

8.2 Survey Data

8.2.1 List of Collected Data

- (1) Meteorological and hydrological data:
Temperature, humidity, rainfall, evaporation, wind velocity,
depth of frost penetration and frozen period (Beijing
Meteorological Bureau 1974-1980)
- (2) Soil data:
Grain size analysis, soil analysis
- (3) Geological log chart:
Place of No. 1 and No. 3 well
- (4) Plan view of the Centre:
Map Scale 1:2000 (by Survey of Beijing, Jan. 1972)
Plan of existing Centre Scale 1:500
Plan of Newly-established field Scale 1:500
Notice of boundary stake on newly established field and
drawings for application (Scale 1:2000)
- (5) Data for cost estimate:
Cost estimate book published by Beijing Municipal
Construction Committee in 1986
- (6) Controlled pumping up volume of groundwater:
Notice of Groundwater Control in 1988
- (7) Permission letter of land utilization for newly-established field:
The Government of Beijing 6th July, 1987
- (8) Contract documents:
Agreement of Construction between the Centre and the No. 2
Construction Corporation on Aug. 5, 1987

- (9) Pamphlet of pipe:
Beijing Plastic Product Factory
- (10) Physical properties test report for pipes:
Beijing Plastic Product Factory
- (11) Detailed design report on integrated agricultural laboratory plan
and supervising report on Model Infrastructure Improvement Works
in San Jiang Plain
- (12) Estimate of construction unit price:
Beijing Municipal No. 2 Construction Corporation
- (13) Plan of distribution pipes and drain pipes arrangement:
Ministry of Irrigation and Power Beijing Survey Academy,
Scale 1:500

8.2.2 Survey Data

(1) Topography

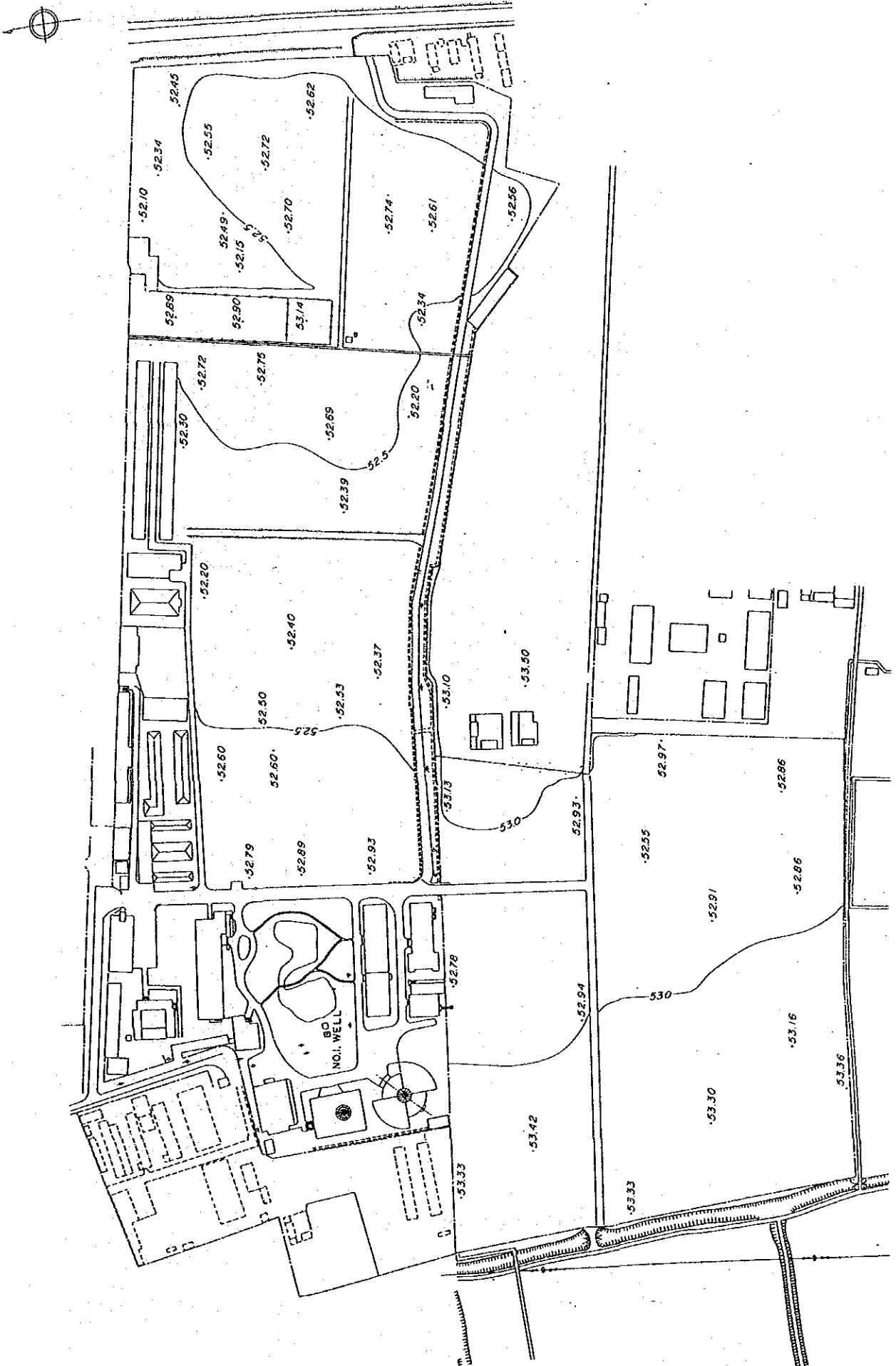


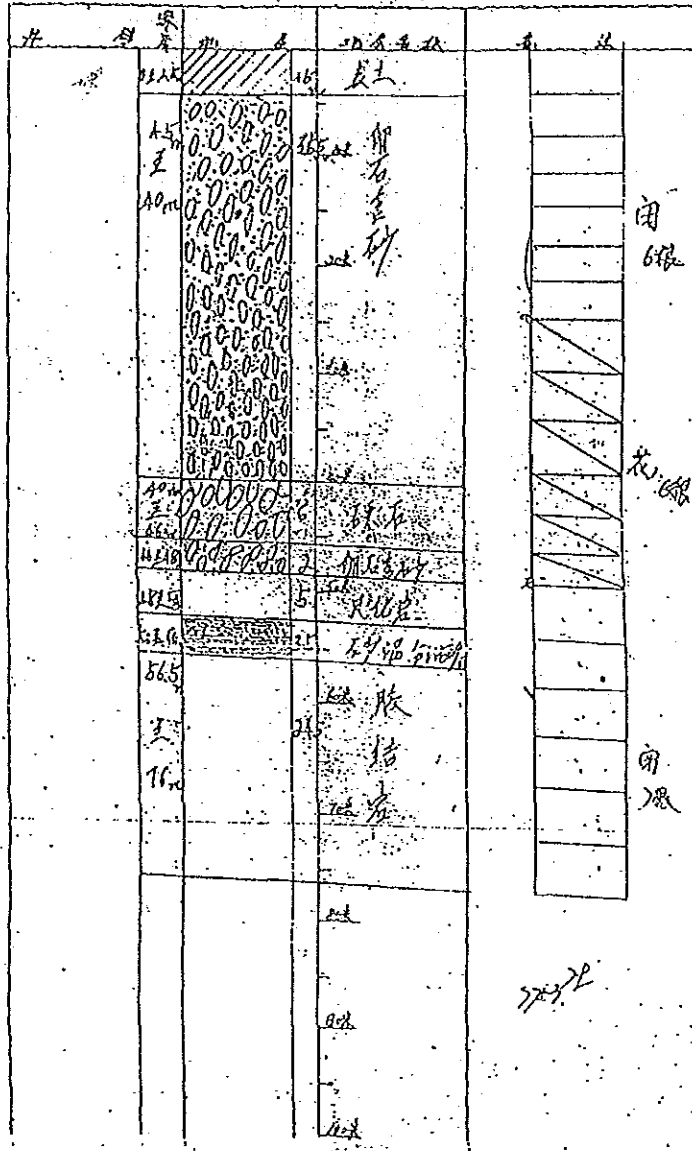
Fig. 8.1 Contour Map of the Research Center

(2) Geology

1号井的地质构造和完井记录表

80年11月10日

井名	1号井	井口直径	200mm	完井日期	80年3月31日
井深	16.7m	井底直径		完井时间	80年3月10日



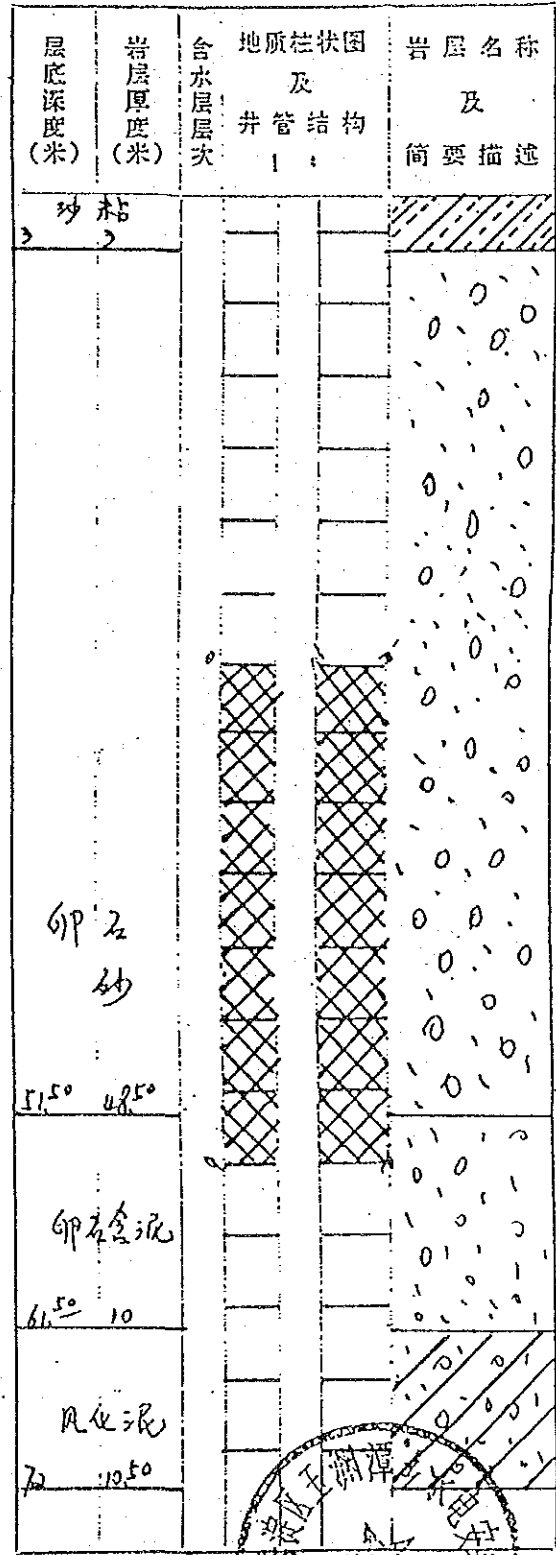
完井 30日 10日 10日

11/4

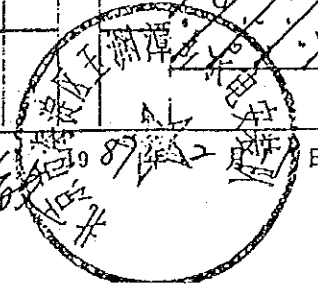
Fig. 8.2 Well Construction Data (No. 1 Well)

海淀区凿井资料卡片

图幅名称	农科所		
区统一编号	003		
公社编号			
位 置	五路居 六队 北 水队		
地面标高(米)			
地下水埋深 (井口到水面) (米)	以前	39	
	现在	23	
抽水试验	降低水位	3 米	
	涌水量	737 吨/小时	
井 管	种类	铸铁管	口径 12 吋
井 深	原有	70 米	现有 70.50 米
打井方法	冲机钻		
施工单位	国营水电队		
施工日期	1987年2月17日		
装 出 水 机 情 况 及 况	电动机	瓦	
	水泵型号		
	装配日期		
出水量			吨/小时
地下室深度			米
灌溉面积			亩
高 压 线	公里	低压线	公里
变 压 器	号	千伏安	



资料来源 收集人 填写人
 Fig. 8.3 Well Construction Data (No. 3 Well)



Semi Log

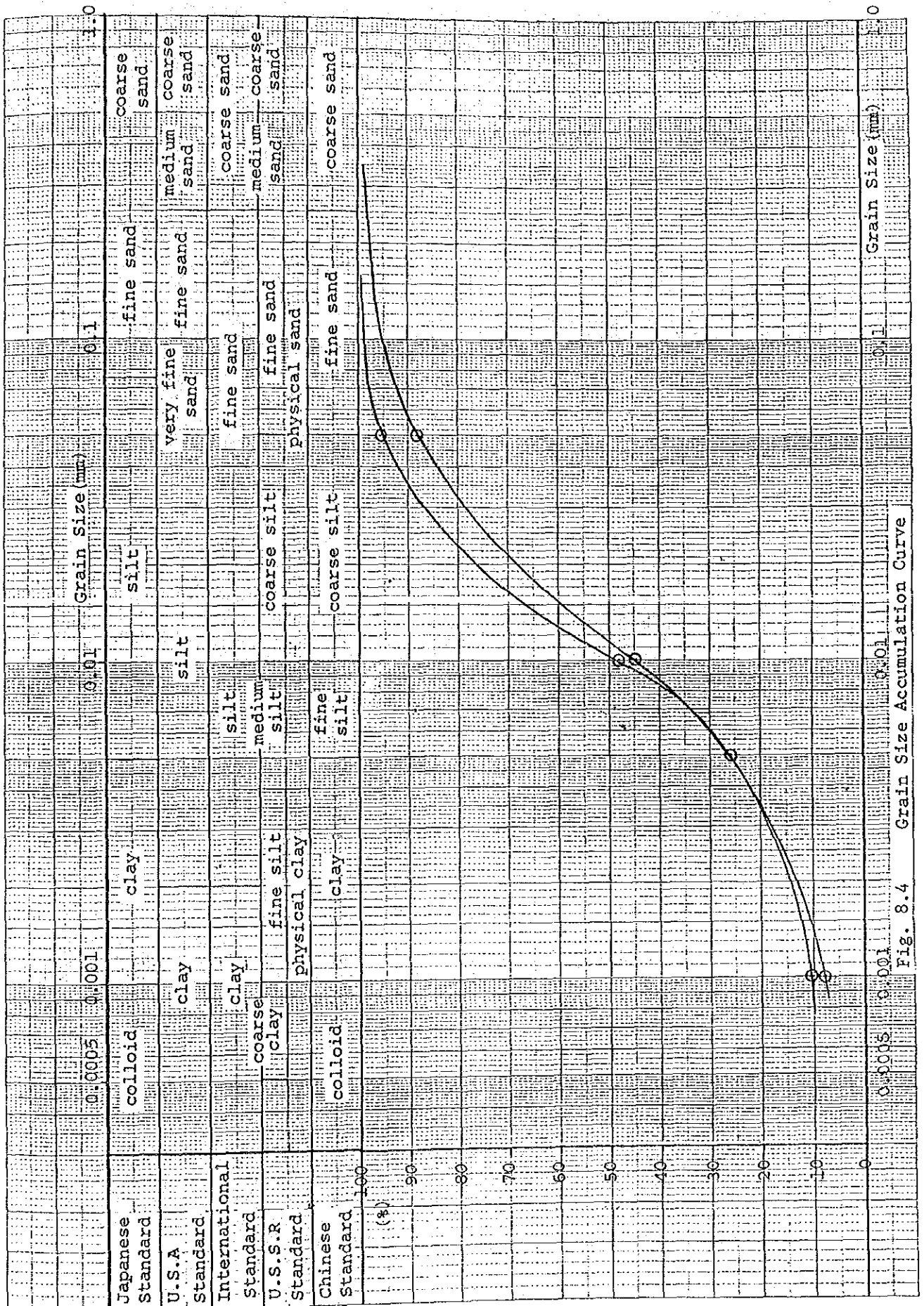


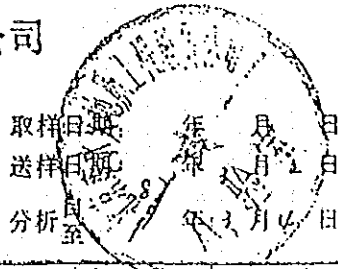
Fig. 8.4 Grain Size Accumulation Curve

(4) Groundwater

Table 8.2 Results of Water Quality Analysis (No.3 Well) - 1

北京市水文地质工程地质公司

水质全分析报告表
 编号: 87-25
 野: 板井蔬菜队内自备井
 室: 87-25
 取样地点: 板井蔬菜队内自备井
 水温: °C 气温: °C



离子	每公升水中含量		
	毫克	毫克当量	毫克当量
K'	4.01	0.10	0.8
Na'	12.12	2.26	18.6
Ca''	123.02	6.14	50.4
Mg''	44.66	3.67	30.1
Fe'''	0.168		
Fe'''	0.168		
NH ₄ '	0.0		
Mn'''	0.010		
Al'''	0.000		
Cu'''	0.000		
Pb'''	0.000		
Zn'''	0.018	0.001	
Li'	0.05	0.007	0.1
总计	224.056	12.178	100
HCO ₃ '	366.12	6.00	50.6
CO ₃ ''	0.00		
Cl'	61.3	1.73	14.6
SO ₄ ''	126.6	2.64	22.3
NO ₃ '	91.41	1.47	12.4
NO ₂ '	0.010		
F'	0.32	0.02	0.1
Br'	0.000		
I'	0.000		
HPO ₄ ''	0.024	0.001	
总计	645.784	11.861	100

项目	德国度	项目	毫克/公升
全硬度	27.5	可溶SiO ₂	15.5
暂时硬度	16.8	H ₂ S	
永久硬度	10.7	溶解氧	
负硬度	0.0	消耗氧	0.75
		固形物	7.25
		灼热残渣	48.3
总碱度	16.8	灼热减量	24.2
酸度		游离二氧化碳	7.92
侵蚀性二氧化碳		固定二氧化碳	132.00
		N ₂ O ₅	79.62
PH值	7.70	N ₂ O ₃	0.08
		HBO ₂	0.56

备注:

分析者: _____

审核:

Table 8.3 Results of Water Quality Analysis (No.3 Well) - 2

北京市地质局水文地质工程地质队

特殊项目分析报告表

水样编号: 室内编号: 87-14 取样日期: 87.3.3
 取样地点: 西郊板井蔬菜所
 水 温: ℃ 气 温: ℃ 分析日期: 87.3.4

项 目	含 量 (毫克/升)	备 注
C ₆ H ₅ OH	0.000	
CN ⁻	0.000	
有 机 磷		

分析者:

审核者:

关于下达一九八八年供水指标的通知

北京市自来水公司

一九八八年仍是近些年来北京水资源匮乏形势严重的一年，为确保全市人民生活正常生活，根据京政发〔1987〕35号文件及其他有关文件的要求，对全市非居民用水户实行全面计划供水。各用水户必须严格按照计划指标控制供水（两种水源分别考核），超计划部分实行累进加价收费。在六至八月份的高峰供水季节，提高累进加价收费额度。

一、超计划加价收费办法：

类别	超计划幅度	六至八月份加价倍数			其它季、月加价倍数
		大饭店、工业、建筑工地	机关、学校	中小学、医院	
自来水	10%以下	10	5	3	1
	10%~20% (不含10%)	20	10	6	2
	20%~30% (不含20%)	30	15	9	3
	30%~40% (不含30%)	40	20	12	4
自备井水	40%以上 (不含40%)	50	50	15	5
	超计划用水部分		20		

二、你单位一九八八年计划供水指标：（水表支，查表卡片编号：_____）

自来水：_____
 自备水：_____

1716

计量单位：吨

项目	全年合计	第一季度	四月一五月份	六月份	七月份	八月份	九月份	第四季度
自来水								
自备水	505963	210468	501008	49886	27053	25253	70253	65868

北京市节约用水办公室



70日

(5) Meteorology

Table 8.6 Summary of Climatic Record in Beijing Municipality

历年各月逐旬日最低气温 $\geq 0.0^{\circ}\text{C}$ 日数及初终期

年 份	10			11			12			1			2			3			4			全 年	初 终 日 期	年 份
	初	中	下	初	中	下	初	中	下	初	中	下	初	中	下	初	中	下	初	中	下			
1974-75	0	0	0	2	3	0	9	9	10	10	10	10	10	10	10	5	4	6	0	0	0	23/10	30/3	1974-75
75-76	0	0	0	0	0	0	9	9	10	10	10	10	10	10	10	8	3	2	0	0	0	30/10	3/4	75-76
76-77	0	0	0	0	0	0	9	9	10	10	10	10	10	10	10	8	3	2	0	0	0	25/3	25/3	76-77
77-78	0	0	0	0	0	0	8	8	10	10	10	10	10	10	10	8	3	2	0	0	0	4/11	18/2	77-78
78-79	0	0	0	0	0	0	8	8	10	10	10	10	10	10	10	7	2	5	1	0	0	8/11	1/4	78-79
79-80	0	0	0	0	0	0	8	8	10	10	10	10	10	10	10	7	2	5	1	0	0	28/10	5/10	79-80
80-81	0	0	0	0	0	0	8	8	10	10	10	10	10	10	10	10	1	2	0	0	0	16/4	16/4	80-81
1974-80 7年平均	0.0	0.0	1.3	2.0	6.4	8.3	9.7	9.7	11.0	10.0	11.0	10.0	10.0	10.0	10.0	7.5	5.4	4.0	0.4	0.1	0.0	31/10	2/4	1974-80 7年平均

