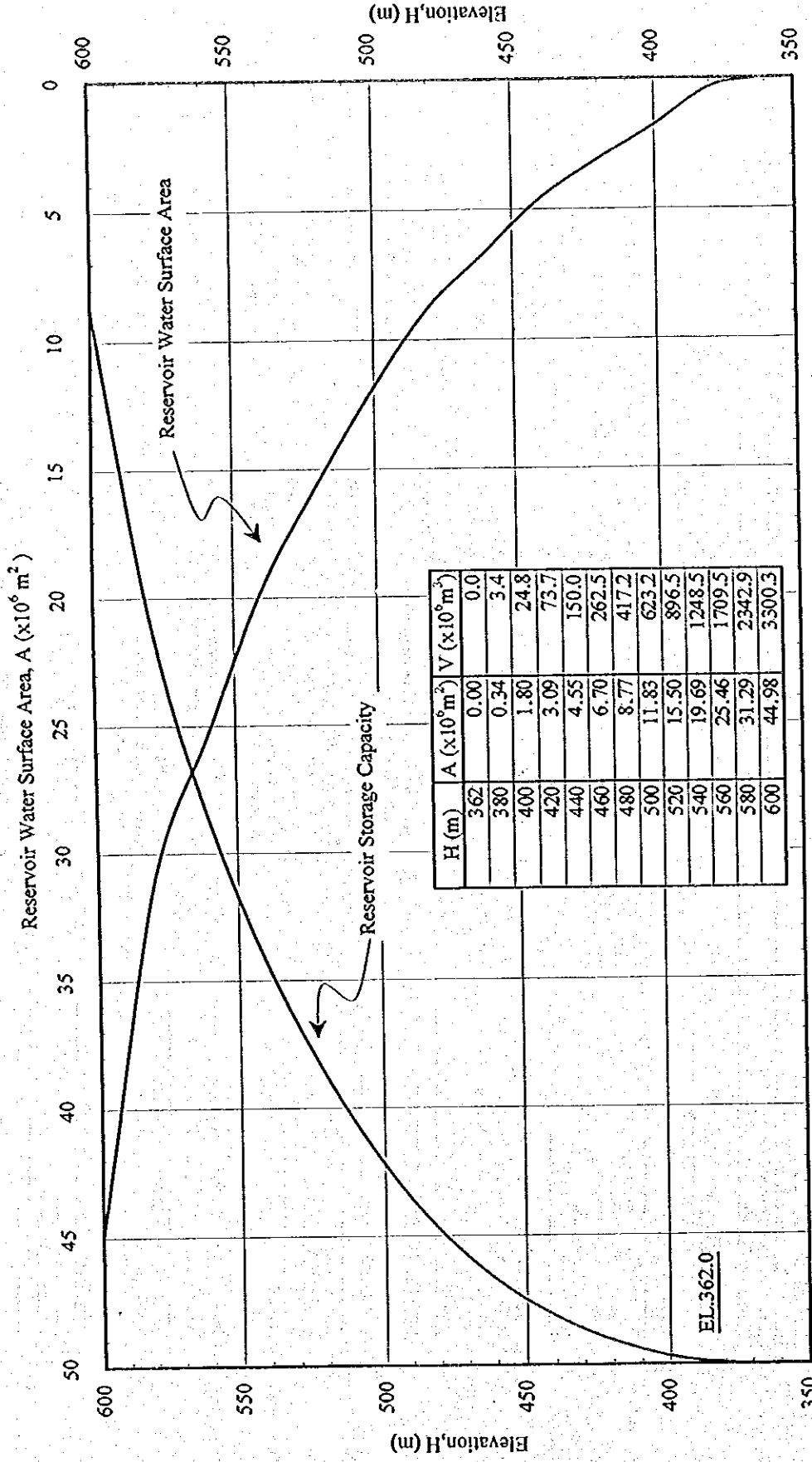


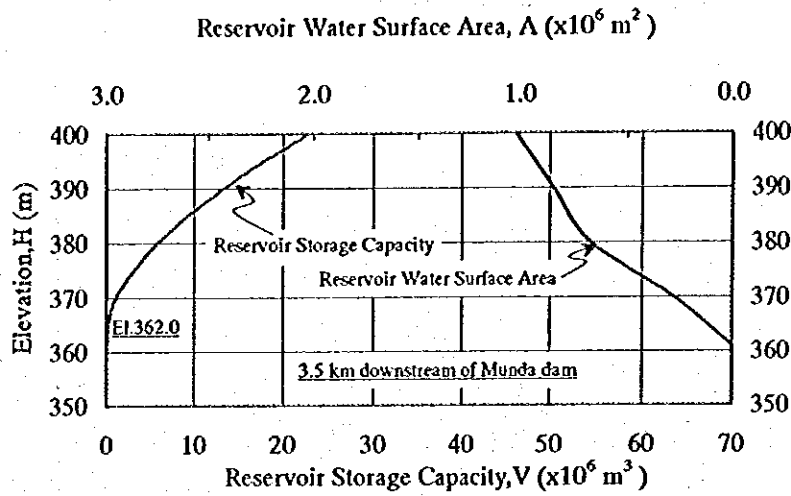
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Figure G1.5
Flow Chart of Reservoir Simulation Model

- Where,
- Reservoir**
 - FSL: Full supply level (El.m)
 - MOL: Minimum operating level (El.m)
 - WL1: Water level at the beginning of month (El.m)
 - WL2: Water level at the end of month (El.m)
 - WL: Monthly average water level (El.m)
 - Smax: Maximum storage volume (at FSL) (mill.m³)
 - Smin: Minimum storage volume (at MOL) (mill.m³)
 - S1: Storage volume at the beginning of month (mill.m³)
 - S2: Storage volume at the end of month (mill.m³)
 - Se: Effective storage volume (m)
 - Tailrace**
 - Hevap: Evaporation depth (El.m)
 - TWLp: Tail water level for generation (El.m)
 - TWLre: Water level of re-regulation pond (El.m)
 - TWL1: Tail water level of maximum discharge (m³/sec)
 - Qin: Inflow discharge (m³/sec)
 - Qspill: Spillout discharge (m³/sec)
 - Qpmax: Maximum discharge for power generation (m³/sec)
 - Qpeak: Peak generation discharge (m³/sec)
 - Qnp: Non-peak generation discharge (m³/sec)
 - Discharge**
 - Qpeak: Peak generation discharge (m³/sec)
 - Qnp: Non-peak generation discharge (m³/sec)
 - Volume**
 - Vin: Inflow volume (mill.m³)
 - Vevap: Evaporation volume (mill.m³)
 - Virr: Irrigation volume (mill.m³)
 - Vspill: Spillout volume (mill.m³)
 - Vmax: Maximum volume for power generation (mill.m³)
 - Vmin: Minimum volume for power generation (mill.m³)
 - Vpeak: Peak generation volume (mill.m³)
 - Vnp: Non-peak generation volume (mill.m³)
 - Hydropower**
 - UnitN: Total installed capacity (MW)
 - PeakH: Peak generation unit (nos.)
 - Hepeak: Peak generation hour (hour)
 - Hepeak: Effective water head (m)
 - fg: Combined efficiency (-)
 - Ppeak: Peak power (MW)
 - Pnp: Non-peak power (MW)
 - Epeak: Peak energy (GWh)
 - Enp: Non-peak energy (GWh)

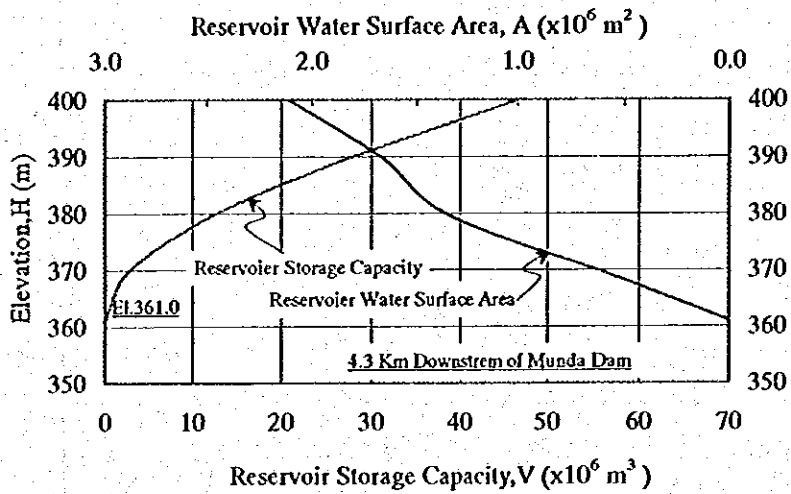


Note: The curves are derived from the aerephoto maps of 1/10,000 (WAPDA-JICA, 1999)



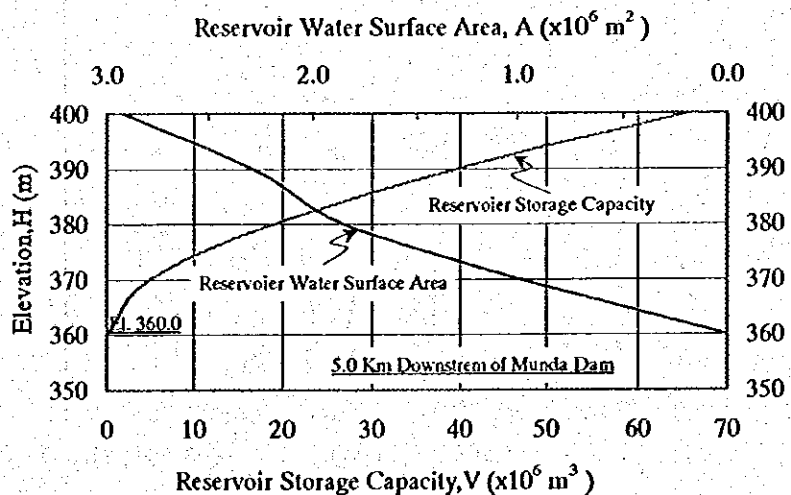
Site-A

H (El.m)	A ($\times 10^6 \text{ m}^2$)	V ($\times 10^6 \text{ m}^3$)
362	0.00	0.00
370	0.28	1.13
380	0.67	5.90
390	0.84	13.47
400	1.02	22.78



Site-B

H (El.m)	A (km^2)	V (mill.m ³)
361	0.00	0.00
370	0.63	2.85
380	1.36	12.83
390	1.67	27.98
400	2.11	46.87



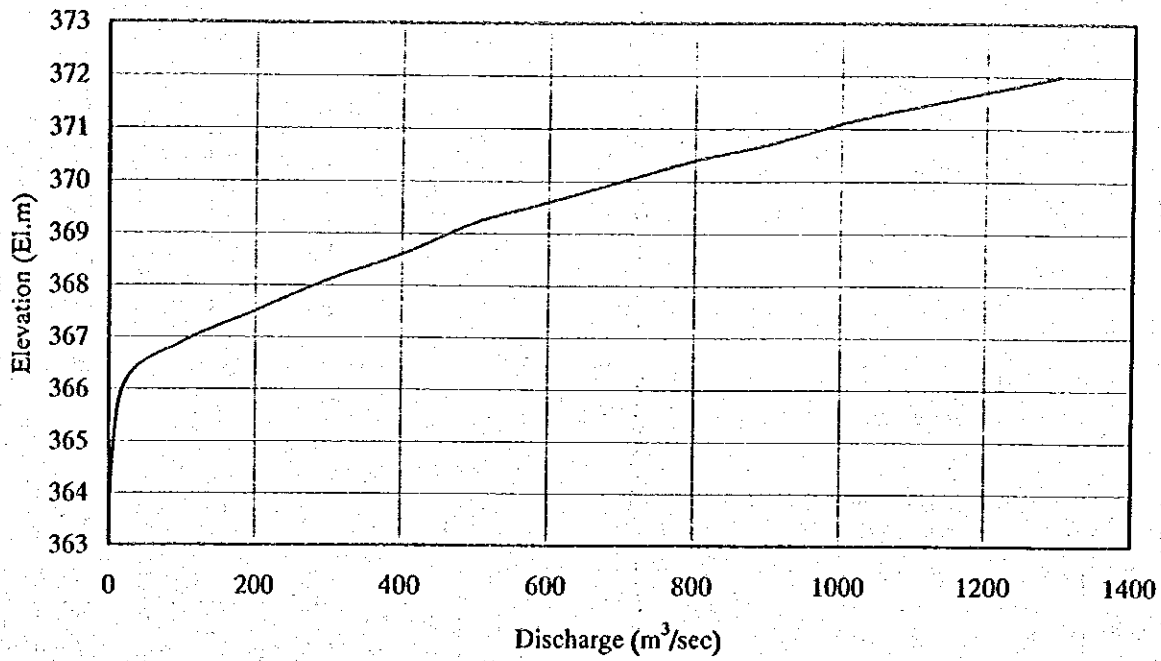
Site-C

H (El.m)	A (km^2)	V (mill.m ³)
360	0.00	0.00
370	0.98	4.92
380	1.85	19.11
390	2.28	39.78
400	2.92	65.78

