

Appendix VI: **Technical Note (1), February 2, 2016**

TECHNICAL NOTES  
ON  
THE PREPARATORY SURVEY  
ON  
THE PROJECT FOR URGENT IMPROVEMENT OF WATER SECTOR  
FOR  
THE HOST COMMUNITIES OF SYRIAN REFUGEES  
IN NORTHERN GOVERNORATES IN THE HASHEMITE KINGDOM OF JORDAN  
PHASE 2

Based on the Minutes of Discussions (hereinafter referred to as "M/D") on the Preparatory Survey on the Project for Urgent Improvement of Water Sector for the Host Communities of Syrian Refugees in Northern Governorates in the Hashemite Kingdom of Jordan Phase 2 (hereinafter referred to as "the Project") signed on 21st December, 2015 between the Preparatory Survey Team (hereinafter referred to as "the Team") of Japan International Cooperation Agency (hereinafter referred to as "the JICA") and Water Authority of Jordan (hereinafter referred to as "WAJ") of the Government of the Hashemite Kingdom of Jordan, the consultant members of the Team had a series of discussions and conducted field surveys from 22nd December, 2015 to 31st January 2016. As a result of the discussions and the surveys, both sides confirmed and agreed the technical conditions described as per Attachments.

Amman, February 4th, 2016



Mr. Tawfiq Z. Habashneh  
Secretary General  
Water Authority of Jordan  
Ministry of Water and Irrigation



For Mr. Kazufumi Momose  
Leader  
JICA Study Team



## Attachment

### 1.1 Target years

The target year of the Project will be 2020 immediately after the Project completion, meeting the policy of Japan's Grant Aid, which focuses on an urgent improvement project.

### 2.1 Population of Hawwara and Sarieh

The total population of the planned facilities is taken as the population of permanent residents of Jordan and the Syrian refugee population in 2020. Since the future change in refugees cannot be predicted, the population of refugees in 2020 is taken as constant and equivalent to the population of refugees in 2013.

The future population of Hawwara in 2020 is 21,631 persons and the future population of Sarieh in 2020 is 32,583 persons. (Table 2.1.1 and 2.1.2)

**Table 2.1.1 Future Population of Hawwara and Population of Syrian refugees**

Year	Future population Population of permanent residents of Jordan (Department of Statistics)	No. of refugees (July 2013, Ministry of the Interior) [proportional allotment]	Total population	Remarks
2016	16,919	3,298	20,217	
2020	18,333	3,298	21,631	Plan

**Table 2.1.2 Future Population of Sarieh and Population of Syrian refugees**

Year	Future population Population of permanent residents of Jordan (Department of Statistics)	No. of refugees (July 2013, Ministry of the Interior) [proportional allotment]	Total population	Remarks
2016	25,486	4,968	30,454	
2020	27,615	4,968	32,583	Plan

### 2.2 Planned per capita Demand

#### (1) Planned per capita consumption

The planned water use per capita per day is as given below, based on the planned values in the "Water Reallocation Strategy 2010) of MWI. WAJ has been using 1.5 to 2.0 as the hourly factor, although this figure varies depending on the project; for this project, 1.5 will be used as the minimum required limit.

**Table 2.2 Planned Water Use per Capita per day**

S.N.	Item	Rural area (Hawwara, Sariéh)
1	Domestic water (Lpcd)	80
2	For commercial use	3% of domestic use
3	For industrial use	2% of domestic use
4	For tourism use	-
5	For emergency use	5% of domestic use
6	<b>Daily average water use (Lpcd)</b>	88
7	Seasonal peak factor	17% of domestic use
8	<b>Daily maximum water use</b>	103
9	<b>Hourly factor</b>	50% more than daily maximum water use

## (2) Planned water leakage ratio

The planned water leakage ratio is as follows; according to the Study on Water Sector for the Host Communities of Syrian Refugees in the Hashemite Kingdom of Jordan, Master Plan, Water supply (hereinafter referred to as the M/P), chapter 3.

