Ministry of Planning and
Ministry of National Economy
Palestinian National Authority (PNA)

Japan International Cooperation Agency (JICA)

No.

Feasibility Study
on
Agro-industrial Park Development
in
the Jordan River Rift Valley

Final Report

Volume 2
(Reference Data and Materials of Engineering Study)
2/2

March 2009

JAPAN INTERNATIONAL COOPERATION AGENCY

KRI INTERNATIONAL CORP.
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Chapter II Engineering Calculation Sheet

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RD-1 Pavement Design for Off-site Access Roads and On-site Roads

1. Methodology of the Pavement Design

2. Pavement Design for Access Roads

3. Pavement Design for On-site Major and Minor Roads

1. Methodology of the Pavement Design

Pavement design of the Access road and On-site roads were designed on the basis of "Design of Pavement Structures 1993" published by American Association of State Highway and Transportation Officials (AASHTO).

The Methodology for pavement design base on above manual is shown as following figure.

Estimation of EASL using traffic volume

↓

Estimation of Design Lane Traffic ($DsgnW_{18}$)

↓

Estimation of Structural Number (SN)

↓

Estimation of Thicknesses of Each Pavement Layer

Flow of the Pavement Design

2. Pavement Design for Access Roads

Pavement Design of Access Road for Stage I

The Estimation for design EASL toward traffic volume from the agro-industrial park is shown following table. In this estimation, analysis period was defined as 10 years for considering the short term use.

Design ESAL of Access Road for Stage I

Vehicle Types	Design Daily Traffic Volume (vehicles/day)	Design Annual Traffic Volume (vehicles/year)	Design Traffic *Analysis period of 10years	ESAL Factor	Design ESAL
Passenger cars	440	160,600	1,606,000	0.001	1,606
Buses	60	21,900	219,000	0.870	190,530
Single Unit Trucks	80	29,200	292,000	0.980	286,160
Heavy Trailer	70	25,550	255,500	1.480	378,140
Total	650	237,250	2,372,500		856,436

Design lane traffic ($DsgnW_{18}$) was calculated by applying following formula. In this calculation, Directional distribution factor is setup a value of 0.5 as general and lane distribution factor is setup a value of 1.0 for one lane in each direction of travel.

$$DsgnW_{18} = D_D \times D_L \times \text{Total } W_{18}$$

where, Total W_{18} : Design ESAL

D_D : Directional distribution factor

D_L : Lane distribution factor

As the result of above estimation, design fane traffic of 428,218 was obtained.

And Structural number (SN) is examined by applying the following formula.

$$\log W_{18} = Z_R \times S_0 + 9.36 \log(SN+1) - 0.20 + \frac{\log\left(\frac{\Delta PSI}{4.2-1.5}\right)}{0.40 + \frac{1094}{(SN+1)^{5.19}}} + 2.32 \log(M_R) - 8.07$$

where, W_{18} : the Number of ESALs over the lifetime of the pavement

SN : Structural number

Z_R : Standard normal deviate

S_0 : Overall Standard Deviation

ΔPSI : $p_o - p_t$

MR : Roadbed Soil Resilient Modulus (psi)

In the estimation, each coefficient is defined as shown in the following table.

Pavement Design factor of Access Road for Stage I

Factor	Value	Remarks
Z_R	-1.037	Reliability: 85%
S_0	0.45	
p_o	4.2	
p_t	2.5	
M_R	12,000psi	1500 x CBR *CBR=8 (assumption)

Source: JICA Study Team

Result of above calculation, structural number of 2.42 was obtained. And the estimated thickness of the pavement structure is calculated from the structural number equation as:

SD=a1*D1+a2*D2+a3*D3

Thicknesses of each pavement layer (asphalt, base and sub-base) are determined as associated SN of the pavement is satisfied with structural number required as shown in the following table.

Calculation of Layer Thickness of Access Road for Stage I

Layer	Description	Layer Coefficient	Drainage Coefficient *Assumption	Elastic Modulus (psi) *Assumption	Practical Layer Thickness (cm)	Associated SN
D1	AC Layer	0.420	1.00	400,000	5.0	0.83
D2	Gran Base	0.132	1.00	28,500	35.0	1.82
					Total SN	2.65>2.42

Source: JICA Study Team

The design procedure results in the following preliminary thickness of;

D1 (i.e., thickness of the asphalt concrete layer) = 5 cm

D2 (i.e., thickness of the base course layer) = 35 cm

Pavement Design of Access Road

Estimation for design EASL toward traffic volume from the agro-industrial park is shown following table. In this estimation, analysis period was defined as 20 years.

Design ESAL for Access Road

Vehicle Types	Design Daily Traffic Volume (vehicles/day)	Design Annual Traffic Volume (vehicles/year) *1year=365days	Design Traffic *Analysis period of 20years	ESAL Factor	Design ESAL
Passenger cars	4,190	1,529,350	30,587,000	0.001	30,587
Buses	570	208,050	4,161,000	0.870	3,620,070
Single Unit Trucks	820	299,300	5,986,000	0.980	5,866,280
Heavy Trailer	260	94,900	1,898,000	1.480	2,809,040
Total	5,840	2,131,600	42,632,000		12,325,977

Source: JICA Study Team

Design lane traffic ($DsgnW_{18}$) was calculated by applying following formula. In this calculation, Directional distribution factor is setup a value of 0.5 as general and lane distribution factor is setup a value of 0.9 for two lanes in each direction of travel.

$$DsgnW_{18} = D_D \times D_L \times Total\ W_{18}$$

where, Total W_{18} : Design ESAL

D_D : Directional distribution factor

D_L : Lane distribution factor

As the result of estimation, design fane traffic of 5,546,690 was obtained. And Structural number (SN) is examined by applying the following formula.

$$\log W_{18} = Z_R \times S_0 + 9.36\log(SN+1) - 0.20 + \frac{\log\left(\frac{\Delta PSI}{4.2-1.5}\right)}{0.40 + \frac{1094}{(SN+1)^{5.19}}} + 2.32\log(M_R) - 8.07$$

where, W_{18} : the Number of ESALs over the lifetime of the pavement

SN : Structural number

Z_R : Standard normal deviate

S_0 : Overall Standard Deviation

ΔPSI : $p_o - p_t$

MR : Roadbed Soil Resilient Modulus (psi)

In the estimation, each coefficient is defined as shown in the following table.

Pavement Design factor for Access Road

Factor	Value	Remarks
Z_R	-1.037	Reliability: 85%
S_0	0.45	
p_o	4.2	
p_t	2.5	
M_R	12,000psi	1500 x CBR *CBR=8 (assumption)

Source: JICA Study Team

Result of above calculation, structural number of 3.69 was computed. And the estimated thickness of the pavement structure is calculated from the structural number equation as:

SD=a1*D1+a2*D2+a3*D3

Thicknesses of each pavement layer (asphalt, base and sub-base) are determined as associated SN of the pavement is satisfied with structural number required as shown in the following table.

Calculation of Layer Thickness for Access Road

Layer	Description	Layer Coefficient	Drainage Coefficient *Assumption	Elastic Modulus (psi) *Assumption	Practical Layer Thickness (cm)	Associated SN
D1	AC Layer	0.420	1.00	400,000	7.0	1.16
D2	Gran Base	0.132	1.00	28,500	30.0	1.56
D3	Gran. Sub-base	0.110	1.00	15,000	30.0	1.30
					Total SN	4.02>3.69

Source: JICA Study Team

The design procedure results in the following preliminary thickness of:

D1 (i.e., thickness of the asphalt concrete layer) = 7 cm
D2 (i.e., thickness of the base course layer) = 30 cm
D3 (i.e., thickness of the sub-base course layer) = 30 cm

3. Pavement Design for On-site Major and Minor Roads

Pavement Design of Major Road

Traffic volume trough on major road is assumed to be same volume as generated from agro-industrial park. The estimation for design EASL is shown following table. In this estimation, analysis period was defined as 20 years.

Design ESAL for Major Road

Vehicle Types	Design Daily Traffic Volume (vehicles/day)	Design Annual Traffic Volume (vehicles/year) *1year=365days	Design Traffic *Analysis period of 20years	ESAL Factor	Design ESAL
Passenger cars	4,190	1,529,350	30,587,000	0.001	30,587
Buses	570	208,050	4,161,000	0.870	3,620,070
Single Unit Trucks	820	299,300	5,986,000	0.980	5,866,280
Heavy Trailer	260	94,900	1,898,000	1.480	2,809,040
Total	5,840	2,131,600	42,632,000		12,325,977

Source: JICA Study Team

Design lane traffic ($DsgnW_{18}$) was calculated by applying following formula. In this calculation, Directional distribution factor is setup a value of 0.5 as general and lane distribution factor is setup a value of 1.0 for one lane in each direction of travel.

$DsgnW_{18} = D_D \text{ x } D_L \text{ x Total } W_{18}$

where, Total W_{18} : Design ESAL

D_D : Directional distribution factor

D_L : Lane distribution factor

As the result of estimation, design fane traffic of 6,162,989 was obtained. And Structural number (SN) is examined by applying the following formula.

$$\log W_{18} = Z_R \times S_0 + 9.36\log(SN+1) - 0.20 + \frac{\log\left(\frac{\Delta PSI}{4.2-1.5}\right)}{0.40 + \frac{1094}{(SN+1)^{5.19}}} + 2.32\log(M_R) - 8.07$$

where, W_{18} : the Number of ESALs over the lifetime of the pavement

SN : Structural number

Z_R : Standard normal deviate

S_0 : Overall standard deviation

ΔPSI : $p_o - p_t$

MR : Roadbed Soil Resilient Modulus (psi)

In the estimation, each coefficient is defined as shown in the following table.

