provinces and major Cities)	Urban population	Urban population covered by water connection	Rural population covered by water connection	Percentage of urban population covered by water connection	Number of cities covered by urban water facilities	The number of connections/ subscribers	The length of water distribution network	The length of water transmission lines	NRW
		Person	Person	Person	Percent	City	Item	km	km	Percent
Total (National Level)		**60,435,444**	**58,742,873**	**1,132,682**	**98.70**	**1,125**	**14,963,718**	**144,082**	**27,671**	**25.5**
1	East Azerbaijan	2,880,934	2,880,934	0	100.00	58	992,688	8,756	1,108	19.6
2	West Azerbaijan	2,065,778	2,065,778	0	100.00	38	576,128	4,423	679	22.4
3	Ahwaz	1,335,678	1,335,678	0	100.00	5	317,416	2,528	200	30.7
4	Alborz	2,459,251	2,448,853	0	99.58	19	377,432	2,808	655	23.5
5	Ardebil	833,467	833,230	0	99.97	23	284,529	2,254	450	22.8
6	Bushehr	753,028	729,551	0	96.88	33	227,038	3,201	850	36.6
7	Chaharmahal and Bakhtyari	566,660	560,703	5,957	98.95	34	195,226	1,574	327	23.4
8	Fars	1,707,895	1,567,928	64,384	95.57	80	622,292	6,766	2,275	26.6
9	Golestan	1,014,480	943,385	71,088	92.99	22	259,483	2,727	428	25.8
10	Gilan	1,629,850	1,629,506	0	99.98	48	418,809	4,879	631	21.1
11	Hamedan	1,090,137	1,088,413	0	99.84	29	335,843	2,561	442	25.1
12	Hormozgan	1,100,963	941,865	149,124	99.09	36	219,295	2,985	1,076	19.2
13	Ilam	444,097	416,763	27,334	93.85	19	127,305	1,293	451	23.6
14	Isfahan	4,081,566	4,031,840	49,726	98.78	93	1,069,365	11,358	2,302	17.5
15	Kashan	426,970	424,835	0	99.50	12	134,279	1,778	342	21.6
16	Kerman	1,902,977	1,790,887	100,376	99.38	69	554,529	8,967	1,868	23.9
17	Kermanshah	1,406,134	1,405,338	0	99.94	27	355,074	2,944	538	45.1
18	Khuzestan	2,402,896	2,252,358	150,538	93.74	57	625,224	6,772	1,510	42.4
19	Kohgiluye and Boyerhmad	465,583	463,524	3,216	99.50	15	128,739	1,369	281	26.5
20	Kordestan	1,065,401	1,064,104	0	99.88	24	297,447	4,151	382	28.1
21	Lorestan	1,128,695	1,127,166	0	99.86	24	354,524	2,664	520	28.5
22	Markazi	1,100,305	1,094,277	0	99.45	30	294,887	3,151	673	21.5
23	Mashhad	2,969,000	2,966,031	0	99.90	1	830,285	3,649	500	20.6
24	Mazandaran	1,976,692	1,738,279	212,033	98.67	52	537,600	6,716	975	32.3
25	North Khorasan	498,820	486,718	12,000	99.98	18	170,042	1,214	267	23.2
26	Qazvin	939,118	939,118	0	100.00	26	273,427	1,850	251	18.4
27	Qom	1,170,964	1,170,964	0	100.00	6	287,469	2,099	154	20.0
28	Khorasan Razavi	1,814,427	1,757,606	56,821	96.87	73	606,860	5,036	1,793	31.6
29	Semnan	537,356	524,737	12,619	97.65	19	227,361	2,277	458	23.7
30	Shiraz	1,761,097	1,760,745	0	99.98	1	416,205	2,980	230	25.9
31	Sistan and Balouchestan	1,574,843	1,375,115	194,374	99.66	37	304,447	3,931	1,280	25.1
32	South Khorasan	396,271	395,458	200	99.85	21	164,392	1,926	572	30.9
33	Tehran	13,318,843	12,959,030	0	97.30	41	1,814,105	15,578	2,273	24.6
34	Yazd	939,336	896,890	22,892	97.92	16	360,855	5,363	642	18.2
35	Zanjan	675,932	675,266	0	99.90	19	203,118	1,556	289	24.0

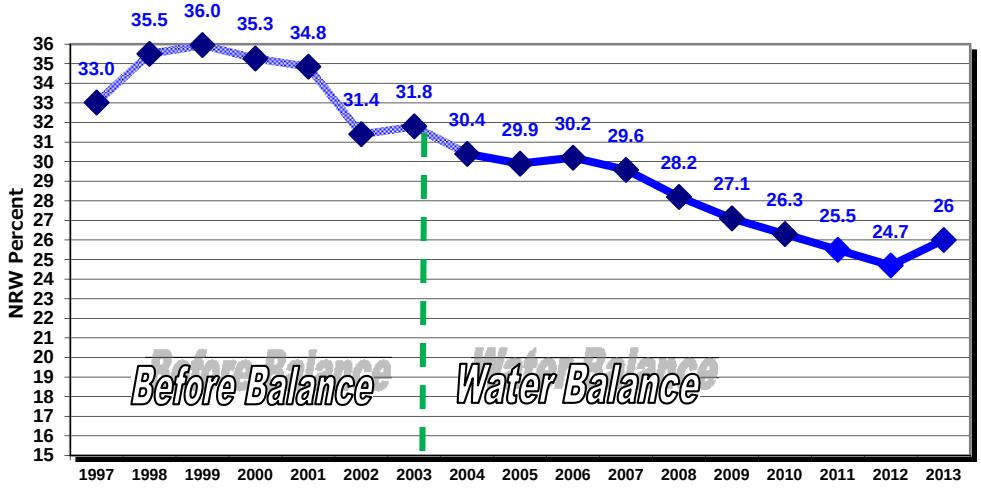
Source: Based on response to the questionnaire sent to NWWEC, 2015

In 2003 NWWEC introduced IWA based water balance auditing to all the WWCs in Iran. Now all the WWCs are mandated to analyze water allocation accordingly (Table 4-3-3). The IWA method promotes the importance of accurate measurement of water flow. As a result, the NWR decreased steadily as shown in Figure 4-3-1. Table 4-3-4 shows the national water balance in 2013.

Table 4-3-3 IWA Classification of System Input Volume

<table>
<tr><td rowspan="8">System Input Volume</td><td rowspan="4">Authorized Consumption</td><td rowspan="2">Billed Authorized Consumption</td><td>Billed Metered Consumption</td><td rowspan="2">Revenue Water</td></tr>
<tr><td>Billed Unmetered Consumption</td></tr>
<tr><td rowspan="2">Unbilled Authorized Consumption</td><td>Unbilled Metered Consumption</td><td rowspan="6">Non-Revenue Water</td></tr>
<tr><td>Unbilled Unmetered Consumption</td></tr>
<tr><td rowspan="4">Water Losses</td><td rowspan="2">Apparent Losses</td><td>Unauthorized Consumption</td></tr>
<tr><td>Metering Inaccuracies and Data Handling Errors</td></tr>
<tr><td rowspan="3">Real Losses</td><td>Leakage on Transmission and/or Distribution Mains</td></tr>
<tr><td>Leakage and Overflows at Utility's Storage Tanks</td></tr>
<tr><td>Leakage on Service Connections up to Point of Customer Metering</td></tr>
</table>

Source: JICA Survey Team, 2016



Source: The answers to the questionnaire to NWWEC, 2015/ NWWEC

Figure 4-3-1 NRW Before and After Introduction of IWA Water Balance (NWWEC)

Table 4-3-4 Analysis of System Input Volume in Iran (2013)

NWWEC	A	Inputs m^3/year % of input	B	Total inputs m^3/year % of input	C	Outputs m^3/year % of input	D	Outputs m^3/year % of input	E	Outputs m^3/year % of input	F	Outputs m^3/year % of input
National Water and Wastewater Engineering Company (2013)	Well	3046110815 54.3	System input volume	5607292262 100.00	Authorized consumptions	4313986870 76.9	Authorized billed consumptions	4221584901 75.3	Water delivered to other networks (bulk sale)	1220718402.2	Revenue water	4221584901 75.3
									Billed metered consumptions	3831848646 68.3		
	Qanat	18403933 0.3							Billed unmetered consumptions	267664415 4.8		
	Spring	164720621 2.9					Nonrevenue authorized consumptions	92401969 1.6	Unbilled metered consumptions	20024296 0.4	Non-Revenue Water	1385707361 24.7
									Unbilled unmetered consumptions	72377674 1.3		
	Purchase of treated water	957271910 17.1			Water losses	1293305392 23.1	Apparent losses	550239838 9.8	Unauthorized consumptions	163309242 2.9		
									Data management and system errors	120165803 2.1		
									Meter inaccuracies	266764793 4.8		
	WTP input	1348290839 24.0					Real losses	Top-Down 743065553 13.3	Leakage in distribution network	364845504 6.2		
									Leakage in transmission lines	46916387 0.8		
								Down-Top 726665889 13.0	Overflows from storage tanks	5303665 0.1		
									Leakage from tanks	15340547 0.3		
	Other sources	72494144 1.3							Leakage on service connections	312249785 5.6		

Source: NWWEC

As indicated above, since 2003 when the principle of water balance program was applied, the NRW ratio has been decreasing. More specific measures that contributed to such a decrease in the NRW ratio include installation of PRVs (pressure reducing valves) to control pressure, repair of extensive leakages from large diameter distribution mains and repair of leakage from valves[23].

4-3-2 Human Resources

Each provincial WWC has independent authority in staff appointment, except for the CEO who is appointed by MOE. In Iran, there is a legal mandate to reduce public sector manpower, thus WWCs are to have an approval of NWWEC when it has new recruits. Due to employment constraints, private sector outsourcing is on the rise. In ZPWWC, the ratio of permanent staff to contract workers is 1 to 1. MWWC has reduced its permanent staff from 1,200 to 600, while there are 2,000 contract workers. In other words, a large proportion of field level technical jobs are carried out by private company technicians. Therefore, it is crucial to raise the level of capability of private sector technicians. There is hardly any movement of field workers, permanent or otherwise, due to the local hire system. Table 4-3-5 shows the size of the workforce and served population for the 5 cities. The served population per worker is the highest in Mashhad City with 5,000 people/employees; the lowest is Zanjan City with approximately 2,000. The index figures for large cities in Japan are between 2,000 and 3,000. Therefore, the performance of WWCs in Iranian cities in manpower aspect is similar to that of Japanese cities. The pipe lengths per employee in Iranian cities are in 5 to 20 km.

Table 4-3-5 Manpower Indicators in Surveyed Iranian Cities[24]

		Tehran City	Zanjan City	Isfahan City	Khansar City	Mashhad City
1	Served Population	8,818,159	417,579	1,975,119	22,644	2,966,031
2	Length of Pipe	15,460	1,100	4,040	187	4,915
3	Staff size	3,165	212	570	10	598
4	Population/Staff	2,786	1,970	3,465	2,264	4,960
5	Pipe Length/Staff	4.9	5.2	7	18.7	8.2

Source: Financial Statement from WWCs, 2015/JICA Survey Team

[23] Based on the hearing survey to NWWEC

[24] In case of Provincial Water and Wastewater Companies (such as IPWWC and WPWWC), the number of staff is calculated by adding the number of staff in Headquarters to the number of staff in each WWC/Affair under them.

4-3-3 Financial Condition

Budget

WWCs start preparation of budgets in October through November and the board meetings in December will decide on the budget for the following fiscal year. For instance in IPWWC 90% of the budget is allocated out of its own resource and the remaining 10% is sourced from the central government allocations to be approved by MPO. The lending for capital works are registered in National Obligation to Development Funds to be included as part of the balance sheet. The budgets are approved by provincial MPO offices. Otherwise, a large construction project budget needs to be approved by MPO headquarter.

WWCs set 140 performance indicators to evaluate operation performances of each WWC without direct linkage to incentive schemes. In the case of IPWWC, however, the company paid a token bonus to employees when they became the top performer in NRW reduction.

Water Tariffs

Water tariffs are the same for the whole country. Rates are proposed by NWWEC and submitted to the Iranian Assembly by MOE. Then, the water tariff plan has to be approved by the High Council of Economy. The water tariff structure is composed of a basic charge (around 12,000 IRR = 43.94 JPY) and a meter-based charge. The current meter rates are shown in Table 4-3-6. The unit price increases with the volume of water use.

In addition to the standardized rates, a weighting factor is established for each city in accordance with its income level. For example, in Tehran Province, the rate is 45% higher than the standard rate. During the dry summer season (June to September); a drought charge of 25% also applies.

Table 4-3-6 Water Tariff Structure for Domestic Households in Iran (for Meter Rate)

Monthly water usage (m^3)	Fee calculation formula for each usage category (IRR)
0 to 5	(x * 709.5)
5 to 10	(x * 1,061.5 -1,760)
10 to 15	(x * 1,413.5 -5,280)
15 to 20	(x * 1,851.5-11,850)
20 to 25	(x * 2,700-28,810)
25 to 30	(x * 4,248- 67,510)
30 to 35	(x * 5,790 -113,770)
35 to 40	(x * 7,722-181,390)
40 to 50	(x * 16,371 -541,750)
Over 50	(x * 33,462-1,378,300)

Source: NWWEC

Water tariffs for non-domestic users are shown in Table 4-3-7.

Table 4-3-7 Water Tariff Structure for Non-Domestic Users in Iran

Purpose of service	IRR /m^3	JPY/m^3
Commerce	9,972	34.104
Industry	5,760	19.699
Government, Public Service	7,776	26.594
Education or Religion	2,880	9.850
Construction	10,800	36.936
Others (Fire Hydrant, supply to local WWCs, etc.)	1,440	4.925

Source: NWWEC

The water tariff coefficients are set for each city in Iran as indicated in Table 4-3-8.

The wastewater service rate is 70% of the water tariff for domestic households and 100% for non-domestic users.

Table 4-3-8 Water Tariff Coefficients of Cities in Iran

Province	Coefficient	City
Eastern Azerbaijan	1.30	Tabriz
	1.15	Sardroud, Khosro Shahr, Maragheh, Marand, Bonab, Shabestar, Sharafkhaneh, Shand Abad, Gougan, Azar Shahr, Ilkhchi
	0.96	Other cities in the province
Western Azerbaijan	1.15	Orumiyeh
	1.00	Takab
	0.92	Khoy, Mahabad, Miandoab, Boukan
	0.77	Salmas, Makou, Bazargan, Piran Shahr, Naghadeh, Sardasht, Silvaneh, Sarv, Noushin, Gard Keshaneh, Ghareh Ziaoddin, Firouragh, Rabt, Mir Abad, Ghoushchi, Taze Shahr, Chahar Borj, Barough, Mohammad Yar, Simineh, Shahin Dezh, Mahmoud Abad, Keshavarz, Oshnavieh, Nalous, Avajigh, Siah Cheshmeh
	0.70	Other cities in the province
Ardebil	1.06	Ardebil
	0.84	Meshgin Shahr, Pars Abad
	0.70	Other cities in the province
Isfahan	1.27	Isfahan
	1.22	Kashan, Naeen
	1.02	Ardestan, Shaheenshahr, Shahreza, Khemeini Shahr, Zarrinshahr, Fouladshahr, Falavarjan, Meymeh, Teeran, Nik Abad, Mohammad Abad, Nasr Abad, Kouhpayeh, Baharestan, Hassan Abad, Varzaneh, Harand, Ezhieh, Doroche, Ghahdarijan, Abrisham, Najaf Abad, Goldasht, Kahriz Sang
	0.85	Golpayegan, Khansar, Semirom, Fereidounshahr, Zavvareh, Rezvan Shahr, Koushak, Zeeba Shahr, Hana, Vanak, Komeh, Booeen, Miandasht, Afous, Daran, Damaneh, Barf Anbar, Pirbakran, Baharan, Keleeshaad, Imanshahr, Manzarieh, Gougad
	0.72	Other cities in the province
Alborz	1.32	Karaj
	1.13	Nazar Abad
	1.04	Other cities in the province
Ilam	1.16	Ilam
	0.78	Mehran, Dehloran, Darreh Shahr, Bedreh, Meymeh, Pahleh, Mousian, Loumar, Sarableh, Tohid, Saleh Abad, Abdanan, Zarneh, Eyvan
	0.70	Other cities in the province
Bushehr	1.26	Bushehr, Bandar Genaveh
	0.81	Borazjan, Bandar Deylam
	0.70	Other cities in the province
Tehran	1.45	Tehran
	1.13	Varamin, Islam Shahr, Pakdasht, Qods, Gharchak, Shahriar, Baghestan, Andisheh, Malard, Golestan, Nasimshahr
	1.04	Other cities in the province
Chahr Mahal va Bakhtiari	1.01	Shahre Kurd
	0.65	Other cities in the province
Southern Khorasan	1.02	Birjand
	0.58	Other cities in the province
Khorasan Razavi	1.45	Mashhad
	1.33	Neyshabour
	1.30	Gonabad, Sabzevar, Tarbat Heydarieh
	1.16	Kashmar, Ghouchan, Bajestan, Targhabeh, Shandiz, Ghasem Abad
	0.97	Taybad, Torbat Jam, Khaf, Sarakhs, Dargaz, Bardaskan, Khalil Abad, Fariman, Chenaran, Kalat, Joghtay, Neghab, Bayg, Dowlat Abad, Kadkan, Robat Sang, Rashtkhar, Nokhandan, Chapeshlu, Davarzan, Rivash, Malek Abad, Razavieh, Dorud, Ghadamgah, Kharv, Eshgh Abad, Nashtifan, Salami, Golbahar, Binaloud
	0.82	Other cities in the province
Northern Khorasan	1.02	Bojnourd
	0.65	Esfarayen, Shirvan
	0.63	Other cities in the province

Khouzestan	1.04	Ahvaz, Dezful, Andimeshk, Masjid Soleyman, Izeh
	0.67	Abadan, Khorram Shahr, Shiban, Bandar Mahshahr, Behbahan, Shoushtar, Shoush, Hamidiyeh, Shadegan, Dezab, Safi Abad, Mianroud, Qal'eh Khajeh, Bagh Malek, Qal'eh Tal, Lali
	0.60	Other cities in the province
Zanjan	1.14	Zanjan
	0.80	Other cities in the province
Semnan	1.05	Semnan
	0.81	Shahroud, Damghan, Mahdi Shahr
	0.70	Other cities in the province
Sistan va Baluchestan	1.66	Zahedan new distribution network, Chabahar and Kenarak desalination plant
	1.03	Zabol
	0.50	Zahedan old distribution network, other resources in Chabahar and Kenarak (than the desalination plant)
	0.79	Iran Shahr, Khash, Saravan, Sarbaz, Zehak, Rasak, Nik shahr, Fanuj, Doust Mohammad, Bonjar, Mohammad Abad, Adimi, Negur
	0.70	Other cities in the province
Fars	1.14	Shiraz
	1.05	Marvdasht, Lar, Gerash, Ouz, Khanj
	0.91	Karzin (Fat'h Abad)
	0.81	Kazeroun, Firouz Abad, Abadeh, Jahrom, Daram, Fasa, Nour Abad, Lamard, Ashkenan, Ahl, Mehr
	0.70	Other cities in the province
Qazvin	1.08	Qazvin
	0.82	Takestan, Eghbalieh, Abyek, Mohammadieh, Bidestan, Alvand
	0.70	Other cities in the province
Qom	1.35	Qom
	0.71	Other cities in the province
Kurdistan	1.11	Sanandaj
	0.87	Baneh, Saghez, Gharveh, Marivan
	0.73	Other cities in the province
Kerman	1.16	Kerman, Rafsanjan
	1.08	Sirjan
	1.00	Baft
	0.77	Bam, Jiroft, Bahraman, Zarand, Mahan, Shahre Babak, Bardsir, Rabor, Bezenjan, Dehaj, Golbaf, Bagheyn, Chatroud, Faryab, Golzar, Negar, Anbar Abad, Mardehak
	0.70	Other cities in the province
Kermanshah	1.09	Kermanshah
	0.76	Other cities in the province
Kohgiluyeh and Boyer-Ahmad	0.98	Yasooj
	0.72	Margoon, Dogonbadan, Dehdasht, Charam, Basht, Sisakht, Likak
	0.60	Kohgiluyeh and Boyer-Ahmad
Golestan	1.06	Gorgan
	0.75	Gonbad, Bandar Turkmen, Minoo Dasht, Ali Abad, Fazel Abad, Kord Kooy, Sarkhon Kalateh, Galikesh, Anbar Alum, Agh Ghola, Bandar Gaz, Kalaleh, Azad Shahr, Khan Bebin, Ramian, Daland, Nokadeh
	0.70	Other cities in the province
Gilan	1.06	Rasht
	0.84	Bandar Anzali, Astara, Lahijan, Lengeroud, Roudsar, Fouman, Some'eh Sara, Astaneh Ashrafieh
	0.71	Other cities in the province
Lorestan	1.08	Khorram Abad
	0.83	Borujerd, Ali Goudarz, Dorud, Nour Abad, Kouhdasht
	0.70	Other cities in the province
Mazandaran	1.16	Babol
	1.08	Sari
	0.86	Amol, Gha'emshahr
	0.72	Ramsar, Chalous, Babolsar, Tonekabon, Mahmoud Abad, Noshahr, Fereidounkenar, Kelar Dasht, Marzan Abad, Rineh, Gazanak, Amir Kola, Gatab, Behshahr, Khalil Shahr, Salman Shahr, Abbas Abad, Kelar Abad, Nashtaroud, Khorram Abad, Ketalem and Sadat Shahr, Alasht, Pol Sefid,

		Zir Ab, Shirgah, Baladeh, Chamestan, Nour
	0.70	Other cities in the province
Markazi	1.20	Arak
	1.13	Mahallat
	0.98	Ashtian
	0.75	Saveh, Nobaran, Delijan, Tafresh, Khomein, Khandab, Sanjan, Rahroud, Ghourchi Bashi, Naragh, Komijan, Astaneh, Shazand, Hendoudur, Toureh
	0.70	Other cities in the province
Hormozgan	1.31	Bandar Abbas
	1.18	Gheshm
	1.05	Mianab, Bandar Lengeh, Bandar Kong
	0.91	Other cities in the province
Hamedan	1.17	Hamedan
	0.88	Malayer, Nahavand, Asad Abad
	0.74	Touysarkan, Maryanaj, Kabootar Ahang, Bahar, Razan, Sarkan, Azandarian, Jokar, Samen, Zanganeh, Firoozan, Barzul, Kian, Ghahavand, Famenin, Jouraghan, Gol Tappeh, Saleh Abad, Damagh, Farasfaj, Gharveh-e Darjazin
	0.70	Other cities in the province
Yazd	1.31	Yazd, Hamidieh, Shahedieh
	1.22	Ardakan, Meybod
	0.94	Tabas, Taft, Behabad, Bafq, Mahriz, Zaraj, Ashkezar
	0.78	Other cities in the province

Source: NWWEC

It is well recognized by the government to coverage the water tariff to actual delivery costs to maintain sustainability of water supply businesses in the long run. The First National Conference on Water Economy during the period of July 26-27 in 2016, one of the main themes was the need to raise water tariff as a major policy agenda. Similarly, the mass-media also are pro-active in addressing water tariff issues in terms of water conservation.

Tariff revisions require approvals from the parliament and High Council of Economy. As shown in the First National Conference on Water Economy, the need for tariff increases to maintain financial sustainability of WWCs. Tariff revisions were incorporated in the Fifth Five Year National Development Plan (target year:2011-2016) with 20% annual increase but often affected by political circumstances and was only realized in 2010, 2013 and 2015.

Progressive Tariff Structure

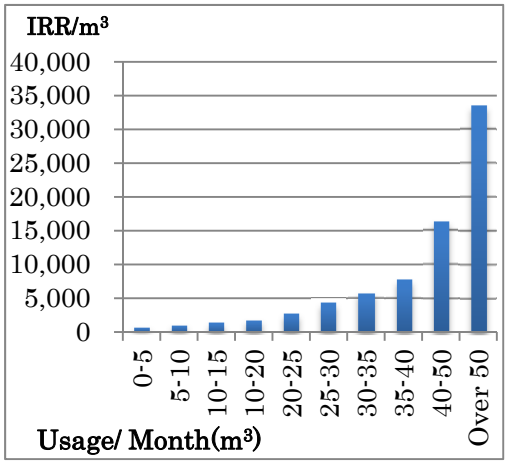
A tariff system that reflects the scarcity of water can send a stronger message than any water-saving campaign to the consumer. The higher the price of water is the greater would be the impact on changing the behavior of wasteful use. However, this has to be balanced against the duty of the government to provide the basic needs for its people, in particular for the socially vulnerable and the lower income groups. For this reason, there is a limit to the extent that the tariff can be raised. Volumetric billing and progressive tariff structure would both be needed to achieve this balance. Iran

has already achieved 100% installation of consumer meters nation-wide despite some issues related to meter accuracy. It also has a nationally standardized progressive tariff structure. The following two figures (Figure 4-3-2 and Figure 4-3-3) compare the marginal tariffs per volume of Iran and Tokyo[25]. It is difficult to compare the progressivity of the water tariff structures of two cities with differing income levels. Tokyo has more progressive tariff structure than Iran at the median consumption level of around 20-30 m^3 per month, and its marginal charge for 5 m^3 or less is zero. The consumption bracket of 5-10 m^3 is used as the reference point for comparison. The variable charge per m^3 at the 25-30 m^3 consumption bracket is 2.3 times that of 5-10 m^3, and increases to 6.3 times at 40-50 m^3 , and 31 times at 50 m^3 or more in Iran. Tariff increase for over 50 m^3 is very high. In Tokyo, the variable charge is 22 JPY／m^3 for 5-10 m^3; and is up by 7.4 times at 20-30 m^3, 9.2 times at 30t50 m^3, 9.7 times at 50-100 m^3. In Tokyo progressivity continues to 1,000 m^3. For the consumption above 1,000 m^3 the marginal charge is 18 times.

In the case of a 5-person household, the consumption of the 50 m^3 per month is equal to 330 lpcd, slightly above standard consumption. There is sufficient water-saving incentive generated by the tariff system in Iran. However, it is also possible to have additional brackets above 50 m^3 as used in Tokyo.

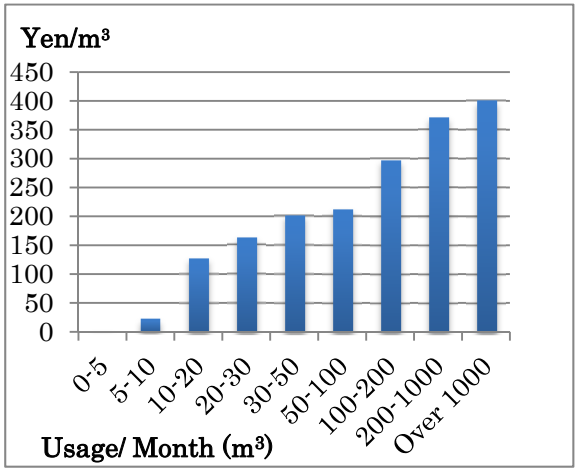
In terms of fixed monthly fees, Iran's charge is 12,000 IRR whereas Tokyo's is 860 JPY. The ratio between fixed fee and volumetric charge at the monthly volume of 20 m^3 is 10.8 in Iran and 5.3 in Tokyo. The ratio in Iran has room for moderation to ease the financial burden for the lower income groups. It is necessary to have more data on consumer income distribution and behaviors for further consideration.

[25] According to economic theory, consumption decision is dictated by marginal cost, i.e. variable tariff per additional 1m^3 consumption of water and not the average tariff.



Source：NWWEC

Figure 4-3-2 Variable Charge of Water Consumption According to Consumption Volume in Iran



Source：Water Section of Municipality of Tokyo

Figure 4-3-3 Variable Charge of Water Consumption According to Consumption Volume in Tokyo

Financial State

Although each provincial WWC is an independent organization with independent financial and accounting system, on average only around 20% of their operational cost is covered by water charges. Due to low water tariff, they are operating in the red. Nevertheless, during dire fiscal difficulties faced by the central government in 2000s, the government introduced a new quasi-tax, “government reimbursement” on the sales of water with an eye on rich cash inflows. Approximately 30% of the sales are taken under this government reimbursement. In 2014, the rate was reduced to 0.3%. For an overall deficits of the water supply operations, subsidies from the national government under the “Contribution to National Development Funds” as well as consumer deposits as “Service Connection Fees” are used to cover the deficits.

As seen in Table 4-3-9, all the companies surveyed are operating in deficits. The operating costs to sales ratios are 150% for Tehran Province, 183% for Isfahan Province, 187% for Zanjan Province, 148% for Mashhad City, and 287% for Khansar City. Mashhad City has the highest coverage of operating costs by sales, followed by Tehran Province, Isfahan Province, Zanjan Province, and Khansar City, indicating an economy of scale in operation.

On overall financial performance, the current loss to sales ratios[26] are -104% for Tehran Province, -149% for Zanjan Province, -81% for Mashhad City,-351% for Khansar City and -133% for Isfahan Province, indicating large deficits. Larger cities show better financial performance in general. Tehran Province, Zanjan Province and Isfahan Province provided information on balance sheets. Since water supply is cash based business, in general the current ratio shows good performance: 80% for Tehran Province, 145% for Zanjan Province and 128% for Isfahan Province. Zanjan Province and Isfahan Province's liquidity is particularly good. Total asset to sales ratio is quite high in general: 2,144% for Tehran, 2,204% for Zanjan Province and 3023% for Isfahan Province. The asset value is more than 20 times sales, indicating low turnover of investment. Retained loss to sales ratios is also high: 3.17 year worth for Tehran Province, 7.34 year worth for Zanjan Province and 6.87 year worth for Isfahan Province. The central government provides lending or contributions from the National Development Fund every year. In 2014, Tehran Province received 1.46 trillion IRR (5.3 billion JPY) covering 30% of the 5.3 trillion (19.4 billion JPY). In the case of Zanjan Province, the contribution from the central government was 0.33 trillion IRR (1.2billion JPY) which exceeded the loss of 0.25 trillion IRR (0.85 billion JPY). It is evident from the balance sheet analysis that lending is the key to offsetting the deficit operations.

Table 4-3-9 Financial Indicators of 4 Water and Wastewater Companies (2014)

		Tehran Province	Zanjan Province	Mashhad City	Khransar City	Isfahan Province
1	Operating Cost to Sales Ratio	150%	187%	148%	287%	183%
2	Current Loss to Sales Ratio	-105%	-148%	-81%	-349%	-133%
3	Current Ratio	80%	145%	-	-	128%
4	Total Asset to Sales Ratio	2144%	2204%	-	-	3023%
5	Retained Loss to Sales Ratio	-317%	-734%	-	-	-687%

Source: Financial Statement from WWCs, 2015/JICA Survey Team

Private Sector Participation, including BOT

Water supply is a public service that should be available to all regardless of income. Therefore the distribution of water is maintained as a public service and a local monopoly. On the other hand, water production can be open to private sector participation. The Iranian Government is promoting

[26] For the reference of detailed financial data and analysis, see 5-2-2 for TPWWC, 5-3-2 for ZPWWC, 5-4-2 for IPWWC, 5-5-2 for KWWC and 5-6-2 for MWWC.

private sector participation in Build Own Operation (BOO) and Build Operation Transfer (BOT) schemes as a means to reduce public sector expenditures. Due to dwindling water resources, the private sector is also strongly encouraged in participating in desalination projects because of its technical capability. There are several desalination plants already in operation along the coastal areas. The overall desalination capacity of Iran is relatively small at approximately 300 MLD, with an average capacity of 5 MLD. The largest desalination plants are now under construction at SAKO with 1,000 MLD and at Charbahar with 760 MLD. They are for industrial use and not for urban water supply.

4-3-4 Existing Training Centers

During the study period, two existing training centers, “Professional Training Center (PTC), Shahid Beheshti University” in Tehran and “Isfahan Higher Education and Research Institute (IHEARI)” were visited by survey team.

(1) Professional Training Center (PTC), Shahid Beheshti University

General

PTC was established under jurisdiction of MOE in 1969 and it was absorbed and merged with private university (Shahid Beheshti University) in 2014. There are many kinds of private training centers which are part of private university. IHEARI was also established by MOE and still under control of it as governmental training center.

PTC has seven branch facilities in Iran as listed below and the PTC in Tehran is a center of these 7 branches located in (1) Hormoz City, (2) Kerman City, (3) Khoramabad City, (4) Arak City, (5) Semnan City, (6) Zanjan City and (7) Mashhad City.

PTC introduced Integrated Training Management System which enables integrated management of training courses, training materials and system management. PTC has developed a network with overseas organizations and companies and has signed number of MOU with many agencies.

The PTC facilities exist in extensive land space (about 50 ha) and are holding 70 classrooms, 200 workshops/laboratories, restaurants and dormitories which have 680 beds.

The operational costs of the PTC are allocated by the university and the revenue of the PTC is tuition fee of training. Collected tuition fee is entered into university account. Direct costs such as salaries of trainers, operation and maintenance costs of the facilities are covered by the tuition fee. Tuition is varied by respective course, about 10 USDper hour per person in average. 50 USD/day for meal and dormitory will be charged separately.

Training Curriculum

PTC develops the training curriculum and textbooks based on the analysis of the needs of the industries with considering Capacity Development and it also asses the training courses. The training courses are implemented in the various fields such as: Water and Environmental Engineering, Power and Electrical Engineering, Power Generation Engineering, Oil, Gas, Refinery Engineering, Management, Economy, Law, and Insurance. To cover these various fields, there are more than 6,000 training courses provided.

Regarding NRW reduction, following training courses are provided and duration of training course is usually for two weeks.

- NRW management
- Reduction of UFW
- Economical assessment of NRW project
- Water balancing and night flow
- Innovation water distribution networks
- Leakage management
- Automatic valves in water system
- DMA design and pressure management
- Water demand management

Training courses listed above include following syllabus.

- Terminology （UFW, NRW, ILI, ELL, ALI, Real and Apparent Loss）
- Water balance table
- Pressure management
- Speed and asset management
- Water theft
- Water meters, accounting errors

- DMA establishment, night flow
- Burst and leakage management strategy
- Network modeling
- Service connection
- Economical/cultural aspects
- Successful case studies

Planned training courses are announced on the website of the PTC and direct applications can be made from each WWC. Some of the courses may not be held with few applicants. There are 2,000 training courses regarding water sector in a year (some of the courses are multiply held in a year) and 20 courses of them are NRW-related.

The PTC recognized following points to improve its training capacity.

- Necessity of practical training site/facility
- Economic analysis of NRW reduction
- Case study of good practice and establishment of pilot area for training

Attendants of training, trainee

Most of trainees are from governmental companies and these companies bear their tuition fees. In water supply sector, most of trainees are from WWCs. There are also participants from some private consulting firms. Of the annual 20,000 participants, about 7,000 people per year have been taking the training of water supply sector.

Trainers

There are 41 full-time base trainer (called academy staff) and approximately 900 part time based trainers those who are from other universities or private companies. There are about 30 trainers regarding water and environmental sectors. All trainers should have carrier of actual work/business of the field concerned.

(2) Isfahan Higher Education and Research Institute (IHEARI)

General

IHEARI is a governmental training center established in 1970 by MOE which covers field of Water and Wastewater, Water Environment, Power Generation and Management. There are six similar

training centers, including IHEARI in Iran (Isfahan, Tehran, Azerbaijane Sharghi, Kemanshah, Fars, and Khorasane Razavi). IHEARI covers Isfahan Province and neighboring three provinces (Chahar Mahall and Bakhitari, Yazd, and Kerman). These six training centers cover all over Iran.

There is no relation to the PTC mentioned above: PTC belongs to private university and IHEARI is directly under the jurisdiction of the MOE.

Private training center such as the PTC mainly provide theoretical classroom training. On the other hand, IHEARI provides more practical OJT. IHEARI is partnered with University of Applied Science and Technology.

IHEARI is located in suburb of Isfahan City, having following laboratories and workshop.

- Water quality analysis laboratory (11 quality parameters including BOD、COD、pH、EC, etc. Equipment was provided by OISCA)
- Microbiology laboratory (total coliform, fecal coliform, etc)
- Water quality analysis laboratory (atomic absorption spectrometer)
- Civil engineering (concrete)
- Piping/Plumbing workshop (piping for AC and PE, saddle installation, other materials. This workshop was established referring to workshop in Japan)
- Soil engineering
- Pump Workshop

Tuition fee of the training is 200,000 IRR/hour (about 700 JPY/hour) per person. Minimum number of trainee for each course is 12 trainees. The tuition fee mentioned above will be revised every year based on inflation ratio (10 to 15%) and the fee is decided by MOE. Additional costs for dormitory will also be required. These fees are for domestic training and there is different fee system for overseas training. About 80 % of operation costs of IHEARI is covered by these tuition fees and remaining 20％ is subsidized by MOE.

IHEARI has a plan to improve and expand its facilities for plumbing workshop. Not only indoor training but also training on actual pipeline in the field will be required. It has a plan to conduct training on actual water supply pipeline in Isfahan City.

Missions of the IHAERI

Purposes of establishment of the IHEARI are as follows.

- Implementation of professional and technical training course
- Holding workshops and seminars
- Implementation of research and publishing the results
- Having university like program by accepting university students

Training curriculum

Ordinary training courses related to water supply and wastewater are about 500 courses and these coursed are programmed by MOE. When the courses were implemented, about 10 to 20 % of training contents will be prepared by IHEARI, however, basic syllabus, curriculum, classes are decided by MOE and the basis cannot be modified by IHEARI. There are also special training courses especially for activities at workshops or seminars.

There are two kinds of training courses, 24 hour course (for four days), and 36 hour course (for six days). Respective courses are the combination of theoretical study and practical activities (some courses are only for the theoretical studies) by different trainees for the study and practical activities.

Trainees

Four to five training courses regarding NRW reduction are held in every year and most of attendants are from WWCs including some attendants from private sectors.

Trainers

Trainers for NRW reduction course are usually invited from other universities or IHEARI in-house trainer, or also from IPWWC. The trainers should have practical working experiences as staff of NWWEC or other WWCs.

MOE has comprehensive and effective training evaluation system. The evaluation system consists of Pre-training evaluation, Post-training evaluation, Post six-months training evaluation, and Post three year training evaluation. This kind of evaluation system is only implemented by MOE and other private training centers do not have these evaluation system.

The facilities in IHEARI may be used for the trainings of the project, when JICA implements the technical assistance project

4-4 Plans and Policies

4-4-1 Policy Issues

The most serious challenge in the water supply sector in Iran is the depletion of water resources, exacerbated by the decrease in the rainfall in recent years due to the climate change and the increase in demand for irrigation and by the growth in urban population. Expanding the water resources by reducing NRW in the water distribution systems has been established as a policy in the water supply sector, in addition to developing new water resources.

Desalination of seawater and construction of water canals from lakes and other water reservoirs are among the simple ways to develop new water resources. However, for the country where a large proportion of its people live inland, this approach presents huge obstacles such as the need to build extensive water transmission networks and finding a way to reduce water losses in the system. Therefore, treated sewage is beginning to be recognized as a potential water resource in Iran. Treated sewage is used as greywater in Japan. There would be high demand for such water for irrigation, industries and afforestation in Tehran and other urban areas.

The Government of Iran has recognized NRW reduction as one of the national goals and has been successful in collecting the information on NRW and monitoring the achievement in NRW reduction at the national level. The government's effort to reduce NRW has proven successful so far. However, the target for the annual national average NRW set in the Fifth Five Year National Development Plan (target year: 2011-2016) is too ambitious, and a more achievable target of 3% in five years is set in the draft Sixth Five Year National Development Plan (target year: 2016-2021), which has been submitted to the Iranian Assembly for discussion.

4-4-2 UN Millennium Development Goals

The United Nations adopted the Millennium Development Goals (MDGs) at the Millennium Summit held in 2000. Numerical targets to be achieved by 2015 were set for eight development

goals to eradicate extreme poverty and hunger[27]. The MDG in the area of water and sanitation is as follows:

Goal 7: To ensure environmental sustainability. Target 7-A: To halve the proportion of the universal population without sustainable access to clean and safe drinking water and basic sanitation by 2015.

The achievements made in the area of drinking water and sanitation in Iran are shown in Table 4-4-1. Significant improvements have been made particularly in the sanitation area and targeted goals have been achieved for both drinking water and sanitation facilities.

Table 4-4-1 Achievement Made Under MDGs for Water and Sanitation

Item		Progress (%)		MDG Achievement
		Urban		
		1990	2015	
Access to the safe drinking water	Urban	99	98	Achieved
	Suburban	84	92	
	Whole	92	96	
Access to the basic sanitation facilities	Urban	78	93	Achieved
	Suburban	62	82	
	Whole	71	90	

Source: UNICEF Statistics by Topic Water and Sanitation, 2015/UNICEF (http://data.unicef.org/overview/water-sanitation-hygiene-data.html)

Sustainable Development Goals (SDGs) were established based on the MDGs and there is continued effort in the area of water and sanitation to meet targets established under Goal 6 for years beyond 2015 (Table 4-4-2).

[27] Millennium Development Goals, United Nations, 2000 (http://www.un.org/millenniumgoals/)

Table 4-4-2 Sustainable Development Goals (SDGs) Related to Water and Sanitation Sector

6	Ensure availability and sustainable management of water and sanitation for all
6.1	By 2030, achieve universal and equitable access to safe and affordable drinking water for all.
6.2	By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations.
6.3	By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.
6.4	By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity.
6.5	By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate.
6.6	By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.
6.a	By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies.
6.b	Support and strengthen the participation of local communities in improving water and sanitation management.

Source: Transforming our world: the 2030 Agenda for Sustainable Development, 2015/United Nations

Gholamali Khoshroo, the permanent representative to the United Nations, demonstrated his positive attitude to tackle SDGs in his address to the United Nations General Assembly in 2015. He introduced the National Committee for Sustainable Development in Iran (NCSD) that superseded national ministries and cut across institutions. NCSD has been deeply involved in developing the National Development Policy based on MDGs since its establishment in 1992[28]. The principle of SDGs will be entrenched in the Sixth Five Year National Development Plan (target year: 2016-2021). Furthermore, he mentioned the application of Public-Private-Partnership for the achievement of the SDGs.