**Table 2.3 Planned Leakage Ratio**

Index	2020	Remarks
Leakage ratio (%)	20	Leakage ratio of 2020 referred from the M/P

## (3) Planned per capita Consumption

The planned demand water volume is given in the table below using the planned leakage ratio and planned water use per capita per day.

**Table 2.4 Planned Conditions for Demand Water Volume**

Item	2020
	Rural Area
A. Planned water use per capita per day (Lpcd)	88
B. Planned average water supply volume per capita per day (Lpcd)	110
C. Planned maximum water supply volume per capita per day (Lpcd)	128

## (4) Planned water supply Pressure

The water supply pressure for this project is taken as minimum 0.25 to 0.29 MPa and maximum 0.78 to 0.98 MPa in principle, assuming water can be distributed to a four-story building directly.

**Table 2.5 Dynamic Water Supply Pressure Used in This Project**

Minimum water supply pressure	Maximum water supply pressure
0.25-0.29 MPa (Water can be supplied to a four-story building)	0.78-0.98 MPa assumed in principle.

## (5) Planned water Supply

The planned water supply volume is given in the table below using the population and planned conditions for

demand water volume.

**Table 2.6 Planned Water Supply Volume in Hawwara**

Year	population	Daily average water (m <sup>3</sup> /day)	Daily maximum water supply Volume (m <sup>3</sup> /day)	Hourly maximum water supply Volume (m <sup>3</sup> /hrs)
2020	21,631	2,379	2,769	173

**Table 2.7 Planned Water Supply Volume in Sarieh**

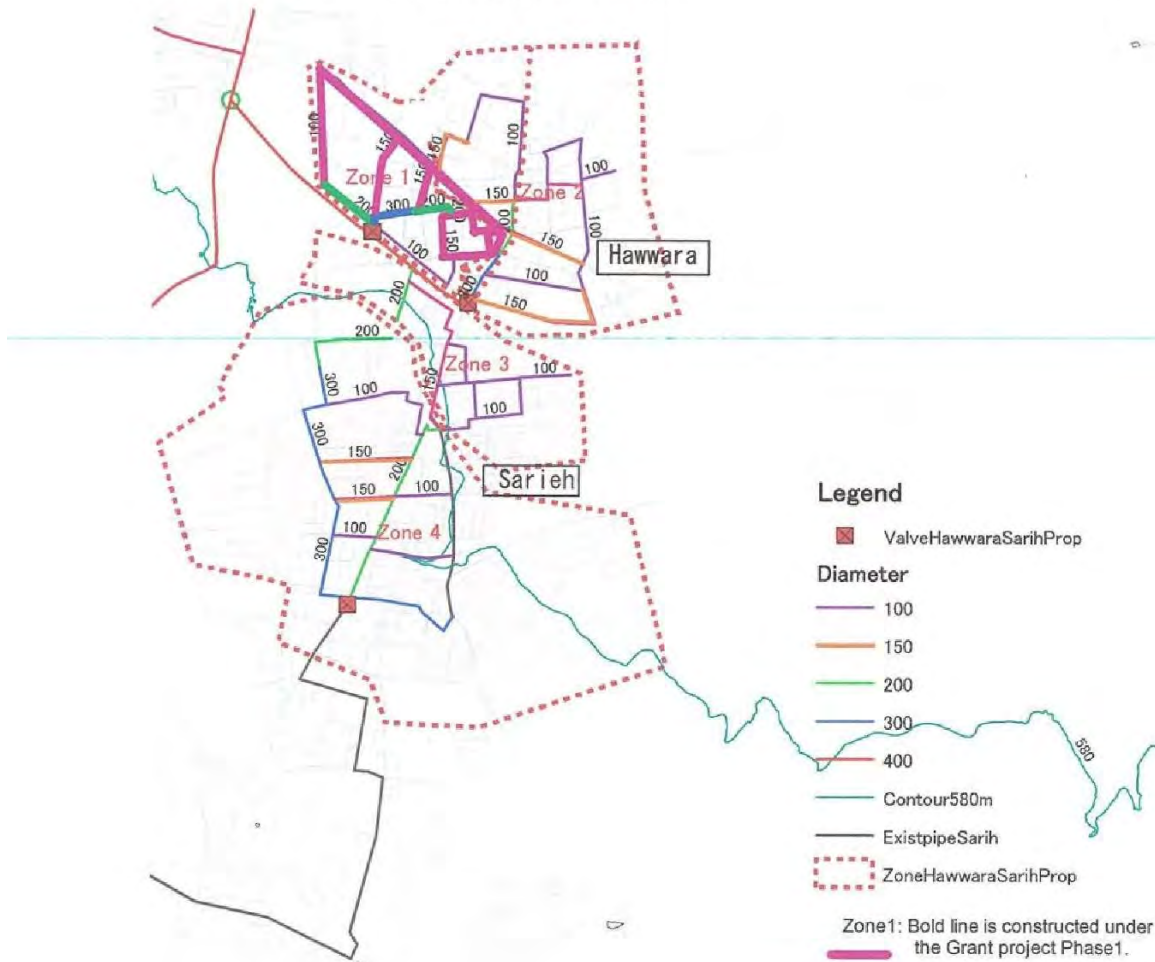
Year	population	Daily average water supply Volume (m <sup>3</sup> /day)	Daily maximum water supply Volume (m <sup>3</sup> /day)	Hourly maximum water supply Volume (m <sup>3</sup> /hrs)
2020	32,583	3,584	4,171	261