Pavement Design factor for Major Road

Factor	Value	Remarks
Z_R	-1.037	Reliability: 85%
S_0	0.45	
p_o	4.2	
p_t	2.5	
M_R	12,000psi	1500 x CBR *CBR=8 (assumption)

Source: JICA Study Team

Result of above calculation, structural number of 3.75 was computed. And the estimated thickness of the pavement structure is calculated from the structural number equation as:

SD=a1*D1+a2*D2+a3*D3

Thicknesses of each pavement layer (asphalt, base and sub-base) are determined as associated SN of the pavement is satisfied with structural number required as shown in the following table.

Calculation of Layer Thickness for Major Road

Layer	Description	Layer Coefficient	Drainage Coefficient *Assumption	Elastic Modulus (psi) *Assumption	Practical Layer Thickness (cm)	Associated SN
D1	AC Layer	0.420	1.00	400,000	7.0	1.16
D2	Gran Base	0.132	1.00	28,500	30.0	1.56
D3	Gran. Sub-base	0.110	1.00	15,000	30.0	1.30
					Total SN	4.02 > 3.75

Source: JICA Study Team

The design procedure results of major road in the following preliminary thickness of:

D1 (i.e., thickness of the asphalt concrete layer) = 7 cm
D2 (i.e., thickness of the base course layer) = 30 cm
D3 (i.e., thickness of the sub-base course layer) = 30 cm

Pavement Design of Minor Road

Minor road was assumed to be taken a half of traffic volume generated from agro-industrial park. Therefore the Design EASL of minor road was adopted 6,162,989 as a half of Design ESAL of major road.

Design lane traffic ($DsgnW_{18}$) was calculated by applying following formula. In this calculation, Directional distribution factor is setup a value of 0.5 as general and lane distribution factor is setup a value of 1.0 for one lane in each direction of travel.

$DsgnW_{18} = D_D \times D_L \times \text{Total } W_{18}$

where, Total W_{18} : Design ESAL

D_D : Directional distribution factor

D_L : Lane distribution factor

As the result of estimation, design fane traffic of 3,081,494 was obtained. And Structural number (SN) is examined by applying the following formula.

$$\log W_{18} = Z_R \times S_0 + 9.36\log(SN+1) - 0.20 + \frac{\log\left(\frac{\Delta PSI}{4.2-1.5}\right)}{0.40 + \frac{1094}{(SN+1)^{5.19}}} + 2.32\log(M_R) - 8.07$$

where, W_{18} : the Number of ESALs over the lifetime of the pavement

SN : Structural number

Z_R : Standard Nomal Deviate

S_0 : Overall Standard Deviation

ΔPSI : $p_o - p_t$

MR : Roadbed Soil Resilient Modulus (psi)

In the estimation, each coefficient is defined as shown in the following table.

Pavement Design factor for Minor Road

Factor	Value	Remarks
Z_R	-1.037	Reliability: 85%
S_0	0.45	
p_o	4.2	
p_t	2.5	
M_R	12,000psi	1500 x CBR *CBR=8 (assumption)

Source: JICA Study Team

Result of above calculation, structural number of 3.35 was computed. And the estimated thickness of the pavement structure is calculated from the structural number equation as:

SD=a1*D1+a2*D2+a3*D3

Thicknesses of each pavement layer (asphalt, base and sub-base) are determined as associated SN of the pavement is satisfied with structural number required as shown in the following table.

Calculation of Layer Thickness for Minor Road

Layer	Description	Layer Coefficient	Drainage Coefficient *Assumption	Elastic Modulus (psi) *Assumption	Practical Layer Thickness (cm)	Associated SN
D1	AC Layer	0.420	1.00	400,000	5.0	0.83
D2	Gran Base	0.132	1.00	28,500	30.0	1.56
D3	Gran. Sub-base	0.110	1.00	15,000	30.0	1.30
					Total SN	3.69 > 3.35

Source: JICA Study Team

The design procedure results for minor road in the following preliminary thickness of:

D1 (i.e., thickness of the asphalt concrete layer) = 5 cm
D2 (i.e., thickness of the base course layer) = 30 cm
D3 (i.e., thickness of the sub-base course layer) = 30 cm

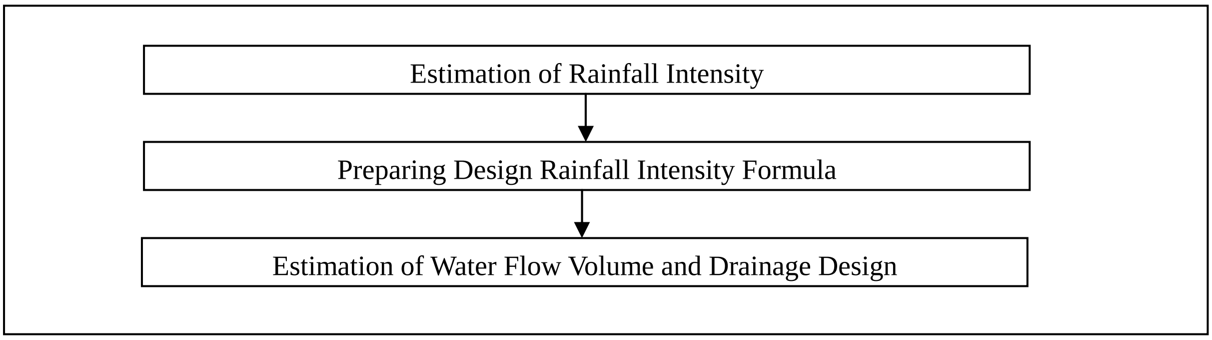
RD-2 Design for Storm Water Drainage Design

1. Methodology of Drainage Design

2. Drainage Design

1. Methodology of Drainage Design

The figure below shows the flow of design for storm water drainage channel.

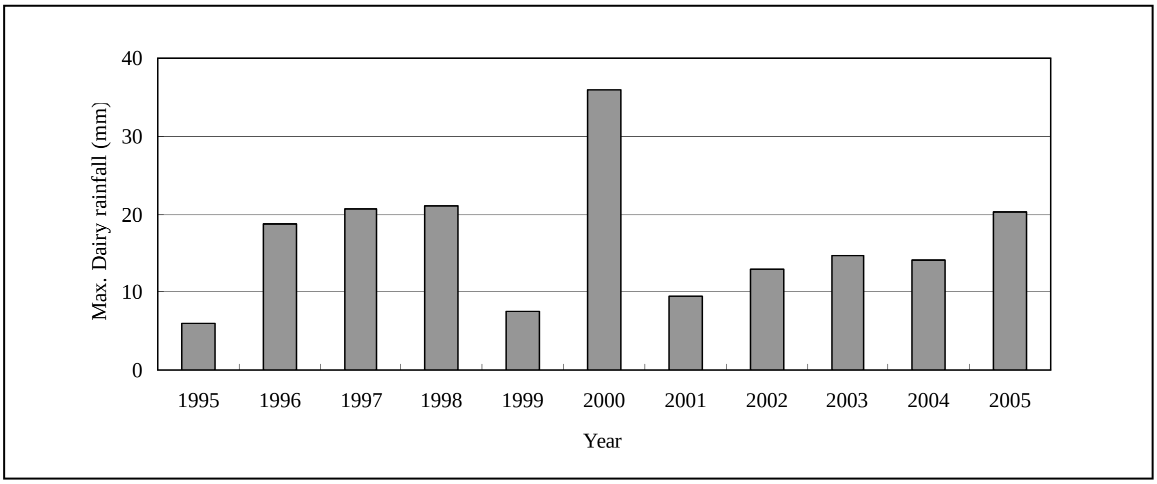


Flow of Design for Storm Water Drainage Channel

2. Drainage Design

<u>Estimation of Rainfall Intensity</u>

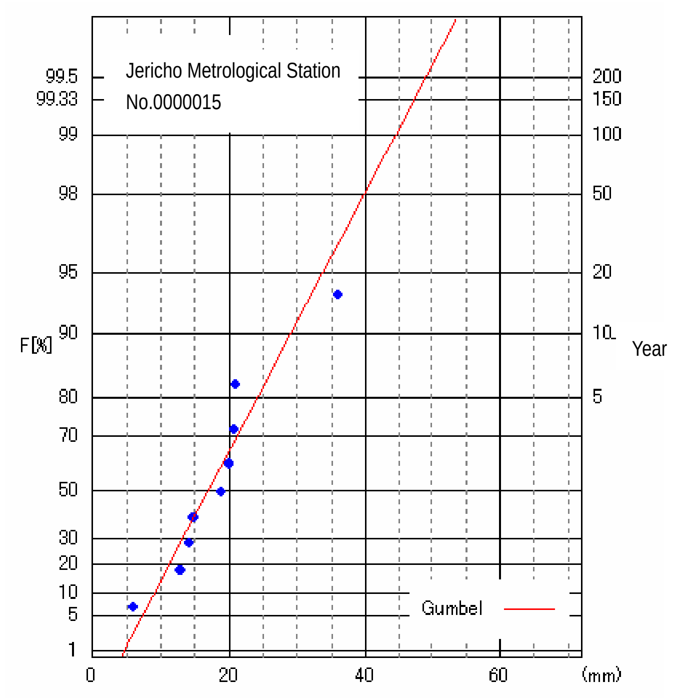
Maximum dairy rainfall volumes for the period of 1995 to 2005 at Jericho metrological station No. 0000015 are shown in the following Figure III-4-11. It is indicated 36.9mm/day of maximum volume in the decade from 1995.