4-4-3 The Fifth Five-Year National Development Plan

The Iranian government sets the National Development Plans in a five year cycle. The current development policies are all based on the Fifth Five Year National Development Plan (target year:

[28] News Article “Iran stresses enhanced SDG measures by 2030”, 2015/Islamic Republic News Agency

2011-2016). This Plan explicitly indicated pro-environment policy shift including global warming mitigation measures as well as emphasis on water basin management in fear of national desertification. The Article 140 stipulates the obligations of industrial, cattle-farming and service industries in collection and treatment of wastewater from their operations.

4-4-4 The Sixth Five-Year National Development Plan

Iran prepares the Five Year National Development Plan every five years and is moving towards the Sixth Five Year National Development Plan (2016-2021). Although initially the Sixth Five year National Development Plan was to start on March 21, 2016, there would be a delay of several months as a consequence of legislative election. This plan includes targets for the water and wastewater sector with indicators for water and wastewater services established for NWWEC. Targets established for water supply services are as follows:

- To improve capability to supply clean water up to 1.5 billion m^3 in order to achieve the targeted water supply coverage rate of 99.8%.
- To enhance efficiency of the water distribution network and to reduce NRW rate by 3% in five years.
- To renovate aging facilities and pipelines at a rate of 10% annually.
- According to NWWEC, there should be a shift in the approach from water resources management to water demand management which would put a stronger focus on users.

4-4-5 NWWEC Vision 2021

NWWEC developed the “NWWEC Vision 2021” that defines its mission and strategies for the period up to 2021.

[Mission of NWWEC as described in the NWWEC Vision 2021]

- To implement public services in the area of water and wastewater sector that falls under the responsibility of MOE
- To utilize resources and facilities owned by its subsidiary organizations, based on the policies of MOE to improve operational efficiency and productivity
- To develop programs for water and wastewater services under the leadership and supervision of MOE

[Strategies as described in the NWWEC Vision 2021]

- To develop water supply and wastewater programs for realizing appropriate supply of drinking water and treatment of wastewater and to contribute to improvement in public health
- To develop the most appropriate water consumption model for the country as well as to enhance its own management capability for balancing water resource demand and supply and for managing the public's water usage behavior
- To act as a leading organization in establishing the balance between population growth, industry development and water resource management
- To implement risk management in designing, constructing and operating related facilities in order to offer proper water and wastewater services in terms of quality, quantity and continuity
- To construct a wastewater treatment service that does not damage water and environmental resources, both qualitatively and quantitatively and a system for using recycled water in order to meet different intended purposes of use, based on the market mechanism
- To promote development of water-related technologies and private companies' participation in international markets by supporting and nurturing private industries
- To promote system integration and generalization at the level of water and wastewater operators, so that appropriate evaluation and monitoring processes and decision-making will be conducted in technical, financial and social terms
- To develop national regulations and standards in order to realize optimization of facilities for the country's water supply and drainage systems
- To promote diversification of the water supply system
- To establish a more effective project management system for facilities construction, taking into account identification of priority projects, economical methods and phased implementation

[Targets described in the NWWEC Vision 2021]

- To achieve 100% coverage of the water supply system in urban and suburban areas
- To achieve 60% coverage of the wastewater treatment system in urban areas and 30% in suburban areas
- To improve industrial wastewater treatment so that the predetermined standards will be achieved
- To improve the water service tariff system in order to achieve a fiscal balance
- To realize more efficient water management using advanced technologies
- To reduce NRW to an acceptable level
- To improve economic efficiency by improving citizens' awareness of water usage

- To promote public-private cooperation in water supply projects
- To achieve higher efficiency in the country’s water input system by separating pipelines for different intended uses or using packaged water
- To shift from water supply management to water demand management

CHAPTER 5 PRESENT STATUS OF THE WATER SUPPLY SECTOR IN THE SURVEY AREA

5-1 Present Status of the Water Supply Sector in the Survey Area

5-1-1 Background Information

Table 5-1-1 shows the background information on the water supply sector in the survey areas.

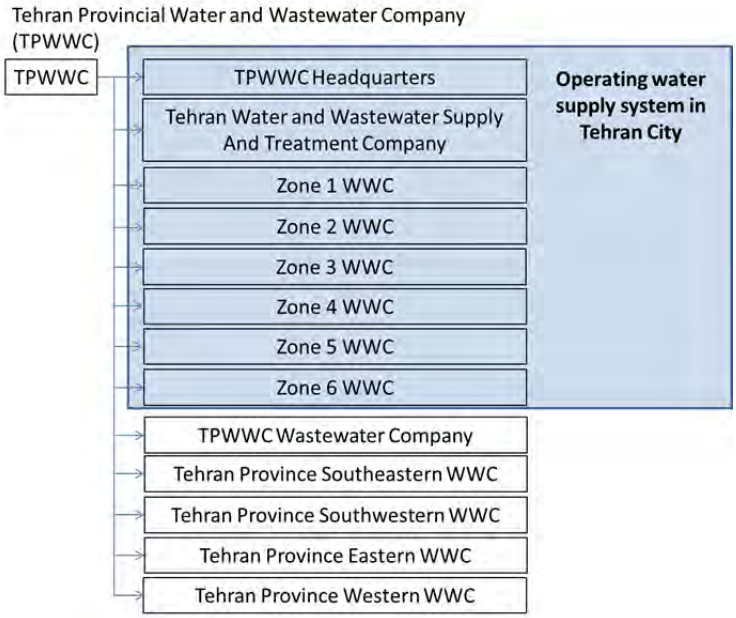
Table 5-1-1 Background Information for the Survey Areas

	Tehran City	Isfahan City	Khansar City	Zanjan City	Mashhad City
WWC	TPWWC	IPWWC	KWWC	ZPWWC	MWWC
Population	Approx. 8.8 million	Approx. 1.98 million	Approx. 23,000	Approx. 0.42 million	Approx. 3 million
Served Population	Approx. 8.8 million	Approx. 1.98 million	Approx. 23,000	Approx. 0.42 million	Approx. 3 million
Service Ratio	100%	100%	100%	100%	100%
WTP	4 WTPs in the city	1 WTP in the city	None (8 reservoirs of 7,400m^3)	1 WTP in the city	3 WTPs
Supplied Volume	29 million m^3/d	0,48 million m^3/d	11,000 m^3/d	96,000 m^3/d	0.6 million m^3/d
Supply Volume per day per capita	345	243	505	229	203
Nos. of Meters	Approx. 1 million	Approx. 0.42 million	Approx. 7,500	Approx. 137,000	Approx. 0.83 million
Nos. of Connections	Approx. 1 million	Approx. 0.42 million	Approx. 7,500	Approx. 138,000	Approx. 0.84 million
Pipe Material	ACP, SP, GIP, PE and recently DIP	ACP, SP, GIP, PE and recently DIP	ACP (58%), PE (24%), GIP (2%) and DIP (16%)	PE (50%), ACP (49%) and DIP (1%)	ACP (60%), PE, PVC, SP and DIP
Pipeline Length	9,120 km	4,040 km	Distribution 122km Transmission 53km	Approx. 1,100 km	4,770 km
SCADA	Introduced	Introduced	Not yet	Not yet	Introduced
DMA	Partially developed Can be monitored with water pressure gauge and PRV	Under the development	Not developed	Under the development	Under the development
GIS	Introduced	Introduced	Not introduced	Introduced (2 assignments)	Introduced
NRW	27%	13.6%	60% (Leakage 44%)	25.2%	20.6%

Meter Reading	Outsourcing 100% (300 to 500 readers from around 10 companies)	Outsourcing 100% (75 readers) 250 water meter reader for the entire Isfahan Province	Outsourcing 100% (2 readers)	Outsourcing to a private company with 22 readers	Outsourcing to 5 private companies with totally 200 readers)
Nos. of the staff for NRW Reduction	2 full-time assignments and 3 of concurrent assignments	Zone 6 with 6 engineers in Isfahan City and 3 engineers in main section	2 engineers with 5-6 in charge for emergency	2 personnel	3 personnel
Leak Repair	Outsourcing 100% (10 companies in Iran, but with doubtful skill)				
Meter Replacement	For free if with error	Broken meters bored by IPWWC	Broken Meters bored by KWWC	Broken Meters bored by ZPWWC	
Duration of the Meter Reading	Every 45 days for normal users Every 30 days for larger consumers	Every 45 days	Every 45 days	Every 45 days for normal users Every 30 days for larger consumers	Every 45 days for domestic users Every 30 days for larger consumers
Meter Reading and Data Input	Hand-held device	Hand-held device	Hand-held device	Tablet	Hand-held device
Water Tariffs	Set forth nationally by NWWEC Even though adjusted according to the income level of each city, average rate is 0.1USD/m^3 (while operational cost is 0.5USD/m^3)				
Monitoring System	SCADA, DMA	Yes	No GIS, No DMA	Under the development	Yes

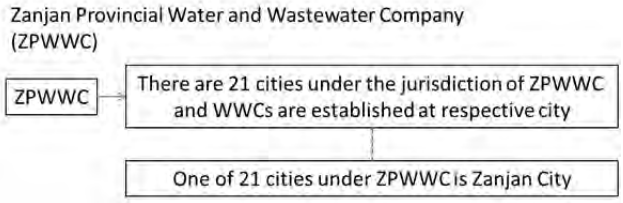
Source: The answers to the questionnaire to NWWEC, 2016/NWWEC

The relationship between each city in the survey area and the WWCs which operate water supply system in each area are shown in detail in Figure 5-1-1, Figure 5-1-2, Figure 5-1-3 and Figure 5-1-4.



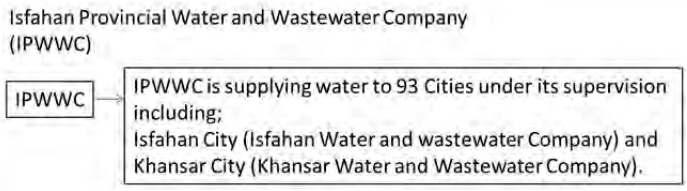
Source: Prepared by the survey team base on the hearing to TPWWC

Figure 5-1-1 Tehran Provincial Water and Wastewater Company



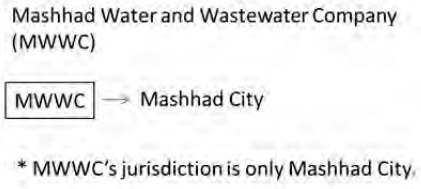
Source: Prepared by the survey team base on the hearing to ZPWWC

Figure 5-1-2 Zanjan Provincial Water and Wastewater Company



Source: Prepared by the survey team base on the hearing to IPWWC

Figure 5-1-3 Isfahan Provincial Water and Wastewater Company



Source: Prepared by the survey team base on the hearing to MWWC

Figure 5-1-4 Mashhad Water and Wastewater Company

5-1-2 Water Supply System

Distribution Mains

Polyethylene, asbestos cement and ductile iron pipes are mainly used in the distribution mains. The installation of polyethylene pipes have only begun recently. Although water leakage from old and degraded pipelines has been an issue for all the WWCs in the survey area, the progress of the systematic replacement of the degraded pipes has been slow. Polyethylene, steel and PVC pipes are used in service connections. Currently PE and PEX pipes are used for splitting deviations. The inspection standards of NWWEC are used in the inspection of the materials approved for the replacement of distribution mains. To pass this inspection, a material has to withstand the water pressure 1.5 times the maximum working pressure of the main continuously for 24 hours.

Distribution mains are installed at the depth of 1.2 m. The base of the pipe sits on a 10 cm layer of compacted soft soil. The pipe is covered with a 30 cm layer of soft soil free of stones. Then, a slightly coarser soil is laid to the thickness of approximately 60 cm and the soil layer is compacted.

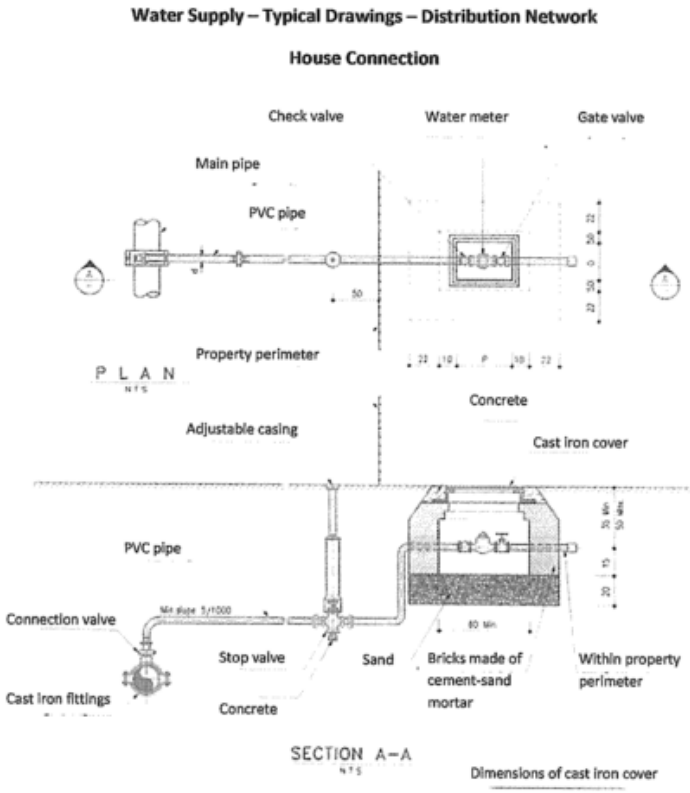
TPWWC, ZPWWC, IPWWC and MWWC are using a GIS system to create and update the pipeline drawings and these drawings are well-developed. While the coordinates and elevations of the facilities including wells, water treatment plants and service reservoirs, types and diameters of the pipes and the data of the valves are displayed on their GIS, detailed information have not been obtained and detailed data have yet to be entered as attributes. The GIS system has not been introduced in the WWCs operating in small cities such as Khansar City (KWWC).

Water Meters

Water meters are property of respective WWC. Water meters are installed at almost all connections. Most of the meters are manufactured domestically under license from an Italian manufacturer and from other European and Asian companies/countries as well. Some meters have domestically manufactured casing and internal operating parts manufactured in China and Turkey. While Class B (R80) water meters are widely used in Iran, Class C (R100 or above) water meters with a higher measurement accuracy have been introduced in recent years.

Almost all the water meters are installed in meter boxes located on the premises of the customers. In order to prevent illegal connections on the pipe between the stop valve and the water meter,

NWWEC stipulates that a stop valve should be installed within 50 cm from the gate to customer's premises on the outside and a water meter should be installed within 50 cm from the gate on the inside (see Figure 5-1-5).



Note: Inside the water-meter pit shown in figure above, water meter, valve, and one-way valve are installed.
Source: The answers to the questionnaire to NWWEC, 2015/ NWWEC

Figure 5-1-5 Standard Design of House Connection

Because there is no rule that stipulates the regular replacement of water meters, they are used until they break down. If a meter is used for a long time, the accuracy of the reading will decrease and the occurrence of malfunctions will increase. Because approximately 5% of the water meters are malfunctioning and the preference is given to the replacement of such malfunctioning meters, the progress of the replacement of old and degraded meters has been slower than it should be. Therefore, the percentage of the meters installed 10 and more years ago has been on the increase. If the inspection of a meter upon request from a customer reveals that the error in the reading is 5% or more or if a meter is found malfunctioning, a WWC will replace such a meter at its own expense.

Reading of Water Meters and Tariff Collection

Customer information is stored in and managed on databases. It is possible to extract data such as the number of malfunctioning meters and customer records in a certain water consumption range by conducting conditional searches. The databases have been utilized in this way for the replacement of malfunctioning meters and discovering illegal connections.

Meter reading is entirely outsourced to private companies. The meters at ordinary households are read every 45 days and at large-scale users every 30 days. A meter reader enters the data into a hand-held device manufactured in Iran and the data is uploaded to a PC at the water tariff center. When the customers are out and the readers cannot read a meter in the premises, they leave the memorandum with their phone number so that the customer will read the meter by themselves (self-reading of the meter by the customers) and write it down in the memorandum and will report the number to the introduced phone number.

According to IPWWC, every meter readers are supposed to record and submit minimum 120 water-meters per day, based on which they would schedule their work time table. In case of inaccessible water-meters, they have to reach for more water-meters to meet the minimum number required i.e. 120 (this figure is specific to Isfahan Province).

A water bill will be given to customer directly by meter reader. While most of the customers pay the bills from an ATM, they may also do so with their mobile phones or through the Internet, etc. In the case of an apartment building with only one water meter, the residents would determine the percentage of the bills for each household based on the floor area or the size of household, and a representative collects and sends the payment to the WWC. Customers are required to pay within 15 days of the receipt of the bills. If a customer fails to pay after a second bill has been delivered, the service to the customer will be terminated.

If the water consumption increases because of a leak within a building, the subscriber’s bill is formulated/calculated in accordance with the volume of consumption for the same period last year. This relief measure would not apply if the leak recurs within two years of the first incidence.

5-1-3 Non-Revenue Water

NRW Ratio

Table 5-1-2 shows the NRW ratios of the cities covered by TPWWC, ZPWWC, IPWWC (IWWC), MWWC and KWWC.

Table 5-1-2 NRW Ratio

Area	NRW Ratio (%)
Tehran City	27.0
Zanjan City	25.2
Isfahan City	13.6
Mashhad City	20.6
Khansar City	60.0

Source: Based on the hearing survey to WWCs

While the NRW ratio of Isfahan City (IWWC) is the lowest among all the cities in Iran, that of Khansar City (KWWC), under the same supervision of IPWWC, is extremely high at 60.0%. Activities to reduce NRW, mostly in water leak detection, have been implemented intensively in large cities including Tehran City, Isfahan City and Mashhad City.

An analysis of NRW conducted by NWWEC estimates the accuracy of the percentage of NRW calculated from the difference between the total system input and the charged metered consumption at approximately 90%. The accuracy does not reach 100% because flow meters have not been installed on some of the water producing wells in smaller cities.

WWCs supply water free of charge to mosques, and other religious facilities. Such unbilled consumption is measured with water meters installed on their premises.

The estimate of unbilled unmetered consumption is relatively accurate because it is the amount of water used mainly for cleaning pipelines that can be roughly estimated from the duration of the cleaning process. Since none of the WWCs has accurate figure of apparent losses, this is based on estimates. Illegal connections, one of the causes of apparent losses, are often found in ordinary houses. While the number of illegal connections in parks and factories is small because it is difficult to discover them in those places, such illegal connections have been a serious problem because the consumption per illegal connection is large (see Table 4-3-3).

The illegal connections include service connections without a water meter, a branch line connected to a service connection before the meter or illegal modification of the meters. Dismantling of the meter is often discovered by meter readers. Illegal connections are also found by inspection of customers with low water consumption.

Illegal modifications such as drilling holes on the rotor blades and truncating impellers inside a water meter have been discovered. The water meters have been disassembled in all these cases. Therefore, sealing a meter with adhesive tape is an effective measure to prevent illegal modification because the tape will be torn when the meter is disassembled. However, because of the lack of budget, a sealed meter would be installed only when a malfunctioning meter is replaced.

The metering inaccuracy is another factor contributing to the apparent losses. All the WWCs in the survey area, excluding IPWWC, estimate the metering inaccuracy in their respective service areas from the number of the cases of the meter malfunction and the proportion of the old meters installed 10 and more years ago. IPWWC randomly samples water meters in use.

The major cause of water leakage from polyethylene distribution mains is cracks in the pipes. Water leaks are often found at joints on asbestos cement mains. Cracks on polyethylene joints and pipes are the cause of water leaks from service connections in many cases. Water leaks from heat-fused PVC pipe joints are observed frequently. Tree roots also damage pipes in some cases.

Private companies repair water leaks in mains. The site of a water leak is excavated with an asphalt cutter and a backhoe and the leak is repaired with a coupling. The time required for the repair is generally under an hour. While asbestos cement is no longer used for new pipelines, it may be used for the repair of old asbestos cement pipe. Records are kept of the repair work including the state, cause and amount of water leakage and parts used. Where it is possible to measure the size of the leakage hole, the volume of water-loss is calculated based on the size/dimension of the leakage area (diameter of the hole or gap width), the water network current pressure and estimated time lapse since the occurrence of the leakage.

Water Leak Detection System

A water meter is inspected using a digital sound detector. If abnormal sound is detected, a water leak detector is used to locate the leak. The exact location of the leak is identified by boring at the site and confirming the moisture content in the ground. Once the location of a leak has been identified, the maintenance center will be notified and the leak will be repaired immediately. A similar method is used in Japan and it is considered an appropriate leak detection method in Iran where leaks from service connections are detected frequently.

While the outsourcing of the leak detection and repair to private companies is on the rise, Iran does not have a certification system to ensure technical capability of these private companies. Therefore, there is a concern over the quality of leak detection and repair conducted by private contractors. MWWC has doubts about the technical capacity of leak detection companies because, while they find many leaks near stop valves, they find far fewer on distribution mains.

When leak detection is outsourced, the work has to be monitored and supervised by WWCs staff with sufficient knowledge and expertise. The technical capacity of these staff is not sufficient. It is necessary to provide more staff training.

Equipment for Reducing NRW Owned by WWCs

Table 5-1-3 shows the leak detection equipment owned by the three provincial WWCs, MWWC and KWWC.

Table 5-1-3 List of the Leak Detection Equipment Owned by the WWCs

No.	Province/ City		Leak Detection					Leak Reapair			
			Listening Stick	Geophone	Multi-sensor Correlator	Correlator	GPR	Backhore	Asphalt Cutter	Drainage Pump	GPS
			Number/ Product Country/ Procured Year								
1	TPWWC	Zone 1		4/UK	1/UK	4/UK	2/Canada		4/IR	10/IR	4/UK
		Zone 2		3/UK			3/Canada		3/IR	9/IR	9/UK
		Zone 3					1/Canada		2/IR	3/IR	1/UK
		Zone 4		3/UK		2/UK	2/Canada		3/IR	3/IR	3/UK
		Zone 5		1/UK		3/Uk	1/Canada		3/IR	3/IR	4/UK
		Zone 6		3/UK		2/Uk	2/Canada		3/IR	3/IR	5/UK
		Southeastern		2/Uk		1/UK			6/IR	6/IR	2/UK
		Southwestern							5/IR	5/IR	5/UK
		Eastern		2/UK		2/UK				3/IR	
		Complex & Town							7/IR	5/IR	6/UK
2	ZPWWC		1	1	0	0	0	1			
			Japan/2014	Japan/2014							
3	IPWWC		2	2		2	1				
			Japan/UK	Japan/UK		UK	Canada				
4	MWWC		0	0		0	0	4			
								Maintenance			
5	KWWC		0	0		0	0				

Source: JICA Survey Team, 2016

Each zone office of TPWWC has leak detection equipment. The leak detection teams of ZPWWC and IPWWC also have leak detection equipment. MWWC and KWWC do not have such equipment. Most of the leak detection equipment is manufactured either in Japan or the U.K. TPWWC and IPWWC also own ground penetrating radars (GPRs) manufactured in Canada. The GPRs are utilized in the identification of the locations of underground non-metal pipelines and the detection of illegally connected non-metal pipes.

5-1-4 Promotion of Water Conservation

The WWCs appeal to the general public through TV programs and newspapers ads to save water at high consumption times of year. They also visit schools to teach students the importance of saving water. IPWWC would issue/attach a “high volume consumption warning notice” to the water bills for subscribers who consume more than 1.5 times above the standard consumption model (the household consumption model per unit of domestic subscription permits only 20m^3 of consumption per month (every 30 day)). MWWC distributes water saving valves to large-scale consumers including schools, mosques and factories as a measure to promote water saving. However, MWWC has yet to verify the outcome of this effort. Because of the budgetary limitation, the water saving valves has not been distributed to ordinary households.

5-2 Present Status of the Water Supply Sector in the City of Tehran

5-2-1 Characteristics of the City

Tehran Province, in which the City of Tehran, the capital of Iran is located, occupies an important position in the waterworks network in Iran. TPWWC has more than 60 years of history of operating the waterworks in the province. Tehran Province has an area of 12,981 km^2 (of which 577 km^2 is occupied by Tehran City) that corresponds to 1.2% of the total land area of Iran. The province has a population of 14 million (2015), 20% of the total population of the country, of which 8.7 million live in Tehran City and 92% in urban areas.

Tehran City is surrounded by mountain ranges in the north and the desert in the south. The elevation in the northern mountainous areas is over 1,800 m while that of southern areas is 900 m. The city has been developed mainly in the northern and eastern upper areas and the southern lower area along the desert. Recently, some new residential areas are being developed in the west. The climate in Tehran City is continental with significant temperature difference between summer and winter. To avoid the heat in the summer and to have an access to water resources from the northern mountains, affluent people tend to live in the northern part of the city and the infrastructures in these areas are better developed than that of southern areas near the desert.

The average temperature in the city is around 15 to 18 degrees Celsius. The precipitation in the city is very much affected by the elevation difference with annual precipitation over 400 mm in the north and less than 150 mm in the south. Most of the precipitation is snowfall in the winter, with 1,200 mm recorded at the crest of the northern mountains.[29]

5-2-2 Outline of the Water Supply Sector

(1) Water Sources

Approximately 70% (752,000,000 m^3/year) of the water supplied to Tehran City comes from surface water and 30% (315,000,000 m^3/year) from groundwater sources. There are 560 water wells that supply water to the city.

(2) Water Treatment Plants

[29] Tehran City Official Web Site, Tehran municipality, Public & International Relations Department (http://en.tehran.ir/Default.aspx?tabid=106)

There are four water treatment plants namely, Jalalie WTP (No. 1), Kan WTP (No. 2), Tehran Pars WTP, and No. 5 WTP, in Tehran Province.

(3) Transmission and Distribution Mains

Table 5-2-1 shows the lengths of the mains by zone.

Table 5-2-1 List of Pipe Length and Valves in TPWWC

Item	Unit	Zone						Total
		1	2	3	4	5	6	
Length of Pipeline	Km	1,708	1,806	1,429	1,397	1,117	1,663	9,120
PRV	Nos.	315	78	154	3	37	51	638
Valve	Nos.	16,330	16,773	16,424	60	17,675	21,419	88,681

Source: Questionnaire filled in by TPWWC

The maximum diameter of pipes is 1,200 mm. CIP, CIP, PVC, ACP, PE and GIP pipes are used.

(4) Water Transmission and Distribution Control

TPWWC has established several DMAs in its service area and installed flow meters, hydraulic gauges and pressure reducing valves (PRVs) in each DMA. It is possible to monitor the water transmission and distribution in these DMAs with the introduction of a water pressure monitoring and regulation system. The PRVs installed throughout the service area can be operated centrally from the Central Control Center. This system controls the water pressure in each water distribution zone. Turbidity and pH of the water are monitored at the boundary of each zone.

(5) Measures to Reduce NRW

TPWWC is 1) detecting illegal connections, 2) taking measures to reduce water leaks, and 3) introducing new technologies to reduce NRW. TPWWC intends to 1) further reduce water leaks, 2) upgrade the distribution mains network, 3) introduce a remote-control system, and 4) establish new DMAs to reduce NRW in future. Thus, it intends to acquire not only technical knowledge but also management expertise to reduce NRW.

Each WWC in Tehran City has outsourcing agreements with private companies specialized in water leak detection. These contracts stipulate that TPWWC shall pay fixed fees to the contractors for each water leak detected on a distribution main or service connection. Private companies are also engaged

for the detection of illegally connected pipes and valve casings filled with soil.

WWCs use different fee structures for the water leak detection. For example, TPWWC pays 2.2 million IRR (approximately 8,000 JPY) for each water leak detected on a service connection and 7 million IRR (approximately 25,000 JPY) for distribution main; and MWWC pays 3.2 million IRR (approximately 11,000 JPY) and 16 million IRR (approximately 58,000 JPY) for these same services. These fees do not include the charges for repair. Fee structures stipulated in the outsourcing contracts for other services have not been confirmed.

TPWWC assigns one or two employees per zone to a team specialized in detecting illegal connections. In the other WWCs, the detection of the illegal connections is performed by the employees as one of their duties. The illegal connections are often found at large-scale consumers, including car washes, restaurants, factories and city parks.

TPWWC responds to telephone inquiries from 72 districts in its service area at the Call Center that can be reached by dialing #122. The Center receives 10,000 to 12,000 inquiries every day. Seven, fourteen and seven female telephone operators work between 8:00 to 10:30, 10:30 to 14:30 and 14:30 to 16:00 shifts during the day, and three male telephone operators work between 16:00 to 24:00 and 24:00 to 08:30 shifts during the night. Private companies repair water leaks and replace water meters with parts and materials, in accordance with instructions provided by TPWWC.

The telephone inquiries received at the Call Center are sorted into those concerning 1) water leaks, 2) water stoppage, 3) fees and fee payment methods, and 4) water quality. The information is entered in a SAMABFA system introduced six months ago.

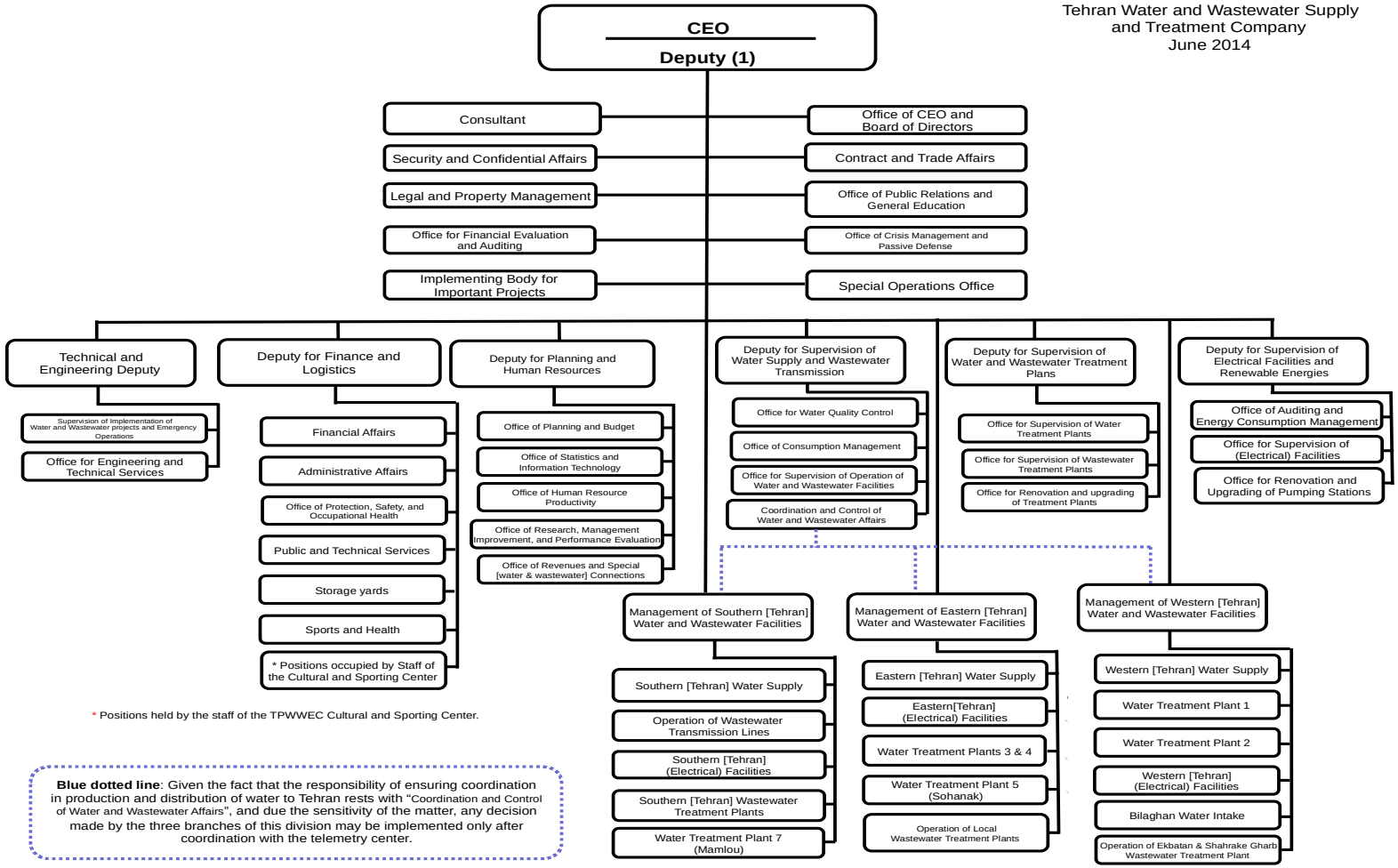
This system displays the number and types of inquiries, and locations of reported incidents on a screen monitor at the Call Center. It also analyzes the response time: from the time the call comes in to the time the problem is resolved. Telephone operators conduct follow up calls to assess customer satisfaction so that improvements can be made in the future. Approximately 75% of the respondents said that they were satisfied with the services.

(6) Organization

TPWWC is composed of eleven local WWCs and Tehran WWC, 12 in total in addition to the headquarter (Figure 5-1-1).

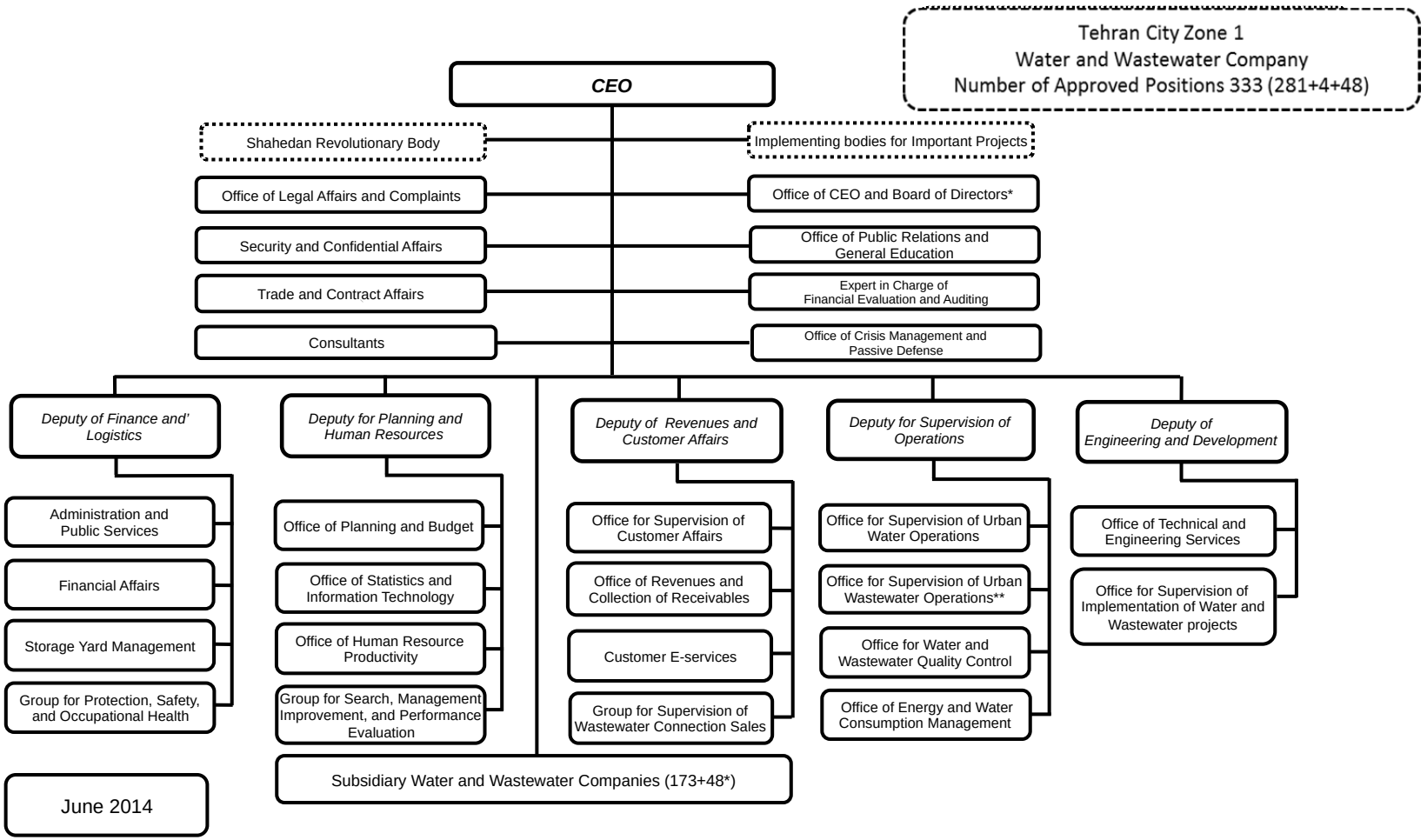
Figure 5-2-1 shows the organizational chart of TPWWC. Deputies are executives of major functional departments such as Finance and Logistics, Planning and Human Resources, Revenue and Customer Affairs, Engineering and Development, Supervision of Operations, as well as acting CEO as required. Basically, Tehran WWC is in charge of the water and sewerage long-term development plan, and manages the facilities related to water purification/production and transmission to local water distribution companies. In sewer operations, it is only in charge of the management of sewage treatment plants. The ten local WWCs are in charge of direct service provision to customers, including water distribution and sewage collection. Zone 1 to 6 companies are in charge of the city of Tehran, while south-western, south-eastern, western, and eastern companies are in charge of the surrounding cities. Figure 5-2-2 shows Tehran Zone 1 Water Supply and Sewerage Systems Company's organizational chart.

As shown in Table 5-2-2, TPWWC has a total workforce of 4,075 in 2014. 38% of the workforce has college or higher education; 10% (397 persons) with graduate degrees; of which 7 are PhDs. Table 5-2-3 shows personnel classification by responsibilities. 3% or 134 persons are in management, which is relatively small.



Source: TPWWC

Figure 5-2-1 Organizational Chart of Tehran Provincial Water and Wastewater Company



* The term "Head of Office" will be used to refer to this position.
** This office is only provided for districts with wastewater facilities in operation or under construction.

Source: TPWWC

Figure 5-2-2 Organizational Chart of the Tehran Zone 1 Water and Wastewater Company

Table 5-2-2 Number of Staff by Educational Background in TPWWC

		Number of Permanent and Temporary Personnel						Number of staff in the repairs department	TOTAL
		PhD	Master's	Bachelor's	Associate's	High School Diploma	Some school education		
1	TPWWC (headquarters)	5	117	159	11	17	8	0	317
2	Tehran Water and Wastewater Supply and Treatment Company	1	73	254	69	168	105	175	845
3	Zone 1 WWC	0	27	106	29	18	5	20	205
4	Zone 2 WWC	0	17	110	28	56	21	50	282
5	Zone 3 WWC	0	30	136	19	58	22	13	278
6	Zone 4 WWC	0	11	85	20	51	44	45	256
7	Zone 5 WWC	0	13	106	33	92	35	18	297
8	Zone 6 WWC	0	12	110	35	70	51	53	331
9	Tehran Wastewater Company	1	26	105	15	18	2	0	167
10	Tehran Province Southeastern WWEC	0	8	67	36	56	20	23	210
11	Tehran Province Southwestern WWEC	0	11	80	37	83	49	91	351
12	Tehran Province Eastern WWEC	0	17	78	13	32	13	16	169
13	Tehran Province Western WWEC (Cities and Residential Complexes West of Tehran City)	0	28	159	33	72	28	47	367
TOTAL		7	390	1555	378	791	403	551	4075

Source: TPWWC

Table 5-2-3 Number of Staff by Responsibility in TPWWC

		TOTAL	Number of Managers	Number of Technicians	Number of Office Managers	W&W Experts and Assistants
1	TPWWC (headquarters)	317	6	0	6	59
2	Tehran Water and Wastewater Supply and Treatment Company	845	35	117	6	931
3	Zone 1 WWC	205	8	6	1	38
4	Zone 2 WWC	282	8	6	1	38
5	Zone 3 WWC	278	8	6	1	38
6	Zone 4 WWC	256	8	6	1	38
7	Zone 5 WWC	297	8	6	1	38
8	Zone 6 WWC	331	11	11	3	68
9	Tehran Wastewater Company	167	6	2	6	48
10	Tehran Province Southeastern WWEC	210	8	4	2	49
11	Tehran Province Southwestern WWEC	351	11	5	2	62
12	Tehran Province Eastern WWEC	169	7	6	2	30
13	Tehran Province Western WWEC (Cities and Residential Complexes West of Tehran City)	367	10	9	4	101
TOTAL		4075	134	184	36	1538

Source: TPWWC

(7) Finance

As shown in Table 5-2-4 there is no substantial difference in the financial performance of TPWWC between 2013 and 2014. While the sales (Table 5-2-4 1.) increased by 20%, and government reimbursement (Table 5-2-4 2.)[30] reduced to 1%, direct operating costs (Table 5-2-4 4.) increased by

[30] "Government Reimbursement" was introduced by the central government to requisition cash from all the water companies due to fiscal difficulties faced by the government. In 2014, the payment was

25%, and management costs (Table 5-2-4 6.) increased by 70%, to register a reduction of overall deficit by 1% (Table 5-2-4 8.).

Table 5-2-4 Profit and Loss Statement for Tehran Provincial Water and Wastewater Company (2014)

		Note	2014	2013 (restated)	Changes between 2014-2013
1.	sales and revenue from services		5,081,485,511,527	4,219,690,077,384	20%
2.	government reimbursement		-9,994,471,030	-1,344,262,649,750	-99%
3.	Net sales 1+2	27	5,071,491,040,497	2,875,427,427,634	76%
4.	Costs of products sold / services provided	28	-7,609,664,761,810	-6,090,548,076,816	25%
5.	Gross profit (loss) 3+4		-2,538,173,721,313	-3,215,120,649,182	-21%
6.	general administrative expenses	29	-2,822,462,208,221	-2,165,291,908,476	30%
7.	Other revenue and operational expenses (net)	30	72,345,477,624	42,481,410,535	70%
	6+7		-2,750,116,730,597	-2,122,810,497,941	30%
8.	Current profit (loss) 5+6+7		-5,288,290,451,910	-5,337,931,147,123	-1%
9.	Financial expenses	31	-6,670,865,274	-6,435,944,069	4%
10.	Other revenue and non-operational expenses (net)	32	-30,285,092,531	-36,978,476,196	-18%
11.	Profit (loss) of normal activities before tax deduction 8+9+10		-5,325,264,409,715	-5,381,345,567,388	-1%
12.	Tax on profits from normal activities		-183,787,735	0	
13.	Profit (loss) of normal activities 11+12		-5,325,430,197,450	-5,381,345,567,388	-1%
14.	Unexpected expenses		0	0	
15.	Tax on unexpected expenses		0	0	
16.	Net profit (loss) 13+14+15		-5,325,430,197,450	-5,381,345,567,388	-1%
17.	Minori Adjustment		25,854,010,999	26,241,966,135	-1%
18.	Net profit (loss) after deduction of minority interest 16+17		-5,299,576,186,451	-5,355,103,601,253	-1%
	Retained earnings (losses)				
16	Net retained earnings (losses)		-5,325,430,197,450	-5,381,345,567,388	-1%
19.	Retained earnings (losses) for beginning of year		-13,664,999,327,726	-10,485,977,897,998	30%
20.	Annual adjustments	33	-51,671,480,806	-145,862,961,113	-65%

reduced to 1%.