历年日平均气温稳定 $\geq 0.0^{\circ}\text{C}$ 、 5.0°C 、 10.0°C 、 15.0°C 、 20.0°C 初终期和积温

年 份	0.0°C			5.0°C			10.0°C			15.0°C			20.0°C			积 温
	初	终	日数	初	终	日数	初	终	日数	初	终	日数	初	终	日数	
1974-75	2/12	4/12	284	4/9	10/3	30/10	19/30	28/30	216	11/4	7/10	28/9	15/5	13/9	122	
75-76	10/11	10/11	266	1/4	3/11	16/11	23/10	23/10	197	5/5	7/10	27/9	18/5	12/9	116	
76-77	10/11	10/11	285	1/4	3/11	16/11	23/10	23/10	197	5/5	7/10	27/9	18/5	12/9	116	
77-78	10/11	10/11	285	1/4	3/11	16/11	23/10	23/10	197	5/5	7/10	27/9	18/5	12/9	116	
78-79	10/11	10/11	285	1/4	3/11	16/11	23/10	23/10	197	5/5	7/10	27/9	18/5	12/9	116	
79-80	10/11	10/11	285	1/4	3/11	16/11	23/10	23/10	197	5/5	7/10	27/9	18/5	12/9	116	
80-81	10/11	10/11	285	1/4	3/11	16/11	23/10	23/10	197	5/5	7/10	27/9	18/5	12/9	116	
1974-80 7年平均	10/11	10/11	283.3	1/4	3/11	16/11	23/10	23/10	197	5/5	7/10	27/9	18/5	12/9	116	

历年地面温度稳定 $\geq 0.0^{\circ}\text{C}$ 、 5.0°C 、 10.0°C 初终日期

年 份	$\geq 0.0^{\circ}\text{C}$			$\geq 5^{\circ}\text{C}$			$\geq 10^{\circ}\text{C}$		
	初	终	日数	初	终	日数	初	终	日数
1974-75	2/12	4/12	284	4/9	10/3	30/10	19/30	28/30	216
75-76	10/11	10/11	266	1/4	3/11	16/11	23/10	23/10	197
76-77	10/11	10/11	285	1/4	3/11	16/11	23/10	23/10	197
77-78	10/11	10/11	285	1/4	3/11	16/11	23/10	23/10	197
78-79	10/11	10/11	285	1/4	3/11	16/11	23/10	23/10	197
79-80	10/11	10/11	285	1/4	3/11	16/11	23/10	23/10	197
80-81	10/11	10/11	285	1/4	3/11	16/11	23/10	23/10	197
1974-80 6年平均	10/11	10/11	283.3	1/4	3/11	16/11	23/10	23/10	197

历年各月最大冻土深度及0、10、30厘米处冻结、解冻日期

年 份	最 大 冻 土 深 度 (cm)												解 冻 日 期	解 冻 日 期			
	1	2	3	4	5	6	7	8	9	10	11	12					
1974-75	3	23	31	30.3	42	46	42	32	10	27	12	42	4/12	4/12	26/12	3/3	10/3
75-76	2	23	31	30.3	42	46	42	32	10	27	12	42	4/12	4/12	26/12	3/3	10/3
76-77	2	23	31	30.3	42	46	42	32	10	27	12	42	4/12	4/12	26/12	3/3	10/3
77-78	2	23	31	30.3	42	46	42	32	10	27	12	42	4/12	4/12	26/12	3/3	10/3
78-79	2	23	31	30.3	42	46	42	32	10	27	12	42	4/12	4/12	26/12	3/3	10/3
79-80	2	23	31	30.3	42	46	42	32	10	27	12	42	4/12	4/12	26/12	3/3	10/3
80-81	2	23	31	30.3	42	46	42	32	10	27	12	42	4/12	4/12	26/12	3/3	10/3
1974-80 7年平均	2	23	31	30.3	42	46	42	32	10	27	12	42	4/12	4/12	26/12	3/3	10/3

Source: Beijing Meteorological Agency

8.3 Relevant Data

8.3.1 Agriculture in Beijing Municipality

Table 8.7 Agricultural Output in Beijing Municipality

Crops	Seeded Area 10 ³ ha (%)	Total Output 10 ³ t	Average Yield t/ha
A. Food Crops	529.6 (83.0)	2,015	3.8
Rice paddy	46.1	270	5.9
Wheat	287.1	660	3.5
Potatoes	7.2	20	2.8
Corn	200.7	835	4.2
Kaoliang	12.5	30	2.4
Others	76.0	200	2.6
B. Industrial Crops	27.5 (4.3)		
Raw cotton	3.4	2.1	0.6
Oil stuff	19.3	20.6	1.1
Hemps	0.3	0.2	0.6
Sugar stuff	0.3	3.9	-
Tobacco	0.1	0.4	-
Others	4.1		
C. Other Crops	81.0 (12.7)	-	-
Vegetable	56.8	-	-
Gourds	4.9	-	-
Feed crop	15.3	-	-
Green manure	3.0	-	-
Others	1.0	-	-
Total	638.1 (100)		

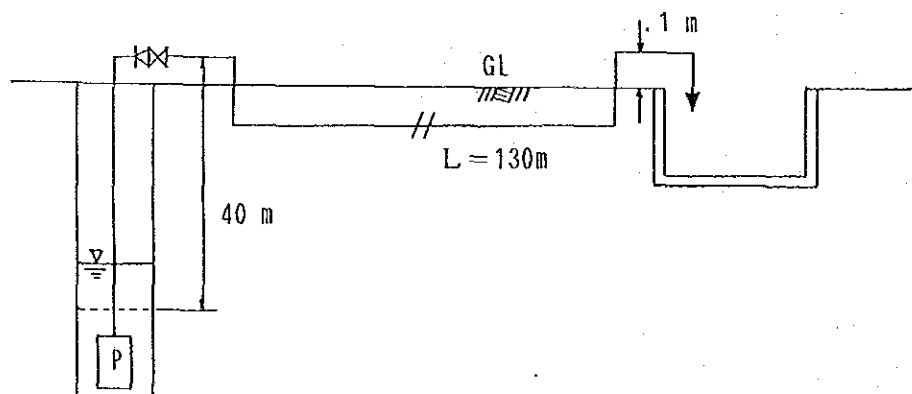
Source: Beijing Vegetable Research Centre

8.3.2 Detail of Water Supply Facilities to be Undertaken by the Government of China

Table 8.8 Summary of Construction Works by Chinese Side

Item	Volume	Remarks
1. Transmission Pipeline	210 m	Cast Iron Pipe ϕ 150 mm (No. 1, No. 3 Well - New Water Tank)
2. Water Tank	Lump	Made by RC, Effective capacity 220 m ³
3. Delivery Pump	2 sets	Pumping capacity 1,500 lit./min. Head 40 m (Irrigation Block No. 1 and No. 2)
4. Pressure Tank	1 unit	Volume 1.6 - 2.1 m ³
5. Delivery Pump	2 sets	Pumping Capacity 500 lit./min. Head, 35 m (Irrigation Block No. 3)
6. Distribution Pipeline	Lump	Cast Iron Pipe including pipeline to greenhouse
7. Reconstruction of existing water tank	Lump	Effective Capacity 10 m ³ or more

(1) Water pipe



Type: Cast iron pipe
Pumping quantity: $Q = 2.0 \text{ m}^3/\text{min.} = 0.033 \text{ m}^3/\text{sec.}$
Pipe length: $L = 130 \text{ m}$

Coefficient of velocity, $C = 0.80$, using the formula of Hazen-Williams.

a. In case of pipe diameter 150 mm

$$A = \pi/4 \cdot D^2 = 0.01767 \text{ m}^2$$

$$V = Q/A = 0.033/0.01767 = 1.868 \text{ m/s}$$

Friction loss head

$$\begin{aligned} h_1 &= (6.819 \cdot L \cdot v^{1.852}) / (C^{1.852} \cdot D^{1.167}) \\ &= 6.819 \times (130 + 40) \times 1.868^{1.852} / (80^{1.852} \times 0.15^{1.167}) \\ &= 7.71 + 2.37 = 10.08 \text{ m} \end{aligned}$$

Around the valve

$$h_2 = 2.0 \text{ m}$$

Total friction loss head

$$H = h_1 + h_2 = 10.1 + 2.0 = 12.1 \text{ m}$$

$$\begin{aligned} \text{Total pump} &= \text{Gross head} + \text{Friction loss head} \\ &= 41 + 12.1 = 53.1 = 54 \text{ m} \end{aligned}$$

b. In case of pipe diameter 125 mm

$$A = \pi/4 \cdot D^2 = 0.01227 \text{ m}^2$$

$$V = Q/A = 0.033/0.01227 = 2.689 \text{ m/s}$$

Friction loss head

$$\begin{aligned} h_1 &= (6.819 \cdot L \cdot v^{1.852}) / (C^{1.852} \cdot D^{1.167}) \\ &= 6.819 \times (130 + 40) \times 2.689^{1.852} / (80^{1.852} \times 0.125^{1.167}) \\ &= 18.73 + 5.76 = 24.49 \text{ m} \end{aligned}$$

Around the valve

$$h_2 = 2.0 \text{ m}$$

Total friction loss head

$$H = h_1 + h_2 = 24.5 + 2.0 = 26.5 \text{ m}$$

$$\begin{aligned} \text{Total pump} &= \text{Gross head} + \text{Friction loss head} \\ &= 41 + 26.5 = 67.5 = 68 \text{ m} \end{aligned}$$

Therefore, pipe diameter 150 mm is recommendable.

(2) Pump

a. Irrigation block No. 1 and No. 3, water supply system

Necessary pumping capacity:	1,500 l/min.
Necessary head:	40 m
Sprinkler nozzle pressure:	25.0 m
Friction loss head:	8.0 m
Around pump:	3.0 m
Gross head:	4.0 m
Total	40.0 m

b. Irrigation block No. 2, water supply system

Necessary pumping capacity:	500 l/min.
Necessary head:	35 m
Sprinkler nozzle pressure:	25.0 m
Friction loss head:	4.0 m
Around pump:	2.0 m
Gross head:	4.0 m
Total	35.0 m

(3) Volume of water tank

A volume of water tank is estimated at a volume of irrigation pump for two hours.

Necessary effective volume:	
Irrigation water:	180 m ³ (90 m ² /hr x 2 hr)
Living water:	40 m ³
Total	220 m ³

Table 8.9 Irrigation Water Requirement

Block	Plot	Total Length of Drip Line (m)	Actual Irrigation Requirement (l/min)
No. 1	A	7,600	348.33
	B	11,200	513.33
	E ₁	3,168	145.20
	E ₂	4,851	222.24
	F	3,930	180.13
Subtotal		30,749	1,409.23
No. 2	C	6,660	305.25
	D	12,600	577.50
	G ₁	3,300	151.25
	G ₂	7,150	327.71
	H	144*	78.00
Subtotal		29,710 144**	1,439.71
No. 3	I	10,000	458.33
	J	9,562	438.25

* : Total length of water-conveyance hose

** : + Water-conveyance

8.3.3 Irrigation Planning

Computation of Irrigation Interval

(1) Determination of available moisture in effective root zone

$$AM = \frac{1}{100}(F_{ca} - W_{pn}) S_{an}D_n$$

AM: Available moisture in effective root zone

F_{cn}: Field capacity in each layer (%)

W_{pn}: Primary wilting point in each layer (%)

S_{an}: Apparent-specific gravity in each layer

D_n: Depth in each layer (cm)

Substituting every value recommended by the Chinese Standard for the above formula, each AM is as follows:

Table 8.10 Soil Characteristics of Existing Experimental Farm

Section	Depth (cm)	S _a	F _c	W _p	Remarks
1	0 - 10	1.17	32.18	11.00	
2	10 - 20	1.25	32.18	11.00	
3	20 - 30	1.25	32.18	11.00	
4	30 - 40	1.25	32.18	11.00	

Table 8.11 Available Moisture in Existing Experimental Farm

Section	Depth (cm)	AM
1	0 - 10	1/100 (32.18 - 11.00) x 1.17 x 100 = 24.78
2	10 - 20	1/100 (32.18 - 11.00) x 1.25 x 100 = 26.47
3	20 - 30	- ditto -
4	30 - 40	- ditto -

Table 8.12 Soil Characteristics of New Experimental Farm

Section	Depth (cm)	S _a	F _c	W _p	Remarks
1	0 - 10	1.42	26.76	11.00	
2	10 - 20	1.31	26.76	11.00	
3	20 - 30	1.31	26.76	11.00	
4	30 - 40	1.31	26.76	11.00	

Table 8.13 Available Moisture in New Experimental Farm

Section	Depth (cm)	AM
1	0 - 10	$1/100 (26.76 - 11.00) \times 1.42 \times 100 = 22.38$
2	10 - 20	$1/100 (26.76 - 11.00) \times 1.32 \times 100 = 20.80$
3	20 - 30	- ditto -
4	30 - 40	- ditto -

(2) Computation of total readily available moisture (water quantity per irrigation)

Table 8.14 TRAM in Existing Experimental Farm

Section	Depth (cm)	Absorption Ratio	AM	TRAM	TRAM
1	0 - 10	40	24.78	$24.78 \times 1/40 \times 100 = 61.95$	61.95
2	10 - 20	30	26.47	$26.78 \times 1/30 \times 100 = 89.27$	(Limit Layer)
3	20 - 30	20	26.47	$26.78 \times 1/20 \times 100 = 133.90$	
4	30 - 40	10	26.47	$26.78 \times 1/10 \times 100 = 267.80$	

Table 8.15 TRAM in New Experimental Farm

Section	Depth (cm)	Absorption Ratio	AM	TRAM	TRAM
1	0 - 10	40	22.38	$22.38 \times 1/40 \times 100 = 55.95$	55.95
2	10 - 20	30	20.80	$20.80 \times 1/30 \times 100 = 89.27$	(Limit Layer)
3	20 - 30	20	20.80	$20.80 \times 1/20 \times 100 = 104.0$	
4	30 - 40	10	20.80	$20.80 \times 1/10 \times 100 = 208.0$	

As a result of the calculation, it is confirmed that the important soil layer for growth in TRAM is the first layer in the newly-established field. Its value is 55.95 mm.

(3) Computation of irrigation interval

The irrigation interval is computed six days interval (55.95 / 8.89 = 6.29 days) from TRAM (55.95 mm) and irrigation requirement (8/0.9 = 8.89 mm/day).

(4) Computation of Drip Irrigation Interval

Moisture zone of drip irrigation is decided by the combined ratio of each emitter's moisture zone. Depletion of moisture content for optimum growth is changed to available moisture of drip irrigation point on the measure of TRAM estimate.

Therefore, the computation of drip irrigation interval is as follows:

a. DTRAM

$$\begin{aligned} DTRAM &= (F_c - O_1) \cdot D \cdot \frac{1}{C_p} \\ &= (1 - C_r) \times TRAM \end{aligned}$$

F_c : Water holding capacity after 24 hours

O_1 : Available moisture of drip irrigation point

C_p : Coefficient of moisture absorption ratio

C_r : Crop coefficient

-Cucumber, Green pepper 0.15

C_r -Lettuce 0.10

-Egg plant 0.08

Since the variety of crops is not determined, using the coefficient of 0.15 after due consideration of safety.

$$\begin{aligned} DTRAM &= (1 - 0.15) \times TRAM \\ &= 0.85 \times 55.95 = 47.56 \end{aligned}$$

And assuming the total area after consideration of the moisture width.

TRAM of assuming total area conversion
= TRAM x moisture ratio (P)

$$(P) = \frac{\text{Moisture width} \times \text{Moisture length} \times \text{Number of drip line}}{\text{Field area}}$$

Considering one unit of the Research Centre,

Moisture width: 0.4 m

Moisture length: 100 m

Drip line: Standard size for 25 m by 100 m is 26 lines

So,

$$P = \frac{0.4 \times 100 \times 26}{2,500 \text{ m}^2} = 0.42$$

Therefore, assuming TRAM 0.42 x DTRAM.

$$0.42 \times 47.56 = 19.98$$

Assuming TRAM = 19.98 mm

Therefore, Drip Irrigation Interval become

$$\frac{19.98}{8.89} = 2.25 \text{ days}$$

The Drip Irrigation Interval shall be two days.

8.3.4 Propagation velocity of water-hammer wave

Propagation velocity of water hammer wave can be obtained by following formula.

$$a = \sqrt{\frac{1}{\frac{W}{g} \left(\frac{1}{K} + \frac{D \cdot C_1}{E \cdot t} \right)}}$$

- where, a : Propagation velocity (m/sec)
 g : Acceleration of gravity, 9.80 (m/sec²)
 W : Unit weight of water, 1,000 (kg/m³)
 K : Volume modulus of water, 2.0 x 10⁸ (kg/m²)
 E : Longitudinal elastic modulus of pipe,
 3.0 x 10⁸ (kg/m²)
 D : Diameter of pipe (m)
 t : Thickness of pipe (m)
 C₁ : Coefficient from laying condition, 1.0

The calculation results is shown as below:

Diameter:	D mm	125	100	75
Thickness:	t mm	7.5	7.1	5.9
Velocity:	A m/s	422	434	456

In connection with time (2 L/a) that pressure wave return inthe pipe line (length: L) and time (T) of opening and closing valve, water hammer pressure of 3 cases are calculated as below:

1) In case of suddenly closing

$$T = 0$$

$$H_{\max} = \frac{a \cdot V}{g}$$

$$h_x = H_{\max}$$

2) In case of rapidly closing

$$T \leq 2 \cdot L/a$$

$$H_{\max} = \frac{aV}{g}$$

$$x < \frac{aT}{2}, \quad h_x = \frac{aV}{g} \cdot \frac{x}{x_0}$$

$$x \geq \frac{aT}{2}, \quad h_x = H_{\max}$$

3) In case of slowly closing

$$T > \frac{2L}{a}$$

$$H_{\max} = \left(\frac{K_1}{2} + \sqrt{k_1 + \frac{k_1^2}{4}} \right) H_0$$

$$h_x = \frac{aV}{g} \cdot \frac{\mathcal{M}}{T} \cdot \frac{x}{L}$$

where, H_{\max} : Maximum water hammer head (m)

h_x : Water hammer head at the section of x (m)

V : Initial velocity (m/sec)

x_0 : aT/s (m)

x : Length from intake (m)

T : Time of closing valve (sec)

H_0 : Hydrostatic pressure at the position of valve (m)

\mathcal{M} : $2 L/a$

L : Length of pipeline (m)

K_1 : $\left(\frac{LV}{gH_0T} \right)^2$

Therefore, it is to reduce the initial velocity or increase the time of closing valve because of reducing the water hammer pressure.

