Inventory of Existing Irrigation Facilities on the South Main Canal

Serial No.	21				
Type or Name of Structure				Survey Date	2006/06/25
Location	Coordinates in UTM Indian Thailand grid	North	1264749	East	0445170
	Station No. refer to the Report for Topographic Survey carried out by Khmer Consultant Engineering Corporation Ltd. 30 September 2006				6+380

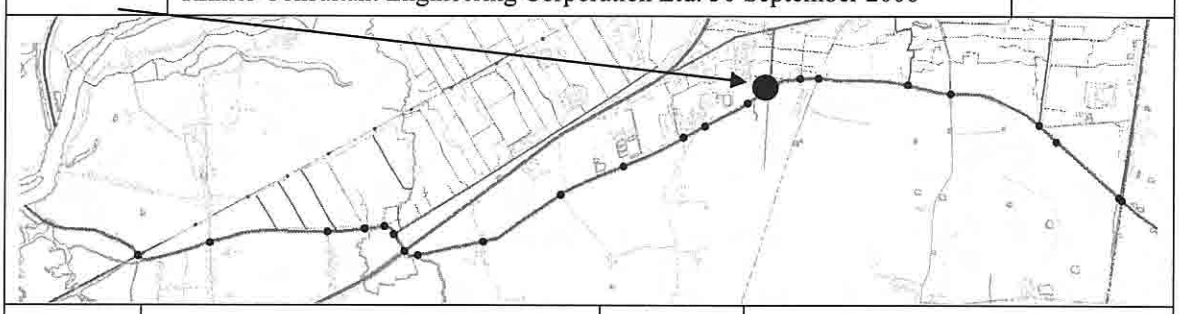


Photo-1	view from the left bank	Photo-2	view from the left bank

Description of the Structure

Observation

The right bank was excavated to drain water from right side paddy field to main canal.

Improvement Plan

The new drain inlet will be constructed. The canal slope should be rehabilitated by proper way such as masonry.

Inventory of Existing Irrigation Facilities on the South Main Canal

Serial No.	22				
Type or Name of Structure	Turnout to secondary canal (RS-4)			Survey Date	2006/06/25
Location	Coordinates in UTM Indian Thailand grid	North	1264742	East	0445185
	Station No. refer to the Report for Topographic Survey carried out by Khmer Consultant Engineering Corporation Ltd. 30 September 2006				6+394.402

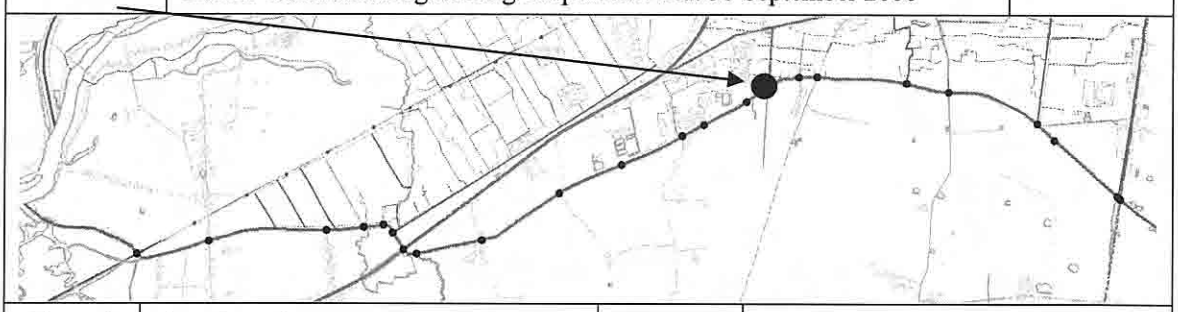


Photo-1	view from the upstream	Photo-2	secondary canal (RS-4)

Description of the Structure
Turnout structure was provided on the left bank to divert water from the South Main Canal to the secondary canal RS-5.
Observation
It was observed that modification or replacement of gate structure is required if the design water level is raised.
Improvement Plan
The existing structure without rehabilitation will be used for intake to secondary canal SMC-S-2. The existing canal will be rehabilitated by proper way.