Source: Palestinian Water Authority

Maximum Dairy Rainfall Data for the period 1995-2005 at Jericho Metrological Station

Rainfall Intensity of each return period was estimated using Gumbel's method with above rainfall data. Gumbel's method is estimation approach that makes a graph by plotting data on the Gumbel matrix. The result of estimation of rainfall intensity is shown in following Figure III-4-12 and Table III-4-10. In view of safety and reasonable, 29 mm/day of return period 10 year is accepted for storm water drainage design.



Source: JICA Study Team

Maximum Dairy Rainfall for 1995-2005 at Jericho Metrological Station

Rainfall Intensity of Each Return Period

Return period	5 year	**10 year**	20 year	30 year	50 year	100 year
Rainfall (mm/day)	24	**29**	33	36	40	45

Source: JICA Study Team

Preparing Design Rainfall Intensity Formula

Rainfall intensity formula for calculation of storm water volume is prepared using Talbot's Formula. In this calculation, 1 hour rainfall volume is 14 (mm / h) of half of dairy rainfall volume 29 (mm /h) as assumption. The Talbot's Formula is expressed below;

$$I_N^{24} = R_N^{24} \times \beta_N$$

$$\beta_N = a' / (T + b)$$

$$a' = b + 24$$

$$b = (24 - \beta_N^{t} \times t) / (\beta_N^{t} - 1)$$

$$\beta_N^{t} = I_N^{t} / I_N^{24}$$

$$I_N^{t} = R_N^{t} \times (24 / t)$$

where, I_N^{24} : 24hours rainfall intensity for N years of return period (mm/24h)

R_N^{24} : 24hours rainfall volume for N years of return period (mm)

β_N : characteristic coefficient value for N years of return period

I_N^{t} : t hours rainfall intensity for N years of return period (mm/24h)

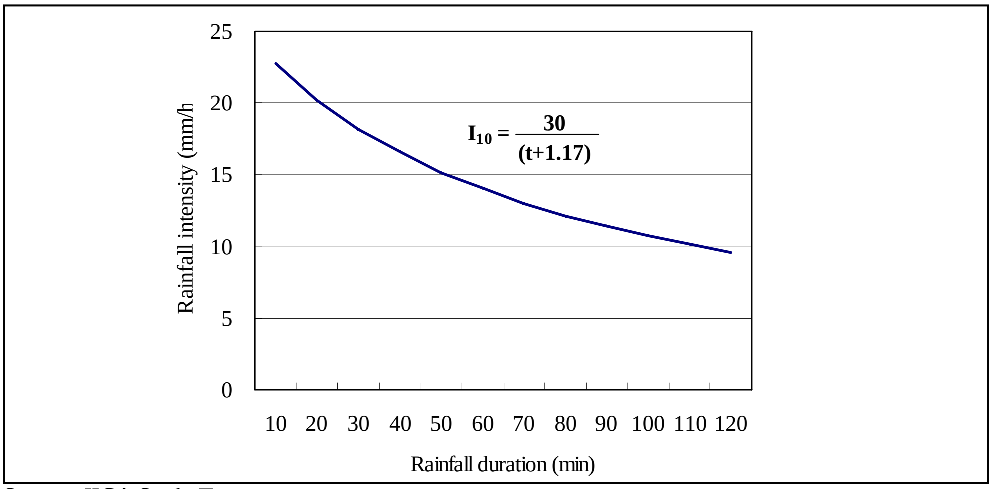
R_N^{t} : t hours rainfall volume for N years of return period (mm)

t : discretionary duration (h)

T : rainfall duration (h)

a', b : value for the constants

Result of the calculation, design rainfall intensity formula was obtained as below.



Source: JICA Study Team

Design Rainfall Intensity Formula

Estimation of Water Flow Volume and Drainage Design

<Volume of storm water flow>

The type and size of drainage are planed as it has capability of carrying off storm water to the river. The volumes of storm water flow are examined the applying rational formula as expressed below.

$Q = C\ I\ A$

where, Q : design flow (m^3/s)

C : drainage area runoff coefficient (-)

I : design rainfall intensity (mm/h)

A : drainage area (m^2)

In estimating the volume of storm water flow, drainage area runoff coefficient is set up a value of 0.5 as general value in development area.

<Drainage capability for facility design>

Flow conditions of designed drainage are examined by applying the "Manning's Formula" as expressed below.

$V = 1/n \times R^{2/3} \times I^{1/2}$

$Q = V \times A$

where, V : flow velocity (m/s)

n : roughness coefficient (-)

R : hydraulic radius (m)

I : flow gradient (-)

Q : discharge (m^3/s)

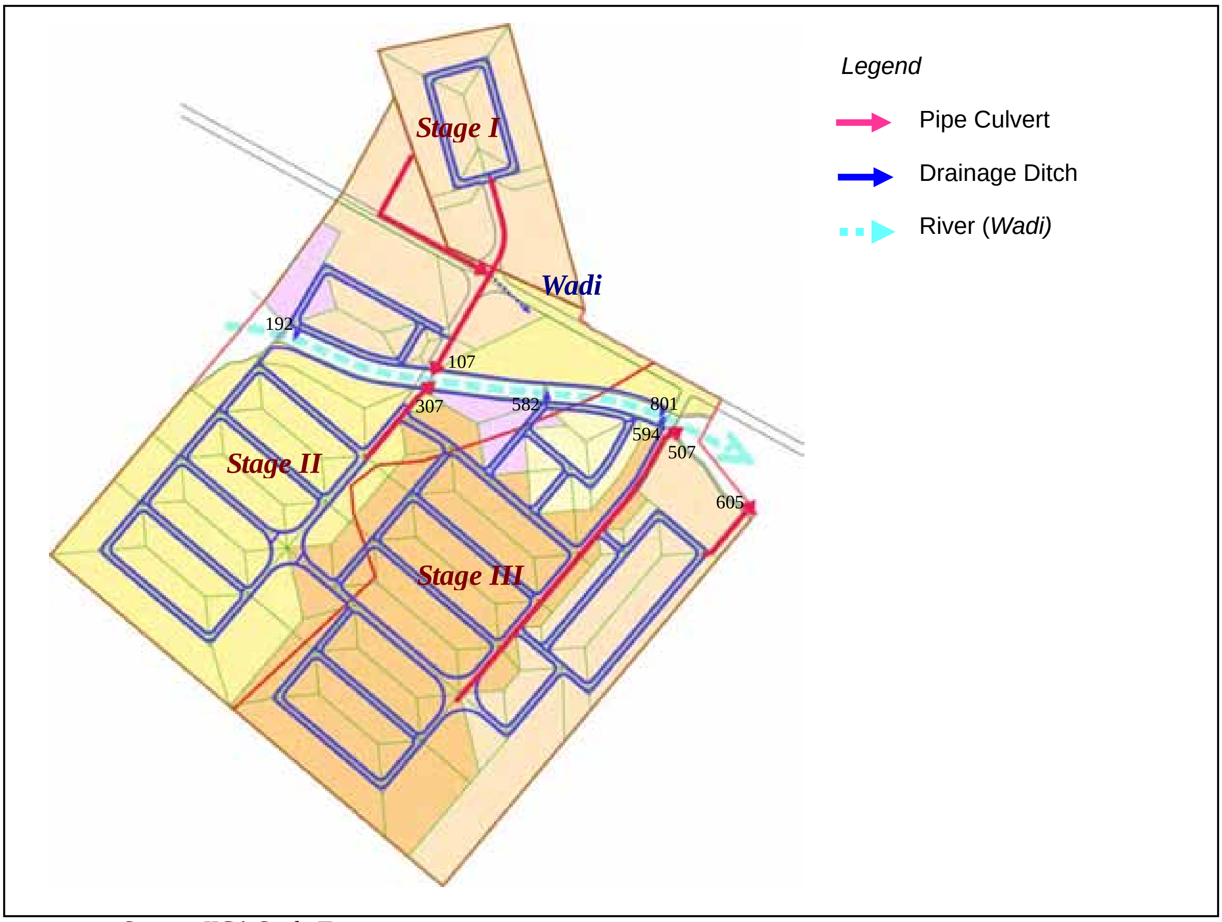
A : section area of flow (m^2)

Possible storm water in the agro-industrial park is planned to be collected, discharged through primarily the roadside ditch along the road network and release to the *Wadi*. Pipe culvert is installed in the section that capability of the road side ditch is lacking. As Result of calculation for storm water drainage, drainage designs in the section of discharge to on-site river are shown in table below and designed drainage network is shown in figure below.