8.3.5 Breakdown of Construction Cost

(1) Unit Price of Labourer and Materials

Table 8.16 Unit Price of Labourer and Materials

No.	Description	Unit	Price(yuan)	Remarks
1	Skilled labourer	man day	15.00	
2	Unskilled labourer	man day	10.00	
3	Assistant labourer	man day	5.00	
4	Sand	m ³	22.00	
5	Crushed stone	m ³	21.00	
6	Gravel	m ³	18.00	
7	Brick	piece	0.10	
8	Nail	kg	2.15	
9	Wire(22#)	kg	2.90	
10	Wire(8#)	kg	1.97	
11	Steel bar	t	865.00	
12	Wooden Form	m ³	497.00	
13	Diesel oil	kg	1.30	
14	Machine oil	kg	1.50	
15	Lubricating oil	kg	3.60	
16	Gasoline	kg	1.00	
17	Asphalt	t	453.00	
18	Cement	t	150.00	
19	Manhole cover(FC)φ600mm	set	168.00	
20	Manhole cover(concrete)φ600mm	set	94.00	
21	Reinforced concrete pipe φ600mmx2m	piece	210.00	
22	Steel sheet	kg	0.96	

(2) Unit Price of Construction

Table 8.17 Price Schedule -1

No.	Work	Unit Price(yuan)		Remarks
		Labourer	Material	
1	Excavation	m3	5.12	
2	Backfilling	m3	2.74	
3	Sand bed	m3	2.74	29.04
4	Disposal of spoil soil	m3	2.31	
5	PVC pipe laying ϕ 125mm	m	0.68	
6	PVC pipe laying ϕ 100mm	m	0.60	
7	PVC pipe laying ϕ 75mm	m	0.50	
8	PVC pipe laying ϕ 50mm	m	0.43	
9	PVC pipe laying ϕ 40mm	m	0.43	
10	PVC pipe laying ϕ 25mm	m	0.35	
11	Pipeline earthwork ϕ 125mm	m	12.43	
12	Pipeline earthwork ϕ 100mm	m	12.10	
13	Pipeline earthwork ϕ 75mm	m	11.77	
14	Pipeline earthwork ϕ 50mm	m	11.44	
15	Pipeline earthwork ϕ 40mm	m	11.31	
16	Pipeline earthwork ϕ 25mm	m	11.12	
17	Installation of sluice valve ϕ 100mm	no.	28.85	
18	Installation of sluice valve ϕ 75mm	no.	27.35	
19	Installation of sluice valve ϕ 50mm	no.	21.00	
20	Installation of air valve ϕ 50mm	no.	5.45	
21	Installation of filter ϕ 150mm	no.	31.70	
22	Installation of filter ϕ 75mm	no.	27.35	
23	Installation of small valve ϕ 40mm	no.	2.65	
24	Installation of small valve ϕ 25mm	no.	1.34	
25	Installation of dripline	ha	255.00	
26	Installation of control head	set	18.75	
27	Sluice valve hole	no.	5.50	204.38
28	Air valve hole	no.	5.50	204.38
29	Scour valve hole	no.	5.50	204.38
30	Drain pit	no.	12.47	310.78
31	Metering valve hole ϕ 75mm, ϕ 50mm	no.	32.74	68.36
32	Gravel foundation	m3	2.74	21.00

Table 8.18 Price Schedule -2

No.	Work	Unit	Unit Price(yuan)		Remarks
			Labourer	Material	
33	Pipeline protection work	m3	25.58	91.97	
34	Road arrangement	m2	3.79	8.85	
35	Drainage canal arrangement	L.S	185.00	363.00	
36	Installation of water gauge	L.S	20.00		
37	Filter protection work o150mm	no.	96.67	183.42	
38	Filter protection work o 75mm	no.	77.71	152.62	
39	Plain concrete	m3	25.58	91.97	
40	Mortar (1:3)	m3	15.00	102.60	
41	Brick masonry	m2	7.01	21.13	

(3) Breakdown of Construction Cost

Table 8.19 Construction Cost
Summary

Section	Total Amount (Japanese Yen)
A. Earthwork for pipeline	871,000
B. Pipe laying	36,000
C. Installation of valves	23,000
D. Installation of dripline	40,000
E. Installation of control heads	19,000
F. Construction of sluice valve hole	36,000
G. Construction of air valve hole	22,000
H. Construction of scour valve hole	167,000
I. Construction of metering valve hole	21,000
J. Appurtenant work	66,000
Grand Total	1,301,000

Table 8.20 Section A. Earthwork for pipeline

No.	Work	Unit	Q'ty	Unit Price (₹)	Amount (₹)
A.1	Excavation	m ³	2,699.4	179.2	483,732
A.2	Backfilling	m ³	2,573.3	95.9	246,779
A.3	Sand bed	m ³	117.4	1,112.3	130,584
A.4	Disposal of spoil soil	m ³	126.1	80.85	10,195
Total Section A					871,000 (rounded)

Table 8.21 Section B. Pipe laying

No.	Work	Unit	Q'ty	Unit Price (₱)	Amount (₱)
B.1	Pipe laying ϕ 125	m	40	23.80	952
B.2	do. ϕ 100	m	557	21.00	11,697
B.3	do. ϕ 75	m	471	17.50	8,242
B.4	do. ϕ 50	m	807	15.05	12,145
B.5	do. ϕ 40	m	23	15.05	346
B.6	do. ϕ 25	m	236	12.25	2,891
Total Section B		(m)	(2,134)		36,000 (rounded)

Table 8.22 Section C. Installation of valves

No.	Work		Unit	Q'ty	Unit Price (₹)	Amount (₹)
C.1	Installation of sluice valve	∅100	No.	3	1,009.75	3,029
C.2	do.	∅ 75	No.	1	957.25	957
C.3	do.	∅ 50	No.	1	735.00	735
C.4	Installation of scour valve	∅ 50	No.	9	735.00	6,615
C.5	Installation of air valve	∅ 50	No.	5	190.75	953
C.6	Installation of filter	∅150	No.	1	1,109.50	1,109
C.7	do.	∅ 75	No.	1	957.25	957
C.8	Installation of small valve	∅ 40	No.	1	92.75	92
C.9	do.	∅ 25	No.	86	46.90	4,033
C.10	Installation of metering valve	∅ 75	No.	4	957.25	3,829
C.11	do.	∅ 50	No.	2	735.00	1,470
Total Section C						23,000 (rounded)

Table 8.23 Section D. Installation of dripline

No.	Work	Unit	Q'ty	Unit Price (₹)	Amount (₹)
D.1	Plot A	ha	0.76	8,925.00	6,783
D.2	Plot B	ha	1.12	"	9,996
D.3	Plot C	ha	0.67	"	5,979
D.4	Plot D	ha	1.26	"	11,245
D.5	Vinylhouse E1	ha	0.32	"	2,856
D.6	Vinylhouse F	ha	0.39	"	3,480
Total Section D		(ha)	(4.52)		40,000 (rounded)

Table 8.24 Section E. Installation of control head

No.	Work	Unit	Q'ty	Unit Price (₹)	Amount (₹)
E.1	Plot A	set	2	656.25	1,312
E.2	Plot B	set	5	"	3,281
E.3	Plot C	set	2	"	1,312
E.4	Plot D	set	5	"	3,281
E.5	Plot E2	set	2	"	1,312
E.6	Plot G1	set	2	"	1,312
E.7	Plot G2	set	3	"	1,968
E.8	Plot I	set	4	"	2,625
E.9	Plot J	set	5	"	3,281
Total Section E		(set)	(30)		19,000 (rounded)

Table 8.25 Section F. Construction of sluice valve hole

No.	Work		Unit	Q'ty	Unit Price (₹)	Amount (₹)
F.1	Construction of sluice valve hole	∅100	No.	3	7,345.80	22,037
F.2	do.	∅ 75	No.	1	"	7,345
F.3	do.	∅ 50	No.	1	"	7,345
Total Section F						36,000 (rounded)

Table 8.26 Section G. Construction of air valve hole

No.	Work	Unit	Q'ty	Unit Price (₹)	Amount (₹)
G.1	Construction of air valve hole $\phi 50$	No.	3	7,345.80	22,037
Total Section G					22,000 (rounded)

Table 8.27 Section H. Construction of scour valve hole

No.	Work	Unit	Q'ty	Unit Price (₹)	Amount (₹)
H.1	Construction of scour valve hole	No.	9	7,345.80	66,112
H.2	Construction of drain pit	No.	9	11,313.75	101,823
Total Section H					167,000 (rounded)

Table 8.28 Section I. Construction of metering valve hole

No.	Work	Unit	Q'ty	Unit Price (₱)	Amount (₱)
I.1	Construction of metering valve hole	ø75 No.	4	3,538.50	14,154
I.2	do.	ø50 No.	2	"	7,077
Total Section I					21,000 (rounded)

Table 8.29 Section J. Appurtenant work

No.	Work	Unit	Q'ty	Unit Price (₹)	Amount (₹)
J.1	Pipeline protection work	m ³	3.2	4,114.25	13,165
J.2	Road arrangement	m ²	50	309.75	15,487
J.3	Drainage canal arrangement	L.S.	1	19,180.00	19,180
J.4	Installation of water level gauge	L.S.	1	700.00	700
J.5	Filter protection work ϕ 150	No.	1	9,803.15	9,803
J.6	do.	ϕ 75 No.	1	8,061.55	8,061
Total Section J					66,000 (rounded)

8.3.6 Contract Documents (Draft)

(1) Contract Agreement (Draft)

CONTRACT AGREEMENT

MODEL INFRASTRUCTURE IMPROVEMENT WORKS
FOR
BEIJING VEGETABLE RESEARCH CENTER PROJECT
CONTRACT FOR CIVIL WORKS

AGREEMENT

THIS AGREEMENT made between JAPAN INTERNATIONAL COOPERATION AGENCY, JICA (Hereinafter called "The EMPLOYER") of the one part and whose Resistered Office is at (Hereinafter called "THE CONTRACTOR") of the other part.

WHEREAS the Employer is desirous that certain works should be constructed, namely the Construction of Irrigation Systems in Model Infrastructure Improvement Works for the Beijing Vegetable Research Center Project and has accepted the Contractor for the Construction Completion of such Works NOW THIS AGREEMENT WITNESSETH AS FOLLOWS:

ARTICLE 1

(a) Description of Work

The Contractor shall carry out the construction works of the Irrigation Systems in Model Infrastructure Improvement Works for the Beijing Vegetable Research Center Project in the People's Republic of China.

(b) Contract Documents

The following documents shall be deemed to form and to read and construed as part of this Agreement, namely:

- (i) The Drawings
- (ii) The Conditions of Contract
- (iii) The Specifications
- (iv) The Bill of Quantities
- (v) The Schedule of Rates and Prices (if any)

ARTICLE 2 - CONTRACT SUM OF CONSTRUCTION

The construct sum of construction shall be
.....
.....

ARTICLE 3 - TIME LIMIT OF SUBMISSION OF PRICED BILL OF QUANTITIES

The Contractor shall submit a copy of the Priced Bill of Quantities to the Employer within seven (7) days after signing by both parties of this agreement. The Contractor reserves the right to remeasure the work and check the Bill, both for quantity and description of required.

ARTICLE 4 - COMMENCEMENT AND TIME FOR COMPIETION

The Contractor shall commence the work within ten (10) days after signing by both parties of this agreement, and complete the work by _____, 1988.

ARTICLE 5 - DELAYS

In a case where it is clear that the Contractor is failing to fulfill his obligations within the period referred to in the preceding Article, the Contractor shall inform the Employer of this by a letter as soon as possible, and if the Employer agrees that the delay is due to such causes as natural calamity or others for which the Contractor is not liable, a reasonable extension of time will be approved. In this case, the sum referred to in Article 16 will not be collected.

ARTICLE 6 - PROCESS OF CARRYING OUT OF WORK

The Contractor shall carry out the work in accordance with the Drawings and Specifications referred to in Article 1 (b). In cases where it is necessary for the Contractor to carry out such work as is not mentioned therein for the purpose of promoting the present construction or for reasons of established practices, the Contractor shall carry out the said work under the direction of the Employer. In cases where the Contractor finds any doubt in the plans of construction, the Contractor shall ask the Employer for the necessary directions before commencing the work on that part for which there exists some doubt.

The Employer must provide such information and details within seven (7) days of the written request from the Contractor.

ARTICLE 7

The Contractor shall follow the direction of the Employer or a supervisor to be appointed by the Employer (Hereinafter called "The Supervisor"). As to materials for the construction, the Contractor shall use only those inspected and approved by the Employer or the Supervisor. In cases where any defective work has been done as a result of such use of materials which have not been inspected by the Supervisor, or of disobedience to the direction of the Supervisor, the Contractor shall be liable to change the materials or repair the work at his own responsibility. The construction shall be carried out in accordance with the proper technique, and durability shall be the principal aim as regards to the construction.

ARTICLE 8 - WORKMEN

As to the workmen to be hired by the Contractor for the work, the Contractor shall assume the responsibility as entrepreneur or employer, as provided for by Laws and Regulations in the People's Republic of China.

ARTICLE 9 - TRANSFER OF RIGHT AND OBLIGATION

The Contractor shall not assign or sublet to a third party the whole or part of the construction except in cases where the Contractor has obtained written approval from the Employer.

ARTICLE 10 - DAMAGES

In cases where any damage is caused to the Employer or a third party, materials or constructions, through carelessness on the part of the Contractor during the course of work or transportation of materials, the Contractor shall be liable to repair or compensate such damages at his own expense by the date appointed by the Employer or the third party.

ARTICLE 11

In cases where the Contractor fails to repair or compensate such damages referred to in the preceding Article by the fixed date, the Employer may pay for such repair on behalf of the Contractor, and collect compensation from the Contractor by deducting the amount from the sum of construction to be paid to the Contractor by the Employer under the provisions of Article 21, and in cases where the damages exceed the sum of construction, the Employer may collect the deficit from the Contractor.

ARTICLE 12

(a) Change of Construction Drawings and Submission of Necessary Documents
In cases where the Employer feels it necessary to discontinue the work owing to unavoidable circumstances, or to alter the plan of construction, the Employer may request the Contractor to calculate, on the basis of the unit prices as detailed in the priced Bill of Quantities referred to in Article 3, as to increase or decrease in the sum of construction resulting from the suspension or alteration of the work, and the Contractor shall comply with the request. When the Employer orders such a suspension or alteration, depending on the statement of the above mentioned calculation, the Contractor shall submit a written consent by the date appointed by the Employer.

- (b) Where work cannot be properly measured and valued on the basis of the unit price in the Bill of Quantities referred to in Article 3, the Contractor will be allowed to calculate on the basis of the daywork rates which shall be approved by the Employer before their application.

ARTICLE 13

(a) Price Adjustment

In the case of the costs of materials rising sharply as a result of the fluctuation in the market prices due to an unexpected change in the economic conditions, a reasonable adjustment of the contract sum or the unit prices in the Bill of Quantities will be made through negotiations between the Employer and the Contractor.

- (b) In a case where a loss such as may render it unreasonable for the contract sum referred to in Article 2, is inflicted upon the Contractor by virtue of the Employer's failure to provide the information and details referred to in Article 6 or to obtain the necessary approvals under the local bye-laws, then a reasonable adjustment of the above mentioned sum will be made on the basis of the detailed claim submitted by the Contractor.

ARTICLE 14 - RIGHT TO RESCIND CONTRACT AND PENALTY

In cases where the Contractor fails to fulfil his obligations under this contract, the Employer may rescind the whole or part of the Contract. In such a case, the Employer may collect from the Contractor a sum as a penalty of ten percent (10%) of the amount which is equivalent to the rescinded. In cases where the damages caused on the Employer, on account of the non-fulfilment of Contract by the Contractor, exceed the sum referred to in the preceding paragraph, the Employer may further demand the Contractor to pay the excess.

ARTICLE 15

In cases other than provided for in Article 14 where the Contractor fails to fulfil his obligations, or in cases where the fulfilment of obligations by the Contractor is regarded to be difficult, the Employer may ask a third party to fulfil, at the cost of the Contractor, the whole or part of the obligations of the Contractor. Even if liability of the Contractor exceeds the contract sum referred to in Article 2 in consequence of this, the Contractor shall not raise any objection to it.

ARTICLE 16

In cases other than provided for in Article 14 where the Contractor fails to complete the construction at his own responsibility within the period referred to in Article 4, the Contractor shall be liable, within a period fixed by the Employer, to pay the Employer per week of delay a sum equivalent to 0.1 percent (0.1%) of the contract sum referred to in Article 2.

ARTICLE 17 - DAMAGE CAUSED BY NATURAL CALAMITY, ETC.

In cases where serious damages occur to the completed part of the work, or the materials, tools etc., already carried into the field of construction, the Contractor shall promptly inform the Employer of the circumstances. If such damages are caused by a natural calamity, an earthquake, a flood, a civil war, a war, an epidemic, or a general/trade strike, riot or other unavoidable reasons, for the occurrence of which no responsibility can be attributed to either the Employer or the Contractor, and it is admitted that the Contractor has paid the care of good administrator to avoid the occurrence of such damages, the Employer shall be liable for the amount of the damages which shall be fixed through negotiations between the Employer and the Contractor.

ARTICLE 18

(a) Inspection

The work at any stage shall be subject to inspection to be conducted by the Employer or an inspector appointed by the Employer in the presence of the Contractor, and necessary labour and articles required for such an inspection shall be provided by the Contractor.

(b) In cases where the work fails to pass the inspection referred to in the preceding paragraph, the Contractor shall carry out necessary repair at his own cost under the direction of the Employer.

ARTICLE 19 - DATE OF COMPLETION OF CONSTRUCTION AND OBLIGATION THEREAFTER

The date of completion of construction shall be regarded as that on which the final work, including removal of temporary facilities and cleaning, has passed the inspection referred to in Article 18, and on that date the object of the construction shall be delivered to the Employer by the Contractor. For a period of one year thereafter, any defect in the construction, the cause of which is judged in the opinion of the Employer to be attributable to faulty or inadequate techniques or materials employed by the Contractor, shall be immediately repaired or improved by the Contractor at the cost of the Contractor.

ARTICLE 20 - PAYMENT

The Employer agrees to effect payments for the Works to the Contractor in the following manner:-

(a) Advance Payment, to be effected upon the bringing of equipment and materials required for the Works and properly stored at the job site by the Contractor and of value estimated by the Supervisor.

An amount of which corresponds to Forty (40) per cent of the Contract Price shall be paid upon signing of this Contract.

(b) Final Payment, to be effected upon the satisfactory completion of the Works by the Contractor and accepted by the Supervisor.

The remainder of which corresponds to Sixty (60) per cent of the Contract Price, shall be paid after issue of the Final Certificate by the Employer for payment to the Contractor. Payment under (b) shall be effected within ten (10) days after the respective acceptance of the Works by the Supervisor.

ARTICLE 21 - INTEREST FOR THE DELAY OF PAYMENT

In cases of the payment referred to in Article 20 being delayed owing to a cause or causes attributable to the Employer, the Contractor may request the Employer to pay interest on arrears of payment at one percent (1%) over the bank rate.

ARTICLE 22

(a) Settlement of Dispute

If there arises any dispute with regard to this Agreement on the Detailed Drawings or Specifications referred to in Article 1 (b), it shall be settled by a mutual consultation between the Employer and the Contractor.

(b) If it should not be possible to reach a mutual agreement between the Employer and the Contractor on such dispute, then it shall be referred to an Arbitrator or Arbitrators acceptable to both the Employer and the Contractor and the decision of this Arbitrator or Arbitrators shall be binding on both the Employer and the Contractor.

IN WITNESS WHEREOF, the parties hereto have hereunto set their respective hands and seals, the day and year first above written.

Signed Sealed and Delivered by

Signed Sealed and Delivered by

(Resident Representative)

(Contractor)

CONDITIONS OF THE CONTRACT

1. Objectives

The Employer, Japan International Cooperation Agency (JICA) wants to construct an Irrigation System in the Beijing Vegetable Research Center Project in the People's Republic of China.

2. Work Schedule

The Contractor shall submit to the Employer for this approval the detailed work schedule for performing the construction works specified in Article 1 (b) of the Contract within fifteen (15) days after signing by both parties of this agreement.

3. Operation of Work

To control the construction works, the engineer of the Contractor is required to stay at the construction office. If the engineer does not stay at the office without appropriate reason, the Employer reserves the right to stop the works or part of works instantly and the Contractor is required to be responsible for any damage from this neglect.

4. Progress Report

The progress reports shall be submitted to the Employer by the Contractor every month. If there is any delay of work from agreed schedule, the Contractor shall submit the modified work schedule to the Employer to justify for such a delay so as to achieve the originally set target.

5. Acceptance of Completed Work

Upon receipt of the written request from the Contractor, the Employer will check the work actually performed in the field. If everything is satisfactorily completed, the Employer will accept that part of work within seven (7) days after the receipt of the request. If there are any inconsistency and shortcomings in the work presented by the Contractor, the Employer will reserve the right not to accept the work. During the improvement of the work, it will be regarded that the work has not been accepted. After completion of the improvement work, the Contractor shall request the Employer to inspect it. If the improvement work is satisfactorily completed, the Employer will accept the work within seven (7) days after the receipt of the request.

However, the acceptance does not necessarily mean the discontinuation of the responsibility of the Contractor for possible damages of that part of the work. The complete acceptance takes place only when all the works have been completed and accepted.

6. Increase or Decrease of Unit Price

In the event of remarkable fluctuation in the costs of labor, materials, equipment, etc., the adjustment of unit prices may be made based on the escalation factors through negotiations between the Employer and the Contractor. However, no adjustment will be made in case of the delay of construction works due to the fault of the Contractor.

7. General Text

The construction works shall be proceeded in accordance with the Drawings and Specifications in every respect. In case, however, the Employer adds to or revises the original Drawings and/or Specifications in order to attain further engineering perfection, the Contractor is required to proceed with the construction in accordance with the added or revised drawings and/or specifications in every without any objections.

8. Alignment, Leveling and Site-Plan Setting

The Employer is to inform the Contractor of the bench mark which gives the base elevation to be used for the construction. The succeeding steps shall be the duty of the Contractor. The Contractor shall set and determine the alignment and elevations in accordance with the Drawings in the construction area and ask for the inspection of the Employer prior to the commencement of the construction. The Contractor is required to preserve all the pegs that indicate the alignment and elevations in a good condition throughout the construction period. In cases where the Employer requests the Contractor shall conduct checking survey and submit the results to the Employer as soon as possible.

GENERAL SPECIFICATIONS

1. General Description

In the Beijing Vegetable Research Center Project, it is urgently necessary to prepare irrigation facilities of the Experimental Farm that serve for the activities of the Project. Therefore, the Japan International Cooperation Agency (JICA) intends to construct an irrigation system for an area of 8.6 ha in the Research Center under the Model Infrastructure Improvement Works for the Beijing Vegetable Research Center Project. The irrigation system will consist of drip system and low pressure sprinkler system in order to economize water.

The works provided for in this Contract are:

- the installation of irrigation pipelines including the related facilities.

2. Scope of Contract

The Contractor shall, except as otherwise provided for in the Contract, furnish all labor, materials, Constructional Plant, Temporary Works and other necessary for the construction of the Works. The Contractor shall execute, complete and maintain the Works in strict accordance with the Specifications and Drawings or as directed by the Supervisor.

The Works to be carried out under the Contract will include the followings.

- (1) The construction and maintenance of any temporary facilities and access roads required by the Contractor for the execution of the permanent works.

- (2) The installation of irrigation pipelines and their related facilities.

- Irrigation Pipeline : Approx. 2,100 m

3. Equipment and Materials to be Supplied by the Employer

The Employer will supply the Contractor the below-listed equipment and materials and the Contractor shall use the said equipment and materials only for the execution of the Work.

The Contractor shall thoroughly check and examine the list of equipment and materials hereof and the Drawings, and shall satisfy himself as to the quantities of the equipment and materials to be supplied under this Clause. If there is any incompleteness in the quantities, the Contractor shall so notify the Employer in writing. Failure to do so shall in no way relieve the Contractor from his obligation to complete the Works.

These equipment and materials will be handed over to the Contractor at the Site within 30 days from the commencement order.

(See Attached Lists of Equipment and Materials.)

4. Setting Out

The Contractor shall be entirely responsible for the accurate setting out of the Works from the information supplied on the Drawings and the instruction given by the Supervisor.

5. Drawings

The attached drawings accompany and form a part of this Specification. During the progress of the Works, additional drawings will be issued by the Supervisor as necessity arises to supplement, supersede or further set forth details shown on the Drawings hereto attached and such additional drawings shall thereupon become part of the Specification.

6. Construction Program

Within seven (7) days after the award of the Contract, the Contractor shall submit to the Supervisor for his approval, a construction program in bar chart form or otherwise, as may be required by the Supervisor, showing in detail his proposed schedule of operation and providing for the orderly completion of the Work by the dates specified in the Contract. The Supervisor's estimate of the construction time schedule shown on the Drawings is to be used only for consideration by the Contractor and does not relieve the Contractor from preparing and submitting his own time bar construction schedule.