21.	Depreciation on revaluation surplus	25	2,351,534,631,087	2,296,515,617,967	2%
22.	Adjusted retained earnings (losses) for beginning of year 19+20+21		-11,365,136,177,445	-8,335,325,241,144	36%
24.	Attributable profit 16+22		-16,690,566,374,895	-13,716,670,808,532	22%
25.	Legal reserve				
26.	Other reserves				
27.	Recommended dividend				
28.	Minor Adjustment		125,390,610,850	99,536,599,850	26%
29.	End-of-year retained earnings (losses) 24+25+26+27+28		-16,565,175,764,045	-13,617,134,208,682	-18%

Source: TPWWC

When the profit and loss statement registers deficits, these need to be added to retained losses as part of equity in the balance sheet, as shown in Table 5-2-5.

Normally private companies will go bankrupt if the situation continues. However, in the Iranian water sector, there is financial support from the Government. The support does not come in the form of subsidy but rather as equity contribution from the National Obligations and Development Funds (Table 5-2-5 23.). The net increase in this item between 2013 and 2014 for Tehran is 1.46 trillion IRR (5.3 billion JPY) to cover around 30% of the total deficit of 5.3 trillion IRR (19.4 billion JPY). In addition, TPWWC received over 10 trillion IRR (36.6 billion JPY) from customer deposits for service connections (Table 5-2-5 27.). Therefore, it has sufficient cash inflow to sustain its operation.

Table 5-2-5 Balance Sheet for Tehran Provincial Water and Wastewater Company (2014)

Unit: IRR

Assets		Note	2014/3/20	3/20/2013 (restated)	Changes 2014 -2013
CURRENT ASSETS					
1.	Cash	5	778,922,495,882	1,440,469,315,171	-46%
2.	Short-term investments				
3.	Trade accounts and notes receivable	6	873,961,081,339	718,284,739,590	22%
4.	Other accounts and notes receivable	7	5,812,901,700,952	4,317,997,407,170	35%
5.	Stock inventory	8	43,478,482,794	42,266,876,690	3%
6.	Orders and prepaid liabilities	9	18,262,516,353	17,517,630,552	4%
7.	TOTAL CURRENT ASSETS		7,527,526,277,320	6,536,535,969,173	15%
NON-CURRENT ASSETS					
8.	Tangible fixed assets	10	96,760,749,280,318	89,391,894,121,190	8%
9.	Non-tangible assets	11	263,487,544,736	210,452,180,416	25%
10.	Long-term investments	12	7,294,601,000	7,294,601,000	0%
11.	Other assets	13	5,926,702,730,582	5,826,656,566,089	2%
12.	TOTAL NON-CURRENT ASSETS		102,958,234,156,636	95,436,297,468,695	8%
13.	TOTAL ASSETS		110,485,760,433,956	101,972,833,437,868	
Liabilities and shareholders' equities		Note	2014/3/20	3/20/2013 (restated)	Changes 2014-2013
CURRENT LIABILITIES					
14.	Trade accounts and notes payable	14	1,095,849,724,496	768,155,996,473	43%
15.	Other accounts and notes payable	15	6,600,913,729,914	5,020,566,107,862	31%
16.	Advances	16	1,388,268,408,700	1,088,745,714,798	28%
17.	Provision for [income] taxes	17	2,177,900,982	9,217,090,635	-76%
18.	Dividends payable		0	0	
19.	Financial liabilities	18	347,716,851,279	319,454,787,336	9%
20.	TOTAL CURRENT LIABILITIES		9,434,926,615,371	7,206,139,697,104	31%
NON-CURRENT LIABILITIES					
21.	Long-term accounts and notes payable	19	529,191,862,241	413,368,934,207	28%
22.	Long-term financial liabilities	18	2,008,758,915,501	2,259,031,712,333	-11%
23.	National obligations and development funds*[1]	20	8,166,562,783,286	6,704,990,242,221	22%
24.	Provision for staff termination benefits	21	591,015,374,006	459,631,668,580	29%
25.	TOTAL NON-CURRENT LIABILITIES		11,295,528,935,034	9,837,022,557,341	15%
26.	TOTAL LIABILITIES		20,730,455,550,405	17,043,162,254,445	22%

GENERAL AND SHAREHOLDERS' EQUITIES					
GENERAL REVENUES					
27.	Connection fees	22	22,576,918,464,274	19,723,224,823,650	14%
28.	Other Incomes	23	23,309,166,326,845	16,011,760,745,094	46%
	SHAREHOLDERS' EQUITIES				
29.	Capital	24	2,132,700,000,000	2,132,700,000,000	0%
30.	Capital from revaluation surplus*[2]	24-1	56,460,633,946,801	58,812,168,577,888	-4%
31.	Registered capital from development projects	24-2	650,061,635,873	650,061,635,873	0%
32.	Unregistered capital from development projects	24-3	979,938,946,852	979,974,271,649	0%
33.	legal reserves		15,247,354	15,247,354	0%
34.	Retained earnings (losses)		-16,565,175,764,045	-13,617,134,208,682	22%
35.	TOTAL GENERAL REVENUES AND SHAREHOLDERS' EQUITIES		89,544,258,803,954	84,692,771,092,826	6%
36.	Minor Adjustment		211,046,079,597	236,900,090,597	-11%
37.	GRAND TOTAL		110,485,760,433,956	101,972,833,437,868	8%

Source: TPWWC

(8) Future Plan

The plan for the water supply sector to 2031 in Tehran Province is described in "The Tehran Province Water Supply Prospects and the Proposed Action Plan for Development of Water and Wastewater Infrastructure (August 2015)."

It provides the population and water demand projections and discusses the required water resource development. The water production per person per day is assumed to decrease from 345 lpcd at present to 306 lpcd by 2031. Various measures are proposed for the improvement of the water treatment plants, renewal of pipelines, prevention of water leaks, regulation of water distribution pressure and reduction in the numbers of illegal connections and malfunctioning meters.

The plan also proposes the promotion of the physical separation for the supply of potable water and water for the other purposes (*e.g.* flushing toilets) in new developments.

5-3 Present Status of the Water Supply Sector in the City of Zanjan

5-3-1 Characteristics of the City

Zanjan City is the capital of Zanjan Province, which is located west of Tehran Province. The Caspian Sea is 120 km north-northeast of the city. Zanjan City has a population of 420,000 in 2015.

The climate in Zanjan City is characterized by the significant temperature difference between summer with the average maximum temperature of 27 degrees Celsius, and winter with the average minimum temperature of -19 degrees Celsius. The highest temperature is 32 degrees Celsius and the lowest temperature -27 degrees Celsius. The average precipitation is 420 mm, most of which comes in winter[31].

5-3-2 Outline of the Water Supply Sector

(1) Water Source

A third of the supplied water to Zanjan City comes from surface water and the rest from groundwater. At present, groundwater is taken from 54 wells (out of a total of 80 wells). The use of water from one of the surface water sources, the reservoir of the Taham Dam, began in 2008. Although the reservoir used to hold 80 million m^3 of water, it now holds only 35 million m^3 because of evaporation and overuse for irrigation. The reservoir is expected to dry up, rendering this water source unusable in the next three years[32]. The planning for the construction of the new Mushkumper Dam as a replacement is in the early stages and the dam will take 10 to 20 years to complete. The design storage capacity and the issues concerning water rights have not been worked out. The water to be retained in this reservoir may contain salt, in which case the water will have to be desalinated.

Only groundwater in the wells in the east of the city can be used for drinking. The wells in the central part of the city have nitrate and nitrogen levels that exceed the allowable limit. In addition, a fall of 40 m in the groundwater level has been confirmed in the field survey[32]. A total of 1050 L/sec. (or 97,720 m^3/day) of water used to be pumped from the 18 wells in the east of the city 30 years ago. At present, it is reduced to 300 L/sec (or 25,920 m^3/day). Every water-producing well is equipped with a flow meter. It is believed that there are 18,000 wells for irrigation in Zanjan City and that 7,000 of them may be illegal.

[31] climate-data.org, 2015
[32] Based on the interviews conducted with the ZPWWC

(2) Water Treatment Plant

There is one water treatment plant with the design capacity of 1,270 L/sec (109,728 m^3/day). Half of the plant has been constructed and is in use, operating only at 300 L/sec (25,920 m^3/day) because of the shortage of surface water. The construction of the plant began in 2001 and its operation started in 2008, at the same time as the operation of the Taham Dam.

(3) Transmission and Distribution Mains

There are seven service reservoirs in the city with a storage capacity of 150,000 m^3. The total length of the distribution pipeline is 1,100 km, half of which were installed 35 to 50 years ago. The PRVs installed on the pipelines are operated manually.

ZPWWC supplies water to 235,000 connections (2014), 137,000 of which are in Zanjan City. 1,600 illegal connections (connections with no water meters) were found last year and 1,100 this year. Water meters were installed on these service connections to make them legal.

ZPWWC employs two workers specialized in GIS. Only ZPWWC has workers specialized in GIS. They are responsible for updating the drawings of the distribution mains network.

(4) Water Transmission and Distribution Control

ZPWWC plans to establish five pressure zones in its service area. It has established three pressure zones. ZPWWC will subdivide each pressure zone into DMAs after completing the remaining zoning. Water pressure and flow rate in the pipelines in the three established pressure zones are monitored. Half of the 1,100 km distribution mains are made of pipes installed over 35 to 50 years ago. 4,000 to 5,000 malfunctioning meters are replaced every year.

(5) Measures to Reduce NRW

ZPWWC is supplying water to 21 cities. The water leak detection team has two staff members with three years working experience. Although they are temporary workers from a private contractor, they are unlikely to leave because they are employed locally. The team mainly works in Zanjan City. When ZPWWC receives a request for water leak detection from another city, it dispatches the team to that city. However, ZPWWC has been unable to provide sufficient technical support in water leak detection because of the limited availability of human resources and equipment.

ZPWWC accepts requests for the repair of water leaks at its Call Center that can be reached by dialing #122. The Center only accepts calls from Qeydar City and Zanjan City. Six male operators respond to inquiries 24 hours a day in two shifts. Until last year, the Center received approximately 20 calls per day reporting water leak incidents in Zanjan City. The calls have been reduced to approximately seven per day. The installation of five additional PRVs is considered to be the reason for this reduction. After the installation of these valves, the maximum water pressure in the water pipes has been reduced from 9 to 3-5 bars.

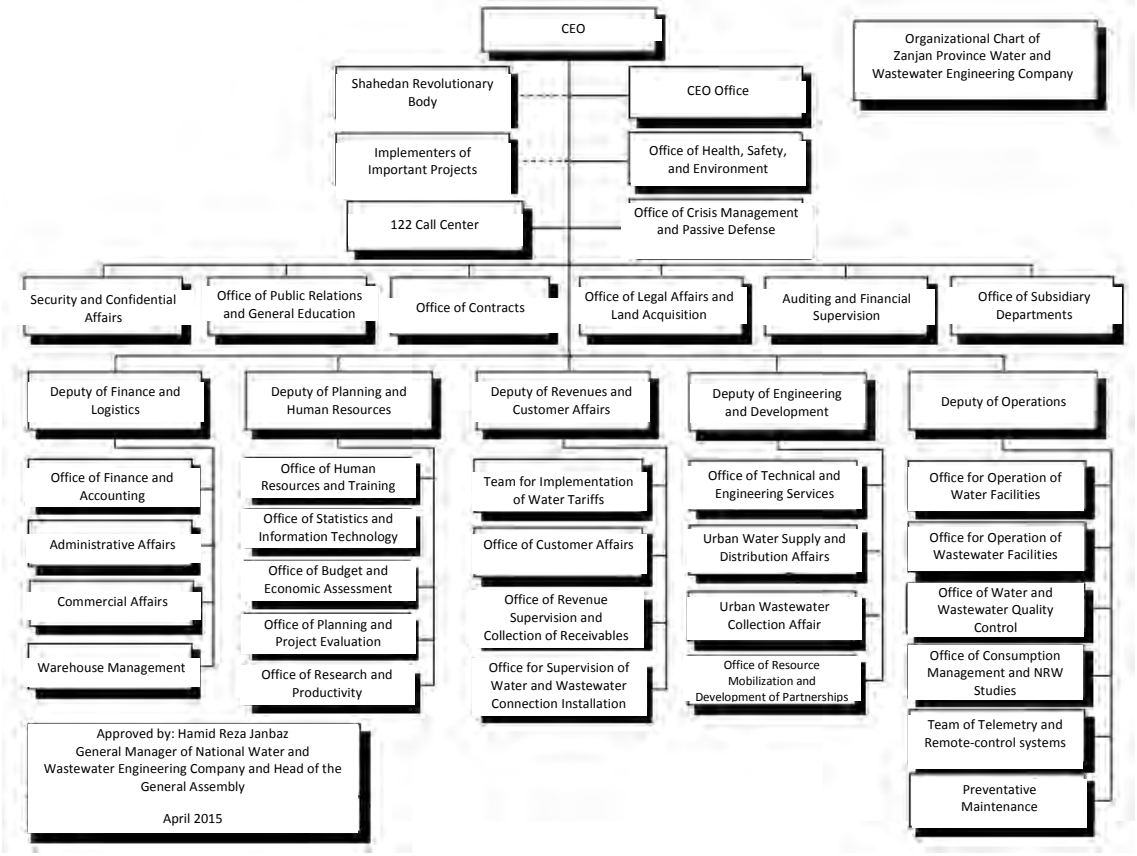
Last year, 2,700 water leaks from service connections and 750 from distribution mains were repaired, in response to calls from residents. The principal cause of these leaks is degradation of the pipes.

While the existence of 6,000 broken meters has been confirmed, there may be many more. ZPWWC repairs 4,000 to 5,000 meters every year, depending on the availability of budget. It replaced approximately 4,500 meters last year.

As the temperature sometimes drops below -20°C in winter in Zanjan Province, approximately 1,500 frozen meter incidents occur every year. TV messages warn residents of the risk and suggest practical measures, such as keeping the meter warm by wrapping the pipe and meter with resin and cloth. Cases of warming the meters with electric heaters at apartments have been confirmed in the field survey.

(6) Organization

Figure 5-3-1 shows the organizational chart of ZPWWC. ZPWWC and TPWWC have similar organizational structures as both are licensed and supervised by NWWEC. Table 5-3-1 provides ZPWWC's work force composition. The total number of staff in 2014 stood at 302, of which 170 or 56% have college or higher education. When compared to 2013, the work force showed a net decline of 14 people as a result of 19 attrition and 5 new hires.



Source: ZPWWC

Figure 5-3-1 Organizational Chart of Zanjan Provincial Water and Wastewater Company

Table 5-3-1 Employee Table of Zanjan Water and Wastewater Company

Education	Production		Support services		Operations		Tal (current year)	Technical and Engineering					2014			Changes			2013
	water	wastewater	Warehousing and logistics	Public services	sales	Administrative		Development	Oversight and Tech & Engineering	Installation (water)	Installation (wastewater)	total	Total personnel	male	female	Laid off	employed	transferred	Total personnel
PhD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Master's degree	4	1	1	0	2	10	18	4	6	0	0	10	28	19	9	0	0	7	21
Bachelor's degree	19	4	2	1	8	61	95	4	3	1	1	9	104	80	24	2	0	0	106
Associate's degree	9	0	4	1	8	14	36	0	2	0	0	2	38	32	6	2	0	(5)	45
Total Higher Education	32	5	7	2	18	85	149	8	11	1	1	21	170	131	39	4	0	2	172
High School Diploma	10	0	3	2	7	9	31	0	1	0	2	3	34	32	2	4	3	(2)	37
Some school education	31	0	0	1	6	3	41	0	0	3	0	3	44	44	0	8	0	0	52
Total primary/secondary education	41	0	3	3	13	12	72	0	1	3	2	6	78	76	2	12	3	(2)	89
Total	73	5	10	5	31	97	221	8	12	4	3	27	248	207	41	16	3	0	261
Service and temporary personnel	8	0	1	21	13	11	54	0	0	0	0	0	54	37	17	3	2	0	55
Grand total	81	5	11	26	44	108	275	8	12	4	3	27	302	244	58	19	5	0	316
Laid off	6	0	1	0	3	4	14	1	0	1	0	2	16	0	0				

Source: The answers to the questionnaire to ZPWWC, 2015/ ZPWWC

Human resource training is highly important. Knowledge sharing with other provinces is implemented in some areas. Exchange programs and visits are undertaken with IPWWC to share information. In addition, ZPWWC is conducting training courses, inviting lecturers from TPWWC once or twice a year, organized by NWWEC. ZPWWC considers that they need more training geared to augmenting skill levels and specific needs of their operations engineers.

(7) Finance

ZPWWC's profit and loss statement (2014) and balance sheets (2014) are shown below (Table 5-3-2, Table 5-3-3). The corporation's financial performance is showing a slight improvement in these two years. Sales (Table 5-3-2 1.) have doubled in 2014 on the back of a 20% increase in net sales and revenues from service (Table 5-3-2 3.) coupled with a 99% reduction in reimbursement to the Government (Table 5-3-2 2.). However, the reduction in gross loss (Table 5-3-2 5.) was limited to 19% as the cost of products and services (Table 5-3-2 4.) rose by 18%. Administrative expenses (Table 5-3-2 6.) increased by 42%. The overall result (Table 5-3-2 9.) was a 2% decrease in overall loss.

Table 5-3-2 Profit and Loss Statement for Zanjan Provincial Water and Wastewater Company (2013, 2014)

Unit: IRR

		Note	2014	2013	Changes between 2014-2013
1.	sales and revenue from services		169,147,963,401	140,756,202,135	20%
2.	government reimbursement		-505,666,330	-55,362,029,415	-99%
3.	Net sales 1+2		168,642,297,071	85,394,172,720	97%
4.	Costs of products sold / services provided		-316,617,664,056	-268,753,750,909	18%
5.	Operating profit (loss) 3+4		-147,975,366,985	-183,359,578,189	-19%
6.	general administrative expenses		-106,603,163,315	-74,951,227,297	42%
7.	Other revenue and operational expenses (net)		1,937,718,709	722,881,552	168%
8.	6+7		-104,665,444,606	-74,228,345,745	41%
9.	Current profit (loss) 5+8		-252,640,811,591	-257,587,923,934	-2%
10.	Financial expenses		-17,399,002	-6,844,727	154%
11.	Other revenue and non-operational expenses (net)		1,870,484,987	4,642,202,122	-60%
12.	10+11		1,853,085,985	4,635,357,395	-60%

13.	Profit (loss) of normal activities before tax deduction 9+12		-250,787,725,606	-252,952,566,539	-1%
14.	Tax on profits from normal activities				
15.	Profit (loss) of normal activities 13+14		-250,787,725,606	-252,952,566,539	-1%
16.	Unexpected expenses				
17.	Tax on unexpected expenses				
18.	Net profit (loss) 15 + 16 +17		-250,787,725,606	-252,952,566,539	-1%
Retained earnings (losses)					
18.	Net retained earnings (losses)		-250,787,725,606	-252,952,566,539	-1%
19.	Retained earnings (losses) for beginning of year		-1,007,977,733,942	-744,632,414,988	35%
20.	Annual adjustments		3,302,741,208	-7,090,011,207	-147%
21.	Adjusted retained earnings (losses) for beginning of year 19+20		-1,004,674,992,734	-751,722,426,195	34%
22.	Attributable profit 18 + 21		-1,255,462,718,340	-1,004,674,992,734	25%
23.	Legal reserve				
24.	Other reserves				
25.	Recommended dividend				
26.	End-of-year retained earnings (losses) 22+23+24+25		-1,255,462,718,340	-1,004,674,992,734	25%

Source: ZPWWC

As with TPWWC, ZPWWC has always incurred losses for its operation (Table 5-3-3). It reports retained losses as a part of its shareholders' equities. The negative cash flow is offset by capital from the Government in the form of investment from the National Obligations and Development Funds (Table 5-3-3 23). The increase in this account for ZPWWC between 2013 and 2014 was 0.33 trillion IRR, exceeding the total loss of 0.25 trillion IRR in cash inflow.

Table 5-3-3 Balance Sheets for Zanjan Provincial Water and Wastewater Company (2013, 2014)

Unit: IRR

Assets		Note	2014/3/20	3/20/2013 (restated)	Changes 2014-2013
CURRENT ASSETS					
1.	Cash	5	1,827,952,302	184,751,583	889%
2.	Short-term investments		0	0	
3.	Trade accounts and notes receivable	6	63,903,991,145	71,604,386,803	-11%
4.	Other accounts and notes receivable	7	79,342,384,273	76,473,538,209	4%
5.	Stock inventory	8	1,107,947,859	1,220,699,348	-9%
6.	Orders and prepaid liabilities	9	23,757,840	424,595,966	-94%
7.	TOTAL CURRENT ASSETS		146,206,033,419	149,907,971,909	-2%
NON-CURRENT ASSETS					
8.	Tangible fixed assets	10	3,529,530,919,147	3,341,885,437,893	6%
9.	Non-tangible assets	11	2,075,260,087	2,026,116,087	2%
10.	Long-term investments	12	0	0	0
11.	Other assets	13	93,100,668,505	24,217,846,496	284%
12.	TOTAL NON-CURRENT ASSETS		95,175,928,592	26,243,962,583	263%
13.	TOTAL ASSETS		3,770,912,881,158	3,518,037,372,385	7%
Liabilities and shareholders' equities		Note	2014/3/20	3/20/2013 (restated)	Changes 2014-2013
CURRENT LIABILITIES					
14.	Trade accounts and notes payable	14	26,868,293,150	14,537,179,154	85%
15.	Other accounts and notes payable	15	74,124,566,737	31,834,833,889	133%
16.	Advances	16	169,515,000	792,370,813	-79%
17.	Provision for [income] taxes	17	0	0	
18.	Dividends payable		0	0	
19.	Financial liabilities	18	0	0	
20.	TOTAL CURRENT LIABILITIES		101,162,374,887	47,164,383,856	114%
NON-CURRENT LIABILITIES					
21.	Long-term accounts and notes payable	19		13622649177	-100%
22.	Long-term financial liabilities	18	0	0	
23.	National obligations and development funds*[1]	20	1,729,484,731,547	1,398,117,731,547	24%
24.	Provision for staff termination benefits	21	30,295,010,608	24,991,495,243	21%

25.	TOTAL NON-CURRENT LIABILITIES		1,759,779,742,155	1,436,731,695,967	22%
26.	TOTAL LIABILITIES		1,860,942,117,042	1,483,896,079,823	25%
GENERAL REVENUES AND SHAREHOLDERS' EQUITIES					
GENERAL REVENUES					
27.	Connection fees	22	489,172,993,472	447,277,323,065	9%
28.	Other Incomes	23	611,491,488,984	562,769,962,231	
	SHAREHOLDERS' EQUITIES				
29.	Capital	24	2,064,769,000,000	2,064,769,000,000	0%
30.	Capital from revaluation surplus*[2]	24-1	0	0	
31.	Registered capital from development projects	24-2	0	0	
32.	Unregistered capital from development projects	24-3	0	0	
33.	legal reserves		0	0	
34.	Retained earnings (losses)		-1,255,462,718,340	-1,004,674,992,734	25%
35.	TOTAL GENERAL REVENUES AND SHAREHOLDERS' EQUITIES		1,909,970,764,116	2,034,141,292,562	-6%
36.	Minor Adjustment				
37.	GRAND TOTAL		3,770,912,881,158	3,518,037,372,385	7%

Note 1 : Government Obligation to Development Funds: lending outstanding from the central government for long term development work

Note 2 : Capital from revaluation surplus: revaluation of assets due to changes in accounting

Source: ZPWWC

Outsourcing

Table 5-3-4 indicates the state of ZPWWC's outsourcing to the private sector. In 2015, roughly 90% of the outsourcing was in meter reading, billing and meter replacement. In 2014, the percentage share of these costs was roughly 60%. This was because ZPWWC had allocated roughly 30% of its annual budget to water distribution networks and repairs and maintenance of sewage treatment plants. Total budget is kept at approximately 9 billion IRR. The percentage of expenses for outsourcing to the private sector is still limited at around 3.0% of the total direct cost of operation.

Table 5-3-4 ZPWWC Outsourcing Budget

Unit: million IRR

	2014	2015
Meter Reading/Billing/Meter Replacement	5,345	8,076
Distribution Network Development	627	0
Maintenance of Network and Treatment Plant	3,416	979
Telecommunication	43	50
Others	38	26
Total	9,469	9,105
Direct Cost of Operation	316,618	
Percentage Share of Outsourcing	3.0%	

Source: ZPWWC

Investment Expenditures

At ZPWWC, the annual investment expenditures in the last five years ranged between 20 billion IRR and 40 billion IRR. Leakage detection accounted for a mere 2% of the investment expenditures.

(8) Future Plan

ZPWWC has a 1-year short-term plan and a 2-year medium-term plan. The “Short-Term Crisis Management Plan,” implemented in 2015 is still on-going in 2016. The plan includes improvement and construction of transmission mains, construction of new wells and zoning in part of Zanjan City. The “Medium-Term Crisis Management Plan,” to be implemented in 2016 and 2017, includes the construction of three new wells, improvement and construction of distribution mains in the old part of the city, construction of a 10,000 m^3 reservoir and installation of a new transmission main to the reservoir. New wells are needed to access more groundwater. These plans are formulated on the assumption that the existing water sources are utilized at their full capacities. However, as the capacities of the existing water sources are decreasing, the plans have to be revised.

In response to the problem of dwindling water stock in the reservoir mentioned above, several scenarios are discussed in the Water Crisis and ZPWWC Water Supply Plan. As a comprehensive measure against the problem, the construction of the Moshampa Dam and the installation of a transmission main from the dam to Zanjan City are proposed. However, the details have yet to be determined.

5-4 Present Status of the Water Supply Sector in the City of Isfahan

5-4-1 Characteristics of the City

Isfahan Province is the cultural capital of Iran. IPWWC is one of the oldest WWCs in Iran, established more than 50 years ago. The percentage of NRW in Isfahan City (13.6%) is the lowest in the country. IPWWC considers that NRW can be reduced by using the latest technologies and seeks financial assistance from Japan after the lifting of the economic sanctions.

Population of Isfahan Province was about 3.29 million in 1975 to 1976 and occupied 7.1 % of total population of Iran. After year 1976, population was once decreased. From 2006 to 2016, population tended to increase again and reached 5.091 million in year 2016.

Isfahan Province is located in the north of Zayandeh Rud River, surrounded by wilderness at an elevation of 1,500 m. It has a desert climate, with an average precipitation of 120 mm per year. The driest season in August and September has no precipitation and most precipitation comes in December to April, with the average of 20 mm per month. July is the hottest month with the average maximum temperature of 28.2 degrees Celsius. The coldest month is January when the average maximum temperature drops to 2.2 degrees Celsius.

5-4-2 Outline of the Water Supply Sector

(1) Water Sources

The reservoir of the Zayandeh-Rood Dam is a source of water for IPWWC. The water in the reservoir is transmitted from the water intake facility to the treatment plant through a 3,000 mm-diameter aqueduct. In addition, IPWWC requires $3m^3$/sec ($259,200m^3$/day) of groundwater supply. Therefore, IPWWC is also operating ten wells.

(2) Water Treatment Plant

IPWWC treats raw water at the Baba Sheikh Ali Water Treatment Plant.

(3) Transmission and Distribution Mains

A network of transmission mains has been installed. The longest transmission main is 200 km. 95 percent of the water can be transmitted by gravity in the network. The remaining 5% is pumped to the destination.

(4) Water Transmission and Distribution Control

The water pressure and flow rates in the water transmission and distribution system can be monitored at the Central Control Center. The zoning of the system is in progress.

(5) Measures to Reduce NRW

IPWWC supervises the water supply to 93 cities. It has 40 workers responsible for NRW reduction. Two water leak detection teams with four members were established in 2014. They are mainly working in Isfahan City. IPWWC dispatches a team to WWCs under its supervision when the WWCs submit a request. However, it has been unable to provide sufficient support to the WWCs because of the shortage of human resources. The water leak detection teams have so far inspected 240 km of distribution mains and detected 221 water leaks with a total leakage of 347 L/sec in 2014 and 2015.

There are 6 zones in Isfahan City. A worker responsible for NRW reduction is assigned to each zone. They repair water leaks 24 hours a day in two shifts.

Water-meters purchased through tender procedures can be gradually delivered to IPWWC during a contract period (usually within 3 to 9 months). Since the water-meters manufacturer will be selected through public bidding, the manufacturer/provider may vary each year. Depending on the manufacturer production capacity, the number of meters delivered to IPWWC varies part by part. Right before stocking in warehouse, water-meters have to undergo a lab test. To save more on the initial time, 10% of the parts are exposed to the quality tests/standards there. If during this initial test (10 percent of the whole single-part delivered) more than 5% of the equipment fail to meet the required standards, then the whole batch/part is rejected and returned to the supplier without testing the remaining parts. Otherwise and in case of less than 5% failure, the testing goes on for every and each part in the package to the end, one by one.

Meter Test Bench

(6) Organization

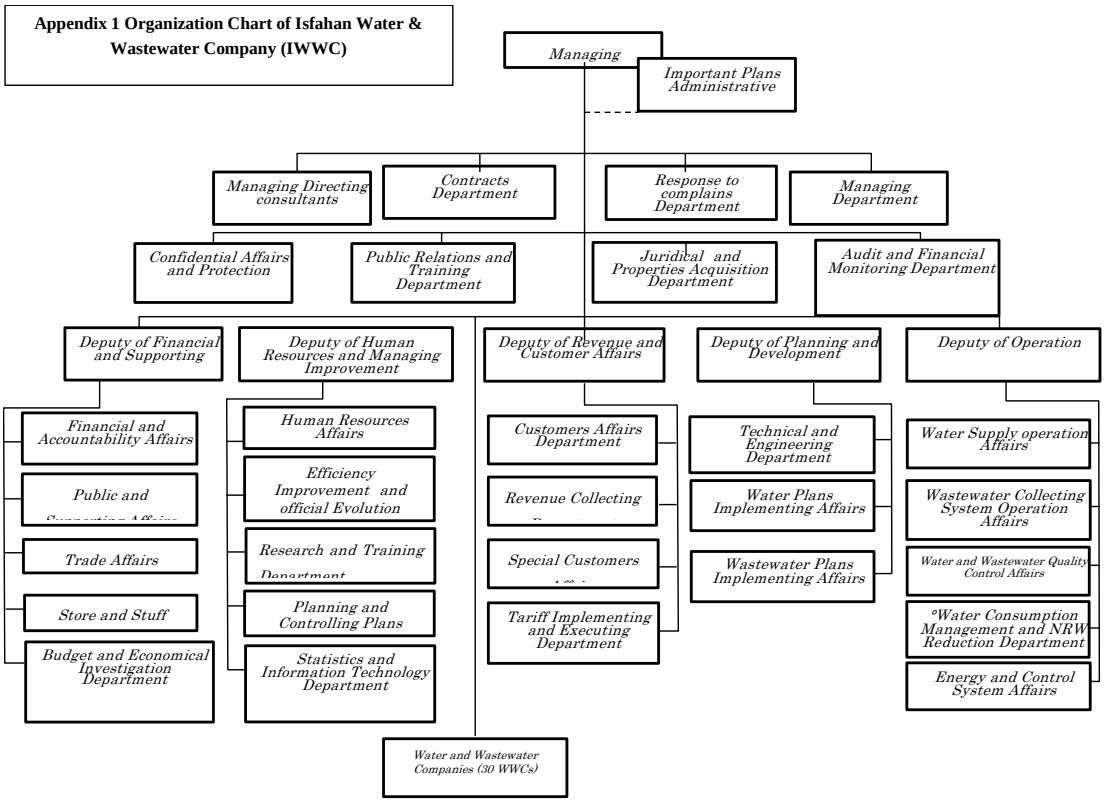
Figure 5-4-1 shows the organizational chart of IPWWC. There are 996 permanent personnel in a total of 3,031 staff. Like other WWCs, the Non-permanent personnel occupy the majority of IPWWC staff as a result of the staff reduction. The Non-permanent staff is composed of 130 outsourced staff, 485 project-based staff and 1,400 contracted workers. (Table 5-4-1)

IPWWC operates water and sewage services to 34 districts and 93 cities in the region, one of which is Khansar City. Its organizational structure is almost identical to that of TPWWC as the two are licensed and supervised by NWWEC.

Table 5-4-1 Organization Composition of Isfahan Provincial Water and Wastewater Company, 2016

Permanent Personnel/ Official	996
Non-Permanent Personnel/ Outsourced	130
Non-Permanent Personnel/ Project-Based	485
Non-Permanent Personnel/ Contracted	1,400
Total	3,011

Source: IPWWC



Source: IPWWC

Figure 5-4-1 Organizational Chart of Isfahan Provincial Water and Wastewater Company

Like other WWCs of the other provinces, IPWWC has a section specializing in NWR. Mr. Saleh, the leader of this section, attended the Japan Training organized by JCCME and has superb problem solving skills. Their Water Pressure Monitoring Station is designed in-house based on the training received in Japan. It is demonstrating high operational performance. Mr. Saleh is also strongly promoting Khansar's Pilot Project that is expected to introduce and deploy Japanese advanced technologies. IPWWC has personnel with high innovative skills and excellent leadership qualities. Having such a counterpart makes a big difference when unexpected events arise after starting an operation. In this regard, Khansar City is the ideal location to conduct the pilot project.

According to IPWWC, while they are fully capable of constructing and operating software such as GIS and Water Gems (hydraulic network models), there is a serious need to further strengthen capacities to reduce NRW through technical assistance.

(7) Finance

IPWWC's profit and loss statement (2015) and balance sheets (2016) are shown in Table 5-4-2 and Table 5-4-3. The company's financial performance is showing an increase in deficits in these two years. Sales (Table 5-4-2 1.) increased by 20.8% but the operating loss (Table 5-4-2 5.) increased by

4.1% due to an increase in costs of products sold and services (Table 5-4-2 4.) by 13.2%. As well as the administrative costs (Table 5-4-2 6.) increased by 19%, the overall deficits (Table 5-4-2 13.) increased by 13.7%. According to IPWWC staff, the budget for NRW reduction is set aside as an independent budget item. For instance, in 2015 IPWWC allocated 5.2 million USD (1.5 million USD from the central government and the balance from its own resources) for NRW reduction budget.

Table 5-4-2 Profit and Loss Statement for Isfahan Provincial Water and Wastewater Company (2015)

Unit: IRR

		Note	2015	2014	Changes between 2014-2013
1.	sales and revenue from services		1,437,434,794,422	1,189,459,547,714	20.8%
2.	government reimbursement		-2,944,721,439	-3,028,563,300	-2.8%
3.	Net sales 1+2		1,434,490,072,983	1,186,430,984,414	20.9%
4.	Costs of products sold / services provided		-2,464,624,101,503	-2,176,293,047,400	13.2%
5.	Operationg profit (loss) 3+4		-1,030,134,028,520	-989,862,062,986	4.1%
6.	general, administrative expenses		-850,148,019,542	-714,464,447,745	19.0%
7.	Other revenue and operational expenses (net)		36,778,801,705	36,871,320,378	-0.3%
8.	6+7		-813,369,217,837	-677,593,127,367	20.0%
9.	Current profit (loss) 5+8		-1,843,503,246,357	-1,667,455,190,353	10.6%
10.	Financial expenses		-1,559,075,341	-8,556,424,978	-81.8%
11.	Other revenue and non-operational expenses (net)		46,013,620,685	93,488,909,897	-50.8%
12.	10+11		44,454,545,344	84,932,484,919	-47.7%
13.	Profit (loss) of normal activities before tax deduction 9+12		-1,799,048,701,013	-1,582,522,705,434	13.7%
Retained earnings (losses)					
13.	Net retained earnings (losses)		-1,799,048,701,013	-1,582,522,705,434	13.7%
14.	Retained earnings (losses) for beginning of year		-8,136,527,841,310	-6,557,643,333,374	24.1%
15.	Annual adjustments		-10,459,945,687	-6,821,748,189	53.3%
16.	Adjusted retained earnings (losses) for beginning of year 14+15		-8,146,987,786,997	-6,564,465,081,563	24.1%
17.	Legal reserve				
18.	Other reserves				

19.	Recommended dividend				
20.	End-of-year retained earnings (losses) 13+16		-9,946,036,488,010	-8,146,987,786,997	22.1%

Source: IPWWC

As with other WWCs, IPWWC has always incurred losses for its operation (Table 5-4-3). It reports retained losses as a part of its shareholders' equities. The negative cash flow is offset by capital from the central government in the form of lending from the National Obligations and Development Funds (Table 5-4-3 23.). The increase in this account for IPWWC between 2015 and 2016 was 0.8 trillion IRR (2.7 billion JPY). In addition, there is connection fee deposit (Table 5-4-3 27.) of 0.6 trillion IRR (2 billion JPY). A total of 1.6 trillion IRR cash inflow almost offsets the total loss of 1.8 trillion IRR (6.1 billion JPY) in cash inflow.

Table 5-4-3 Balance Sheet for Isfahan Provincial Water and Wastewater Company (2016)

Assets		Note	2016/3/10	2015/3/10	Changes 2016-2015
CURRENT ASSETS					
1.	Cash	5	34,185,413,826	36,169,239,074	-5%
2.	Short-term investments		64,601,824,055	144,990,951,898	-55%
3.	Trade accounts and notes receivable	6	348,410,751,357	286,961,714,854	21%
4.	Other accounts and notes receivable	7	924,191,178,447	681,488,611,785	36%
5.	Stock inventory	8	43,714,883,839	42,713,245,121	2%
6.	Orders and prepaid liabilities	9	10,197,249,178	5,795,523,536	76%
7.	TOTAL CURRENT ASSETS		35,400,586,791,968	34,998,100,445,821	1%
NON-CURRENT ASSETS					
8.	Tangible fixed assets	10	35,400,586,791,968	34,998,100,445,821	1%
9.	Non-tangible assets	11	89,085,934,789	86,044,817,939	4%
10.	Long-term investments	12	20,987,042,518	6,433,890,000	226%
11.	Other assets	13	1,018,963,979,287	864,306,072,108	18%
12.	TOTAL NON-CURRENT ASSETS		36,529,623,748,562	35,954,885,225,868	2%
13.	TOTAL ASSETS		37,954,925,049,264	37,153,004,512,136	2%
Liabilities and shareholders' equities		Note	2016/3/10	2015/3/10	Changes 2016-2015
CURRENT LIABILITIES					
14.	Trade accounts and notes payable	14	223,912,631,352	228,827,867,520	-2%
15.	Other accounts and notes payable	15	842,237,176,033	510,101,753,547	65%
16.	Advances	16	100,616,862,983	71,054,208,588	42%
17.	Provision for [income] taxes	17	0	0	
18.	Dividends payable		0	0	
19.	Financial liabilities	18	57,560,910,588	123,705,457,010	-53%
20.	TOTAL CURRENT LIABILITIES		1,224,327,580,956	933,689,286,665	31%
NON-CURRENT LIABILITIES					
21.	Long-term accounts and notes payable	19	270,853,779,717	77,357,106,164	250%
22.	Long-term financial liabilities	18	885,794,230,040	735,792,130,040	20%
23.	National obligations and development funds*[1]	20	4,033,338,658,897	3,223,168,319,352	25%
24.	Provision for staff termination benefits	21	165,993,493,591	153,345,061,560	8%
25.	TOTAL NON-CURRENT LIABILITIES		5,355,980,162,245	4,189,662,617,116	28%
26.	TOTAL LIABILITIES		6,580,307,743,201	5,123,351,903,781	28%

GENERAL REVENUES AND SHAREHOLDERS' EQUITIES					
GENERAL REVENUES					
27.	Connection fees	22	5,894,355,377,211	5,294,251,916,677	11%
28.	Other Incomes	23	3,687,294,298,555	3,157,937,512,885	17%
	SHAREHOLDERS' EQUITIES				
29.	Capital	24	31,491,000,000,000	31,491,000,000,000	0%
30.	Capital from revaluation surplus*[2]	24-1	139,224,900,000	139,224,900,000	0%
31.	Registered capital from development projects	24-2	4,362,476	4,362,476	4,362,476
32.	Other Reserves	24-3	35,851,706,536	35,851,706,536	0%
33.	legal reserves		122,694,928	122,694,928	0%
34.	Retained earnings (losses)		-9,872,873,598,005	-8,117,009,948,167	22%
35.	TOTAL GENERAL REVENUES AND SHAREHOLDERS' EQUITIES		31,374,979,741,701	32,001,383,145,335	-2%
36.	Minor Adjustment		-362,435,638	28,269,463,020	-101%
37.	GRAND TOTAL		37,954,925,049,264	37,153,004,512,136	2%

Note 1 : Government Obligation to Development Funds: lending outstanding from the central government for long term development work

Note 2 : Capital from revaluation surplus: revaluation of assets due to changes in accounting

Source: IPWWC

(8) Management

IPWWC has created comprehensive management information system based on GIS with all the information of network facilities, customer information, and locations of GPS mounted service automobiles, operation status of pumping stations/reservoirs, pressure monitoring stations at 132 locations. All the information can be accessed and displayed on screen in real time or as time series data. The system is already linked with the data centers located at 24 districts. System integration must follow international standards. However, the data transaction system is not yet established with regard to collection and processing of data input from decentralized stations. This operation is not fully established thus there may be some delay in information aggregation leading to some risks of database obsolescence.

(9) Future Plan

While the population and water demand projections for every 10 years to 2031 have been made in the future plan, a facility development plan to meet the projected demands has not been made. At present, water is transmitted and distributed from a treatment plant using water taken from the reservoir of the Zayandeh-Rood Dam. The second treatment plant is being constructed under the Golab Treatment Plant Development Project. The design treatment capacity of the new plant is set at

approximately 864,000 m^3/ day.