Inventory of Existing Irrigation Facilities on the South Main Canal

Serial No.	23				
Type or Name of Structure	Fish catching net			Survey Date	2006/06/25
Location	Coordinates in UTM Indian Thailand grid	North	1264827	East	0445341
	Station No. refer to the Report for Topographic Survey carried out by Khmer Consultant Engineering Corporation Ltd. 30 September 2006				N/A

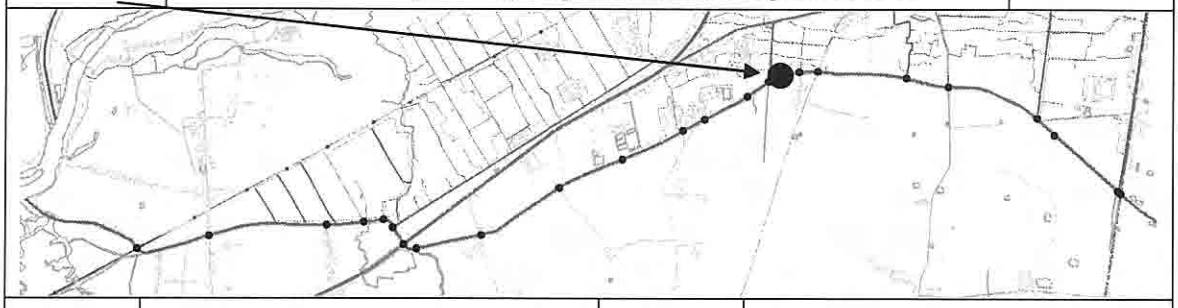
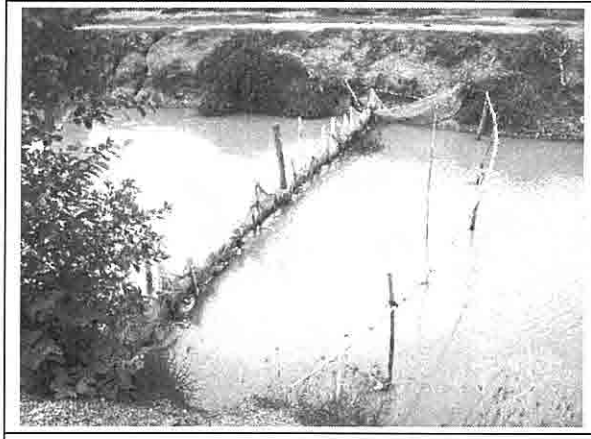


Photo-1	view from the left bank upstream	Photo-2	



Description of the Structure
Observation
Improvement Plan

Inventory of Existing Irrigation Facilities on the South Main Canal

Serial No.	24				
Type or Name of Structure	Wooden bridge			Survey Date	2006/06/25
Location	Coordinates in UTM Indian Thailand grid	North	1264822	East	0445402
	Station No. refer to the Report for Topographic Survey carried out by Khmer Consultant Engineering Corporation Ltd. 30 September 2006				6+594.481

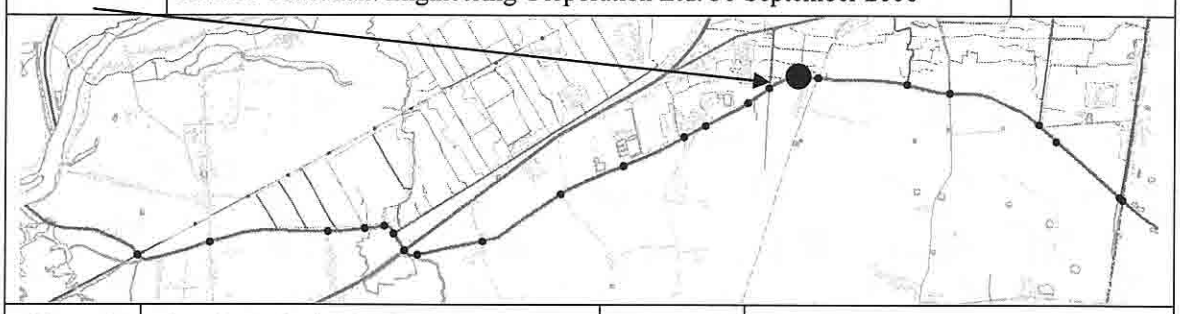


Photo-1	view from the left bank upstream	Photo-2	view from the left bank

Description of the Structure

Observation

Height of the bridge is same as the canal bank level.