Available water supply volumes in 2020 are expected to be 99.2%<sup>1</sup> of planned water demand volume in both areas respectively.

<sup>1</sup> The total amount of water demand and the total amount of water available for the northern governorates is expected to be 91.76 Million Cubic Meters (MCM)/year and 91 (MCM)/year respectively. Supposed that the water supplied equality in each area for the northern governorates, 99.2% of planned water demand volume would be able to supply.

### 3.1 Zoning

The zoning is shown below. The area was divided into four distribution zones considering the elevation, the roads and the existing pipeline network.



### 3.2 Water distribution

Water resources development has been continuously conducted in Jordan. Development of two additional water sources in the foreseeable future is considered. Depending on the water resources scenario, distribution system will differ.

- Water distribution and pipe network until 2020 (Case 1)

Case 1 is based on additional 19 MCM/year (10 MCM/year from Disi project and 9 MCM/year from rehabilitation of eastern wells) for the 4 Northern governorates. In this case, water is distributed from the Hofa reservoir to Hawwara and Sarih.

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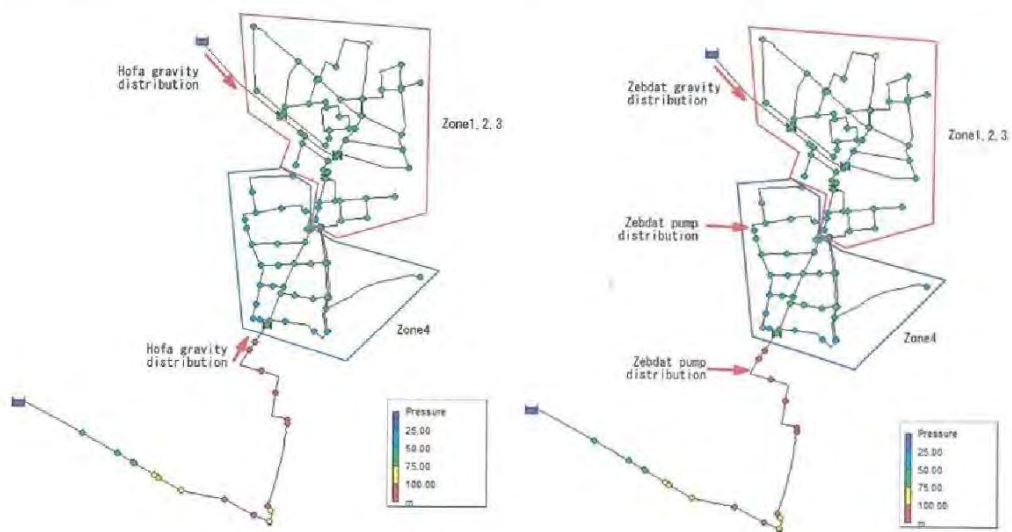
- Water distribution and pipe network after 2020 (Case 2)