Result of Storm Water Drainage

Drainage No.	Drainage area (ha)	Drainage type	Volume of Strom Water (m^3/s)
107	22.65	Pipe Curvert 800mm	0.680
192	1.68	Roadside Ditch	0.012
307	26.18	Pipe Curvert 800mm	0.812
507	31.62	Pipe Curvert 800mm	0.949
582	1.95	Roadside Ditch	0.062
594	2.97	Roadside Ditch	0.092
605	16.36	Pipe Curvert 800mm	0.507
801	3.64	Roadside Ditch	0.106

Source: JICA Study Team



Source: JICA Study Team

Planned Network of Drainage

WS-1 Results of Interview Survey on Working Periods

Questionnaire

1. How long is the standard hour of operation per day? _________ Hours/ Day
   Starts time _________
   Ends time _________
2. When is holiday? Weekly: _____________________ (Ex. Friday and Saturday)
   Annually: _________________, ___days (Ex. Lamadan Period, 7days)
3. Do you have some special operating period? Yes No
   If yes,
   a), when is that period? ___________, ___days (Ex. Lamadan Period, 7days)
   b), how long is the hour of operation per day? _________ Hours/ Day

Answers

No.	Name of Company	Interview Date	1. Standard Operation Hour				2. Holiday		3. Special Operation Hours		
			Working Hours (hours)	Starts Time (hh:mm)		Ends Time (hh:mm)	Weekly	Annually (days)	Answer (Yes or No)	Periods	Working Hours (hh:mm)
1	Rich for Food Processing	25 June 2008	8.0	8:00	~	16:00	Friday	12.0	Yes	45 days	10.0
2	Ali brothers Agricultural Co.	26 June 2008	9.0	7:00	~	16:00	None	7.0	Yes	4 months	24.0
3	Al-Juneidi for Trade & Industrial Engineering Co.	10 July 2008	8.5	8:00	~	16:30	Friday	10-12	No	-	-
4	Salwa Food Co.	23 Jun. 2008	15.0	7:00	~	22:00	Friday	8.0	Yes	Ramadan month (22 days)	7.5
5	K.A.R for Maccaroni & Food Stuff manufacturing Co.	02 July 2008	8.0	8:00	~	16:00	Friday	8.0	Yes	6 weeks	24.0
6	Golden Wheat Mills	02 July 2008	8.0	7:30	~	15:30	Friday	10.0	Yes	6 months	24.0
7	Al-Sanabel Maccaroni & Vermicelli Production Co.	02 July 2008	8.5	7:30	~	16:00	Sunday	12.0	Yes	110 days	16.5
8	Amro & Rushdi Alool Co.	10 July 2008	6.0	5:00	~	11:00	Friday	12.0	No	-	-
9	Al-Juneidi Co. for Dairy Products	10 July 2008	8.0 except cooling (24 hours)	8:00	~	16:00	Friday	9.0	Yes	60 days	18.0
10	Al-Hijaz for Chocolate	26 June 2008	8.0	6:00	~	14:00	Friday	8.0	Yes	July - December	24.0
11	Al-Morooj (Mawasem) Feed Co.	23 June 2008	8.5	7:30	~	16:00	Friday	8.0	Yes	36 days	0.0

WS-2 Calculation for Rate of Loading and Hourly Factor

■ Working Hours for Standard Operation Period

No.	Subtotal	Day	Total/year
1	8.0	256	2,048
2	9.0	201	1,809
3			0
4	15.0	305	4,575
5	8.0	269	2,152
6	8.0	146	1,168
7	8.5	191	1,624
8			0
9	8.0	244	1,952
10	8.0	148	1,184
11	8.5	269	2,287
		Sub-total A	18,798

0 0 0 0 0 0 0 0 0 0 0 0 0.5 0.5 1.5 3 4.5 4.5 4.5 4.5 4.5 4.5 4.5 4.5 4.5 4.5 4.5 4.5 4 4 4 3.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0 0 0 0

Hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Subtotal
Total	0.0	0.0	0.0	0.0	0.0	0.0	1.0	4.5	9.0	9.0	9.0	9.0	9.0	9.0	8.0	7.5	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	81

■ Working Hours for Special Operation Period

No.	Subtotal	Day	Total/year
1	10.0	45	450
2	24.0	105	2,520
3			0
4	15.0	0	0
5	24.0	36	864
6	24.0	157	3,768
7	16.5	110	1,815
8			0
9	18.0	60	1,080
10	24.0	157	3,768
11	9.0	36	324
		Sub-total B	14,589

2 2 2 2 2 2 2 2 2 2 2 2 2.5 2.5 4 4.5 4.5 4.5 4.5 4.5 4.5 4.5 4.5 4.5 4.5 4.5 4.5 4.5 4.5 4.5 4.5 4.5 4 4 3.5 3.5 3.5 3.5 3.5 3.5 3.5 3.5 3.5 3.5 3 3 3 3

Hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Subtotal	
Total	4.0	4.0	4.0	4.0	4.0	4.0	5.0	8.5	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	8.0	7.0	7.0	7.0	7.0	7.0	6.0	6.0	164.5	= Daily Maximum (D.M)
MAX	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	216.0	= Hourly Maximum (H.M)

Daly Average(D.A) :	91.5	(= (Sub-totalA + Sub-totalB) / 365)		
Rate of Loading (D.A./D.M)	0.556	→	0.56	(= 1.8)
Hourly Factor (H.M./D.M)	1.31	→	1.3	

Notes: 1) Numbers from 1 to 11 are shown factories which replied to the questionnaire.

2) Factory No.3 and No.8 are not included because these two factory dose not have special operation periods.

WS-3 Results of Field Interview Survey on existing Agricultural Wells (1/5)

License No. **19-13/006** Survey date 07 June 2008 Location Left Bank/ Al-Magtas St. Status Pumping for Agriculture. Depth 100 m Quantity 30 m3/hour Quality Brackish Information - Dried up & drilled 30m (70m→100m) in 2007.	
License No. **19-13/015A** Survey date 07 June 2008 Location Left Bank/ Al-Magtas St. Status Pumping for Agriculture. Depth 130 m Quantity 70 m3/hour Quality Brackish Information (Nobody there at survey time.)	
License No. **19-13/018** Survey date 07 June 2008 Location Right Bank/ Al-Qadesiya St. Status Dried Up Depth - Quantity - Quality - Information - Dried up & drilled 50m (70m→120m) in 1006, but water dose not come out.	
License No. **19-13/020** Survey date 07 June 2008 Location Right Bank/ Al-Qadesiya St. Status Pumping for Agriculture. Depth 100m Quantity 5 m^3/hr Quality Sweet Information - Dried up & drilled 30m (70m→100m) in 2007.	

WS-3 Results of Field Interview Survey on existing Agricultural Wells (2/5)

License No.	**19-13/024A**
Survey date	04 June 2008
Location	Right Bank/Horse Riding Club
Status	Pumping for Agriculture.
Depth	90 m
Quantity	35 m^3/hr
Quality	Brackish

Information
- Possible to purchase the water.
- Well was filled 30m (120m→90m) against salt.

License No.	**19-13/025A**
Survey date	04 June 2008
Location	Left Bank/ Al-Magtas St.
Status	Dried Up
Depth	-
Quantity	-
Quality	-

Information

(Nobody there at survey time.)

License No.	**19-13/026A**
Survey date	04 June 2008
Location	Right Bank/ Al-Qadesiya St.
Status	Pumping for Iron Industry.
Depth	95 m
Quantity	75 m3/hour
Quality	Brackish

Information
- Possible to purchase the water.

License No.	**19-13/029A**
Survey date	04 June 2008
Location	Right Bank/ Al-Qadesiya St.
Status	Not Active
Depth	-
Quantity	-
Quality	-

Information
- Pump is broken, but water is exist.

WS-3 Results of Field Interview Survey on existing Agricultural Wells (3/5)

License No. **19-13/047** Survey date 07 June 2008 Location Left Bank/ Al-Magtas St. Status Dried Up Depth - Quantity - Quality - Information - Dried up since 2006.	
License No. **19-13/048** Survey date 07 June 2008 Location Left Bank/ Al-Magtas St. Status Pumping for Agriculture. Depth 112 m Quantity 55 m3/hour Quality Drinkable Information	(Photo is not available.)
License No. **19-13/049** Survey date 07 June 2008 Location Left Bank/ Al-Magtas St. Status Pumping for Agriculture. Depth 75 m Quantity 35 m3/hr Quality Brackish Information - Improved in 2006.	
License No. **19-13/050A** Survey date 07 June 2008 Location Left Bank/ Al-Magtas St. Status Pumping for Agriculture. Depth 120 m Quantity 50 m3/hr Quality Brackish Information - Quantity is decresing. 90m3/hr could be pumped up before 4-5 years.	

WS-3 Results of Field Interview Survey on existing Agricultural Wells (4/5)

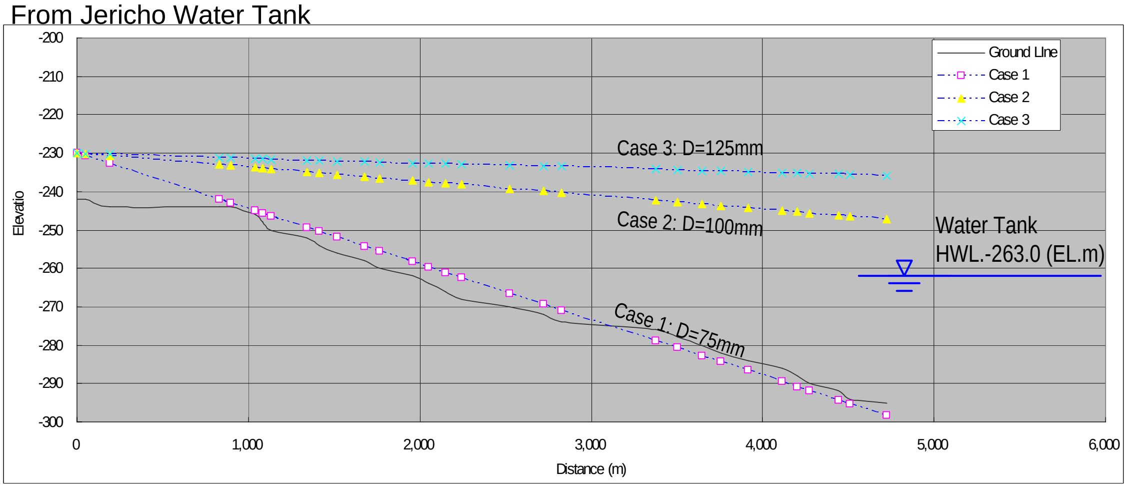
License No. **19-13/052** Survey date 07 June 2008 Location Left Bank/ Al-Magtas St. Status Pumping for Agriculture. Depth 120 m Quantity 55 m3/hr Quality Drinkable Information - Quality was changed from salty to sweet since few years ago.	
License No. **19-13/055** Survey date 07 June 2008 Location Left Bank/ Al-Magtas St. Status Pumping for Agriculture. Depth 110 m Quantity 40 m3/hr Quality Drinkable Information - Pumping is interrupted due to the internal problem.	
License No. **19-14/023** Survey date 07 June 2008 Location Left Bank/ Al-Magtas St. Status Dried Up Depth - Quantity - Quality - Information (Nobody there at survey time.)	
License No. **19-14/037** Survey date 07 June 2008 Location Left bank/ Route 449 Status Pumping for Agriculture. Depth 120 m Quantity 15 m3/hr Quality Brackish Information - Drilled 40m (80m→120m) in 2008 against salt.	

