

Table 5.8 Various Irrigation Water Demand By Year

Year End	Irrigation Water Demand (Mld)				
	2000	2003	2010	2013	2020
Option 1a	7.11	18.12	23.923	16.849	16.849
Option 1b	5.366	13.74	18.894	13.779	13.779
Option 2 i.e. Proposed Option Using					
Lake Water	5.203	10.627	8.088	5.622	5.622
STP Water	0.000	1.651	8.478	6.983	6.983
Trucking	1.009	2.344	0.192	0.192	0.192
JBA Water*	0.163	1.210	2.082	1.240	1.240

* for Public and Private Realms

Table 9.1 Irrigation Zoning And The Water Demand (Public Realm Only)

a) From Lake

Zone	Intake	Source	Precinct	Water Demand (m3/day)
I	PH1	Lake	2, 3 & 18	457
II	PH2	Lake	3 & 4	457
III	PH3	Lake	16, 17 & 19	443
IV	PH4	Lake	7, 8, 9 & 10	355
V	PH5	Lake	5, 6 & 20	611
VI	PH6	Lake	12	237
VII	PH7	Lake	13	1029

b) From Sewage Treatment Plant

Zone	Intake	Source	Precinct	Water Demand (m3/day)
IX	SP1	STP1	14, 15 & DE	695
X	SP2	STP2	5, 6 & 19	6269

c) From JBA Water Main

Zone	Intake	Source	Precinct	Water Demand (m3/day)
		JBA Main	All precincts Except 3, 4, 12, 13, 17, 18 & 20	924

d) Trucking (From Lake)

Zone	Intake	Source	Precinct	Water Demand (m3/day)
		Lake	11 & 16	95

Note : Detailed water source/ demand for each landuse area is given in Appendix SC of the Executive Summary.

Table 9.2 Proposed Grouping of Trucking Zone

Group	Precinct	Requirement of Truck			
		Number	Depot & Kiosk Location	Depot	Water Refilling Kiosk
1	16	1	Prec. 12*, 13* & 15	2 No. (25m x 25m)	2 No. (20m x 40m)
2	11	4	Prec. 7 & 8	1 No. (35m x 35m)	1 No. (20m x 40m)

*Note: * The kiosk & depot as proposed in Precinct 12 & 13 respectively is provisional only and will be utilised in the event that the kiosk or depot location in precinct 15 cannot be made available.*

TABLE 9.3
COST ESTIMATE AND LAND AREA REQUIRED FOR PROPOSED IRRIGATION SYSTEM

	CAPITAL COST			OPERATION & MAINTENANCE COST PER YEAR						LAND AREA (m ² m)
	Demand (m ³ /d)	Capacity (kW)	Amount (RM)	Operation Cost			Maintenance Cost		Total Amount (RM)	
				Usage (kW/day)	Rate (RM)	Amount (RM)	% of Capital C	Amount (RM)		
INTAKE										
PH1 for Zone I (PjP 2, 3 & 18)	457	3*13	690,000.00	352	0.23	21,050.00	2.00%	13,800.00	34,850.00	16*12
PH2 for Zone II (PjP 3 & 4)	457	3*13	690,000.00	352	0.23	21,050.00	2.00%	13,800.00	34,850.00	16*12
PH3 for Zone III (PjP 16, 17 & 19)	443	3*12	690,000.00	328	0.23	19,614.00	2.00%	13,800.00	33,414.00	16*12
PH4 for Zone IV (PjP 7, 8, 9 & 10)	738	3*13	690,000.00	352	0.23	21,050.00	2.00%	13,800.00	34,850.00	16*12
PH5 for Zone V (PjP 5, 6 & 20)	611	3*20	700,000.00	520	0.23	31,096.00	2.00%	14,000.00	45,096.00	16*12
PH6 for Zone VI (PjP 12)	237	3*7	570,000.00	208	0.23	12,438.00	2.00%	11,400.00	23,838.00	16*12
PH7 for Zone VII (PjP 13)	1,029	3*22	830,000.00	568	0.23	33,966.00	2.00%	16,600.00	50,566.00	16*12
SP1 for Zone IX (PjP 14, 15 & DE) - pond not inclusive	695	3*21	700,000.00	544	0.23	32,531.00	2.00%	14,000.00	46,531.00	16*12
SP2 for Zone X (PjP 5, 19 & 20) - pond not inclusive	6,269	3*181	2,000,000.00	4,408	0.23	263,598.00	2.00%	40,000.00	303,598.00	18*14
Sub-total	10,936		7,560,000.00			456,393.00		151,200.00	607,593.00	1,788
	Nominal Diameter (mm)	Length (m)	Rate (RM)	Amount (RM)						(m wide)
PIPE RETICULATION										
Zone I (PjP 2, 3 & 18)	110 - 160	4,500	124.00	558,000.00			2.00%	11,160.00	11,160.00	2.00
Zone II (PjP 3 & 4)	110 - 160	4,150	124.00	514,600.00			2.00%	10,292.00	10,292.00	2.00
Zone III (PjP 16, 17 & 19)	110 - 160	7,210	124.00	894,040.00			2.00%	17,880.80	17,880.80	2.00
Zone IV (PjP 7, 8, 9 & 10)	110 - 160	16,000	124.00	3,436,050.00			2.00%	68,721.00	68,721.00	2.00
Zone V (PjP 5, 6 & 20)	110 - 160	8,000	124.00	992,000.00			2.00%	19,840.00	19,840.00	2.00
Zone VI (PjP 12)	110 - 140	5,780	104.00	601,120.00			2.00%	12,022.40	12,022.40	2.00
Zone VII (PjP 13)	110 - 225	1,900	190.00	682,700.00			2.00%	13,654.00	13,654.00	2.00
Zone IX (PjP 14, 15 & DE)	110 - 160	8,360	124.00	1,036,640.00			2.00%	20,732.80	20,732.80	2.00
Zone X (PjP 5 & 19)	110 - 350	14,000	204.00	3,256,350.00			2.00%	65,127.00	65,127.00	2.00
Precinct 1 - Oval Road	110 - 140	4,000	104.00	1,679,400.00			2.00%	33,588.00	33,588.00	
Sub-total		73,900		13,650,900.00				273,018.00	273,018.00	2 m wide
COMMITTED COSTS										
Precinct 2				2,982,201.00						
Precinct 16				3,554,360.00						
				6,536,561.00						

Sheet 1/3

TABLE 9.3
COST ESTIMATE AND LAND AREA REQUIRED FOR PROPOSED IRRIGATION SYSTEM

	CAPITAL COST					OPERATION & MAINTENANCE COST PFR YEAR					LAND AREA (m*m)			
	Park & Nursery		Civic & Road		Amount (RM)	Operation Cost		Maintenance Cost		Total Amount (RM)				
	Area (sq m)	Rate (RM/Ha)	Area (Ha)	Rate (RM/Ha)		% of Capital C	Amount (RM)	% of Capital C	Amount (RM)					
WATERING SYSTEM														
Zone I (PjP 2, 3 & 18)	0.76	52,500.00	5.37	52,500.00	322,085.00	3.00%	9,663.00	2.00%	6,442.00	16,105.00	-			
Zone II (PjP 3 & 4)	1.10	52,500.00	4.83	52,500.00	311,490.00	3.00%	9,345.00	2.00%	6,230.00	15,575.00	-			
Zone III (PjP 16, 17 & 19)	0.38	52,500.00	3.74	52,500.00	215,969.00	3.00%	6,479.00	2.00%	4,319.00	10,798.00	-			
Zone IV (PjP 7, 8, 9 & 10)	0.85	52,500.00	6.15	52,500.00	367,642.00	3.00%	11,029.00	2.00%	7,353.00	18,382.00	-			
Zone V (PjP 5, 6 & 20)	-	-	8.22	52,500.00	431,477.00	3.00%	12,944.00	2.00%	8,630.00	21,574.00	-			
Zone VI (PjP 12)	0.47	52,500.00	2.15	52,500.00	137,923.00	3.00%	4,138.00	2.00%	2,758.00	6,896.00	-			
Zone VII (PjP 13)	3.74	52,500.00	0.87	52,500.00	242,141.00	3.00%	7,264.00	2.00%	4,843.00	12,107.00	-			
Zone IX (PjP 14, 15 & DE)	1.76	52,500.00	12.09	52,500.00	727,456.00	3.00%	21,824.00	2.00%	14,549.00	36,373.00	-			
Zone X (PjP 5 & 19)	5.17	52,500.00	14.36	52,500.00	1,025,288.00	3.00%	30,759.00	2.00%	20,506.00	51,265.00	-			
Precinct 1 - Oval Road	-	-	2.00	52,500.00	105,000.00	3.00%	3,150.00	2.00%	2,100.00	5,250.00	-			
Other public realms by JBA water	0.99	52,500.00	12.39	52,500.00	702,581.00	3.00%	21,077.00	2.00%	14,052.00	35,129.00	-			
Sub-total					4,589,052.00		137,672.00		91,782.00	229,454.00	-			
					Rate (RM)	Amount (RM)	% of Capital C	Amount (RM)	% of Capital C	Amount (RM)	Amount (RM)	(m*m)		
INTEGRATED IRRIGATION MANAGEMENT SYSTEM														
Hardware and Software					Lump Sum	1,000,000.00	3.00%	30,000.00	2.00%	20,000.00	50,000.00	-		
Sub-total						1,000,000.00		30,000.00		20,000.00	50,000.00	-		
					Number	Rate (RM)	Amount (RM)	Demand (m3/day)	Rate (RM/m3)	Amount (RM)	% of Capital C	Amount (RM)	Amount (RM)	(m*m)
TRUCK														
Lorry (for Precinct 16)					5 trips	1		16	13.00	54,418.00		54,418.00	-	
Lorry (for Precinct 11)					26 trips	4		79	13.00	266,682.00		266,682.00	-	
Depot (for Precinct 16)					Lump	Sum	50,000.00		3.00%	1,500.00	2.00%	1,000.00	2,500.00	25*25
Depot (for Precinct 11)					Lump	Sum	150,000.00		3.00%	4,500.00	2.00%	3,000.00	7,500.00	35*35
Refilling Kiosk (for Precinct 16)					0	300,000.00	150,000.00		3.00%	4,500.00	2.00%	3,000.00	7,500.00	1*(20*40)
Refilling Kiosk (for Precinct 11)					1	300,000.00	300,000.00		3.00%	9,000.00	2.00%	6,000.00	15,000.00	1*(20*40)
Sub-total							650,000.00			340,600.00		13,000.00	353,600.00	3,450
										Cost of trucking if planting reduced by 50 %		2,521,698.00	Sheet 2/3	

TABLE 9.3
COST ESTIMATE AND LAND AREA REQUIRED FOR PROPOSED IRRIGATION SYSTEM

	CAPITAL COST			OPERATION & MAINTENANCE COST PER YEAR					LAND AREA (m ² m)	
	Volume (m ³)	Rate (RM)	Amount (RM)	Operation Cost		Maintenance Cost		Total Amount (RM)		
				Demand (m ³ /day)	Rate (RM)	Amount (RM)	% of Capital C			Amount (RM)
EXCAVATION for Storage Pond at STP										
SP1 at STP1 (PjP 14)	1,030	12.00	12,360.00				2.00%	247.00	247.00	40*40
SP2 at STP2 (PjP 19)	7,192	12.00	86,304.00				2.00%	1,726.00	1,726.00	70*70
LINING OF POND										
SP1 at STP1 (PjP 14)	720	200.00	144,000.00				2.00%	2,880.00	2,880.00	
SP2 at STP2 (PjP 19)	2,205	200.00	441,000.00				2.00%	8,820.00	8,820.00	
Sub-total	11,147		683,664.00					13,673.00	13,673.00	6,500
	Capacity (m ³ /day)		Amount	Demand (m ³ /day)	Rate (RM)	Amount (RM)	% of Capital C	Amount (RM)	Amount (RM)	
DISINFECTION using sodium hypochlorite										
STP1 for SP1	695		50,000.00	695	0.006	9,250.00	2.00%	1,000.00	10,250.00	10*15
STP2 for SP2	6,269		100,000.00	6,269	0.006	74,542.00	2.00%	2,000.00	76,542.00	10*15
Sub-total	6,964		150,000.00	6,964		83,792.00		3,000.00	86,792.00	300
				Demand (m ³ /day)	Rate (RM)	Amount (RM)			Amount (RM)	
JBA WATER										
Public Realms			1,000,000.00	924	1.40	336,172.00			336,172.00	-
Private Realms *				3,070	1.40	1,117,391.00			1,117,391.00	-
Sub-total			1,000,000.00	3,993		1,453,563.00			1,453,563.00	
	Number	Rate (RM)	Amount (RM)	Operator (No.)	Rate (RM)	Amount (RM)	% of Capital C	Amount (RM)	Amount (RM)	
Tools and Equipment	Lump	Sum	200,000.00		3.00%	6,000.00	2.00%	4,000.00	10,000.00	-
Sub-total			200,000.00			6,000.00		4,000.00	10,000.00	
GRAND TOTAL			36,020,177.00			2,508,020.00		569,673.00	3,077,693.00	12,038

Sheet 3/3

Note:

- 1) Watering window =
- 2) Irrigation Frequency =
- 3) Truck capacity =
- 4) Truck trip =

- 8 hour
- 260 per day per year
- 3 cubic meter
- 6 no. per day

- 5) Intake capacity for trucking =
- 6) Irrigation time for trucking =
- 7) Filling time for trucking =
- 8) Water depth in SP1 & SP2=

- 4 trucks per time
- 8 hour
- 0.5 hour per batch
- 2.4 m

- 9) Pond Freeboard = 0.6 m
- 10) Pond slope = 2.0 (1 : H)
- 11) Pond Storage = 1.0 day demand
- 12) Watering systems at public realms are excluded.
- 13) All intake pump quantities are based on two duty and one standby

* Watering systems at private realms estimated to RM 35 million for a total gross area of 167.69 ha are excluded.