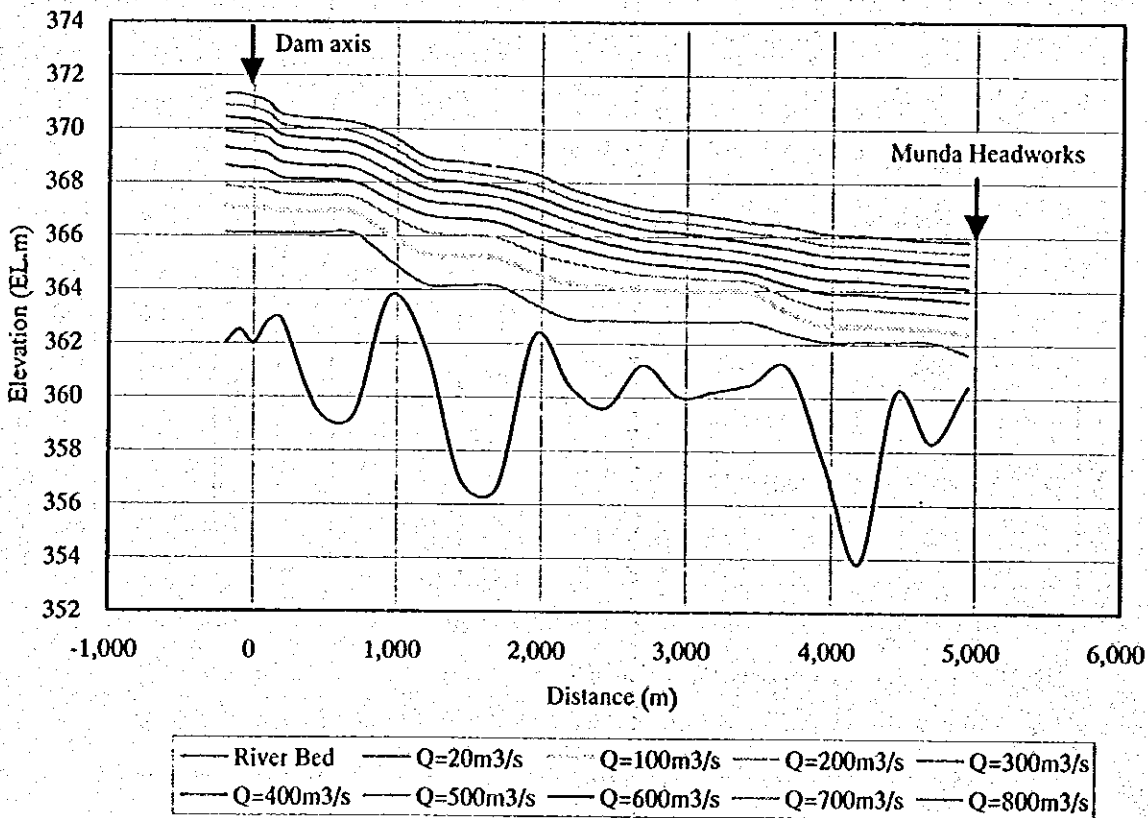
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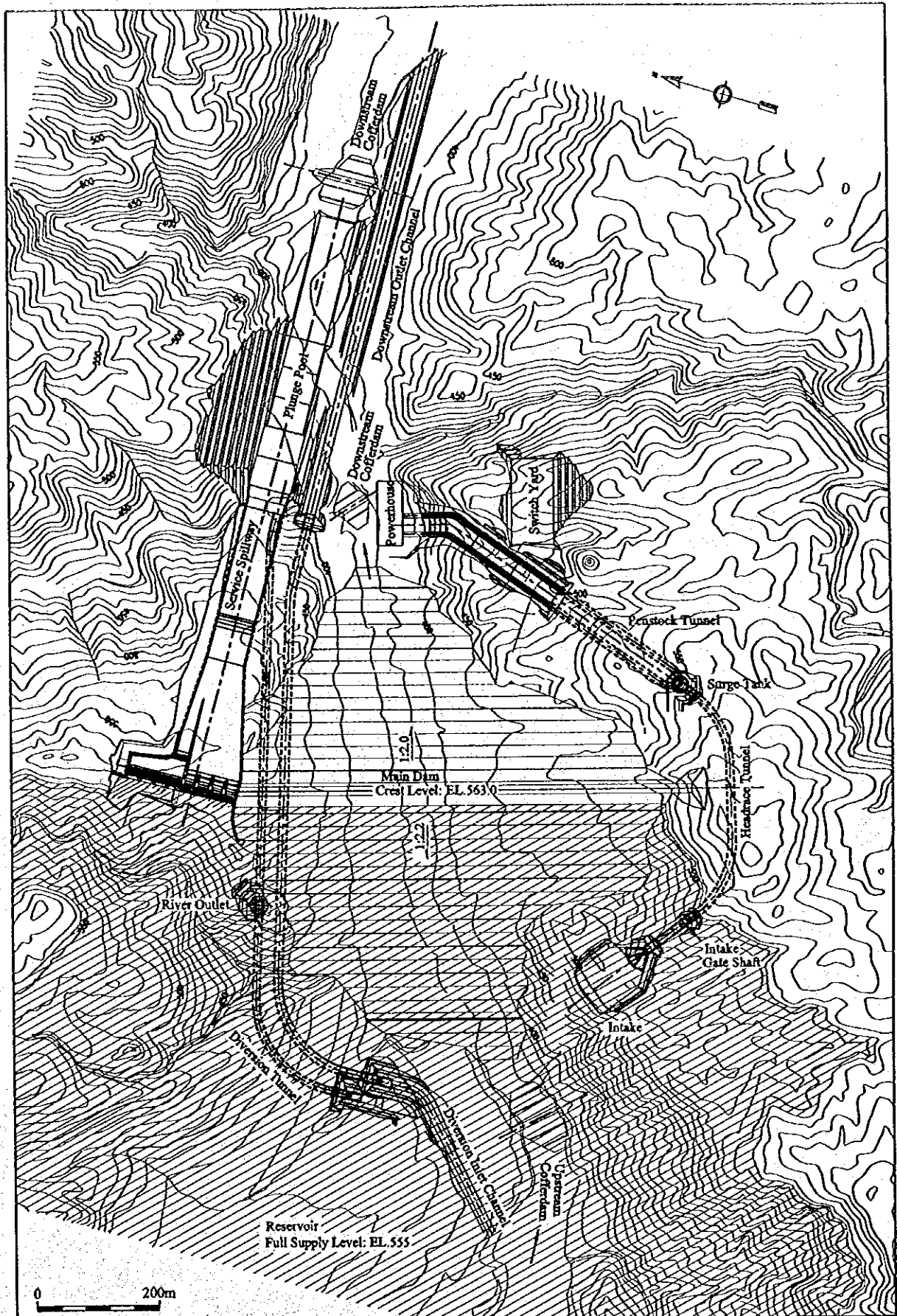
The curves are derived from the aerophoto maps of 1/10,000 (WAPDA-JICA, 1999)

Tailrace HQ Curve (400m downstream of Dam axis)



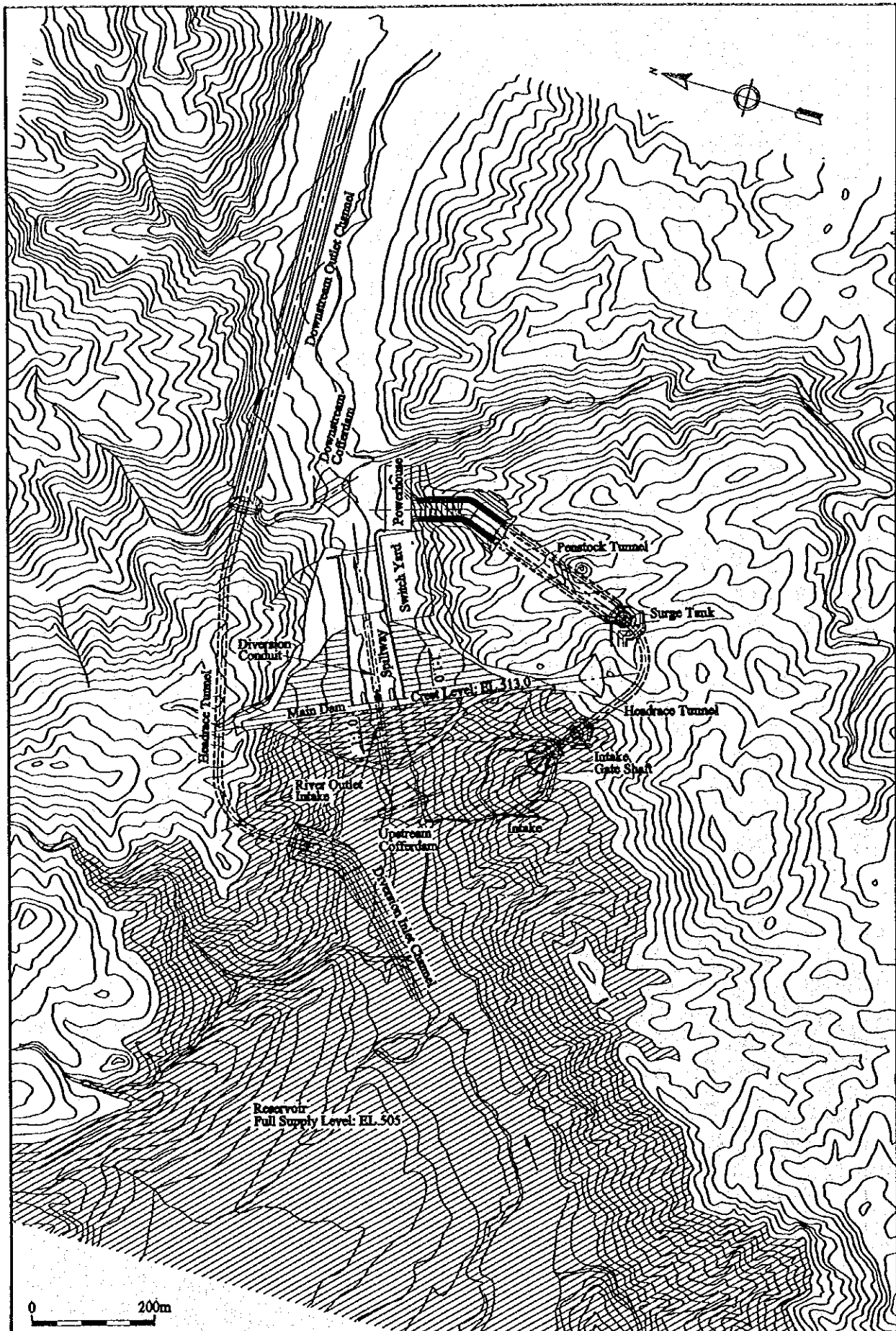
Water Surface Profile between Munda Dam and Headworks





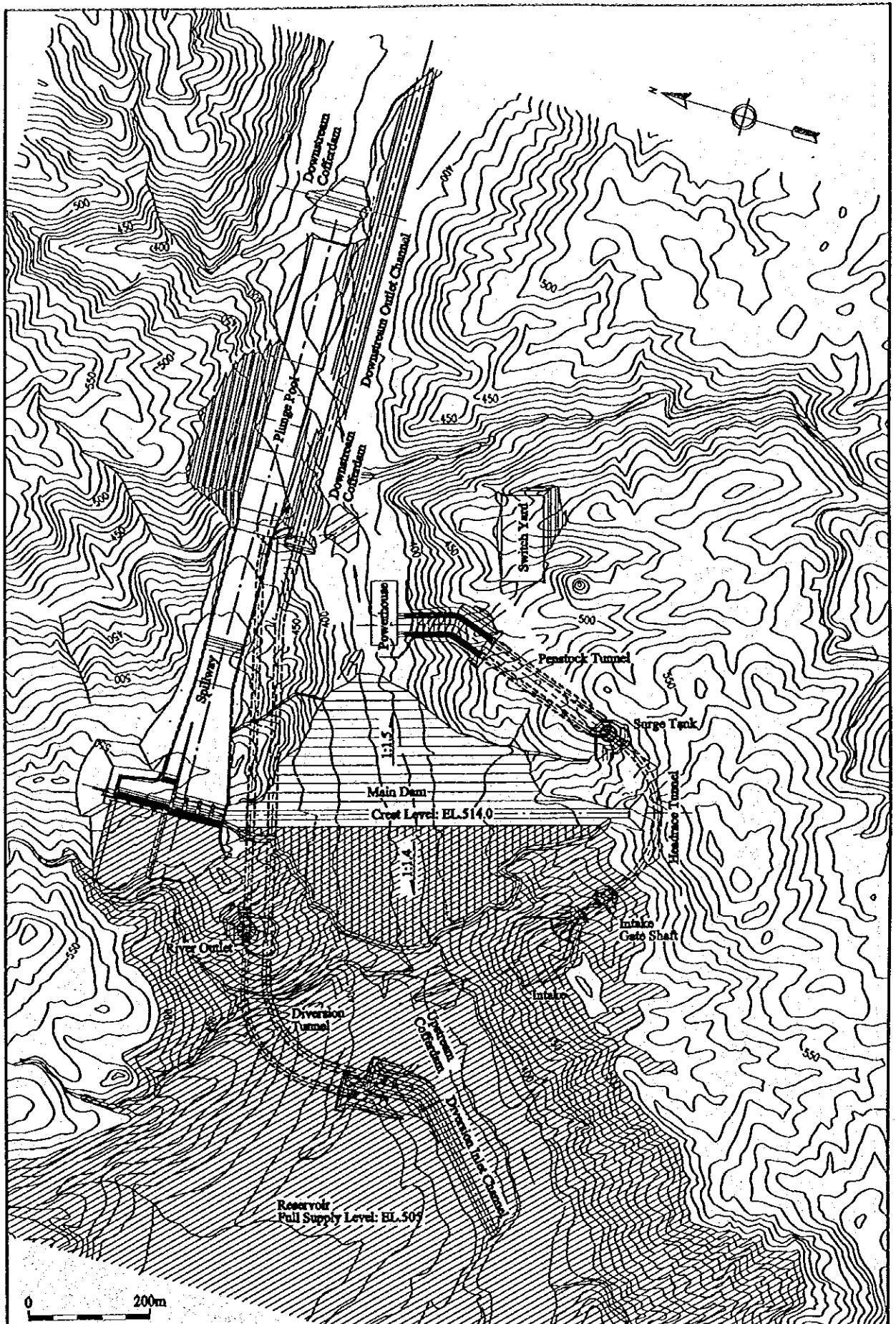
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Figure G1.9
 Alternative ECRD at Munda Site