The reduction of the water consumption per person per day from the present 153 lpcd to 115 lpcd is proposed in the plan.

5-5 Present Status of the Water Supply Sector in the City of Khansar

5-5-1 Characteristics of the City

Khansar City is located in the mountainous region in the western part of Isfahan Province. It has an area of 950 km^2 and is located at approximately 2,300 m above sea level. There is a mountain range of 3,000m west of the city. There are many steep terrains in the city. There is marked temperature differences in the area: above 30°C in the summer and -8.5°C in winter. Khansar City is well known as a "Garden City" in Iran and the beautiful scenery of the city attracts many tourists. The population in the city of approximately 23,000 residents increases to 80,000 in the summer.

5-5-2 Outline of the Water Supply Sector

(1) Water Sources

The existing water supply system derives all its water from groundwater sources. KWWC is operating 9 water wells. Water is pumped up at the rate of 140 L/sec (or 12,000m^3/day) from these wells. Some of them become springs during the summer when the groundwater level rises.

(2) Water Treatment Plant

Water supply to Khansar City Water Treatment Plant is from Qomroud River originating from Aligoudarz City in Lorestan Province (surface waters).

Now the construction of Khansar City Water Treatment Plant in the emergency phase has been completed with and filtration method. And yet parts of structures and facilities are left half/undone to be completed in the next phase (the treatment plant conventional phase is centrifloc method).

(3) Transmission and Distribution Mains

The river flooded the city some 20 years ago. As the flood washed away houses south of the river, there are areas where the underground water pipelines are not located. The pipeline maps have not been updated regularly. GIS system of the pipe network is under development phase and the pipe drawings are prepared using AutoCad.

There are 7,464 water connections in Khansar City (2014). There are 124 km of the distribution mains and 63 km of transmission mains. More than 60% of these were installed over 30 years ago. The diameters of the distribution mains are between 200 and 320 mm, whilst those of transmission mains are between 100 and 300 mm. The distribution mains consist of asbestos cement (58%), polyethylene (24%), ductile cast iron (16%) and steel pipes (2%).

There are 8 utility reservoirs in the city. Many of them are located to the southwest and southeast because the elevation of the city center is lower than the surrounding area. There is a utility reservoir receiving water from wells north of the city.

(4) Water Transmission and Distribution Control

Khansar City is located in an area with steep slopes and large differences in elevation. Although pressure reducing valves are installed on distribution mains at two locations, there is an area where the water pressure exceeds 9 bars south of the city. Like those already operational in Isfahan, there are 15 online barometer gages pending for installation in Khansar City out of which only 4 are installed. The relevant data is now accessible online in a system with GIS platform.

In cold seasons, due to shortage of water throughput from the city south wells, Miyan'tir well joins the network from a distance of 8.5 kilometers from Be'sat reservoir. If it's needed, water could be pumped from Be'sat reservoir (elevation: 2,184m) to Char'Bagh reservoir (elevation: 2,251m) along 2 kilometers of network pipes.

(5) Measures to Reduce NRW

KWWC has two engineers responsible for NRW reduction. They supervise the replacement of malfunctioning meters and repair of water leaks. Due to water leaks are not detected in a systematic manner because of the shortage of human resources, technical knowledge and equipment, the percentage of NRW in the service area of KWWC is high (60%). The water leak detection team of IPWWC detected underground water leaks at 9 locations in Khansar City.

As mentioned above, Water leaks from mains in Khansar City occur frequently. This is because the water pressure is very high in certain areas, approximately 60% of the 124 km transmission mains consist of pipes installed long time ago and many of them are asbestos cement pipes. The error ratios of water meters are high and they break down frequently because 60% of them have been in use for more than 10 years.

(6) Organization

KWWC belongs to IPWWC. The staff size is 10 regular staff persons and 7 contract workers among who are 5 engineers and 7 clerical staff members. In the case of pipe bursts, all the staff members are engaged in repair regardless of job designations. IPWWC has stationed one NRW expert in KWWC from their own NRW Section and recruited another engineer in March 2016.

(7) Finance

Table 5-5-1 shows the profit loss statement of KWWC. The financial situation is gradually deteriorating from 2012 to 2014. In 2013 and 2014 the net sales (Table 5-5-1 3.) increased by 26% and 53%, while the corresponding service costs (Table 5-5-1 4.) increased only 1% and 25% respectively. However, the administrative costs (Table 5-5-1 6.) increased by 95% and 33% during the same period to exceed the increases in net sales (Table 5-5-1 3.). As a result, the overall deficits (Table 5-5-1 8.) increased by 21% and 23% in each year.

Table 5-5-1 Balance Sheets for Isfahan City Water Supply Sector (2012−2014)

Unit: IRR

		2014	2013	2012	Changes 2014-2013 (%)	Changes 2013-2012 (%)
1.	Sales	4,750,803,344	4,546,673,162	3,651,015,964	4%	25%
2.	Subsidies charged by govt.	-	-1,447,964,945	-1,186,555,580		22%
3.	Net sales 1+2	4,750,803,344	3,098,708,217	2,464,460,384	53%	26%
4.	Cost of products sold	-13,655,695,230	-10,931,579,338	-10,819,903,023	25%	1%
5.	Gross profit (loss) 3+4	-8,904,891,886	-7,832,871,121	-8,355,442,639	14%	-6%
6.	general administrative expenditures	-7,634,811,195	-5,726,537,680	-2,943,267,133	33%	95%
7.	Other operational revenues (expenditures)	-156,918,630	-65,326,901	33,769,590	140%	-293 %
8.	Current profit (loss) 5+6+7	-16,696,621,711	-13,624,735,702	-11,264,940,182	23%	21%
9.	Miscellaneous revenues	98,139,906	149,594,376	142,478,008	-34%	5%
10.	Profit (loss) resulting from ordinary activities prior to tax deduction	-16,598,481,805	-13,475,141,326	-11,122,462,174	23%	21%
11.	Tax	-	-	-		
12.	Net profit (loss) 8+9+10+11	-16,598,481,805	-13,475,141,326	-11,122,462,174	23%	21%

Source: IPWWC

(8) Future Plan

According to KWWC's response to the questionnaire sent out by the Survey, 60% of their facilities are in a state of deterioration. Nevertheless, a rehabilitation plan including renovation of facilities and replacement of the distribution mains and service connections has yet to be formulated due to budget constraints. Only *ad hoc* measures are being taken to deal with problems.

(9) Discussions on the Location for Possible Technical Cooperation

In the basic survey for the Pilot Project for Management of NRW in Khansar City conducted by JCCME in 2014, part of the operational zone of KWWC in the south was selected as the target area because of the large number of old distribution mains and high water pressure in the mains. IPWWC

and KWWC have already expressed their preference to designate the entire city as the pilot project area, if JICA decides to implement the technical cooperation project.

Khansar City is located in a narrow valley running from south to north. If the pilot project area is to be created by dividing the city into northern and southern sections, the numbers of valves to be installed and locations at which pipelines would be interrupted will be high. Therefore, it is proposed that the city be divided into eastern and western sections. In addition, consideration is given to the river that runs through the lower elevation in the city. The water pipelines end at this river. The plan to divide the city area described in Figure 5-5-1: The blue squares and the red circles on the map indicate the locations of reservoirs and water wells, respectively.

By dividing the city center into eastern (green shading) and western (blue shading) areas along the river and creating another area north of the city center (pink shading) (Figure 5-5-1), the numbers of interrupted pipelines and valves to be installed can be kept to a minimum. There are reservoirs in each area and the available water will be distributed evenly to those areas. There is little difference in the number of customers in the eastern (green shading) and western (blue shading) areas. The size of the service areas is almost the same.

As the total length of the distribution mains in Khansar City is 124 km, the size of DMAs will be large if the city is divided into three areas. Therefore, it is recommended that a field study be conducted in future and its results can be utilized in the detailed discussion of the boundaries of DMAs and area division.

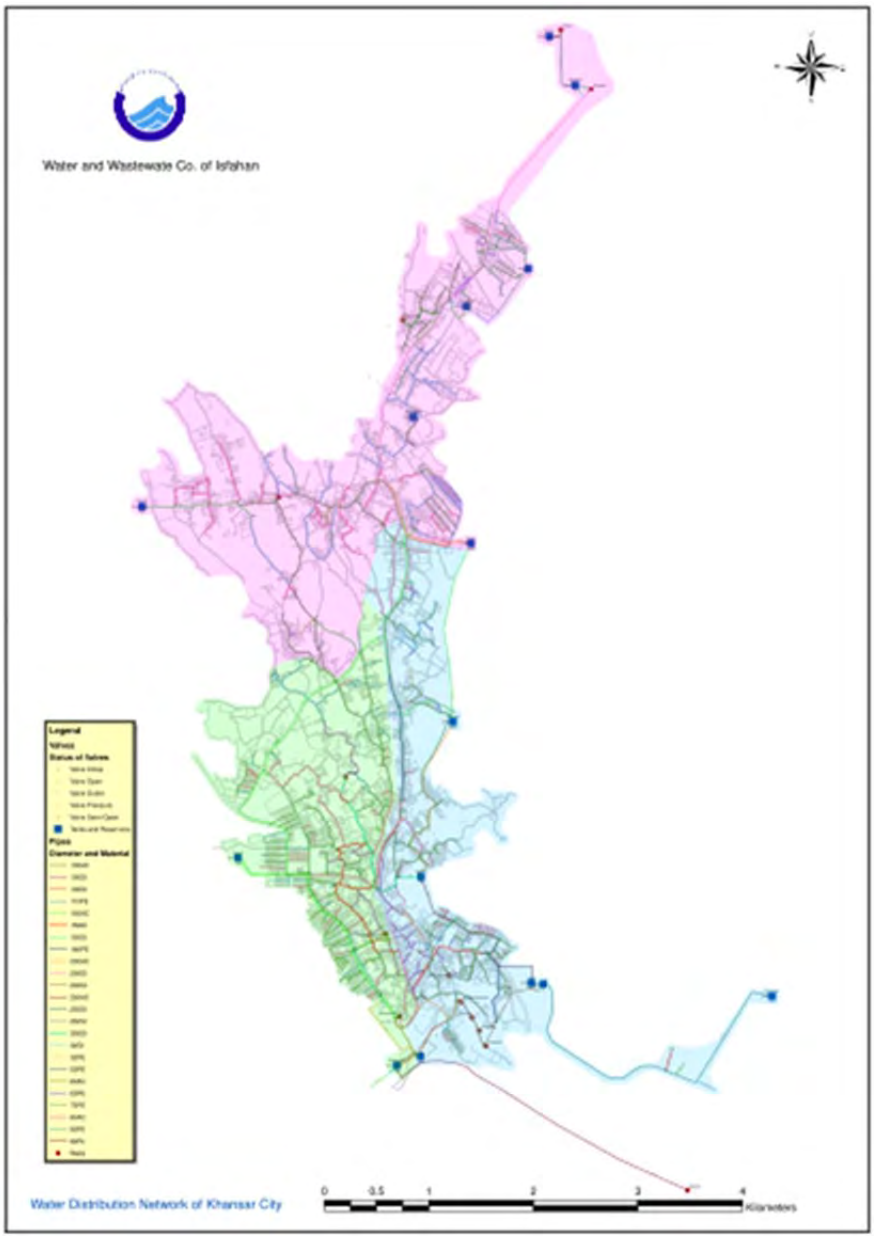


Figure 5-5-1 Proposed Zoning of Water Service Areas in Khansar City

IPWWC supervises WWCs with high NRW in 8 other cities located in areas with topographic conditions similar to Khansar City, namely Fereydunshahr, Fereydan, Domaneh, Daram, Semirom, Kommeh, Vanak and Natanz. There are many cities with similar topographic conditions in service areas of other Province in Iran. Therefore, it would be possible to consider the current operational state of KWWC as typical in rural cities in Iran. NWWEC appointed Khansar City as a candidate site for the implementation of activities to reduce NRW because if a technical cooperation project is implemented at KWWC, and if its achievement will be a good example, the knowledge,

technologies and experience gained can be applied to similar cities.

5-6 Present Status of the Water Supply Sector in the City of Mashhad

5-6-1 Characteristics of the City

Mashhad City is located in the northeast of Iran. It is the second largest city with a population of approximately 3 million, and visited by 25 million tourists every year. It is one of the holiest cities in Iran. Most of the tourists are pilgrims visiting the Imam Reza Holy Shrine.

The climate in Mashhad City is defined as steppe climate with little rainfall. The annual average temperature is 13.5 degrees Celsius and the average precipitation is around 250 mm. The average precipitation is 55 mm/month, with most of it in March. July and August are the driest months with the average temperature of 25.2 degrees Celsius. January is the coldest month with the average temperature of 0.1 degrees Celsius.[31]

5-6-2 Outline of the Water Supply Sector

(1) Water Sources

Water supplied to Mashhad City derives mostly from three dammed reservoirs. The Doosti Dam, supplies approximately 40% of the water. There are three water treatment plants, one for each of the three reservoirs. In addition, there are approximately 400 water wells in the city.

A total of 2.2 billion m^3/year of water is supplied to the city per year. Table 5-6-1 below shows the breakdown of the water supply by source.

Table 5-6-1 Water Sources for Mashhad City

Doosti Dam	39.1%
Kardeh Dam and Torogh Dam	2.9%
Spring and Aqueduct	3.9%
Wells	54.1%

Source: MWWC

(2) Water Treatment Plants

Water taken from the Doosti Dam, the Kardeh Dam and the Torogh Dam are treated at their respective treatment plants. Water Treatment Plants No. 1 (Doosti) and No. 2 (Torogh) use hydraulic pulsator flocculator clarifiers manufactured in France.

(3) Transmission and Distribution Mains

There are 445 km of the transmission and 4,470 km of distribution mains. A 1,300 km portion of these mains is in need of repair or replacement. There are 32 utility reservoirs in the city. The total capacity of these reservoirs has to be increased from 500,000 m^3 to 1,200,000 m^3 due to population increase[33].

Approximately 60% of the 4,470 km distribution mains are asbestos cement pipes. The rest are cast iron, galvanized steel, polyethylene or PVC pipes. Asbestos concrete pipes are molded from cement and asbestos. If they are buried underground for a long period of time, the elution of the alkali components will take place and reduce the strength of the pipes. These asbestos cement pipes installed more than 30 years ago, will need to be replaced in a systematic manner in the near future.

(4) Water Transmission and Distribution Control

Mashhad City is divided into four districts and five regions. These five regions are planned to be subdivided into 20 zones. The plan for the subdivision has been formulated, but not yet implemented. The number of service connections is 1,160,000. Water pressure and flow rates can be monitored at Central Control.

(5) Measures to Reduce NRW

MWWC has seven workers responsible for NRW reduction. Four of them are assigned to each of the four districts. Water leak detection is conducted by private companies under contract to each district. The workers responsible for the NRW reduction supervise the work of the contractors.

MWWC has a maintenance center at each district for the repair of water leaks and replacement of meters. The repair of water leaks and other works are conducted by contractors 24 hours a day. A server-client type database has been established. Data on repair of water leaks is transmitted from a tablet computer in the field to the maintenance center.

MWWC has selected a priority district in which activities to reduce NRW are to be promoted. The water supply system in this district was built by a developer and later transferred to MWWC. The system has high incidents of water leaks because of the poor quality of pipe materials and installation work and high incidents of illegal connections compared to other areas. Water pressure in the northern part of this area is less than 1 bar. However, it is not possible to increase the pressure in this area without causing more water leaks.

[33] Based on the interviews conducted with MWWC

The inspection standards of NWWEC are used in the inspection of the materials for the replacement of distribution mains. To pass this inspection, the material has to withstand the water pressure 1.5 times the maximum working pressure of the main continuously for 24 hours.

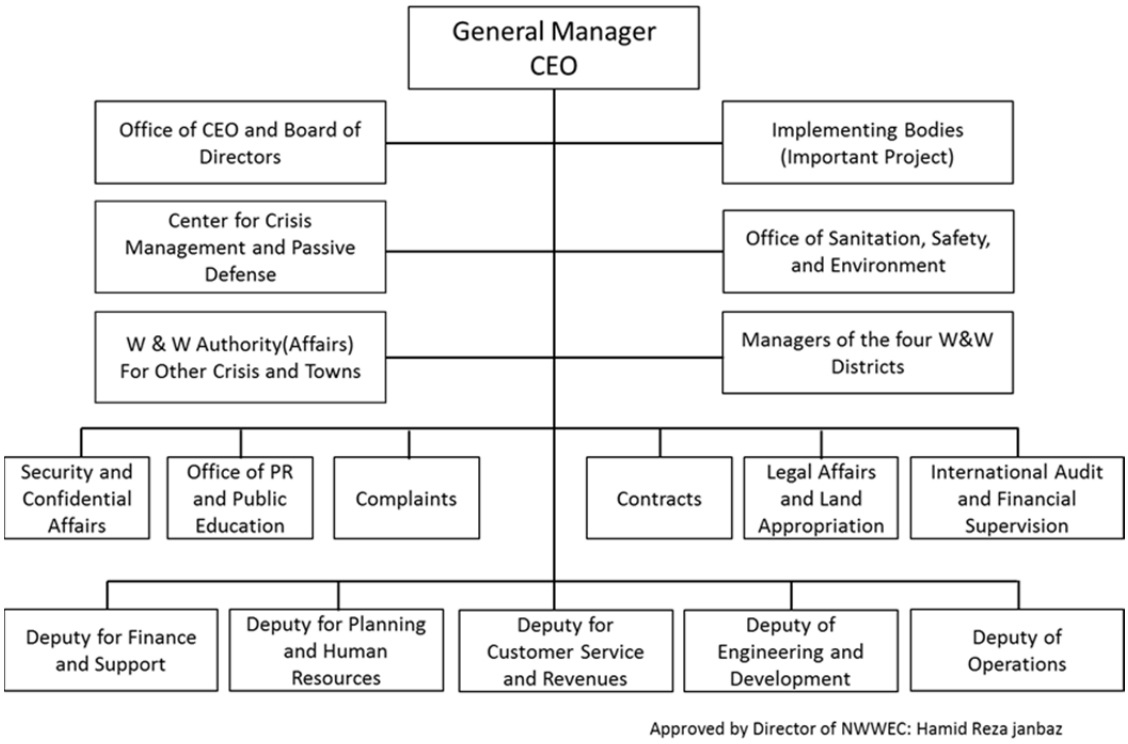
The error ratio of the water meters in use is estimated to be high at 7.7% because it is assumed that 1) approximately 20% of the meters in use were installed more than 10 years ago; 2) 1/3 of these old meters are not fully operational; and 3) 10% of the old meters are not operational at all. As the priority is given to the replacement of malfunctioning meters, the pace of the replacement of old meters is very slow.

Illegal connections are often found at the time of meter reading. Many illegal connections do not have water meters. Water meters will be installed on these connections to make them legal.

Mashhad has established an advanced maintenance database system capable of calculating leakage volume automatically when the data is entered for repair works. The database has a client/server system which allows direct input of data at local maintenance centers which has dedicated transceiver communication system connected to the customer call center. Incident reports are entered manually at headquarter for integration into the GIS. At present, the decentralized data entry system is at its test phase. The GIS database integrates the cadastral and customer information database.

(6) Organization

MWWC’s organizational chart is shown in Figure 5-6-1.



Source: MWWC

Figure 5-6-1 Organizational Chart of Mashhad Water and Wastewater Company

(7) Finance

Financial performance of the MWWC improved drastically between 2013 and 2014. With general sales (Table 5-6-2 1.) increased by 26% and the reimbursement to the central government (Table 5-6-2 2.) reduced to 1%, and net sales (Table 5-6-2 3.) showed an increase of 92%. The increase in direct cost of service (Table 5-6-2 4.) was only 11%, and the gross loss or the operating loss (Table 5-6-2 5.) down by 41%. Administrative costs (Table 5-6-2 6.) increased by 27% and the overall deficit (Table 5-6-2 8.) was reduced by 25%.

Table 5-6-2 Profit and Loss Statement for Mashhad Water and Wastewater Company (2013, 2014)

Unit: IRR

		Note	1393 (2014-2015)	1392 (2013-2014)	Changes between 2014-2013
1.	sales and revenue from services provided		922,096,650,749	731,740,262,477	26%
2.	government reimbursement		-1,715,088,900	-251,937,106,107	-99%
3.	Net sales 1+2	23	920,381,561,849	479,803,156,370	92%
4.	Costs of products sold / services provided	24	-1,366,025,672,550	-1,233,408,982,836	11%
5.	Operating profit (loss) 3+4		-445,644,110,701	-753,605,826,466	-41%
6.	general administrative expenses	25	-300,549,561,717	-236,799,144,632	27%
7.	Other revenue and operational expenses (net)	26	234,736,120	636,502,591	-63%
			-300,314,825,597	-236,162,642,041	27%
8.	Current profit (loss) 5+6+7		-745,958,936,298	-989,768,486,507	-25%
9.	Financial expenses	27	-275,236,986	-331,409,863	-17%
10.	Other revenue and non-operational expenses (net)	28	3,253,964,983	3,572,940,190	-9%
			2,978,727,997	3,241,530,327	-8%
11.	Profit (loss) of normal activities before tax deduction 8+9+10		-742,980,208,301	-986,526,938,180	-25%
12.	Tax on normal activities		0	0	
13.	Profit (loss) of normal activities		-742,980,208,301	-986,526,938,180	-25%
14.	Unexpected expenses		0	0	
15.	Tax on unexpected expenses		0	0	
16.	Net profit (loss) 11+12+13+14+15	29	-742,980,208,301	-986,526,938,180	-25%
17.	Retained earnings (losses)				
18.	Net retained earnings (losses)		-742,980,208,301	-986,526,938,180	-25%
19.	Retained earnings (losses) for beginning of year 16+17+18		-4,160,024,980,612	-3,201,641,196,834	30%
20.	Annual adjustments	30	-39,442,230,003	-11,299,075,601	249%
21.	Adjusted retained earnings (losses) for beginning of year		-4,199,467,210,615	-3,212,940,272,435	31%
22.	Attributable profit		-4,942,447,418,916	-4,199,467,210,615	18%
23.	Legal reserve		0	0	
24.	Other reserves		0	0	
25.	Recommended dividend		0	0	
26.	End-of-year retained earnings (losses) 19+20+21+22+23+24+25		-4,942,447,418,916	-4,199,467,210,615	18%

Source: MWWC

Table 5-6-3 shows the investment budgets of MWWC during the period of 2012 and 2015. The total investment budget varied significantly between 17.02 billion IRR (2015) and 35.53 billion IRR (2014). The ratio of the investment budget to the sales was 49% in 2014 (The total of 2014 in Table 5-6-3 below / The sales and revenue from services provided (Table 5-6-2 1. in 2013-2014 above) but was drastically reduced to 18% in 2015 (The total of 2015 in Table 5-6-3 below / The sales and revenue from services provided (Table 5-6-2 1. in 2014-2015 above), even when there was an increase in sales. Pipe work, i.e. maintenance and expansion of transmission and distribution networks is the largest item in the investment budget, followed by construction of wells and reservoirs.

Table 5-6-3 Record of Investment of Mashhad Water and Wastewater Company

Unit: Million IRR

Year	Pipe Network	Wells	Reservoir	Service Connections	Sewer	Treatment Plant	Planning	Others	TOTAL
2012	91,023	9,894	45,212		550		12,055	32,347	191,081
2013	91,560	68,936	13,272	22,475			837	28,750	225,831
2014	130,228	117,700	2,999	7,500			27,418	69,497	355,342
2015	63,255	83,433	2,309			992		20,269	170,258
TOTAL	376,066	279,963	63,792	29,975	550	992	40,310	150,863	942,512

Source: Analytics of JICA Survey Team based on the data provided by NWWEC

(8) Future Plan

MWWC has prepared the future plan to year 2041, with inputs from consultants. While the details of the plan are not available at present, it is expected to deal with the estimated increase in population from 3 million in 2015 to 5 million by 2041.

CHAPTER 6 MAJOR ISSUES IN THE WATER SUPPLY SECTOR IN IRAN

6-1 Securing Sufficient Budget for Expanded NRW Program

(1) Variance in NRW Levels

Iranian water companies throughout the country have been undertaking NRW reduction with the guidance of NWWEC for the last ten years. The core of the program is the standardized water audit system adopted from IWA. The program is one of the most progressive undertakings in the field of NRW among the developing countries to demonstrate the administrative capacity of the Iranian Government. Isfahan City at 13.6% of the NRW ratio is the leader in Iran. However, the NRW of Khansar City, which is also under the supervision of IPWWC, is at 60% even though the same provincial WWC is managing these cities. Likewise, there is a growing disparity between cities covered by the same Provincial WWC in their NRW levels. Focusing on high NRW areas should bring higher economic return on investment. NWWEC has to make the appropriate policy decisions in targeting high NRW areas.

The leakage reduction measures are limited to passive ones, such as the repair and replacement of damaged facilities in response to customer reports on pipe bursts and water leaks. In the 5 cities surveyed the availability of manpower and equipment is inadequate for adopting more aggressive leakage reductions, such as extensive leakage detection and preventive maintenance. More manpower and equipment would be required to implement active leakage detection measures. Preventive maintenance would incur higher costs such as those for more frequent pipe replacements.

In order to further reduce NRW, more investment is also needed to establish distribution zoning and introduce SCADA system.

To tackle the high NRW in cities where this is a problem, the effort must be extended to locations which could be some distances apart. Transportation, communication, coordination and additional staff would be required and commitment must be made to secure much higher budgetary allocation.

(2) Reduction in Apparent Losses

In general, apparent losses in Iran are relatively high. As discussed above, there is no regular replacement program for consumer meters, thus the average age of meters is rising. There are many malfunction water meters but their replace is slow because of the lack of budget. Another factor that contributes to apparent losses is procurement of inexpensive but low quality meters. More investment is needed for regular replacement of meters and procurement of better quality meters.

6-2 Restructuring of Tariff

As described in Chapter 4, Iran already has a progressive tariff structure to encourage water saving by consumers. However, the average tariff is quite low particularly for consumption under 50 m^3 per month, resulting in limited success in achieving better water saving outcomes. Raising tariff level would encourage better water saving by the consumer and also reduction of NRW for the supplier.

6-3 Technical Capability of Private Contractor

As described in Chapter 4 and 5, all the governmental institutions including WWCs in Iran are required by the Government to reduce their staff size. Private contractors would have to be used if NRW reduction effort is to be expanded.

WWCs are already outsourcing meter reading/billing, repair, meter inspection, leak detection, repair and replacement work. There is a serious need for developing WWCs' supervisory as well as field work capability in NRW reduction since these companies do not have this expertise. In the longer term, the improvement in the private companies' technical expertise in NRW reduction would also be required.

There are many consulting firms in Iran. The establishment procedures of new consulting firm are rather simple and there may be 200 to 1,000 consulting firms (actual figure is not clear) and some companies have only a few staff. There are 10 to 20 consulting firms related to water sector including listed firms.

6-4 Regional Variation in NRW Ratio

In big cities such as Tehran City, Isfahan City and Mashhad City, the water supply systems are operated and maintained using advanced technologies. A telemetering system was introduced for monitoring the entire water supply system in Tehran City and in parts of Isfahan and Mashhad Cities. However, the technological level of the WWCs responsible for rural cities, such as Zanjan City and Khansar City, is lower.

The wide variation of NRW ratios from region to region is a concern. The NRW ratio for KWWC responsible for Khansar City is 60%, while the range in Iran including other WWCs is 17% to 30%. The reason for such variation could be the lack of sharing of technologies or lessons learnt among WWCs.

6-5 Accuracy in Calculating NRW Ratio

As mentioned above, in 2003, the Water Balance Program was introduced by IWA to promote the analysis of NRW to clarify and solve the problem of NRW. The leadership of NWWEC and efforts of WWCs are commendable.

TPWWC uses the minimum night flow (MNF) to calculate real losses in DMAs. DMAs have been established in some parts of Tehran City. According to the Tokyo Metropolitan Waterworks, MNF can be used for estimating the quantity of leakage only when the DMA has less than about 400 house connections. The number of house connections in the DMAs in Tehran City exceeds 3,000. Therefore, the MNF in Tehran City cannot be used for this purpose.

Although each aspect of NRW can be calculated based on certain assumptions, total NRW can be calculated based on the difference between the total volume of water supplied and the water consumption measured and billed. Accurate data can be obtained using this calculation. However, according to NWWEC, the total NRW ratio obtained this way may have some margin of error.

Some of the flow meters at the exit of wells and water treatment plants that would provide the measurement of the total volume of supplied water may not be working properly or are missing. Fixing this problem could improve the accuracy of estimating the total NRW ratio.

Therefore, as stated in the Fifth Five Year National Development Plan (target year: 2011-2016), it is important to identify a more accurate rate of NRW in the future in order to determine how the annual 0.5% NRW reduction can be achieved.

6-6 Motivation of Staff Assigned to NRW Reduction

Even if the most advanced engineering/technologies and equipment for NRW reduction were introduced, they would not be used effectively if the workers are not sufficiently motivated. The motivation is particularly critical for workers who have to deal with leak detection at night time or emergency leak repair during holidays.

6-7 Contamination of Groundwater

In urban areas the sewerage systems are underdeveloped. Nitrate-nitrogen concentration in groundwater from wells located in the cities has been rising to the extent that WWCs are forced to stop using groundwater. During field investigation in the course of this survey, contamination of groundwater was reported in Tehran, Zanjan, and Mashhad Cities. Contaminated groundwater may

be used after purification. For a more permanent solution, the development of sewerage systems is indispensable.

CHAPTER 7 DIRECTION OF COOPERATION

7-1 Request Made by the Iranian Side

7-1-1 Details of the Request

The detailed information related to the request made by the Iranian side is shown in Table 7-1-1.

Table 7-1-1 Request Made by Iran

Date of Request	18th, October, 2014
Requested by	Ministry of Energy, Islamic Republic of Iran / National Water and Wastewater Engineering Company
Request for	Implementation of a Technical Cooperation Project for NRW Reduction
Project Purpose	Improvement of the Planning Capacity for NRW Reduction Improvement of the Project Implementation Capacity for NRW Reduction Institutionalization of the Internal Training Programs for NRW Reduction
Project Area	Khansar City in Isfahan Province

7-1-2 Relevance of the Request

Purpose of the request from the Iranian side is to learn Japanese technologies regarding NRW reduction. As described in Chapter 4, since target of NRW reduction is defined in the Sixth Five Year National Development Plan (2016-2021), contents of the request from Iranian side is conforming to the national plan and judged as adequate.

As described in Chapter 6, the issues faced by the water supply sector of Iran are:

- The need to effectively use the limited water resource and improve the management of WWCs through NRW reduction.
- The need to reduce the large regional variation in NRW and bring the WWCs to the same technological capability in dealing with NRW reduction.
- The need to raise the technical level for NRW reduction in Iran as a whole, including that of private companies engaged in NRW reduction.
- The need to promote budget appropriation for NRW reduction in order to acquire the required technologies.
- The need to improve the accuracy in the analysis of NRW.

The requests to acquire technologies for reducing NRW are deemed relevant. It is also necessary to bridge the regional gaps, particularly for Khansar City, which has a high NRW ratio, and is thus an

appropriate candidate for a pilot project.

Iran's request concerning NRW reduction is relevant. Attention should be paid to ensuring that technologies, experience and knowledge acquired through the project would be shared throughout the country. The development of training programs and training materials should be included as requested, in order to help the country implement internal training programs in the long term.

7-2 Proposed Technical Cooperation Project Based on the Survey Results and Request Made by the Iranian Side

The request made by the Iranian side is relevant as they are in line with the country's higher-level plans. A technical cooperation project to reduce NRW is proposed to promote technology transfer for NRW reduction. The project should also include development of training programs and preparation of training materials necessary for sharing the technology and know-how across the country.

7-2-1 Outline of the Proposed Technical Cooperation Project

The outline of the proposed technical cooperation project is shown in Table 7-2-1.

Table 7-2-1 Outline of the Proposed Technical Cooperation

Outline of the Project (Tentative)		Related organizations
Overall Goal	The internal training program for NRW reduction for NWWEC is systematically implemented.	NWWEC, RCUWM
Project Purpose	The structure is developed to systematically implement internal training program for NRW Reduction for NWWEC.	NWWEC, RCUWM
Output 1	Capacity of NWWEC, RCUWM, IPWWC and KWWC for planning NRW reduction is enhanced.	NWWEC, RCUWM, IPWWC, KWWC
Output 2	Capacity of IPWWC and KWWC for implementing NRW reduction activities is enhanced.	IPWWC, KWWC
Output 3	Capacity for planning and implementing internal training for NRW reduction for NWWEC is enhanced.	NWWEC, RCUWM, IPWWC, IHEARI
Output 4	Information on water supply sector in Japan, including the experience of NRW reduction and cost recovery/financial management etc. of water utilities, etc. is shared.	NWWEC, RCUWM, IPWWC, KWWC, IHEARI

The pilot project and necessary field training for NRW reduction would be implemented in Khansar City. Although NRW reduction plan will be prepared for the entire city area of Khansar, the pilot

project will cover only part of the city area. The exact location of the pilot site will be determined during the project, and training participants will not only be staff of IPWWC and KWWC, but also other cities for the purpose of sharing the opportunity to learn and disseminate the information, skills and knowledge.

7-2-2 Sharing of Responsibilities for Iranian Side

The Iranian side will share the responsibilities as shown in Table 7-2-2

Table 7-2-2 Sharing of Responsibilities for Iranian Side

Level	Organization	Roles/ Responsibilities
National	NWWEC	• Implementation organization of the project • Overall coordination (Project secretariat) • Project progress monitoring/coordination • Planning of training programs for human resources development • Sharing technologies/experiences of the pilot project with other provinces • Inputs from Iranian side (allocation of budgets, etc.) • Assignment of counterparts
	RCUWM	• Preparation of NRW Reduction Program • Preparation of training program/text books
Provincial	IPWWC	• Implementation and coordination of the project in Khansar • Preparation of NRW Reduction Program • Preparation of training program/text books (with the actual training implemented by IHEARI) • Sharing technologies/experiences of the pilot project with other cities • Assignment of counterparts including NRW management team
Regional	KWWC	• Implementation of the pilot project • Preparation of NRW Reduction Program • Civil works related to the pilot project • Recommendations on the training program/text books • Assignment of counterparts including NRW management team and action teams • Receiving counterparts from other cities

For training programs, the Iranian counterpart should assign a manager from NWWEC for the development of the overall plan, an officer for training materials and a project manager from Isfahan Province for the pilot project in Khansar City.

To ensured that the overall plan would be approved by the Iranian Government and budgets be continuously appropriated, a joint coordination committee (JCC) composed of representatives of NWWEC, MOE and MPO should be established and a structure should be in place to obtain

feedback and approval on important matters along the various phases in the planning of the training courses, and reviewing the outcomes of the pilot project.

The details of the inputs and undertakings on Iranian and Japanese sides would be finalized in the Detailed Planning Survey of the Project that would be conducted after the official approval of the Project by the Government of Japan. Meanwhile, both sides have agreed on the general framework of undertakings to be taken by each side as follows:

Iranian side/s:

- Allocation of budget (for implementing the project such as administrative and operational expenses, local traveling cost for Iranian personnel)
- Assignment of counterpart personnel
- Office space and its running cost
- Tax exemption and custom clearance for the equipment provided by JICA

Japanese side:

- Dispatch of experts
- Training of Iranian counterparts in Japan and the third country
- Provision of necessary equipment to be used in the NRW reduction pilot project in Khansar city

7-2-3 Five Considerations for Project Support

An evaluation of five considerations for the technical cooperation support is indicated in Table 7-2-3.

Table 7-2-3 Evaluation of Five Considerations for Project Support

Considerations	Evaluation
Relevance: Appropriateness and necessity of the project, including whether the objectives would address the beneficiaries' needs, the approach would solve the problems and issues, and there is consistency between the recipient's and Japan's assistance policies.	Water resource is absolutely in shortage in Iran. Efforts are made to control water demand by launching nationwide water-saving campaigns and raising water tariffs in the dry season. At the same time, the public service sector is required to vigorously reduce NRW and improve techniques for that purpose. As the Fifth Five Year National Development Plan (target year: 2011- 2016) clearly identified the intention to tackle NRW and established targets for NRW reduction, the Technical Cooperation Project is consistent with the Five Year National Development plan. Effective water use in Iran is a national policy. NRW reduction is one of the important issues facing the water supply sector and should be monitored continuously.
Effectiveness: Whether the objectives of the project have been achieved and whether there are any benefits to the service population and society in general.	IPWWC and KWWC will develop their capacity in NRW reduction. NWWEC as central and responsible organization of water supply sector will cooperate in the preparation of the training program. This experience will establish the internal training component at IPWWC.
Efficiency: Whether the resources deployed have been utilized effectively, i.e. input versus output of the project.	In Iran each province has an independent water and wastewater service organization. NWWEC can ensure nationwide long-term technical improvement in NRW reduction by developing training programs in this regard. Programs for reducing NRW and related training materials to be developed as part of this Technical Cooperation Project will be utilized nationwide. Mechanisms or system for effective usage of equipment provided during the Technical Cooperation Project should be part of the Project.
Impact: Positive and negative changes brought about by project implementation, including direct/indirect, and predicted/ unpredicted outcomes.	More advanced techniques would be needed to maintain or further improve the NRW ratio. Technical capacity of the work force can be improved through human resource development. Objective evaluation of the training process will be useful by employing a technical certification system. Counterparts from KWWC, IPWWC and various WWCs will participate in the Project. They will share the technologies and experiences with interested parties across the country by holding seminars and through staff exchanges.
Sustainability: Whether the outcomes of the project have long term impacts.	NWWEC requested Japanese assistance in developing national-level training programs based on the planned pilot project. The Iranian side has demonstrated its commitment by obtaining the required facilities for the implementation of the training programs. It is expected that effects will be maintained for the long term. The Iranian side also proposed that existing training schemes of NWWEC, the training center of MOE and the Regional Centre on Urban Water Management (RCUWM; where seminars are often held) should be utilized. Consensus would be needed on sustainable implementation of these

	training including scheduling and arrangements, among Iranian participants including MOE. Furthermore, to ensure the long term viability of the training plan, financial (budgeting), organizational, and institutional arrangements should be considered.

Appendices

1. List of Officers Discussed

No.	Name of Organization	Title	Name
Iranian Side			
1	NWWEC	Member of the Board of Directors & Deputy for Supervision on Operataions	Hamid Reza Tashauoei
2	NWWEC	Manager	Ali Seyedzadeh
3	NWWEC	Manager	Mohammad Khalilipir
4	NWWEC	Expert	Ali Akbar Ghazali
5	RCUWM	Director	Ali Chavoshian
6	RCUWM	Deputy	Alireza Salamat
7	RCUWM	Head	Alireza Zamini
8	RCUWM	Researcher	Naser Dehghanian
9	RCUWM		Saeed Alipoor
10	TPWWC	Manager	Moslem Pournosrat
11	TPWWC	Deputy	Farid Zahiri
12	TPWWC		Zohre Miradi
13	TPWWC		Hadi Bekhyr
14	TPWWC		Hossien Derakhsh
15	TPWWC		Zohre Shebifar
16	TPWWC		Hadi Aqebatbekhyr
17	TPWWC Zone 6	General Director	Asghar Karami
18	TPWWC Zone 6	Deputy Director	Asghar Kangarlou
19	ZPWWC	Deputy	Ali Naderkhani
20	ZPWWC		Faiiaz Yoursefy
21	ZPWWC		Kobra Atrak
22	IPWWC	Executive Manager	Hashem Amini
23	IPWWC	Manager	S. Mohsen Saleh
24	IPWWC	Deputy Manager Financial & Support Dept.	Hossen Esnashari
25	IPWWC	Manager of Operation	Mehdi Jahagiri
26	IPWWC	Management and Financial	Reza Narolahzaden
27	IPWWC		Sara Ahmadi
28	IPWWC		Asieh-Sadat Mollabashi

No.	Name of Organization	Title	Name
Iranian Side			
29	IPWWC		Ali Rezasherafati
30	Khansar Government	Mayor of Khansar City	S. Hassan Shafati
31	KWWC	General Manager	Nabiy Khobroo
32	KWWC		Mehdi Janhangiri
33	KWWC		Mehdi Kiari
34	MWWC	Manager	Shahrooz Sharghi
35	MWWC	Manager	Javad Andalibi
36	MWWC	Manager	S Mohammad Tafajoli
37	MWWC	Manager	Jafar Esmaeilzadeh
38	MWWC	Manager	Alireza Sedghian
39	MWWC	Manager	Amin Bozorgmehr
40	MWWC	Deputy	Majid Foruzesh
41	MWWC	Deputy	Javanshir Shadmehri
42	PTC	Director of Professional Training Center	Abdollah Rashidi
43	PTC	Head of Civil, Water & Environmental Eng. Dept.	Nemat Hassani
44	PTC	Assistant Professor	Moshammed Reza Jalili
45	PTC	Coordinator	Sayed Hojat Mondheri
46	IHEARI	Head	Mohamad Reza Fadaei
47	IHEARI	Head of branch water	Mostapha Zareapour
48	IHEARI	Training Manager	M. Arebi
49	IHEARI	Technical Training Manager	Farhad Shafiei
50	IHEARI	Manager of Financial Affair	Zabihollah Sabbaghi
51	IHEARI	Manager of Electricity Dept.	Behnam Ramezy
52	IHEARI	Public Relations	Hossein Arshadi
53	Rahdan-c Sama Consulting Enginners Co.		Kauveh Jamari
54	Interpreter		Hadi Rezvani

No.	Name of Organization	Title	Name
Japanese Side			
55	Embassy of Japan in Iran		Nobuhiko WATANABE
56	Embassy of Japan in Iran		Akira NOROTA
57	Embassy of Japan in Iran		Ryouta ONODERA
58	JICA Iran Office	Chief Representative	Kohei SATO
59	JICA Iran Office	Representative	Ryusuke IKEDA
60	JICA Iran Office	Project Fomulation Advisor	Norikazu YAMAZAKI
61	JICA Iran Office	Program Officer	Rosita Fakhrevaezi
62	Middle East Division 2, Middle East and Europe Department	Deputy Director	Makiko OKUMURA
63	Middle East Division 3, Middle East and Europe Department	Deputy Assistant Director	Jinya MIZUTANI
64	Water Resources Group, Global Environment Department, JICA	Deputy Director General, and Group Director	Eiji IWASAKI
65	Water Resources Team 1, Global Environment Department, JICA	Director	Eriko TAMURA
66	Water Resources Group, Global Environment Department, JICA	Senior Adviwsor (Urban Water Supply)	Sadanobu SAWARA
67	Water Resources Team 1, Global Environment Department, JICA	Deputy Director	Shingo FUJIWARA
68	Water Resources Team 1, Global Environment Department, JICA	Technical Advisor	Mayu OMURA

2. Questionnaires

Data collection survey on water supply sector in the Islamic Republic of Iran

Questionnaire

National Level: Ministry of Energy （MOE）

MOE-1

List of relevant laws and regulations related to the construction and operation of water supply facilities.
- Water Supply Law
- Regulations related to water quality, tariff setting etc.