Table 9.4 Grand Summary Of Cost Estimate For Proposed Irrigation System

	Capital Cost RM	Annual O & M RM
<u>Pipe System</u>		
Intake & Pump (at Lake & STP)	7,560,000	607,593
Pipe Reticulation	13,650,900	273,018
Watering System	4,589,052	229,454
Intake Pond Excavation at STP	683,664	13,673
Disinfection for STP	150,000	86,792
Sub-total	26,633,616	1,210,530
Committed Costs		
Truck	650,000	353,600
JBA Water	1,000,000*	1,453,563
<u>Operation , Maintenance &</u>		
Tools & Equipment	200,000	10,000
Integrated Irrigation Management (IIMS)-soft & hardware	1,000,000	50,000
Subtotal	1,200,000	60,000
GRAND TOTAL	36,020,177	3,077,693

** Allow Cost for tapping from existing JBA pipe

FIGURE

- Figure 2.1 Catchment Boundary For Putrajaya Lake
- Figure 2.2 Monthly Rainfall Distribution
- Figure 2.3 Stacked Frequency Analysis At Ladang West Country
- Figure 2.4 Stacked Frequency Analysis At Ladang Galloway
- Figure 2.5 Schematic Of Rainfall – Runoff Model
- Figure 2.6 Observed and Simulated Hydrographs at Prang Besar With 800 mm per annum Runoff
- Figure 2.7 Daily Stimulated Runoff (1947 to 1998)
- Figure 2.8 Stacked Frequency Analysis At Prang Besar
- Figure 5.1 Geological Map On Soil Series
- Figure 5.2 Typical Bungor Series
- Figure 5.3 Water Capacity In Relation To Soil Texture And Moisture Constants
- Figure 5.4 Soil Moisture Constant In Term Of Atmosphere Of Tension
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- Figure 5.7 Water Demand For Option 2
- Figure 5.8 Water Demand For Various Options Using Lake Water
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- Figure 6.2 Underground Tank Cell For Rainfall Harvesting (See Chapter 6)
- Figure 6.3 Longitudinal Cross Sections Of Lake/Wetland
- Figure 6.4 Components of Lake Balance Computations (See Chapter 6)
- Figure 6.5 Putrajaya Lake Drawdown Chart (See Chapter 6)
- Figure 9.1a Typical Irrigation Pipe Location For 16m Road
- Figure 9.1b Typical Irrigation Pipe Location For 22m Road
- Figure 9.1c Typical Irrigation Pipe Location For 32m Road
- Figure 9.2a Typical Irrigation Pipe Location For Primary 'CUT'
- Figure 9.2b Typical Irrigation Pipe Location For Secondary 'CUT'
- Figure 9.2c Typical Irrigation Pipe Location For Tertiary 'CUT'
- Figure 9.3 Typical Irrigation Pipe Location For Promenade
- Figure 9.4 Truck Depot Layout
- Figure 9.5 Truck Refilling Kiosk Layout
- Figure 10.1 Location of Hydrological Stations
- Figure 10.2 Location of Meteorological Stations
- Figure 10.3 Remote Hydrological Stations (See Chapter 10)
- Figure 10.4 Soil-Plant-Water Relationship (See Chapter 10)
- Figure 10.5 Actual Evaporation – Soil Moisture Relation (See Chapter 10)
- Figure 10.6 Flow Chart of the Irrigation Decision Support System (See Chapter 10)