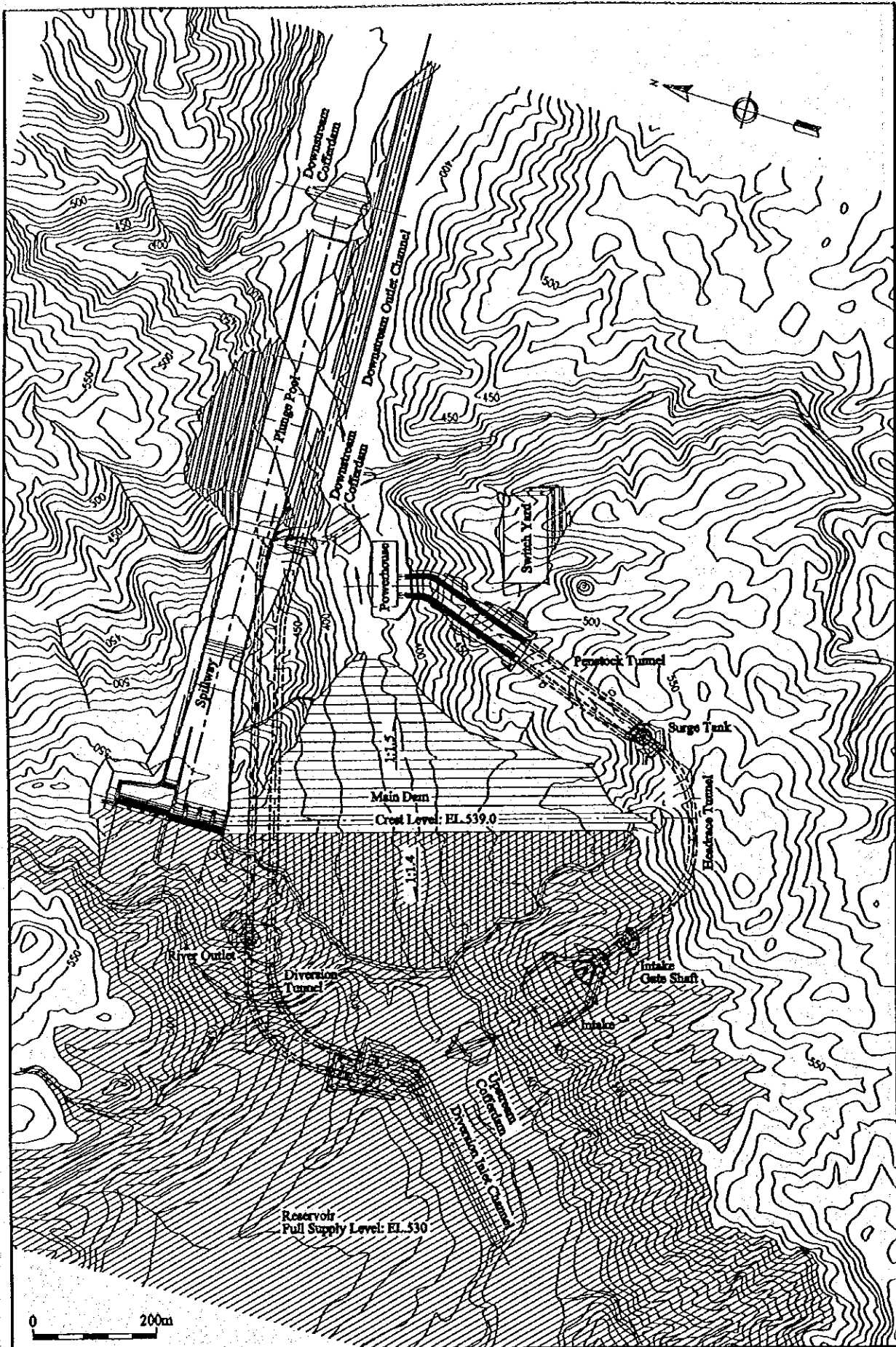
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Figure G1.10
 Alternative RCC at Munda Site



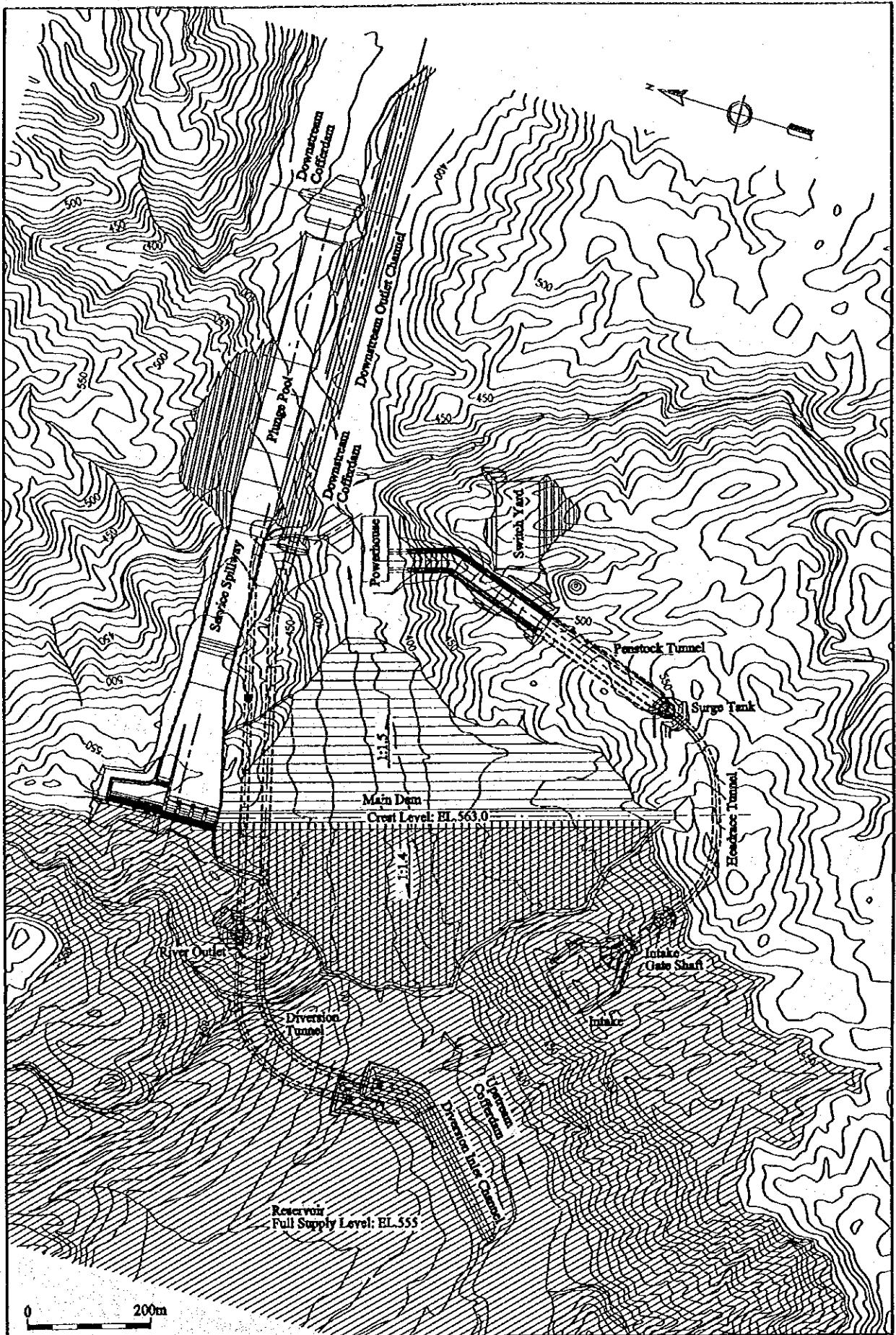
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Figure G1.11-1
 Layout of 164m High Dam at Munda Site



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Figure G1.11-2
 Layout of 189m High Dam at Munda Site



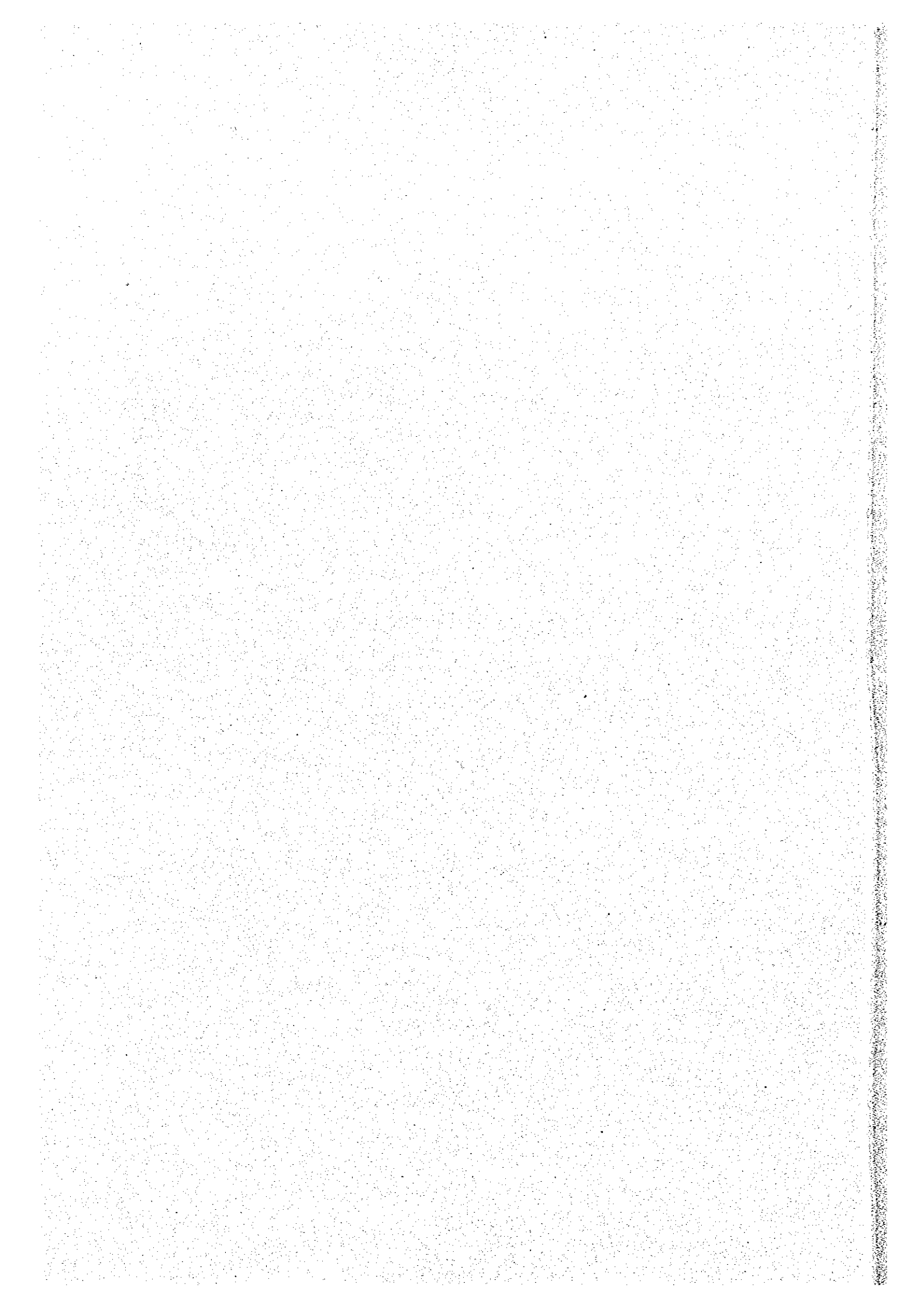
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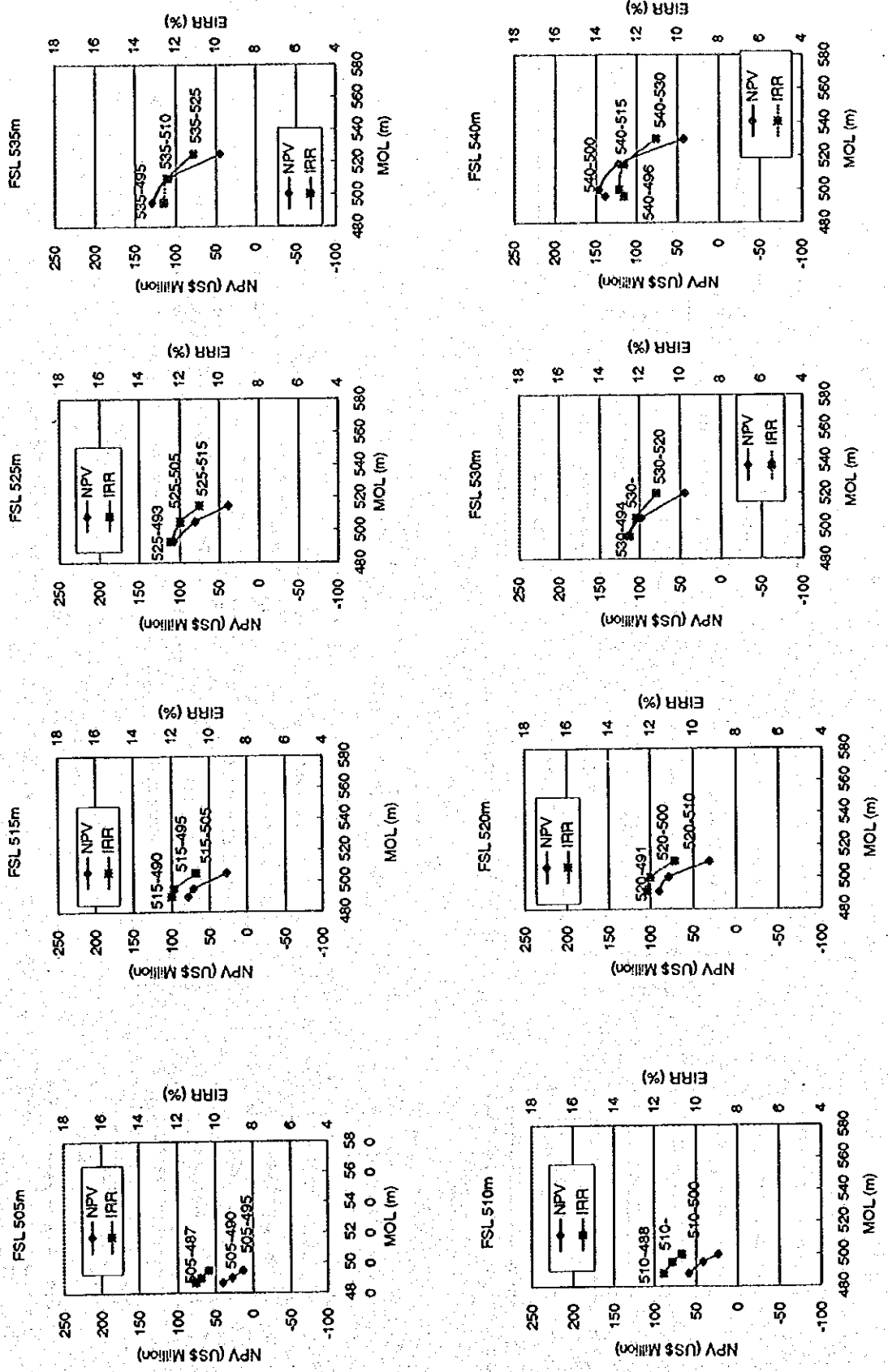
Figure G1.11-3
 Layout of 213m High Dam at Munda Site



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Figure G1.11-4
 Layout of 237m High Dam at Munda Site





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Figure G1.12
 NPV and EIRR for Alternative FSL and MOL (1/2)