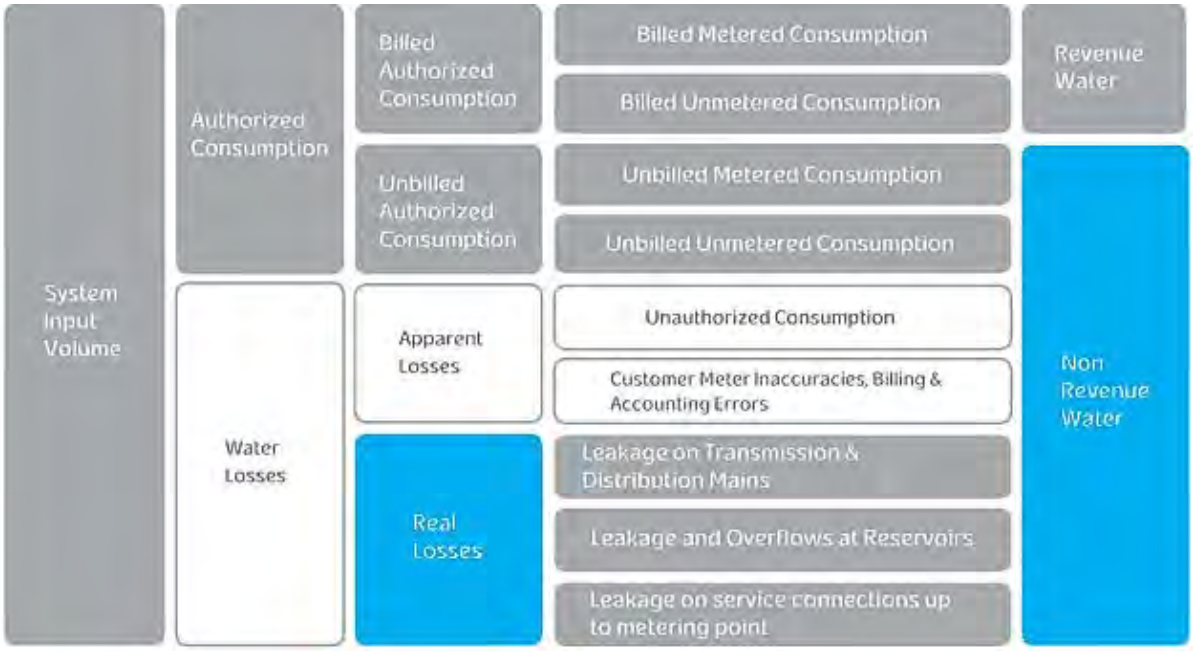
Title of Law	Year of approval and approval reference	Considerations
Fair Water Distribution Law	1983, Iran Parliament	According to article 45 of I.R.Iran constitution law, water is a public property owned by the Government
Water Allocation Law	1983, Iran Parliament	Act of the Establishment, 1983
Act of the Establishment of Water and Wastewater Companies	1983, Iran Parliament	Act of the Establishment of Water and Wastewater Companies, 1983
The Law of Promotion of investment in Water Projects in Iran and Enforcing By law	2002, Iran Parliament	Investments and properties, management and operation of dams and water supply systems are permissible by considering the water rights by the public and private sectors by taking into account general policies of principle 44 of the I.R. Iran Laws and constitution.
5-year National Development Plan (2011-2016)	2010, Iran Parliament	Implementing the country's water management decispilne is based on the national, water basin and provincial levels. Article 140- Industrial, animal husbandry, service, production and other units which produce sewage and pollute water with a higher amount in comparison with the standard level are obliged to execute sewage collection facilities and wastewater treatment systems. Otherwise they will be fined.
Design Criteria of Urban and Rural Water Supply and Distribution Systems	2013, MOE, Bureau of Engineering and Technical Criteria for Water and Wastewater	The application range of the criteria include determination of water supply studies basis, water requirements and designing water supply projects
An Addendum to Part of Government Financial Regulations, Article 37	2005, Management and Planning Organization (MPO)	Water, electricity and fuel tariffs for governmental, non-governmental, public and private educational centers are calculated and paid based

			on educational tariffs
	Drinking Water; Physical and Chemical Specification	2010, Institute of Standards and Industrial Research of Iran (ISIRI)	Determination of physical, chemical and radioactive features for drinking water
	Quality Control Manuals of Water Treatment Plants	2006, Management and Planning	Introducing and descripting of qualitative experiments required for monitoring and optimizing treatment process and operation works in urban water treatment plants

MOE-2	*Organization chart and number of staff of respective departments/sections* ***Refer to the Collected Data List No. 1-1***
MOE-3	*Water supply sector development plan in National Development Plan* There is 5-year National Development Plan (NDP) in Iran. So far, 1st, 2nd, 3rd and 4th National Development Plan has been already finished. The 5th NDP has been started from 21 March 2011 and it will be finished by March 20, 2016. So, now we are in the last months of the 5th National Development Plan. The 6th NDP will be started from March 21, 2016 for another five years. However, due to Parliament election in March 2016, start of 6th NDP perhaps will be postponed for a few months. As this is the end of 5th NDP, we are in a gray zone. The 6th NDP has not finalized yet. The first draft has been prepared by the Government. However, it has to be approved by Iranian parliament. It will take a few months of hot discussion to be finalized. Therefore, it is very difficult to talk about overall strategy for water works and development plan in water sectors of Iran at this stage. There is a specific chapter at any NDP regarding water sectors. This chapter is about strategy and the way forward for the next five years. Attention is to the economic, security, and environmental value of water in accelerating its usage, supplies, preservation, and consumption and transboundary rivers and shared water resources management, prioritizing the joint use of aquatic resources. Moreover, emphasize is to restore groundwater resources and provide access to safe and clean drinking water or urban and rural areas.
MOE-4	*Any target of water supply improvement in the National Development Plan* NWWEC is shifting gradually its policy from water resources management to water demand management. Reducing the Non-Revenue Water (NRW) is also one element of NWWEC in NDP. NWWEC objectives and strategies during 6th NDP are as follow: A- Increasing Sewage/Wastewater Treatment capacity to 530 MCM during 6th NDP in order to cover 52% of urban population with access to Sewage/Wastewater Treatment. Comment: At the moment urban wastewater treatment coverage is 41.50%. By the end of 5th NDP (in less than five months from now) the urban wastewater treatment coverage would be 42%. So, during 6th NDP this coverage will increase by 10%. B- Increasing safe and clean urban water supply capacity to 1500 MCM during 6th NDP in order to provide access for 99.8% of urban population. Comment: At the moment, access to drinking water for urban population is 99.1%. By the end of 5th NDP it would be 99.2%. C- Increasing water supply network efficiency by demand management as well as reducing non-revenue water (NRW). The quantitative target for non-revenue water reduction rate is to reduce it by 0.5% per year during 6th NDP (in total 3% during five years of 6th NDP period). Comment 1: The average non-revenue rate in water supply network of Iran is 26% (based on last estimation on April 2015). However, this rate is based on the best available data and engineering estimation. It is not an accurate calculation. NWWEC believes there are a few percent errors in this estimation. Comment 2: The target for non-revenue rate reduction in 5th NDP was 1.7% per year. It was too ambitious. It has

	never achieved. The actual progress in reduction of non-revenue water during 5th NDP is not clear. D- Renovation of old facilities and old water supply pipelines by 10% of total pipe lines per year during 6th NDP. E- Installing water meter (water gauge) in all water sources that are using for urban drinking water.
MOE-5	*What is the most serious issue relating to water supply* 1- Located in one of the most arid regions in the world, Iran has an annual average precipitation rate of about 250 millimeters. Exacerbating the severity of water shortages, as much as 70 percent of precipitation is lost to evaporation. The country's population has increased about 8 times during the last 80 years and it has got from 10 million in 1920 to more than 78 million in 2015. At present Iran is the 17th most populated countries in the world and based on the data presented in UN it will be classified as one of the 10 most populated regions in the world by the end of 2050. Therefore the need for water has been increased but still the quantity of water is not adequate. At the same time water price is low and it is not considered as an economic good with its market value. 2- Another reason of the shortage in producible water is the water losses from water distribution systems. In the other hand the water resources hasn't well management. Water distribution network is old, the wastewater collection is not sufficient and there isn't any plan to use the purified sewage. 3- Lack of trained human resources and experts
MOE-6	*Policy of private sector participation in water supply sector Any concession contract, partial operation by private sector, or privatization* In order to increase the private section partnership involvement in water and wastewater plans, the following steps have been taken: - Approving and notifying article 142 of the fifth development plan of the I. R. Iran. - Creating a line for ensuring water / wastewater purchase in the annual budget law. - Improving BOO (Build, Operate, Own) and BOT (Build, Operate, Transfer) contracts with foreign partners When the government decided to use the private sector investment in the irrigation and drainage projects, a special committee in the regional water authorities was established in 1992. In each province, this committee developed a methodology for participation and determined the priority of each project. In 1994, in order to increase the efficiency of the program, the government of Iran approved the private participation as a law cited in article 44 (constitution law) in the parliament and Ministry of Energy was appointed to manage this participation. Since 1994, the Bureau of Irrigation and Drainage Development Projects directs the private sector participation program. This section has issued several guidelines on parameters to be used in project evaluation, discount rates, wages and inflation rates to apply to projects. Up to 1990 the water and sanitation sector was highly decentralized. Most water and wastewater service provision was the responsibility of municipalities and provinces. This was changed through a fundamental sector reform in 1990 with the ratification of the Provincial Water and Wastewater Companies Law of September 1990. In September 2003 the Government of Iran and the World Bank agreed on a sector strategy with the targets for improved cost recovery and collection and increased efficiency. It is not clear what were the baseline data in 2003 and to what extent progress has been made to reach these targets. In November 2008 the government announced that it has approved the construction of 177 dams nationwide. Dams in Iran serve primarily for hydropower generation, irrigation and flood control. However, one of the projects will provide drinking water and water for industrial use to the cities of Qom, Golpaygan, Delijan, Saveh, Khomein and Nimvar in the central provinces of Qom, Isfahan and Markazi. In April 2012, the government launched a project to transfer Caspian Sea water to the central regions of Iran, bringing about 200 million cubic meters (7,062 cubic feet) of water per year. As the grounds were paved in recent years for the involvement and investment of the private sector in the national water and wastewater industry; the selection and reference of desalination projects to the private sector have been

	made by the non-governmental sector while the tasks of ensuring the funds for purchase of water from private investors and all the technical and contractual issues of for the relevant systems are addressed by the Bureau for Procurement of Funds and Participation of Non-Governmental Organizations of the National Water and Wastewater Engineering Company. Fortunately the national water and wastewater sector is leading the pace in the field of private participation in the region and has undertaken great and valuable initiatives in this context to provide better service to the population of Iran. Today, the major bulk of water demands of Iran, particularly the southern regions are supplied by the private sector in the frame of desalination plants. Given the current trend and the expanding participation of private sector, the creation of desalination systems in the country is expected to draw more investors, and promises the accelerated development of private participation in the plans of the water and wastewater industry. * ***Refer to the Collected Data List*** No. 3-4
MOE-7	*Any performance indicators to evaluate water supply condition* The International Water Association (IWA) has standardized the method for audit of water losses that called “Water Balance” and has presented new indicators in order to investigate and enable more efficient water distribution systems. After the successful application of performance standards and indicators recommended by the International Water Association by a number of countries, the National Water and Wastewater Engineering Company (NWWEC) decided to use the studies for the management and assessment of water losses in the networks under its control. Accordingly after review of the required information, NWWEC prepared the strategic program (recommended by IWA) for reduction of water losses in the network, the first step of which consisted of preparing the Water Balance program. High levels of NRW reflect huge volumes of water being lost through leaks (real/physical losses), water not being invoiced or not being accurately measured (apparent/ commercial losses) or both. A Water Balance audit details how much of each type of loss is occurring and how much it is costing the water utility. The key concept behind this approach is that water should not be "unaccounted-for". In conducting a water balance audit, a quantity is determined for the major components of water consumption and water loss, and a price is placed on each component in order to assess its financial impact on the water utility. A detailed and accurate water balance forms the basis for an effective NRW management strategy.

	 NWWEC objectives and strategies during 6th NDP: A- Increasing Sewage/Wastewater Treatment capacity to 530 MCM during 6th NDP in order to cover 52% of urban population with access to Sewage/Wastewater Treatment. Comment: At the moment urban wastewater treatment coverage is 41.50%. By the end of 5th NDP (in less than five months from now) the urban wastewater treatment coverage would be 42%. So, during 6th NDP this coverage will increase by 10%. B- Increasing safe and clean urban water supply capacity to 1500 MCM during 6th NDP in order to provide access for 99.8% of urban population. Comment: At the moment access to drinking water for urban population is 99.1%. By the end of 5th NDP it would be 99.2%. C- Increasing water supply network efficiency by demand management as well as reducing non-revenue water. The quantitative target for non-revenue water reduction rate is to reduce it by 0.5% per year during 6th NDP (in total 3% during five years of 6th NDP period). Comment: The average non-revenue rate in water supply network of Iran is 26% (based on last estimation on April 2015). However, this rate is based on the best available data and engineering estimation. It is not an accurate calculation. NWWEC believes there is a few percent error in this estimation. Comment: The target for non-revenue rate reduction in 5th NDP was 1.7% per year. It was too ambitious. It has never achieved. The actual progress in reduction of non-revenue water during 5th NDP is not clear. D- Renovation of old facilities and old water supply pipelines by 10% of total pipe lines per year during 6th NDP. E- Installing water meter (water gauge) in all water sources that are using for urban drinking water.
MOE-8	*Mechanism of water tariff setting* The current urban tariff system is based on a fixed fee that depends on the size of the connection pipe and on the type of customer (household or other types), and on a volumetric charge based on increasing block-tariffs. The fixed fee, or the subscription fee, was about 12000 Rials in 2015 (33 US cents) for most domestic customers while the structure of variable tariffs is based on a complex formula. The formula is the same for all companies and there is no volumetric charge if consumption falls below 15 cubic meters per month. Above this minimum, the tariff increases with the level of consumption and generally varies across companies. The average volumetric tariff

	for the country stood at about 34900 IRR (10 US cents) in 2015. It varied from 18 cents for monthly consumption below 15 cubic meters. The tariff rate increased by 15% for 15-20 cubic meters monthly consumption and increased by 20% for 20-40 and for more than 40 cubic meter the cost increased by 30% of monthly consumption.
MOE-9	*Mechanism of coordination with external funding agencies, selection of priority projects, any on-going projects financed by external funding agencies* The main external partner of the Iranian water and sanitation sector from 2000 to 2010 was the World Bank. Today the main external partners are the Islamic Development Bank, the United Nations and NGOs. In addition, up to now 99 BOO and BOT contracts with an amount equivalent to 45439 Billion Rials (1.5 Billion USD) have been exchanged from which many are in their operation phases.

Data collection survey on water supply sector in the Islamic Republic of Iran

Questionnaire

National Level: National Water and Wastewater Engineering Company (NWWEC)

<table>
<tr><td>NWC-1</td><td>

List of relevant laws and regulations related to the construction and operation of water supply facilities.
- Water Supply Law
- Regulations related to water quality, tariff setting etc.

Deputy of urban water and wastewater has been established in Ministry of Energy in 1989 and the plan of establishing water and wastewater companies has been submitted to the Parliament of Iran in 1990 and it was approved in 31st of December, 1990.

National Water & Wastewater Engineering Company was approved by Cabinet in 2002 based on the Article 4 of the Third Plan of Economic, Social and Cultural Development and in order to fulfill the provisions of Article (17) of establishing the water and wastewater companies.

Based on the proposal of Ministry of Energy, the Association of specialized holding company of National Water and Wastewater Engineering Company was approved by Iran's Management and Planning Organization and Ministry of Economic and Finance Affairs.

The main purpose of establishing the concerned company is to organize the official activities of Ministry of Energy in water & wastewater affairs including the correct management, supervision and evaluate the performance, guidance and governance, increase the efficiency and operation and the optimal use of resources of subsidiaries companies in the policies of Ministry of Energy and also choosing the Ministry of Energy to do the supervision and compile the programs.

The status of the established water and wastewater companies until September 2014 is as follows: 34 urban water and wastewater companies and 30 rural water and wastewater companies.

And also based on the approval in the part of cabinets, all the concerned affairs of rural water and wastewater companies were delivered to the National Water & Wastewater Engineering Company (NWWEC) and according to the above mentioned approval, all the authorities of Ministry of Agriculture has been delivered to Ministry of Energy as follows ; in the subject of making policy, planning, establishing, reconstructing, developing, keeping installations and rural potable water networks and as well as healthy discarding of rural wastewater.

The following are list of some related laws and regulations:

Title of Law	Year of approval and approval reference	Considerations
Fair Water Distribution Law	1983, Iranian Parliament	According to article 45 of Iran constitution law, public water is owned by the government
Water Allocation Law	1983, Iranian Parliament	Act of the Establishment, 1983
Act of the Establishment	1983, Iranian	Article 1 of act of the Establishment

</td></tr>
</table>

	of Water and Wastewater Companies	Parliament	of Water and Wastewater Companies, 1983
	The Law of Promotion of investment in Water Projects in Iran and Enforcing By law	2002, Iranian Parliament	Investments and properties, management and operation of dams and water supply systems are permissible by considering the water rights by the public and private sectors by taking into account general policies of principle 44 of the I.R. Iran Laws and constitution.
	5-year National Development Plan (2011-2016)	2010, Iranian Parliament	Implementing the country's water management decispilne is based on the national, water basin and provincial levels. Article 140- Industrial, animal husbandry, service, production and other units which produce sewage and pollute water with a higher amount in comparison with the standard level are obliged to execute sewage collection facilities and wastewater treatment systems. Otherwise they will be fined.
	Design Criteria of Urban and Rural Water Supply and Distribution Systems	2013, MOE, Bureau of Engineering and Technical Criteria for Water and Wastewater	The application range of the criteria include determination of water supply studies basis, water requirements and designing water supply projects
	An addendum to part of government financial regulations, article 37	2005, Management and Planning Organization (MPO)	Water, electricity and fuel tariffs for governmental, non-governmental, public and private educational centers are calculated and paid based on educational tariffs
	Drinking Water; Physical and Chemical Specification	2010, Institute of Standards and Industrial Research of Iran (ISIRI)	Determination of physical, chemical and radioactive features for drinking water
	Quality Control Manuals of Water Treatment Plants	2006, Management and Planning	Introducing and descripting of qualitative experiments required for monitoring and optimizing treatment process and operation works in urban water treatment plants
NWC-2	*Organization chart and number of staff of respective departments/sections* **** Refer to the Collected Data List No. 3-1***		
NWC-3	*Please name the institutions responsibilities for the following activities:* (i) Overall financing (ii) Daily operation (iii) Regular maintenance (iv) Construction and investment		

	(v) Water quality monitoring and control (vi) Tariff Setting (vii) Human resource development (training) (viii) Recruitment and allocation of engineers and managers at local water company The following answers are presented for each question in according to organization chart of NWWEC: (i) Deputy of Financial and Supporting (Deputy-Managing Director of the NWWEC) (ii) Deputy of Supervising on the Operation ((Deputy-Managing Director of the NWWEC) (iii) Deputy of Supervising on the Operation (Deputy-Managing Director of the NWWEC) (iv) Deputy of Development & Planning (Deputy-Managing Director of the NWWEC) (v) Sanitary Management of Water and Wastewater, and Management of Supervision on Improving Methods for Wastewater System Operation (under the Deputy of Supervising on the Operation) (vi) Economic Assessment and Consumers Service (under the supervision of NWWEC Managing Director) (vii) Deputy of Human Resources and Improving the Management ((Deputy-Managing Director of the NWWEC) (viii) Deputy of Financial and Supporting (Deputy-Managing Director of the NWWEC) and Staff selection office under the managing-director of NWWEC
NWC-4	*Financial accounts (profit and loss and Balance Sheet)* N/A *Organization for tariff setting* In general water tariff is suggesting by NWWEC and MOE in the annual budget of the government of Iran. It needs to be approved by the Parliament of Iran. However, there is some other way to change the water tariff. For example if there is general permission for the government to increase price for its services including water supply. The last time water tariff has been increased by the High Council of Economy of Iran and has been announced by Deputy-President and Head of the Iran Management and Planning Organization. Generally speaking urban water tariff is about 3000 IRR per Cubic meter (1 USD=37,000 IRR). However, the actual water price is 15000 IRR. This means Government of Iran is providing 12000 IRR subsidiaries. Therefore, always there is a push and trend to increase water tariff for government side, however Iranian parliament and some other organization are trying to limit increase in water tariff to support low income consumers. Staffing and responsibilities (High Council Approval?) Yes. Basically there is need to be approved by High Council of Economy Tariff setting mechanism There is a fixed tariff (about 12,000 IRR) and a variable tariff. The following is estimation of variable tariff for household based on Tehran Province case and after October 2015

Water Consumption Per Month (Cubic Meter), X	Water Tariff Formula for different water use (IRR)
0 to 5	**(X * 709.5)**
5 to 10	**(x * 1061.5 -1760)**
10 to 15	**(x * 1413.5 -5280)**
15 to 20	**(x * 1851.5-11850)**
20 to 25	**(x * 2700-28810)**
25to 30	**(x * 4248- 67510)**
30 to 35	**(x * 5790 -113770)**
35 to 40	**(x * 7722-181390)**
40 to 50	**(x * 16371 -541750)**
Over 50	**(x * 33462-1378300)**

The rate calculated using the above table will be multiply by the following residential factor based on residential cities in Tehran province. Tehran city and its surrounding cities have a higher price compare with remote cities in Tehran Province:

Cities in Tehran Province	Residential price factor
Tehran city and its surrounding (high-income)	1.45
Middle income cities	1.13
Low income cities and close to the water sources	1.04

Note 1: For consumer with more than 25 cubic meter per months, the above tariff will be increased by 1.25 in summer time (June, July, August and September)
Note 2: Waste water treatment for each household is 70% of their water consumption fee.
Note 3: The above table is for domestic use. There is different tariff for other users such as industry, commercial, governmental office, education, etc.

Methodology, organization involved
The current urban water tariff system is based on a fixed arte that depends on the size of the connection pipe and on the type of customer (domestic, industry, commercial, education, government and public use, etc), and on a volumetric charge based on increasing block-tariffs.

The fixed rate, or the subscription fee, is about 12,000 IRR in 2015 (1USD=37,000 IRR) for the most domestic customers while the structure of variable tariffs is based on a complex formula (tables mentioned in the above question). The formula is the same for all companies and there is no volumetric charge if consumption falls below 15 cubic meters per month. Above this minimum, the tariff increases with the level of consumption and generally varies across companies. The average volumetric tariff for the country stood at about 34,900 IRR in 2015.
Tariff review interval
Annualy, in general.

Staff and time involve
N/A

NWC-5	*Does NWWEC subsidies the companies incurring financial losses in operation* Yes. There is a subsidy for water supply system in Iran. The water tariff is covering only

	20% of actual water price. The subsidy is not a direct subsid, but in the form of budget for operation and development of the network using national budget.
NWC-6	*List of projects financed in the last three years and the size of budget allocation* N/A
NWC-7	*Procurement methods including public announcement requirements and tender* Using standard approaches such as: - Open tendering (majority of cases) - Restricted tendering - RFP (for special projects) - Two Stage Tendering - Request for Quotations - Single-Source (very few cases)
NWC-8	*Procurement decisions and procedure* It has a normal procedure and will be done according to law and regulation.
NWC-9	*Water supply sector development plan in National Development Plan* There is a specific chapter at any NDP regarding water sector. This chapter is about strategy and the way forward for the next five years. We answered this question in other questionnaires.
NWC-10	*Any target of water supply improvement in the National Development Plan* As we answered in other questionnaire, NWWEC is shifting gradually its policy from water resources management to water demand management. Reducing the Non-Revenue Water (NRW) is also one element of NWWEC in NDP. NWWEC objectives and strategies during 6th NDP are as follow: A- Increasing Sewage/Wastewater Treatment capacity to 530 MCM during 6th NDP in order to cover 52% of urban population with access to Sewage/Wastewater Treatment. Comment: At the moment urban wastewater treatment coverage is 41.50%. By the end of 5th NDP (in less than five months from now) the urban wastewater treatment coverage would be 42%. So, during 6th NDP this coverage will increase by 10%. B- Increasing safe and clean urban water supply capacity to 1500 MCM during 6th NDP in order to provide access for 99.8% of urban population. Comment: At the moment, access to drinking water for urban population is 99.1%. By the end of 5th NDP it would be 99.2%. C- Increasing water supply network efficiency by demand management as well as reducing non-revenue water (NRW). The quantitative target for non-revenue water reduction rate is to reduce it by 0.5% per year during 6th NDP (in total 3% during five years of 6th NDP period). Comment: The average non-revenue rate in water supply network of Iran is 26% (based on last estimation on April 2015). However, this rate is based on the best available data and engineering estimation. It is not an accurate calculation. NWWEC believes there are a few percent errors in this estimation. Comment: The target for non-revenue rate reduction in 5th NDP was 1.7% per year. It was too ambitious. It has never achieved. The actual progress in reduction of non-revenue water during 5th NDP is not clear. D- Renovation of old facilities and old water supply pipelines by 10% of total pipe lines

	per year during 6th NDP. E- Installing water meter (water gauge) in all water sources that are using for urban drinking water.
NWC-11	*What is the most serious issue relating to water supply* 1- Government controlled and low water tariff 2- Another reason of the shortage in producible water is the water losses from water distribution systems. In the other hand the water resources hasn't well management. Water distribution network is old, the wastewater collection is not sufficient and there isn't any plan to use the purified sewage. 3- Lack of trained human resources and experts 4- Economic Sanction and difficulty to access advanced technologies and financial support.
NWC-12	*Policy of private sector participation in water supply sector* *Any concession contract, partial operation by private sector, or privatization* In order to increase the private section partnership involvement in water and wastewater plans, the following steps have been taken: - Approving and notifying article 142 of the fifth development plan of the I. R. Iran. - Creating a line for ensuring water / wastewater purchase in the annual budget law. - Improving BOO (Build, Operate, Own) and BOT (Build, Operate, Transfer) contracts with foreign partners When the government decided to use the private sector investment in the irrigation and drainage projects, a special committee in the regional water authorities was established in 1992. In each province, this committee developed a methodology for participation and determined the priority of each project. In 1994, in order to increase the efficiency of the program, the government of Iran approved the private participation as a law cited in article 44 (constitution law) in the parliament and Ministry of Energy was appointed to manage this participation. Since 1994, the Bureau of Irrigation and Drainage Development Projects directs the private sector participation program. This section has issued several guidelines on parameters to be used in project evaluation, discount rates, wages and inflation rates to apply to projects. Up to 1990 the water and sanitation sector was highly decentralized. Most water and wastewater service provision was the responsibility of municipalities and provinces. This was changed through a fundamental sector reform in 1990 with the ratification of the Provincial Water and Wastewater Companies Law of September 1990. In September 2003 the Government of Iran and the World Bank agreed on a sector strategy with the targets for improved cost recovery and collection and increased efficiency. It is not clear what were the baseline data in 2003 and to what extent progress has been made to reach these targets. In November 2008 the government announced that it has approved the construction of 177 dams nationwide. Dams in Iran serve primarily for hydropower generation, irrigation and flood control. However, one of the projects will provide drinking water and water for industrial use to the cities of Qom, Golpaygan, Delijan, Saveh, Khomein and Nimvar in

	the central provinces of Qom, Isfahan and Markazi. In April 2012, the government launched a project to transfer Caspian Sea water to the central regions of Iran, bringing about 200 million cubic meters (7,062 cubic feet) of water per year. As the grounds were paved in recent years for the involvement and investment of the private sector in the national water and wastewater industry; the selection and reference of desalination projects to the private sector have been made by the non-governmental sector while the tasks of ensuring the funds for purchase of water from private investors and all the technical and contractual issues of for the relevant systems are addressed by the Bureau for Procurement of Funds and Participation of Non-Governmental Organizations of the National Water and Wastewater Engineering Company. Fortunately the national water and wastewater sector is leading the pace in the field of private participation in the region and has undertaken great and valuable initiatives in this context to provide better service to the population of Iran. Today, the major bulk of water demands of Iran, particularly the southern regions are supplied by the private sector in the frame of desalination plants. Given the current trend and the expanding participation of private sector, the creation of desalination systems in the country is expected to draw more investors, and promises the accelerated development of private participation in the plans of the water and wastewater industry. **** Refer to the Collected Data List No. 3-4***
NWC-13	*Any performance indicators applied to evaluate water supply condition* N/A
NWC-14	*Details of NWWEC Vision 2021* **According to the NWWEC, the company missions are defined as follows:** 1. Organizing the incumbency activities of Ministry of Energy in water and wastewater affairs, including true management, supervision, leadership and guidance. 2. Desirable use of subgroup companies' facilities within the framework of Ministry of Energy policies towards improving productivity and increasing efficiency. 3. Choose Ministry of Energy for doing supervisions and codifying plans in the context of water and wastewater industry. **The strategies of NWWEC are defined as follows:** 1. Development of a general plan and access to quantitative and qualitative, national and international indicators of water and wastewater towards improving national health and public hygiene and also programming in order to provide potable water and hygienic sewerage disposal services for whole of the society with respect to following the water general plan of the country. 2. Improving the management of supply and demand, the public culture of consumption, as well as designing and executing the optimal potable and hygienic water consuming model in the country. 3. Playing a key role in settling population and industrial centers in logistic programs in proportion with capacities and limitations of water sources of the country. 4. Development of risk management , crisis and passive defense in designing , constructing and operating the installations with the approach of continuous service delivery , decreasing the vulnerability of structures and water and wastewater installations and preventing depletion in quality and quantity of potable water as well as sewerage services.

<table>
<tr><td></td><td>5. Developing the collecting systems and the sewerage filtering systems and recycling and reusing sewerage with a proper quality in relation to the type of consumption, the receptive environment and the market mechanism along with qualitative and quantitative protection of water and environmental sources.
6. Develop the exports of technical, engineering, water and wastewater equipment and the packing of the water and as well presence in the global markets with the approach of strengthening and supporting the private sector.
7. Improving and establish the general and pervasive integrated system (informative and evaluative) of technical , financial , economic and social performance at the level of water and wastewater units and institutions of the country, in order to strengthen the monitoring , evaluation and deciding systems.
8. Bedding and codification of the operational programs for executing and improving the national regulations of buildings , related to optimization of equipment and internal installations of water and wastewater for residential and non-residential units as well as implementation of water branch separations in residential complexes .
9. Diversification of producing systems and distribution of potable and hygienic water as well as using non-conventional waters (such as desalinations , water packing , two network systems in special regions , water separation for different consumptions , rainwater gathering , using air moisture and water distribution stations .
10. Improving the scheme and project management systems with emphasis on prioritization, generalization of engineering economy methods, finishing the incomplete schemes and stepwise operation of schemes during the periods of construction and execution.

The following are some additional information:
- Achieve to 100% water supply coverage in urban and rural area
- Achieve to 60% wastewater treatment coverage in urban area and 30% in rural areas
- Improve industrial wastewater treatment to standard level
- Improve water tariff system for balancing financial operation
- Improving water operation efficiency using advanced technology
- Improve situation of non-revenue water to an acceptable level
- Public awareness for water as an economic good
- Public/private sectors participation in water supply projects
- Improve water distribution system using dual water network and package water
- Shifting to water demand management rather than water supply management</td></tr>
<tr><td>NWC-15</td><td>Results or evaluation of the 5th 5year National Water Supply Plan (2010 – 2015)

It has not been done yet. However, it is widely said that achievement rate is about 60%.</td></tr>
<tr><td>NWC-16</td><td>List of provincial water and wastewater company with their description (Name, jurisdiction, number of WWC, total population, served population, water source, capacity of supply, treatment method, number of house connection, length of pipeline (raw, clear transmission, distribution), NRW ratio, etc.)

The following table includes the requested information about NWWEC (2013):

<table>
<tr><td>Number of provincial water and wastewater companies under NWWEC</td><td>35</td></tr>
<tr><td>Total Population</td><td>55,927,282</td></tr>
<tr><td>Urban population covered by water connection</td><td>54,289,571</td></tr>
<tr><td>Rural population covered by water connection</td><td>893,707</td></tr>
</table>
</td></tr>
</table>

Percentage of population covered by water connection	98.67 %
The number of connections/subscribers	14,447,000
Maximum capacity of water supply	8160 MCM per year
Surface volume of water	2449 MCM per year
Volume of groundwater	2976 MCM per year
Total volume of produced water	5607 MCM per year
The volume of household water sales	3011 MCM per year
The volume of non-domestic water sales	1024 MCM per year
Total volume of water sales	4035 MCM per year
Non-revenue water	25.62 %
The length of water distribution network	142000 km
The length of water transmission line	26,232 km
The capacity of wastewater treatment plants	370,8000 m^3/day

**** Refer to the Collected Data List No. 3-2***

NWC-17

Information explaining "Strategic Program" (recommended by IWA) or "Water Balance Program" to reduce NWR, do you use categorization of NRW defined by IWA?

Yes. NWWEC is following IWA categorization as follow:

<table>
<tr><td rowspan="6">System Input Volume</td><td rowspan="4">Authorized Consumption</td><td rowspan="2">Billed Authorized Consumption</td><td>Billed Metered Consumption</td><td rowspan="2">Revenue Water</td></tr>
<tr><td>Billed Unmetered Consumption</td></tr>
<tr><td rowspan="2">Unbilled Authorized Consumption</td><td>Unbilled Metered Consumption</td><td rowspan="5">Non-Revenue Water</td></tr>
<tr><td>Unbilled Unmetered Consumption</td></tr>
<tr><td rowspan="4">Water Losses</td><td rowspan="2">Commercial Losses</td><td>Unauthorized Consumption</td></tr>
<tr><td>Metering Inaccuracies and Data Handling Errors</td></tr>
<tr><td rowspan="3">Physical Losses</td><td>Leakage on Transmission and/or Distribution Mains</td></tr>
<tr><td>Leakage and Overflows at Utility's Storage Tanks</td></tr>
<tr><td>Leakage on Service Connections up to Point of Customer Metering</td></tr>
</table>

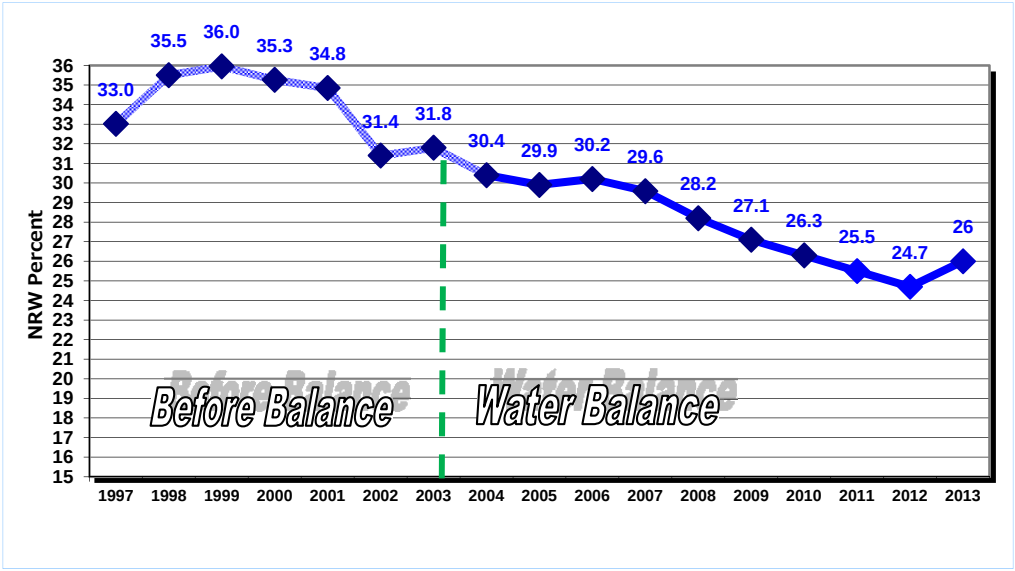
Step by Step Method Driven from IWA in Order to Assess NRW in Water Supply Systems

The IWA Water Balance Program has been implemented in all the national cities (1060 in total) yielding to acceptable outcomes on identifying the conditions of the networks from

the aspects of real losses, apparent losses and Non-Revenue Water. Before the program this form of information was unavailable, while today it is available for every city. Currently all projects in the NWWEC affiliated companies are based on a target oriented strategy and are designed and defined accordingly. The results of the water balance program have illustrated the weaknesses of each network and through
an economic analysis (made possible by the software distributed to each company) the priorities of each NRW reduction project are set. Moreover since successful implementation of Water Balance program depends on accurate measurement of parameters and correct engineering estimation of some components, the companies are encourage to upgrade the measuring equipment at their disposal.

After implementation of Water Balance Program a number of information was obtained on the situation of Non-Revenue Water in Iranian cities, which were not available before.

Figures below present the water balance table based on the NRW components and their ratio for the year 2013.



The NRW percentage in Iran before and after water balance program and the future plan

NWWEC	A	Inputs m³/year % of input	B	Total inputs m³/year % of input	C	Outputs m³/year % of input	D	Outputs m³/year % of input	E	Outputs m³/year % of input	F	Outputs m³/year % of input
National Water and Wastewater Engineering Company (2013)	Well	3046110815 54.3	System input volume	5607292262 100.00	Authorized consumptions	4313986870 76.9	Authorized billed consumptions	4221584901 75.3	Water delivered to other networks (bulk sale)	122071840 2.2	Revenue water	4221584901 75.3
	Qanat	18403933 0.3							Billed metered consumptions	3831848646 68.3		
	Spring	164720621 2.9							Billed unmetered consumptions	267664415 4.8		
	Purchase of treated water	957271910 17.1					Nonrevenue authorized consumptions	92401969 1.6	Unbilled metered consumptions	20024296 0.4	Non-Revenue Water	1385707361 24.7
	WTP input	1348290839 24.0			Water losses	1293305392 23.1			Unbilled unmetered consumptions	72377674 1.3		
	Other sources	72494144 1.3					Apparent losses	550239838 9.8	Unauthorized consumptions	163309242 2.9		
									Data management and system errors	120165803 2.1		
									Meter inaccuracies	266764793 4.8		
							Real losses	Top-Down 743065553 13.3 Down-Top 726665889 13.0	Leakage in distribution network	364845504 6.2		
									Leakage in transmission lines	46916387 0.8		
									Overflows from storage tanks	5303665 0.1		
									Leakage from tanks	15340547 0.3		
									Leakage on service connections	312249785 5.6		

The water balance table based on the NRW components and their ratio for the year 2013

NWC-18	*Any training program, workshop organized by NWWEC periodically for capacity development of staff* NWWEC launched the water balance program in the year 2005, with the objective of assessing and managing the losses in networks of the subsidiary companies. Given the fact that companies had different definitions for UFW components prior to this action, there was an initial need for training the staff on the use of standard terms and for introducing the new indicators and methods for reduction of Non-Revenue Water. To this end the Company undertook extensive activities to train the relevant staff, which included: - Organization of Specialized Training Workshops (350 man/hours) - Organization of a training course (5400 man/hours) - Holding explanatory meetings (640 man/hours) - Organization of 36 local workshops in the companies for urban managers (5700 man/hours) - Cooperation with the WBI for organization of a 2-day workshop targeted at all the Operational Deputies and staff in charge of Non-Revenue Water in the companies. After these activities, NWWEC undertook started to implement the program through measures described below: • Study, translation and compilation of various references • The compilation of Water Balance Manual • Design of software in EXCEL environment • Collecting data from companies, analysis and generating reports

<table>
<tr><td></td><td>

- Defining indicators to control data accuracy and preparing the draft benchmarks for NRW components
- Calculating the acceptable level of NRW (standard) in each city

</td></tr>
<tr><td>NWC-19</td><td>Data of NRW ratio of respective provincial/regional WWC
NRW Rate: 24.7% (2013)
* Refer to the Collected Data List No. 3-1</td></tr>
<tr><td>NWC-20</td><td>Reason of wide variation of NRW ratio (national average: 26%. Some regional ratio is more than 60%)

- Distribution network age
- Water consumption condition (variation)
- Accurate measurement of parameters and correct engineering estimation of some components</td></tr>
<tr><td>NWC-21</td><td>If NWWEC established several center of NRW reduction in nationwide, which city would be selected, Teheran, Mashhad, …..)