**IRRIGATION MASTER PLAN FOR PUTRAJAYA
CATCHMENT BOUNDARY FOR PUTRAJAYA LAKE**

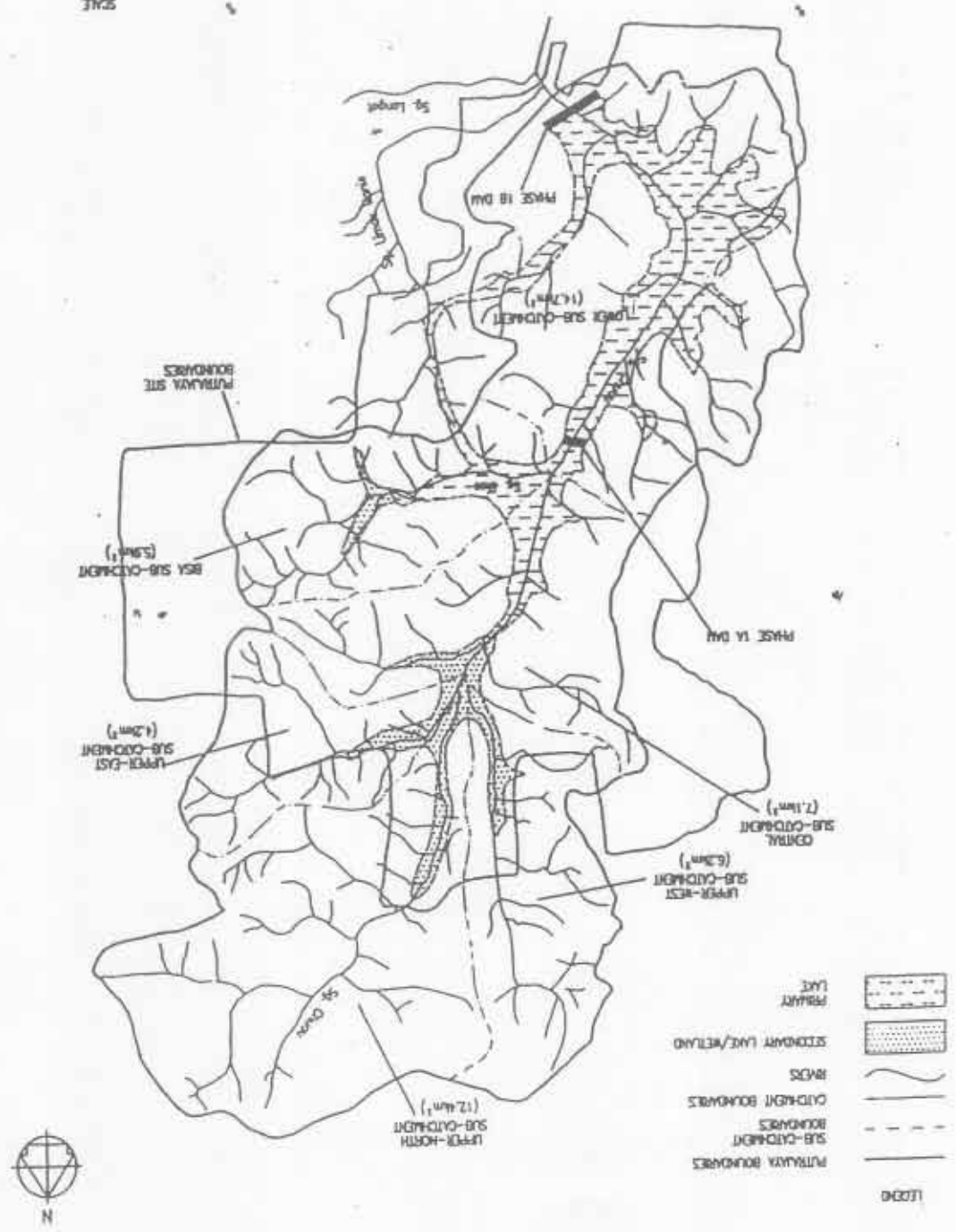


Figure 2.1

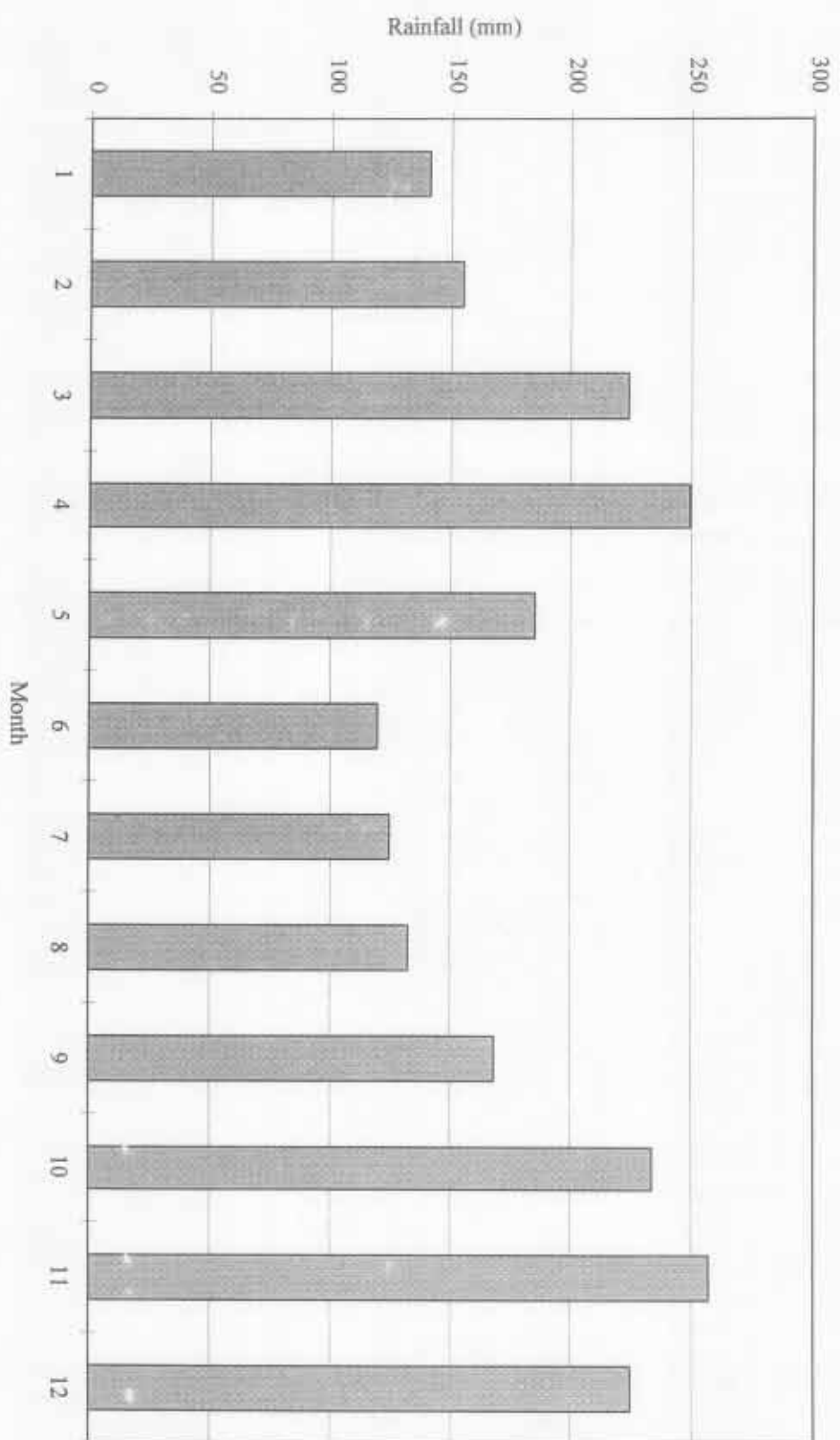


Figure 2.2 : Monthly Rainfall Distribution

Figure 2.3 Stacked Frequency Analysis At Ladang West Country

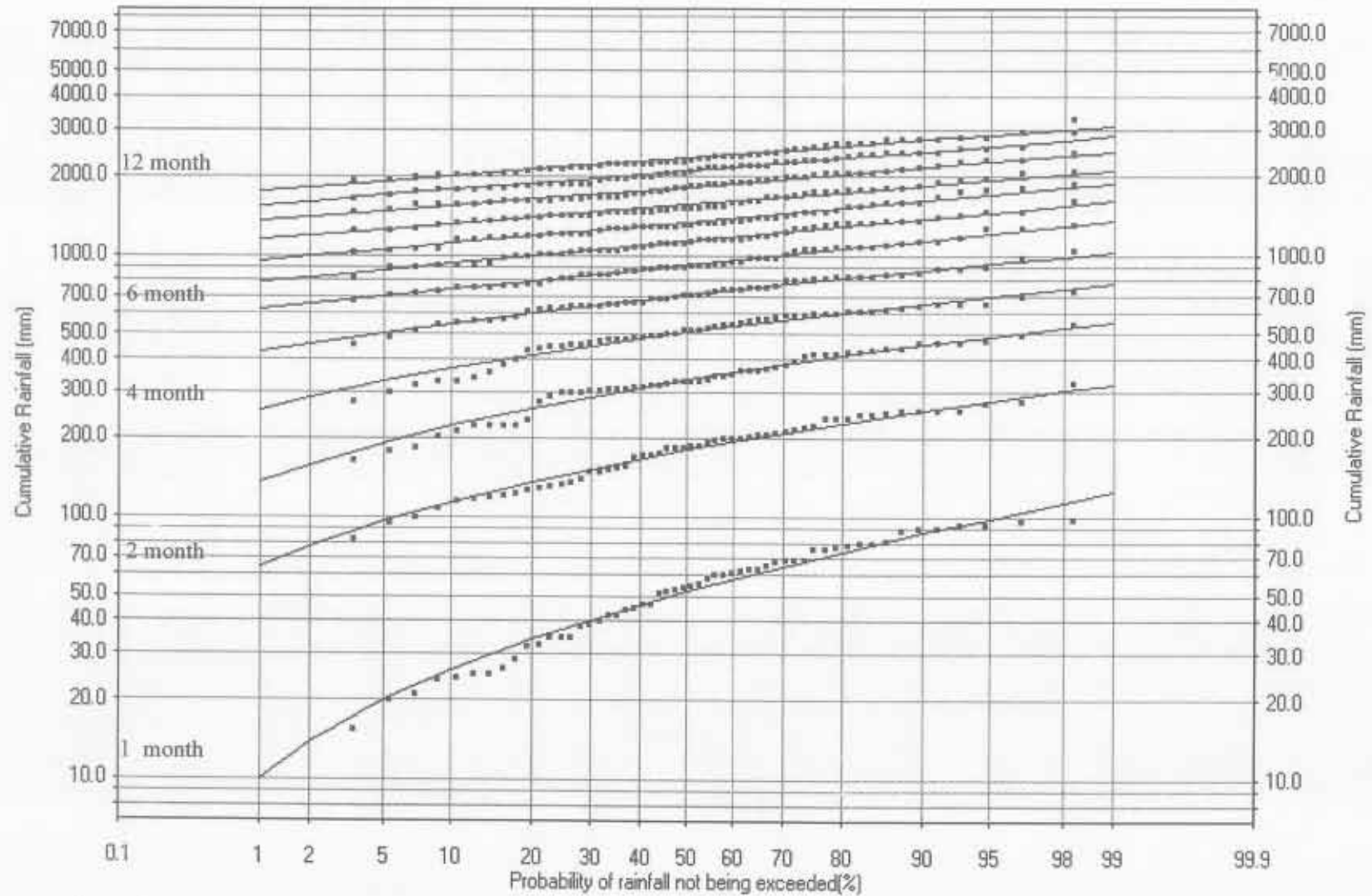


Figure 2.4 Stacked Frequency Analysis At Ladang Galloway

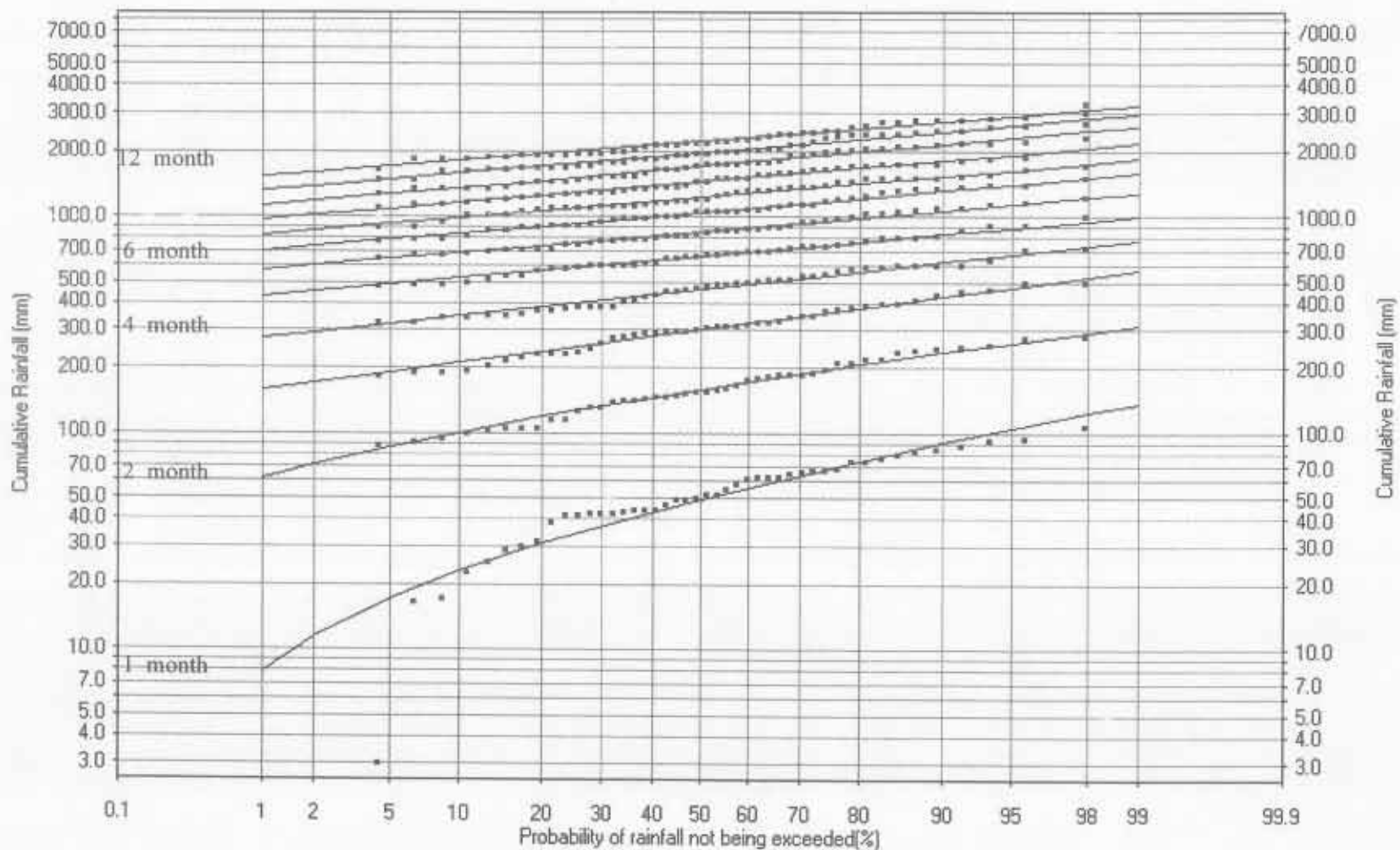
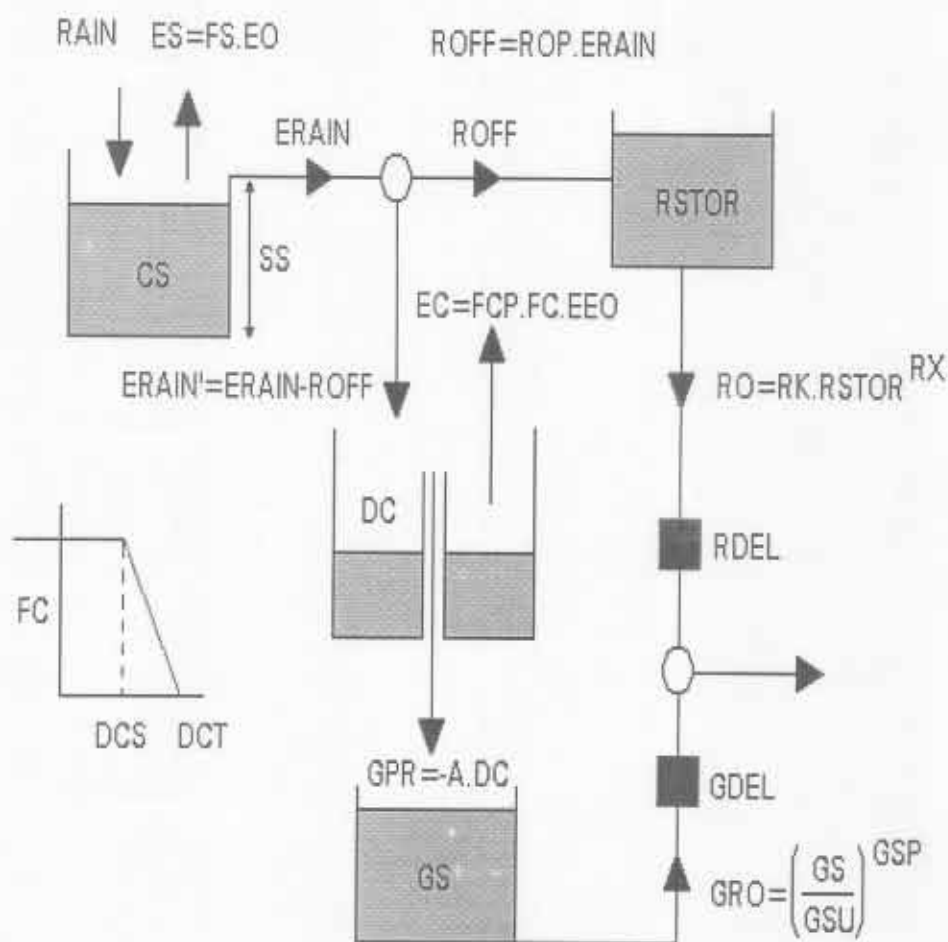