The submission to and approval by the Supervisor of such program shall not relieve the Contractor from any of his duties of responsibilities under the Contract.

PROGRESS REPORT AND PHOTOGRAPHS

7. Progress Report

(1) The Contractor shall, before the tenth (10) day of each month or at any time designated by the Supervisor, submit five (5) copies of a monthly progress report in a form acceptable to the Supervisor on the progress of the Works during the preceding month. The report shall show but not be limited to:

- (a) the total percentage of progress as of the end of the report period and the percentage of each type of work progress for each structure during the preceding month,
- (b) list of activities scheduled to be in progress or actually in progress during the report period with the Contractor's actual forecast start and/or completion date for each activity,
- (c) lists of works done, and labours and equipment used during the report period,
- (d) list of the equipment and materials supplied by the Employer and used during the report period,
- (e) list of activities scheduled to be started within one (1) month with forecast starting dates, and
- (f) photographs set out in Clause 7 (2) hereof.

From time to time during the execution of the Contract, the Supervisor is empowered to call meetings, either in his office or at the Contractor's offices or on site, as he deems necessary for the purpose of control of the Contract. As required by the Employer or the Supervisor, responsible representatives of the Contractor shall attend such meetings.

(2) Photographs

The Contractor shall, if so required, furnish to the Supervisor photographs of the work in progress at the locations directed by the Supervisor throughout the Contract period. The photographs to be furnished to the Supervisor shall be attached with monthly progress report specified in Clause 7 (1) and shall be in five (5) copies and suitably inscribed. The negatives of the photographs shall be the property of the Employer and no prints from these negatives may be supplied to any person or persons without the approval of the Supervisor. The cost of such photographs shall not be paid separately and shall be deemed to be included in the rates for the various items in the Bill of Quantities.

PRECAUTIONS FOR SAFETY

8. General

(1) The Contractor shall take all necessary precautions against risks of loss of life or of injury to any person employed on the Works or to employees of the Employer and the Supervisor or of others or to visitors or to persons having good and sufficient reasons to be about the Works and to his end shall properly safeguard the Works to the satisfaction of the Supervisor.

The Contractor shall furthermore take all necessary precautions against damage to the property of the Employer or of other located at or adjacent to the Site.

The Contractor shall report promptly to the Supervisor all accidents involving the death of or serious injury to any person, on the Site or resulting from the Contractor's operations.

No separate payment will be made for complying with the provisions of this Clause and all costs shall be deemed to be included in the Rates for the various items in the Bill of Quantities.

(2) Temporary Fencing

If required, the Contractor shall erect and maintain at his own expense suitable and approved temporary fencing to enclose such areas of the Works to be carried out and all area of land occupied by the Contractor within the Site as may be necessary to implement his obligations as specified in the Conditions of Contract to the satisfaction of the Supervisor.

Where any temporary fence has to be erected alongside a public road, footpath, railway, etc., it shall be of the type required by and shall be to the satisfaction of the Authority concerned.

9. Contractor's Offices, Stores and Workshops

The Contractor shall provide, maintain and remove when directed, such temporary buildings as Contractor's offices, workshops and adequately fenced store compounds as are necessary for the execution of the Works.

Not less than 14 days before constructing such buildings, the Contractor shall submit site plans and general particulars to the Supervisor for his approval.

10. Assistance to the Supervisor

The Contractor shall render all necessary assistance to the Supervisor and shall provide as required pegs, poles, straight edges, stagings, moulds, templates, profiles and all other requisites to be used for checking and measuring the Works.

11. Water and Power Supply

The Contractor shall provide, operate, maintain and remove when directed upon completion of the Works, an adequate supply of water and electricity to his office, workshops and places of Work on the Site.

12. Materials and Standards

The Contractor shall inform the Supervisor of the names of the persons or firms from whom he desires to obtain any materials, ironwork, pipes, manufactured articles or other things which are to be supplied by him for use in the Works and, except as regards trifling and unimportant matters, no order shall be placed except with the sanction of the Supervisor. The Contractor shall keep the Supervisor fully advised of the orders and delivery dates of materials. Delivery shall be made sufficiently in advance to enable to further samples to be taken and tested, if required.

All materials and equipment to be furnished under the Contract shall be new and shall conform to the authorized standard for materials and tests in Japan. Other national or international standards may be accepted provided the requirements therein are, in the opinion of the Supervisor, equivalent to the current issue of the said standards.

If the Contract Documents conflict in any way with any or all of the above standards or codes, the Contract Documents shall have precedence and shall govern.

13. Specifications, Drawings and Data to be Supplied by the Contractor

The Contractor shall submit to the Supervisor for approval five (5) sets of complete specifications, drawings and data for materials and equipment to be supplied under the Contract within fourteen (14) days from the Supervisor's order to commence.

However, it is to be understood that approval of the specifications, drawings and data will not exonerate the Contractor from any responsibility as stipulated elsewhere in the Contract.

MEASUREMENT AND PAYMENT

14. Measurement and Payment

(1) Excavation

Measurement for excavation will be made for the net volume in cubic meters of earth excavated from the natural ground surface to the lines and grade shown on the Drawings or as directed by the Supervisor. Payment for excavation measured as above shall be at the Rate entered in the Bill of Quantities, which shall include the cost of excavation, trimming of side slopes, draining, earth slip or slide prevention; laying out, constructing and maintaining catch-water drains in good order during the works; hauling and disposal of the excavated material; backfilling for structures, except if it is already covered under other items in the Bill of Quantities; removal of materials in earth slips or slides, including the costs of all materials, labour, depreciation of equipment and all else necessary therefor and incidental thereto.

(2) Backfill for Structure

Measurement for backfill for structures shall be made for the net volume of filled materials measured in cubic meters after compacting and trimming of the slope as shown on the Drawings or as directed by the Supervisor.

Payment for backfilling of the structures measured as above shall be made at the Contract Rate per cubic meter in the Bill of Quantities, which Contract Rate for backfilling shall include the cost of supplying suitable material, placing by hand tools or machines, mixing, harrowing (if required), spreading, trimming, watering and compacting, and the cost of all other works connected therewith. The Contract Rate shall apply whatever the source of the material.

(3) Concrete

Measurement of concrete for payment shall be made only to the neat lines of the structures as shown on the Drawings or as established by the Supervisor. In measuring concrete for payment, the volume of all cavities, depressions and openings shall be deducted. Payment for concrete in any concrete measured as above shall be made at the Rates in the Bill of Quantities for:

Payment of concrete in the various parts of the Work shall be made at the Rates per cubic meter in the Bill of Quantities. The Rate shall include the cost for excavation, cost of all labour and materials, depreciation of equipment required in the construction, handling of cement, and the cost for concrete form of furnishing all labour, equipment and materials, erecting and removing the forms, depreciation of the forms, scaffoldings, backfilling and also the cost of all other necessary works connected therewith.

(4) Brick

Measurement of brick for payment shall be made for the net volume in cubic meter after compaction to the dimensions shown on the Drawings or as directed by the Supervisor. The Rates for brick shall include the cost of furnishing bricks and of pointing, cutting and fitting to spandrills, masonry and concrete, etc., and of all templates, centering, scaffolding and labour required to complete the Work as specified or as shown on the Drawings.

(5) Plastering and Cement Mortar

Measurement of plastering and cement mortar for payment shall be made for the net volume in cubic meter of cement mortar shown on the Drawings or as directed by the Supervisor. Payment for plastering measured as above shall be at the Rate entered in the Bill of Quantities, which shall include the cost for plastering of all labour and materials except cement, depreciation of tools and equipment, and other necessary works.

(6) Reinforcing Bar

Measurement for payment for furnishing and placing reinforcing bars shall be made only of the weight of the bars placed actually in the concrete in accordance with the Drawings or as directed by the Supervisor. Payment for furnishing and placing of reinforcing bars shall be made at the Rate per unit weight in the Bill of Quantities, which shall include the cost of furnishing and attaching wire ties and metal supports, if used, and of delivering, unloading, hauling, storing, sorting, cutting, bending, cleaning, placing, and securing the maintaining in position all reinforcing bars, as shown on the Drawings or as directed by the Supervisor.

(7) Precast Concrete Pipe

Measurement for precast concrete pipes shall be made for the length from end-to-end of the pipes in place, and no allowance shall be made for lap at joints or of connecting pipes shall include the cost of furnishing of all labour required in handling, hauling, and storing the pipe; preparing a suitable and even bedding; and laying the pipe and constructing the joints.

(8) Installation of Irrigation Pipelines

Measurement for the installation of irrigation pipelines shall be made for the length from end to end of the pipes in place as shown on the Drawings or as directed by the Supervisor, and no allowance shall be considered for laps at joints or of connecting pipes to wall, collars or structures. The payment for the installation of irrigation pipelines shall be made at the Rate stated in the Bill of Quantities, which shall include the cost of furnishing, unloading, hauling and handling the necessary materials such as sand, etc. except pipes and fittings, furnishing all labourer's tools and other necessary items.

(9) Land Grading

The measurement of land grading for payment shall be made for only the area where the land grading has been done in accordance with the Supervisor's direction at Site. The payment shall be made at the Rate provided in the Bill of Quantities, which shall include the cost of tools, labourers and materials necessary for completing the works under this item including excavation, handling and hauling the excavated materials, placing and spreading in fill, smoothing and

finishing the ground surface within the allowance to satisfy the Supervisor, and other incidental items of the work. No extra payment shall be made for the extra volumes due to shrinkage, swelling, losses or compaction of soil, increasing or decreasing of volume to cause repairment or additional works.

(10) Others

Measurement for payment for each of the items other than the items specifically mentioned above shall be made on the basis of the respective units indicated in the Bill of Quantities. The respective Contract Rate shall include the cost of furnishing all labour, materials, Constructional Plant, plant and appliance, and the performance of all work necessary to complete the works intended to be covered under the items, including minor works not mentioned but normally deemed to form a part of the works.

LIST OF MATERIALS FOR IRRIGATION SYSTEM 1

Item	Specifications	Quantity
PVC pipe (VP)	φ125 x 4 m	11 nos.
	φ100 x 4 m	147 nos.
	φ 75 x 4 m	122 nos.
	φ 50 x 4 m	208 nos.
	φ 40 x 4 m	7 nos.
	φ 25 x 4 m	76 nos.
PVC socket (TS)	φ 50	203 nos.
	φ 40	7 nos.
	φ 25	54 nos.
PVC reducer (TS)	φ125 x 100	1 no.
	φ100 x 75	2 nos.
	φ 75 x 50	14 nos.
	φ 50 x 40	1 no.
	φ 40 x 25	1 no.
PVC tee (TS)	φ125 x 100	1 no.
	φ100	1 no.
	φ100 x 75	5 nos.
	φ100 x 50	6 nos.
	φ 75	5 nos.
	φ 75 x 50	19 nos.
	φ 50	5 nos.
	φ 50 x 25	40 nos.
	φ 40 x 25	2 nos.
φ 25	1 no.	
PVC elbow (TS)	φ125	1 no.
	φ100	5 nos.
	φ 75	2 nos.
	φ 50	17 nos.
PVC bend (TS)	φ100 x 45°	4 nos.

LIST OF MATERIALS FOR IRRIGATION SYSTEM 2

Item	Specifications	Quantity
Socket (SGP)	ϕ 25	44 nos.
Elbow (SGP)	ϕ 50	125 nos.
	ϕ 25	83 nos.
Reducing elbow (SGP)	ϕ 50 x 20	28 nos.
Bend (SGP)	ϕ 75 x 45°	16 nos.
	ϕ 50 x 45°	8 nos.
Tee (SGP)	ϕ 50 x 20	60 nos.
	ϕ 50 x 13	4 nos.
	ϕ 40 x 13	30 nos.
	ϕ 20 x 8	41 nos.
Bushing (SGP)	ϕ 50 x 40	60 nos.
	ϕ 25 x 20	41 nos.
	ϕ 13 x 8	30 nos.
Nipple (SGP)	ϕ 50	99 nos.
	ϕ 40	90 nos.
	ϕ 25	41 nos.
	ϕ 20	82 nos.
	ϕ 8	71 nos.
Polyethylene pipe	ϕ 50	420 m
	7/8"	277 m
Dripline	ϕ 16	45,158 m
Drip starter	ϕ 16	570 nos.
Drip adapter	ϕ 16	110 nos.
PLA tee	ϕ 50	14 nos.

LIST OF MATERIALS FOR IRRIGATION SYSTEM 3

Item	Specifications	Quantity
PLA adapter	ϕ 50	28 nos.
Drip end	ϕ 16	680 nos.
PVC valve socket (TS)	ϕ 75	8 nos.
	ϕ 50	36 nos.
	ϕ 25	45 nos.
Galvanized Steel Pipe	ϕ125 x 2,000 L	2 nos.
	ϕ 75 x 2,000 L	2 nos.
	ϕ 75 x 600 L	8 nos.
	ϕ 75 x 565 L	8 nos.
	ϕ 50 x 5,500 L	1 no.
	ϕ 50 x 1,500 L	1 no.
	ϕ 50 x 1,000 L	30 nos.
	ϕ 50 x 600 L	4 nos.
	ϕ 50 x 565 L	4 nos.
	ϕ 50 x 500 L	63 nos.
	ϕ 25 x 1,500 L	7 nos.
Ball valve	ϕ 8	71 nos.
	ϕ 20	64 nos.
3-way valve	ϕ 50	30 nos.
PE tee	7/8"	41 nos.
PE elbow	7/8"	82 nos.
Pressure gauge		71 nos.
Angle valve	ϕ 50 x 90°	1 no.
	ϕ 25 x 90°	4 nos.

LIST OF MATERIALS FOR IRRIGATION SYSTEM 4

Item	Specifications	Quantity
Hose with coupling	∅ 25 x 10 m	1 no.
	∅ 25 x 2.5 m	7 nos.
BC nipple	∅ 25	8 nos.
BC connector	∅ 4	8 nos.
Tube	∅ 4 x 1,200 L	8 nos.
Fiberglas spike	1.0 m	8 nos.
Mini-sprinkler	∅2.5 mm	8 nos.
Cap	∅ 25	1 no.
Filter	6"	1 no.
	3"	1 no.
PVC flange (TS)	∅100	6 nos.
	∅125	2 nos.
	∅ 75	4 nos.
	∅ 50	20 nos.
Elbow with flanges	∅125 x 90°	6 nos.
	∅ 75 x 90°	6 nos.
Pipe with flanges	∅125 x 1,282	2 nos.
	∅125 x 200(with branch)	1 no.
	∅ 75 x 1,409	2 nos.
	∅ 75 x 300	1 no.
	∅ 75 x 200(with branch)	2 nos.
	∅ 75 x 100	4 nos.
Reducer	∅150 x 125	1 no.
	∅150 x 125(with branch)	1 no.

LIST OF MATERIALS FOR IRRIGATION SYSTEM 5

Item	Specifications	Quantity
Sluice valve with handwheel	ø125	1 no.
	ø 75	5 nos.
	ø 50	40 nos.
	ø 25	41 nos.
	ø 20	1 no.
Air valve	ø 50	5 nos.
Solvent cement	can	5 nos.
Pressure-reducing valve	ø 40	30 nos.
	ø 20	41 nos.
Metering valve	3"	4 nos.
	2"	2 nos.
Flange	ø125	3 nos.
	ø 75	3 nos.
Rabbit coupler	ø 20	64 nos.
Riser saddle	ø100 x 50	2 nos.
Dresser tee	ø 75 x 50	1 no.
Sluice valve without handwheel	ø100	3 nos.
	ø 75	1 no.
	ø 50	1 no.
MF joint	ø125	1 no.
	ø 75	1 no.
Valve key		5 nos.
Scour valve	ø 50	9 nos.

LIST OF MATERIALS FOR IRRIGATION SYSTEM 6

Item	Specifications	Quantity
Quick coupler	ϕ 50	30 nos.
Cap	ϕ 50	30 nos.
New coupler	ϕ 50	30 pair
Delivery hose	ϕ 50 x 2 m	2 nos.
Line tee	ϕ 50 x 90°	2 nos.
Line elbow	ϕ 50 x 90°	2 nos.
Aluminium pipe	ϕ 50 x 6 m	60 nos.
Riser with supports	3/4" x 1 m	28 nos.
Sprinkler head	3.6 x 2.4 mm	28 nos.
End cap		4 nos.
Chemical injector	with hydraulic motor	1 set
Water level gauge	with 3 points	2 sets

(4) Technical Specifications (Draft)

TECHNICAL SPECIFICATIONS

A. EARTHWORKS

A.01 Excavation-General

All excavation shall be carried out to the lines and levels shown on the Drawings or to such lines and levels as the Supervisor may direct. The Contractor shall trim all permanent excavations to the levels and dimensions shown on the Drawings.

Before commencing excavation, the Contractor shall survey and take levels over the entire area in which excavation is to be carried out. The surface levels so determined shall be subject to the Supervisor's Approval, and measurement of excavation shall be based upon the approved surface levels.

When any excavation has been taken out and trimmed, the Supervisor shall be informed accordingly so that he may inspect the completed excavation, and no excavation shall be filled in or covered with concrete until it has been inspected and the Contractor has been authorized to precede with the Works.

If from any cause whatsoever excavations other than for concrete work are carried out beyond their true line and level other than at the direction of the Supervisor, the Contractor shall at his own cost make good to the required line and level with approved material and in such a manner as the Supervisor may direct.

If from any cause whatsoever excavations for concrete works are carried out beyond their true line and level other than at the direction of the Supervisor, the Contractor shall at his own cost fill in to the required line and level with concrete similar in grade to that intended to be used in the true excavation unless otherwise directed.

A.02 Excavation for Structures

Excavation for foundation work shall be carried out in a safe manner and to the lines and levels shown on the Drawings or to such lines and levels as may be approved by the Supervisor. Firm foundations are to be achieved by moistening and tamping if necessary.

A.03 Excavation for Trenches of Irrigations Pipelines

Excavation for trenches of irrigation pipelines shall be made in accordance with Clause A.01 hereof, and excavation is to be executed in such a manner as shown on the Drawings or as directed by the Supervisor.

A.04 Backfilling-General

No excavations for foundation work shall be backfilled before they have been inspected by the Supervisor. Backfilling shall, unless otherwise specified, be carried out with approved materials and shall be well compacted in 15-centimeter layers compacted thickness to the satisfaction of the Supervisor. Topsoil, vegetation or other organic material shall be excluded from backfilling material.

A.05 Backfilling for Trenches of Irrigation Pipelines

Trenches of irrigation pipelines shall be backfilled after completion of the field test as directed by the Supervisor. Backfilling shall be carried out in accordance with Clause A.04 hereof. Backfill is to be executed such a manner as to deposit material without any damage to the pipe and to fill completely all spaces surrounding the pipe. The material shall be compacted in 7.5-centimeter layers compacted thickness below the crown of the pipe and in 15-centimeter above the crown of the pipe, to the satisfaction of the Supervisor.

A.06 Fill Adjacent to Structures

Fill materials adjacent to structures shall be placed in such a manner as will ensure that they can be satisfactorily compacted without damage to the structures. Compaction adjacent to all structures shall be carried out by hand or by a suitable hand operated plant.

Unless otherwise specified, no fill material shall be placed and no compaction shall be permitted adjacent to concrete for fourteen (14) days after the placing of the concrete.

Compaction of backfilling material placed above buried concrete, however mature, shall not be permitted to be carried out with vibrating rollers within 0.5 meter vertically of the surface of the concrete, except with the prior approval of the Supervisor.

A.07 Land Grading

The land grading shall include the supply of all labourers, materials and tools, excavating, hauling and filling the excavated soils, planning and finishing the ground surface, and other incidental operations pertaining to land grading works as directed by the Supervisor.

The land grading operation shall generally include the followings:

- (1) Cut of high places, haulage, fill in low places in each land-grading plot to adjust the inclinations and levels in each plot as directed by the Supervisor.
- (2) Cut, haulage, heaping of suitable materials for construction extracted from land grading plot as directed by the Supervisor.
- (3) Planning and finishing to remove any difference in levels and to obtain a surface totally smooth and inclined to the satisfaction of the Supervisor.

B. CONCRETE WORKS

B.01 Cement

The Cement to be used throughout the Works shall be ordinary Portland cement and shall be provided to the Contractor by the Supervisor. The Portland cement shall comply with the requirements of JIS "Ordinary Portland Cement" or its equivalent.

B.02 Storage of Cement on the Works

Immediately after the cement is handed over to the Contractor, it shall be stored in a dry, weathertight, properly ventilated structure, to adequately prevent absorption of moisture. The Contractor's method of handling and storing cement shall be subject to the approval of the Supervisor.

B.03 Concrete Aggregate

All concrete aggregates are to be obtained from sources approved by the Supervisor. They shall be free from earth, clay, chalk, lime, loam, soft clayey shaley or decomposed stone, vegetable and organic matter and other impurities. The stone shall be hard and dense.

B.04 Coarse Aggregates

The nominal sizes of the coarse aggregate in structural concrete shall be 38 millimeters, except where otherwise specified. The coarse aggregate; as far as practicable, shall conform to the grading requirements.

B.05 Fine Aggregate

Grading of the fine aggregate as delivered to the mixer, as far as practicable, shall conform to the requirements.

B.06 Storage of Aggregates

Provision shall be made on the site for the separate storage of fine and coarse aggregates, as well as of each size of coarse aggregate, in such a manner as to avoid the contamination of the concrete by foreign material and to prevent segregation and excessive breakage; stockpiles shall be provided with suitable drainage facilities to ensure, as far as practicable, that the aggregates delivered to the batching equipment shall have the uniform and stable moisture content directed by the Supervisor. Aggregates shall, during not weather, be covered to protect them from the direct rays of the sun.