WS-3 Results of Field Interview Survey on existing Agricultural Wells (5/5)

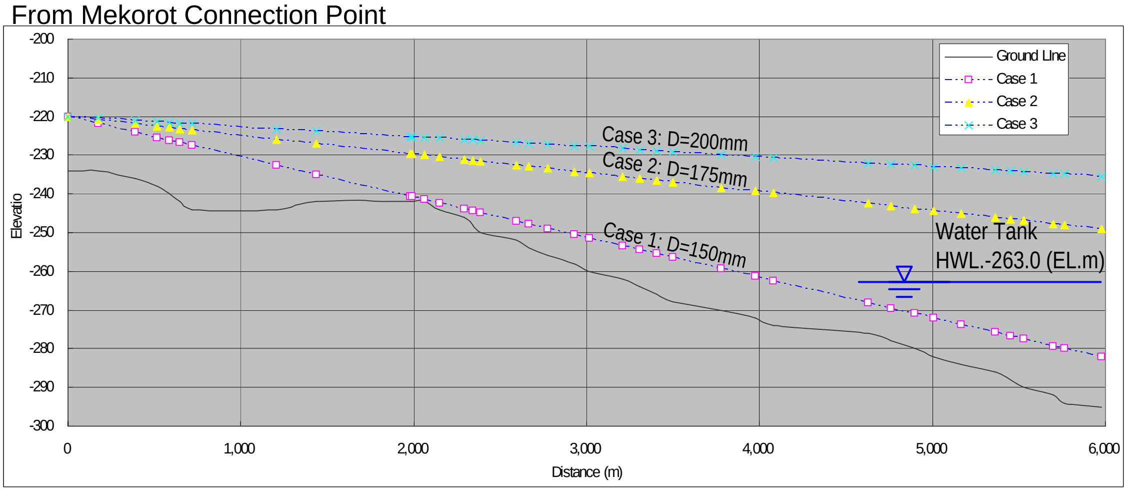
License No. **19-14/052** Survey date 07 June 2008 Location Left bank/ Route 449 Status Dried Up. Depth - Quantity - Quality - Information (Nobody there at survey time.)	
License No. **Jericho Well No.1 (19-14/101)** Survey date 12 June 2008 Location Left Bank/ Ahmad Ashuqairi St. Status Not Active Depth ? Quantity - Quality - Information - When a stone fall into the well, sound hear after 20sec.	
License No. **Jericho Well No.1 (19-14/101)** Survey date 12 June 2008	
License No. **Jericho Well No.1 (19-14/101)** Survey date 12 June 2008	