It is dangerous to go across the bridge.

Improvement Plan

The concrete foot path with effective width of 2.2m will be constructed with canal protection by concrete lining at both upstream and downstream of 5m each. The foot path should have a clearance of 1.0m above design water level.

Inventory of Existing Irrigation Facilities on the South Main Canal

Serial No.	25				
Type or Name of Structure	Wooden bridge			Survey Date	2006/06/25
Location	Coordinates in UTM Indian Thailand grid	North	1264839	East	0445565
	Station No. refer to the Report for Topographic Survey carried out by Khmer Consultant Engineering Corporation Ltd. 30 September 2006				6+735.698

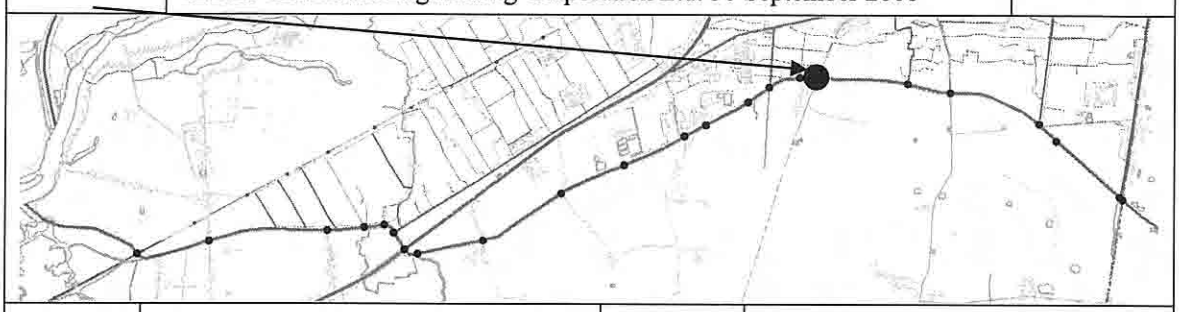


Photo-1	view from the left bank upstream	Photo-2	view of the left bank village road

Description of the Structure

Observation

Height of the bridge is same as the canal bank level.

It is dangerous to go across the bridge.

Improvement Plan

The concrete Bridge with effective width of 3.5m will be constructed with canal protection by concrete lining at upstream and downstream of 5m each after demolishing of existing wooden bridge. The concrete bridge should have a clearance of 1.0m above design water level.

Inventory of Existing Irrigation Facilities on the South Main Canal

Serial No.	26				
Type or Name of Structure	Private irrigation for mango plantation			Survey Date	2006/06/26
Location	Coordinates in UTM Indian Thailand grid	North	1264824	East	0445870
	Station No. refer to the Report for Topographic Survey carried out by Khmer Consultant Engineering Corporation Ltd. 30 September 2006				N/A

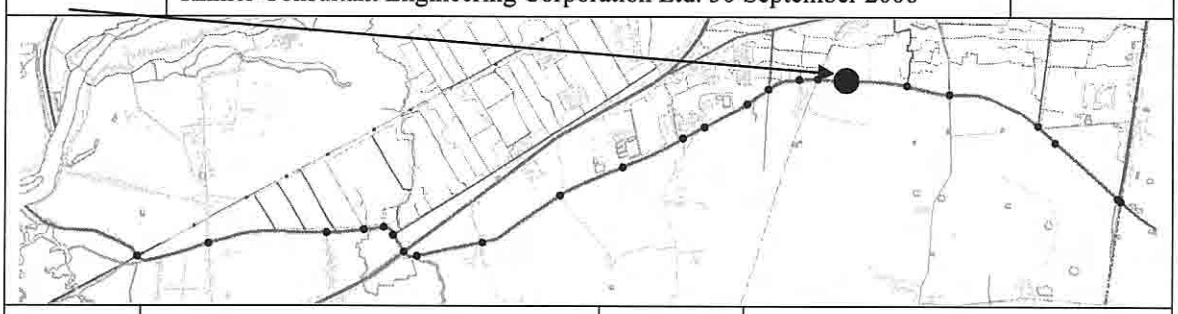


Photo-1	water tank on the right bank	Photo-2	mango plantation on the right bank

Description of the Structure
Observation
Improvement Plan

Inventory of Existing Irrigation Facilities on the South Main Canal

Serial No.	27				
Type or Name of Structure	Secondary canal without name			Survey Date	2006/06/26
Location	Coordinates in UTM Indian Thailand grid	North	1264785	East	0446243
	Station No. refer to the Report for Topographic Survey carried out by Khmer Consultant Engineering Corporation Ltd. 30 September 2006				N/A