Figure 2.5



$$ROP = RC \cdot \left(e^{-RS \cdot DC} + e^{RR \cdot ERAIN} - 1 \right)$$

$$FCP = \frac{DCT - DC}{DCT - DCS}$$

Schematic Of Rainfall – Runoff Model

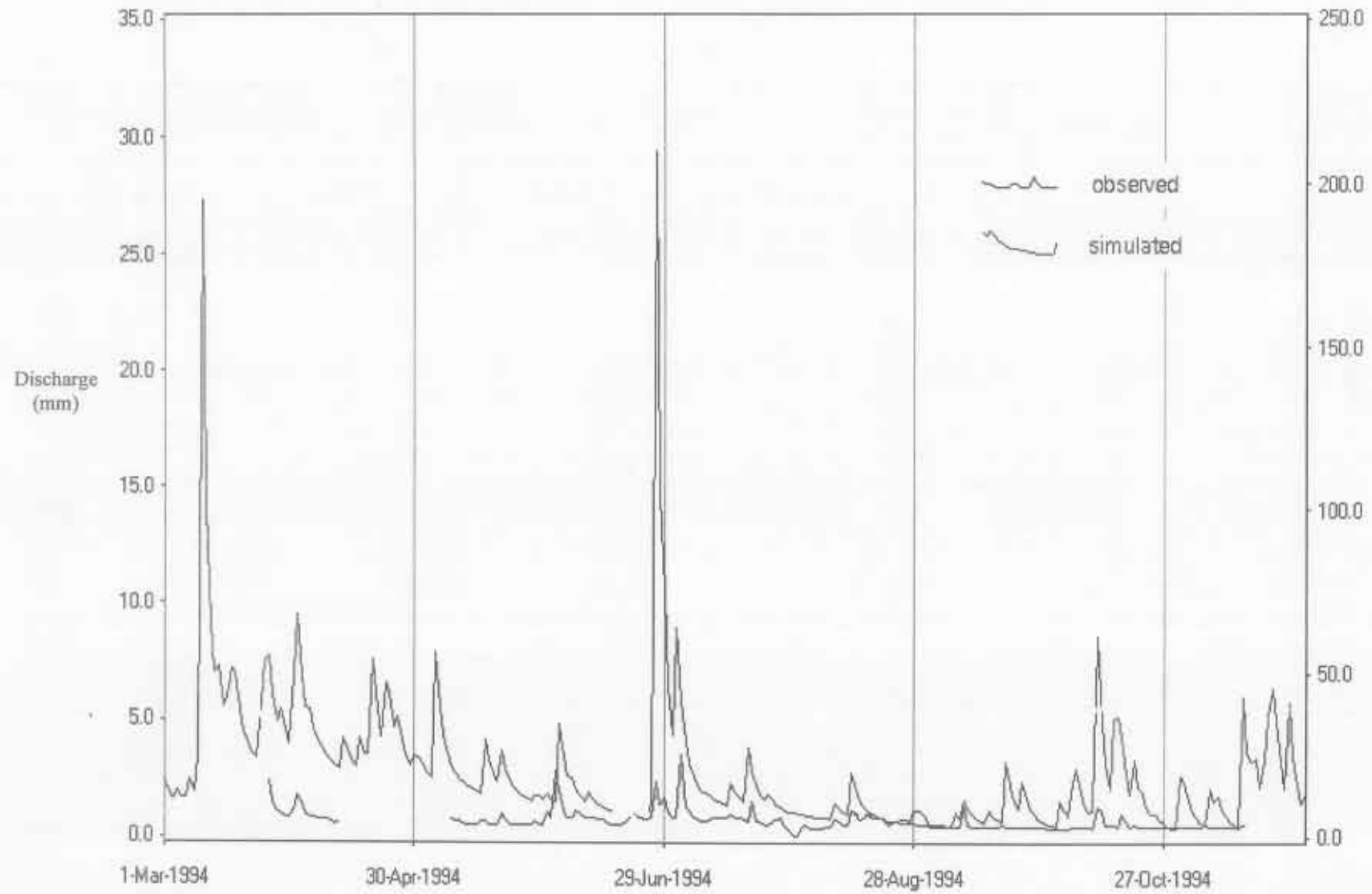


Figure 2.6 Observed and Simulated Hydrographs at Prang Besar With 800mm per annum Runoff

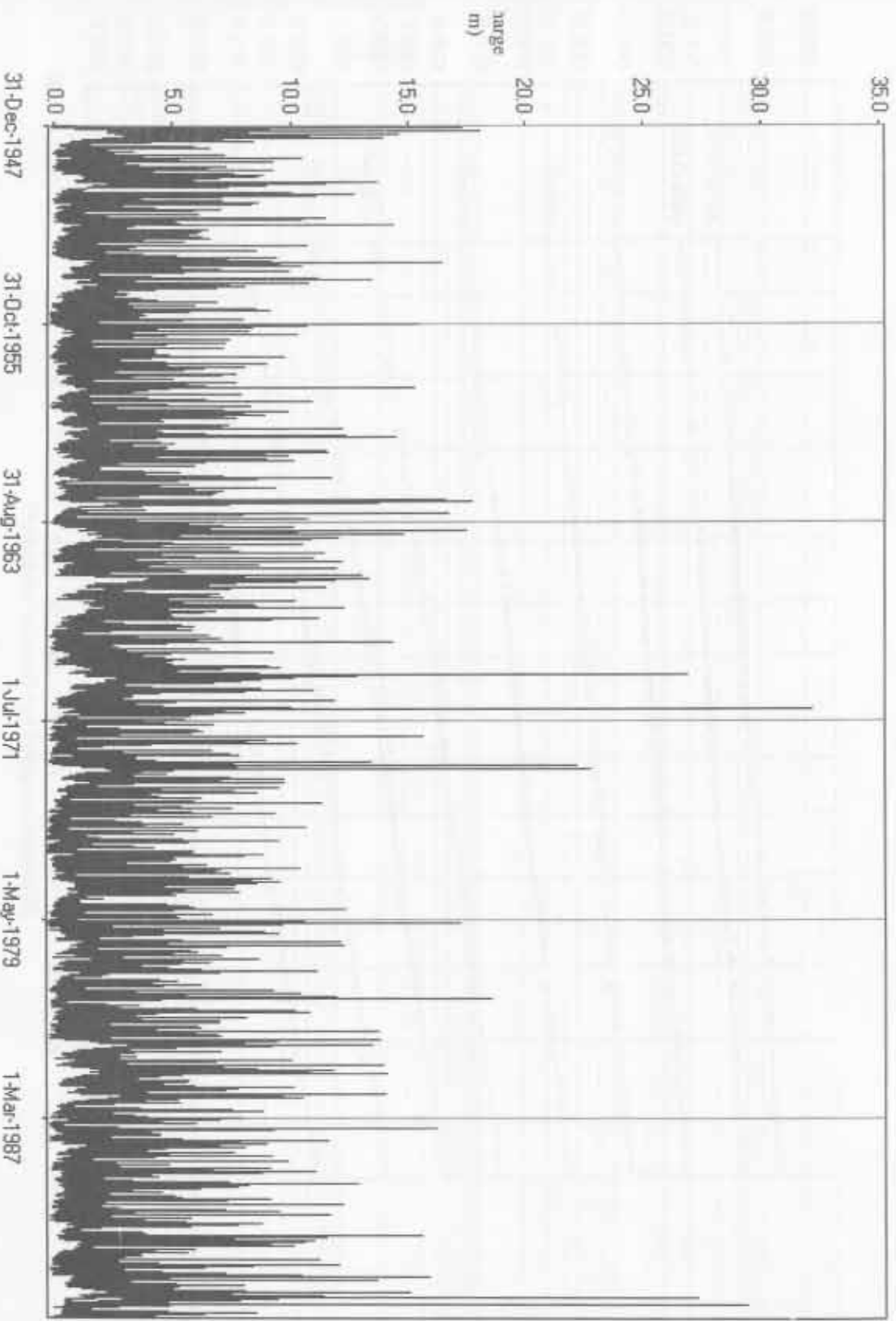


Figure 2.7 Daily Simulated Runoff (1947 to 1998)

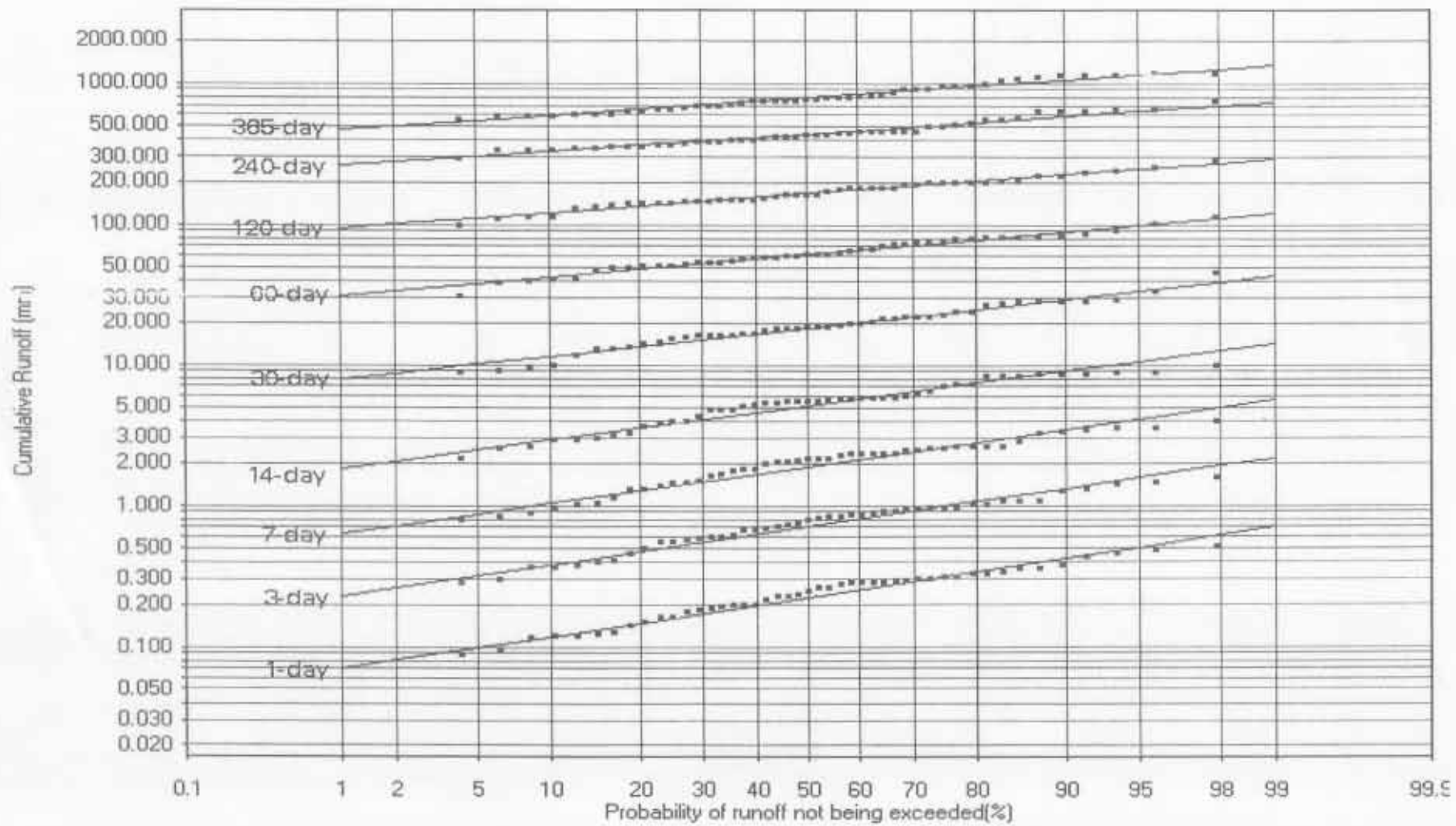
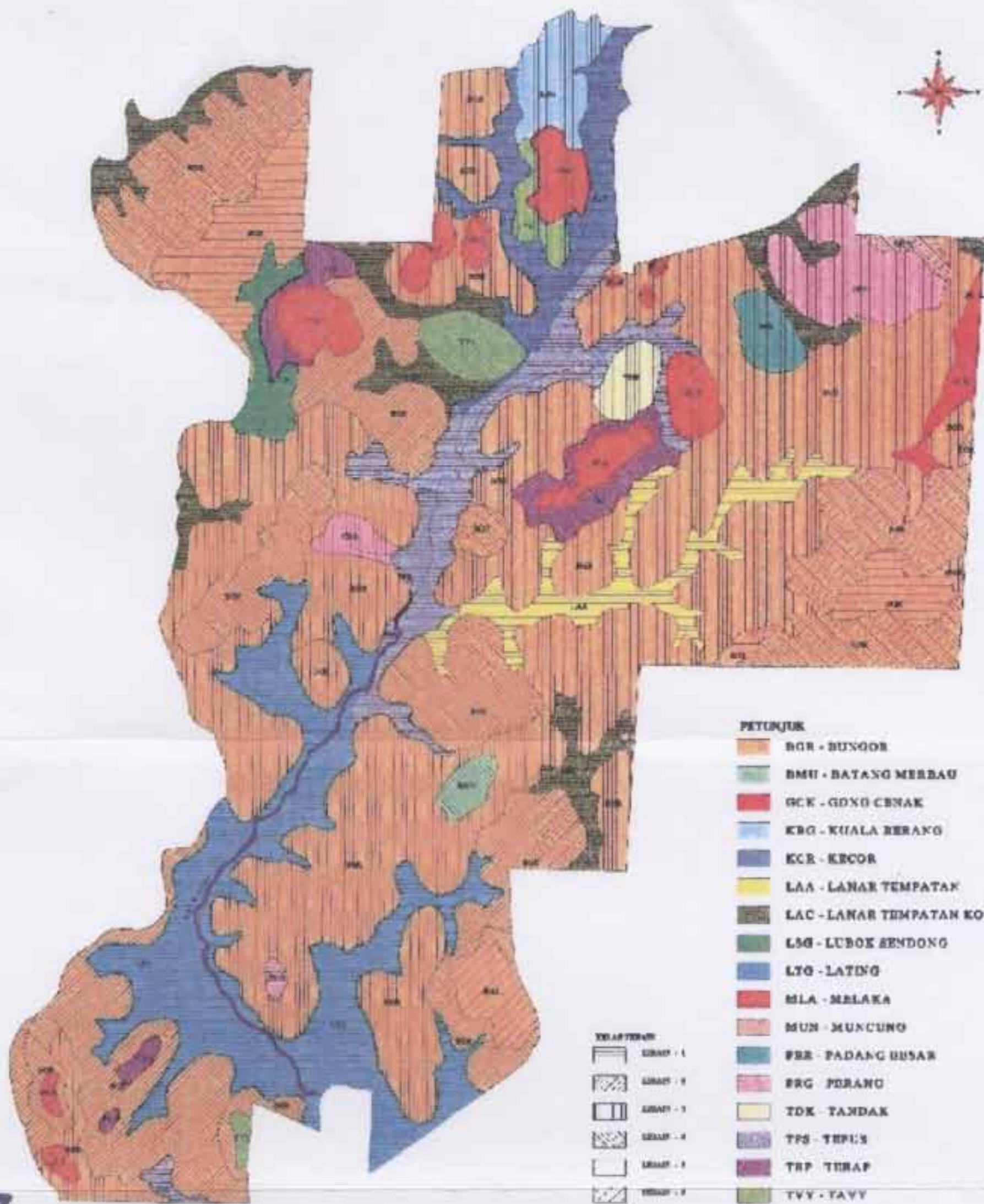