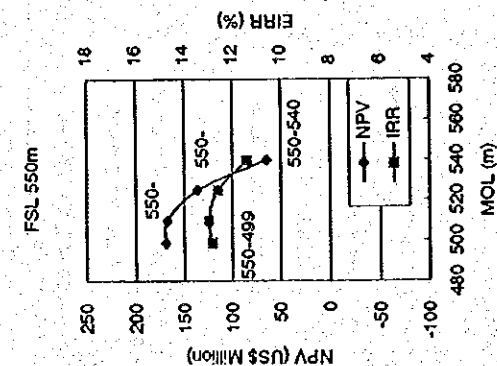
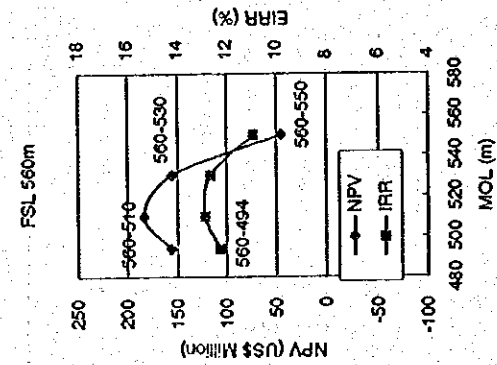
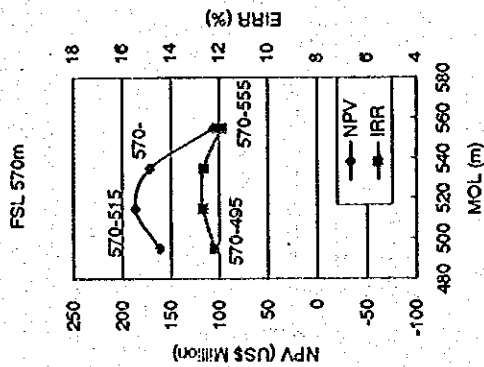
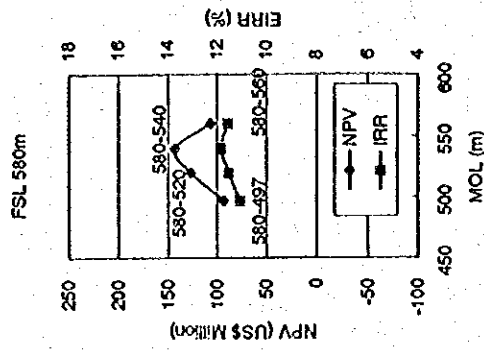
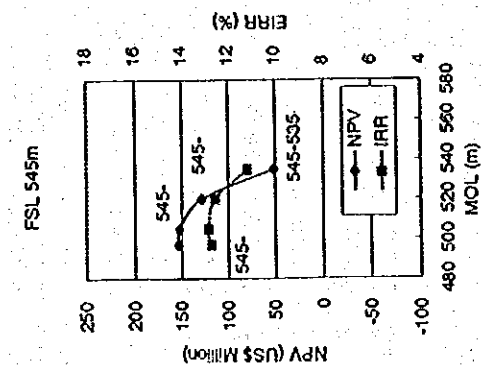
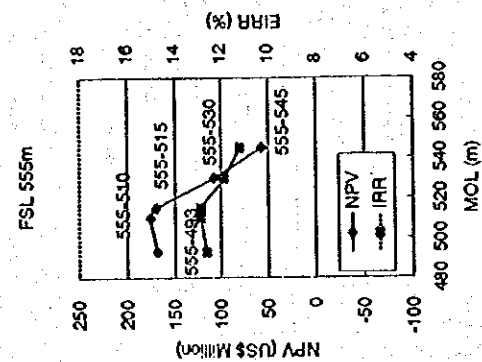
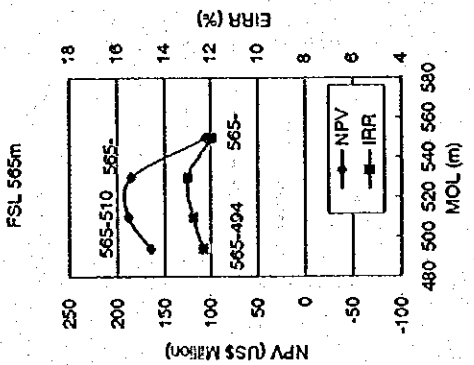
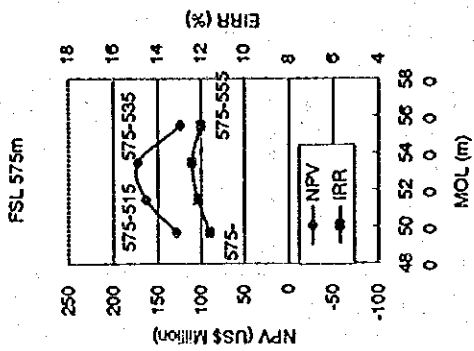
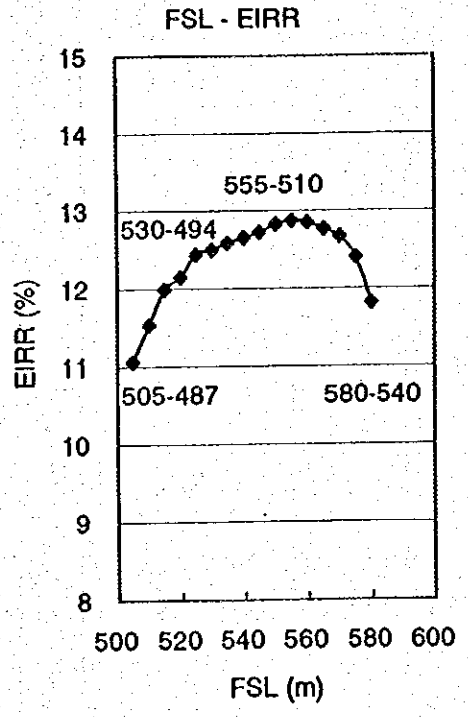
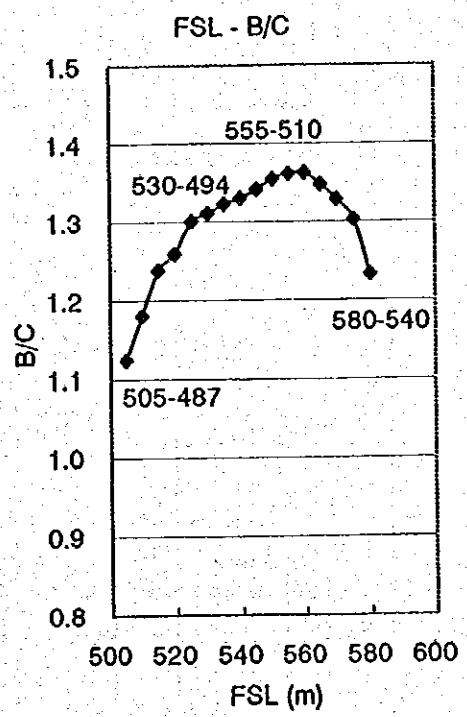
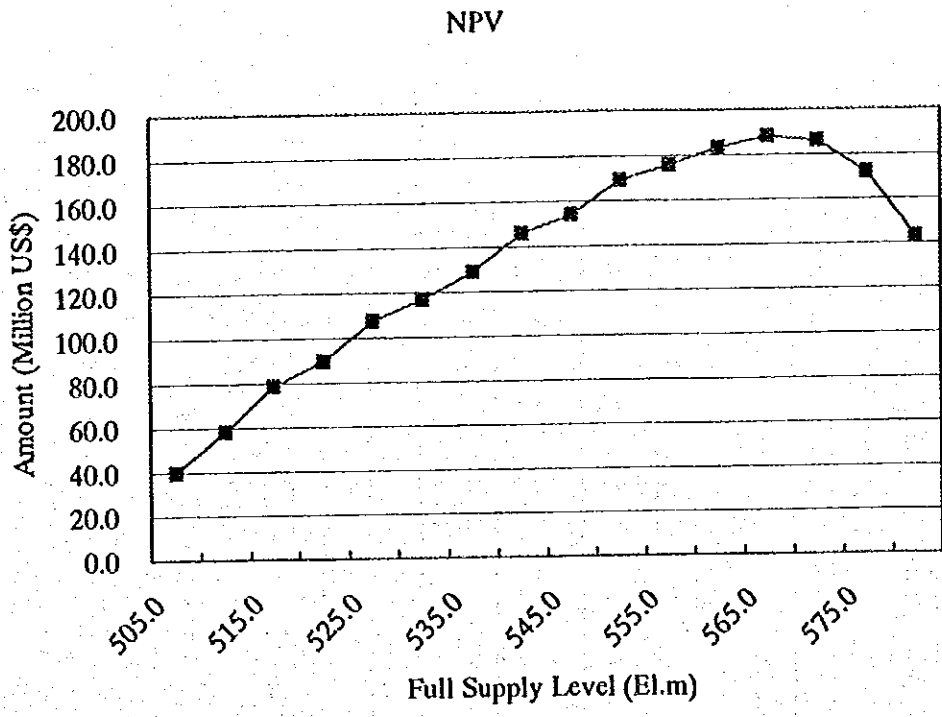
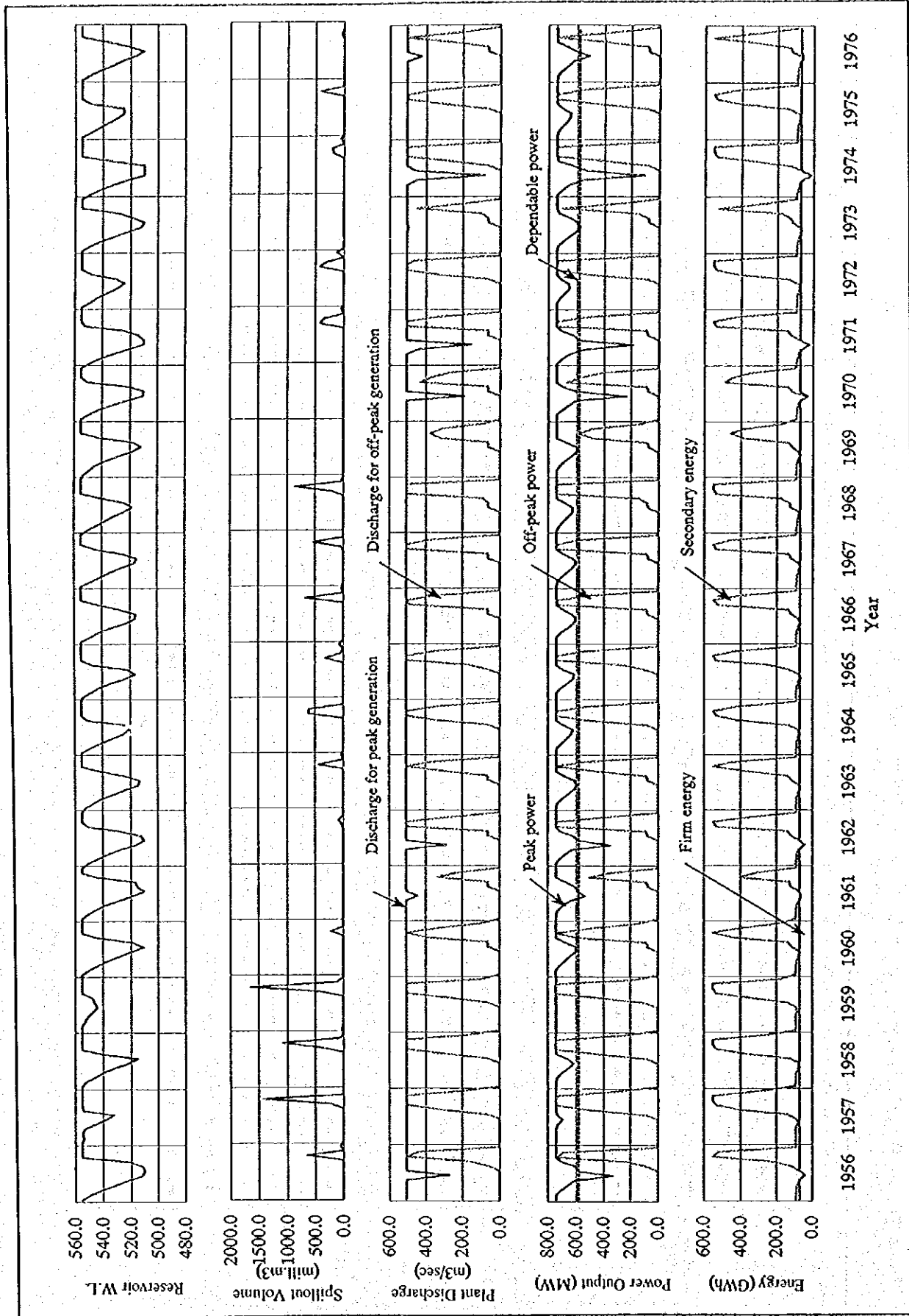


Figure G1.12
NPV and EIRR for Alternative FSL and MOL (2/2)



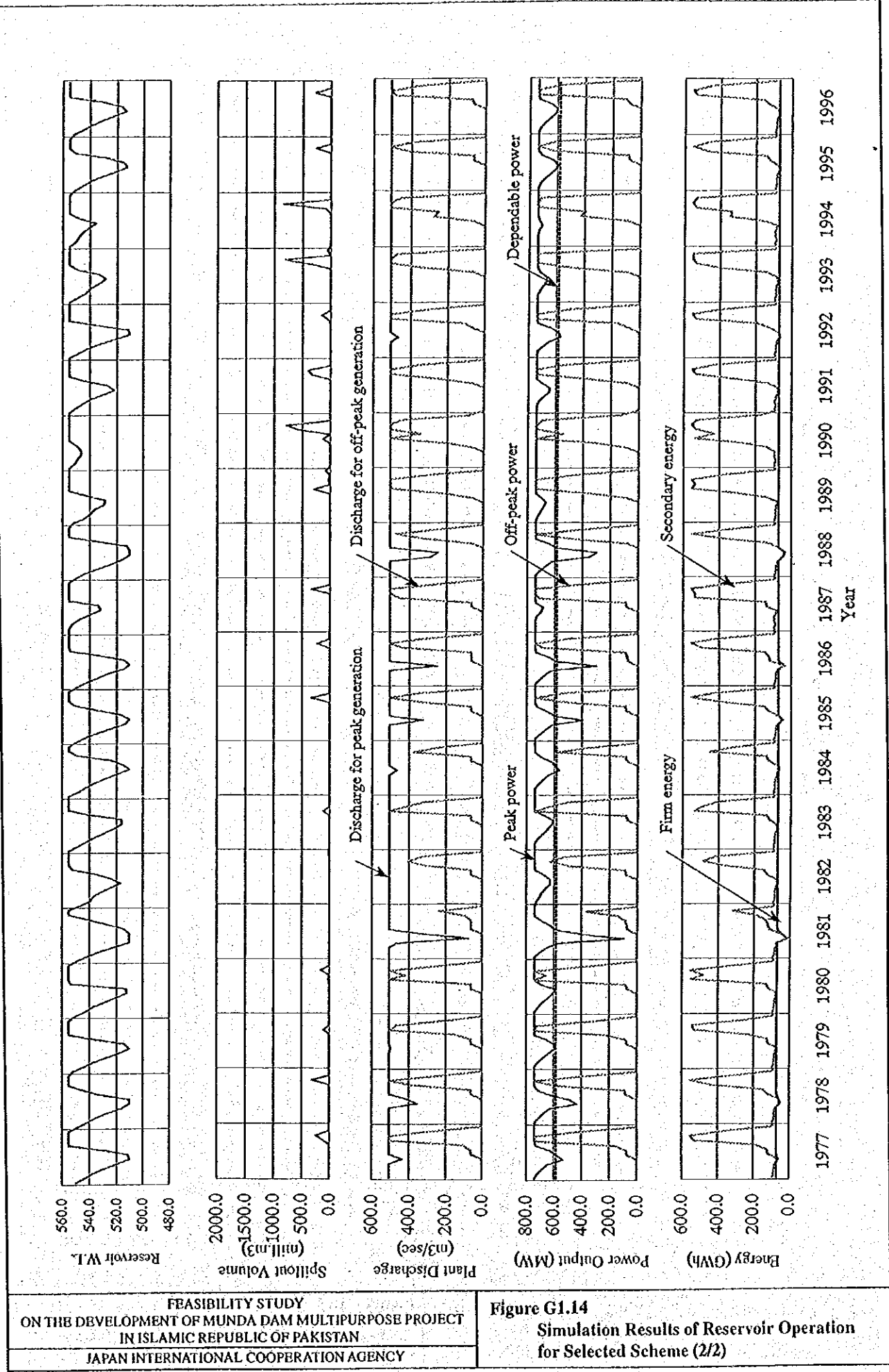
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Figure G1.13
Economic Indices for Alternative FSL