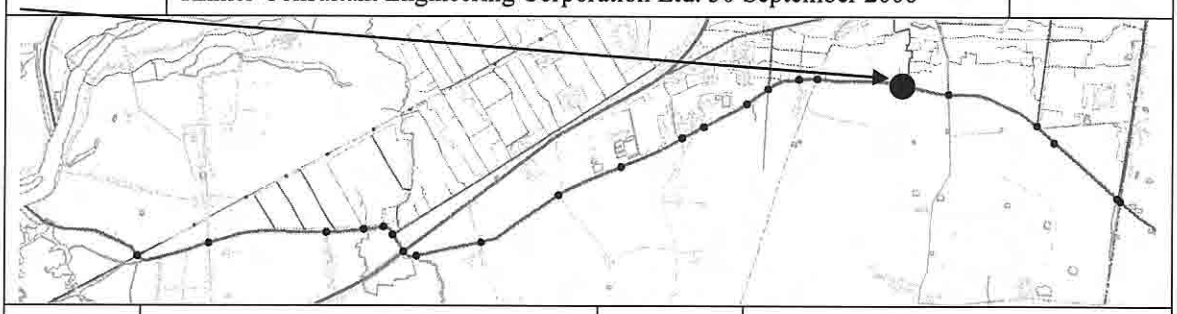


Photo-1	view from the left bank	Photo-2	

Description of the Structure
Secondary canal to left paddy field.
Observation
Improvement Plan

Inventory of Existing Irrigation Facilities on the South Main Canal

Serial No.	28				
Type or Name of Structure	Drain inlet			Survey Date	2006/06/25
Location	Coordinates in UTM Indian Thailand grid	North	1264785	East	0446243
	Station No. refer to the Report for Topographic Survey carried out by Khmer Consultant Engineering Corporation Ltd. 30 September 2006				7+412

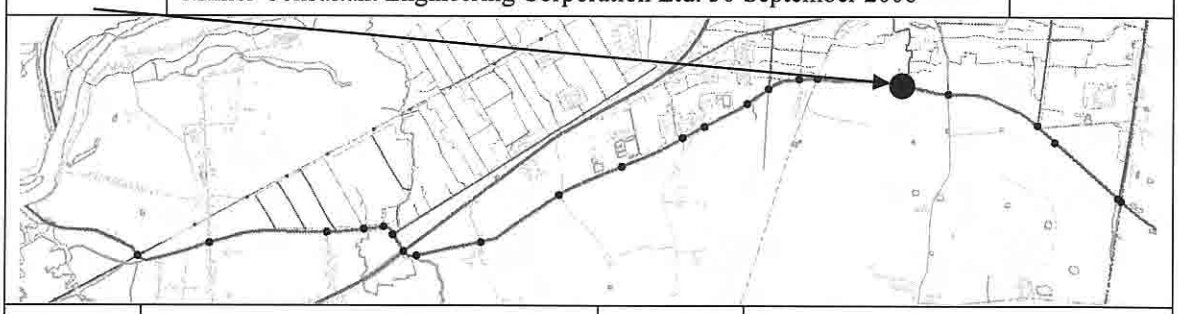


Photo-1	view of the right bank	Photo-2	

Description of the Structure

Observation

The canal bank was excavated to drain water from right side paddy field. The side slope has eroded heavily.

Improvement Plan

The new drain inlet will be constructed. The canal slope should be rehabilitated by proper way such as masonry.