- Khansar
- Tehran
- Isfahan
- Hamdan
- Kermanshah
- Mashhad</td></tr>
<tr><td>NWC-22</td><td>Any authorized free connection or free water consumption

Yes. For some public purposes and very low-income households.</td></tr>
<tr><td>NWC-23</td><td>Any regulation relating to water meters
<table>
<tr><th>Title of regulation</th><th>Year of approval and approval reference</th><th>Considerations</th></tr>
<tr><td>No.364- Guideline for Selection, Installation and Maintenance of measuring facilities of Volume of Consumption water (Water Meter) in Drinking Water Network</td><td>2010, MOE, Bureau of Engineering and Technical Criteria for Water and Wastewater</td><td>Including the basic concepts for water measuring in urban and rural water networks/ connections</td></tr>
</table></td></tr>
<tr><td>NWC-24</td><td>Any regulation for unpaid connection

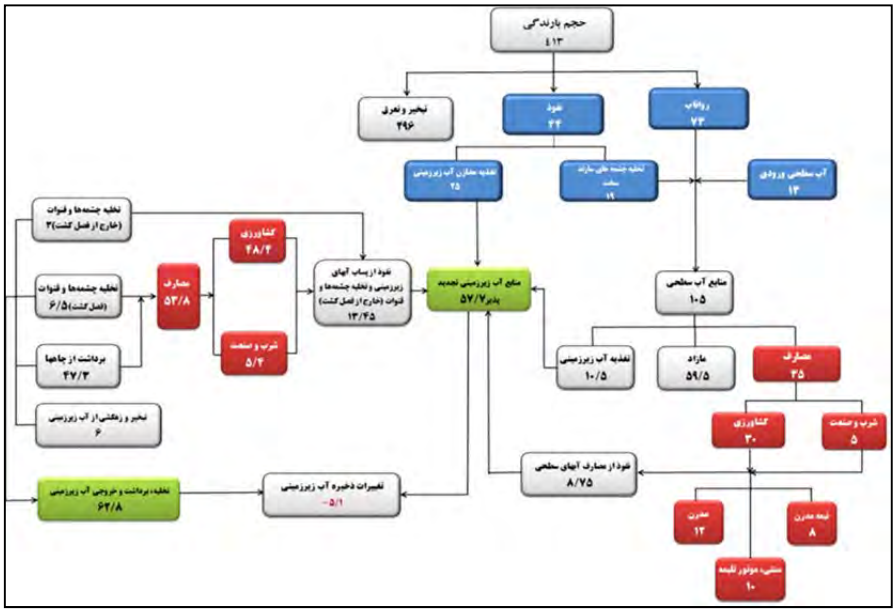
By law, NWWEC and its satellite companies re eligible to disconnect water connection for any unpaid connection.</td></tr>
<tr><td>NWC-25</td><td>Any reports for public awareness, such as annual report
There is several public awareness activities including annual report, billboards, Radio and TV programs as well as smart phone APP.</td></tr>
<tr><td>NWC-26</td><td>How the experiences from JICA Training Course “Urban Water Shortage Management for Iran” were applied

We are not aware of this project. It seems some emergency management office (e.g. after</td></tr>
</table>

<table>
<tr><td></td><td>an earthquake, etc) have been used result of that study.</td></tr>
<tr><td>NWC-27</td><td>Water Quality and Public Health
Monitoring Items, sampling locations and methods
Monitoring frequency
Results of measurements

* Refer to the Collected Data List No. 3-3</td></tr>
<tr><td>NWC-28</td><td>Human Resource Development
Manpower
Number, age and qualification
Recruitment methods for positions, managers, engineers, technicians, clerks etc
Training methods and expenditure
Role of NWWEC and Provincial WWC/Regional WWC

N/A</td></tr>
<tr><td>NWC-29</td><td>Technical standards applied for water supply system including pipeline
<table>
<tr><th>Title of regulation</th><th>Year of approval and approval reference</th><th>Considerations</th></tr>
<tr><td>No.117- Design Criteria of Urban and Rural Water Supply and Distribution Systems</td><td>2013, MOE, Bureau of Engineering and Technical Criteria for Water and Wastewater</td><td>Presentation of design standards for urban and rural water supply and distribution systems</td></tr>
<tr><td>No. 137- Guideline for Operation & Maintenance of Treated Water Reservoirs in Cities</td><td>2012, MOE, Bureau of Engineering and Technical Criteria for Water and Wastewater</td><td>Operating the built reservoirs in urban and rural water supply systems</td></tr>
<tr><td>N0. 420- A draft of Technical Criteria for Modification, Rehabilitation and Improvement of Water Distribution Network</td><td>2014, MOE, Bureau of Engineering and Technical Criteria for Water and Wastewater</td><td>A qualitative evaluation and monitoring of modification, rehabilitation and improvement of water distribution network</td></tr>
<tr><td>No. 556- Guideline for Determining Effective Parameters on Unaccounted for Water (UFW) and Water Losses Reduction Schemes</td><td>2012, MOE, Bureau of Engineering and Technical Criteria for Water and Wastewater</td><td>Comprehensive understanding of Unaccounted Water and relevant parameters, applied methods for basic studies, methods for gathering, analyzing and processing data, executive solutions for water losses reduction, etc.</td></tr>
<tr><td>No. 566- Terms of References of Water Supply Projects «Basic & Detail Design»</td><td>2012, MOE, Bureau of Engineering and Technical Criteria for Water and Wastewater</td><td>Determination of basic standard for implementation of water supply projects studies</td></tr>
</table></td></tr>
</table>

NWC-30	*Ratio of water source, surface water/groundwater* According to the below diagram in Persian from MOE (2011): Annual Ground-water use: 62.8 B.C.M Annual Surface-water use: 35.0 B.C.M **** Refer to the Collected Data List No. 3-3*** 
NWC-31	*Information regarding Waterworks Association in Iran* *Organization* *Function* *Activities* The follow are major Non-governmental association regarding waterworks in Iran:
NWC-3	*Future forecast/plan (national level) of*

Organization name	Site
Iranian Hydropower Association	www.hydropower.org.ir
Iranian Society of Martine and Technology (ISMST)	www.ismst.ir
Iranian Association of Water Resources (IR-W.R)	www.iranwra.com
Iranian Association of Naval Architecture & Marine Engineering	www.iraname.ir
Iranian Civil Society Engineering	isce.aut.ac.ir
Iranian Hydraulic Association	www.iha.ir
Watershed Management Society of Iran	www.wmsi.ir
Iranian Association of Impact Assessment	www.iraneia.ir
Iran Energy Association	www.iranea.ir
Biosafety Society of Iran	www.biosafetysociety.ir
Iranian Society of Environmentalists (IRSEN)	www.irsen.org
Water Research Institute	www.wri.ac.ir
Iran Meteorological Association	www.imsf.ir

2	*Population* *Served Population* *Facility development* *Facility rehabilitation* The population of Iran will be estimated to be 94,924,380 by year 2025.It is projected that up to the year 2021, the access to available water should be as large as 103 billion m^3. It means that agriculture usage will exceed to 95 billion m^3 and drinking and industrial water to 8 billion m^3 respectively. The portion of usage of surface waters will extend from 46 to 54 percent while ground waters decrease from 54 to 46 percent. In other words, about 103 billion m^3 out of 120~130 billion m^3 renewable water is to be considered for the next 25 years Development Plan. The following table illustrates the status of water:

Average precipitation in the country	400 billion m3
Evaporation, percolation and transpiration	270 billion m3
Run-off	130 billion m3
Recharge to ground water tables	38 billion m3
Exploitation from the ground water tables	59 billion m3
Surface water acquisition	33 billion m3

As it is indicated in the above table, the total capacity for water development resources for future is about 12 to 15 billion m3 . Regarding the population growth and decreasing agricultural lands, the water supply and food products will be Iran's two major challenges in the future. In this context, the following issues are to be considered:

- Prevention of losing water in agricultural and urban water sectors
- Increasing water efficiencies
- Changing the consumption patterns
- Renovation and remedial actions of urban water supply networks
- Recycling and treatment of waste and used water
- Utilizing the uncommon waters
- Prevention of water resources pollution
- Prevention of water aquifer depletion
- Increasing of infiltration rate
- Artificial groundwater recharge operations
- Water delivery from far resources to draught region
- Regulated plans for draught combating
- Water supply in crisis conditions

Most importantly uncontrolled population growth and the draught could increase the problems of water shortage and lack of fresh water resources. Hence, the government should take actions to deal with those who do not obey the existing laws and regulations.

**** Refer to the Collected Data List No. 3-1***

Data collection survey on water supply sector in the Islamic Republic of Iran

Questionnaire

Tehran Provincial Water and Wastewater Company (TPWWC)

PWC-1	*Organization chart and number of staff of respective departments/sections* **** Refer to the Collected Data List No. 4-27, 4-28, 4-29, 4-30, 4-31.***
PWC-2	*Financial accounts (profit and loss and Balance Sheet)* **** Refer to the Collected Data List No. 4-23, 4-24.***
PWC-3	*Organization for tariff setting* *Staffing and responsibilities (High Council Approval?)* *Tariff setting mechanism* *Methodology, organization involved* *Tariff review interval* *Staff and time involve* Common in Iran
PWC-4	*List of projects in the last three years and the size of budget allocation* N.A.
PWC-5	*Procurement methods including public announcement requirements and tender* Common in Iran
PWC-6	*Procurement decisions and procedure* Common in Iran
PWC-7	*Water supply sector development plan in Provincial Development Plan* **** Refer to the Collected Data List No. 24, 21.***
PWC-8	*Any target of water supply improvement in the Provincial Development Plan* N.A..
PWC-9	*What is the most serious issue relating to water supply* N.A..
PWC-10	*Policy of private sector participation in water supply sector* N.A..
PWC-11	Any performance indicators applied to evaluate water supply condition N.A..

PWC-12	*List of regional water and wastewater company with their description (Name, jurisdiction, number of WWC, total population, served population, water source, capacity of supply, treatment method, number of house connection, length of pipeline (raw, clear transmission, distribution), NRW ratio, etc)* **** Refer to the Collected Data List No. 4-1～11, 4-14, 4-19.***
PWC-13	*Drawings of water supply system (facilities, pipe network)* N.A..
PWC-14	*Topographic map which shows ground elevation* N.A..
PWC-15	*Any water meter test bench to confirm water meter accuracy* There were a number of laboratories cooperating with the Institute of Standards and Industrial Research of Iran (ISIRI) according to ISO4064 Standard (pre-2005 edition). The ISIRI concluded a memorandum of cooperation with one of the laboratories for the testing of water meters. However, given that the ISIRI has since enforced compliance with the PIML R64 Standard (2013 edition), no laboratory has yet been selected and approved by the Institute.
PWC-16	*Any training program, workshop organized by provincial WWC periodically for capacity development of staff* Common in Iran
PWC-17	*Data of NRW ratio of respective regional WWC* **** Refer to the Collected Data List No. 4-17***
PWC-18	*Any authorized free connection or free water consumption* Certain individuals and institutions are eligible for free water connections including families living on social welfare, mosques, disabled veterans (25% and higher), and families of martyrs [mainly military servicemen and volunteers killed in Iran-Iraq war]. The law has also exempted certain institutions such as mosques, cemeteries for martyrs, and (Islamic and minority) religious institutions from water and wastewater tariffs.
PWC-19	*Any regulation relating to water meters* Regarding the use of remote reading systems in customer meters, a number of pilot projects have been conducted in Tehran Province. However, given the fact that they were all pilot projects, no telecommunications protocol has been determined for this purpose yet. It should be pointed out, however, that in the abovementioned pilot projects, residential meters utilized the M-BUS protocol using radio signals (such as the 868MHz band), and special-use meters (which are scattered throughout TPWWCs) utilized the M-BUS protocol and the GPRS network for data transmission.
PWC-20	*Any regulation for unpaid connection* Customers who fail to pay their water bills shall initially be served a warning notice. Disregard of the warning shall result in disconnection of their water services. In case the customer repeatedly defaults on his/her payments, the WWC

	may even proceed to uninstall the customer's water connection. Customers setting up illegal connections shall be dealt with according to the law.
PWC-21	*Any registered company for construction, connection installation, leak repair, if any, how the license would be issued to such registered company* N.A..
PWC-22	*Status of private sector participation* N.A..
PWC-23	*Use of private companies in the following services:* *- meter reading* *- pipe network repair* *- water facility operations* The reading of customer meters is currently conducted entirely by the private sector. The reading of meters will begin once appropriate administrative processes are completed, contractors are selected, and meter readers have received the necessary training. The readers must read a specific number of meters per day depending on the nature of the terrain and the territory.
PWC-24	*Any subcontracting work relating to NRW reduction to private sector* * ***Refer to the Collected Data List No. 4-25***
PWC-25	*Any reports for public awareness, such as annual report* N.A..
PWC-26	*Major leak points (transmission or distribution pipeline? Branch of house connection? Around water meters?)* N.A..
PWC-27	*Water quantity measurement system, outlet of treatment plant/production groundwater well, outlet of service reservoirs, bulk water meter in distribution system* N.A..
PWC-28	*Transmission and distribution pipe length by its material and its diameter* **** Refer to the Collected Data List No. 4-13***
PWC-29	*Annual Budget of NRW project* N.A..
PWC-30	*Any leaks on trunk main, and how they are detected* **** Refer to the Collected Data List No. 4-32***
PWC-31	*Any staff for leak detection or leak repair* N.A..
PWC-32	*Any leak record sheet or leak repair sheet.* N.A..
PWC-33	*Average time or day for leak repair*

	N.A..
PWC-34	*Materials, spare parts, tools are enough for routine leak repair* N.A..
PWC-35	*Any private contractors for leak detection/repair, their pipe length of leak detection per months, leak detection method, method of leak repair* N.A..
PWC-36	*Leak detection equipment, heavy machine for leak repair, skill of their operation* N.A..
PWC-37	*Number of leaks for one year* N.A..
PWC-38	*Water Quality and Public Health* *Monitoring Items, sampling locations and methods* *Monitoring frequency* *Results of measurements* N.A..
PWC-39	*Human Resource Development* *Manpower* *Number, age and qualification* *Recruitment methods for positions, managers, engineers, technicians, clerks etc* *Training methods and expenditure* N.A..
PWC-40	*Technical standards applied for water supply system including pipeline* N.A..
PWC-41	*Future forecast/plan (provincial level) of* *Population* *Served Population* *Facility development* *Facility rehabilitation* **** Refer to the Collected Data List No. 4-21, 4-22***
PWC-42	*How the outputs from JICA Study "Study on Water Supply System Resistant to Earthquakes in Teheran Municipality in the Republic of Iran" were utilized* N.A..

Data collection survey on water supply sector in the Islamic Republic of Iran

Questionnaire

Zanjan Provincial Water and Wastewater Company (ZPWWC)

PWC-1	*Organization chart and number of staff of respective departments/sections* *The organizational charts and staff numbers of ZPWWC are presented in the attached documents.* **** Refer to the Collected Data List No. 5-2, 5-8, 5-9, 5-10***
PWC-2	*Financial accounts (profit and loss and Balance Sheet)* *Financial statements of the Company in 2014 are presented in the two attached documents.* * ***Refer to the Collected Data List No. 5-4, 5-5***
PWC-3	*Organization for tariff setting* *Staffing and responsibilities (High Council Approval?)* *Tariff setting mechanism* *Methodology, organization involved* *Tariff review interval* *Staff and time involve* All energy tariffs, including water, electricity, and natural gas, are set by the Ministry of Energy. The tariffs proposed by the Ministry are referred to the High Economic Council for approval. Approved tariffs are subsequently notified to all water and wastewater companies around the country.
PWC-4	*List of projects in the last three years and the size of budget allocation* *The list of ZPWWC projects in the past three years is presented in the attached documents.* **** Refer to the Collected Data List No. 5-6, 5-7.***
PWC-5	*Procurement methods including public announcement requirements and tender* All procurements are carried out through tenders and inquiries.
PWC-6	*Procurement decisions and procedure* Please refer to attached documents. (N.A.)
PWC-7	*Water supply sector development plan in Provincial Development Plan* Zanjan and Abhar water supply maps are attached hereto. (N.A.)
PWC-8	*Any target of water supply improvement in the Provincial Development Plan* N.A.

PWC-9	*What is the most serious issue relating to water supply* The most serious issue relating to Zanjan water supply is the old and corroded distribution network, transmission lines, and water supply facilities as well as the drop in groundwater levels and the unsustainable levels of water stored behind the Taham Dam.
PWC-10	*Policy of private sector participation in water supply sector* Policies pursued by the private sector include reducing costs, improving efficiency, and decreasing material warehousing.
PWC-11	*Any performance indicators applied to evaluate water supply condition* Supervision is conducted by the relevant staff members and experts.
PWC-12	*List of regional water and wastewater company with their description (Name, jurisdiction, number of WWC, total population, served population, water source, capacity of supply, treatment method, number of house connection, length of pipeline (raw, clear transmission, distribution), NRW ratio, etc)* N.A.
PWC-13	*Drawings of water supply system (facilities, pipe network)* Drawings of water supply network are presented in document PWC-4 (Concerned documents are not yet found in PWC-4)
PWC-14	*Topographic map which shows ground elevation* There is no comprehensive topographic map available.
PWC-15	*Any water meter test bench to confirm water meter accuracy* Meters are calibrated and tested using a portable [reference] meter.
PWC-16	*Any training program, workshop organized by provincial WWC periodically for capacity development of staff* Training programs and workshops are offered by the NWWEC in province capitals on an annual basis. Ad-hoc courses are also offered on individual WWEC levels as well.
PWC-17	*Data of NRW ratio of respective regional WWC* Please refer to the reports submitted by ZPWWC to the NWWEC.
PWC-18	*Any authorized free connection or free water consumption* According to the Constitution of the Islamic Republic of Iran, disabled war veterans (25% and higher), families of martyrs and deceased former POWs and disabled veterans, and the offspring of disabled veterans (70% and higher) are granted a one-time exemption from all [water and wastewater related] connection expenses for residences not larger than one hundred square meters. Also, all mosques, religious centers, seminaries, martyrs' cemeteries, shrines, and institutions for religious minorities [such as churches, synagogues, etc.] are exempt from water and wastewater tariffs.
PWC-19	*Any regulation relating to water meters* All regulations concerning water meters comply with the standards presented in

	attached documents.
PWC-20	*Any regulation for unpaid connection* Please refer to NWWEC regulations.
PWC-21	*Any registered company for construction, connection installation, leak repair, if any, how the license would be issued to such registered company* Registered companies must submit their applications for appropriate permits (e.g. for network and transmission line expansion and improvement) to the Province Planning and Budget Management Organization.
PWC-22	*Status of private sector participation* Purpose of assigning projects to the private sector is improving productivity (effectiveness + efficiency) including enhancement of quality and reduction of operating costs.
PWC-23	*Use of private companies in the following services:* *- meter reading* *- pipe network repair* *- water facility operations* There are a number of private companies engaged in meter reading, network repairs, and water facility operations.
PWC-24	*Any subcontracting work relating to NRW reduction to private sector* All incidents in different cities of the province are addressed by private sector contractors which are generally considered to be subcontractors.
PWC-25	*Any reports for public awareness, such as annual report* Reports produced for the purpose of raising public awareness are published through the Public Relations Office and the Islamic Republic of Iran Broadcasting (IRIB). Annual reports are published through the [Ministry of Energy] Water Facility Monitoring System and MIS systems.
PWC-26	*Major leak points (transmission or distribution pipeline? Branch of house connection? Around water meters?)* All major leak points (in transmission lines or distribution network) and minor leaks in house connections are recorded and available.
PWC-27	*Water quantity measurement system, outlet of treatment plant/production groundwater well, outlet of service reservoirs, bulk water meter in distribution system* Meters used for measurement of water quantity at outlets of treatment plants, groundwater wells, service reservoirs, and distribution systems are electromagnetic and ultrasonic meters.
PWC-28	*Transmission and distribution pipe length by its material and its diameter* Transmission and distribution pipelines include 1000mm concrete pipes, 500mm asbestos pipes, and 500-700mm cast iron pipes.
PWC-29	*Annual Budget of NRW project* Annual budget allocated by NWWEC for NRW projects is available in the form of legislations.
PWC-30	*Any leaks on trunk main, and how they are detected*

	Detection of leaks on mains is carried out via visual inspections and by use of leak detection equipment. Attached document shows Instructions and Guidelines on the use of Dowsing Rods for Dectection of Buried Pipelines **** Refer to the Collected Data List No. 5-14.***
PWC-31	*Any staff for leak detection or leak repair* Leak detection is carried out by a team of two staff members. Also, a total of 32 staff members are engaged in repair and maintenance work.
PWC-32	*Any leak record sheet or leak repair sheet.* All leaks and repairs are recorded in the 122 system.
PWC-33	*Average time or day for leak repair* The average response time for repair of leaks in the distribution network and service connections is 3 hours.
PWC-34	*Materials, spare parts, tools are enough for routine leak repair* All equipment and spare parts are purchased from reputable manufacturers meeting acceptable quality standards.
PWC-35	*Any private contractors for leak detection/repair, their pipe length of leak detection per months, leak detection method, method of leak repair* Please refer to attached documents. (Attached documents are not yet found.)
PWC-36	*Leak detection equipment, heavy machine for leak repair, skill of their operation* ZPWWC has a number of leak detection equipment at its disposal.
PWC-37	*Number of leaks for one year* The length of distribution network pipelines surveyed for leaks is 300 km annually.
PWC-38	*Water Quality and Public Health* *Monitoring Items, sampling locations and methods* *Monitoring frequency* *Results of measurements* Water is monitored for microbial and physico-chemical contamination, heavy metals, three-halomethanes, toxins and organic matter. Sampling locations and methods are subject to NWWEC standards. Monitoring is conducted on a daily, monthly, and annual basis. The results of measurements are analyzed in accordance with [NWWEC] guidelines and standards.
PWC-39	*Human Resource Development* *Manpower* *Number, age and qualification* *Recruitment methods for positions, managers, engineers, technicians, clerks etc* *Training methods and expenditure* The personnel recruited by ZWWEC are selected based on their university degrees and vacancies in different departments of the Company. Recruitment procedure includes a written admission test and the subsequent obtaining of necessary permits [from NWWEC]. Applicants must be 35 years of age and below. All

	admission tests must be submitted to and approved by the NWWEC.
PWC-40	*Technical standards applied for water supply system including pipeline* Please refer to attached standards.
PWC-41	*Future forecast/plan (provincial level) of* *Population* *Served Population* *Facility development* *Facility rehabilitation* Please refer to document PWC-4. **** Refer to the Collected Data List No. 5-3***

Data collection survey on water supply sector in the Islamic Republic of Iran

Questionnaire

Provincial Level: Isfahan Provincial Water and Wastewater Company (IPWWC)

PWC-1	*Organization chart and number of staff of respective departments/sections* The organizational charts of IPWWC and KWWC are presented in attached documents. **** Refer to the Collected Data List No. 6-4.***
PWC-2	*Financial accounts (profit and loss and Balance Sheet)* N.A.
PWC-3	*Organization for tariff setting* *Staffing and responsibilities (High Council Approval?)* *Tariff setting mechanism* *Methodology, organizations involved* *Tariff review interval* *Staff and time involved* All energy tariffs, including water, electricity, and natural gas, are set by the Ministry of Energy. The tariffs proposed by the Ministry are referred to the High Economic Council for approval. Approved tariffs are subsequently notified to all water and wastewater companies around the country. The only fee WWCs can impose on the provincial level is the fee specified in "Note 3 of the Single Article". **Note 3 of the Single Article:** Increasing expenditures and rising inflation, on the one hand, and the lack of a commensurate increase in connection fees, on the other, is proving to be a serious challenge for water and wastewater companies. Currently, the cost of installing one water and wastewater connection is 4.5 million tomans, while in Isfahan Province, the highest fee charged to subscribers for this purpose is 1.3 million tomans, with the lowest fee being only 500 thousand tomans. One way of responding to this challenge was the effective use of the potential provided by Note 3 of the Single Article which states that preparation expenses can

be charged to the customers.

Until the City Council convenes, a statutory body composed of the Governor-general [of the province], the head of the Province Budget and Planning Organization, the general manager of the Province Water and Wastewater Company, and two parliament representatives [of that province], shall be authorized to evaluate and approve mechanisms of public participation in WWEC projects as proposed by the province WWCs. The outcome of these meetings shall be referred to the Ministry of Energy for final approval and notification to WWECs throughout that province.

From 1997 to the present, 43 cities have, in cooperation with city councils, introduced legislations on imposing preparation fees on customers in order to improve their water distribution and wastewater collection infrastructure. In certain cities, such as Isfahan, two consecutive legislations have been enacted thus far (with the second being more of an amendment to the first legislation).

The procedure for obtaining a permit from city councils is as follows:

Coordination with Engineering and Development Deputy of the company in order to establish the expenses to be covered (including costs of transmission lines, internal networks, treatment plants, etc.)

Determining the revenue to be generated by the legislation according to the number of subscribers affected.

Calculation of expenses to be charged to each individual household and submission of the proposal to the city council followed by negotiations to obtain the permit.

After proposal is approved by the city council, the legislation will be referred to the office of the Minister of Energy for final approval.

Calculation methods:

Several methods have since been used to calculate the fees introduced in legislations. The methods can be found in appendix 3. Please note that these fees are charged only upon installation of new connections.

water tariff and connection fees review interval

Water tariffs and connection fees are not reviewed on a regular basis. For instance, connection fees were updated once in 2006 and remained unchanged until the end of 2014.

According to the Fifth Five-Year Development Plan (2010-2015), it was decided that water tariff would increase by 20 percent every year reaching its real price by the end

	of 2015. In December of 2010, the first stage of the plan was implemented in line with the Subsidy Reform Plan and the water tariff was raised by 20 percent. The tariff was raised twice more in the following years (2013 and 2015), but ultimately failed to reach the goal set in the Fifth Development Plan.
PWC-4	*List of projects in the last three years and the size of budget allocation* N.A.
PWC-5	*Procurement methods including public announcement requirements and tender* All procurements, tenders, and auctions are carried out in accordance with company operational regulations and bylaws which are attached. It should be noted that the abovementioned regulations are under review and amendment. **** Refer to the Collected Data List No. 6-11.***
PWC-6	*Procurement decisions and procedure* Procurements in WWCs are divided into three categories based on the amount of funds required. Procurements up to 13.7 million tomans: These deals are made possible upon provision of one to three invoices. The party in charge of establishing the quality and price of the procured items is the supplier. Procurements between 13.7 and 137 million tomans: These procurements are made through tenders, single source procurement, and price inquiry. Price inquiries and / or single source procurements must be approved by the Trade Commission. The party in charge of the procurement in this category is the supplier and the business manager. Procurements above 137 million tomans: These deals may only be made through tenders and /or single source procurements. The party in charge of arranging the procurements is the Tender Commission. The chairman of the commission is the general manager of the WWEC, the secretary of the commission is the manager of company contracts, and the main members of the commission are the deputy for operations, technical and development deputy, finance deputy, deputy for human resources and management improvement, deputy for revenues, and the customer service deputy. There are also specialized quality approval committees in charge of evaluating the quality of requested items and making appropriate decisions. It should be mentioned that the general manager of the NWWEC reviews and

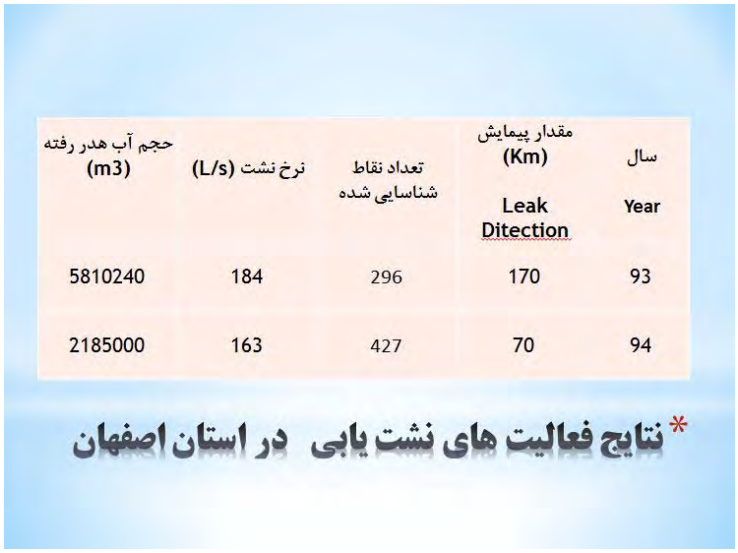
	updates the abovementioned ceilings on an annual basis (further information in appendix 5).
PWC-7	*Water supply sector development plan in Provincial Development Plan* Water supply sector development plans are introduced on an annual basis provided that sufficient government funding is available. For instance, the city of Khansar has reported 13 km of network expansion during the past three years of which 10 km is the water supply pipeline to Khansar (Ghomroud Plan).
PWC-8	*Any target of water supply improvement in the Provincial Development Plan* The IPWWC has embarked on a project to enhance the smartness of its distribution network with the aim of improving water supply and providing more equitable distribution services to its customers. This project will be implemented in three phases. Phase one: monitoring and clarification of dynamic information Determination of key location for the installation of pressure measurement devices Design and manufacture of pressure measurement and monitoring devices and instantaneous transmission of pressure data Installation of pressure measurement stations Establishing the necessary infrastructure and designing a software package for reception, storage, and display of the measurements Phase two: modeling and hydraulic analysis of the network and offering solutions Analysis of the hydraulic model of the current situation Presentation and completion of the plan for improvement and expansion of the distribution network Formulation of guidelines on operationalization of a manual and local transmission and distribution network Development of a model for operationalization of a smart distribution network Phase three: utilization of analysis results Installation of valves and control equipment Network improvement including installation and elimination of pipelines for the purpose of isolation Conducting the zero pressure test and other test for the purpose of controlling isolation

	It is worth pointing out that phase one has been implemented in the City of Isfahan and all pressure measurement and monitoring stations have been installed around the city. The IWWEC has negotiated contracts with the private sector for the completion of the other phases and the project is under implementation. In other cities of the Isfahan Province, pressure measurement devices have been purchased and are being installed. For instance, 15 purchases have been made for the city of Khansar.
PWC-9	*What is the most serious issue relating to water supply* The most important issue facing all water and wastewater companies around the country is the limited water resources. Successive droughts in recent years and the falling groundwater levels, which are also the result of excessive water drawing, are of major concern to people and the officials. In addition to limited water resources, old and aging water supply networks and customer connections are other sources of concern for water and wastewater companies. Lack of high-quality and technologically advanced precise instruments is yet another problem facing plaguing water and wastewater companies.
PWC-10	*Policy of private sector participation in water supply sector* Currently, cooperation of IPWWEC with the private sector is in the form of guaranteed purchase of water through B.O.O. and B.O.T. contracts. For instance, two B.O.O. contracts have been concluded regarding the installation and operationalization of desalination units in the cities of Farrokhi and Mahabad. IPWWEC is also bidding for two B.O.T. contracts concerning the transmission line from the city of Dehaaghaan as well as the expansion of the capacity of Isfahan water treatment plant.
PWC-11 11	*Any performance indicators applied to evaluate water supply condition* IPWWC evaluates the performance of all departments against criteria set by senior managers. These criteria are established on a national level and announced to all WWCs throughout the country. Attached documents presents performance criteria relating to the department of operations. **** Refer to the Collected Data List No. 6-10.***

PWC-12	*List of regional water and wastewater company with their description (Name, jurisdiction, number of WWC, total population, served population, water source, capacity of supply, treatment method, number of house connection, length of pipeline (raw, clear transmission, distribution), NRW ratio, etc.)* Currently, IPWWC covers 93 cities in the province. These 93 cities are covered by 34 autonomous districts each with its own water and wastewater company whose managers are appointed by the general manager of IPWWC. Full details of cities covered are presented in attached documents. **** Refer to the Collected Data List No. 6-14.***
PWC-13	*Drawings of water supply system (facilities, pipe network)* N.A.
PWC-14	*Topographic map which shows ground elevation* N.A.
PWC-15	*Any water meter test bench to confirm water meter accuracy* IPWWC is equipped with a water meter test bench rendering services to all WWECs in the province. The activities of this laboratory are divided into two parts: Testing all metered purchased for IPWWC Testing of meters following complaints from customers The above activities are carried out using two Turkish-made test benches (Baylan Co.) and an Iranian-made complementary test bench. The technical specifications of the above test benches are presented in attached documents. **** Refer to the Collected Data List No. 6-7.***
PWC-16	*Any training program, workshop organized by provincial WWC periodically for capacity development of staff* According to a Ministry of Energy Directive entitled "Comprehensive System of In-Service Training" (****Refer to the Collected Data List No. 6-12.***), IPWWEC offers training courses for its entire workforce. The course curriculum for each individual is developed based on their education and position in the company. Currently, in-service courses are organized by the Isfahan Province Water and Electricity Center for Education and Research (affiliated with the Ministry of Energy). It should be mentioned that the company is also planning on offering training courses to contractors and the private sector.

PWC-17	*Data of NRW ratio of respective regional WWC* **** Refer to the Collected Data List No. 6-14.***
PWC-18	*Any authorized free connection or free water consumption* An approximate 1 percent of all water produced annually is consumed free of charge. Unbilled authorized consumption includes the following: Consumption by religious centers (mosques, etc.) Water required to wash treatment plant filters Water required to wash reservoirs / storage tanks and the water distribution network
PWC-19	*Any regulation relating to water meters* All regulations concerning water meters had been in compliance with ISO 4064 standards up until last year. However, the standard adopted since last year is OIML-R49. The above standards may be found in appendix 19.
PWC-20	*Any regulation for unpaid connection* All activities relating to customer services of WWECs are subject to the NWWEC regulations introduced by the Ministry of Energy. The following sections in the MoE regulations describe the procedures for dealing with defaulting customers. 4-34-48, 4-34-6, 4-42, 4-23-1, 4-40-2, 4-39-2 **** Refer to the Collected Data List No. 6-13.***
PWC-21	*Any registered company for construction, connection installation, leak repair, if any, how the license would be issued to such registered company* No particular action has been taken so far regarding the assignment of projects to private companies holding specific licenses. However, certain plans are being prepared by the NWWEC and will be announced to water and wastewater companies around the country shortly.
PWC-22	*Status of private sector participation* N.A.
PWC-23	*Use of private companies in the following services:* *- meter reading* *- pipe network repair* *- water facility operations*

	N.A.
PWC-24	*Any subcontracting work relating to NRW reduction to private sector* No contracts have been concluded with the private sector in this field so far. However, the company is preparing contracts to assign a number of projects to the private sector, including the entire operation of a city or leak detection activities where the private sector will get paid in proportion to the number of leaks detected and the amount of NRW reduced.
PWC-25	*Any reports for public awareness, such as annual report* **** Refer to the Collected Data List No. 6-23.***
PWC-26	*Major leak points (transmission or distribution pipeline? Branch of house connection? Around water meters?)* Since IPWWC's leak detection activities are carried out by two teams of two (four individuals in total), no customer connection surveys have been planned for cities in the province other than the city of Isfahan. However, upon receiving calls from customers, leak detection teams in cities such as Khansar are dispatched to the location and register the leak points in their files. Major leak points are presented in attached documents. 40 percent of the marked leak points are in the distribution network, 55 percent in connections, and 5 percent around water meters.
PWC-27	*Water quantity measurement system, outlet of treatment plant/production groundwater well, outlet of service reservoirs, bulk water meter in distribution system* N.A..
PWC-28	*Transmission and distribution pipe length by its material and its diameter* N.A..
PWC-29	*Annual Budget of NRW project* NWWEC allocates an annual NRW reduction budget to certain cities of the province including Khansar (# 40902057). Budgets allocated during the past three years are presented in attached documents. **** Refer to the Collected Data List No. 6-22.***

PWC-30 30	*Any leaks on trunk main, and how they are detected* N.A..
PWC-31	*Any staff for leak detection or leak repair* As stated in response to question 26, leak detection is currently carried out by two teams of two (four individuals in total). For the purpose of connection surveys, FSB leak detection devices have been purchased for a number of cities in the province including Khansar, Golpayegan, and Isfahan.
PWC-32	*Any leak record sheet or leak repair sheet.* All leak detection requests and reports as well as the calculation of the volume of water loss are registered in the Integrated Geographical Information Management (IGIM[1]) software since October 2015. For further information on leak detection activities in the past two years, please refer to attached documents. **** Refer to the Collected Data List No. 6-24, 6-25, 6-26.*** 
PWC-33 33	*Average time or day for leak repair*

[1] NAJMA in Persian

	Since leak detection team are solely responsible for the detection of leaks and the repairs are the domain of maintenance teams, the average response time depends on the location and significance of the leak. For instance, in cases where the leak can potentially result in substantial amount of water loss, nearby maintenance teams will be dispatched to the location immediately. However, if minor leaks are reported at nighttime or discovered during leak detection surveys, maintenance teams may be dispatched one to three hours later to fix the issue.
PWC-34	*Materials, spare parts, tools are enough for routine leak repair* Yes. All equipment and spare parts are purchased by the IPWWC and distributed to different regions and cities according to their needs. Each region/city must prepare and submit [to IPWWC] an inventory of required items for the following year before it runs out of those items.
PWC-35	*Any private contractors for leak detection/repair, their pipe length of leak detection per months, leak detection method, method of leak repair* No private company is currently involved in leak detection activities. However, private sector participation in leak detection is among the future plans of the IPWWC.
PWC-36	*Leak detection equipment, heavy machine for leak repair, skill of their operation* The list of equipment used for leak detection is as follows: Two FSB devices for connection surveys Two DNR18 devices for pipeline surveys Two power drills for sound probing (to ensure leak location) Diving Rod and GPR systems to identify the location of underground facilities and discover illegal connections Two vehicles for transportation Given the lack of technical expertise among IPWWC staff, the company sent the four members of the leak detection teams to Tehran to participate in a week-long training course on how to operate the equipment. Obviously, the course has not been able to meet the training needs of the teams and they are currently acting on personal experience. What is needed is that these teams acquire new expert knowledge and be familiarized with the latest technologies in the world.

PWC-37	*Number of leaks for one year* The number of leaks detected and marked in recent years is as follows: 296 leaks in 2014 and 427 leaks in 2015
PWC-38	*Water Quality and Public Health* *Monitoring Items, sampling locations and methods* *Monitoring frequency* *Results of measurements* N.A.
PWC-39	*Human Resource Development* *Manpower* *Number, age and qualification* *Recruitment methods for positions, managers, engineers, technicians, clerks etc* *Training methods and expenditure* All recruitment is conducted through an employment exam and a subsequent interview with the applicants. According to the Ministry of Energy Directive "Comprehensive System of In-Service Training" (appendix 16), an average of 80 hours of training is offered to each employee in a year. On average, 1.2 million tomans is spent on training each employee every year.
PWC-40	*Technical standards applied for water supply system including pipeline* All standards applied by IPWWC regarding pipe-laying or construction of facilities comply with standards set by the Iranian Organization for Management and Planning. Regarding standards applied to the distribution network, please refer to the attached file on distribution network standards. **** Refer to the Collected Data List No. 6-31.***
PWC-41 41	*Future forecast/plan (provincial level) of* *Population* *Served Population* *Facility development* *Facility rehabilitation* For information on Isfahan province population projections, please refer to attached document. (One hundred percent of the province urban population is covered by urban water and wastewater companies.) **** Refer to the Collected Data List No. 6-8.***

	Facility development is conducted based on the needs and development plans of the municipalities of each city. Currently, the only development plan on the agenda is the construction of a treatment plant and water supply to the distribution network (Ghomroud Plan).

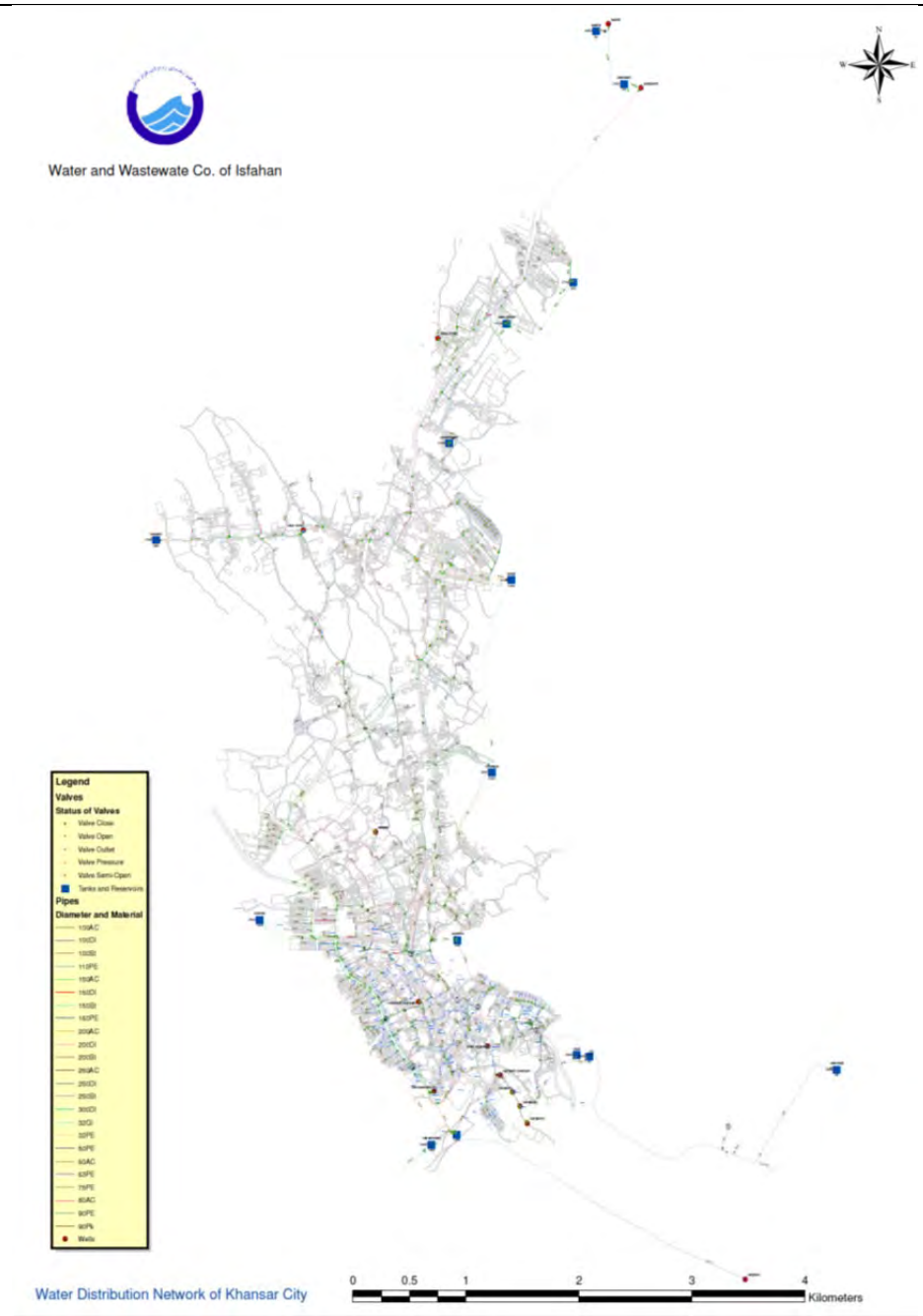
Data collection survey on water supply sector in the Islamic Republic of Iran

Questionnaire

Regional Level: Khansar Regional Water and Wastewater Company (KWWC)

RWC-1	*Organization chart and number of staff of respective departments/sections* **** Refer to the Collected Data List No. 6-4.***
RWC-2	*Financial accounts (profit and loss and Balance Sheet)* **** Refer to the Collected Data List No. 6-6.***
RWC-3	*Organization for tariff setting* *Staffing and responsibilities (High Council Approval?)* *Tariff setting mechanism* *Methodology, organization involved* *Tariff review interval* *Staff and time involve* Refer to answer PWC-3 of IPWWC Questionnaire form
RWC-4	*List of projects in the last three years and the size of budget allocation* **** Refer to the Collected Data List No. 6-9.***
RWC-5	*Procurement methods including public announcement requirements and tender* Same as Isfahan.
RWC-6	*Procurement decisions and procedure* Same as Isfahan.
RWC-7	*Any development plan* (from answer of IPWWC) Water supply sector development plans are introduced on an annual basis provided that sufficient government funding is available. For instance, the city of Khansar has reported 13 km of network expansion during the past three years of which 10 km is the water supply pipeline to Khansar (Ghomroud Plan).
RWC-8	*Any target of water supply improvement* (from answer of IPWWC) In other cities of the Isfahan Province, pressure measurement devices have been purchased and are being installed. For instance, 15 purchases have been made for the city of Khansar.
RWC-9	*What is the most serious issue relating to water supply* Same as Isfahan.
RWC-10	*Any performance indicators applied to evaluate water supply condition* Same as Isfahan.