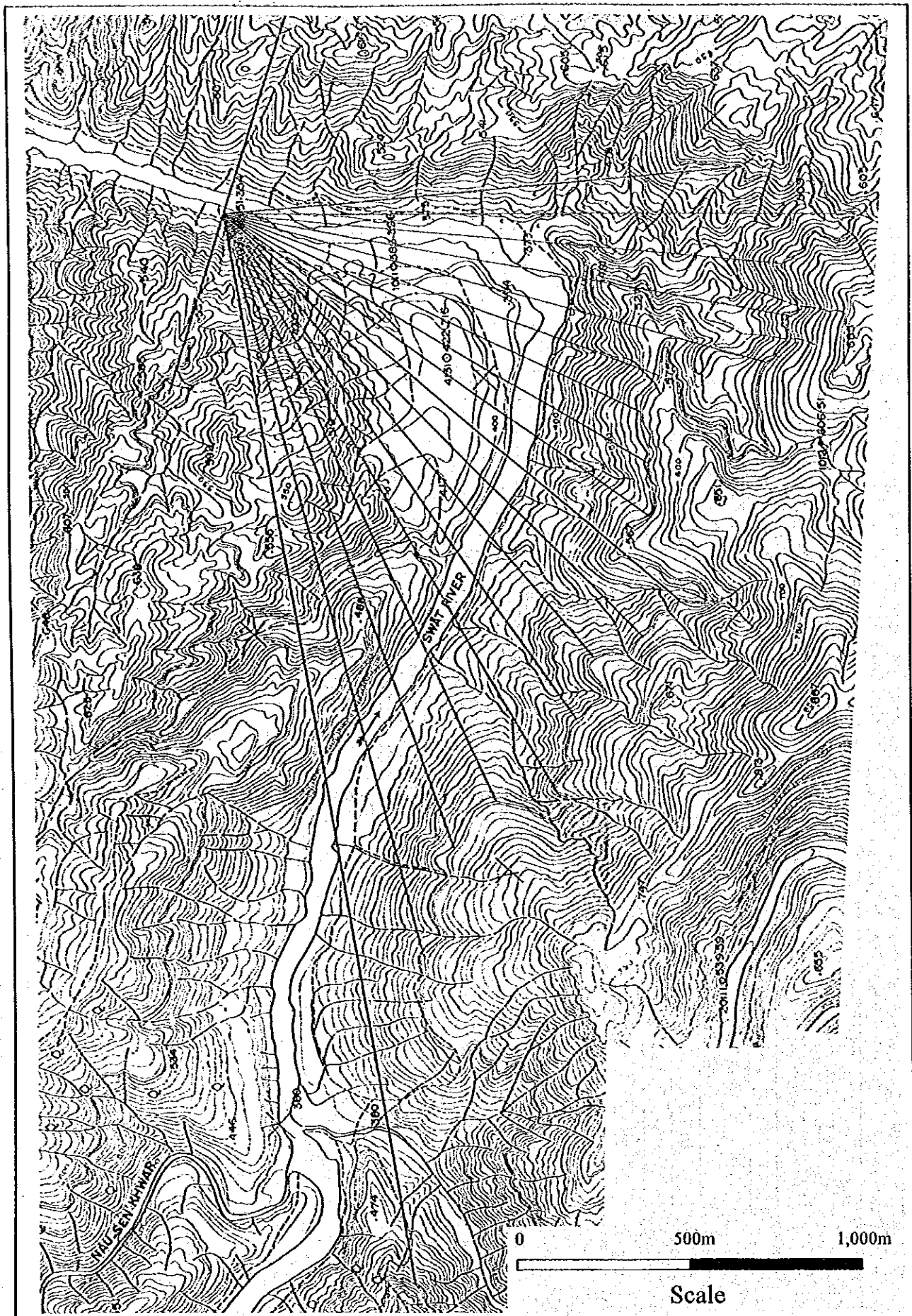
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Figure G1.14
 Simulation Results of Reservoir Operation
 for Selected Scheme (1/2)



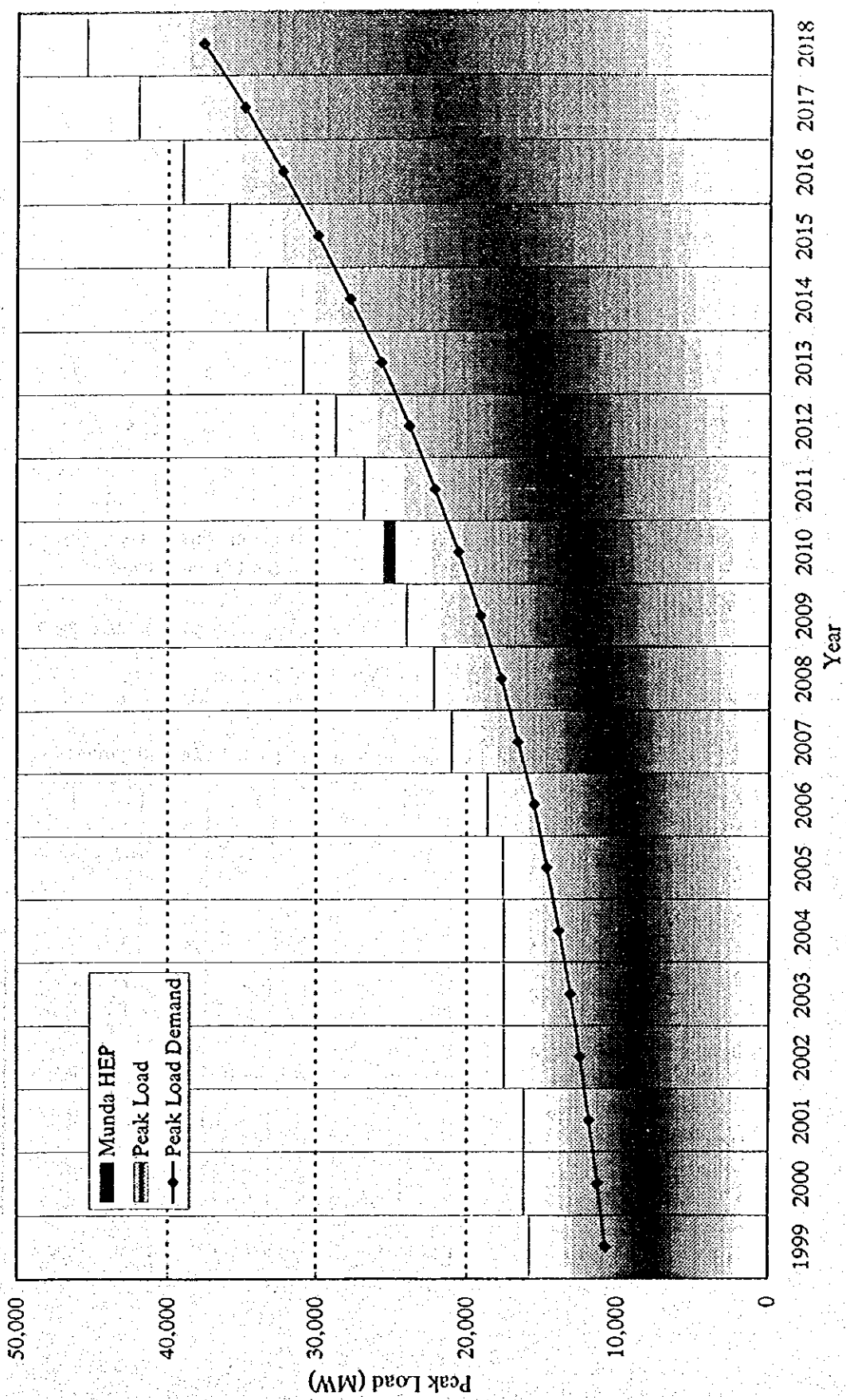
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Figure G1.14
 Simulation Results of Reservoir Operation
 for Selected Scheme (2/2)



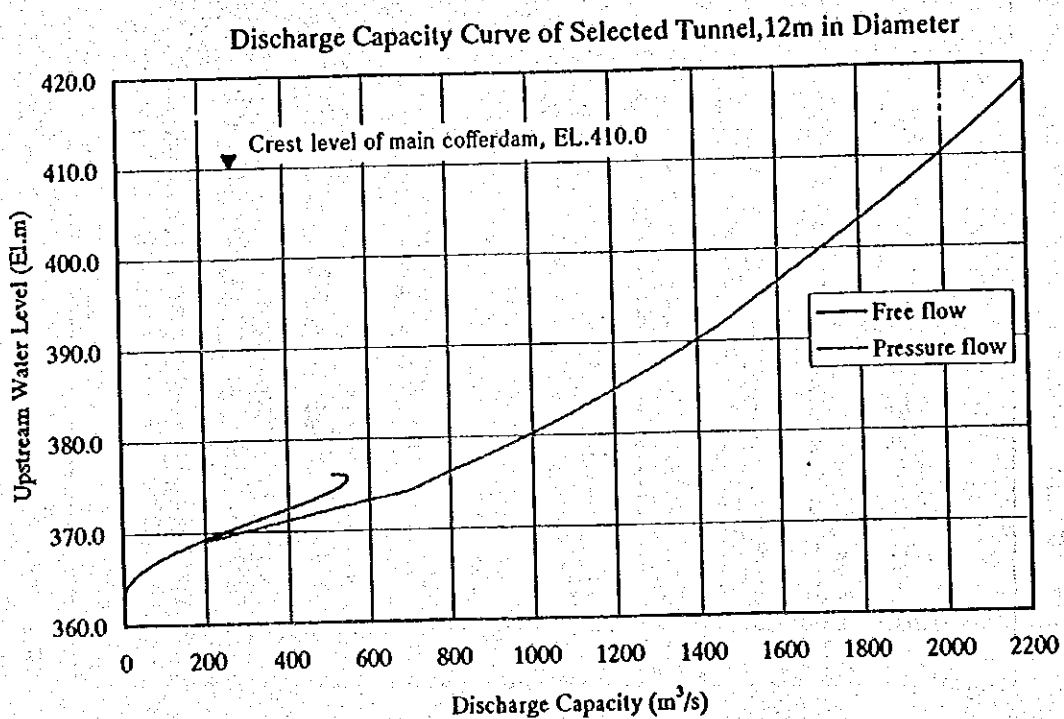
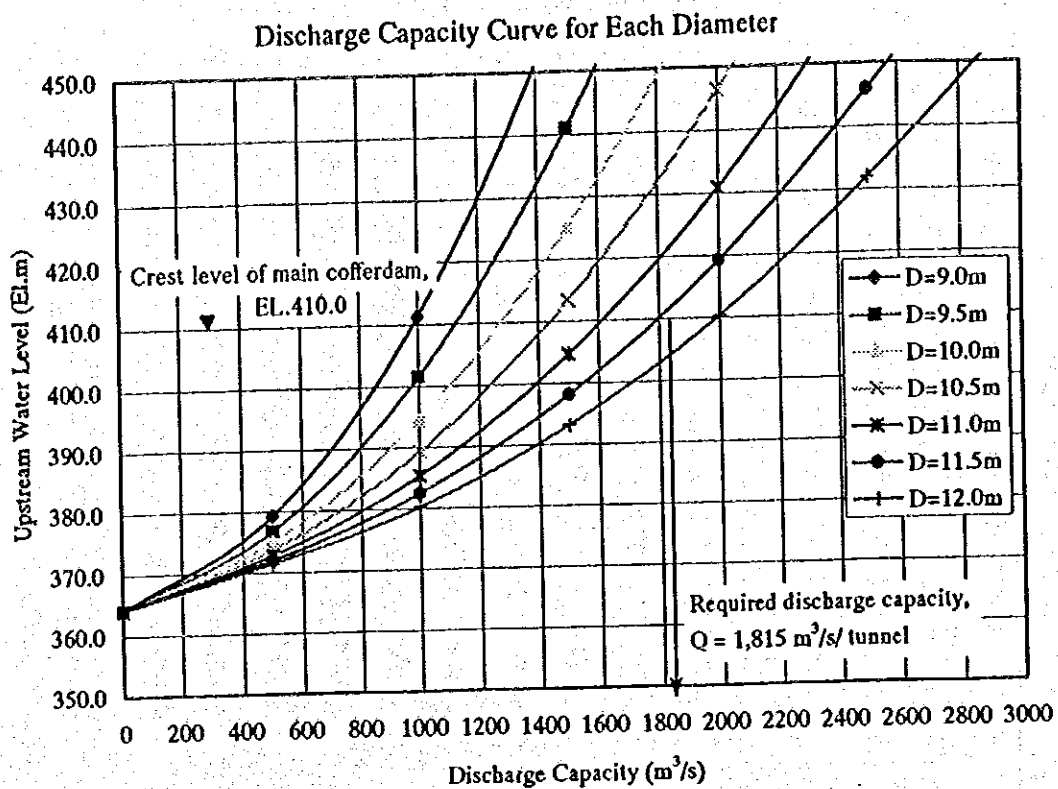
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Figure G1.15
 Estimate of Effective Fetch