Figure 2.8 Stacked Frequency Analysis At Prang Besar



IRRIGATION MASTER PLAN FOR PUTRAJAYA
GEOLOGICAL MAP ON SOIL SERIES

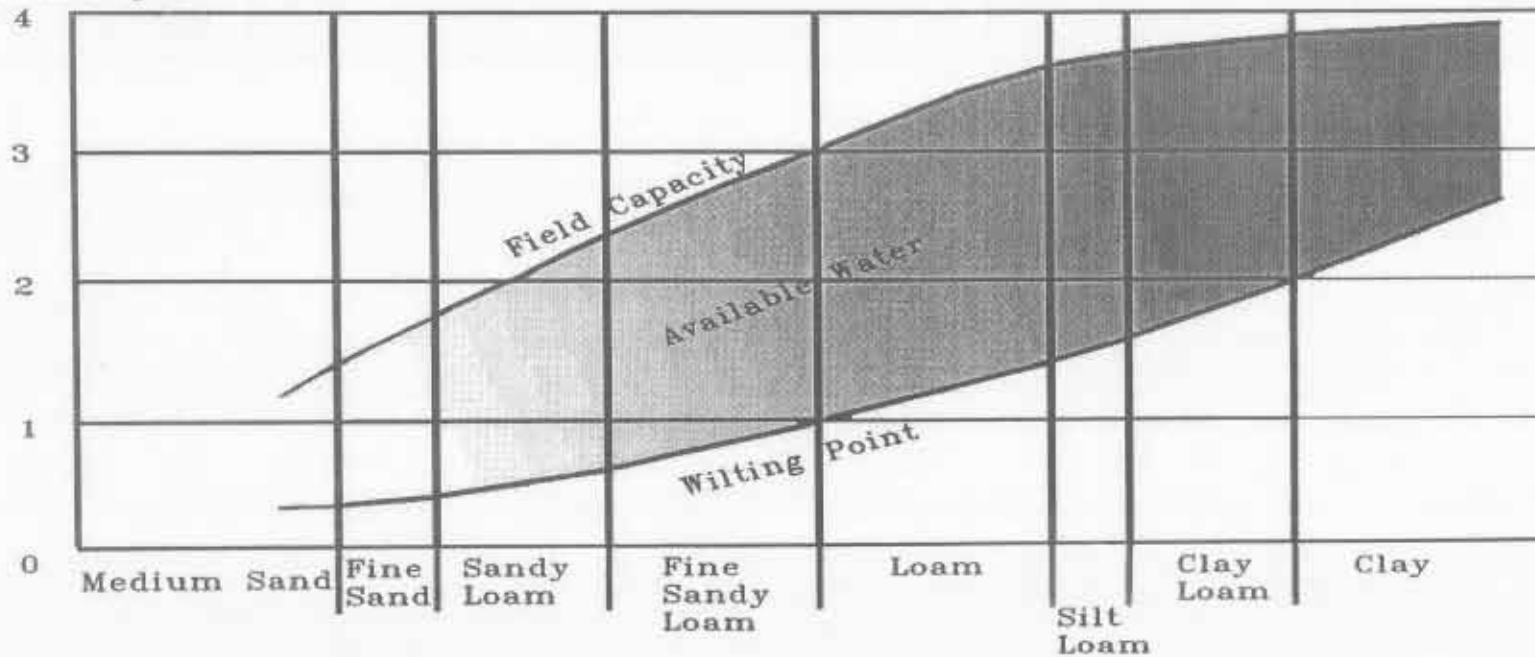
FIGURE 5.1

Figure 5.2



IRRIGATION MASTER PLAN FOR PUTRAJAYA
TYPICAL BUNGOR SERIES

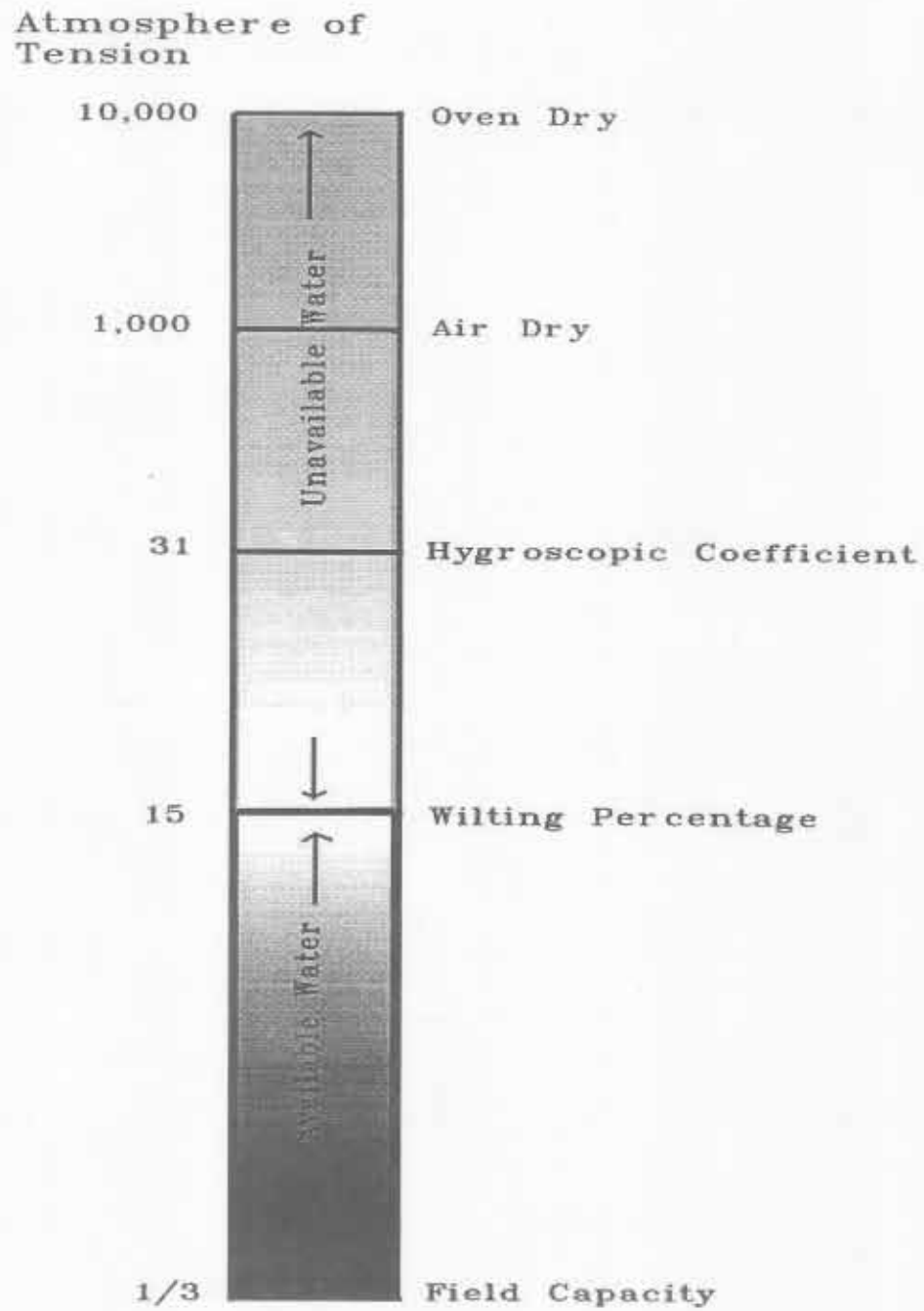
Inches of Water In Each
Foot of Soil Depth



IRRIGATION MASTER PLAN FOR PUTRAJAYA
WATER CAPACITY IN RELATION TO SOIL TEXTURE AND MOISTURE CONSTANTS
 (Source: Soil, their chemistry and fertility in Tropical Asia)