RWC-11	*Description of water supply system (Name, jurisdiction, number of WWC, total population, served population, water source, capacity of supply, treatment method, number of house connection, length of pipeline (raw, clear transmission, distribution), NRW ratio, etc)* **** Refer to the Collected Data List No. 6-2.***
RWC-12	*Any training program, workshop organized by regional WWC periodically for capacity development of staff* All the training courses are the same for Isfahan personnel. Through an integrated approach, the introduction/enlisting of the staff for participation is to be done based on their job grades and by the training center of IPWWC.
RWC-13	*Drawings of water supply system (facilities, pipe network)* **** Refer to the Collected Data List No. 6-2.***

	
RWC-14	*Topographic map which shows ground elevation* N.A.
RWC-15	*Any water meter test bench to confirm water meter accuracy* Meter test bench is installed in Isfahan PWWC
RWC-16	*Data of NRW ratio* **** Refer to the Collected Data List No. 6-2.***

RWC-17	*Any authorized free connection or free water consumption* Same as Isfahan.
RWC-18	*Any regulation relating to water meters* Same as Isfahan.
RWC-19	*Any regulation for unpaid connection* Same as Isfahan.
RWC-20	*Any registered company for construction, connection installation, leak repair, if any, how the license would be issued to such registered company* Same as Isfahan.
RWC-21	*Status of private sector participation* (from answer of IPWWC) All projects assigned to the private sector in Khansar (including operations of wells and storages, installation of connections, and reading of customer meters) along with their costs are detailed in attached documents. **** Refer to the Collected Data List No. 6-9.***
RWC-22	*Any subcontracting work relating to NRW reduction to private sector* Same as Isfahan.
RWC-23	*Any reports for public awareness, such as annual report* **** Refer to the Collected Data List No. 6-15, 6-16, 6-17, 6-18, 6-19.***
RWC-24	*Information of Manufacturer, Country of Origin, Year of Procurement of pumps, disinfection equipment, pipe materials, valves, bulk water meter, water meter* In case the equipment/devices/items needed by the national waste/water companies are not manufactured domestically, only then a foreign procurement is permitted and feasible. For example, some of the flow meters and volume-meters are purchased from BadgeMeter or Krone by IPWWC.
RWC-25	*Any zoning applied to distribution area for distribution control or pressure control* No zoning is applied
RWC-26	*Any candidate area for pilot NRW reduction project implementation* Yes, one pilot project area was selected in southern part of the city.
RWC-27	*Major leak points (transmission or distribution pipeline? Branch of house connection? Around water meters?)* 40 percent of the marked leak points are in the distribution network, 55 percent in connections, and 5 percent around water meters. The map relating to leak detection points was also submitted.
RWC-28	*Water quantity measurement system, outlet of treatment plant/production groundwater well, outlet of service reservoirs, bulk water meter in distribution system* The flow-meters as installed in the output of the wells were shown as well as the table and schematic map of the networks hydraulic was attached where the

<table>
<tr><td></td><td>locations/coordinates of the relative flow-meters in wells, tanks outlets, volume-meters, and their brand/make were also mentioned.</td></tr>
<tr><td>RWC-29</td><td>Transmission and distribution pipe length by its material and its diameter

<table>
<tr><th>Material</th><th>Diameter(mm)</th><th>L (m)</th></tr>
<tr><td>Ac</td><td>100</td><td>37278</td></tr>
<tr><td>DI</td><td>100</td><td>5157.5</td></tr>
<tr><td>ST</td><td>100</td><td>26.41</td></tr>
<tr><td>PE</td><td>110</td><td>17489.15</td></tr>
<tr><td>AC</td><td>150</td><td>17409.13</td></tr>
<tr><td>DI</td><td>150</td><td>4392.5</td></tr>
<tr><td>ST</td><td>150</td><td>821.2</td></tr>
<tr><td>PE</td><td>160</td><td>2038.81</td></tr>
<tr><td>AC</td><td>200</td><td>7.91</td></tr>
<tr><td>DI</td><td>200</td><td>6177.18</td></tr>
<tr><td>ST</td><td>200</td><td>2480.44</td></tr>
<tr><td>AC</td><td>250</td><td>6010.67</td></tr>
<tr><td>DI</td><td>250</td><td>4080.73</td></tr>
<tr><td>ST</td><td>250</td><td>44.64</td></tr>
<tr><td>DI</td><td>300</td><td>1377.99</td></tr>
<tr><td>GL</td><td>32</td><td>60.75</td></tr>
<tr><td>PE</td><td>32</td><td>645.77</td></tr>
<tr><td>PE</td><td>50</td><td>385.45</td></tr>
<tr><td>AC</td><td>60</td><td>486.77</td></tr>
<tr><td>PE</td><td>63</td><td>3750</td></tr>
<tr><td>PE</td><td>75</td><td>259.12</td></tr>
<tr><td>AC</td><td>80</td><td>17957.69</td></tr>
<tr><td>DI</td><td>80</td><td>625.74</td></tr>
<tr><td>PE</td><td>90</td><td>7641.65</td></tr>
<tr><td>PK</td><td>90</td><td>89.53</td></tr>
</table></td></tr>
<tr><td>RWC-30</td><td>Annual Budget of NRW project

NWWEC allocates an annual NRW reduction budget to certain cities of the province including Khansar (# 40902057). Budgets allocated to Khansar during the past three years are presented in attached answer sheet.

* Refer to the Collected Data List No. 6-22.</td></tr>
<tr><td>RWC-31</td><td>Any leaks on trunk main, and how they are detected

* Refer to the Collected Data List No. 6-33.</td></tr>
<tr><td>RWC-32</td><td>Any staff for leak detection or leak repair

No specific staff is assigned only for leak detection/repair.</td></tr>
<tr><td>RWC-33</td><td>Any leak record sheet or leak repair sheet.

Yes, there is leak record.</td></tr>
<tr><td>RWC-34</td><td>Average time or day for leak repair

Refer to answer PWC-33 of IPWWC Questionnaire form</td></tr>
<tr><td>RWC-35</td><td>Materials, spare parts, tools are enough for routine leak repair

Yes, all materials required are supplied by Isfahan PWWC.</td></tr>
<tr><td>RWC-36</td><td>Any private contractors for leak detection/repair, their pipe length of leak detection per months, leak detection method, method of leak repair

Same as Isfahan.</td></tr>
<tr><td>RWC-37</td><td>Leak detection equipment, heavy machine for leak repair, skill of their operation</td></tr>
</table>

	Khansar is in possession of one single leak-detection equipment for FBS branches by FUJI manufacturer, purchased last year.
RWC-38	*Number of leaks for one year* N.A.
RWC-39	*Water Quality and Public Health* *Monitoring Items, sampling locations and methods* *Monitoring frequency* *Results of measurements* **** Refer to the Collected Data List No. 6-32.***
RWC-40	*Human Resource Development* *Manpower* *Number, age and qualification* *Recruitment methods for positions, managers, engineers, technicians, clerks etc* *Training methods and expenditure* (from answer of Isfahan) Staff members employed in KWWC are as follows: 9 permanent (on 30-year contracts), one company, 8 contractors. The full details of the KWWEC personnel are presented in appendix 1 (Khansar organizational chart).
RWC-41	Technical standards applied for water supply system including pipeline Same as Isfahan.
RWC-42	*Future forecast/plan (regional level) of* *Population* *Served Population* *Facility development* *Facility rehabilitation* (from answer of Isfahan) Given the fact that 60 percent of Khansar water supply facilities are old and worn and due to the financial restrictions KWWEC is suffering from, there is no plan to rehabilitate facilities such as connections or the distribution network on a regular basis; rather, renovation and replacement is done only when an incident is reported.

Following question is only for Kansar Water and Wastewater Company (KWWC)

RWC-43	*Description and status of project progress of the new project of water transmission through Qomrud Tunnel and construction of new water treatment plant* By operating Khansar water supply project from QomRood tunnel, the demand for drinking water of 54,000 & rural subscribers will be satisfied. Khansar water supply project is implemented through 34 kilometers of cast/steel, ductile pipe networks, 500 mm diameter. And 4 kilometers of return pipe line from the treatment plant via 400 mm & 250 mm diameter pipes. To construct two tank 2,000 cubic meters and a suction tank 1,000 cubic meters for

	dewatering and watering with a flow of 80 liters per second and a height of 460 m length of 32 km of the exit tunnel to the water treatment plant from Qomroud outlet to water treatment plant. Intake pool and Pumping Station No. 1 of Khansar is completed at an estimated amount of about one billion and 890 million Rials. Also, phase 3 by laying 11 km transmission pipe line with 500 mm diameter from steel and cast iron pipe is set from the pumping station No. 1. Moreover, the construction of over 3,800 meters of distribution network lines for Wist Village area is over now. The pump station No. 2 and the 1,000 c/m suction tank for Kahart is completed. Phase 2 water distribution network, 500 mm, steel/cast, is now completed. The implementing operation for 9,250 meters of 500 mm cast/iron distribution network from the balance tank to water treatment plant is now completed, together with the 2,000 cubic meter tank from phase 1. This project incurred over 7 billion and 120 million Rials as the project cost. The silo for emergency phase is now constructed at water treatment plant site, at a cost of 2,670,000,000 Rials. Also, Maskan Mehr 2,000 c/m tank and the return pipeline, 3,900 meters, 400 mm diameter, as the return line from the water treatment plant to Shahed tank, and the 250 mm line to Maskan Mehr tank are now completed. It is the 2041 outlook that estimates Khansar urban and rural population will reach 54,000 people with a water demand about 3,5 million cubic meter annually. Once Khansar water supply project gets operational & functional, Maskan Mehr residentials will also benefit from this great project and its outcome. Khansar water supply project has cost more than 200 billion Rials since 2009 and will be soon operational.

Data collection survey on water supply sector in the Islamic Republic of Iran

Questionnaire

Mashhad Water and Wastewater Company (MWWC)

PWC-1	*Organization chart and number of staff of respective departments/sections* **** Refer to the Collected Data List No. 7-2.***
PWC-2	*Financial accounts (profit and loss and Balance Sheet)* **** Refer to the Collected Data List No. 7-3.***
PWC-3	*Organization for tariff setting* *Staffing and responsibilities (High Council Approval?)* *Tariff setting mechanism* *Methodology, organization involved* *Tariff review interval* *Staff and time involve* Common in Iran
PWC-4	*List of projects in the last three years and the size of budget allocation* **** Refer to the Collected Data List No. 7-5.***
PWC-5	*Procurement methods including public announcement requirements and tender* Publication is a high-circulation newspaper (twice); registration in the national database for biddings; publication on the Company website
PWC-6	*Procurement decisions and procedure* In a collaborative manner and through holding meetings
PWC-7	*Water supply sector development plan in Provincial Development Plan* Water transmission from the Ardak Dam and Hezar Masjed lime formations; replacement of Eastern and Western Mashhad sewage with agricultural water; transmission of water from the sea; collection from wells (phase 1: 571 l/s)
PWC-8	*Any target of water supply improvement in the Provincial Development Plan* Same as answer for PWC-7
PWC-9	*What is the most serious issue relating to water supply* N.A.
PWC-10	*Policy of private sector participation in water supply sector* Fourteen wells (310 l/s); collection from wells (460 l/s)
PWC-11	*Any performance indicators applied to evaluate water supply condition* Considering the shortage of water resources and the need to find new resources
PWC-12	*List of regional water and wastewater company with their description (Name, jurisdiction, number of WWC, total population, served population, water source, capacity of supply, treatment method, number of house connection, length of*

	pipeline (raw, clear transmission, distribution), NRW ratio, etc) Not applicable.
PWC-13	*Drawings of water supply system (facilities, pipe network)* **** Refer to the Collected Data List No. 7-4.***
PWC-14	*Topographic map which shows ground elevation* N.A.
PWC-15	*Any water meter test bench to confirm water meter accuracy* There is one workshop
PWC-16	*Any training program, workshop organized by provincial WWC periodically for capacity development of staff* An average 60 hours of annual training on a periodic basis
PWC-17	*Data of NRW ratio of respective regional WWC* 20.65 percent
PWC-18	*Any authorized free connection or free water consumption* 12 percent including washing of the distribution network, internal consumption, water hydrants, free water tanks sent to residential complexes
PWC-19	*Any regulation relating to water meters* Water meter standards: Iranian national standard, ISO 4064, OIML
PWC-20	*Any regulation for unpaid connection* N.A.
PWC-21	*Any registered company for construction, connection installation, leak repair, if any, how the license would be issued to such registered company* For leak detection: Gohar Ab Azerbaijan, Ab San'at Energy, Abadgarane Barsava, Zharf Ab Aveed, Farayande Zamin Pardaz, Nashte Javvi Kabir For repairs: Shargh Dezh Gostare Tous, Abad Negin Azarang, Abnavaze Shargh, Zarrin Sakht Sanabad, Jaddeh Sazan Tous, Nazanin Gole Tous, Gostaresh Pajouhane Ofogh Negar
PWC-22	*Status of private sector participation* Same as answer for PWC-21
PWC-23	*Use of private companies in the following services:* *- meter reading* *- pipe network repair* *- water facility operations* The reading of meters and maintenance of pipes is carried out by the private sector. Operationalization of water facilities is conducted partly on consignment and partly through contracts with private contractors.

PWC-24	*Any subcontracting work relating to NRW reduction to private sector* Leak detection, renovation and rehabilitation of connections, and improvement of the network
PWC-25	*Any reports for public awareness, such as annual report* N.A.
PWC-26	*Major leak points (transmission or distribution pipeline? Branch of house connection? Around water meters?)* The annual number of leaks is estimated at 90 in the main network and 890 in connections.
PWC-27	*Water quantity measurement system, outlet of treatment plant/production groundwater well, outlet of service reservoirs, bulk water meter in distribution system* All water supply resources are equipped with meters. They're mostly magnetic meters with a small number being ultrasonic meters.
PWC-28	*Transmission and distribution pipe length by its material and its diameter* The transmission pipeline is 445 kilometers in length and is mostly made of steel. The length of the distribution network is 4470 km composed of the following materials: 59.9% AC, 6.2% CI, 0.2% GRP, 22.8% PE, 6.4%
PWC-29	*Annual Budget of NRW project* Five billion rials (500m tomans) is spent on leak detection along 2500km of pipelines every year. The budget allocated to network improvement, rehabilitation of connections, meter replacement, and regularization of illegal connections will be announced later.
PWC-30	*Any leaks on trunk main, and how they are detected* Detection of leakage in the network and connections using leakage detectors, geophones, and leak noise correlators. The volume of leakage is 1000 m3/km of which 62 percent is attributed to connections and 38 percent to the network.
PWC-31	*Any staff for leak detection or leak repair* Number of permanent personnel (on 30-year employment contracts) for leak detection and supervision: 5
PWC-32	*Any leak record sheet or leak repair sheet.* Number of leaks: Connections: 29489 Transmission pipeline water pools: 9 Distribution network water pools: 215 transmission pipeline: 34 distribution network: 3093
PWC-33	*Average time or day for leak repair* Average time to fix: bursts in pipes: 98 min holes in pipes: 97 min breaks in welded joints: 39 min bursts in joints: 86 min leaks from joints: 65 min

	leaks from meter inflows and outflows: 32 min leaks from stop valves: 33 min leaks from meter body: 47 min leaks from collectors: 178 min
PWC-34	*Materials, spare parts, tools are enough for routine leak repair* N.A.
PWC-35	*Any private contractors for leak detection/repair, their pipe length of leak detection per months, leak detection method, method of leak repair* N.A.
PWC-36	*Leak detection equipment, heavy machine for leak repair, skill of their operation* Excavators, compressors, and cutters are used in excavation and leak repairs. The equipment used for leak detection is listed in the answer to question number 30.
PWC-37	*Number of leaks for one year* is estimated at 90 in the network and 890 in connections
PWC-38	*Water Quality and Public Health* *Monitoring Items, sampling locations and methods* *Monitoring frequency* *Results of measurements* N.A.
PWC-39	*Human Resource Development* *Manpower* *Number, age and qualification* *Recruitment methods for positions, managers, engineers, technicians, clerks etc* *Training methods and expenditure* Personnel: 598; 45 years old on average; the number of staff in different departments is as follows: 10000: 146 20000: 69 30000: 103 40000: 216 70000: 39 80000: 25 MWWEC staff are hired through an employment examination administered by the Ministry of Energy to qualified applicants.
PWC-40	*Technical standards applied for water supply system including pipeline* N.A.
PWC-41	*Future forecast/plan (provincial level) of* *Population* *Served Population* *Facility development* *Facility rehabilitation* Current population: 3,136,000 projected population for the year 2041: 4,939,300 population covered: 100 percent

3. Collected Data List

Region	Middle East	Survey Team Members	Takemasa MAMIYA Hiroshi NISHIMAKI Akihiko OKAZAKI Yuya KAWAHARA	Department	Water Resources Team 1, Global Envirnonmet Department, JICA	Period of Field Survey	22th January 2016 ~1th February 2016, 8th April 2016 ~ 1st May 2016 14th July 2016 ~ 28th July 2016
Country	Islamic Republic of Iran	Companies	Nihon Suido Consultants Co., Ltd ExeIdea Ltd.		Eriko TAMURA Sadanobu SAWARA Mayu OMURA		

No.	Name	Form	Collected Data	Data from Expert	Data from JICA	Text	Issuing Institution	Classification	Blank for JICA Library	Remarks
1. Project Management Office (PMO)										
1-1	MOE Questionnaire	Soft Copy	○				Project Management Office			
2. Ministry of Energy (MOE)										
2-1	MOE Water Tariffs 2016-2016	Soft Copy	○				Ministry of Energy			
2-2	Act of the Establishment of Water ad Wastewater Companies	Soft Copy	○				Ministry of Energy			
2-3	The Law of Promotion of Investment in Water Projects	Soft Copy	○				Ministry of Energy			

2-4	Groundwater Restoration and Balancing	Soft Copy	○				Ministry of Energy			
3. National Water and Wastewater Engineering Company (NWWEC)										
3-1	NWWEC Level Questionnaire	Soft Copy	○				National Water and Wastewater Engineering Company			
3-2	An Overview to Population Coverage and other General Information at Province Level	Soft Copy	○				National Water and Wastewater Engineering Company			
3-3	NWWEC Questionnaire	Soft Copy	○				National Water and Wastewater Engineering Company			
3-4	NWWEC Investment Opportunities	Soft Copy	○				National Water and Wastewater Engineering Company			
3-5	NWWEC Private Sector Investment in Desalination Plants in Iran	Soft Copy	○				National Water and Wastewater Engineering Company			
3-6	Fair Water Distribution Law	Soft Copy	○				National Water and Wastewater Engineering Company			
3-7	Financial Performance Indicators	Soft Copy	○				National Water and Wastewater Engineering Company			
3-8	Governmental Procurement Transactions Regulations	Soft Copy	○				National Water and Wastewater Engineering Company			
3-9	Guidelines on Reduction of Leakage from Home Water Supply Plumbing Systems	Soft Copy	○				National Water and Wastewater Engineering Company			
3-10	The 1st National Conference Agenda	Soft Copy	○				National Water and Wastewater Engineering Company			

3-11	Water Conference Articles	Soft Copy	○				National Water and Wastewater Engineering Company			
3-12	Urban Water Economics (Book)	Soft Copy	○				National Water and Wastewater Engineering Company			
4. Regional Centre on Urban Water Management (RCUWM)										
4-1	RCUWM Brochure	Soft Copy	○				Regional Centre on Urban Water Management			
4-2	RCUWM Website (TRANSLATED)	Soft Copy	○				Regional Centre on Urban Water Management			
4-3	Consulting Company List (NRW)	Soft Copy	○				Regional Centre on Urban Water Management			
5. Tehran Province Water and Wastewater Company (TPWWC)										
5-1	Introduction to Tehran Province and TPWWEC	Soft Copy	○				Tehran Province Water and Wastewater Company			
5-2	Southeastern Tehran WWC Report	Soft Copy	○				Tehran Province Water and Wastewater Company			
5-3	Southwestern Tehran WWC Report	Soft Copy	○				Tehran Province Water and Wastewater Company			
5-4	Tehran City Zone 1 WWC Report	Soft Copy	○				Tehran Province Water and Wastewater Company			
5-5	Tehran City Zone 2 WWC Report	Soft Copy	○				Tehran Province Water and Wastewater Company			
5-6	Tehran City Zone 3 WWC Report	Soft Copy	○				Tehran Province Water and			

							Wastewater Company			
5-7	Tehran City Zone 4 WWC Report	Soft Copy	○				Tehran Province Water and Wastewater Company			
5-8	Tehran City Zone 5 WWC Report	Soft Copy	○				Tehran Province Water and Wastewater Company			
5-9	Tehran City Zone 6 WWC Report	Soft Copy	○				Tehran Province Water and Wastewater Company			
5-10	Eastern Tehran WWC Report	Soft Copy	○				Tehran Province Water and Wastewater Company			
5-11	Western Tehran Cities and Residential Complexes WWC Report	Soft Copy	○				Tehran Province Water and Wastewater Company			
5-12	Taleghan and Bilaghan Intakes	Soft Copy	○				Tehran Province Water and Wastewater Company			
5-13	Tehran City Water Distribution Network	Soft Copy	○				Tehran Province Water and Wastewater Company			
5-14	Tehran Groundwater and Wells	Soft Copy	○				Tehran Province Water and Wastewater Company			
5-15	Tehran Storage Tanks	Soft Copy	○				Tehran Province Water and Wastewater Company			
5-16	Operational Plan to Develop Water Supply Infrastructure of Tehran Province	Soft Copy	○				Tehran Province Water and Wastewater Company			
5-17	Tehran City and Province Water Balance Table (2011-2015)	Soft Copy	○				Tehran Province Water and Wastewater Company			

5-18	Prioritization of Tehran City Water Supply Projects	Soft Copy	○				Tehran Province Water and Wastewater Company			
5-19	Tehran City Treatment Plants	Soft Copy	○				Tehran Province Water and Wastewater Company			
5-20	An Estimate of Water Demand by Cities under the Jurisdiction of TPWWEC	Soft Copy	○				Tehran Province Water and Wastewater Company			
5-21	Tehran Province Water Supply Future Prospect	Soft Copy	○				Tehran Province Water and Wastewater Company			
5-22	Tehran City Water Supply Strategic Plan	Soft Copy	○				Tehran Province Water and Wastewater Company			
5-23	Tehran Province WWC Consolidated Balance Sheet 2014	Soft Copy	○				Tehran Province Water and Wastewater Company			
5-24	Tehran Province WWC Consolidated Profit and Loss Statement 2014	Soft Copy	○				Tehran Province Water and Wastewater Company			
5-25	Network and Connection Leak Detection Action Plan	Soft Copy	○				Tehran Province Water and Wastewater Company			
5-26	Subscriber Regulations	Soft Copy	○				Tehran Province Water and Wastewater Company			
5-27	TPWWC Human Resources	Soft Copy	○				Tehran Province Water and Wastewater Company			
5-28	TPWWC Organizational Chart	Soft Copy	○				Tehran Province Water and Wastewater Company			
5-29	Organizational Chart for Tehran Water and	Soft Copy	○				Tehran Province Water and			

	Wastewater Supply and Treatment Company						Wastewater Company			
5-30	Organizational Chart for Southeastern Tehran WWEC	Soft Copy	○				Tehran Province Water and Wastewater Company			
5-31	Organizational Chart for Tehran Zone 1 WWC	Soft Copy	○				Tehran Province Water and Wastewater Company			
5-32	Kianshahr DMA	Soft Copy	○				Tehran Province Water and Wastewater Company			
5-33	ISNA Article on 2016.07.03 Water Tariff Raise in Tehran	Soft Copy	○				Tehran Province Water and Wastewater Company			
5-34	Tehran City Water Supply Strategic Plan	Soft Copy	○				Tehran Province Water and Wastewater Company			
5-35	Tehran Province WWEC Consolidated Balance Sheet 2014	Soft Copy	○				Tehran Province Water and Wastewater Company			
5-36	Network and Connection Leak Detection Action Plan						Tehran Province Water and Wastewater Company			
6. Zanjan Province Water and Wastewater Company (ZPWWC)										
6-1	Zanjan Questionnaire	Soft Copy	○				Zanjan Province Water and Wastewater Company			
6-2	Zanjan WWEC Staff Info	Soft Copy	○				Zanjan Province Water and Wastewater Company			
6-3	Zanjan WWE Company (Current Situation and Future Plans)	Soft Copy	○				Zanjan Province Water and Wastewater Company			
6-4	Zanjan WWEC Consolidated Balance Sheet	Soft Copy	○				Zanjan Province Water and			

	2014						Wastewater Company			
6-5	Zanjan WWEC Consolidated Profit and Loss Statement 2014	Soft Copy	○				Zanjan Province Water and Wastewater Company			
6-6	Zanjan Construction and Development Contracts 2011-2015	Soft Copy	○				Zanjan Province Water and Wastewater Company			
6-7	Internal Contracts 2014-2015	Soft Copy	○				Zanjan Province Water and Wastewater Company			
6-8	Zanjan WWEC Organizational Charts 1-6	Soft Copy	○				Zanjan Province Water and Wastewater Company			
6-9	Organizational Charts of Other Cities in Zanjan Province	Soft Copy	○				Zanjan Province Water and Wastewater Company			
6-10	ZPWWEC Organizational Chart	Soft Copy	○				Zanjan Province Water and Wastewater Company			
6-11	ZPWWEC Number of Staff in Different Cities	Soft Copy	○				Zanjan Province Water and Wastewater Company			
6-12	Guidelines on Reduction of Leakage from Home Plumbing Systems	Soft Copy	○				Zanjan Province Water and Wastewater Company			
6-13	ZPWWEC Connection Installation Regulations	Soft Copy	○				Zanjan Province Water and Wastewater Company			
6-14	Instructions on the Use of Dowsing Rods for Detection of Underground Pipelines	Soft Copy	○				Zanjan Province Water and Wastewater Company			
6-15	ZPWWEC Regulations for Connection Installation	Soft Copy	○				Zanjan Province Water and Wastewater Company			

6-16	Instructions on the Use of Dowsing Rods for Detection of Underground Pipelines	Soft Copy	○				Zanjan Province Water and Wastewater Company			
7. Isfahan Province Water and Wastewater Company (IPWWC)										
7-1	Isfahan_Completed-Questionnaires	Soft Copy	○				Isfahan Province Water and Wastewater Company			
7-2	Introduction of Khansar	Soft Copy	○				Isfahan Province Water and Wastewater Company			
7-3	Map of Leak Detection	Soft Copy	○				Isfahan Province Water and Wastewater Company			
7-4	Organizational Chart	Soft Copy	○				Isfahan Province Water and Wastewater Company			
7-5	Pipe Length by Material and Diameter	Soft Copy	○				Isfahan Province Water and Wastewater Company			
7-6	Financial Statement	Soft Copy	○				Isfahan Province Water and Wastewater Company			
7-7	Water Meter Test Bench	Soft Copy	○				Isfahan Province Water and Wastewater Company			
7-8	Isfahan Population Estimate	Soft Copy	○				Isfahan Province Water and Wastewater Company			
7-9	Khansar Project Lists Last Three Years	Soft Copy	○				Isfahan Province Water and Wastewater Company			
7-10	Performance Indicators	Soft Copy	○				Isfahan Province Water and Wastewater Company			

7-11	Governmental Procurement Transactions Regulations	Soft Copy	○				Isfahan Province Water and Wastewater Company			
7-12	Training Programs	Soft Copy	○				Isfahan Province Water and Wastewater Company			
7-13	NWWEC Regulations	Soft Copy	○				Isfahan Province Water and Wastewater Company			
7-14	List of Isfahan Province Regional WWECs and Their Reports	Soft Copy	○				Isfahan Province Water and Wastewater Company			
7-15	Khansar Report 2012-2015	Soft Copy	○				Isfahan Province Water and Wastewater Company			
7-16	Khansar Comprehensive Report 2012	Soft Copy	○				Isfahan Province Water and Wastewater Company			
7-17	Khansar Comprehensive Report 2013	Soft Copy	○				Isfahan Province Water and Wastewater Company			
7-18	Khansar Comprehensive Report 2014	Soft Copy	○				Isfahan Province Water and Wastewater Company			
7-19	Khansar Comprehensive Report 2015	Soft Copy	○				Isfahan Province Water and Wastewater Company			
7-20	Khansar Comprehensive Report 2013 (2)	Soft Copy	○				Isfahan Province Water and Wastewater Company			
7-21	Khansar Comprehensive Report 2014 (2)	Soft Copy	○				Isfahan Province Water and Wastewater Company			
7-22	IPWWEC NRW Expenditures 2011	Soft Copy	○				Isfahan Province Water and			

							Wastewater Company			
7-23	IPWWEC NRW Expenditures 2014	Soft Copy	○				Isfahan Province Water and Wastewater Company			
7-24	Isfahan Leak Detection in the Second 5 Months	Soft Copy	○				Isfahan Province Water and Wastewater Company			
7-25	Isfahan Leaks 2014-2015	Soft Copy	○				Isfahan Province Water and Wastewater Company			
7-26	IPWWEC Leak detection Activities 2015	Soft Copy	○				Isfahan Province Water and Wastewater Company			
7-27	Land Use Fees	Soft Copy	○				Isfahan Province Water and Wastewater Company			
7-28	Isfahan Residential and Non-residential Connection Fees	Soft Copy	○				Isfahan Province Water and Wastewater Company			
7-29	Calculation of Water & Wastewater Tariff	Soft Copy	○				Isfahan Province Water and Wastewater Company			
7-20	Tariff Setting Methods	Soft Copy	○				Isfahan Province Water and Wastewater Company			
7-31	Water Transmission Lines Details	Soft Copy	○				Isfahan Province Water and Wastewater Company			
7-32	Distribution Lines Details	Soft Copy	○				Isfahan Province Water and Wastewater Company			
7-33	Khansar Pipeline Map	Soft Copy	○				Isfahan Province Water and Wastewater Company			

7-34	Monitoring Items Sampling Locations Methods	Soft Copy	○				Isfahan Province Water and Wastewater Company			
7-35	Khansar Detailed Balance Sheet	Soft Copy					Isfahan Province Water and Wastewater Company			
7-36	IPWWEC Depreciation	Soft Copy					Isfahan Province Water and Wastewater Company			
7-37	Isfahan Consolidated Balance Sheet	Soft Copy					Isfahan Province Water and Wastewater Company			
7-38	Isfahan Detailed Balance Sheet	Soft Copy					Isfahan Province Water and Wastewater Company			
7-39	Isfahan Profit and Loss Statement	Soft Copy					Isfahan Province Water and Wastewater Company			
7-40	Khansar General Balance Sheet	Soft Copy					Isfahan Province Water and Wastewater Company			
7-41	Khansar Profit and Loss Statement	Soft Copy					Isfahan Province Water and Wastewater Company			
8. Mashhad Water and Wastewater Company (MWWC)										
8-1	Answers to Mashhad Questionnaire	Soft Copy	○				Mashhad Water and Wastewater Company			
8-2	Mashhad WWEC Organizational Chart	Soft Copy	○				Mashhad Water and Wastewater Company			
8-3	MWWEC Financial Statement (FY2014-2015)	Soft Copy	○				Mashhad Water and Wastewater Company			

8-4	Schematic Map of Mashhad Water Resources	Soft Copy	○				Mashhad Water and Wastewater Company			
8-5	MWWEC List of Urban Water Projects implemented by contractors since April 2012	Soft Copy	○				Mashhad Water and Wastewater Company			

4. Minutes of Meetings (Signed)

MINUTES OF MEETINGS
BETWEEN
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
AND
NATIONAL WATER AND WASTEWATER ENGINEERING COMPANY (NWWEC)
ON
"THE DATA COLLECTION SURVEY
ON
WATER SUPPLY SECTOR
IN
THE ISLAMIC REPUBLIC OF IRAN"

JICA has dispatched the Survey Team (hereinafter referred to as "the Team") which is headed by Ms. Eriko TAMURA, to the Islamic Republic of Iran from 15th to 27th of July, 2016 for the data collection survey.

The Team held a series of discussions with NWWEC, RCUWM, IPWWC, IHEARI, KWWC, and other relevant organizations listed in Annex 1. All the abbreviations are also listed in Annex 2.

In the course of discussion, JICA and NWWEC confirmed the main items described in the attachment.

Tehran, 27th July 2016

田村 えり子

Ms. Eriko Tamura
Director of Water Resources Team 1,Water Resources Group, Global Environment Department,
Japan International Cooperation Agency,
Japan

Tashaiuoei

Dr. Hamid Reza Tashaiuoei
Member of the Board of Directors and Deputy for Supervision on Operations,
National Water and Wastewater Engineering Company,
Islamic Republic of Iran

Witnessed by:

讃良 貞信

Mr. Sadanobu Sawara
Senior Technical Advisor of Global Environment Department,
Japan International Cooperation Agency,
Japan

Witnessed by:

Amini

Mr. Hashem Amini
Chairman of the board and Executive Manager,
Water and Wastewater Company of Isfahan Province,
Islamic Republic of Iran

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ATTACHMENT
(Main Points Discussed)

1. Draft final report

The Team explained the contents of the Report, and the Iranian side agreed in principle on the contents. Both sides confirmed that the Iranian sides would review the Report in detail and submit its comments to the Team in writing by 20th August 2016.

2. Purpose of the Technical Cooperation Project supported by JICA

The Team explained that Technical Cooperation Project would be jointly implemented by the Iranian sides and the Japanese side, however, the ownership of the Project lies with the Iranian sides as Japan's status is that of a cooperation partner.

3. Major issues of NRW found by the Team

a. Importance of restructuring tariff system in NRW reduction activities

Reduction of NRW is effective in Iran which has scarce water resources. However, the water tariff system in Iran is insufficient not only for reduction of NRW but also sound management of water supply service. The Team strongly suggested that the Iranian sides would make each and every effort to restructure the existing tariff system; including raising the current water tariffs to an appropriate and sufficient level, and thereby ensure the generation of additional budgets for the improvement of NRW reduction programs.

b. Necessity of budget allocation for NRW reduction

Both sides confirmed that there is a need to increase water utilities' budgets for the implementation of NRW reduction program, which includes the replacement of old pipes and malfunctioning water meters and the training of utilities' staff, not only during the Project but also after the Project terminates continuously, surely and steadily by Iranian sides.

c. Regional gaps

Both sides confirmed that there is a gap in the current level of NRW ratios from region to region. Therefore, both sides agreed that, in order to narrow the gap, it is strongly suggested to establish an internal training system, through which skills, technologies and knowledge for NRW reduction could be transferred from good to poor-performance utilities.

d. Motivation of staff assigned for NRW reduction work

Both sides confirmed that, in order to implement NRW reduction programs on a sustainable basis, it is strongly suggested to create a certain mechanism for enhancing

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the motivation of utilities' staff in charge of NRW reduction, such as commendation of and/or provision of a special bonus to staff with good performance.

4. Ideas of the Technical Cooperation Project

4.1 Draft outline of JICA's Technical Cooperation Project

Both sides tentatively agreed on the outline of JICA's Technical Cooperation Project shown in the following table, and that the final scope and contents of the Project would be discussed and finalized with the Iranian sides in the Detailed Planning Survey that would be conducted after official approval of the Project by the Government of Japan.

Outline of the Project (Tentative)		Related organizations
Overall Goal	The internal training program for NRW reduction for NWWEC is systematically implemented.	NWWEC, RCUWM
Project Purpose	The structure is developed to systematically implement internal training program for NRW Reduction for NWWEC.	NWWEC, RCUWM
Output 1	Capacity of NWWEC, RCUWM, IPWWC and KWWC for planning NRW reduction is enhanced.	NWWEC, RCUWM, IPWWC, KWWC
Output 2	Capacity of IPWWC and KWWC for implementing NRW reduction activities is enhanced.	IPWWC, KWWC
Output 3	Capacity for planning and implementing internal training for NRW reduction for NWWEC is enhanced.	NWWEC, RCUWM, IPWWC, IHEARI
Output 4	Information on water supply sector in Japan, including the experience of NRW reduction and cost recovery/financial management etc. of water utilities, etc. is shared.	NWWEC, RCUWM, IPWWC, KWWC, IHEARI

4.2 Other discussion and agreements

a. Pilot project site for NRW reduction

Both sides agreed that the pilot project and necessary field training for NRW reduction would be implemented in Khansar city. Although NRW reduction plan will be prepared for the entire city area of Khansar, the pilot project will cover only part of the city area. The exact location of the pilot site will be determined during the Project, and training participants will not only be staff of IPWWC and KWWC, but also other cities for the purpose of sharing the opportunity to learn and disseminate the information, skills and knowledge.

b. Strengthening function of training system

The Team emphasized that the information, skills and knowledge provided by Japan and those Iranian sides should be spread in other cities of Iran. Thus, both sides have agreed that function of the training system should be strengthened and the following activities shall be implemented in the Project to promote proliferation of the knowledge

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and skill for NRW reduction.

- Development of manuals, curriculum, and guidelines, using the pilot activities in Khansar City as well as the knowledge and skills of NWWEC, RCUWM and IPWWC to be acquired
- Development of NRW reduction training curriculum, textbooks, teaching aids etc.

c. Expected steps for implementation of Technical Cooperation Project

The tentative steps of the Project were informed to the Iranian sides by the Team as follows;

Step 1: Approval of the Project by the Government of Japan,
Step 2: JICA would dispatch a mission for the Detailed Planning Survey of the Project,
Step 3: Record of Discussion would be signed by JICA Iran Office and NWWEC after the result of the Detailed Planning Survey to be approved by JICA Head Office,
Step 4: The Project would start after completing all of the above steps.

d. Inputs and undertakings (tentative)

Both sides have agreed that the details of the inputs and undertakings on each side would be finalized in the Detailed Planning Survey of the Project, that would be conducted after official approval of the Project by the Government of Japan. Meanwhile, both sides have agreed on the general framework of undertakings to be taken by each side as follows:

Iranian side/s:

- Allocation of budget (for implementing the project such as administrative and operational expenses, local traveling cost for Iranian personnel)
- Assignment of counterpart personnel
- Office space and its running cost
- Tax exemption and custom clearance for the equipment provided by JICA

Japanese side:

- Dispatch of experts
- Training of Iranian counterparts in Japan and the third country
- Provision of necessary equipment to be used in the NRW reduction pilot project in Khansar city

The details of undertakings will be discussed in the Detailed Planning Survey as described in Step 2 of 4.2 c. above.

Amini Teshnaei

ANNEX 1

Participants list for the Discussion

From Iranian Side

NWWEC

Dr. Hamid Reza Tashaucei
Mr. Ali Seyedzadeh
Mr. Ali Akbar Ghazali

RCUWM

Dr. Ali Chavoshian
Mr. Alireza Salamat
Mr. Naser Dehghanian

Shahid Beheshti University

Mr. Abdollah Rashidi Mehrabadi
Mr. Jalili Ghazizadeh
Mr. Nemat Hassani

IPWWC and IWWC

Mr. Hashem Amini
Mr. Hassan Gholami
Mr. S. Mohsen Saleh
Mr. M. Araabi
Mr. Mehdi Kiani
Ms. Sara Ahmadi
Ms. Asieh Mollabashi
Mr. Reza Nurollahzadeh
Mr. Alireza Rahmatpanah
Mr. Hossein Esnaashari

KWWC

Mr. Nabi Khubroo
Mr. Mehdi Jahanshiri
Mr. Abbas Anaali

Khansar Government

Mr. S. Hassan Shafati

IHEARI

Mr. Mohamad Reza Fedaei
Mr. Mostapha Zareapour
Mr. Farhad Shafiei
Mr. Zabihollah Sabbaghi
Mr. Behnam Ramezy
Mr. Hossein Arshadi

From Japanese side

JICA

Ms. Eriko Tamura
Mr. Sadanobu Sawara
Ms. Mayu Omura

Consultant Team

Mr. Takemasa Mamiya
Mr. Hiroshi Nishimaki
Mr. Akihiko Okazak

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ANNEX 2

List of Abbreviations

IHEARI	Isfahan Higher Education and Research Institution
IPWWC	Isfahan Provincial Water and Wastewater Company
Iranian side	all the organization related to this Project
KWWC	Khansar Water and Wastewater Company
Japanese side	JICA and parties related to the Project from Japan
JICA	Japan International Cooperation Agency
NRW	Non-revenue Water
NWWEC	National Water and Wastewater Engineering Company
RCUWM	Regional Centre on Urban Water Management
Report	Draft Final Report
Team	Survey Team

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5. Request from the Government of Iran

Annex ٢A

APLICATION FORM FOR JAPAN'S TECHNICAL COOPERATION

١. **Date of Entry:** Day ١٨ Month ١٠ year ٢٠١٤

٢. **Applicant:** The Government of Islamic Republic of Iran – Ministry of Energy

٣. **Technical Cooperation (T/C) Title:** Non-Revenue Water (NRW) Reduction

٤. **Type of T/C** ***Select only one scheme.**

■ Technical Cooperation Project / Technical Cooperation for Development Planning

☐ Individual Expert ☐ Individual Training ☐ Equipment

٥. **Contact Point (Implementing Agency):**

Address: No ٨ – Shahid Abdolahzadeh Ave. Kehsvarz Blvd. Tehran. Iran. (National Water & Wastwater Eng. Company (NWWEC)).