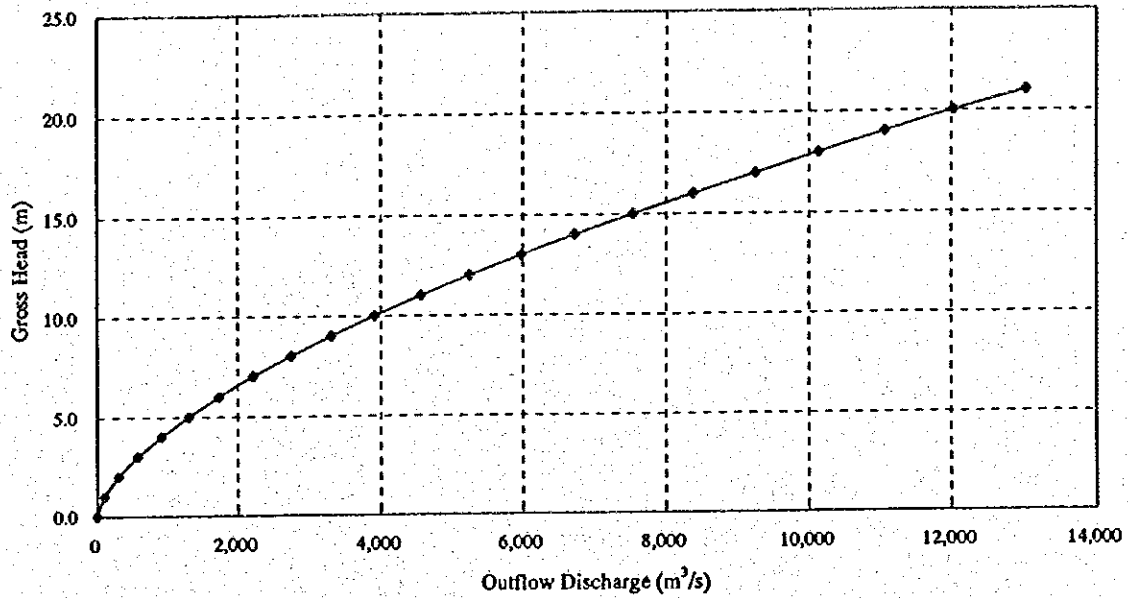


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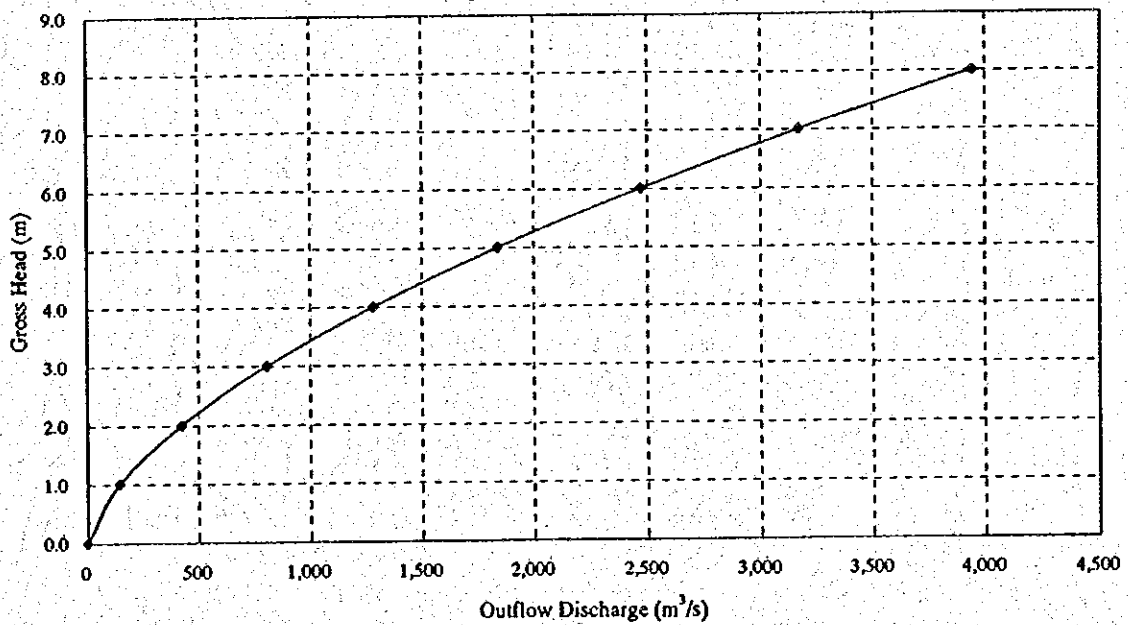
Figure G1.16
 Installed Capacity for Optimum Expansion Plan



**Gated Spillway
(Gates fully opened)**

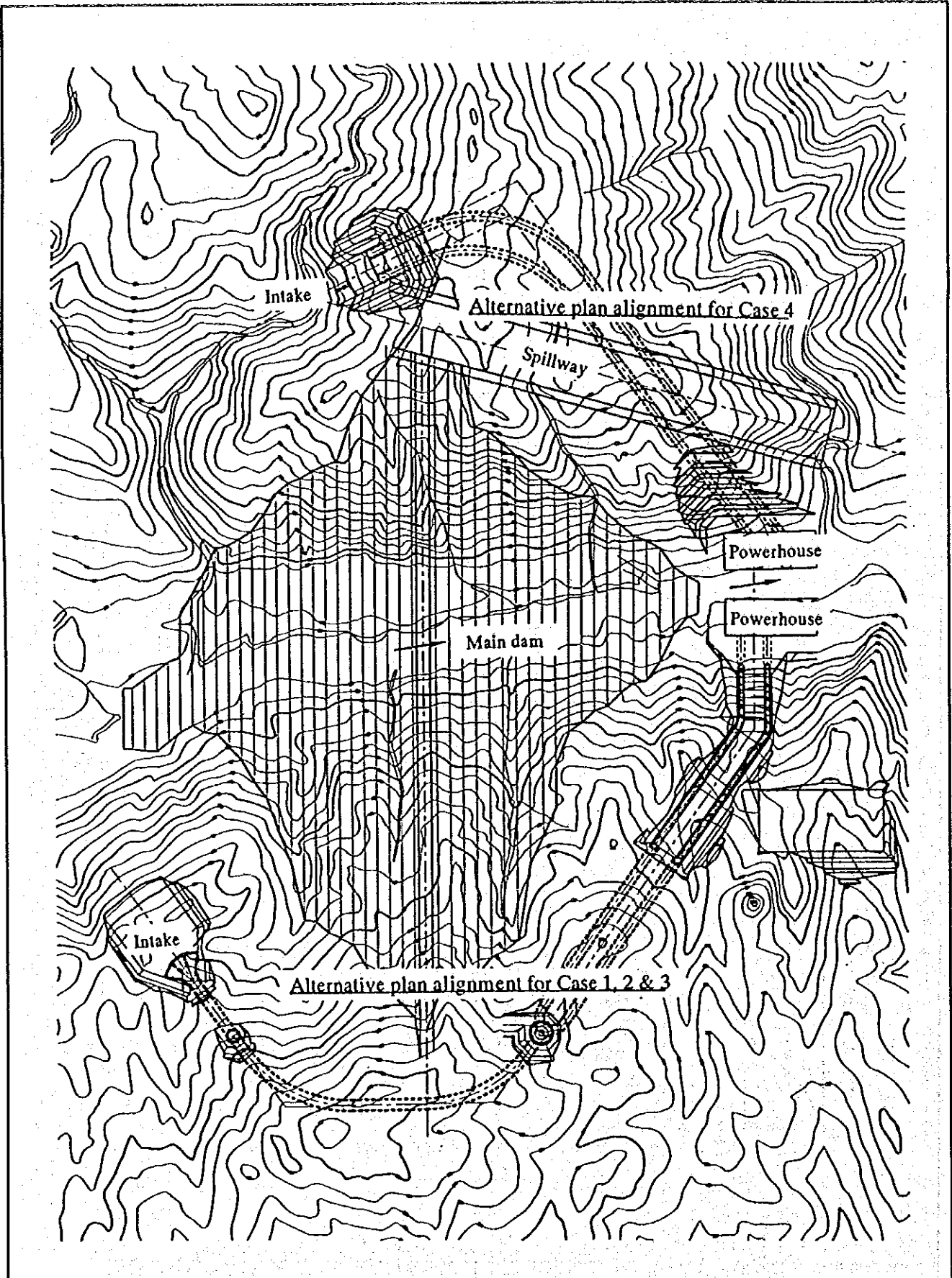


Non-gated Overflow Spillway



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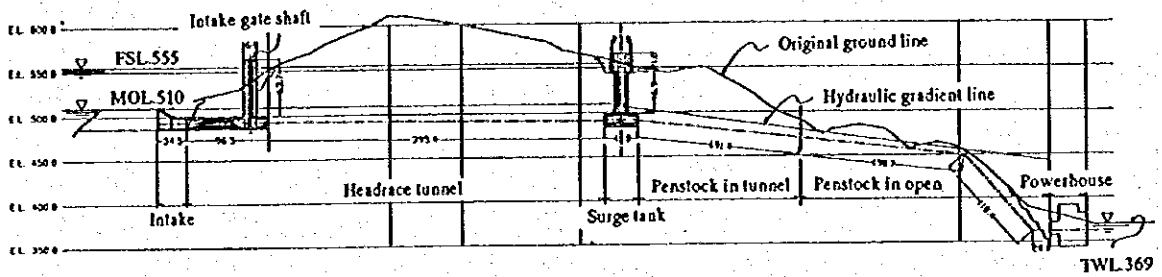
Figure G2.2
Discharge Capacity Curve of Spillway



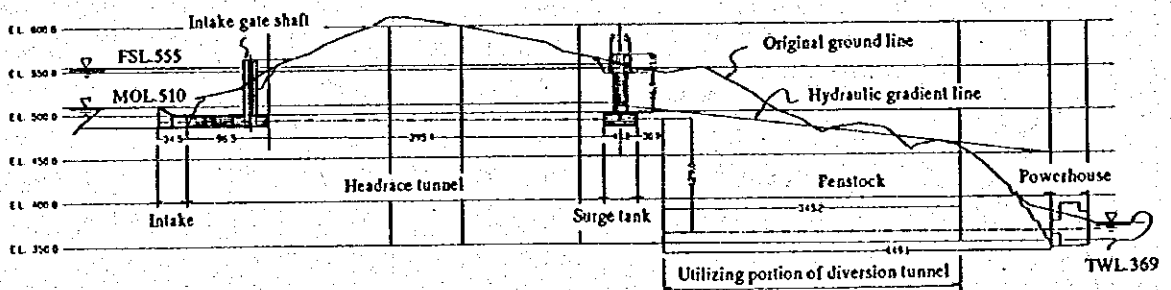
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Figure G2.3
 Waterway Route and Type Alternatives (1/2)

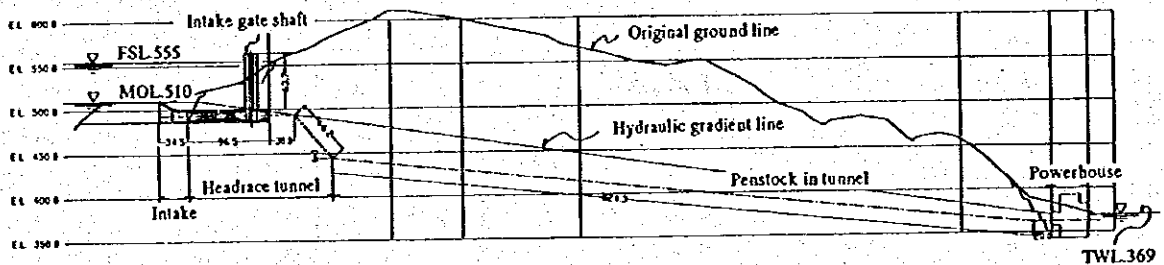
Case 1: Waterway with surge tank on right bank



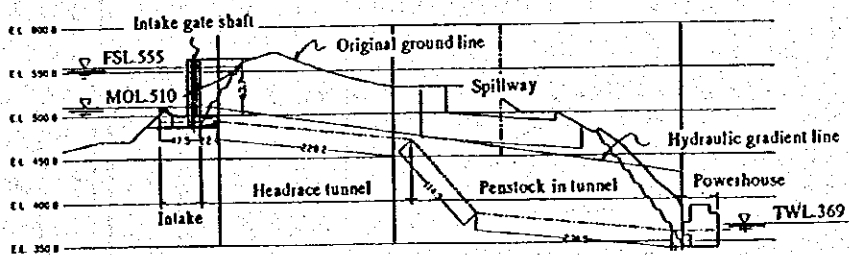
Case 2: Waterway with surge tank on right bank with utilizing diversion tunnel