B.07 Mixing Water

Water for mixing concrete, mortar, and rendering shall be subject to the approval of the Supervisor. It shall be clean, fresh and free from oil, acid, alkali, sugar and vegetable substances, and it shall, be free of organic or inorganic matter in solution or suspension in such amount that it may impair their strength, appearance of durability.

B.08 Concrete Mixer

Concrete shall consist of cement, graded aggregates and water thoroughly mixed and compacted to provide strengths as detailed below.

Type of Concrete Mix	Maximum Size of Aggregate	Specified Compressive Strength at 28 Days
1:2:4	38 mm	180 kg/cm ²
1:3:6	38 mm	120 kg/cm ²

Type of concrete mix is indicated by the volumetric proportions of cement, fine aggregate and coarse aggregate. The mix proportions shown in the table above are given as a guide to the mixes ordinarily needed to achieve the specified strengths and shall not relieve the Contractor of the responsibility to obtain the specified strengths.

B.09 Batching

The aggregates and cement may be proportioned by volume in accurately calibrated gauge boxes unless otherwise directed by the Supervisor.

B.10 Mixing Concrete by Machine

The materials for concrete shall be mixed in an approved mechanical mixer. The mixing time for each batch shall not be less than the minimum mixing time, shall not exceed three (3) times the minimum time, and shall be constant for a series of batches of concrete for a particular structure.

The mixer shall not be loaded beyond their rated capacity, nor shall they be operated at a speed in excess of that recommended by the manufacturer. They shall produce a concrete of uniform consistency and appearance, at a continuous rate approved by the Supervisor.

All mixing equipment shall be clean before commencing mixing, and shall be kept free from set concrete.

B.11 Mixing Concrete by Hand

Where it is not possible to employ machine mixing and approval has been obtained from the Supervisor, concrete shall be mixed by hand, as near as practicable to the site where it is to be deposited. Clean mixing bankers or platforms of sufficient areas for the proper execution of the Work shall be provided. These platforms if constructed of timber shall consist of plants closely jointed so as to avoid the loss of any grout or liquid from the wet concrete. The whole of the aggregate and

cement shall be turned over on the banker in a dry state at least twice. The water shall then be added gradually through a rose head, after which the materials shall again be entirely turned over in a wet state at least three (3) times before leaving the banker.

B.12 Protected Concreting in Unfavorable Weather

No concreting will be allowed in the open during storms or heavy rains. All concreting materials and plant are to be adequately protected against the effects of heavy storms and strong winds.

B.13 No Partially Set Material to be Used

All concrete and mortar must be placed and compacted within 30-minutes of its being mixed: no partially set material shall be used in the Work.

B.14 Depositing Concrete

The arrangements for placing concrete are to be such that in all cases the material may be conveniently handled and placed in the required position as directed by the Supervisor without re-handling or segregation. Wherever possible the concrete is to be deposited from bottom opening skips and in all cases shall be deposited in layers of such depth that each layer can be easily incorporated with the layer below with the use of internal vibrators or by spading, slicing, and ramming. Concrete shall not be delivered by chute or dropped from barrows or otherwise handled through a height greater than 1.5 meters except with the approval of the Supervisor who may order the concrete to be dropped on to a banker to be turned over by hand before being placed.

The area on which any concrete is to be deposited must be made and maintained free from standing water during concreting operations unless otherwise approved. Running water crossing or entering such areas must be brought under control before concreting proceeds.

Concrete in reinforced concrete work shall be deposited in small quantities in a plastic state with a water cement ratio to give the specified strength. The depositing of concrete in individual member shall be continued without stoppage up to an approved pre-arranged construction joint or until the member is completed and shall be finished off in such manner that the junction of members shall be monolithic unless otherwise specified.

B.15 Compaction of Concrete

Concrete shall, during placing, be compacted by vibrators or any other compaction tool of approved type. Compaction shall continue until the concrete being placed shall be judged to be compacted by the appearance of a blistering and even surface except for slight irregularities where the coarse aggregate break through. All air shall this time be expelled.

B.16 Curing and Protection

The Contractor shall take adequate measures to ensure that the concrete is cured. These shall include covering the concrete with burlap matting or other effective means which shall be kept damp continuously for a minimum period of three (3) days after casting or for such other time as the Supervisor may direct. After removal of this covering, the concrete shall then be sprayed with water for a minimum period of a further seven (7) days. Other methods of preventing the water of hydration in the concrete from evaporating may be used with the approval of the Supervisor.

All concrete liable to be affected by running water or wave action shall be adequately protected from damage during the setting period and all temporary protective works shall be erected to the satisfaction of the Supervisor.

B.17 Embedded Items

Before placing concrete, care shall be taken to determine that all embedded items are securely fastened in place as shown on the Drawings or as otherwise directed. All embedded items shall be thoroughly clean and free from oil and other foreign matter, such as loose coatings of rust, paint, scale, mortar, etc. The embedding of wood in concrete shall be prohibited unless specifically authorized.

Any pipelines or other materials embedded in structures under the Contract, as construction expedients, shall conform to the above requirements and upon completion of their use, shall be backfilled with concrete at no extra cost to the Employer.

B.18 Formwork

Forms shall be used, wherever necessary, to confine the concrete and shape it to the required lines. All exposed concrete surface having slopes steeper than 1:1 shall be formed, unless otherwise directed or approved by the Supervisor.

Forms shall be simple; they shall be rigidly constructed of approved materials and shall be braced and strutted to withstand the pressure resulting from placing and vibrating the concrete, constructional loads, wind and other forces without appreciable deformation.

Surfaces of the forms to be in contact with concrete shall be free from adhering foreign matter, projecting nails and the like, grooves, splits or other defects. Shutting boards shall be carefully jointed and so arranged as to be able to swell under the influence of humidity of the concrete, without causing any deformation to the forms. Interstices shall be properly filled with glazier's putty and the water-proofing of the forms shall be sufficient to prevent escape of cement resulting from excess of water in the concrete. However, paper tamping shall not be used unless otherwise approved by the Supervisor.

A non-staining commercial mineral oil or other approved material shall be applied to the faces of the forms before concreting to prevent adherence to the concrete. Care must be exercised to prevent the material applied to the faces of the forms from coming in contact with the reinforcement, but if this should inadvertently occur, the reinforcement must be cleaned.

When forms have been built and have been prepared ready for concreting, they will be inspected by the Supervisor and no concrete shall be placed until the forms have been approved by him. In order to avoid delays in obtaining approval, the Contractor shall inform the Supervisor, at less 24 hours in advance, of his intention to have the forms ready for inspection.

The Contractor shall take full responsibility that the proper time has elapsed for the concrete to attain sufficient strength before forms are removed. Nevertheless, the forms shall not be struck without the prior approval of the Supervisor, and in any case at least three (3) days shall elapse before forms are struck.

Connections shall be so formed as to permit the easy removal of the forms without hammering, etc., and without the necessity of levering against the surface of the concrete.

B.19 Reinforcing Bar

Reinforcing bar for concrete shall be deformed not-rolled milled steel bars complying with JIS, or its equivalent, and shall be supplied to the Contractor by the Employer as required.

The Contractor's method of handling and storing reinforcing bars shall be subject to the approval of the Supervisor.

B.20 Placing of Reinforcing Bar

The number, size, form and position of all reinforcing steel bars, fabric, ties, links, stirrups and other parts of the reinforcement are to be placed in exact accordance with the Drawings and kept in the correct

position in the forms without displacement during the process of vibrating, tamping and ramming the concrete in place. The Contractor shall provide all necessary distance pieces and space bars at his own cost to maintain the reinforcement in the correct position. Any ties, links or stirrups connecting the bars shall be taunt so that the bars are properly braced, the inside of their curved parts shall be in actual contact with the bars around which they are intended to fit. Bars shall be bound together with the best black annealed mild steel wire which is subject to the Supervisor's approval, and the binding shall be twisted tight with proper pliers. The free ends of the binding wire shall be bend inwards.

The Contractor shall provide, at his own cost and to the approval of the Supervisor, working drawings of all reinforcement accompanied by bending schedules and copies of the orders placed for bars.

Before any steel reinforcement is embedded in the concrete any scale, loose rust, oil, grease or other deleterious matter shall be removed. Partially set concrete which may be adhering to the exposed bars during concreting operations shall likewise be removed.

When reinforcement bar has been placed and is ready for concreting, it will be inspected by the Supervisor and no concrete shall be placed until the reinforcement has been approved by him. The Contractor shall inform the Supervisor at least 24 hours in advance of his intention to have the reinforcement ready for inspection.

The minimum concrete cover of reinforcement bar measured from the outside of the bar shall be 3 centimeters.

C. BRICK WORKS

C.01 Bricks

All bricks shall be of the best quality of their respective kinds; they shall be hard, square, sound, throughly well burnt, true to shape, uniform in size, shape and texture, free from lime and hair cracks with well defined arises, uniform in colour, and clean. They shall be

obtained from manufacturers approved by the Supervisor. The porosity shall in no case exceed 20% by weight but in the case of engineering bricks not more than 5% will be allowed. Facing bricks shall, except where otherwise directed, be approved red engineering bricks of the best quality; they shall be of slightly larger dimensions than the brick used for internal work in order to allow neat joints to be formed on the face. Before any order for bricks is placed by the Contractor samples must be submitted to the Supervisor for his approval, together with the name of the manufacturer. Any consignment of bricks delivered on the Works must be equal in every respect to the approved samples submitted. Hand labour shall be employed in discharging and stacking bricks on delivery. No broken, chipped or bats shall be brought on to the Site.

C.02 Cement Mortar

Cement mortar for brick works shall be, unless otherwise specified, Portland cement and sand mixed in the volumetric proportion of 1:3. The size of sand shall be less than 2.5 millimeters. The constituent materials shall be accurately gauged and mixed in an approved manner.

The cement mortar shall be made in small quantities only as and when required, and any mortar which has begun to set or which has been mixed for a period of more than one hour shall be rejected.

C.03 Wet Brick Masonry

Wet brick masonry work shall be built in level courses with bricks of the quality or description specified and to the dimensions shown on the Drawings. Walls are to be carried up in a uniform manner and no one portion raised more than one (1) meter above another at one time, the open end being racked up and no toothed. All perpendes are to be kept strictly plumb and square and the whole properly bonded together so that there are no continuous vertical joints through any two courses of brick work. No broken bricks will be allowed except where necessary to form proper bond. The net brick masonry, where one brick thick or over, shall, unless otherwise directed, or approved, be laid in English bond. All arching, inverting and circular lining is to be built in rings 10-centimeters thick.

Immediately before use bricks are to be immersed in fresh water and thoroughly wetted to the satisfaction of the Supervisor; before continuing partly completed work, the exposed bed shall likewise be wetted. All beds and joints are to be completely filled with cement mortar notwithstanding any local or common custom to the contrary. All brick works are specified to be pointed unless otherwise specified. The face joints shall be raked out to a depth of two (2) centimeters and later refilled with the mortar specified by the Supervisor for each individual case and ironed in to give a neat finished surface. Faces of brick work due to be plastered shall have joints raked out and left open to form a key for plastering. All face works shall be built from scaffolding on the outside and in no case shall face work be built overhand unless specially authorized by the Supervisor. The brick faces of all arches are to be cleaned off after the centres have been struck and the joints left flush with the face.

The laying of brick work is not to be carried out during storms or heavy rain.

C.04 Dry Brick Masonry

Dry brick masonry shall be performed at the location, with thickness and in a manner as shown on the Drawings or as directed by the Supervisor. Bricks used for dry brick masonry shall be of the quality for wet brick masonry specified in Clause C.01 or as directed by the Supervisor.

Bricks shall be placed so that firm foundation is achieved to the satisfaction of the Supervisor.

No broken bricks shall be allowed except where necessary to form proper bond. The manners and methods of placing bricks shall be those directed by the Supervisor.

D. PIPE WORKS FOR IRRIGATION PIPELINE

D.01 General

Rigid polyvinyl chloride (PVC) pipes as well as necessary equipment and fittings to be installed for irrigation pipelines such as Main Irrigation Pipeline, Branch Irrigation Pipelines shall be supplied to the Contractor by the Employer free of charge. These equipment and materials are listed in the General Specifications.

PVC pipe will comply with VP (10 kg/cm²) of JIS K 6741 (Rigid Polyvinyl Chloride Pipe) as shown on the Drawings. The fitting of pipe will comply with JIS K 6743 (Rigid Polyvinyl Chloride Pipe Fitting for Water Works) as solvent welding socket (TS joint).

The installation of irrigation pipelines shall be carried out in accordance with the details shown on the Drawings and the instruction given by the Supervisor.

D.02 Pipe Bedding

The Contractor shall lay pipes not less than 100 centimeters below the ground surface as shown on the Drawings or as directed by the Supervisor. The bedding material of sand below the pipes shall be placed in accordance with the Drawings and shall be well compacted to the satisfaction of the Supervisor.

D.03 Pipe Jointing

Before the pipes are jointed together, the Contractor shall inspect for any damage to the pipes and clean the inside and outside parts of the pipe ends and the joints as directed by the Supervisor. If a TS joint is used, adhesive shall be applied to the pipe to be carefully inserted into the TS joint and held for 30 to 50 seconds.

D.04 Excavation and Backfilling for Trenches

Excavation and backfill of trenches shall be carried out in accordance with Clauses A.03 and A.05, respectively.

D.05 Installation of Appurtenance

The Contractor shall install appurtenance such as air valves, sluice valves and hydrants under the instruction of the Supervisor.

D.06 Field Testing

Before backfilling trenches, all pipelines and their appurtenance shall be tested at the Site to ensure proper water tightness. Field tests shall be performed by the Contractor under the direction of the Supervisor. The Contractor shall prepare all necessary instrument required by the Supervisor for the proper testing of pipelines.

The maximum allowable quantity of leakage per one (1) centimeter of diameter and one (1) kilometer of length shall be 100 liter/day in the pipeline.

Defects found from the above-mentioned tests shall be investigated and shall be repaired immediately at the expense of the Contractor.

After the water conduction tests, the pipelines shall be drained completely and carefully to a safe place such as drainage canal by the Contractor with the approval of the Supervisor.

(5) Bill of Quantities

Bill of Quantities

Summary

Section	Total Amount (Japanese Yen)
A. Earthwork for pipeline	
B. Pipe laying	
C. Installation of valves	
D. Installation of dripline	
E. Installation of control heads	
F. Construction of sluice valve hole	
G. Construction of air valve hole	
H. Construction of scour valve hole	
I. Construction of metering valve hole	
J. Appurtenant work	
Grand Total	

Section A. Earthwork for pipeline

No.	Work	Unit	Q'ty	Unit Price (¥)	Amount (¥)
A.1	Excavation	m ³	2,699.4		
A.2	Backfilling	m ³	2,573.3		
A.3	Sand bed	m ³	117.4		
A.4	Disposal of spoil soil	m ³	126.1		

Total Section A

Section B. Pipe laying

No.	Work	Unit	Q'ty	Unit Price (₹)	Amount (₹)
B.1	Pipe laying ϕ 125	m	40		
B.2	do. ϕ 100	m	557		
B.3	do. ϕ 75	m	471		
B.4	do. ϕ 50	m	807		
B.5	do. ϕ 40	m	23		
B.6	do. ϕ 25	m	236		
Total Section B			(m)	(2,134)	

Section C. Installation of valves

No.	Work		Unit	Q'ty	Unit Price (¥)	Amount (¥)
C.1	Installation of sluice valve	∅100	No.	3		
C.2	do.	∅ 75	No.	1		
C.3	do.	∅ 50	No.	1		
C.4	Installation of scour valve	∅ 50	No.	9		
C.5	Installation of air valve	∅ 50	No.	5		
C.6	Installation of filter	∅150	No.	1		
C.7	do.	∅ 75	No.	1		
C.8	Installation of small valve	∅ 40	No.	1		
C.9	do.	∅ 25	No.	86		
C.10	Installation of metering valve	∅ 75	No.	4		
C.11	do.	∅ 50	No.	2		
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Total Section C						
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Section D. Installation of dripline

No.	Work	Unit	Q'ty	Unit Price (¥)	Amount (¥)
D.1	Plot A	ha	0.76		
D.2	Plot B	ha	1.12		
D.3	Plot C	ha	0.67		
D.4	Plot D	ha	1.26		
D.5	Vinylhouse E1	ha	0.32		
D.6	Vinylhouse F	ha	0.39		
Total Section D		(ha)	(4.52)		

Section E. Installation of control head

No.	Work	Unit	Q'ty	Unit Price (¥)	Amount (¥)
E.1	Plot A	set	2		
E.2	Plot B	set	5		
E.3	Plot C	set	2		
E.4	Plot D	set	5		
E.5	Plot E2	set	2		
E.6	Plot G1	set	2		
E.7	Plot G2	set	3		
E.8	Plot I	set	4		
E.9	Plot J	set	5		
Total Section E		(set)	(30)		

Section F. Construction of sluice valve hole

No.	Work		Unit	Q'ty	Unit Price (¥)	Amount (¥)
F.1	Construction of sluice valve hole	ø100	No.	3		
F.2	do.	ø 75	No.	1		
F.3	do.	ø 50	No.	1		
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Total Section F						
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Section G. Construction of air valve hole

No.	Work	Unit	Q'ty	Unit Price (¥)	Amount (¥)
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G.1	Construction of air valve hole $\phi 50$	No.	3		
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Total Section G

Section H. Construction of scour valve hole

No.	Work	Unit	Q'ty	Unit Price (₹)	Amount (₹)
H.1	Construction of scour valve hole	No.	9		
H.2	Construction of drain pit	No.	9		
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Total Section H					
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Section I. Construction of metering valve hole

No.	Work	Unit	Q'ty	Unit Price (₹)	Amount (₹)
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I.1	Construction of metering valve hole	ø75 No.	4		
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I.2	do.	ø50 No.	2		
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Total Section I

Section J. Appurtenant work

No.	Work	Unit	Q'ty	Unit Price (¥)	Amount (¥)
J.1	Pipeline protection work	m ³	3.2		
J.2	Road arrangement	m ²	50		
J.3	Drainage canal arrangement	L.S.	1		
J.4	Installation of water level gauge	L.S.	1		
J.5	Filter protection work ϕ 150	No.	1		
J.6	do.	ϕ 75	No.	1	
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Total Section J					

(6) Specifications for Procurement of Materials for Irrigation System (Draft)

1. RIGID POLYVINYL CHLORIDE (PVC) PIPES

PVC pipes shall comply with nominal pressure (10kg/cm²:VP) and be conformed to JIS K6741 or equivalent. PVC pipes under 2" shall be plain ended pipes and pipes over 3" shall be pipes with solvent weld socket.

2. RIGID POLYVINYL CHLORIDE (PVC) FITTINGS

PVC fittings shall be conformed to JIS K6743 (TS fittings) or equivalent.

3. FLANGE JOINTS

Flange joints shall sustain a maximum working pressure of 10.0 kg/cm² in safety. Dimension of flange shall meet that of JIS 10 kg/cm² flange.

4. STEEL PIPES

Steel pipes shall be galvanized steel pipe for water service and be conformed to JIS G3442 or equivalent.

5. AUTOMATIC SHUT-OFF METERING VALVE (2" & 3")

Globe-pattern, diaphragm actuated hydraulic valve with automatic shut-off mechanism, flow indicator and totaliser. The valve combines a woltman type water meter and a diaphragm actuated hydraulic valve in one body, and automatically shuts off after delivering a pre-set volume of water.

Working pressure range: 0.7 - 10.0 kg/cm²
Material: Cast Iron

6. 90° ANGLE VALVE, 360° SWIVELLED (1" & 2")

Angle pattern 360° swivelled manual valve, with female thread connection for inlet, and quick coupler for outlet.

Max. pressure: 10 kg/cm²
Material: Cast aluminum for body

7. AUTOMATIC AIR RELEASE VALVE (2")

Heavy duty plastic and zamac construction, male thread connection.

Working pressure range: 0.1 - 12 kg/cm²

8. PRESSURE REDUCING VALVE (1.12" & 3/4")

The pressure reducing valve, direct acting, maintains a fixed pressure on the downstream. Can be set in the field to any desired downstream operating pressure.

Max. inlet pressure: 12 kg/cm²
 Flow rate range: 1.1/2" ... 0.5 - 18.0 m³/hr
 3/4" ... 0 - 5.5 m³/hr
 Connection: Female threads

9. METAL FILTER (6" & 3")

The filter consists of y-pattern steel housing and a 3-D grooved disc element for in-depth high retention capacity of fine and coarse particles.

	6"	3"
Max. Inlet pressure:	10 kg/cm ²	10 kg/cm ²
Max. flow rate:	160 m ³ /hr.	50 m ³ /hr.
Effective filter area:	390 cm ²	1500 cm ²
Mesh size:	#120 - #155	#120 - #155
Distance inlet & outlet:	49.5 cm	75 cm
Weight:	25.0 kg	75 kg

10. SPRINKLER HEAD

Cast bronze construction, designed with a larger water passage, stainless steel fulcrum pin, hammer spring ensures trouble-free performance under the most difficult conditions and a long working life.

Nozzles: 3.6 x 2.4 (mm), 4.0 x 2.4 (mm)
 Pressure: 2.5 kg/cm²
 Discharge rate: 18.2 L/min., 21.7 L/min.
 Connection: 3/4" male thread

11. DRIPLINE

The dripline is produced in 16 mm diameters with self-regulating drippers of liter/hr nominal discharge.

Space between drippers: 0.4 meter
 Recommended working pressure: 0.75 - 2.5 kg/cm²
 Nominal diameter: 16 mm
 Material: Polyethylene
 Max. Possible lateral length: More than 100 meters (in flat area, and max. flow rate difference along the lateral - within 10 5)

12. FERTILIZER & CHEMICAL INJECTOR

The injector needs no external power supply since the linear hydraulic motor contained within the unit is powered by the line pressure.