Case 2 is based on additional 30 MCM/year from western sources in Wadi Al-Arab for the 4 Northern governorates. Wadi Al-Arab project is in the Pre-qualification stage as of January 2016 and the project will be completed by 2018 or 2019. Additional 30 MCM/year will be available at Zebdat reservoir and pumping station. In this case, according to the M/P, water should be distributed from the Zebdat reservoir or pumping station to Hawwara and Sarieh. Distribution pipes from the Zebdat reservoir and pumping station to the zones 1 to 4 is also planned to complete by the year 2020; The detailed design for the distribution pipes is being conducted by JICA and will be completed by the end of 2016. After the completion, WAJ is planning to carry out an international bidding for the construction.

However, even if the above distribution facilities to the zones 1 to 4 are not completed by the year 2020, water can still be distributed based on the Case 1 because routes and sizes of the pipes are the same for both Cases.

- Water pressure for both water distribution cases

Based on the decided routes and diameters of the proposed pipes, dynamic water pressure is calculated as 0.25-0.98 Mpa for both Cases. In the calculation, the sizes of the pipes are the same for both Cases under the network analysis. Below figure indicates that the dynamic water pressures satisfy the planned water supply pressure shown in 2.2 (4) for both Cases..



Case 1 (Additional 19 MCM/year, Before Wadi Arab 2) Case 2 (Additional 30 MCM/year, After Wadi Arab 2)

**Figure 3.2 Water Pressures for Both Cases**

Since rehabilitation of distribution pipeline network in Hawwara and Sarieh requires huge inputs, the

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scope of the Project should be decided so that it suits the project budget. Thus, the priority of rehabilitation should be considered to each zone.

WAJ considers the priority of the zones of the Hawwara and Sarieh as shown in the below table. Priority will be decided based on the area of Phase 1<sup>2</sup> and water pressure. As for area of Phase 1, priority was set to Zone 1, because rehabilitation of distribution pipes has been implemented for a part of Zone 1 by Phase 1. As for water pressure, priority was put for zones with low pressure and water shortage area.

Priority	Zone	Water pressure
1	Zone1	0.10-0.25Mpa
2	Zone2	0.10-0.25Mpa
3	Zone3	Under the survey
4	Zone4	Under the survey

If each zone of water pressure is almost same, another criteria for setting priority will be population density.

In addition, the pipes of distribution main is the first priority in each zone if the budget is limited.

To sum up, the scope of the Project will be decided based on the priority shown in the table. In case the budget is not enough for the full rehabilitation (from distribution main to service pipes) of the prioritized zone, rehabilitation of distribution main in the prioritized zone will be considered as the scope of the Project.

#### 4.1 Pipe Material and others

Ductile iron pipe (DIP) will be used for pipe for distribution main of 100-300mm diameter. Specifications of DIP will conform to ISO 2531 (K-9 pipe). HDPE pipe will be used for pipe of 63mm diameter.

Criteria for buried pipe will conform to Jordan's standards (WAJ, Ministry of Public Works and Housing, Irbid municipality standards).