WS-4 Hydraulic Gradient Lines along the Water Transmission Pipeline

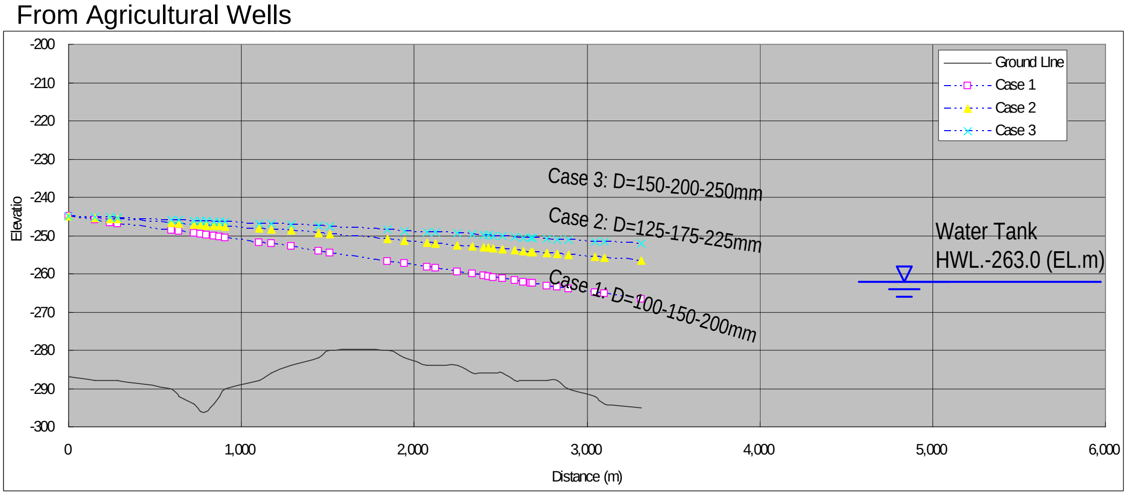
From Jericho Water Tank



From Mekorot Connection Point

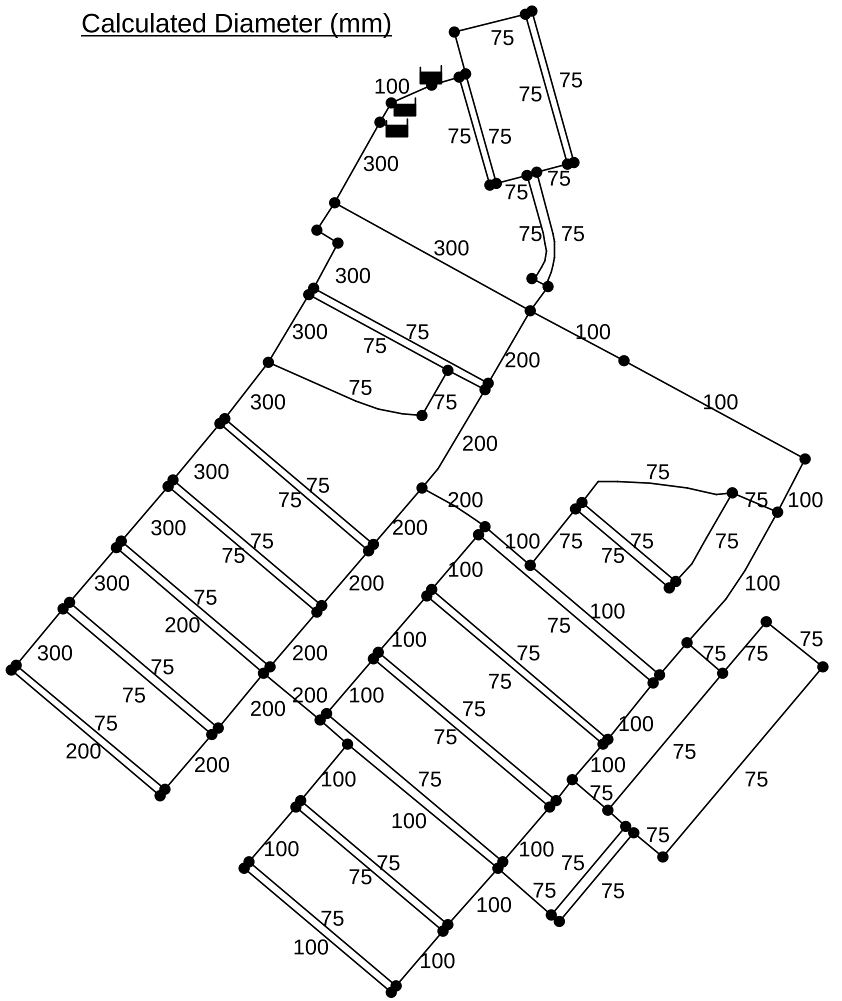


From Agricultural Wells

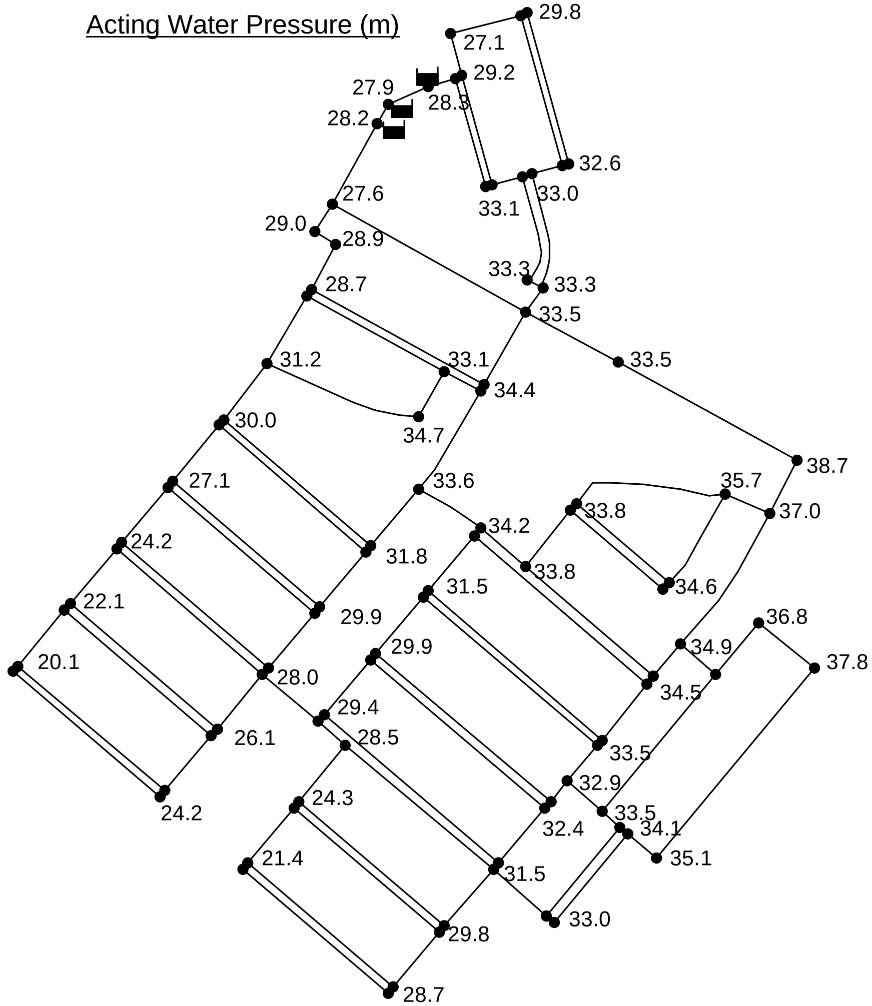


WS-5 Results of the hydraulic analysis for the water distribution networks

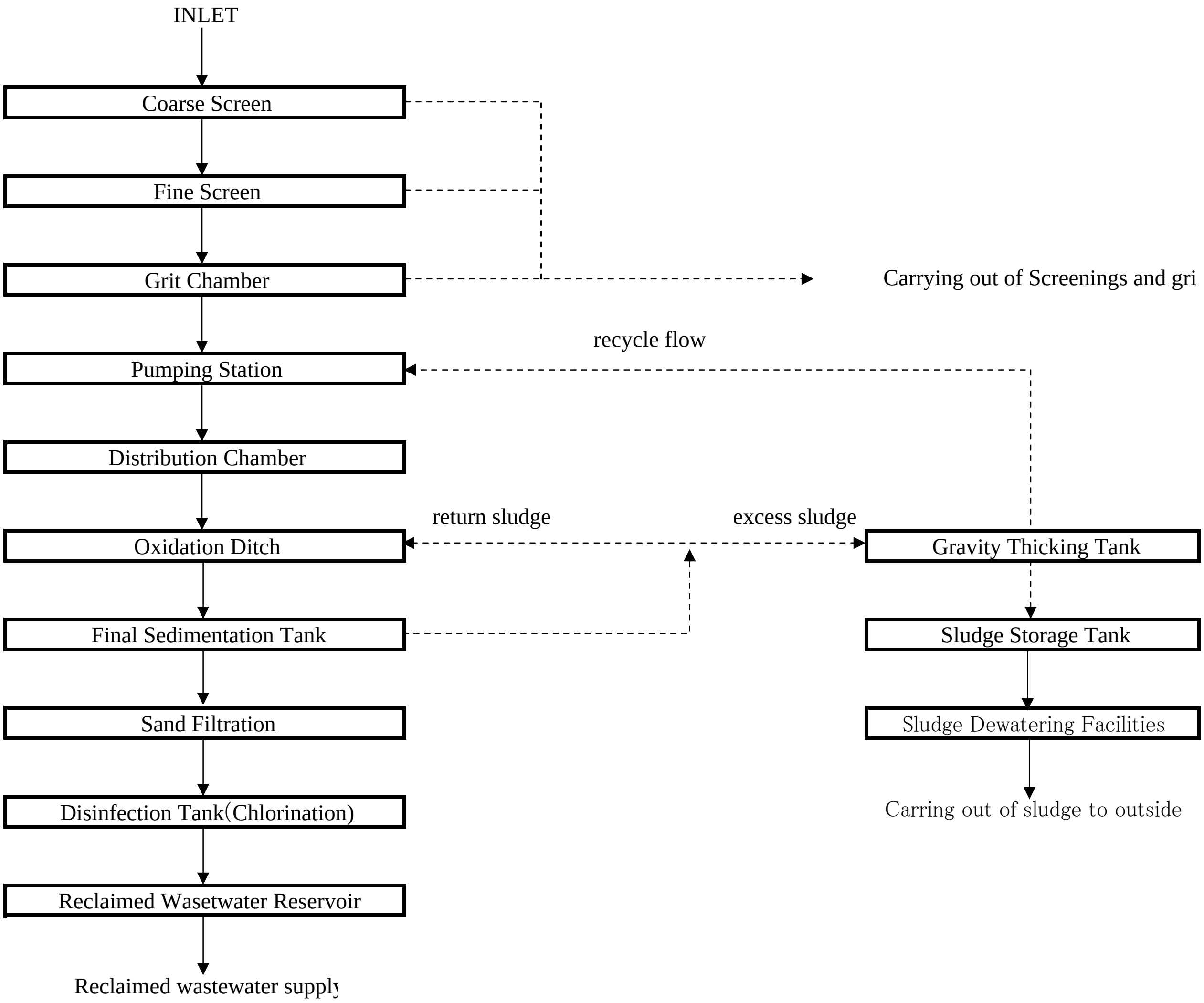
Calculated Diameter (mm)



Acting Water Pressure (m)



WT-1 Wastewater Treatment Flow



Design Solid Volume (Stage I)

S=Qi×[SSi×R1/100+(SSi×(1－R1/100)-SSt)×R2 /100]×1/10^3

= 223 kg/day ⇒ 260.4 m3/day (※6days in a week)

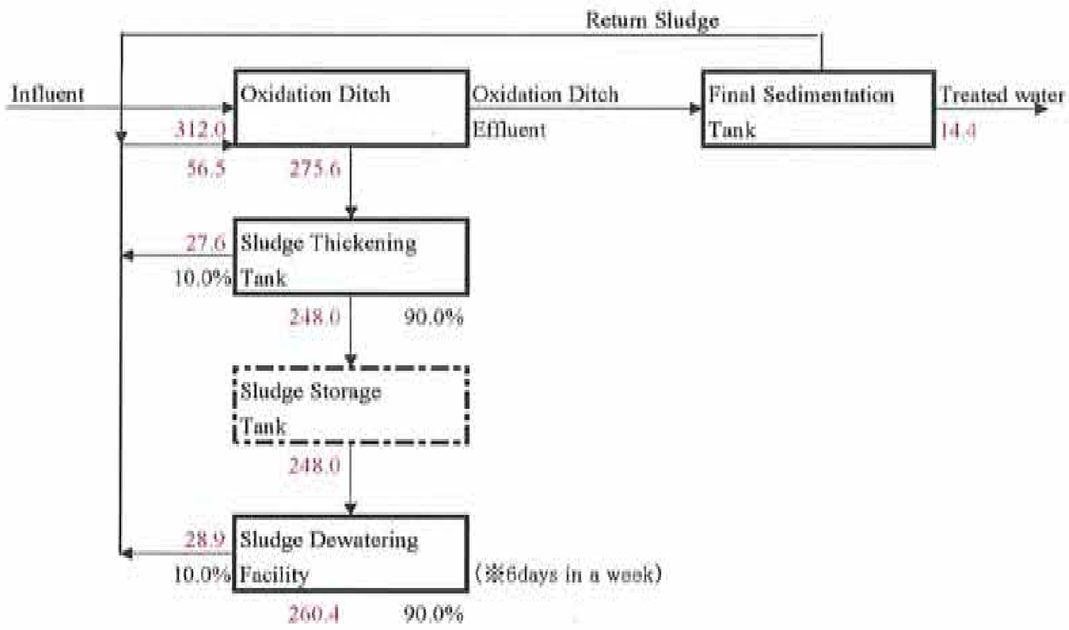
Qi	Design Daily Maximum Wastawater Quantity	480 m3/day
SSi	Design Influent SS Quality	650 mg/L
SSt	Design Effluent SS Quality	30 mg/L
R	Sludge Generation Rate in Oxidation Ditch	75 %

Design Sludge Volume

Design Sludge Generation= S×100/Sludge Density(%)×1/1000(kg)

= 74.4 m3/day ⇒ 86.8 m3/day (※6days in a week)

※Sludge Density = 0.3 %



						SS_concentration
1	Dewatered Sludge	260.4	kg/day	1.7	m3/day	15.0%
2	Thickened S (into Sludge Dewatering Facility)	289.3	kg/day	19.3	m3/day	1.5%
	(into Sludge Storage Tank)	248.0	kg/day			
3	Filtered Water	28.9	kg/day			
4	Sludge into Sludge Thickening Tank	275.6	kg/day	45.9	m3/day	0.6%
5	Thickner Effluent	27.6	kg/day			
6	SS volume in Return Sludge	56.5	kg/day			
7	SS volume in Influent	312.0	kg/day			
8	SS volume in treated water	14.4	kg/day			
9	Excess Sludge Volume	223.2	kg/day	37.2	m3/day	0.6%

Design Solid Volume (Stage II)

S=Qi×[SSi×R1/100+{SSi×(1－R1/100)-SSt}×R2/100]×1/10^3

= 767 kg/day ⇒ 895.2 m3/day (※6days in a week)