Injection rate: upto 320 liters/hr. according to the line pressure
 Min. working pressure: 0.5 kg/cm²
 Max. working pressure: 8.0 kg/cm²
 Water consumption: 3 times the quantity of chemical injected

13. POLYETHYLENE TUBE, LOW DENSITY

Pe tube JIS-6761-1971
Nominal dia. 2"
Outer dia. 60 mm
Wall thickness 4.0 mm
Weight 0.654 kg/cm²
Burst pressure 14.0 kg/cm²
Max. working pressure 4.6 kg/cm²

14. PORTABLE ALUMINUM IRRIGATION PIPE

Aluminum pipe made of 6063S T5 or equivalent, complete with quick couplers containing self-draining gasket.

Minimum pressure rate: 4.5 kg/cm²
Pipe length: 6.0 meter long

15. MINI-SPRINKLER

Turbo-hammer, low capacity, low angle sprinkler

Nozzle dia. 2.5 mm
Working pressure 2.0 kg/cm²
Discharge rate 4.38 L/min.
Dia. coverage 13 meters
Connection 1/2" female

(7) List of Materials for Irrigation System

LIST OF MATERIALS FOR IRRIGATION SYSTEM - 1

Item	Specifications	Quantity
PVC pipe (VP)	$\phi 125 \times 4 \text{ m}$	11 nos.
	$\phi 100 \times 4 \text{ m}$	147 nos.
	$\phi 75 \times 4 \text{ m}$	122 nos.
	$\phi 50 \times 4 \text{ m}$	208 nos.
	$\phi 40 \times 4 \text{ m}$	7 nos.
	$\phi 25 \times 4 \text{ m}$	76 nos.
PVC socket (TS)	$\phi 50$	203 nos.
	$\phi 40$	7 nos.
	$\phi 25$	54 nos.
PVC reducer (TS)	$\phi 125 \times 100$	1 no.
	$\phi 100 \times 75$	2 nos.
	$\phi 75 \times 50$	14 nos.
	$\phi 50 \times 40$	1 no.
	$\phi 40 \times 25$	1 no.
PVC tee (TS)	$\phi 125 \times 100$	1 no.
	$\phi 100$	1 no.
	$\phi 100 \times 75$	5 nos.
	$\phi 100 \times 50$	6 nos.
	$\phi 75$	5 nos.
	$\phi 75 \times 50$	19 nos.
	$\phi 50$	5 nos.
	$\phi 50 \times 25$	40 nos.
	$\phi 40 \times 25$	2 nos.
$\phi 25$	1 no.	
PVC elbow (TS)	$\phi 125$	1 no.
	$\phi 100$	5 nos.
	$\phi 75$	2 nos.
	$\phi 50$	17 nos.
PVC bend (TS)	$\phi 100 \times 45^\circ$	4 nos.

LIST OF MATERIALS FOR IRRIGATION SYSTEM - 2

Item	Specifications	Quantity
Socket (SGP)	ϕ 25	44 nos.
Elbow (SGP)	ϕ 50	125 nos.
	ϕ 25	83 nos.
Reducing elbow (SGP)	ϕ 50 x 20	28 nos.
Bend (SGP)	ϕ 75 x 45°	16 nos.
	ϕ 50 x 45°	8 nos.
Tee (SGP)	ϕ 50 x 20	60 nos.
	ϕ 50 x 13	4 nos.
	ϕ 40 x 13	30 nos.
	ϕ 20 x 8	41 nos.
Bushing (SGP)	ϕ 50 x 40	60 nos.
	ϕ 25 x 20	41 nos.
	ϕ 13 x 8	30 nos.
Nipple (SGP)	ϕ 50	99 nos.
	ϕ 40	90 nos.
	ϕ 25	41 nos.
	ϕ 20	82 nos.
	ϕ 8	71 nos.
Polyethylene pipe	ϕ 50	420 m
	7/8"	277 m
Dripline	ϕ 16	45,158 m
Drip starter	ϕ 16	570 nos.
Drip adapter	ϕ 16	110 nos.
PIA tee	ϕ 50	14 nos.

LIST OF MATERIALS FOR IRRIGATION SYSTEM - 3

Item	Specifications	Quantity
PLA adapter	ϕ 50	28 nos.
Drip end	ϕ 16	680 nos.
PVC valve socket (TS)	ϕ 75	8 nos.
	ϕ 50	36 nos.
	ϕ 25	45 nos.
Galvanized Steel Pipe	ϕ125 x 2,000 L	2 nos.
	ϕ 75 x 2,000 L	2 nos.
	ϕ 75 x 600 L	8 nos.
	ϕ 75 x 565 L	8 nos.
	ϕ 50 x 5,500 L	1 no.
	ϕ 50 x 1,500 L	1 no.
	ϕ 50 x 1,000 L	30 nos.
	ϕ 50 x 600 L	4 nos.
	ϕ 50 x 565 L	4 nos.
	ϕ 50 x 500 L	63 nos.
	ϕ 25 x 1,500 L	7 nos.
	ϕ 25 x 1,000 L	82 nos.
Ball valve	ϕ 8	71 nos.
	ϕ 20	64 nos.
3-way valve	ϕ 50	30 nos.
PE tee	7/8"	41 nos.
PE elbow	7/8"	82 nos.
Pressure gauge		71 nos.
Angle valve	ϕ 50 x 90°	1 no.
	ϕ 25 x 90°	4 nos.

LIST OF MATERIALS FOR IRRIGATION SYSTEM - 4

Item	Specifications	Quantity
Hose with coupling	∅ 25 x 10 m	1 no.
	∅ 25 x 2.5 m	7 nos.
BC nipple	∅ 25	8 nos.
BC connector	∅ 4	8 nos.
Tube	∅ 4 x 1,200 L	8 nos.
Fiberglas spike	1.0 m	8 nos.
Mini-sprinkler	∅2.5 mm	8 nos.
Cap	∅ 25	1 no.
Filter	6"	1 no.
	3"	1 no.
PVC flange (TS)	∅100	6 nos.
	∅125	2 nos.
	∅ 75	4 nos.
	∅ 50	20 nos.
Elbow with flanges	∅125 x 90°	6 nos.
	∅ 75 x 90°	6 nos.
Pipe with flanges	∅125 x 1,282	2 nos.
	∅125 x 200(with branch)	1 no.
	∅ 75 x 1,409	2 nos.
	∅ 75 x 300	1 no.
	∅ 75 x 200(with branch)	2 nos.
	∅ 75 x 100	4 nos.
Reducer	∅150 x 125	1 no.
	∅150 x 125(with branch)	1 no.

LIST OF MATERIALS FOR IRRIGATION SYSTEM - 5

Item	Specifications	Quantity
Sluice valve with handwheel	ø125	1 no.
	ø 75	5 nos.
	ø 50	40 nos.
	ø 25	41 nos.
	ø 20	1 no.
Air valve	ø 50	5 nos.
Solvent cement	can	5 nos.
Pressure-reducing valve	ø 40	30 nos.
	ø 20	41 nos.
Metering valve	3"	4 nos.
	2"	2 nos.
Flange	ø125	3 nos.
	ø 75	3 nos.
Rabbit coupler	ø 20	64 nos.
Riser saddle	ø100 x 50	2 nos.
Dresser tee	ø 75 x 50	1 no.
Sluice valve without handwheel	ø100	3 nos.
	ø 75	1 no.
	ø 50	1 no.
MF joint	ø125	1 no.
	ø 75	1 no.
Valve key		5 nos.
Scour valve	ø 50	9 nos.

LIST OF MATERIALS FOR IRRIGATION SYSTEM - 6

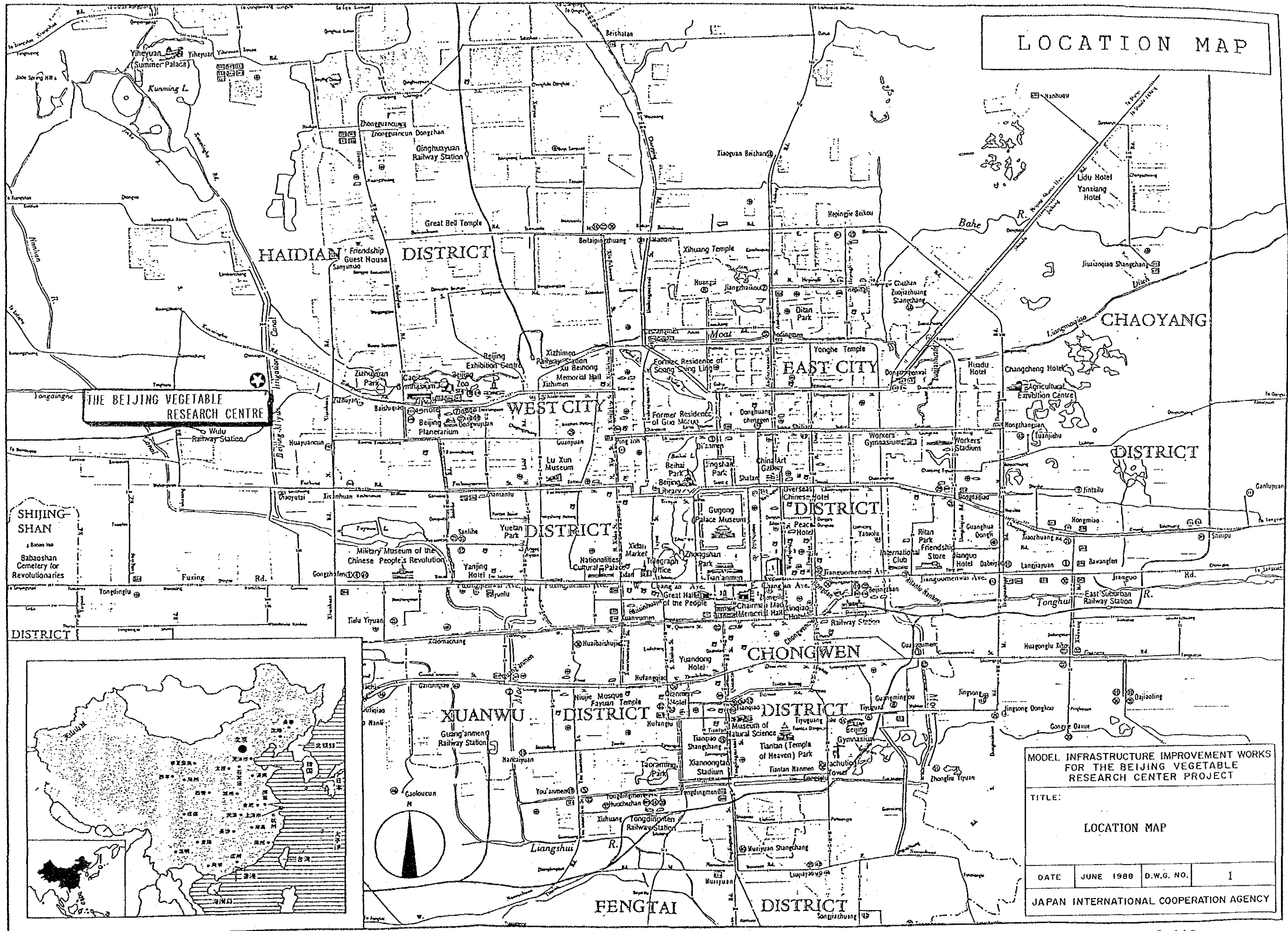
Item	Specifications	Quantity
Quick coupler	ϕ 50	30 nos.
Cap	ϕ 50	30 nos.
New coupler	ϕ 50	30 pair
Delivery hose	ϕ 50 x 2 m	2 nos.
Line tee	ϕ 50 x 90°	2 nos.
Line elbow	ϕ 50 x 90°	2 nos.
Aluminium pipe	ϕ 50 x 6 m	60 nos.
Riser with supports	3/4" x 1 m	28 nos.
Sprinkler head	3.6 x 2.4 mm	28 nos.
End cap		4 nos.
Chemical injector	with hydraulic motor	1 set
Water level gauge	with 3 points	2 sets

(8) List of Drawings

THE BEIJING VEGETABLE RESEARCH CENTRE

LIST OF DRAWINGS

TITLE	
1	LOCATION MAP
2	GENERAL LAYOUT
3	PIPE ARRANGEMENT OF PIPELINE IRRIGATION SYSTEM
4	DRIP IRRIGATION SYSTEM
5	SPRINKLER IRRIGATION SYSTEM
6	HOUSE DRIP IRRIGATION SYSTEM NETHOUSE SPRINKLER IRRIGATION SYSTEM
7	VALVE BOX AND HYDRANT

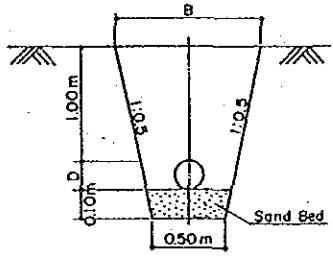
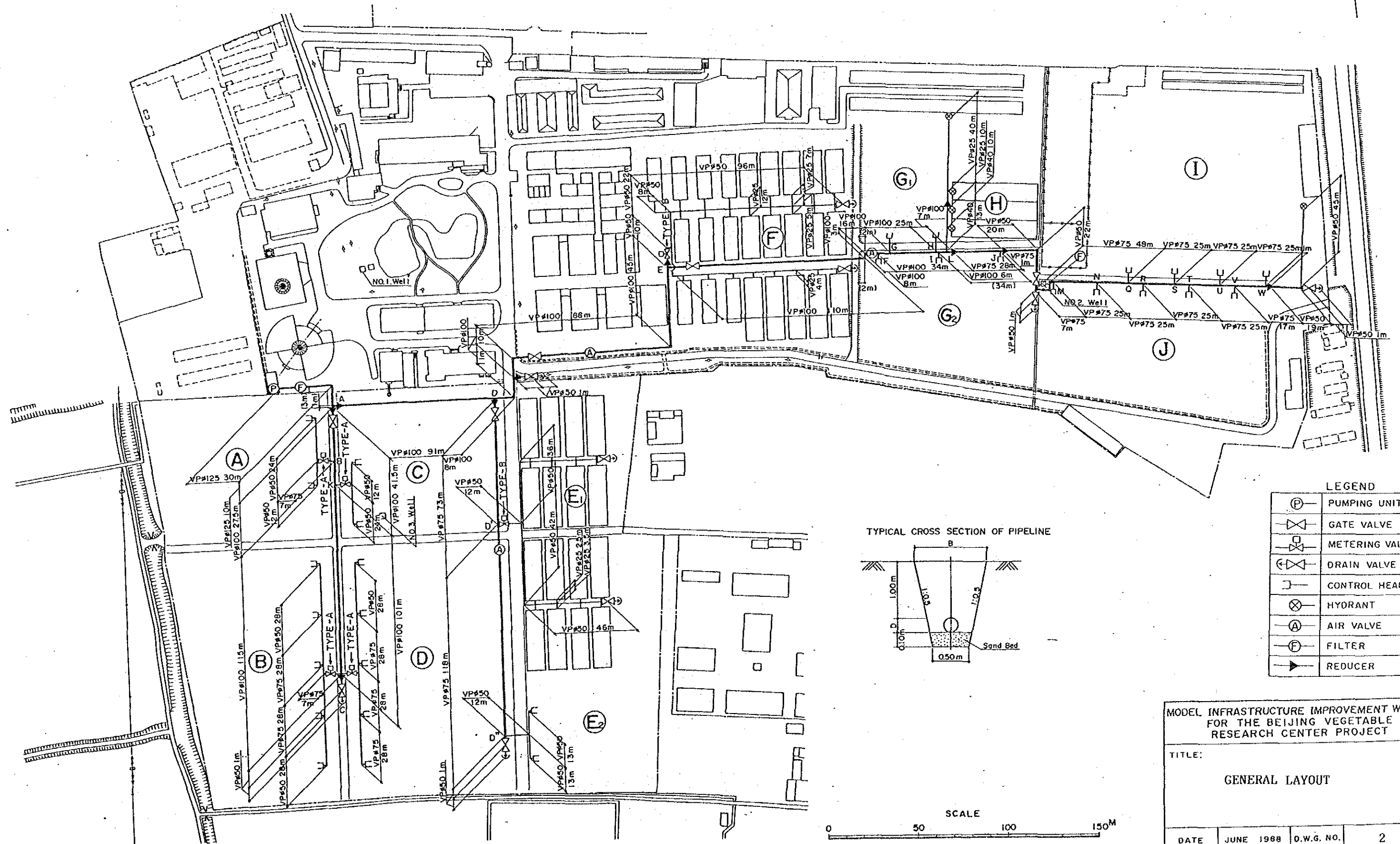
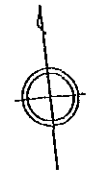


LOCATION MAP

THE BEIJING VEGETABLE RESEARCH CENTRE

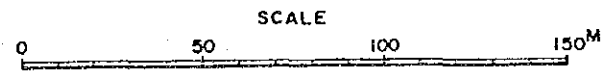
MODEL INFRASTRUCTURE IMPROVEMENT WORKS FOR THE BEIJING VEGETABLE RESEARCH CENTER PROJECT

TITLE:			
LOCATION MAP			
DATE	JUNE 1988	D.W.G. NO.	1
JAPAN INTERNATIONAL COOPERATION AGENCY			



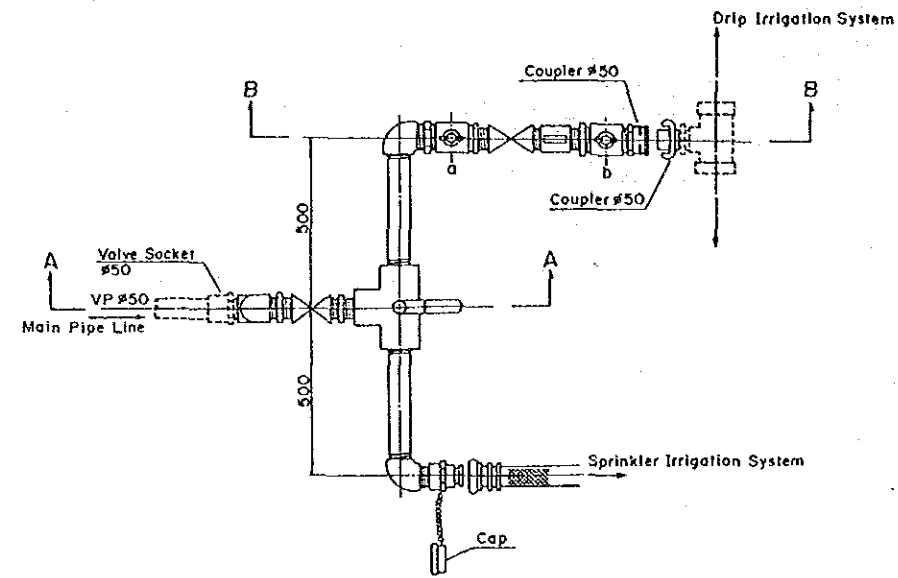
LEGEND

	PUMPING UNIT
	GATE VALVE
	METERING VALVE
	DRAIN VALVE
	CONTROL HEAD
	HYDRANT
	AIR VALVE
	FILTER
	REDUCER

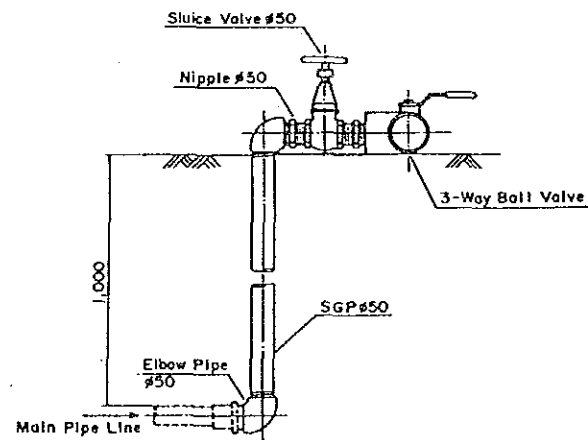


MODEL INFRASTRUCTURE IMPROVEMENT WORKS FOR THE BEIJING VEGETABLE RESEARCH CENTER PROJECT			
TITLE: GENERAL LAYOUT			
DATE	JUNE 1988	O.W.G. NO.	2
JAPAN INTERNATIONAL COOPERATION AGENCY			