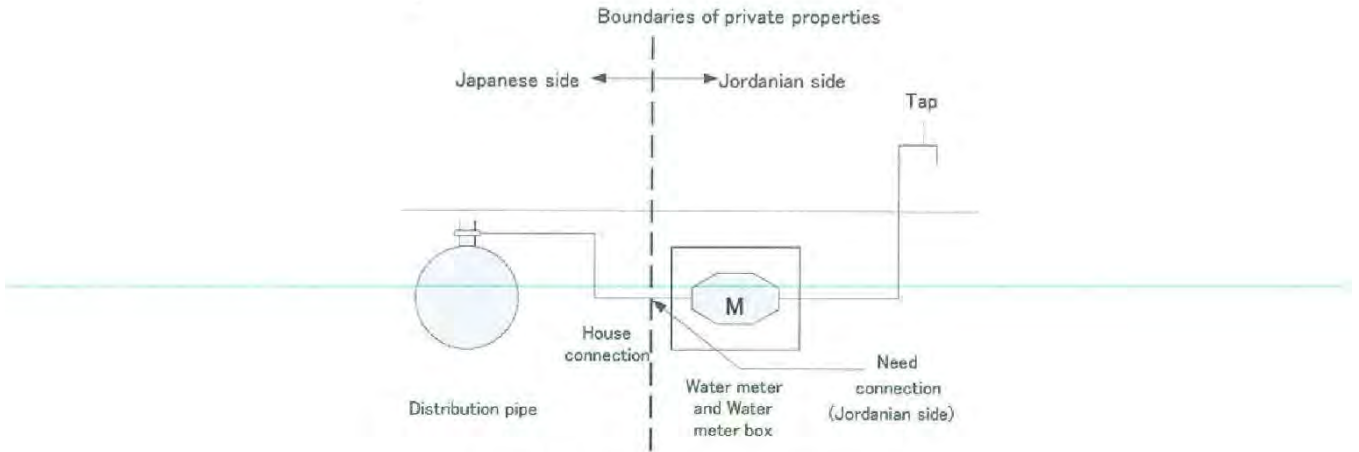
Trenchless construction method will be used because of request from Public Works in principle at important Public Works road crossings.

#### 4.2 Boundary of Service Pipes constructed by the Project

The Project will cover the necessary material and construction of service pipes. Japanese side will be

<sup>2</sup> Phase1 means the Project for Urgent Improvement of Water Sector for the Host Communities of Syrian Refugees in Northern Governorates in the Hashemite Kingdom of Jordan Phase 1.

responsible for the necessary material and construction of service pipes up to boundaries of private properties. Jordanian side will be responsible for connection as well as the necessary material and construction of service pipes in boundaries of private properties. Jordanian side will allocate the budget for the necessary material and construction and select the contractor by bidding. Japanese side and Jordanian side will adjust the schedule of this construction.



**Figure 4.2 Boundary of Service Pipes Laying**

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Date: May 26, 2016

## Minutes of Meeting

Date : May 27, 2016, 15:00-16:00  
Location : YWC Head Office  
Subject : Water Networks Design for Hawwara and Sarih District  
Attachment : Design Concept for Improvement of Water Networks prepared by TEC International Co., Ltd.

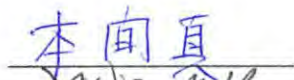


● Yarmouk Water Company (YWC)

Eng. Mohammed Al-Rababah	General Manager
Eng. Hassan Al-Hazaymeh	Assistance General manager
Eng. Salem Alshloul	Director of Irbid Water Directorate
Eng. Malek Rashdan	Director of Bani Obeid
Mr. Khalid Shafmawi	Operator of Bani Obeid

Signature  
  
  
  


● TEC International Co., Ltd. (TECI)

Eng. Makoto Homma	Project Manager
Eng. Takayuki Nojima	Site Representative
Eng. Zuhair Saadat	Senior Project Coordinator
Eng. Suhaib Sahawneh	Assistant Engineer

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TECI explained the design concept of this project using papers prepared by TECI, and then, all the attendances discussed and agreed the followings.

1. YWC confirmed that the budget cannot cover all the area of Zone1, 2, 3, 4, but can do up to Zone1, 2, 3 at maximum.
2. Pipe materials shall be Ductile Iron Pipe (DIP) K9 for 100mm inside diameter or larger and Polyethylene Pipe (PEP) PN25 for smaller than 100mm inside diameter.
3. Pipe class shall be Primary, Secondary Class for larger than 100mm inside diameter and Tertiary Class for 100mm inside diameter or smaller. Service pipes are able to be connected with Tertiary Class pipes, but not with Primary and Secondary Class pipes.
4. All the existing PEP shall not be used for newly building networks because its pressure class is PN16.
5. YWC prepares the GIS maps marked by colored pen showing existing Ductile Iron Pipes (DIP) relatively newly installed. TECI is considering use of these existing DIP under the condition that the existing DIP size is equal to or larger than the size determined by hydraulic calculation and installed in year 2007 or after 2007.