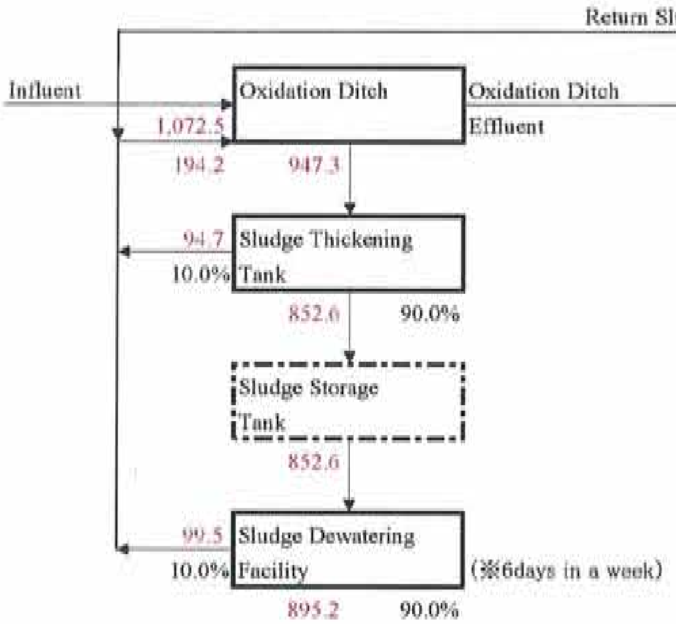
Qi	Design Daily Maximum Wastewater Quantity	1,650 m3/day
SSi	Design Influent SS Quality	650 mg/L
SSt	Design Effluent SS Quality	30 mg/L
R	Sludge Generation Rate in Oxidation Ditch	75 %

Design Sludge Volume

Design Sludge Generation= S×100/Sludge Density(%)×1/1000(kg)

= 255.77 m3/day ⇒ 298.4 m3/day (※6days in a week)

※Sludge Density = 0.3 %



						SS_concentration
1	Dewatered Sludge	895.2	kg/day	6.0	m3/day	15.0%
2	Thickened S (into Sludge Dewatering Facility)	994.7	kg/day	66.3	m3/day	1.5%
	(into Sludge Storage Tank)	852.6	kg/day			
3	Filtered Water	99.5	kg/day			
4	Sludge into Sludge Thickening Tank	947.3	kg/day	157.9	m3/day	0.6%
5	Thickner Effluent	94.7	kg/day			
6	SS volume in Return Sludge	194.2	kg/day			
7	SS volume into Oxidation Ditch	1,072.5	kg/day			
8	SS volume in treated water	49.5	kg/day			
9	Excess Sludge Volume	767.3	kg/day	127.9	m3/day	0.6%

Design Solid Volume (Stage I + II)

S=Qi×[SSi×R1/100+(SSi×(1−R1/100)-SSt)×R2/100]×1/10^3

= 986 kg/day ⇒ 1,150.1 m3/day (※6days in a week)

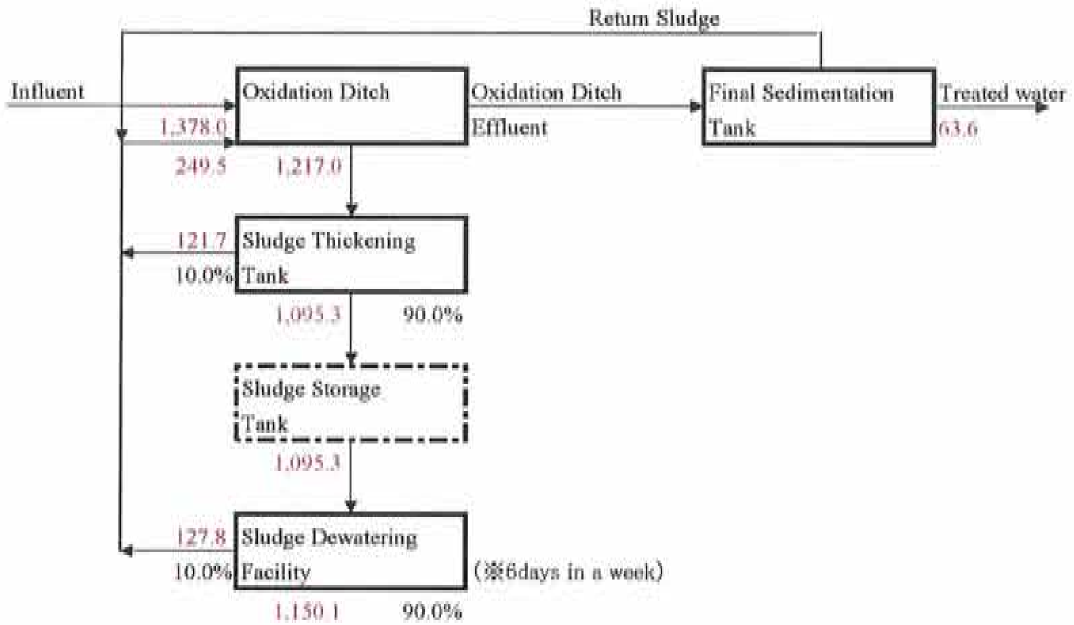
Qi	Design Daily Maximum Wastewater Quantity	2,120	m3/day
SSi	Design Influent SS Quality	650	mg/L
SSt	Design Effluent SS Quality	30	mg/L
R	Sludge Generation Rate in Oxidation Ditch	75	%

Design Sludge Volume

Design Sludge Generation=S×100/Sludge Density(%)×1/1000(kg)

= 328.6 m3/day ⇒ 383.4 m3/day (※6days in a week)

※Sludge Density = 0.3 %



						SS_concentration
1 Dewatered Sludge	1,150.1	kg/day	7.7	m3/day	15.0%	
2 Thickened ! (into Sludge Dewatering Facility)	1,277.9	kg/day	85.2	m3/day	1.5%	
(into Sludge Storage Tank)	1,095.3	kg/day				
3 Filtered Water	127.8	kg/day				
4 Sludge into Sludge Thickening Tank	1,217.0	kg/day	202.8	m3/day	0.6%	
5 Thickner Effluent	121.7	kg/day				
6 SS volume in Return Sludge	249.5	kg/day				
7 SS volume into Oxidation Ditch	1,378.0	kg/day				
8 SS volume in treated water	63.6	kg/day				
9 Excess Sludge Volume	985.8	kg/day	164.3	m3/day	0.6%	

Design Solid Volume (Stage III)

S=Qi×[SSi×R1/100+(SSi×(1－R1/100)-SSt)×R2/100]×1/10^3

= 1,139 kg/day ⇒ 1,329.2 m3/day (※6days in a week)

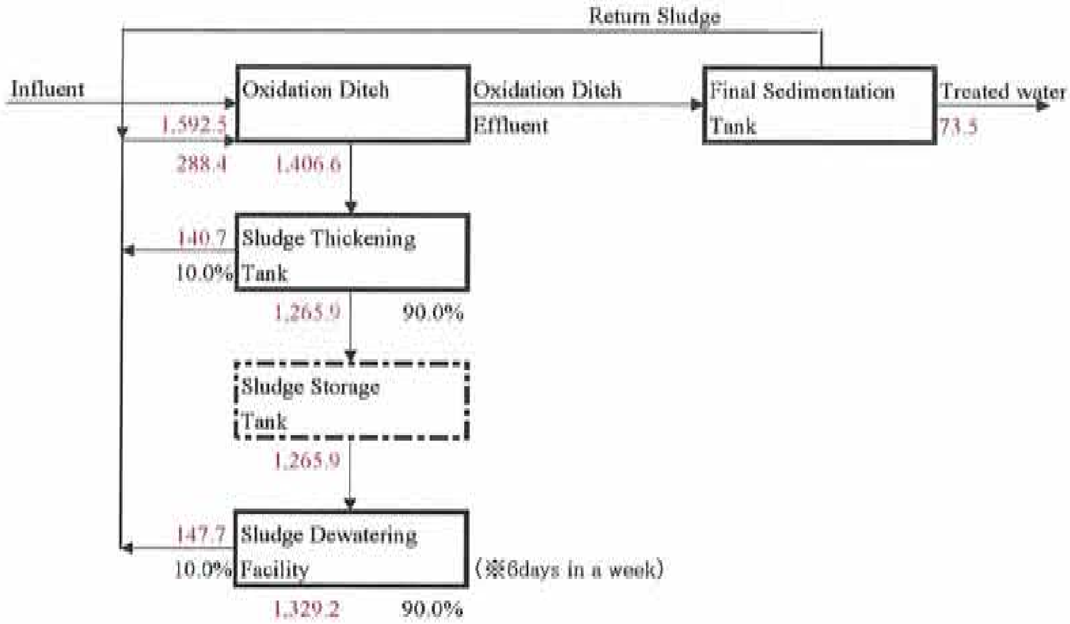
Qi	Design Daily Maximum Wastewater Quantity	2,450 m3/day
SSi	Design Influent SS Quality	650 mg/L
SSt	Design Effluent SS Quality	30 mg/L
R	Sludge Generation Rate in Oxidation Ditch	75 %

Design Sludge Volume

Design Sludge Generation=S×100/Sludge Density(%)×1/1000(kg)

= 379.77 m3/day ⇒ 443.1 m3/day (※6days in a week)