Inventory of Existing Irrigation Facilities on the South Main Canal

Serial No.	29				
Type or Name of Structure	Wooden bridge			Survey Date	2006/06/25
Location	Coordinates in UTM Indian Thailand grid	North	1264720	East	0446569
	Station No. refer to the Report for Topographic Survey carried out by Khmer Consultant Engineering Corporation Ltd. 30 September 2006				7+761.737

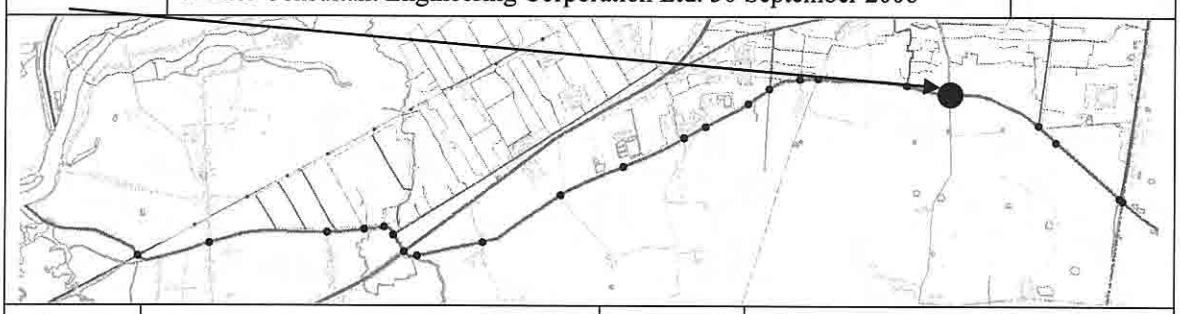


Photo-1	view from the left bank upstream	Photo-2	view of the left bank village road

Description of the Structure

Temporary wooden bridge.

Observation

Height of the bridge is same as the canal bank level.

It is dangerous to go across the bridge. The sand bags are used as abutment of bridge temporarily. The side slope has eroded heavily.

Improvement Plan

The concrete Bridge with effective width of 3.5m will be constructed with canal protection by concrete lining at upstream and downstream of 5m each after demolishing of existing wooden bridge. The concrete bridge should have a clearance of 1.0m above design water level. The new intake structure to secondary canal SMC-S-3 will be constructed just after this bridge

Inventory of Existing Irrigation Facilities on the South Main Canal

Serial No.	30				
Type or Name of Structure	Turnout to secondary canal (RS-6)			Survey Date	2006/06/25
Location	Coordinates in UTM Indian Thailand grid	North	1264467	East	0447261
	Station No. refer to the Report for Topographic Survey carried out by Khmer Consultant Engineering Corporation Ltd. 30 September 2006				8+511.081

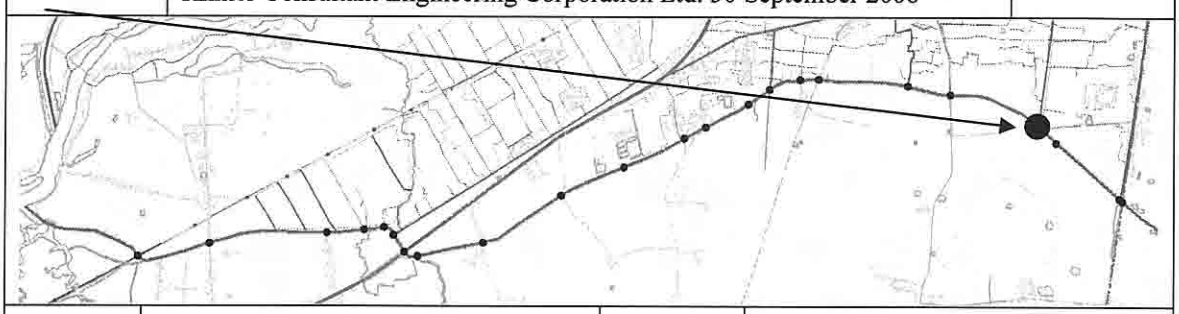


Photo-1	view from the left bank upstream	Photo-2	outlet to the secondary canal

Description of the Structure

The turnout structure was provided on the left bank to divert water from the South Main Canal to the secondary canal (RS-6). The structure has no gate but a wooden stoplog of which size 1.1m width x 1.0m height was provided.

Observation

Improvement Plan

The new intake structure to secondary canal SMC-S-4 with slide gate and concrete pipe of which diameter is 0.5m will be constructed after demolishing of existing structure. The secondary canal will be rehabilitated by proper way.