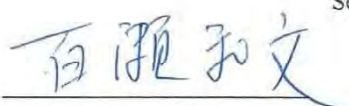
Appendix VIII: **Technical Notes (2), September 1, 2016**

TECHNICAL NOTES  
ON  
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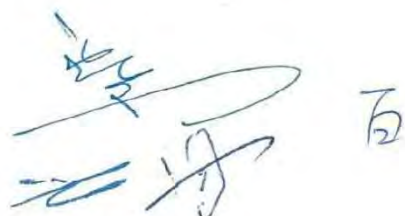


Engineer Tawfiq Z. Habashneh  
Secretary General  
Water Authority of Jordan  
Ministry of Water and Irrigation



Mr. Kazufumi Momose  
Leader  
JICA Study Team

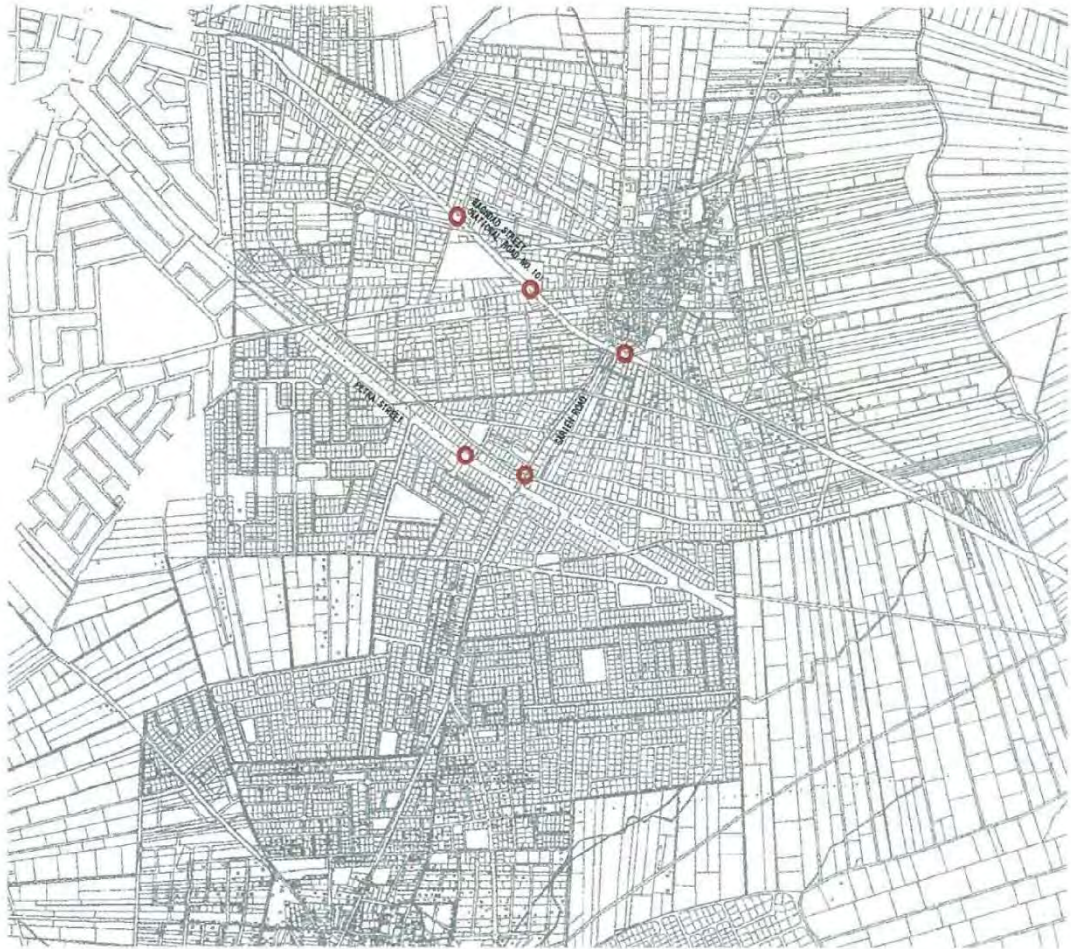
September 1, 2016



1. In Jordan, single pipeline is designed along all the roads except national highways where road is wide. Following this practice in Jordan, single pipeline is designed along all the roads except the national highways of Bagdad road, Petra road and Sarieh road where pipelines are designed along the both sides of the roads to avoid many service pipes crossings on the national highways. This pipeline arrangement is commonly practiced.
2. During the course of this preparatory survey, the suburban areas, which are designed as urban development areas by "Greater Irbid Master Plan" published by Ministry of Municipality Affairs, have been rapidly developed, and roads and power lines have already been constructed in these areas. Considering such situation, WAJ and YWC requested during the preparatory survey period to JICA study team to include those areas in the Project. JICA study team has confirmed the progress of development in the suburban areas and agreed to cover the requested areas in the Project. Also connection of existing pipes to make looping of the network is designed.