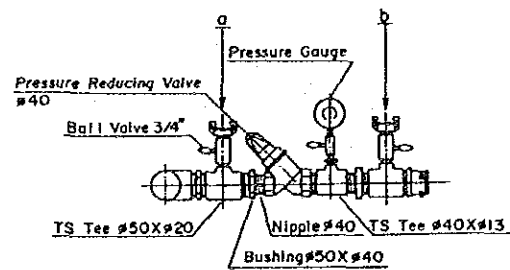
CONTROL HEAD



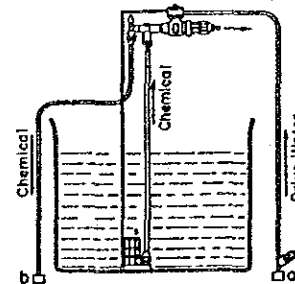
A - A



B - B

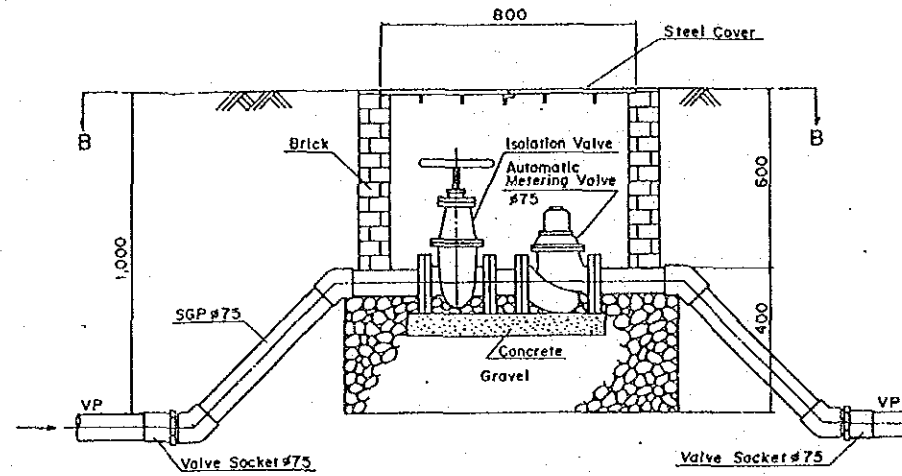


CHEMICAL INJECTOR

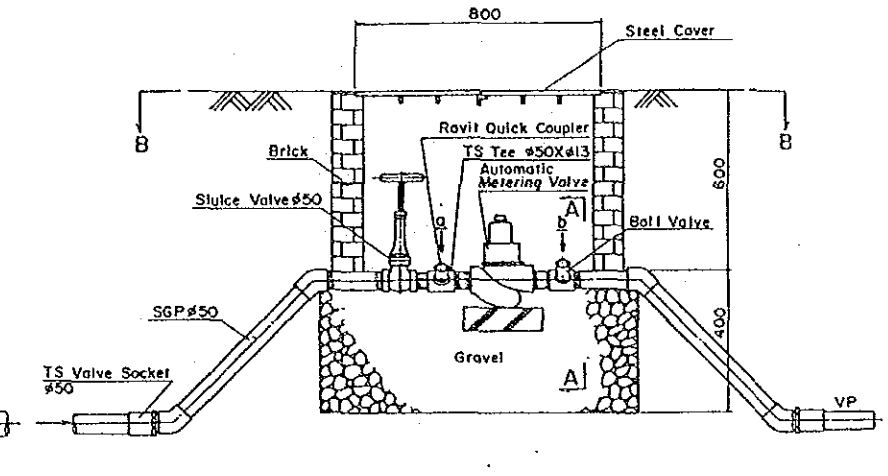


METERING VALVE

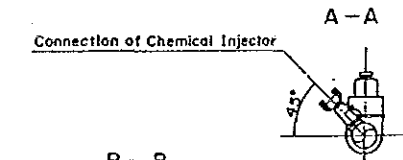
TYPE A



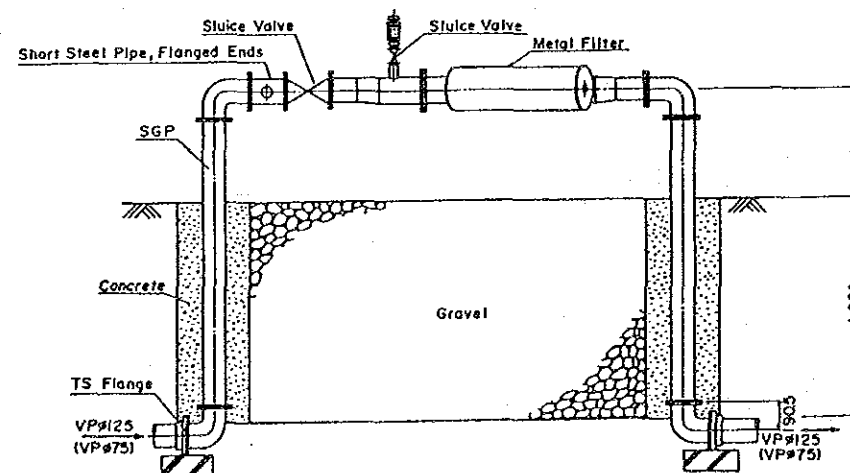
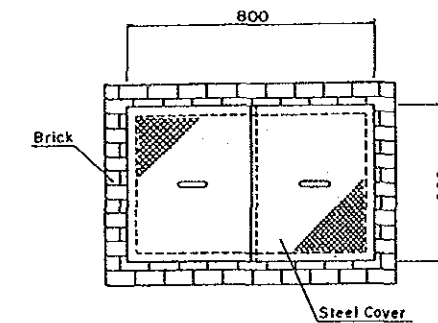
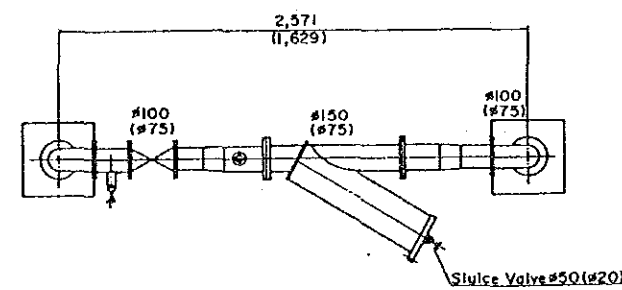
TYPE B



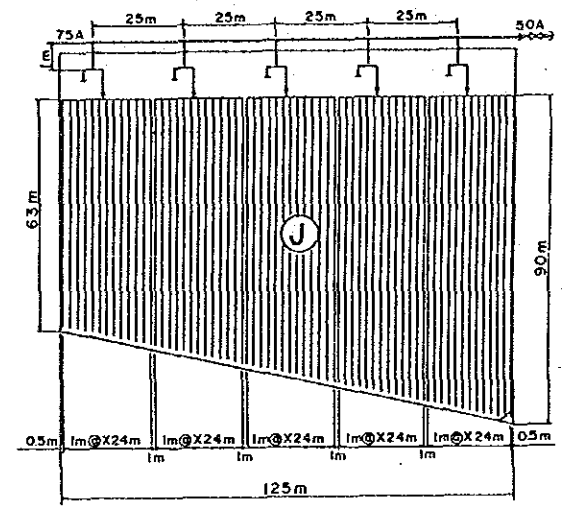
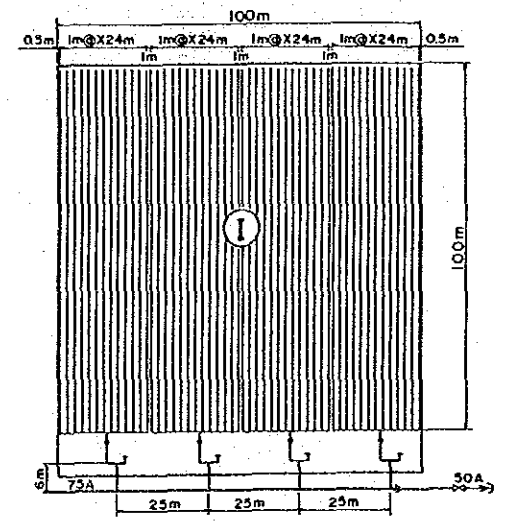
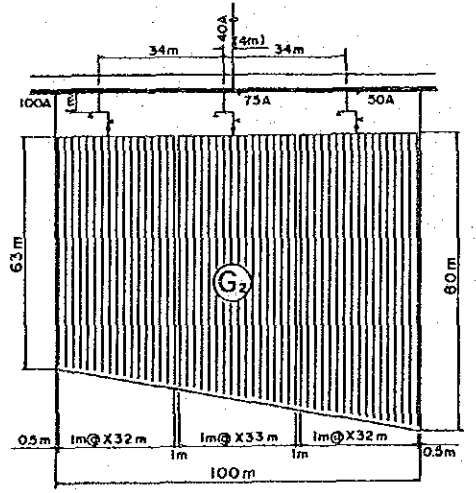
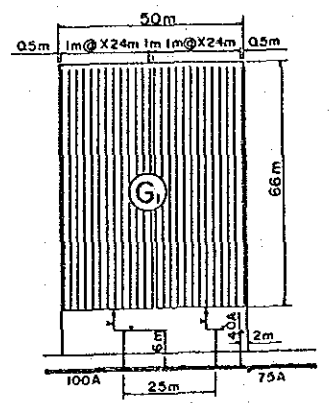
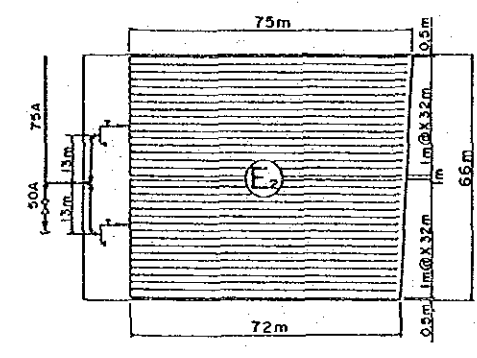
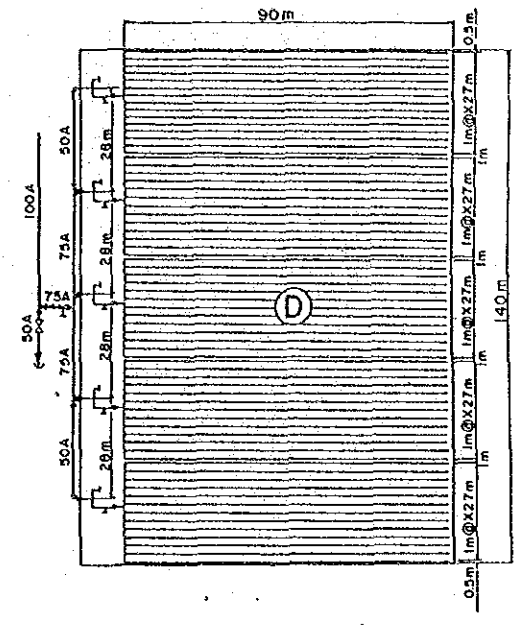
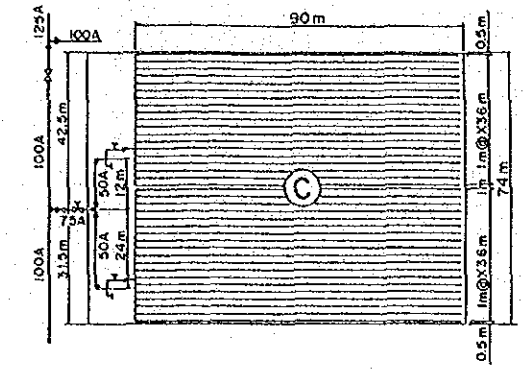
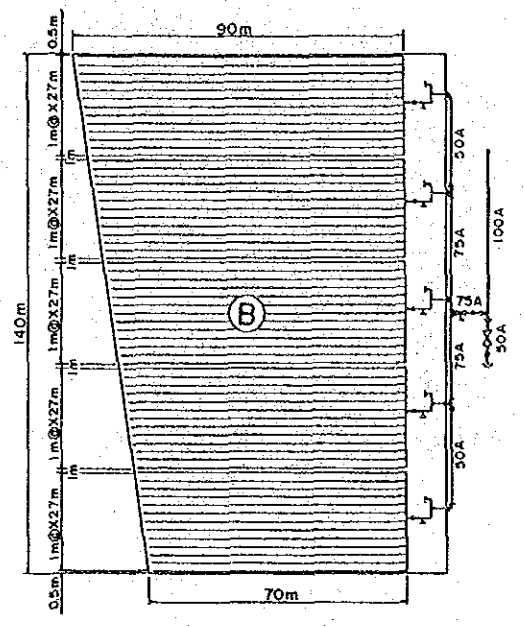
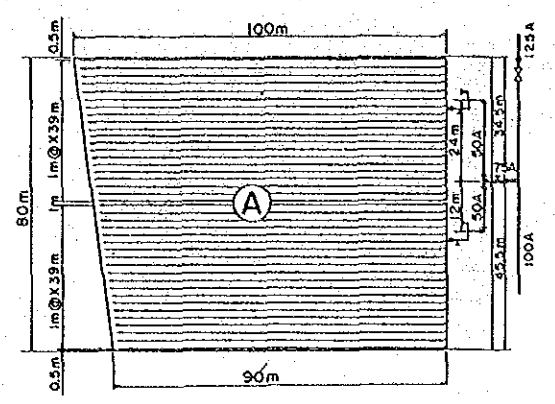
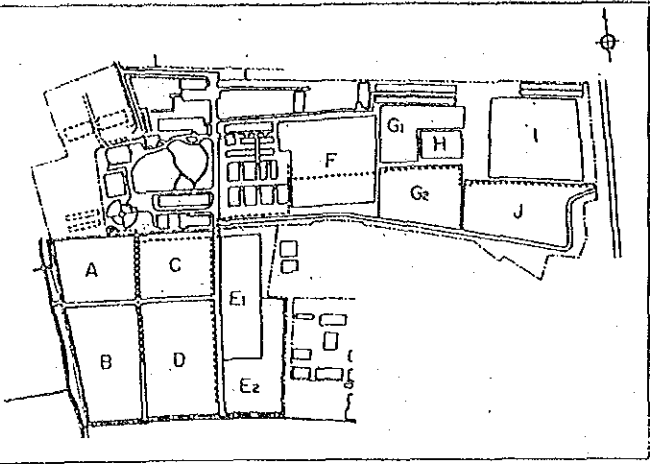
Note: Type A is for plot A, B, C and D.
Type B is for plot E, and F.



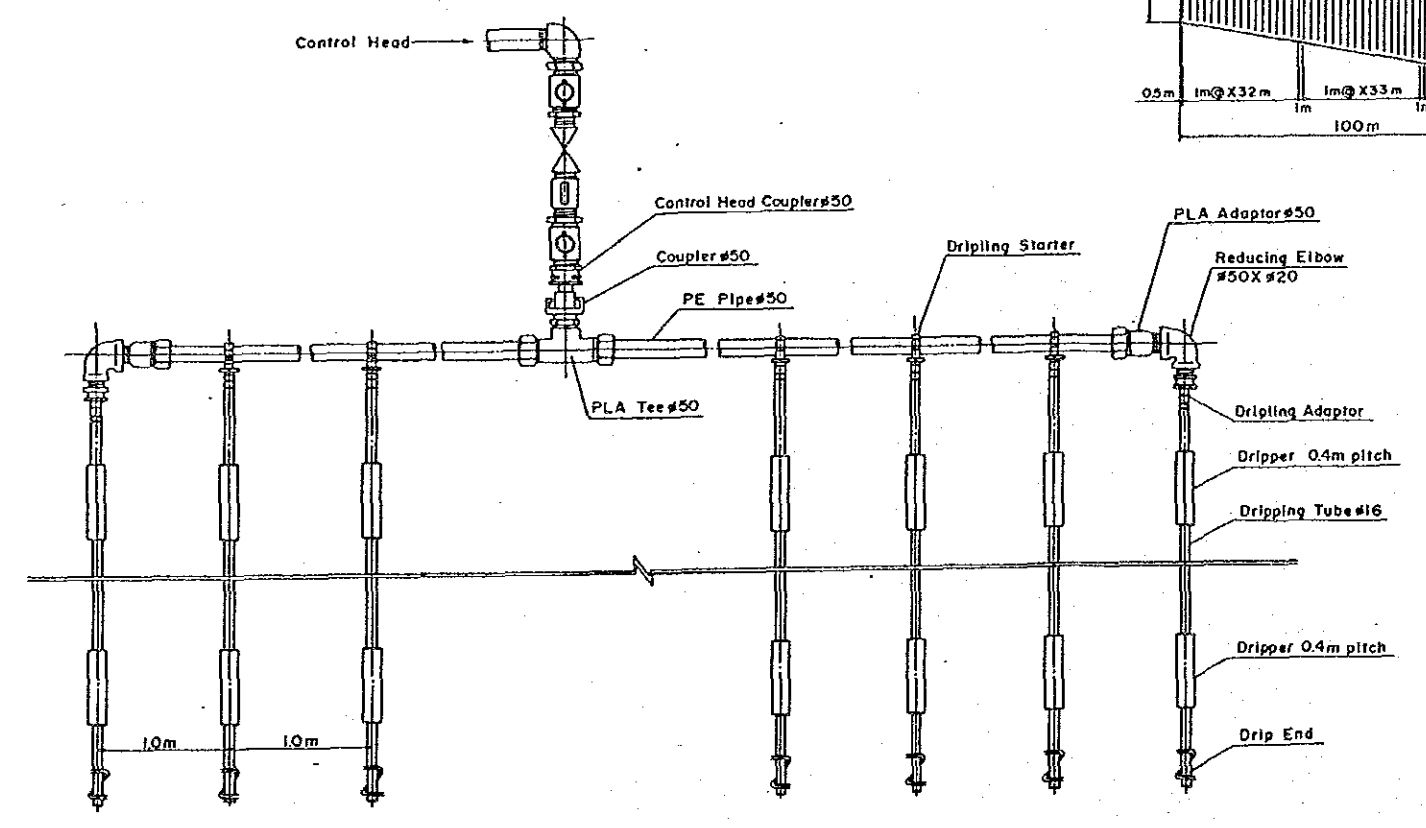
FILTER SYSTEM



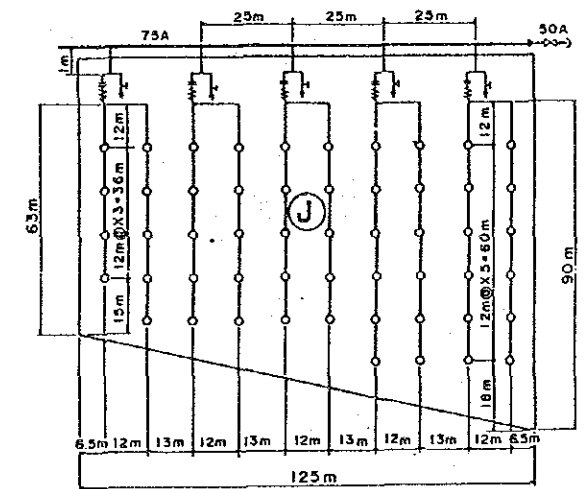
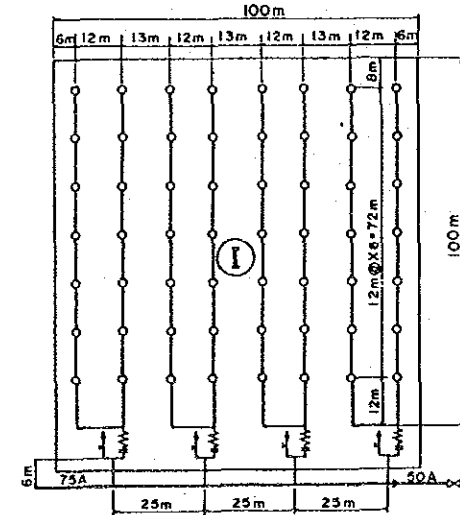
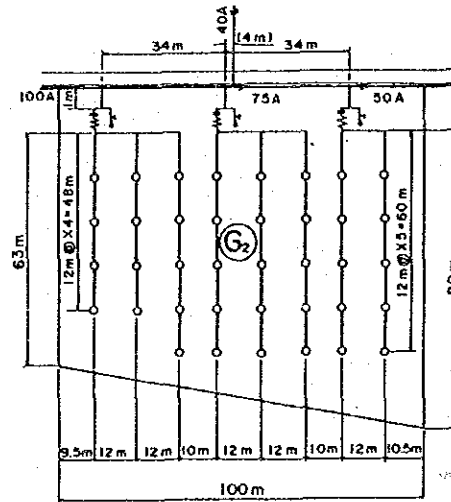
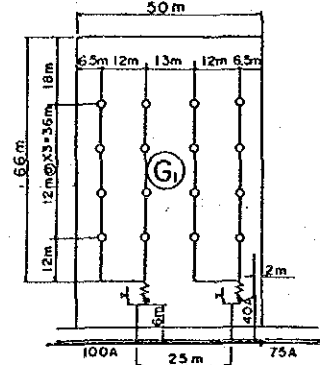
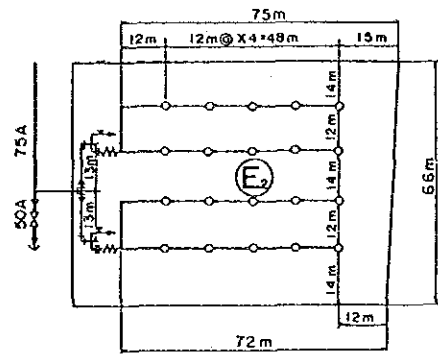
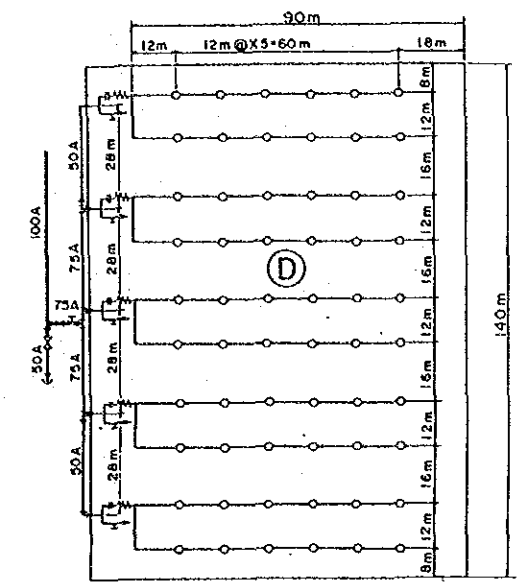
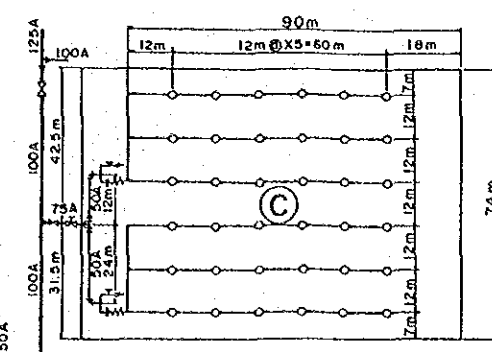
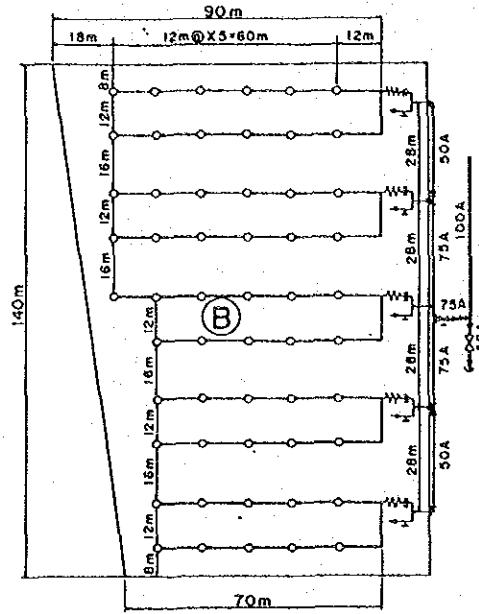
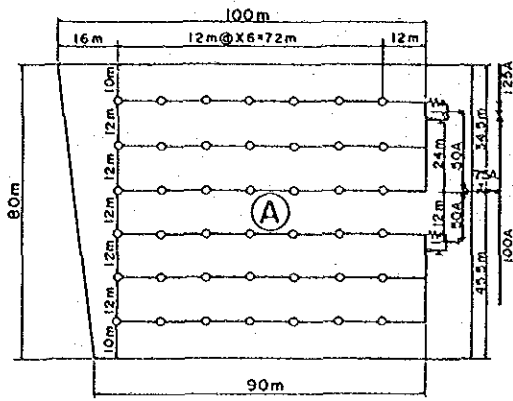
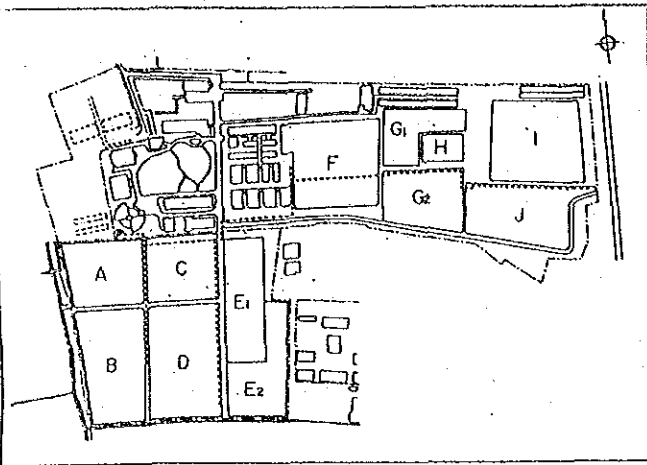
MODEL INFRASTRUCTURE IMPROVEMENT WORKS FOR THE BEIJING VEGETABLE RESEARCH CENTER PROJECT			
TITLE: PIPE ARRANGEMENT OF PIPELINE IRRIGATION SYSTEM			
DATE	JUNE 1988	D.W.G. NO.	3
JAPAN INTERNATIONAL COOPERATION AGENCY			