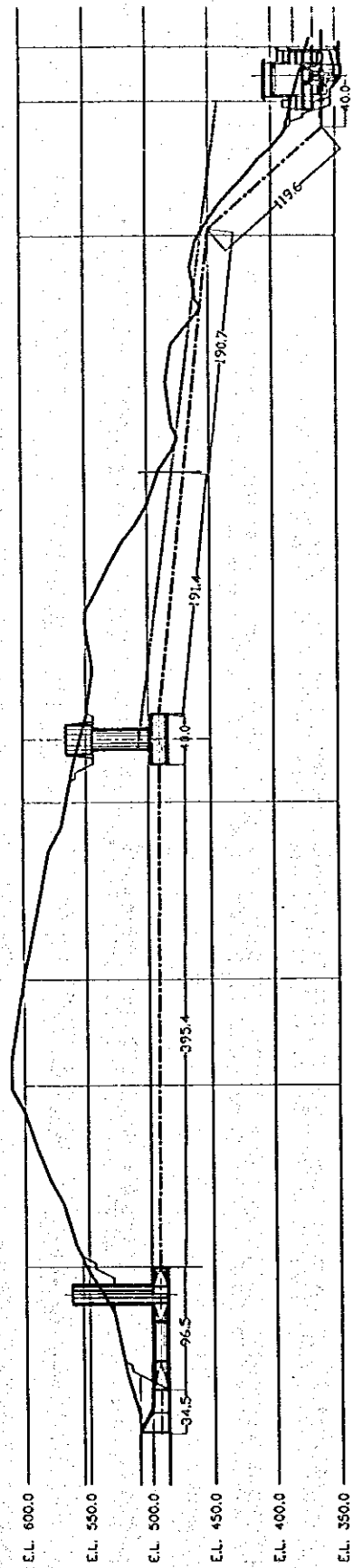
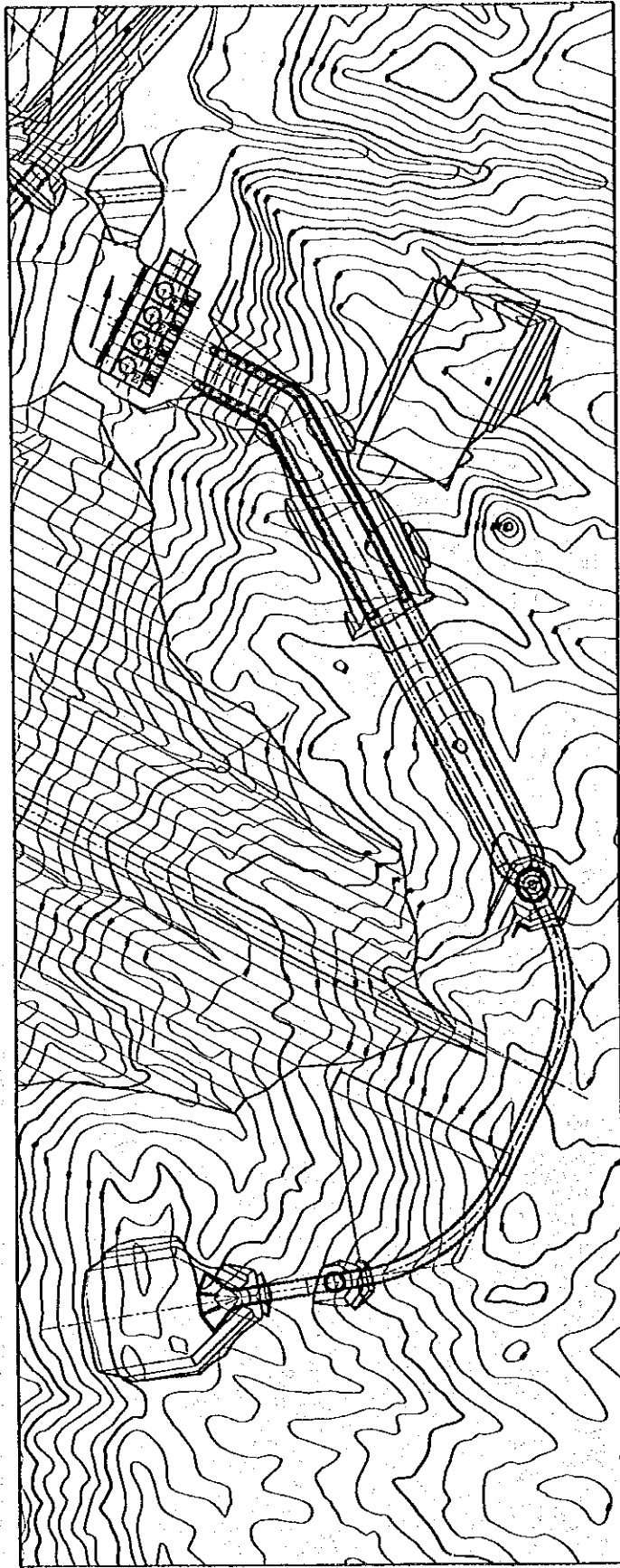


Case-3: Waterway without surge tank on right bank



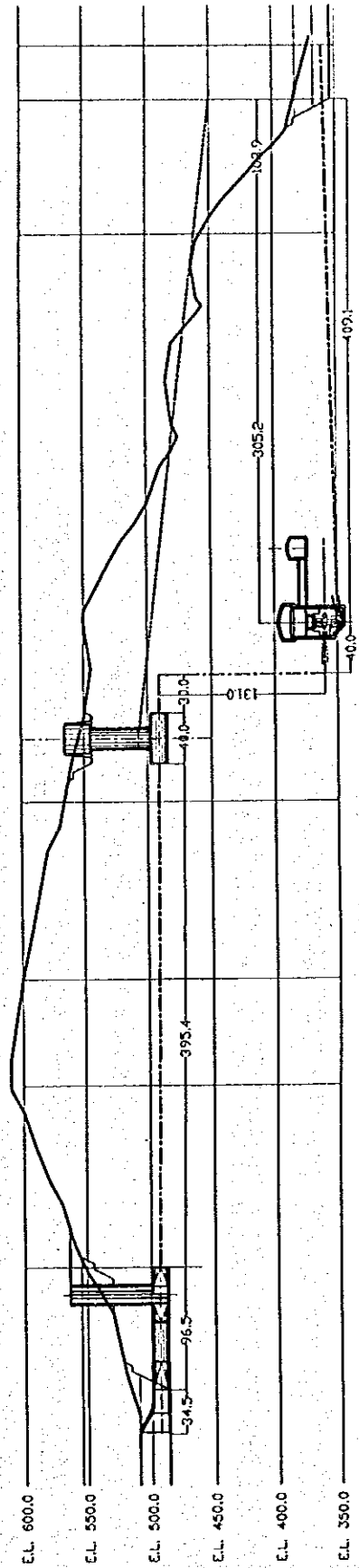
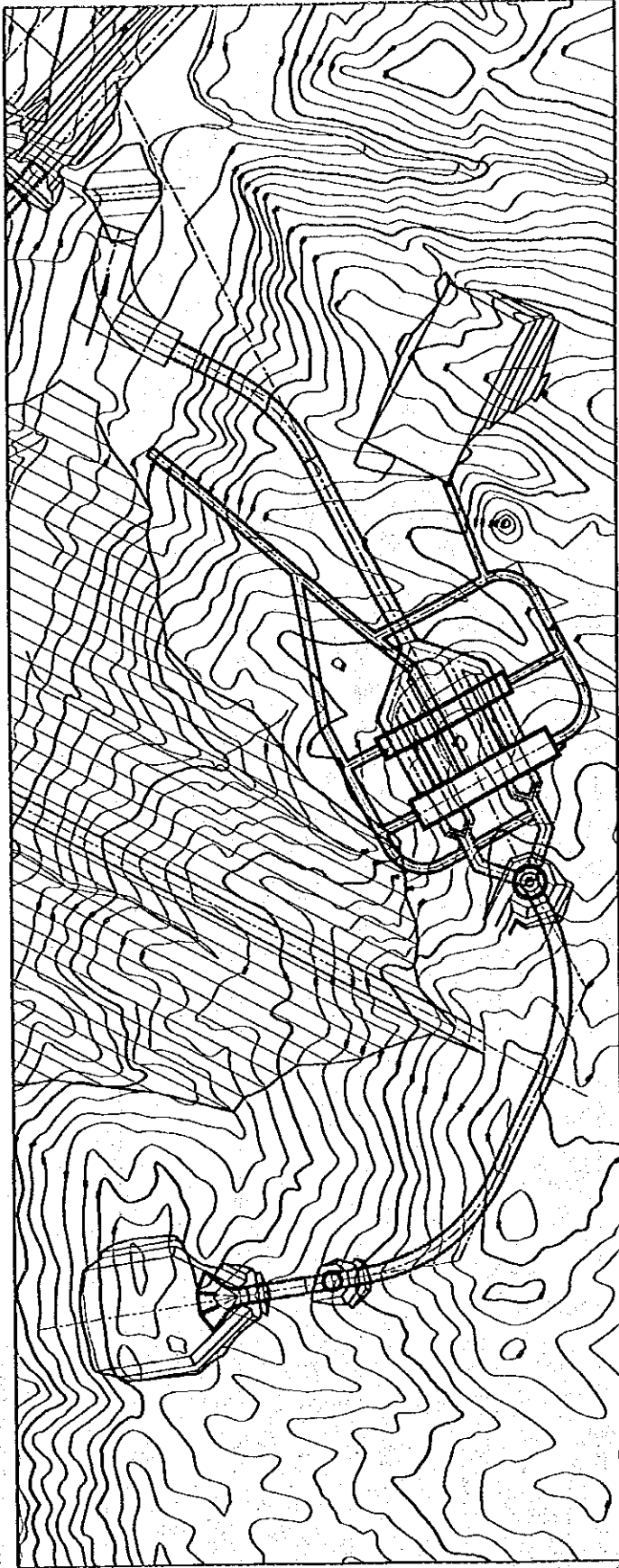
Case-4: Waterway without surge tank on left bank





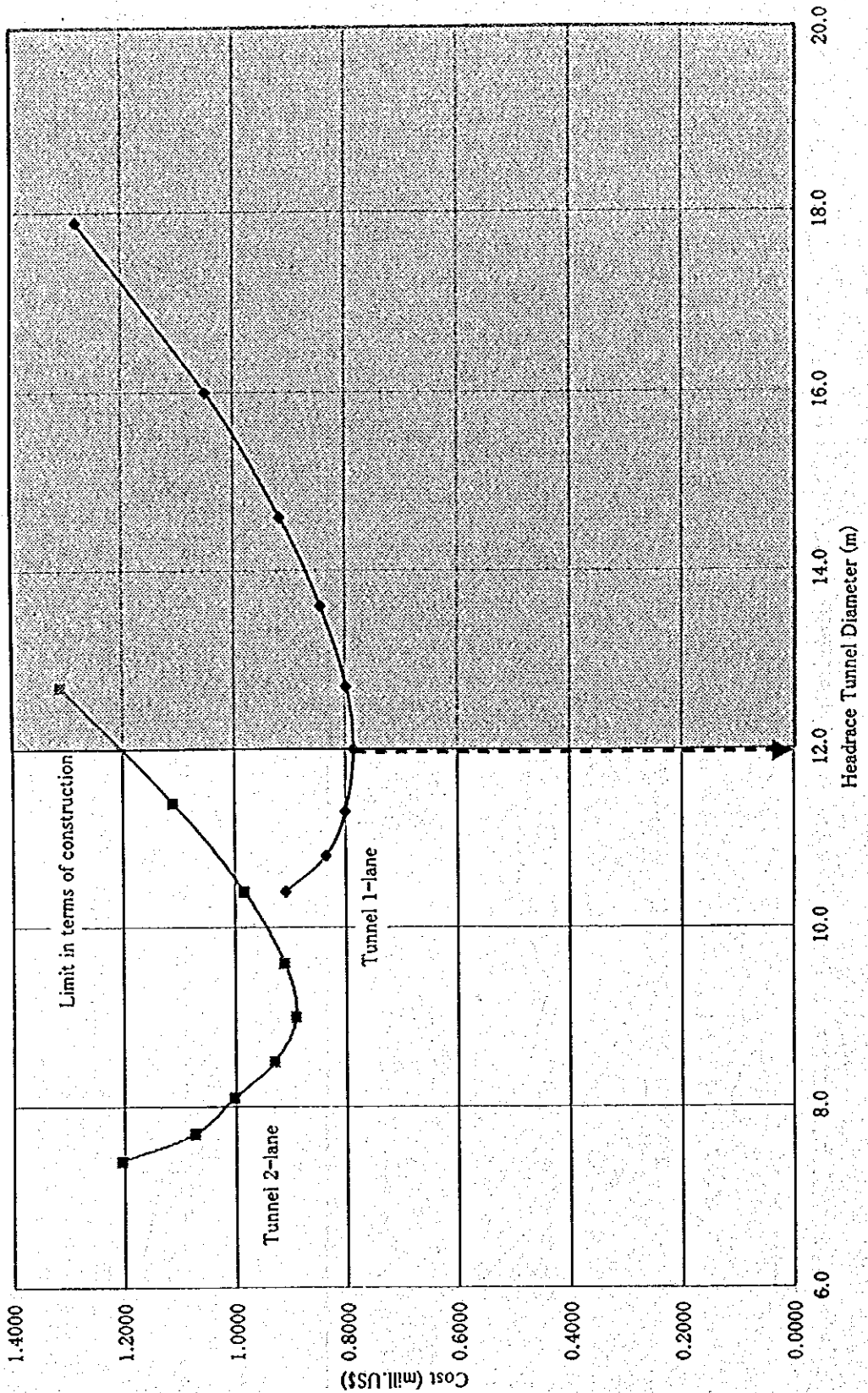
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Figure G2.4-1
 Right Bank Waterway Alternatives,
 Open-air Powerhouse



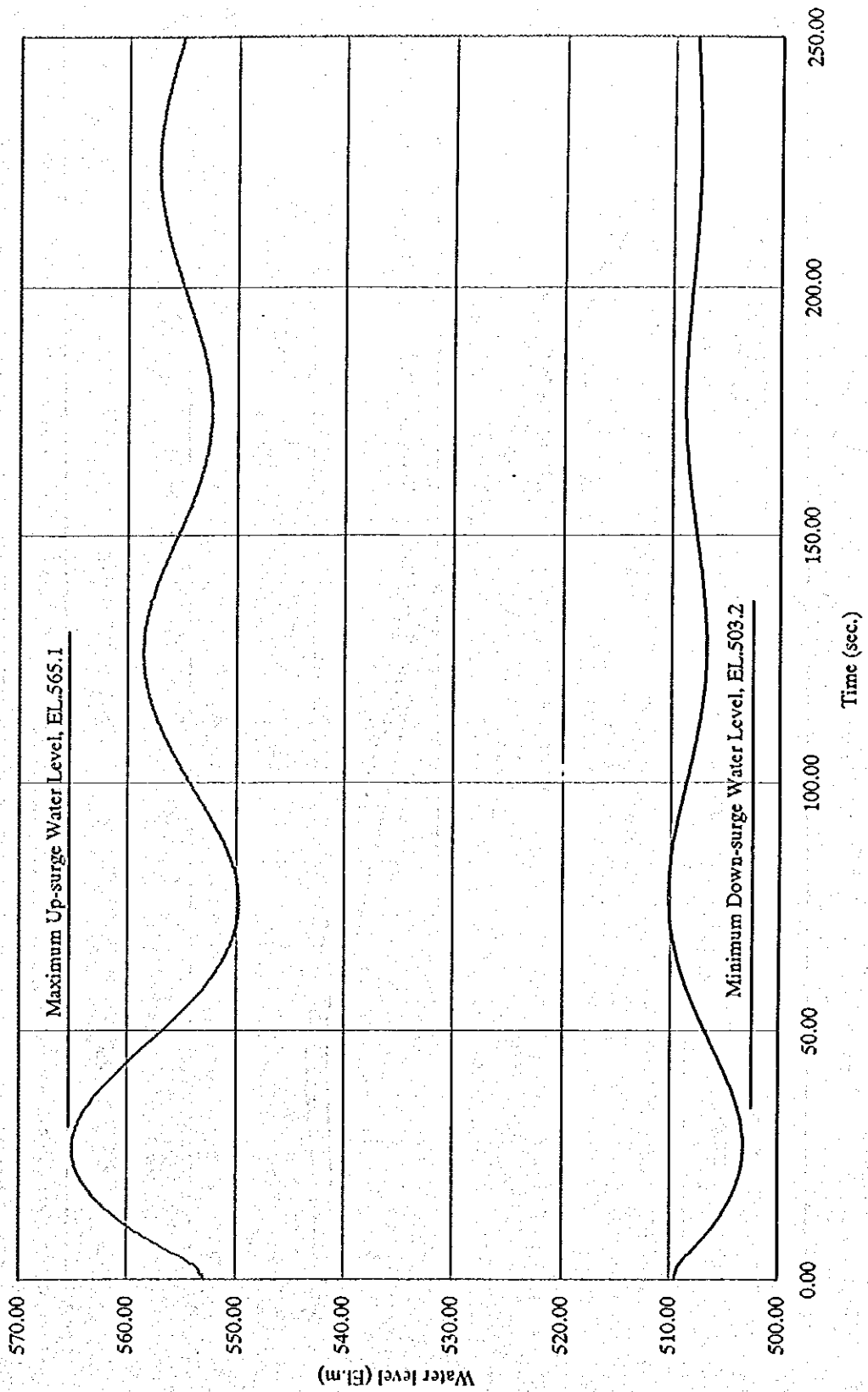
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Figure G2.4-2
 Right Bank Waterway Alternatives,
 Underground Powerhouse