3. Main pipes that cross national highways are designed by employing trenchless method, pursuant to the standard of the Ministry of Public Works and Housing. However, WAJ will seek to avoid trenchless method in consultation with the Ministry of Public Works and Housing and will inform the discussion results to JICA study team by 9 September 2016. JICA study team will re-design road crossing methods based on the results; however, if the results are not available by the above date, five trenchless methods that were designed already will be used.
4. Pipe depth and road restoration methods are designed based on the rules of Ministry of Public Works and Housing for national highways and Greater Irbid Municipality for municipality roads (refer to Figure 2).
5. WAJ and YWC requested JICA Study Team on the implementation order. The requested order is as follows;
  - (1) distribution pipes in zone 1
  - (2) distribution pipes in zone 2
  - (3) distribution pipes in zone 3
  - (4) Material supply of distribution pipes in zone 4House connection in every zone that was agreed previously to be included in the JICA scope will be excluded from the JICA scope. Therefore, an Outline Design report includes construction of every facility in zones 1 to 3 and material supply in zone 4 except house



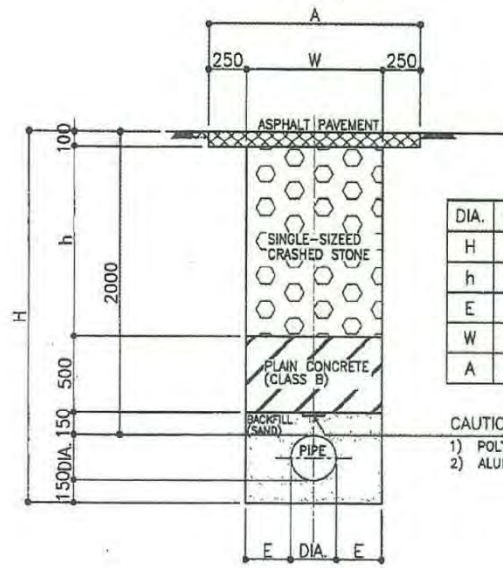
connection in every zone.



**Figure 1 Location of Pipe Jacking Method**

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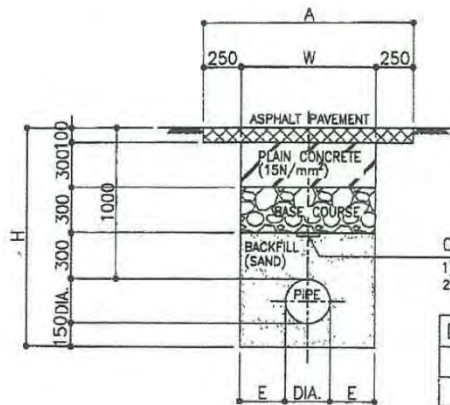
**Cross Section in National Highways managed by  
Ministry of Public Works and Housing (MoPWH)**