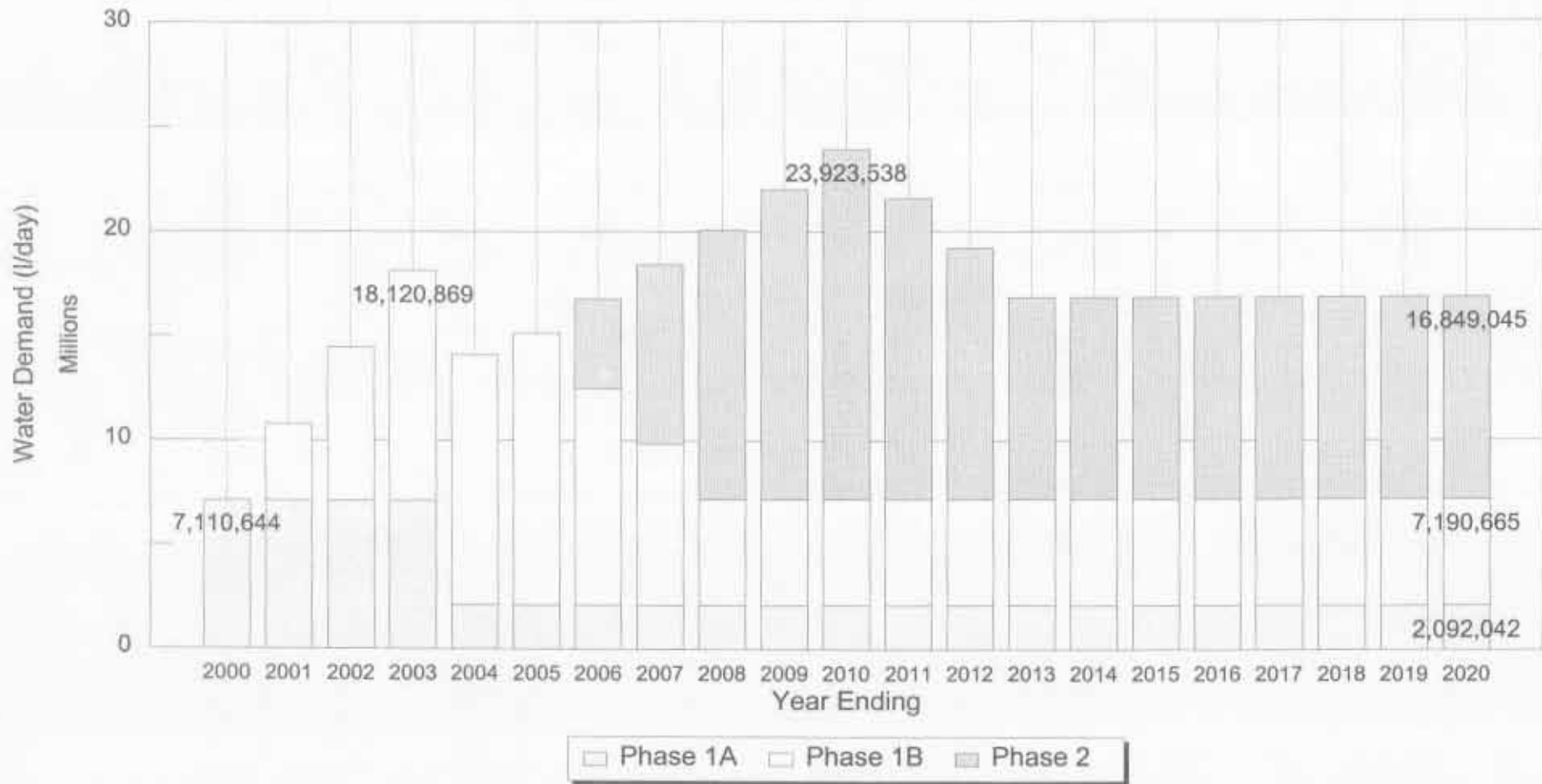
Figure 5.3

Figure 5.4

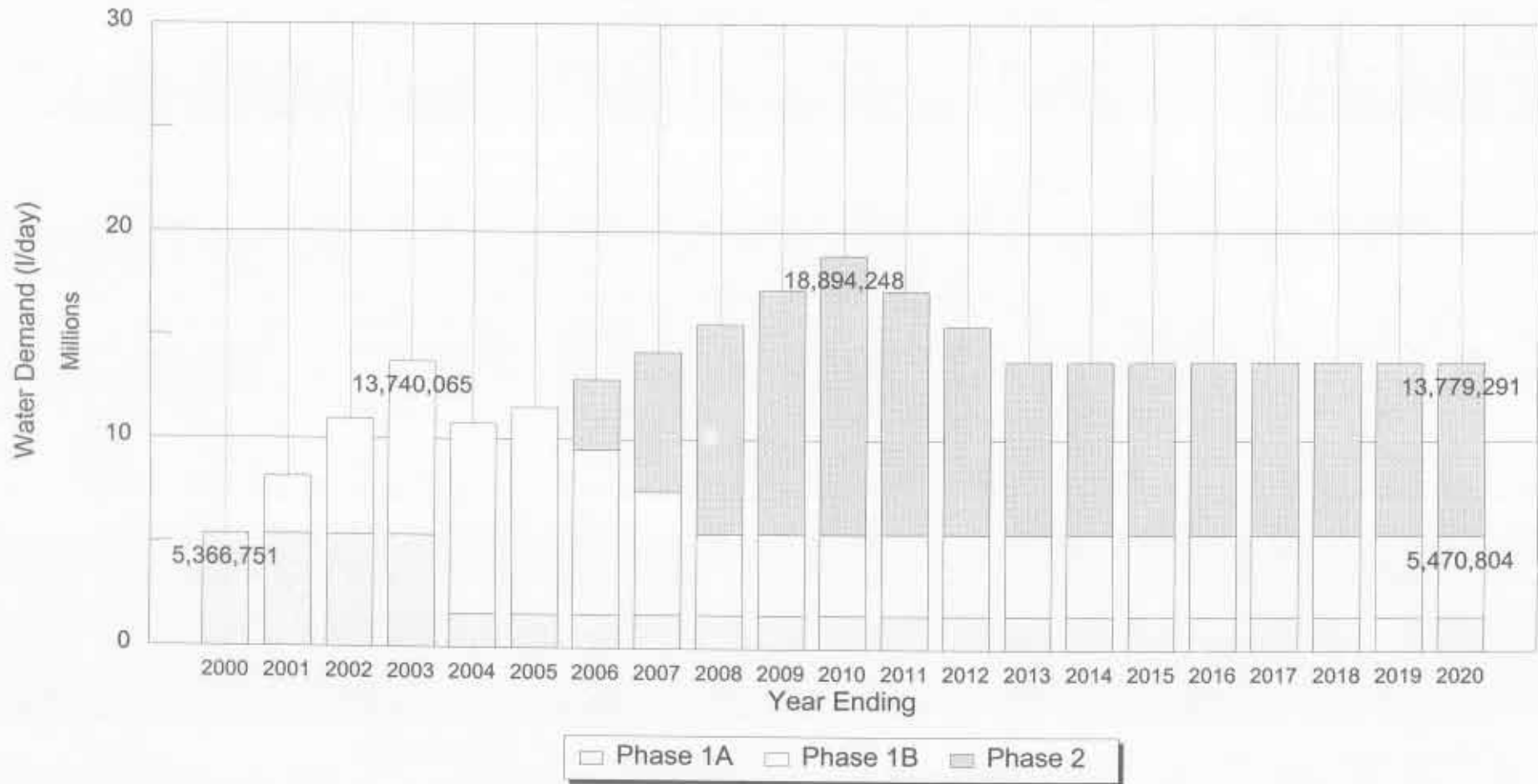


IRRIGATION MASTER PLAN FOR PUTRAJAYA
SOIL MOISTURE CONSTANT IN TERM OF ATMOSPHERE OF TENSION
(Source : Soils, their chemistry and fertility in Tropical Asia)

**Figure 5.5 Water Demand For Option 1a
All 20 Precincts For Public and Private Realms**



**Figure 5.6 Water Demand For Option 1b
All 20 Precincts For Public Realm Only**



**Figure 5.7 Water Demand For Option 2
For Proposed Precincts Using Lake Water**

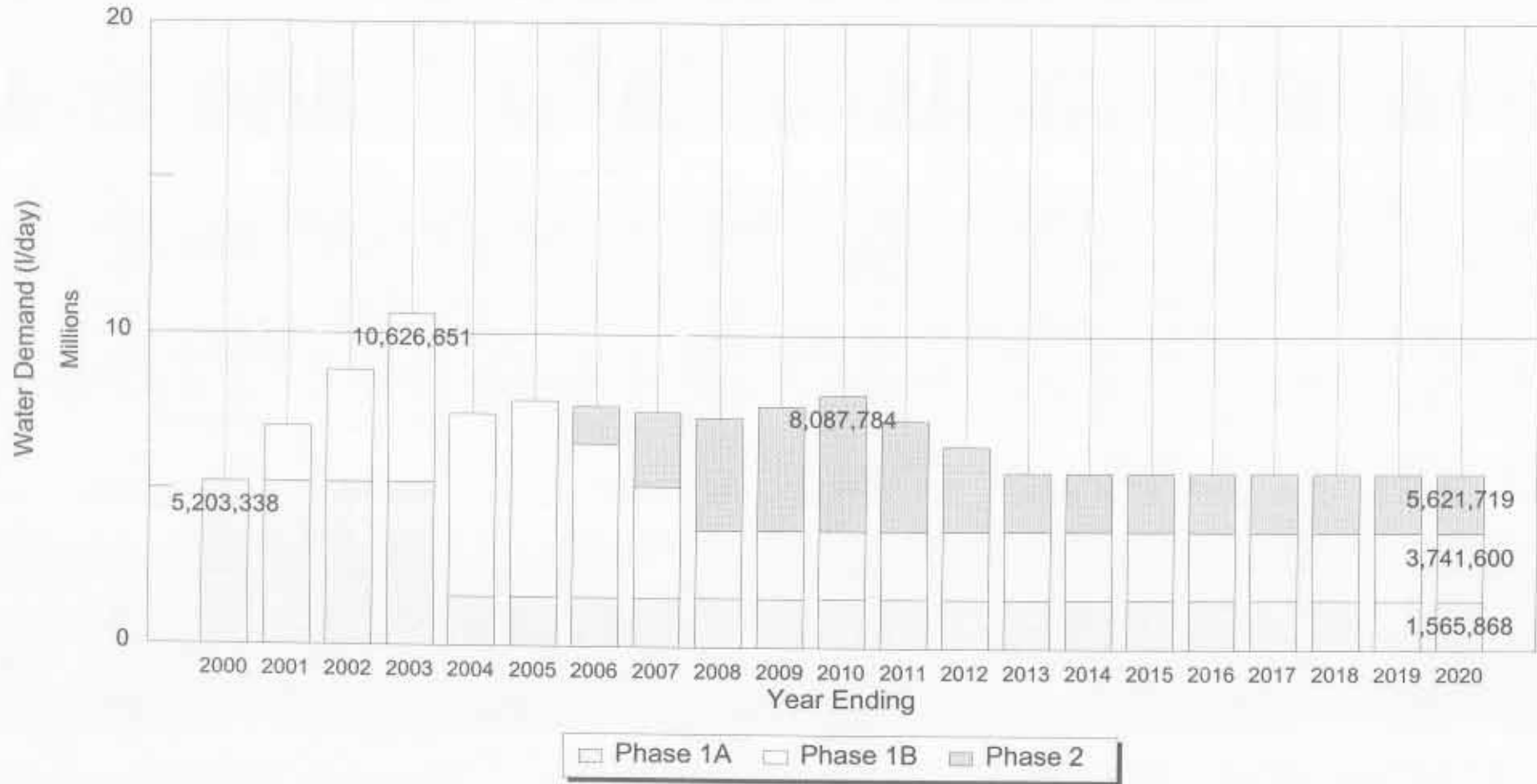
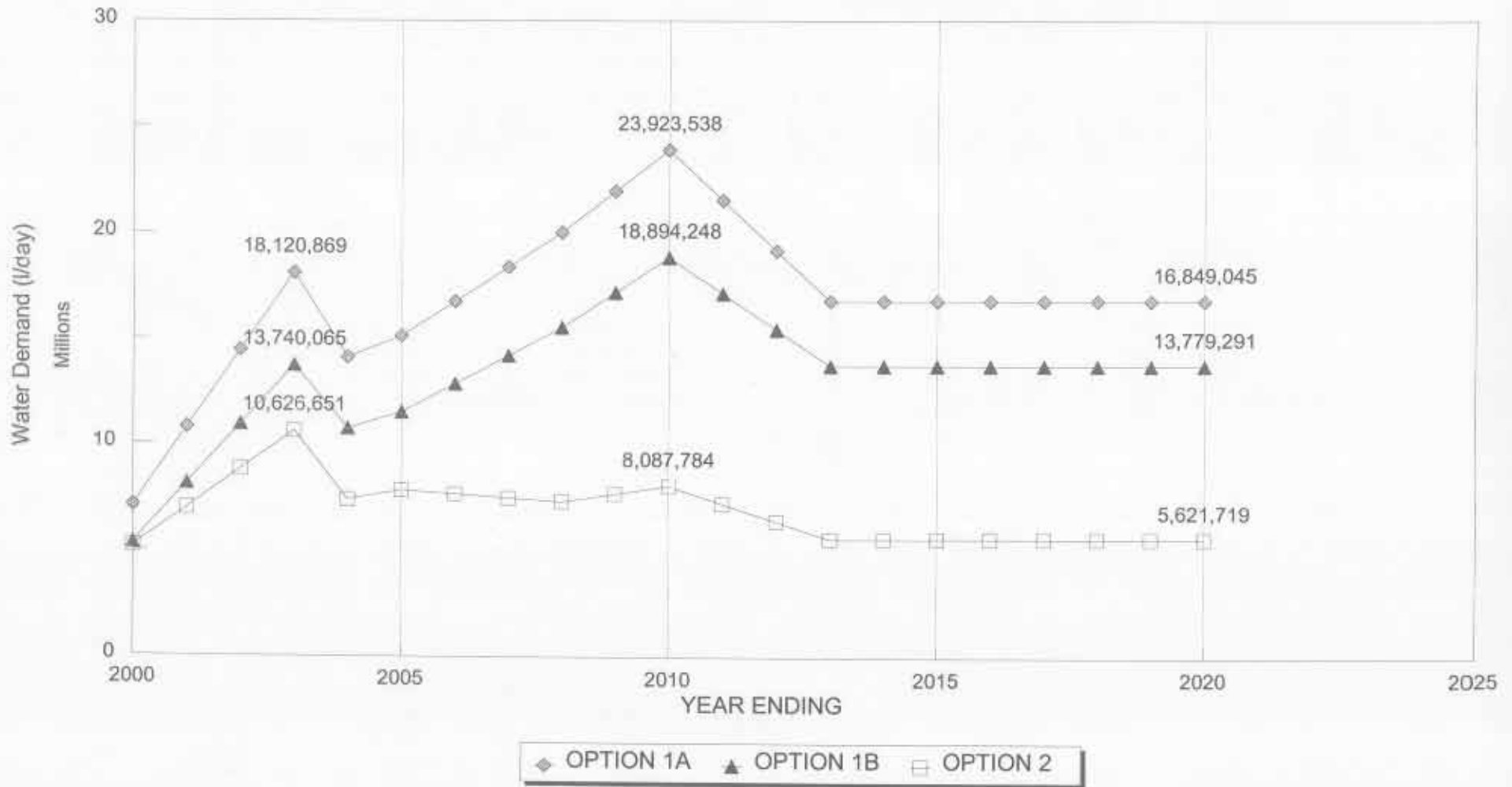
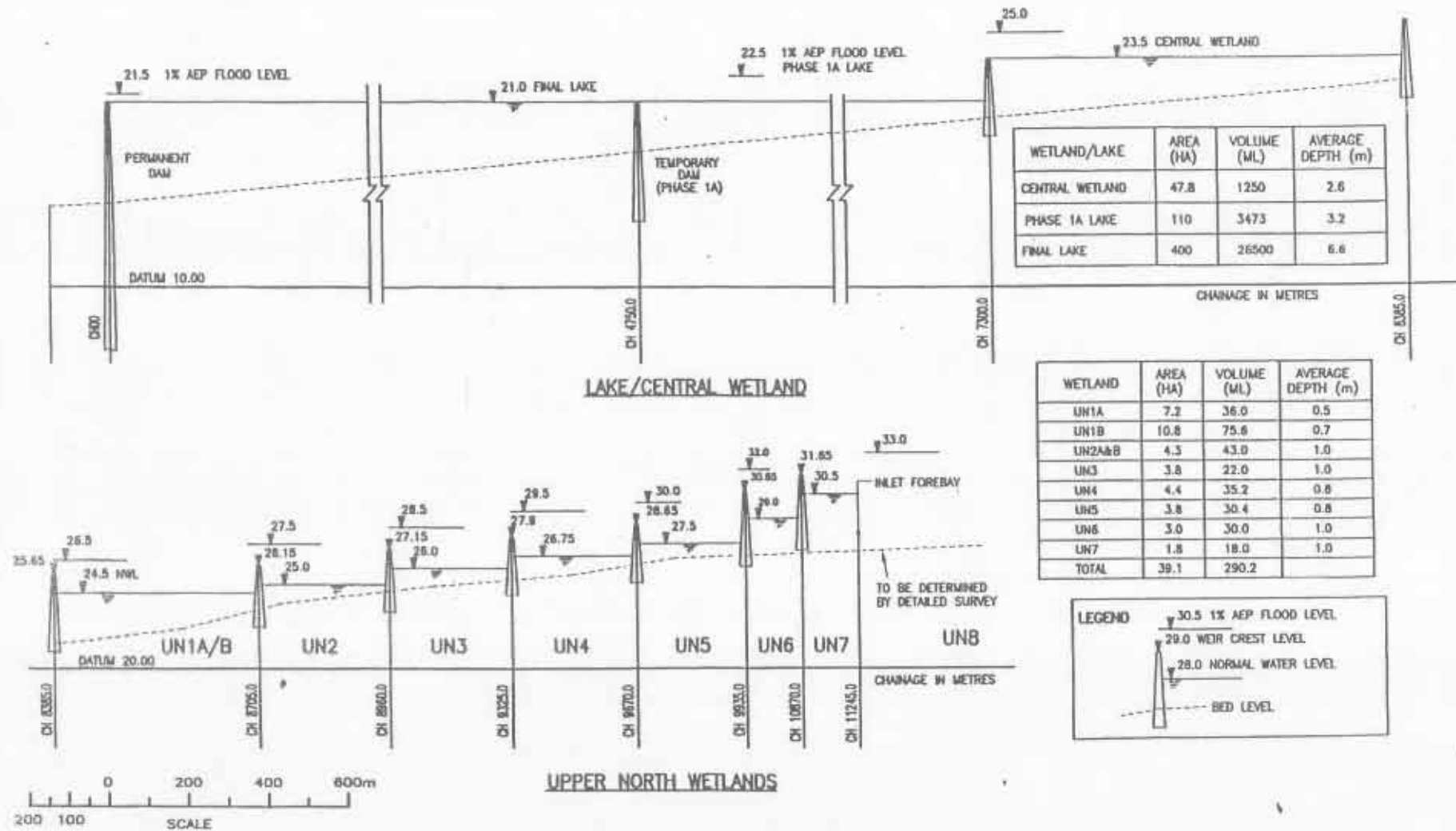