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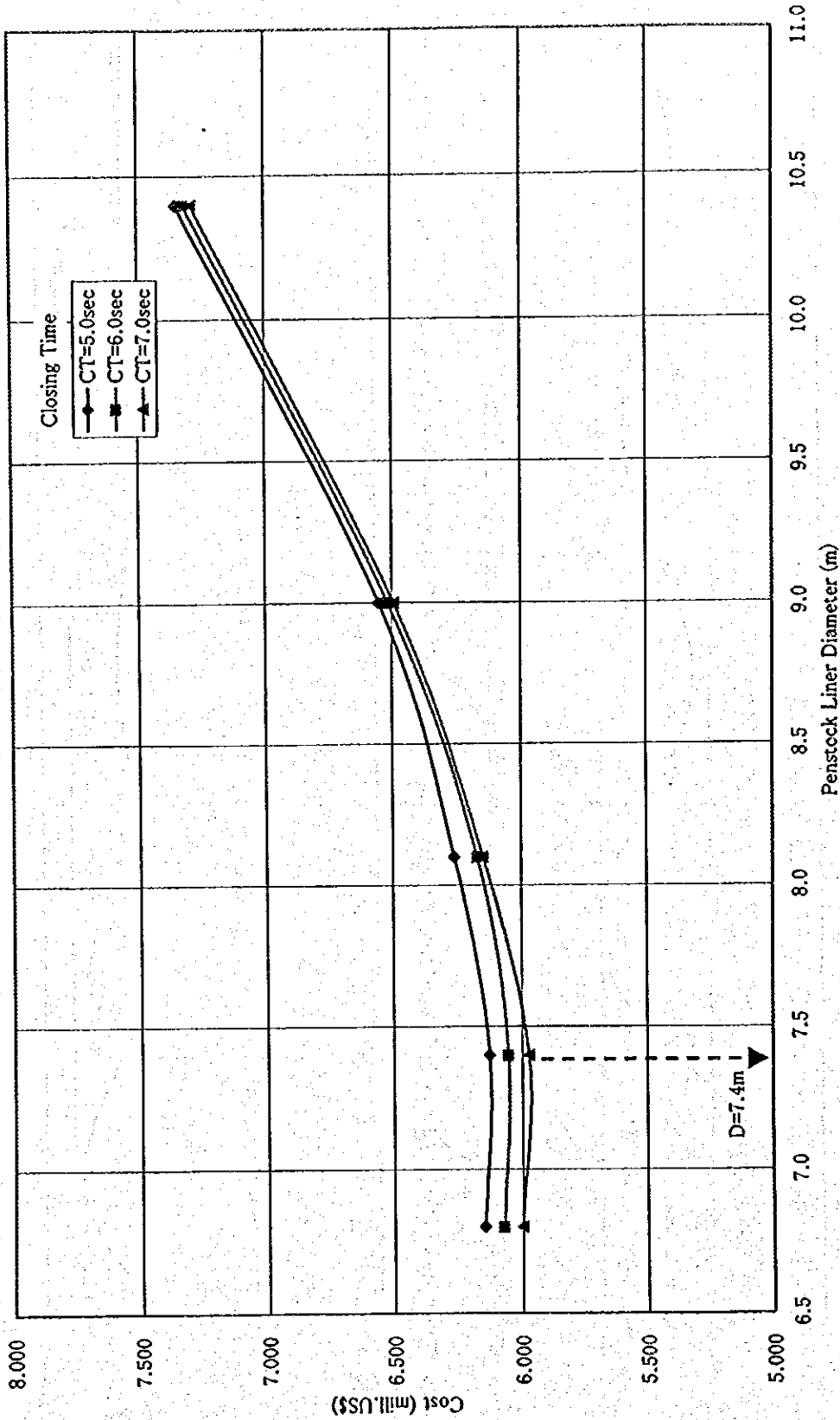
Figure G2.5
 Optimization of Headrace Tunnel Diameter



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Figure G2.6

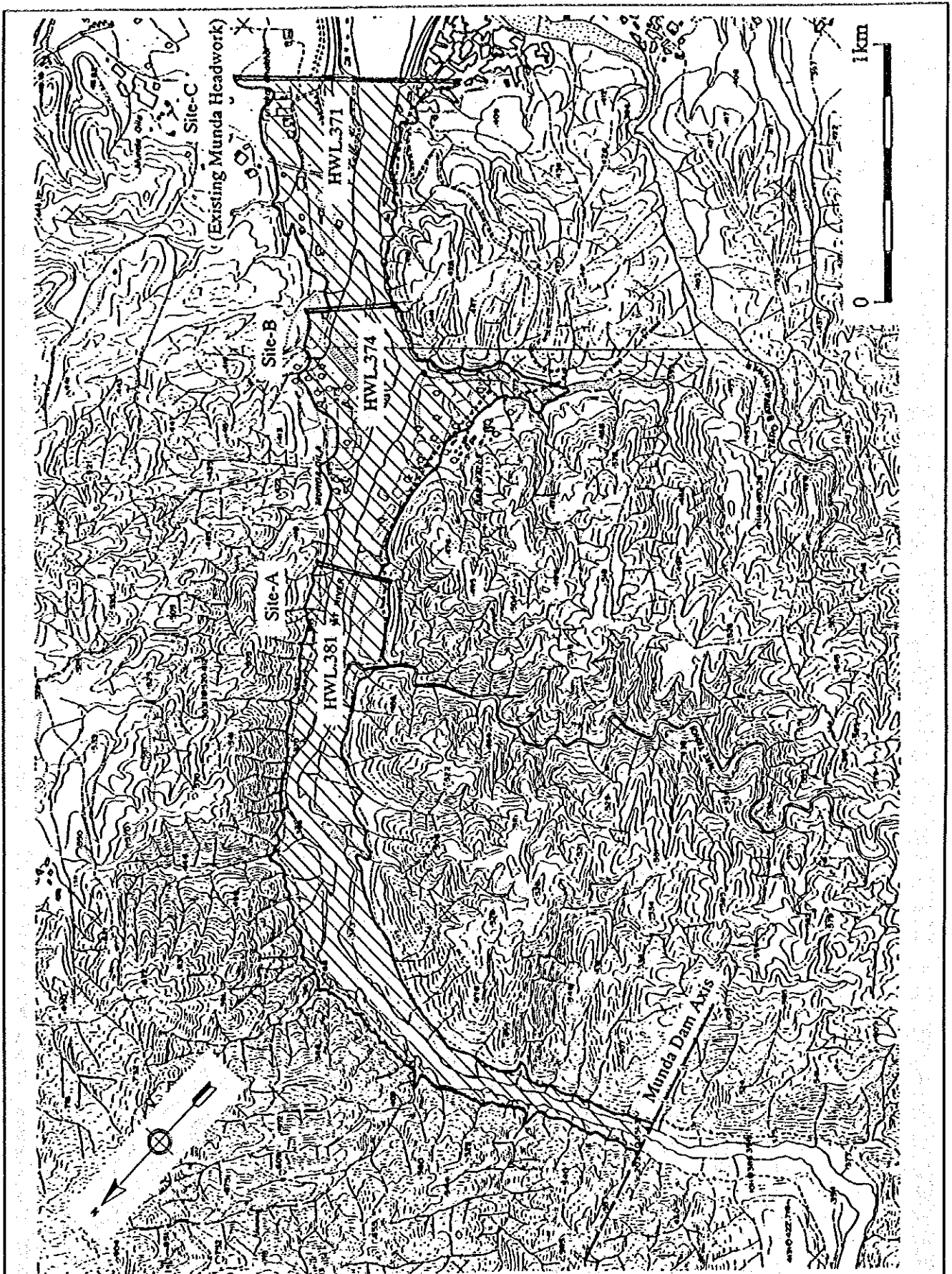
Surging Calculation



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Figure G2.7

Optimization of Penstock Diameter

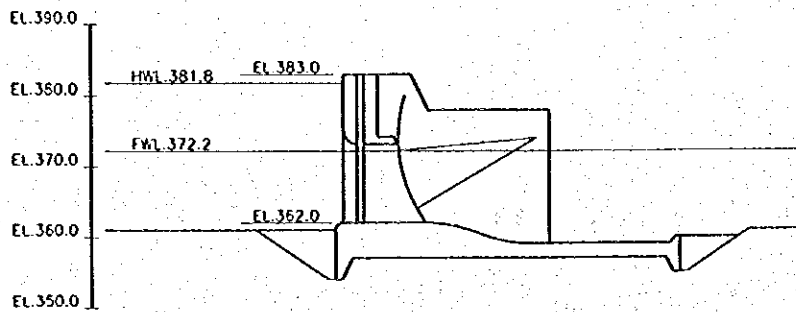


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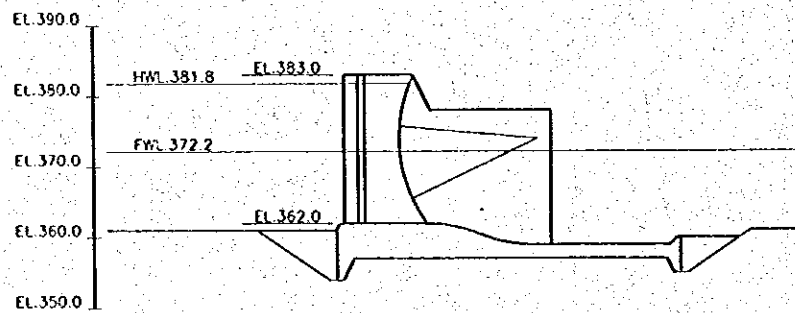
Figure G2.8

Alternative Sites of Re-regulation Weir

Alternative-1: Curtain Wall Type

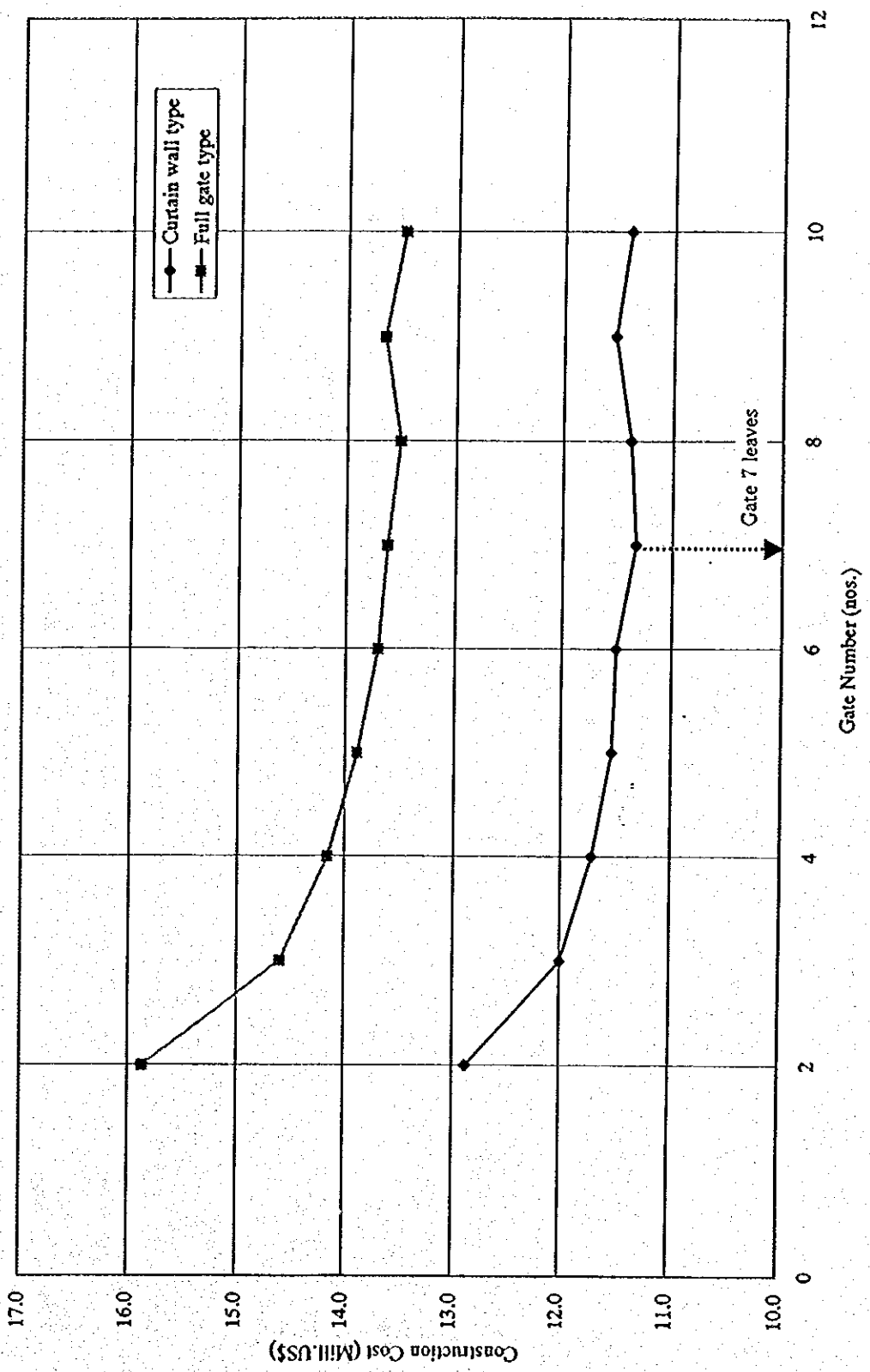


Alternative-2: Full Gate Type



N (nos.)	B (m)	H1 (m)	H2 (m)
2	19.4	11.7	20.8
3	14.4	11.7	20.8
4	11.8	11.7	20.8
5	10.1	11.7	20.8
6	8.9	11.7	20.8
7	8.0	11.7	20.8
8	7.3	11.7	20.8
9	6.8	11.7	20.8
10	6.3	11.7	20.8

N: Gate numbers
 B: Gate span
 H1: Gate height for Alternative-1
 H2: Gate height for Alternative-2



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Figure G2.10
 Optimization of Number of Re-regulation
 Weir Gates