Postal code: ١٤١٥٦١٠٤٤١

Contact Person: Ali Seyedzadeh (Manager of Non-Revenue Water Reduction Bureau)

Tel. No: +٩٨ ٩١٢٧٩٨٨٣٤٢ **Fax No.:** +٩٨ ٢١ ٨٨٩٥١٦٩٧

E-Mail: seyedzadeh@nww.ir

٦. **Background of the T/C**

Located in one of the most arid regions in the world, Iran has an annual average precipitation rate of ٢٥٢ millimeters, approximately one third of the global average. Exacerbating the severity of water shortages, as much as ٧٠ percent of precipitation is lost to evaporation. The country's population has increased about ٨ times during the last ٨٠ years and it has got from ١٠ million in ١٩٢٠ to more than ٧٥ million in ٢٠١٢. At present Iran is the ١٧th most populated countries in the world and based on the data presented in UN it will be classified as one of the ١٠ most populated regions in the world by the end of ٢٠٥٠. Therefore the need for water has been increased but still the quantity of water is not adequate. Another reason of the shortage in producible water is the water losses from water distribution systems.

١

In the other hand the water resources hasn't well management. Water distribution network is old, the waste water distribution collection is not sufficient and there isn't any plan to use the purified sewage. There isn't enough specialist experts in many cities, there isn't measurement instrument in the establishment for measuring and control activities and ....

The drought has enforced NWWEC to change its policy to water consumption management and reducing the Non-Revenue Water (NRW). One of the important methods to save the water resources is the Non-Revenue Water reduction activities.

Although to develop new sources of water require a lot of investment such as withdrawal costs, transmission treatment, storage and distribution costs, but NRW is a virtual resource that this costs is done for it, so for this reason if we can reduce NRW in addition of protect water resource we will save the costs of above items (transmission treatment, storage and distribution).

The Non-Revenue Water refers to a difference between the volume of water entering the system and billed authorized consumption.

In view of the limited water sources Iran, conservation and careful management of this precious resource is of vital importance.

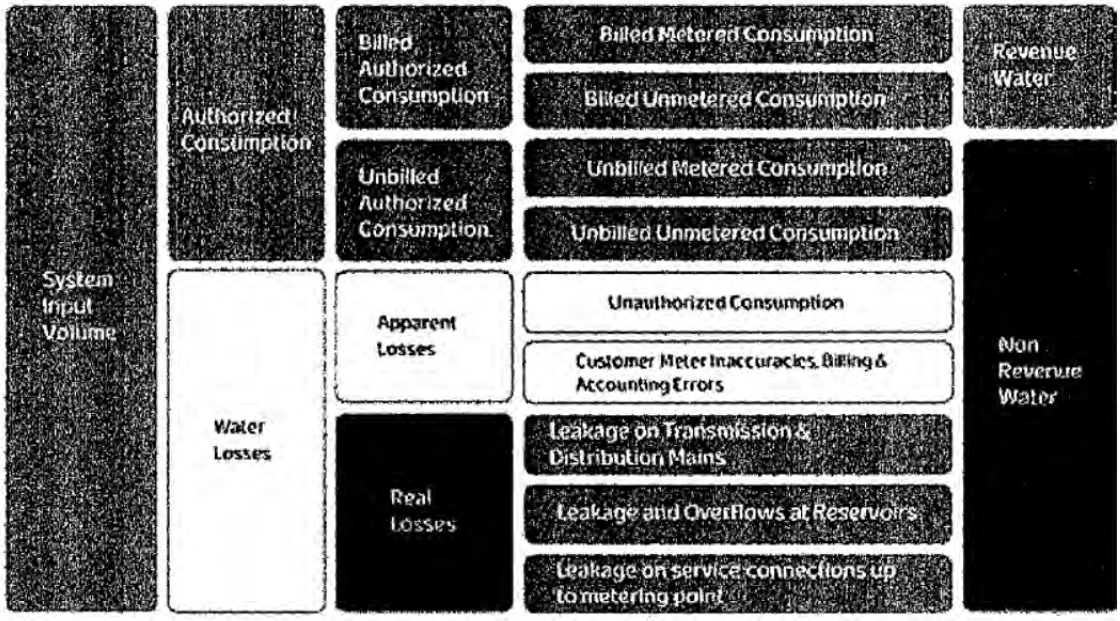
The critical nature of these factors is both a local and global problem, but particularly so in developing countries. For that reason, all around the world, much consideration is given to the best exploitation of existing water sources, the issue of logical consumption and how best to control and reduce water losses in water distribution systems. In answer to the water loss issues, the International Water Association (IWA) has standardized the method for audit of water losses that called "Water Balance" and has presented new indicators in order to investigate and enable more efficient water distribution systems.

After the successful application of performance standards and indicators recommended by the International Water Association by a number of countries, the National Water and Wastewater Engineering Company (NWWEC) decided to use the studies for the management and assessment of water losses in the networks under its control. Accordingly after review of the required information, NWWEC prepared the strategic program (recommended by IWA) for reduction of water losses in the network, the first step of which consisted of preparing the Water Balance program.

High levels of NRW reflect huge volumes of water being lost through leaks (real/physical losses), water not being invoiced or not being accurately measured (apparent/ commercial losses) or both.

A Water Balance audit details how much of each type of loss is occurring and how much it is costing the water utility. The key concept behind this approach is that water should not be "unaccounted-for". In conducting a water balance audit, a quantity is determined for the major components of water consumption and water loss, and a price is placed on each component in

order to assess its financial impact on the water utility. A detailed and accurate water balance forms the basis for an effective NRW management strategy.



The ٤-Component diagram, shown below, is widely used to explain the types of activities that are effective in managing real and apparent losses.

Managing Real Losses

Real losses cannot be completely eliminated. The lowest technically achievable annual volume of real losses - for well-maintained and well-managed systems - is known as Unavoidable Annual Real Losses (UARL). Based on an appropriate combination of all four activities involved in leakage management (shown as arrows in the diagram), real losses can be kept to a minimum. In modern systems three of these methods have proved themselves to be more cost-effective in the short term than pipeline and asset management:

- Active leakage control
- Improvement of speed and quality of repairs
- Optimization of the pressure management in the system

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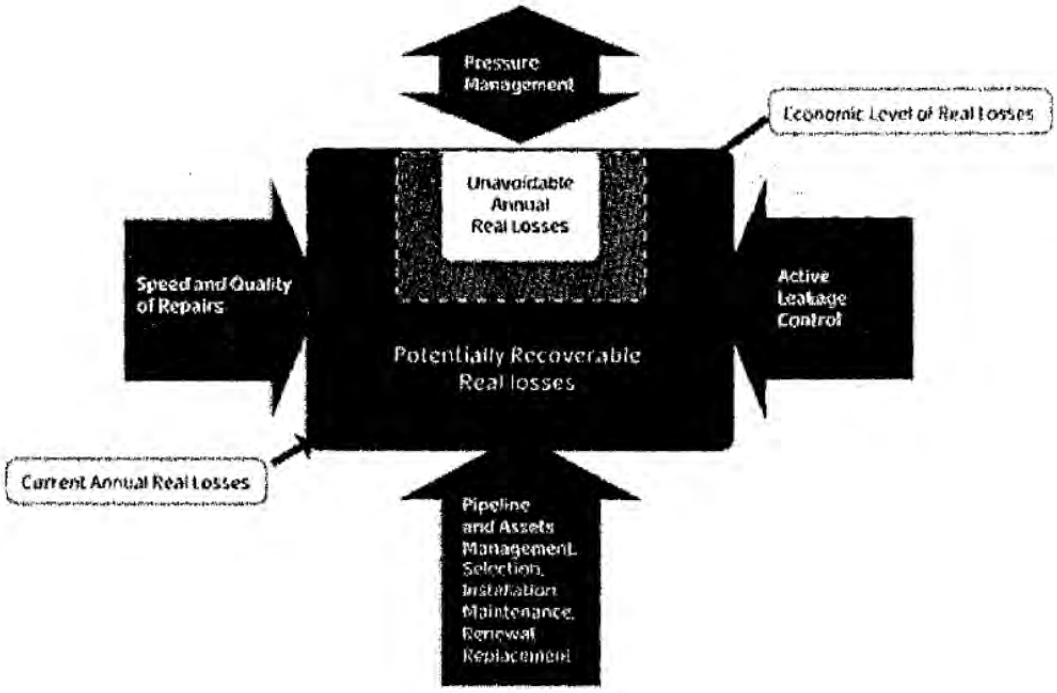
In systems which were built from poor quality materials or which suffer from substandard installation practices, it is often necessary to consider medium and long term solutions which include pipeline and asset management.



Managing Apparent Losses

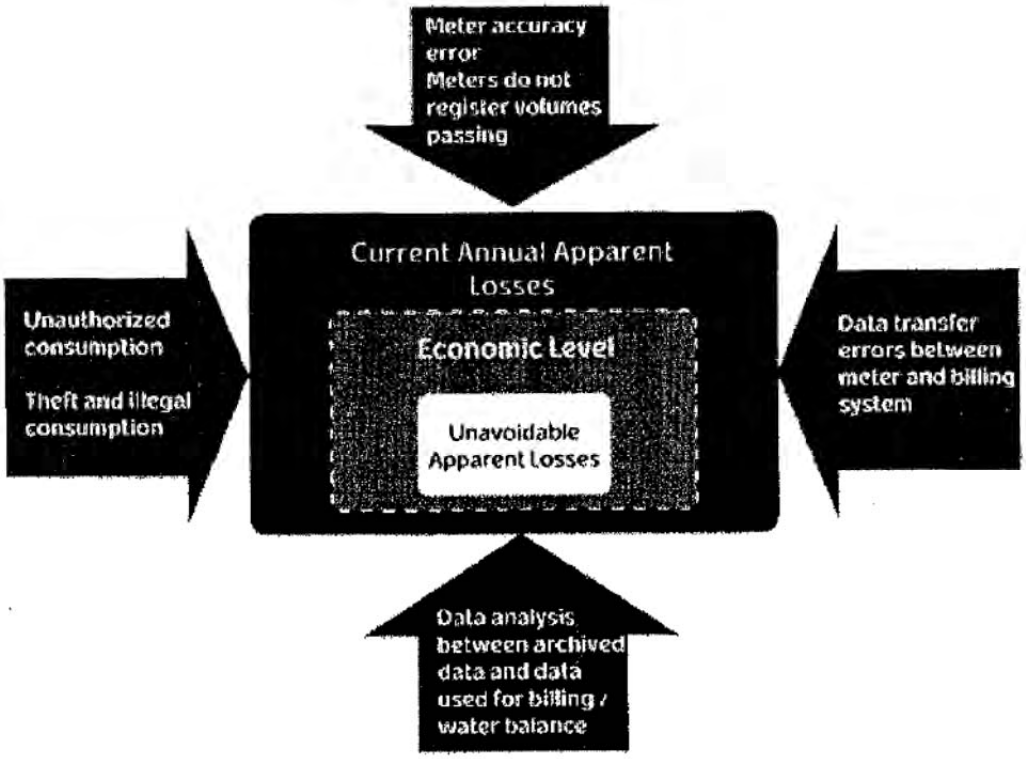
The following four components make up the IWA management strategy for apparent loss:

- Customer meter inaccuracies
- Unauthorized consumption, illegal connections, theft and fraud
- Data analysis errors, between archived data and data used for billing
- Data collection and transfer errors between meter and the billing system

Apparent losses should be no more than a few percentiles of authorized consumption. Combating apparent losses does not require substantial financial resources, but rather demands a firm commitment on the part of the utility management, political will, community support and incentives.

Dealing with all four components in a coordinated fashion will result in reducing the annu quantity of apparent losses to an economic level.

In some cases it is recommended that apparent loss reduction be the first step in an NR reduction strategy, since it requires a relatively low investment and can result in immedia payback.



Some project of NRW reduction Action Plan:

Real Loss Reduction Activities include:

- Sectorization to optimize reservoir distribution networks
- Pipe replacement
- Service connections replacement
- Pressure reducing valve installation
- Pump station optimization
- Leak detection services

- Pipe repair
- District metering area implementation
- ...

Apparent Loss Reduction Activities include:

- Meter replacement
- Unauthorized consumption elimination
- Client database review
- Supply regularization to low income areas
- ...

Successful examples for reduction of Non-Revenue Water in Iran

water & wastewater company name	%NRW	
	2008	2014
Isfahan province water & wastewater company	30.9	18.3
North Khorasan province water & wastewater company	30.8	23.6
Qom province water & wastewater company	25.8	20.7
Hamedan province water & wastewater company	36.1	25.9
Yazd province water & wastewater company	23.0	18.2

As noted earlier, Water Balance is an audit method to identify the components of the Non-Revenue Water for setting goals and priorities for implementation of the water loss reduction projects. Based on the Water Balance results, the executive project of Non-Revenue Water reduction was implemented and leading to a decrease in the years indicated in the graph.

Accordingly, after the relevant training workshops and numerous meetings (over ٨٠ in total) the water and wastewater companies (٣٥ companies) were notified of the mentioned program in a very large scale.

This training includes the following:

- Definition of Non-Revenue Water and its components
- The method of completing the Water Balance tables
- Introduction of Non-Revenue Water reduction strategies
- Implementation of projects to reduction of Non-Revenue Water and losses
- The importance of reduction of Non-Revenue Water in water and wastewater companies

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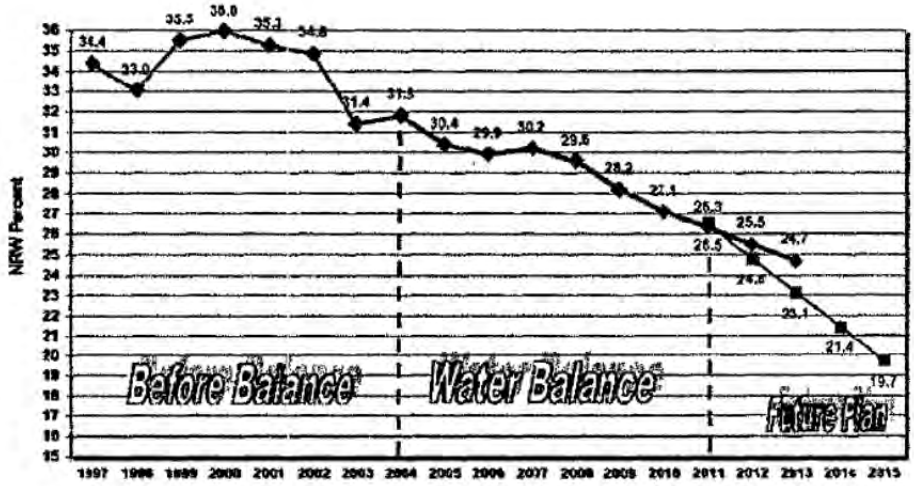
This figure shows the amount of NRW percentage in Iran before and after "Water Balance Program" and the future plan.



Numbers listed in the above table in different years, are the percentage of Non-Revenue Water that it is the ratio between sales and production, so these numbers are accurate.

Due to the high volume of Non-Revenue Water in large cities, so in the first step these cities were very important for NWWEC, but we have more than ۱۰۰۰ towns in Iran which has high NRW but NWWEC hasn't sufficient activities because of some problems as below to reducing its NRW same as big cites:

- Lack of specialist experts
- Need for training
- Need for advanced technical knowledge
- Need for special equipment
- Need for financial resources for over than ۱۰۰۰ towns

The summary table of NRW ratio of each water company in Iran

water & wastewater province company name	%NRW	
	2013	2014
East Azarbaijan	18.8	18.8
West Azarbaijan	22.9	22.6
Ardabil	27.7	25.1
Isfahan	20.3	18.3
Alborz	24.1	23.5
Ahvaz	32.8	31.9
Ilam	27.0	24.2
Boushehr	29.0	28.4
Tehran	26.6	25.4
Charmahal	22.3	22.3
South Khorasan	29.2	28.3
Razavi Khorasan	29.3	29.5
North Khorasan	23.7	23.6
Khozestan	34.0	33.8
Zanjan	24.5	24.3
Semnan	24.3	24.0
Sistan	24.0	25.4
Shiraz	20.1	20.9
Fars	28.2	27.4
Qazvin	18.5	18.4
Qom	21.1	20.7
Kashan	22.0	21.6
Kordistan	26.3	26.1
Kerman	26.8	25.0
Kermanshah	26.5	25.6
Kohgilouyeh	28.5	27.4
Golestan	25.5	25.7
Gilan	21.3	21.1
Lorestan	26.4	25.6
Mazandaran	30.0	29.7
Markazi	22.5	22.3
Mashad	22.1	21.9
Hormozgan	23.2	22.1
Hamedan	26.9	25.9
Yazd	18.3	18.2
Iran	25.5	24.7

It is common knowledge that the NRW in any water utility is a percentage of the water volume pumped into the network, but this simple percentage figure just isn't sufficient to understand the water utility problem and needs an appropriate reduction strategy. Therefore it was necessary to apply the nowadays available methods and tools which had helped to establish a first baseline. Although we had good performance in reducing NRW in Iran but we believe it is possible to reduce the NRW more than it.

Due to the lack of trained specialists on the reduction of Non-Revenue Water in many cities, we are far from the acceptable of Non-Revenue Water. The amount of non-revenue water in Japan is ٣,٧ percent. This amount is so far from the NRW percentage in Iran big cities that many activities have been carried out. Therefore we believe that we can use the development countries experience and knowledge and technologies such as Japan for reducing NRW in our water distribution systems. The main program to achieve the appropriate and acceptable of NRW percentage is the training specialist experts and human resources by developed countries such as Japan and the use of industry-related facilities in this field.

٧. Outline of the T/C

(١) Overall Goal

The main objective of reducing Non-Revenue Water in Iran are preserving limited water resources, increasing efficiency of the facilities and preventing loss of assets.

These objectives will implement in Khansar city as a pilot.

(٢) T/C Purpose

As mentioned earlier in Khansar city is considered as a pilot city to loss reduction activities according to several specific features that it is possible to share the results to other cities:

- Because of the small size of the town, it allows rapid implementation of activities to reduce network losses and the expected results of the project are achieved quickly.
- Because of the centrality of Isfahan Province in Iran and easy access to different parts of the province there is the possibility of creating a visit of pilot stages, for specialist expert in other cities that it can be used as a workshop for engineering.
- Due to the particular circumstances of Khansar a series of problems that cause the loss is gathered and implementation of the pilot provides the generalization of the results to other cities. These problems include the presence of old pipes, fittings inappropriate, corrosive soil type, topography certain conditions, high pressure network, there are several wells and require accurate measuring equipment (flow and pressure), leaks in

reservoir and distribution network, long transmission lines and the failure of a large number of meters, unauthorized consumptions, problem in reading meters and . . . .

One of the main objectives of the Khansar project is the experience to attract foreign investment, including Japan, which if successful could be a good example for emulation in other cities to reduce the Non-Revenue Water.

In order to achieve reducing NRW drastically in the Pilot Project area, it is necessary for NWWEC and Khansar Water and Wastewater Company (KWWC) to build up:

i) Planning capacity related to NRW reduction measures, and
ii) Technical and operational capacity to implement NRW reduction activities at site. In addition, in order to maintain staff's motivation for the NRW reduction activities and to replicate the NRW activities to the other areas in provincial-wide and nationwide, it is necessary for NWWEC and KWWC to develop organizational capacity, so that they can reproduce expert of NRW reduction by themselves.

(۳) Outputs

The outputs are:

- Planning capacity related to NRW reduction measures of the NRW Reduction Management Team is improved.
- Technical and operational capacity to implement NRW reduction activities by NRW Reduction Action Teams is developed.
- Internal trainings for NRW reduction become operational.

(٤) T/C Site

As mentioned earlier, we are looking for a pilot city that would have the following conditions:

- Small size of the town; It allows rapid implementation of activities to reduce network losses and the expected results of the project are achieved quickly.
- Centrality of the town; Easy access to different parts of the province there is the possibility of creating a visit of pilot stages, for specialist expert in other cities that it can be used as a workshop for engineering.
- Existence a set of problems that cause the loss; These problems include the presence of old pipes, fittings inappropriate, corrosive soil type, topography certain conditions, high pressure network, there are several wells and require accurate measuring equipment (flow and pressure), leaks in reservoir and distribution network, long transmission lines and the

failure of a large number of meters, unauthorized consumptions, problem in reading meters and

- Provides the generalization of the results to other cities with implementation of the pilot

Therefore as mentioned earlier the field study has targeted to the area of city of Khansar, which has been operated and maintained by Khansar Water and Wastewater Company (KWWC) under the jurisdiction of Isfahan Water and Wastewater Company (IWWC). The IWWC is also a subset of NWWEC. Other reasons for the selection of KWWC as a pilot for projects to reduce Non-Revenue Water as follows:

- Networks with high levels of Non-Revenue Water percentage of ٦١٪ (the real loss of more than ٤٤٪) which can be reduced with appropriate activities
- Limited water resources
- The high pressure system due to differences in height
- The old distribution network
- Readiness of staff
- Easy access to city and facilities
- Difficult and time consuming to implement loss reduction activities in large cities
- The need to replace pipes

The field study has targeted to the area of city of Khansar, which has been operated and maintained by Khansar Water and Wastewater Company (KWWC) under the jurisdiction of Isfahan Water and Wastewater Company (IWWC), in which the area was selected and provided by the NWWEC.

Khansar is the most western city of Isfahan province. The Isfahan Province covers ٩٥٠ square km, at an altitude of ٢٬٣٠٠ meters, located at hilly terrain and surrounded by higher mountains of more than ٣٬٠٠٠ meters at the west side. The administration has one (١) city, eighteen (١٨) townships and three (٣) villages.

The weather has a big difference in temperature between summer and winter time. The climate is varies seasonally at ٣١ degree Celsius (٣١) in the summer and becomes minus ٨,٥ degree Celsius (-٨,٥) during winter time

According to the national census in the year ٢٠١١-٢٠١٢, the population of the Khansar County is ٣٢٬٤٢٣ of which consist ٢١٬٣٣٨ in the cities and ١١٬٠٨٥ in the villages

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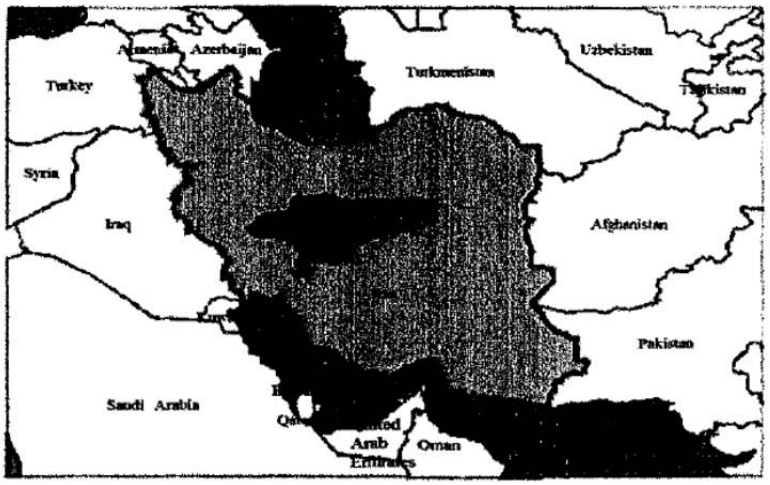
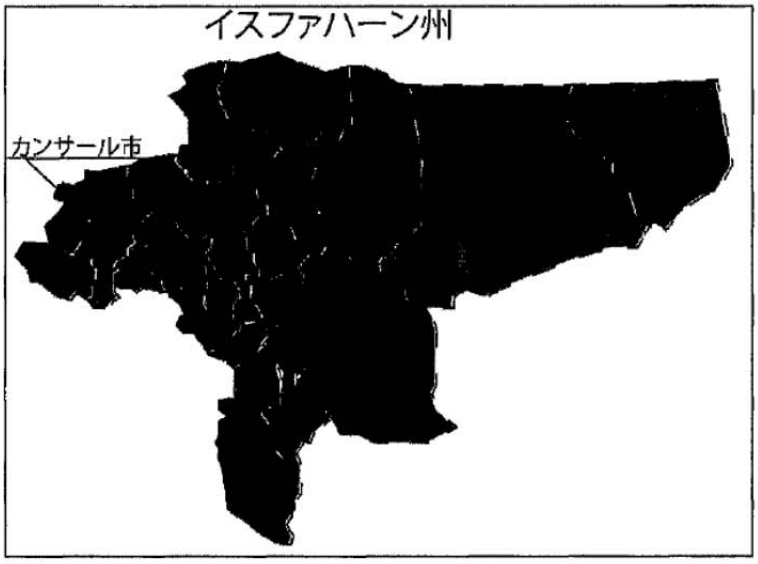
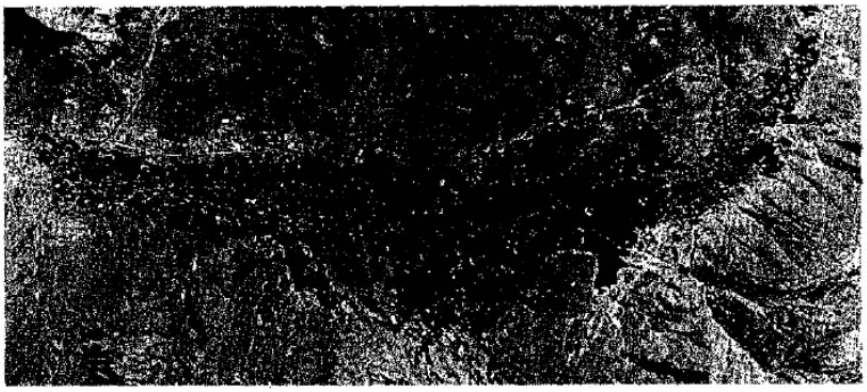
Location map of Water Supply in Isfahan



Location map of City of Khansar



Map of Whole Region of Khansar City (Google Earth)



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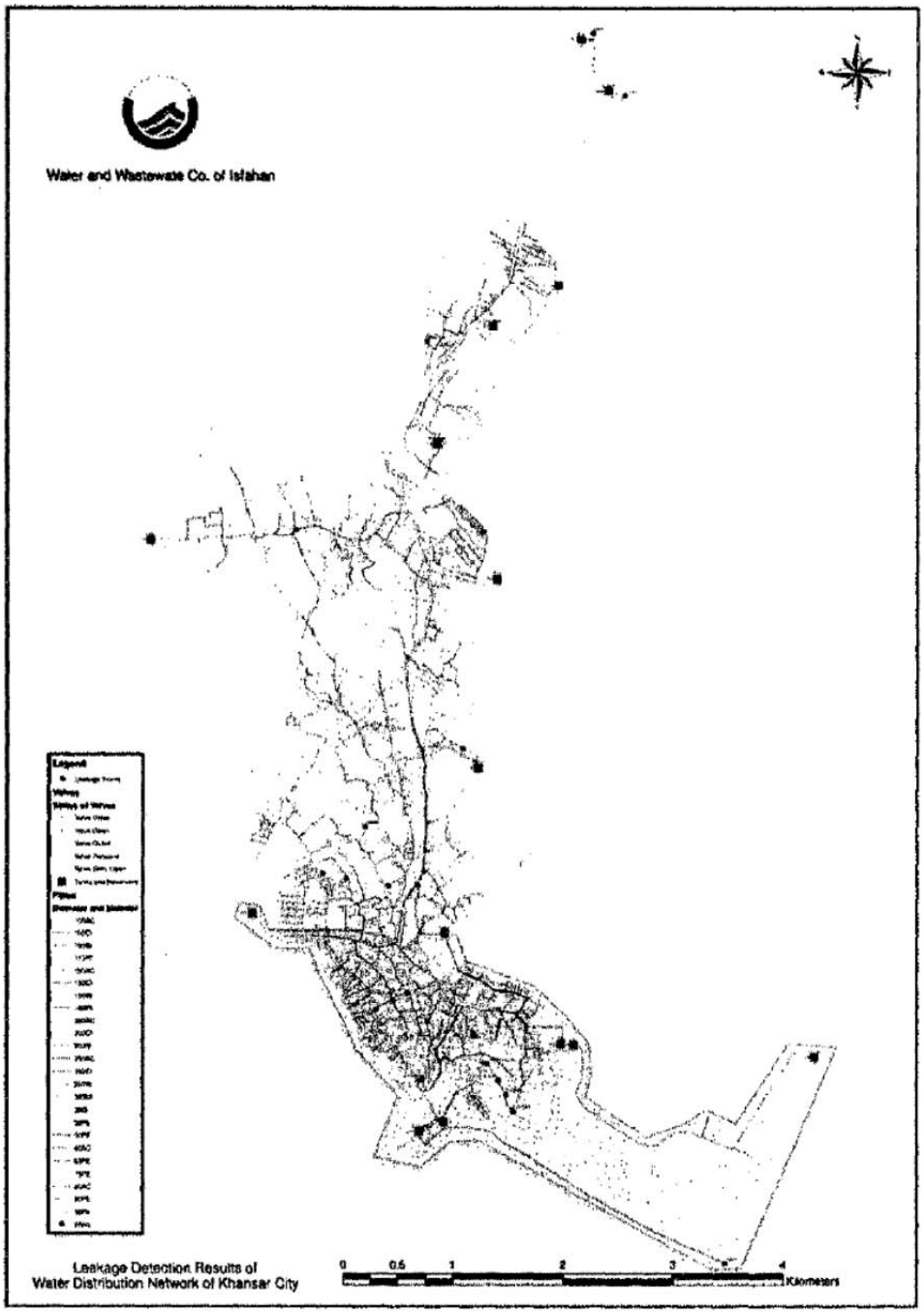


Khansar water distribution network map

KWWC is administratively responsible for supplying water to the cities and number of house connection is ٧،٣٠٠ in the year ٢٠١٣-٢٠١٤ with annual water consumption is ١،٨١٨،٢٥٢ cubic meters (٤،٩٨٠ m³/day.(

The water supply service area of Khansar city is along the river side, located between both sides of the mountains. All the water resource is ground water from ٨ deep wells with capacity of ١٩١ liter per second (l/sec).In the future, surface water supply system is under planning to construct intake dam and now raw water transmission tunnel and water treatment plant(preparation works of leveling) are in progress.

The existing ground water supply system comprises of deep well pump stations and water pumping up through transmission main to ٨ distribution reservoirs which is located at mountain side, by which water is supplied by gravity flow through distribution pipeline to all service area but the block distribution system has not been applied yet in the city. The total capacity is ٧،٤٠٠ m³. The potential energy of the system is approximately ١٠٠ m between the distribution reservoirs and the service areas.

The total length of the transmission pipelines is ٥٣ km, of which comprises asbestos cement pipe, steel pipe and polyethylene pipe with diameter ranging from Ø١٠٠ mm to Ø ٣٠٠ mm. The total length of the distribution pipelines is ١٢٢ km, of which comprises asbestos cement pipe, steel pipe and polyethylene pipe with diameter ranging from Ø٣٢ mm to Ø ٢٠٠ mm. Recently, ductile iron pipe are being used for the important distribution lines.

Future Planning

The water supply development plan for Khansar City is as follows;

- Construction of intake dam
- Construction of raw water transmission tunnel with length of ٣٢ km
- Construction of water treatment plant (started from last year on ground leveling) with capacity of ١٠٠ liter/sec for phase I (in ٥ years) and ١٠٠ liter/sec for phase II and total capacity is ٢٠٠ liter/sec (١٧،٢٨٠ m³/day).
- Rehabilitation of the distribution and service pipeline

(٥) T/C Activities

Contents of the activities:

Output ١: Planning capacity related to NRW reduction measures of the NRW Reduction Management Team is improved.

- Organize a NRW Reduction Management Team consisting of IWWC and KWWC staff.

١٥

- Prepare an annual program of NRW reduction activities for the pilot areas.
- Review existing training programs related to NRW reduction and conduct the training for the NRW Reduction Management Team.
- Monitor and evaluate the progress of NRW reduction measures in the pilot area.
- Review the annual program of NRW reduction activities based on the feedback and lessons in the pilot areas.
- Analyze cost and benefit of NRW reduction activities in case of expanding the activities to the pilot areas and to the entire area of Khansar City (future estimation of expansion).
- Analyze investment cost and its financing, and an incentive mechanism for the staff to expand NRW activities.
- Formulate a NRW reduction roll-out plan to expand the pilot area's activities to the entire Khansar City.
- Formulate an existing pipeline network renewal/restructuring plan in the pilot area based on the existing information (including pipe material, diameter, age and system pressure), in order to allow flexible water transmission and distribution by means of rebuilding the aged system.

Output ٢: Technical and operational capacity to implement NRW reduction activities by NRW Reduction Action Teams is developed.

- Organize NRW Reduction Action Teams for the pilot activities and select the pilot area.
- Investigate the NRW situation by hydraulic isolation of the pilot areas and measurement of NRW ratios.
- Collect the existing information (including pipe material, diameter, age and system pressure) by means of existing document survey and site survey, in order to support the above "Activity ١-٨."
- Prepare a NRW reduction work plan for each pilot area incorporating leak detection, pipe repairing, plumbing, and activities for the reduction of non-physical losses.
- Conduct on-the-job training on leak detection, plumbing and pipe repairing for the NRW Reduction Action Teams.
- Implement NRW reduction activities according to the work plan.
- Prepare Standard Operating Procedure (SOP) for NRW reduction activities.
- Measure results of NRW Reduction Action Team's work (NRW ratio etc.) and provide feedback to the annual program.

Output ٣: Internal trainings for NRW reduction become operational.

- Prepare a training curriculum.
- Prepare training materials.
- Certify eligible lecturers.
- Establish a feedback mechanism to improve the quality of trainings.

- Try the internal trainings.

(٦) Input from the Recipient Government

Input by the Iranian side:

- Counterpart personnel:
  - Project Director (Mr. Seyedzadeh Manager of Non-Revenue Water Reduction & Water Consumption Management in NWWEC and Mr. Saleh Manager of Non-Revenue Water Reduction & Water Consumption Management &GIS in IWWC)
  - Project Manager
  - NRW Reduction Management Team
  - NRW Reduction Action Team

- Facilities for the Japanese Experts
  - Office space,
  - Furniture and facility.
  - Office Equipment
  - Telephone and internet connections
  - Others

- Personnel cost that is necessary for carrying out the activities for the pilot project (including allowances for overtime, night work and holiday work).

- Equipment and material that is necessary for carrying out the activities for the pilot project.
  - Cost for the isolation of the pilot areas (including installation of boxes for flow meters)
  - Valves, Meters
  - Pipe-repairing Cost
  - Project management Cost
  - Public relations to local residents in the pilot areas

(٧) Input from the Japanese Government

Input by the Japanese side:

- Japanese expert:

- Expert on NRW reduction planning (Chief Advisor)
- Expert on monitoring and evaluation/project coordination
- Expert on leak detection techniques
- Expert on service connection techniques
- Expert on construction supervision
- Expert on metering technology
- Expert on finance
- Expert on training program design
- Expert on planning for existing pipeline network renewal/restructuring plan
- Coordinator

- Equipment:
  - Listening stick,
  - Leak detector,
  - Metal pipe locator,
  - Metal locator,
  - Portable pressure recorder,
  - Data logger,
  - Electromagnetic flow meter,
  - Ultrasonic flow meter,
  - Ultrasonic pipe wall thickness meter,
  - Boring bar,
  - Drill bit,
  - Hammer drill,
  - Generator,
  - Office hardware,
  - Pipe material (DCIP with restrained system and/or earthquake resistant system),
  - Equipment for non-water-interruption construction method,
  - water meter,
  - On-site test meter (for water meter accuracy test at site),
  - Others

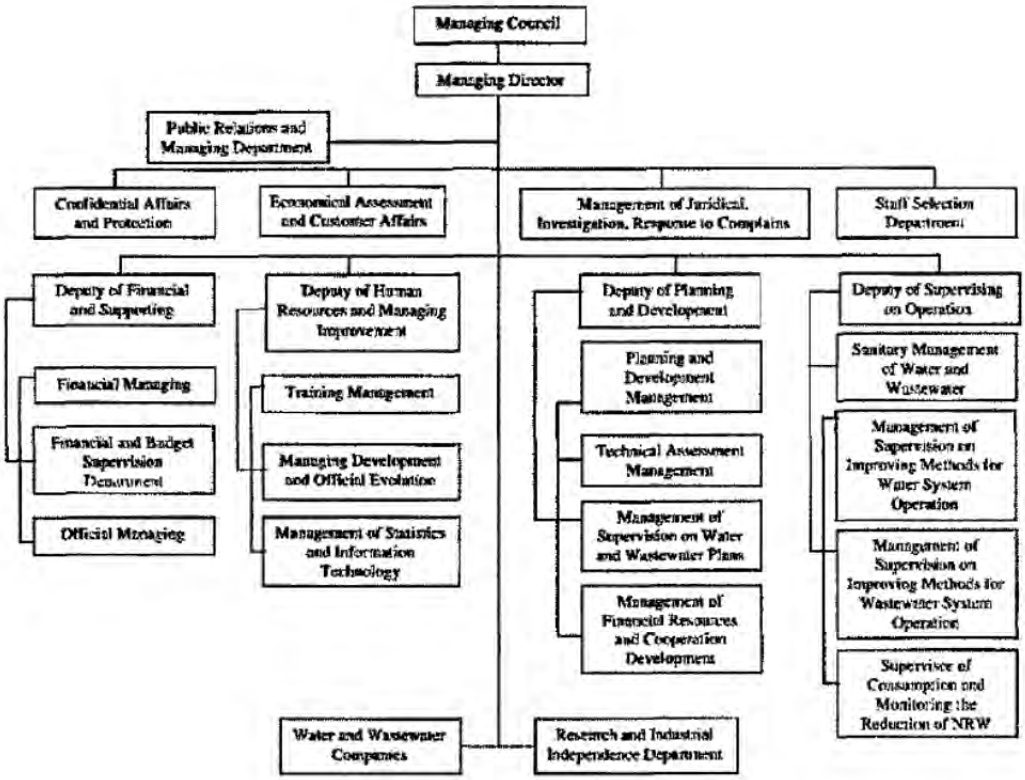
- Regional and overseas training program:
  - For members of NRW Reduction Management Team
  - For members of NRW Reduction Action Team

(٨) Implementation Schedule

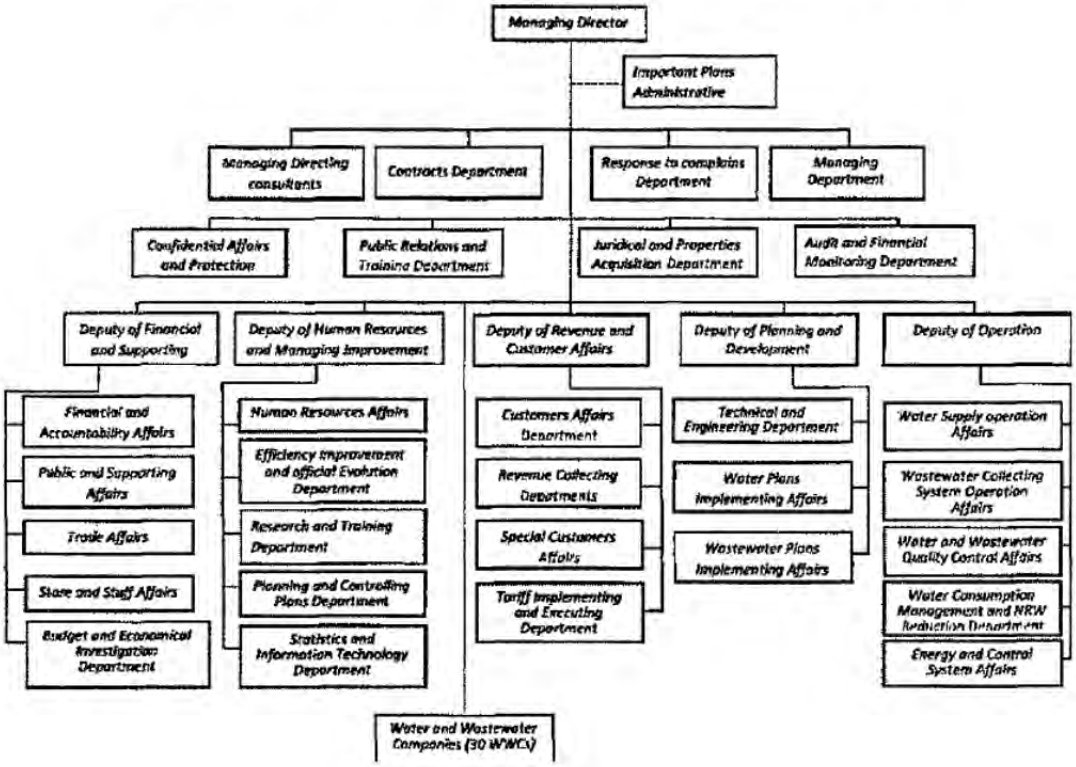
Month Year ~Month Year

٢١ March ٢٠١٥ – ١٩ March ٢٠١٦

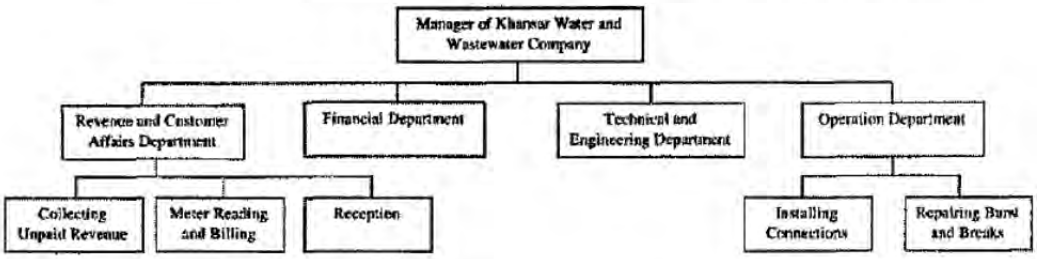
Organization Chart of National Water & Wastewater Engineering Company (NWWEC)



Organization Chart of Isfahan Water & Wastewater Company (IWWC)



Organization Chart of Khansar Water & Wastewater Company (KWWC)



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