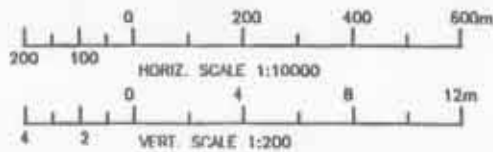
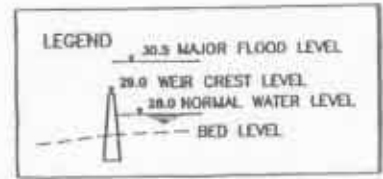
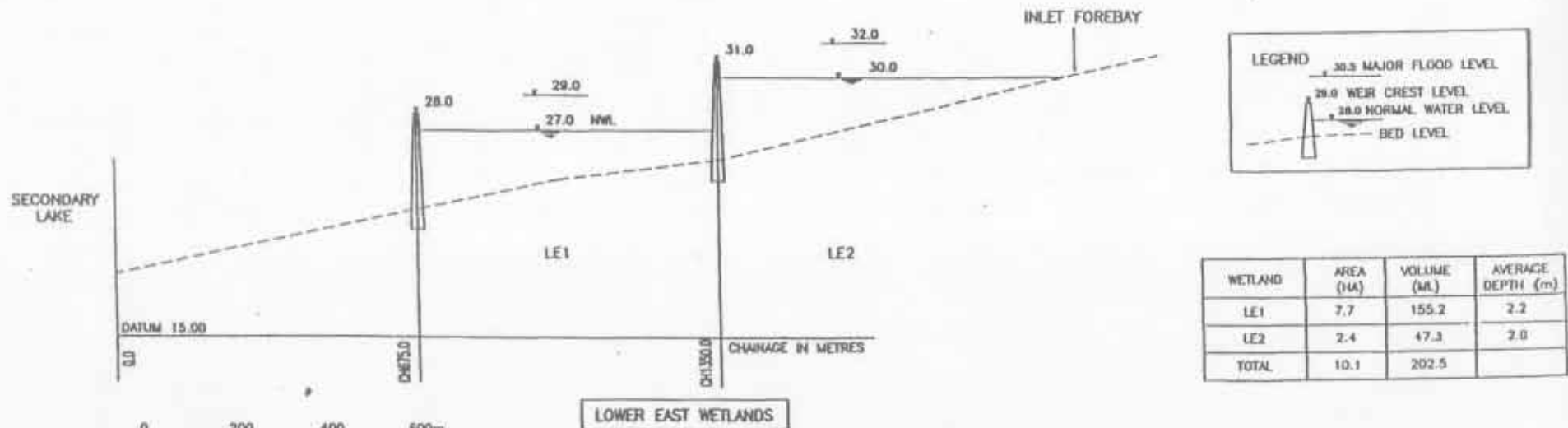
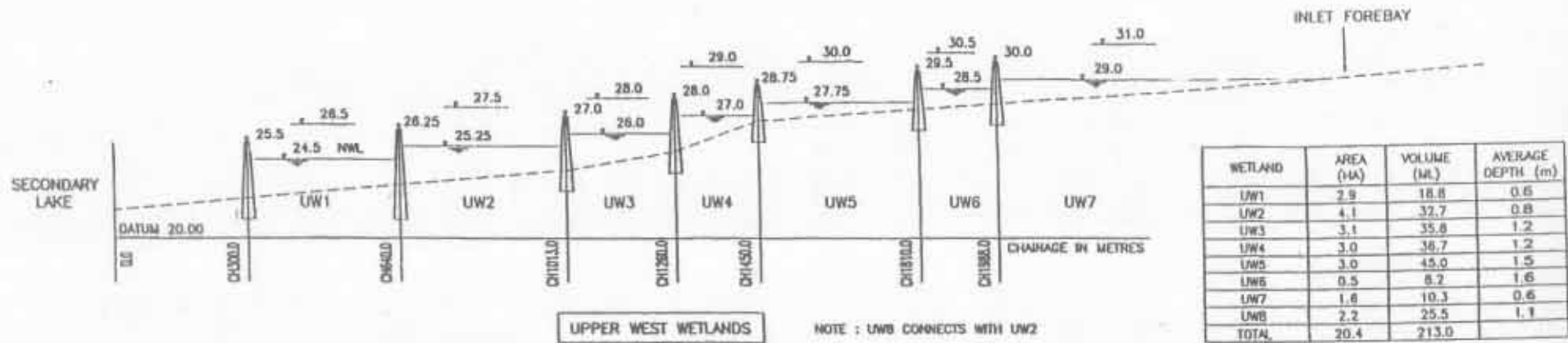
Figure 5.8 Water Demand for Various Options Using Lake Water





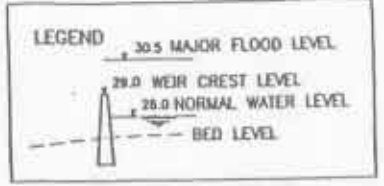
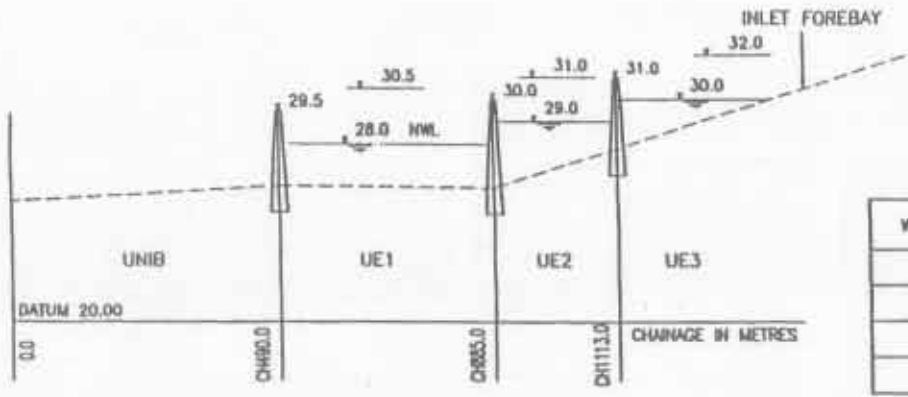
**IRRIGATION MASTER PLAN FOR PUTRAJAYA
LONGITUDINAL CROSS SECTIONS OF LAKE/WETLAND**

Figure 6.3 (1/3)



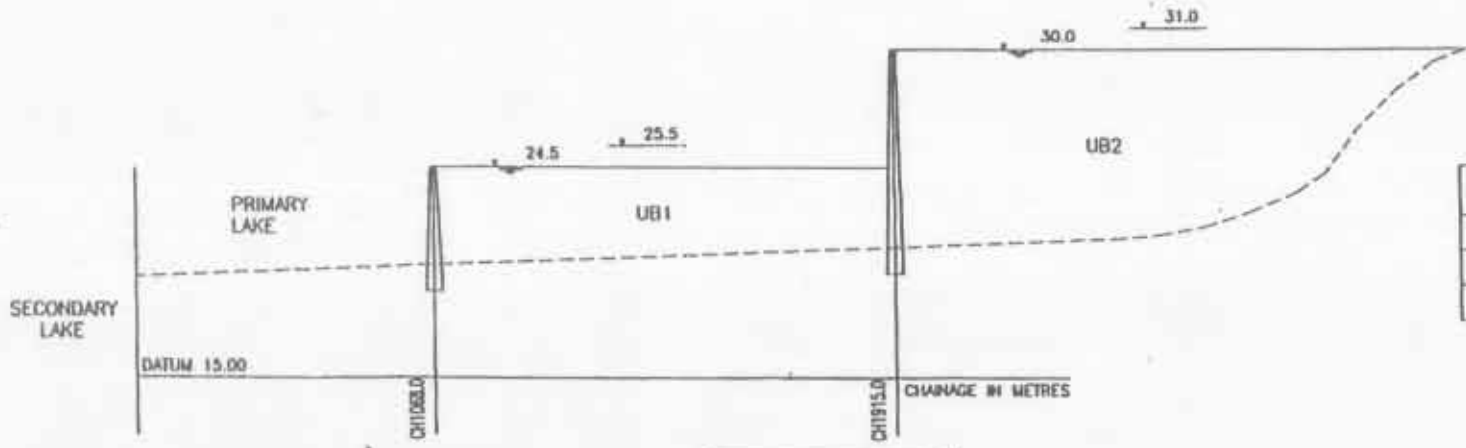
IRRIGATION MASTER PLAN FOR PUTRAJAYA
LONGITUDINAL CROSS SECTIONS OF LAKE/WETLAND (Con't)