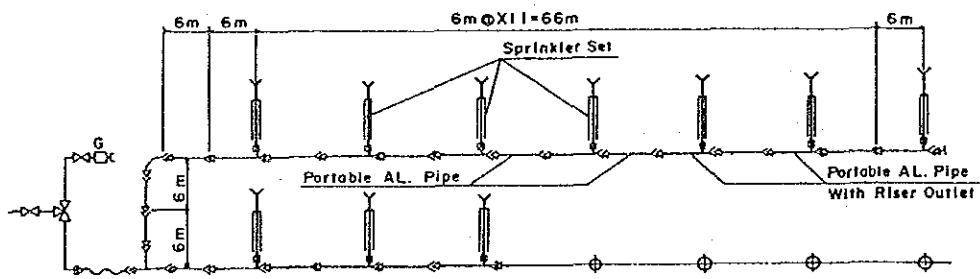
DETAILS OF DRIP LINE



MODEL INFRASTRUCTURE IMPROVEMENT WORKS FOR THE BEIJING VEGETABLE RESEARCH CENTER PROJECT			
TITLE: DRIP IRRIGATION SYSTEM			
DATE	JUNE 1988	D.W.G. NO.	4
JAPAN INTERNATIONAL COOPERATION AGENCY			

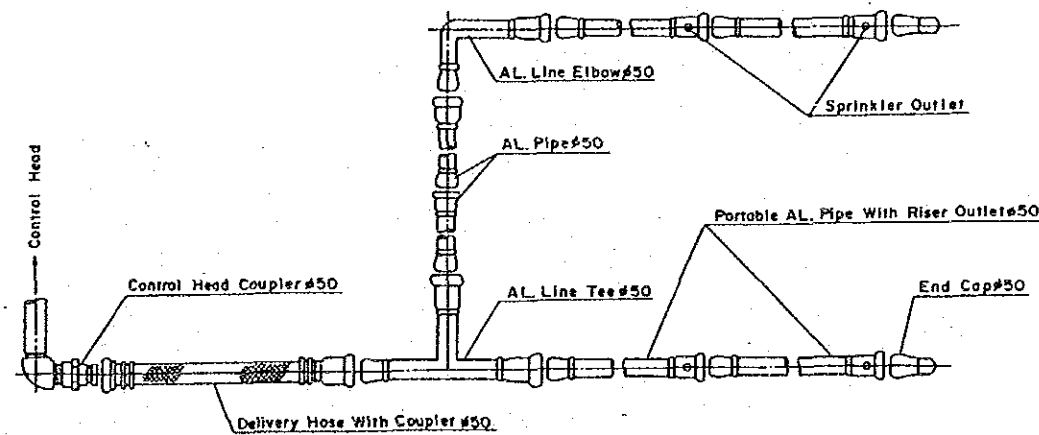
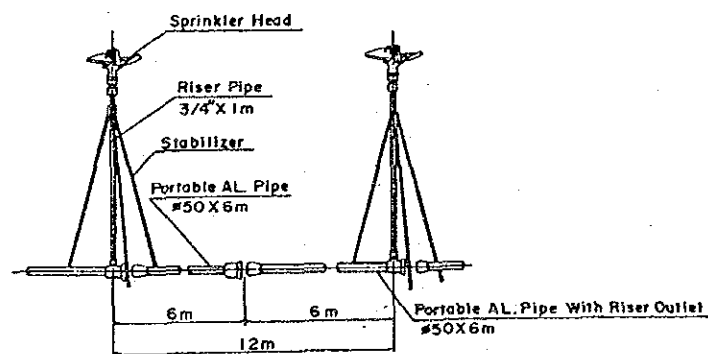


SPRINKLER SYSTEM

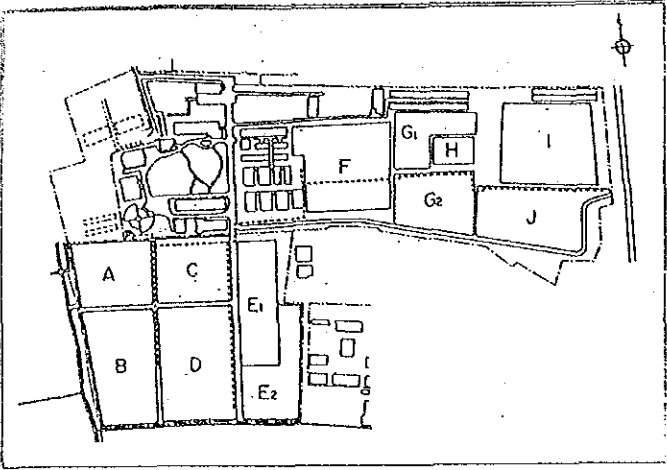


DETAILS OF SPRINKLER PIPE LINE

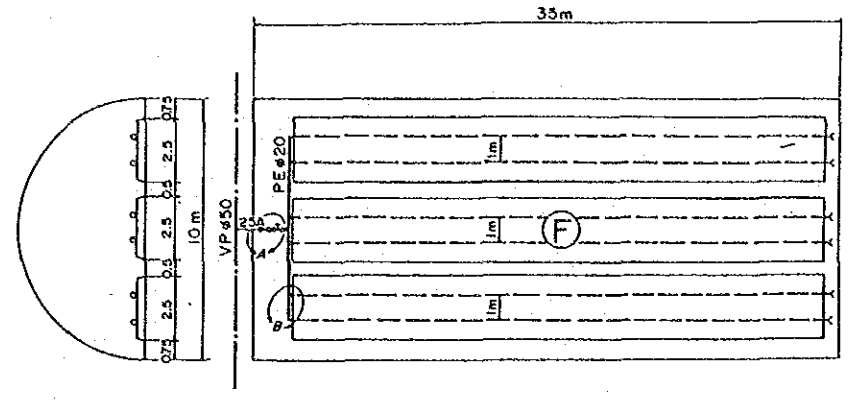
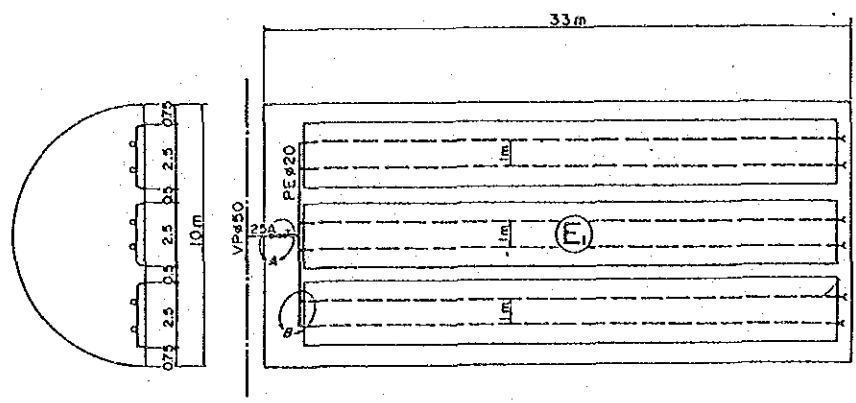
DETAILS OF SPRINKLER



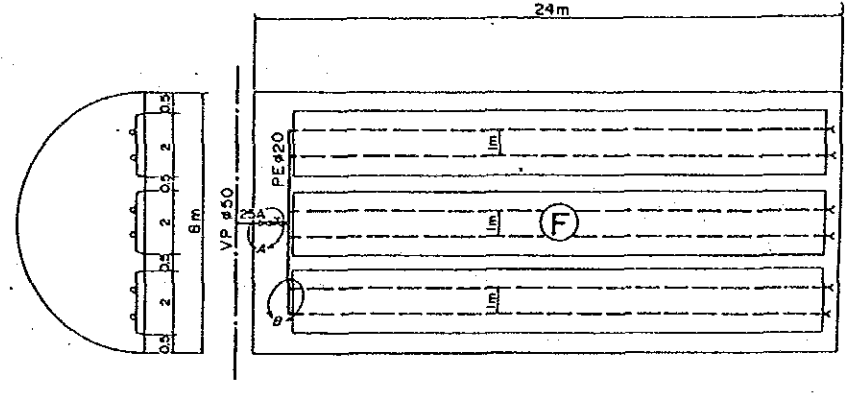
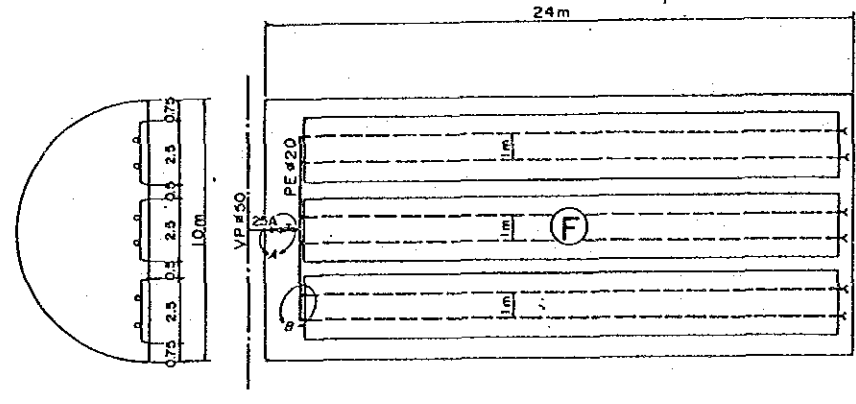
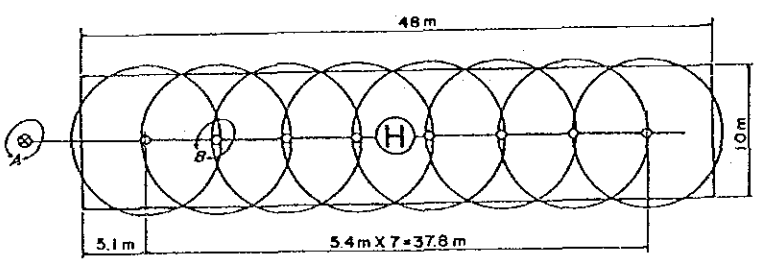
MODEL INFRASTRUCTURE IMPROVEMENT WORKS FOR THE BEIJING VEGETABLE RESEARCH CENTER PROJECT			
TITLE: SPRINKLER IRRIGATION SYSTEM			
DATE	JUNE 1988	D.W.G. NO.	5
JAPAN INTERNATIONAL COOPERATION AGENCY			



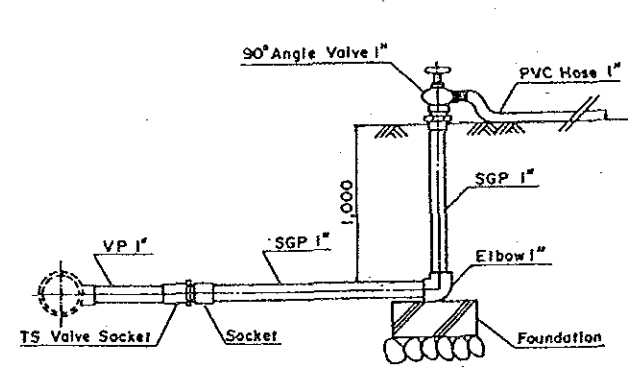
HOUSE DRIPPLING IRRIGATION



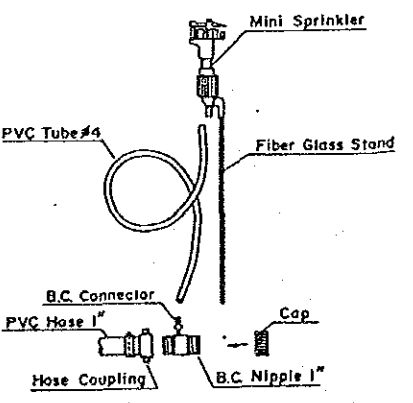
NET HOUSE IRRIGATION SYSTEM



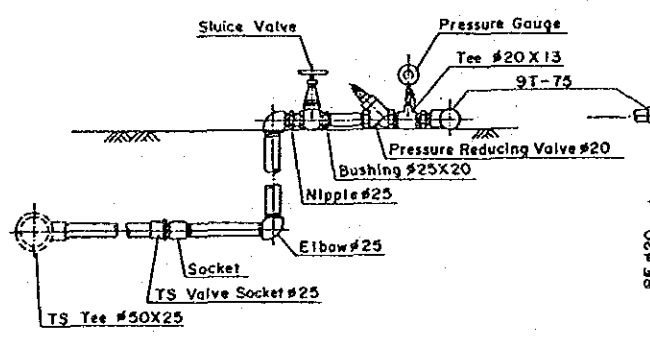
DETAILS A



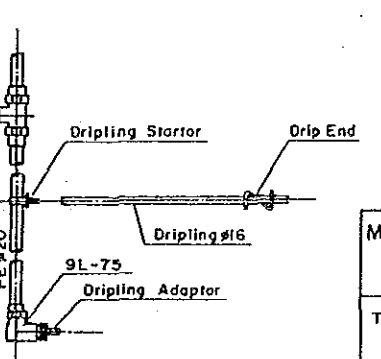
DETAILS B



DETAILS A

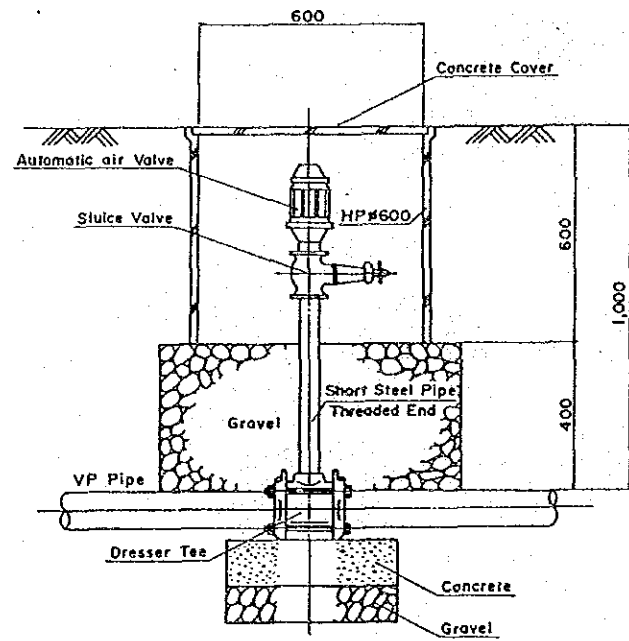


DETAILS B

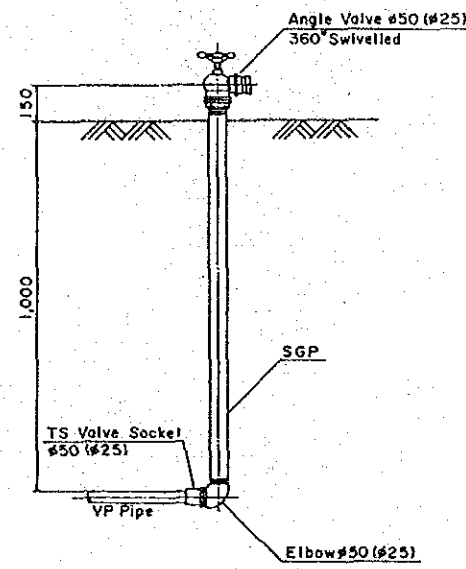


MODEL INFRASTRUCTURE IMPROVEMENT WORKS FOR THE BEIJING VEGETABLE RESEARCH CENTER PROJECT			
TITLE: HOUSE DRIP IRRIGATION SYSTEM NETHOUSE SPRINKLER IRRIGATION SYSTEM			
DATE	JUNE 1988	D.W.G. NO.	6
JAPAN INTERNATIONAL COOPERATION AGENCY			

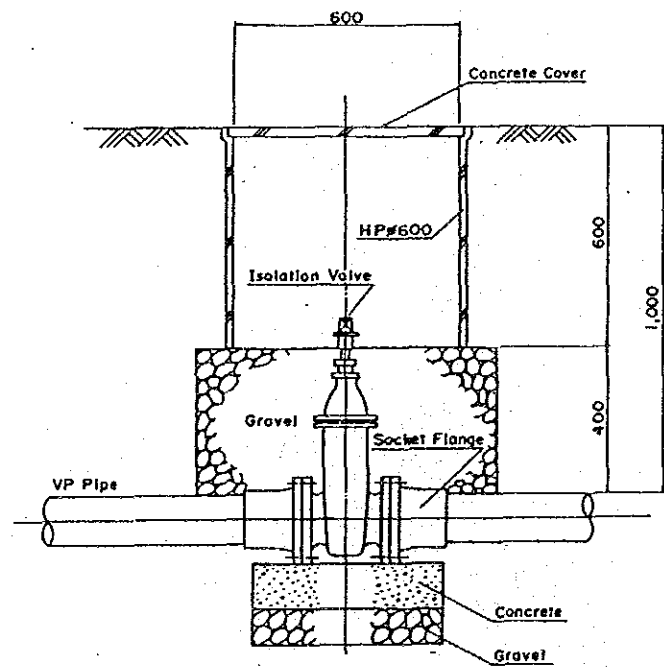
AIR VALVE



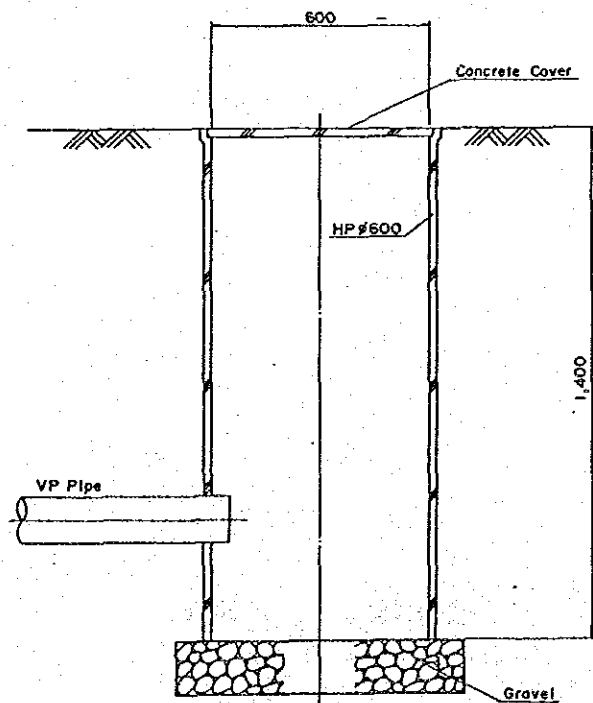
HYDRANT



GATE VALVE



DRAIN BOX



MODEL INFRASTRUCTURE IMPROVEMENT WORKS FOR THE BEIJING VEGETABLE RESEARCH CENTER PROJECT			
TITLE: VALVE BOX AND HYDRANT			
DATE	JUNE 1988	D.W.G. NO.	7
JAPAN INTERNATIONAL COOPERATION AGENCY			

PLATE 11



PLATE 12



JICA