Inventory of Existing Irrigation Facilities on the South Main Canal

Serial No.	31				
Type or Name of Structure	Regulating pond			Survey Date	2006/06/25
Location	Coordinates in UTM Indian Thailand grid	North	1264361	East	0447388
	Station No. refer to the Report for Topographic Survey carried out by Khmer Consultant Engineering Corporation Ltd. 30 September 2006				8+700

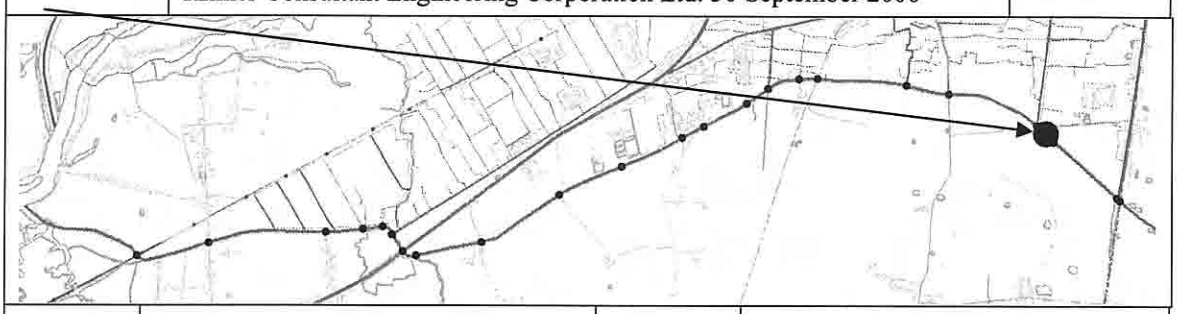
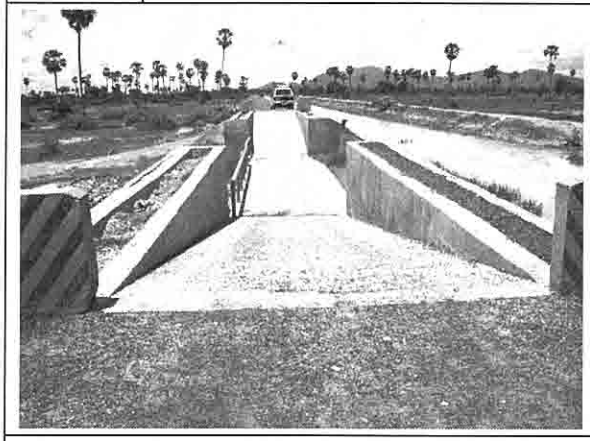


Photo-1	view from the left bank upstream	Photo-2	downstream of the spillway



Description of the Structure

The spillway was provided to release flood water from the regulating pond on the right bank side through the South Main Canal to the left bank side. Length of the spillway crest is about 15m. Height of the spillway crest is 1.85 m lower than the canal left bank level. Since the spillway crest is connected with the canal left bank by slopes, it could be used as a causeway as well. The crest elevation is 32.815m.

Observation

There is no stream on the downstream of the spillway.

Improvement Plan

The existing crest is lower than design water level. The over flow weir with height of 1.25m will be constructed on the crest at upstream of spillway.

Inventory of Existing Irrigation Facilities on the South Main Canal

Serial No.	32				
Type or Name of Structure	Turnout to secondary canal without name			Survey Date	2006/06/25
Location	Coordinates in UTM Indian Thailand grid	North	1263913	East	0447896
	Station No. refer to the Report for Topographic Survey carried out by Khmer Consultant Engineering Corporation Ltd. 30 September 2006				9+359.681