Figure 6.3 (2/3)



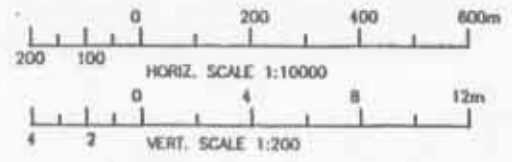
WETLAND	AREA (HA)	VOLUME (ML)	AVERAGE DEPTH (m)
UE1	3.2	37.5	1.2
UE2	3.6	52.3	1.5
UE3	5.1	52.1	1.0
TOTAL	11.9	142	

UPPER EAST WETLANDS



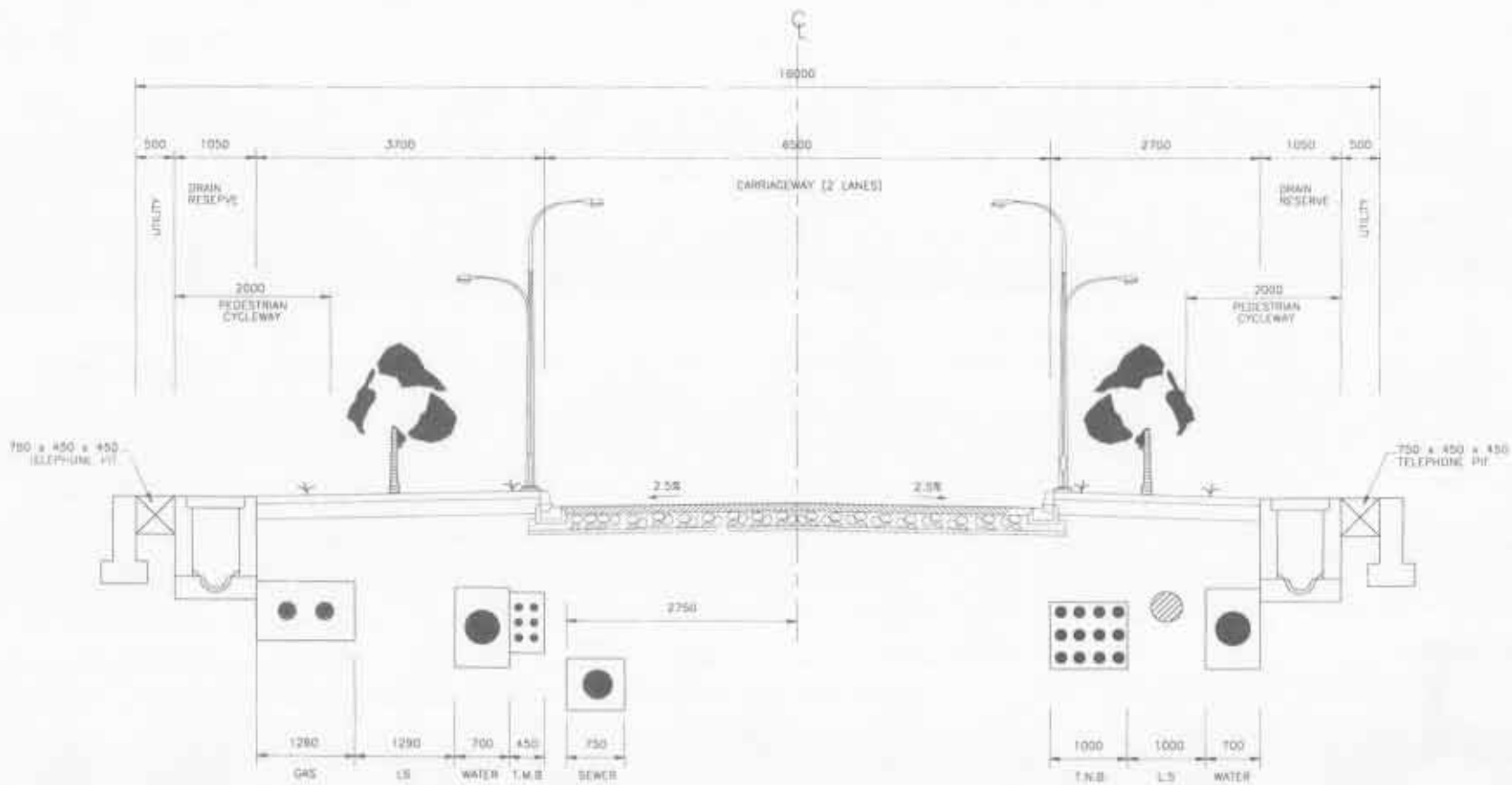
WETLAND	AREA (HA)	VOLUME (ML)	AVERAGE DEPTH (m)
UB1	10.9	335	3.1
UB2	10.2	294	2.9
TOTAL	21.1	628	

UPPER BISA WETLANDS



IRRIGATION MASTER PLAN FOR PUTRAJAYA
LONGITUDINAL CROSS SECTIONS OF LAKE/WETLAND (Con't)

Figure 6.3 (3/3)



1.5m MINIMUM COVER TO ALL UTILITIES
 ALL SEWER MANHOLES TO BE LOCATED
 AT EDGE OF ROAD.

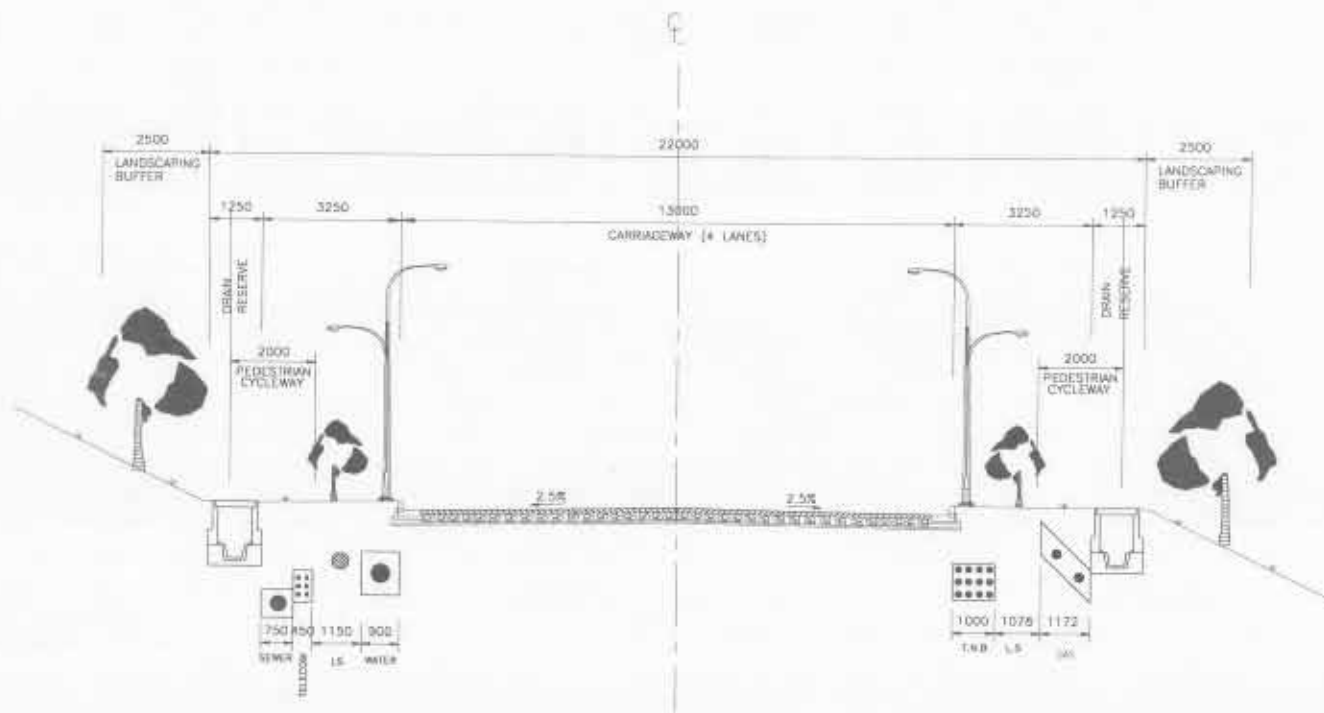
LEGEND

PROPOSED IRRIGATION
 PIPE LOCATION



IRRIGATION MASTER PLAN FOR PUTRAJAYA
 TYPICAL IRRIGATION PIPE LOCATION FOR 16m ROAD

Figure 9.1a



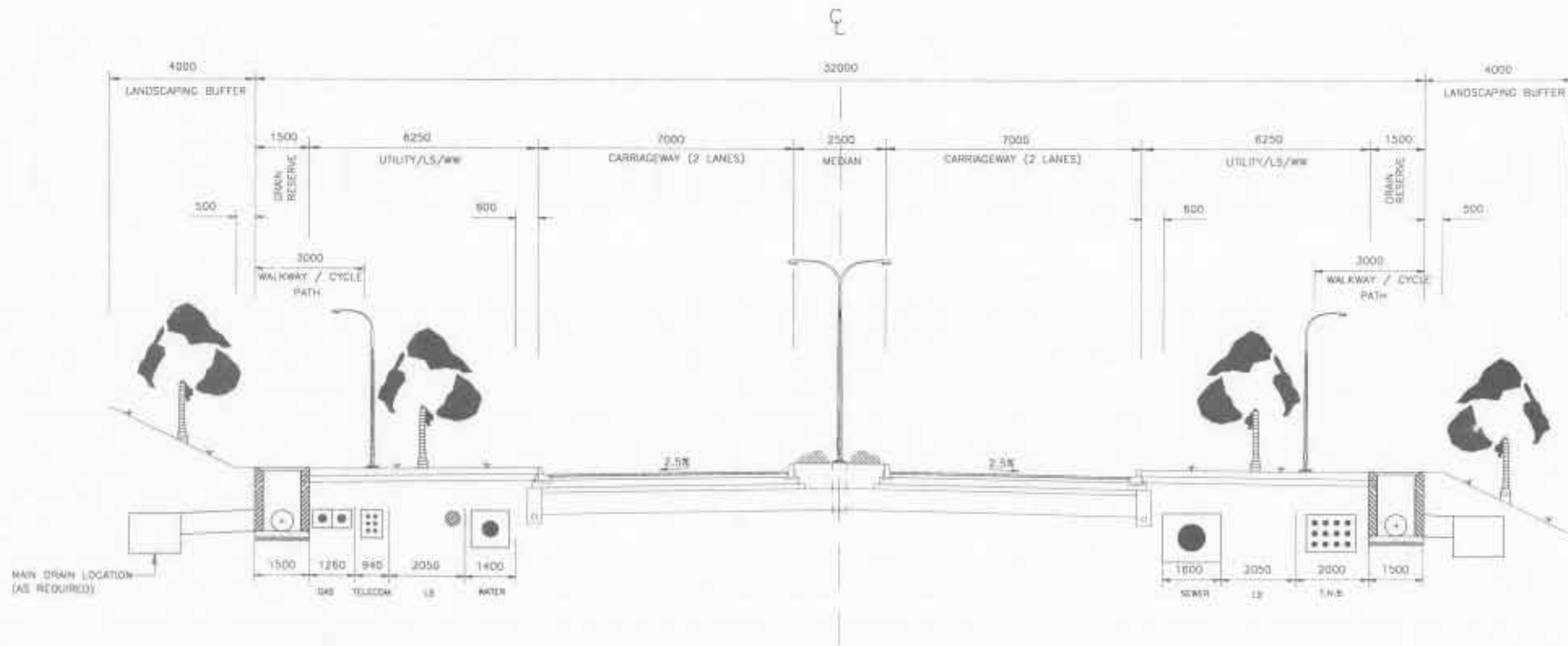
1.5m MINIMUM COVER TO ALL UTILITIES

LEGEND
 ● PROPOSED IRRIGATION PIPE LOCATION



IRRIGATION MASTER PLAN FOR PUTRAJAYA
 TYPICAL IRRIGATION PIPE LOCATION FOR 22m ROAD

Figure 9.1b



1.5m MINIMUM COVER TO ALL UTILITIES

LEGEND

- PROPOSED IRRIGATION PIPE LOCATION



IRRIGATION MASTER PLAN FOR PUTRAJAYA
TYPICAL IRRIGATION PIPE LOCATION FOR 32m ROAD

Figure 9.1c