DIA.	OD63	DN100	DN150	DN200	DN300	DN400
H	2,200	2,250	2,300	2,350	2,450	2,550
h	1,250	1,250	1,250	1,250	1,250	1,250
E	300	300	300	300	300	300
W	650	700	750	800	900	1,000
A	1,150	1,200	1,250	1,300	1,400	1,500

CAUTION TAPE(WIDTH 150mm)  
 1) POLYETHYLENE ROLLED SHEET FOR DUCTILE IRON PIPE  
 2) ALUMINUM COATING ROLLED SHEET FOR POLYETHYLENE PIPE

ROAD ALONG PAVEMENT FOR NATIONAL ROAD AND MAIN ROAD



CAUTION TAPE(WIDTH 150mm)  
 1) POLYETHYLENE ROLLED SHEET FOR DUCTILE IRON PIPE  
 2) ALUMINUM COATING ROLLED SHEET FOR POLYETHYLENE PIPE

DIA.	OD63	DN100	DN150	DN200	DN300	DN400
H	1,200	1,250	1,300	1,350	1,450	1,550
h	-	-	-	-	-	-
E	300	300	300	300	300	300
W	650	700	750	800	900	1,000
A	1,150	1,200	1,250	1,300	1,400	1,500

MUNICIPALITY ROAD PAVEMENT

**Figure 2 Cross Section of Pipe**

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Appendix IX: **Technical Notes (3), November 17, 2016**

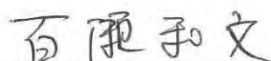
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Amman  
November 17, 2016



Engineer Tawfiq Z. Habashneh  
Secretary General  
Water Authority of Jordan  
Ministry of Water and Irrigation



Mr. Kazufumi Momose  
Leader  
JICA Survey Team



Attachment

1. Both sides recognize that water will be supplied to the project area (Hawarah and Sarieh) as follows;
  - a) The project area will receive water from the Hofa reservoir by gravity: Hawarah through the Hofa – Bait Ras pipeline (being constructed under JICA phase 1 grant-aid project) and Sarieh through Hoson until the Wadi Arab 2<sup>nd</sup> stage project is completed that is scheduled to be operational in 2020 at the latest.
  - b) After the Wadi Arab 2<sup>nd</sup> stage project is completed, the project area is to receive water from the Zebdat reservoir according to the JICA master plan and the related facilities from the Zebdat reservoir/ pumping station and the project area are constructed: Hawarah by gravity and Sarieh by pumping.
2. The team recognizes that water pressure (static pressure plus surge pressure) will be less than 160 m when supplied from the Zebdat reservoir/pumping station while it will be more than 160 m when supplied from the Hofa reservoir if pressure reducing valves (PRVs) are not installed.
3. The pressure reducing valves (PRVs) are already installed in the 1<sup>st</sup> stage grant-aid project to reduce water pressure; 2 along the Hofa – Bait Ras pipeline and 1 each at the inlets of zones 1 and 2 in Hawarah.
4. If all these PRVs are damaged simultaneously and do not function properly, water pressure will increase and exceed 250 m in most of Hawarah and part of Sarie due to differences of elevation between the Hofa reservoir and the project area.
5. WAJ has expressed that simultaneous damage to all PRVs need not consider and the maximum water pressure could be reduced to less than 250 m. Hence, as agreed already, ductile iron pipe (K-9) and polyethylene pipe (PN-25) can be used in the project.
6. WAJ has requested spare parts of PRVs and fitting are included in the project because immediate replacement of PRVs is desirable not to give unnecessary high pressure to the project area and difficulty of procurement of fittings with PN-25.
7. WAJ has expressed that WAJ will take full responsibility of the pipe selection and will not claim to JICA even if the pipes are damaged.



Appendix X: **Approval Letter Issued by WAJ on Draft Final Report**