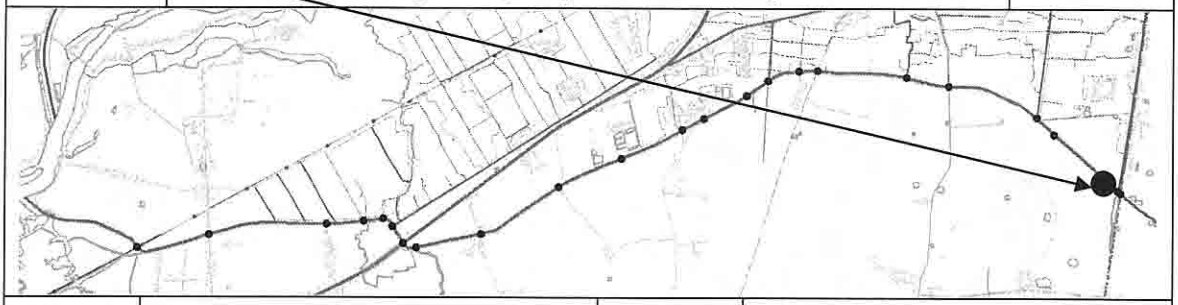


Photo-1	view from the secondary canal	Photo-2	secondary canal (without name)

Description of the Structure

Turnout structure with three slide gates (size: 1.0 m width x 1.6 m height x 3 nos.) was provided to divert water from the South Main Canal to the secondary canal without name. The bed elevation is 31.504m.

Observation

A spindle for the downstream end gate was crooked. However, the structure is functioning well since the secondary canal receives enough water from the South Main Canal.

Improvement Plan

The design water level is higher than top of gates. The new slide gates of which size is 1.0m width and 2.6m height will be installed.

Inventory of Existing Irrigation Facilities on the South Main Canal

Serial No.	33				
Type or Name of Structure	Turnout			Survey Date	2006/06/25
Location	Coordinates in UTM Indian Thailand grid	North	1263913	East	0447896
	Station No. refer to the Report for Topographic Survey carried out by Khmer Consultant Engineering Corporation Ltd. 30 September 2006				9+359

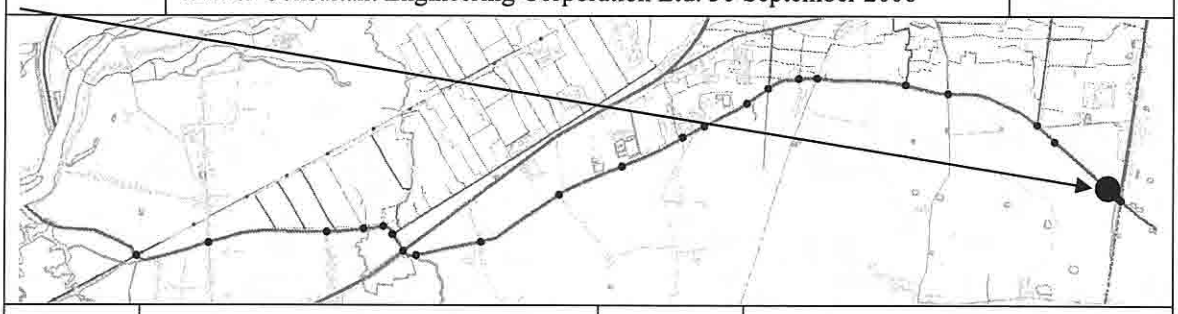


Photo-1	view from the main canal	Photo-2	downstream of the turnout

Description of the Structure

Turnout structure with a slide gates (size: 1.0 m width x 1.6 m height x 1 nos.) was provided to divert water from the South Main Canal to the right bank side paddy fields

Observation

There is no secondary canal on the downstream of the structure.

Improvement Plan

No rehabilitation.

Inventory of Existing Irrigation Facilities on the South Main Canal

Serial No.	34				
Type or Name of Structure	Check structure			Survey Date	2006/06/25
Location	Coordinates in UTM Indian Thailand grid	North	1263913	East	0447896
	Station No. refer to the Report for Topographic Survey carried out by Khmer Consultant Engineering Corporation Ltd. 30 September 2006				9+382.169