※Sludge Density = 0.3 %



						SS_concentration
1	Dewatered Sludge	1,329.2	kg/day	8.9	m3/day	15.0%
2	Thickened S (into Sludge Dewatering Facility)	1,476.9	kg/day	98.5	m3/day	1.5%
	(into Sludge Storage Tank)	1,265.9	kg/day			
3	Filtered Water	147.7	kg/day			
4	Sludge into Sludge Thickening Tank	1,406.6	kg/day	234.4	m3/day	0.6%
5	Thickner Effluent	140.7	kg/day			
6	SS volume in Return Sludge	288.4	kg/day			
7	SS volume into Oxidation Ditch	1,592.5	kg/day			
8	SS volume in treated water	73.5	kg/day			
9	Excess Sludge Volume	1,139.3	kg/day	189.9	m3/day	0.6%

CE-1 Project Cost for Agro-Indusrtial Park Development Stages I, II and III

Infrastructure	Stage I		Stage II		Stage III		Total	
	(NIS)	(USD)	(NIS)	(USD)	(NIS)	(USD)	(NIS)	(USD)
I. Base Cost								
A Off-site								
A. 1 General requirements	2,815,893	0	5,873,962	0	2,695,611	0	11,385,466	0
A. 2 Access roads	8,217,508	0	47,805,851	0	0	0	56,023,359	0
A. 3 Power supply facilities	0	714,284	0	0	0	0	0	714,284
A. 4 Telecommunication facilities	0	150,000	0	0	0	0	0	150,000
A. 5 Water supply facilities	1,148,455	631,110	2,691,919	784,760	693,975	434,710	4,534,349	1,850,580
A. 6 Wastewater treatment facilities	3,347,658	3,685,670	7,994,961	6,560,870	9,515,253	7,502,870	20,857,872	17,749,410
A. 7 Solid waste treatment facilities	3,127,139	175,400	8,356,720	295,890	8,356,720	324,140	19,840,579	795,430
A. 8 Building Structures	0	0	3,278,200	0	0	0	3,278,200	0
Sub-total (A)	18,656,653	5,356,464	76,001,613	7,641,520	21,261,559	8,261,720	115,919,825	21,259,704
B. On-site								
B. 1 General requirements	2,614,937	0	6,955,923	0	7,131,000	0	16,701,860	0
B. 2 Land reclamation	5,634,070	0	40,133,845	0	51,252,975	0	97,020,890	0
B. 3 *Wadi* improvement	0	0	7,409,956	0	4,386,755	0	11,796,711	0
B. 4 Internal roads	4,196,234	0	23,478,225	0	28,515,789	0	56,190,248	0
B. 5 Storm water drainage channel	889,400	0	2,986,600	0	3,265,400	0	7,141,400	0
B. 6 Power distribution facilities	0	392,155	0	1,719,420	0	1,756,634	0	3,868,209
B. 7 Telecommunication facilities	45,000	0	225,000	0	225,000	0	495,000	0
B. 8 Water distribution facilities	2,897,374	141,840	4,683,574	816,840	5,220,334	608,850	12,801,282	1,567,530
B. 9 Wastewater treatment facilities	605,098	0	3,060,190	0	2,895,175	0	6,560,463	0
B. 10 Solid waste collection facilities	0	562,500	0	523,550	0	697,500	0	1,783,550
B. 11 Security facilities	0	2,034,250	0	864,000	126,000	662,750	126,000	3,561,000
B. 12 Building Structures								
i) Parks	86,480	0	896,060	0	1,218,150	0	2,200,690	0
ii) Office building	6,925,240	0	9,728,050	0	7,174,020	0	23,827,310	0
iii) Model factory	17,190,000	0	0	0	0	0	17,190,000	0
iv) Car parking	1,004,500	0	7,149,100	0	4,873,050	0	13,026,650	0
Sub-total (B)	42,088,333	3,130,745	106,706,523	3,923,810	116,283,648	3,725,734	265,078,504	10,780,289
Total (A to B)	60,744,986	8,487,209	182,708,136	11,565,330	137,545,207	11,987,454	380,998,329	32,039,993
II. Land Acquisition								
A Off-site								
A. 1	928,500	0	4,069,100	0	0	0	4,997,600	0
B. On-site								
B. 1	0	0	14,529,000	0	14,907,000	0	29,436,000	0
Sub-total	928,500	0	18,598,100	0	14,907,000	0	34,433,600	0
III. Administration	925,102	127,308	3,019,594	173,480	2,286,783	179,812	6,231,479	480,600
IV. Engineering Services								
(1) Detailed design	3,755,915	516,871	12,259,550	704,329	9,284,339	730,036	25,299,804	1,951,236
(2) Supervision	3,755,915	516,871	12,259,550	704,329	9,284,339	730,036	25,299,804	1,951,236
Sub-total	7,511,830	1,033,742	24,519,100	1,408,658	18,568,678	1,460,072	50,599,608	3,902,472
Total (I to IV)	70,110,418	9,648,259	228,844,930	13,147,468	173,307,668	13,627,338	472,263,016	36,423,065
V. Physical Contingency (10 % of Total I to IV)	7,011,042	964,826	22,884,493	1,314,747	17,330,767	1,362,734	47,226,302	3,642,307
VI. Grand Total (Total I to V)	77,121,460	10,613,085	251,729,423	14,462,215	190,638,435	14,990,072	519,489,318	40,065,372
VII. Grand total equivalent in USD		32,035,713		84,387,055		67,945,193		184,367,960

Note: General requirement (A.1 and B.1) consists of temporary facilities required for the construction such as temporary buildings for staff quarter and labor camp, motor pools, repair shop, warehouse, water supply system and power supply system for the construction works etc., and mobilization and de-mobilization.

CE-2 Project Cost for Agro-Indusrtial Park Development Stages (I+II) and III

Infrastructure	Stage I+II		Stage III		Total	
	(NIS)	(USD)	(NIS)	(USD)	(NIS)	(USD)
I. Base Cost						
A Off-site						
A. 1 General requirements	6,260,758	0	2,695,611	0	8,956,369	0
A. 2 Access roads	47,805,851	0	0	0	47,805,851	0
A. 3 Power supply facilities	0	714,284	0	0	0	714,284
A. 4 Telecommunication facilities	0	150,000	0	0	0	150,000
A. 5 Water supply facilities	3,831,767	1,415,870	693,975	434,710	4,525,742	1,850,580
A. 6 Wastewater treatment facilities	8,774,847	7,081,670	9,515,253	7,502,870	18,290,100	14,584,540
A. 7 Solid waste treatment facilities	9,496,207	338,800	8,356,720	324,140	17,852,927	662,940
A. 8 Building Structures	3,278,200	0	0	0	3,278,200	0
Sub-total (A)	79,447,630	9,700,624	21,261,559	8,261,720	100,709,189	17,962,344
B. On-site						
B. 1 General requirements	8,980,866	0	7,131,000	0	16,111,866	0
B. 2 Land reclamation	45,767,915	0	51,252,975	0	97,020,890	0
B. 3 *Wadi* improvement	7,420,314	0	4,386,755	0	11,807,069	0
B. 4 Internal roads	27,674,459	0	28,515,789	0	56,190,248	0
B. 5 Storm water drainage channel	3,842,400	0	3,265,400	0	7,107,800	0
B. 6 Power distribution facilities	0	2,111,575	0	1,756,634	0	3,868,209
B. 7 Telecommunication facilities	270,000	0	225,000	0	495,000	0
B. 8 Water distribution facilities	5,480,224	949,780	5,220,334	608,850	10,700,558	1,558,630
B. 9 Wastewater treatment facilities	3,089,584	0	2,895,175	0	5,984,759	0
B. 10 Solid waste collection facilities	0	697,500	0	697,500	0	1,395,000
B. 11 Security facilities	0	2,898,250	126,000	662,750	126,000	3,561,000
B. 12 Building Structures						
i) Parks	982,540	0	1,218,150	0	2,200,690	0
ii) Office building	15,641,450	0	7,174,020	0	22,815,470	0
iii) Model factory	17,190,000	0	0	0	17,190,000	0
iv) Car parking	8,153,600	0	4,873,050	0	13,026,650	0
Sub-total (B)	144,493,352	6,657,105	116,283,648	3,725,734	260,777,000	10,382,839
Total (A to B)	223,940,982	16,357,729	137,545,207	11,987,454	361,486,189	28,345,183
II. Land acquisition						
A Off-site						
A. 1	4,606,000	0	0	0	4,606,000	0
B. On-site						
B. 1	14,529,000	0	14,907,000	0	29,436,000	0
Sub-total	19,135,000	0	14,907,000	0	34,042,000	0
III. Administration	3,646,140	245,366	2,286,783	179,812	5,932,923	425,178
IV. Engineering services						
(1) Detailed design	14,803,327	996,186	9,284,339	730,036	24,087,666	1,726,222
(2) Supervision	14,803,327	996,186	9,284,339	730,036	24,087,666	1,726,222
Sub-total	29,606,654	1,992,372	18,568,678	1,460,072	48,175,332	3,452,444
Total (I to IV)	276,328,776	18,595,467	173,307,668	13,627,338	449,636,444	32,222,805
V. Physical Contingency (10 % of Total I to IV)	27,632,878	1,859,547	17,330,767	1,362,734	44,963,645	3,222,281
VI. Total (Total I to V)	303,961,654	20,455,014	190,638,435	14,990,072	494,600,089	35,445,086
VII. Grand total equivalent in USD		104,888,807		67,945,193		172,834,000

Note: General requirement (A.1 and B.1) consists of temporary facilities required for the construction such as temporary buildings for staff quarter and labor camp, motor pools, repair shop, warehouse, water supply system and power supply system for the construction works etc., and mobilization and de-mobilization.