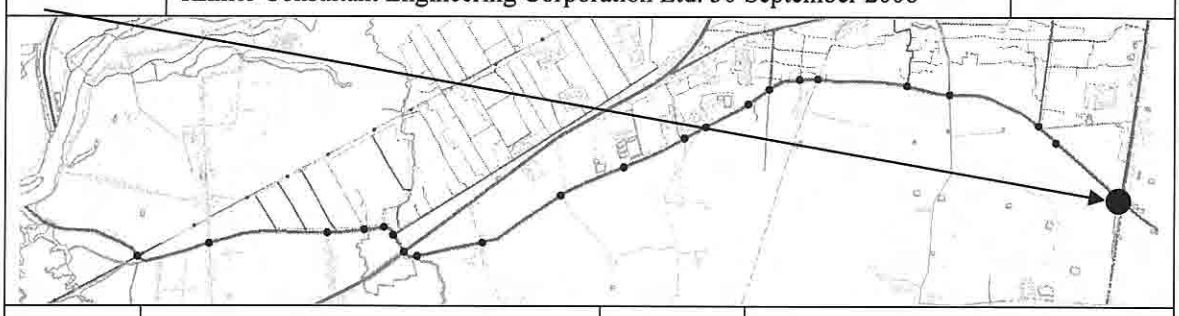
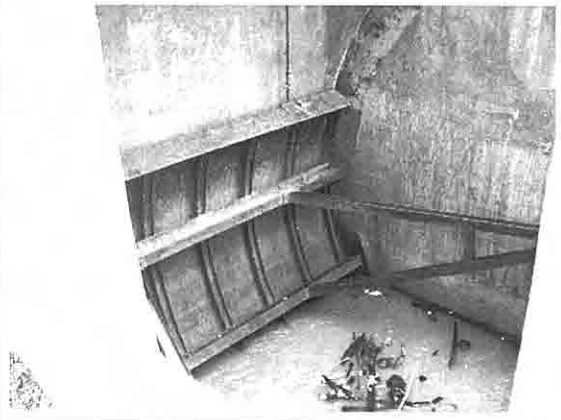


Photo-1	view from the left bank upstream	Photo-2	condition of the radial gate



Description of the Structure
Check structure with a radial gate was provided to regulate water level of the South Main Canal.
Observation
Improvement Plan
No rehabilitation.

Attachments IIIC-2

Hydraulic Calculation

Hydraulic calculation of South main canal (Model Project)

1. Uniform flow calculation of main canal

Manning's formula

$V_1 = 1/n \cdot R^{2/3} \cdot I^{1/2}$

where, V_1 = flow velocity (m/sec)
n = roughness coefficient
R = hydraulic radius (m)
I = hydraulic gradient.

$Q = V_1 \cdot A$

where, Q = design discharge (m^3/sec)
A = flow area (m^2)

$n = \{1/\Sigma p\,(p_1 \cdot n_1^{3/2} + p_2 \cdot n_2^{3/2} + \cdots + pi \cdot ni^{3/2})\}^{2/3}$

pi = wetted perimeter (m)

Free board

$Fb = 0.05h + \beta \cdot hv + hw$

where, h = water depth (m)
β = coefficient = 1.0
hv = velocity head (m)
hw = free board for waving =0.10 m

(1) No.0 to Vat Krouch Intake (No.1+569.255)

$Q =$ 16.30 (m^3/sec)
$L =$ 1570 distance (m)
$dh =$ 0.10 elevation difference of water surface
$I =$ 0.00005 = 1/20,000.00
$n_1 =$ 0.022 = roughness coefficient of side slope
$n_2 =$ 0.022 = roughness coefficient of canal bed
$n =$ 0.022
$B = p_1 =$ 4.5 m = bottom width of canal
$p_2 =$ 6.118 m = wetted perimeter at side slope of canal
$m =$ 1.50 = side slope (horizontal to vertical)

water depth h_1 (m)	A (m^2)	R (m)	V_1 (m/s)	Q (m^3)	Free board (m)
3.39	32.549	1.945	0.501	16.30	0.28

(2) Vat Krouch Intake (No.1+569.255) to No.2+94.206(T-1)

$Q =$ 16.30 (m^3/sec)
$L =$ 524.951 distance (m)
$dh =$ 0.052 elevation difference of water surface
$I =$ 0.00010 = 1/10,000.00
$n_1 =$ 0.022 = roughness coefficient of side slope
$n_2 =$ 0.022 = roughness coefficient of canal bed
$n =$ 0.022
$B = p_1 =$ 4.0 m = bottom width of canal
$p_2 =$ 5.353 m = wetted perimeter at side slope of canal
$m =$ 1.50 = side slope (horizontal to vertical)

water depth h_1 (m)	A (m^2)	R (m)	V_1 (m/s)	Q (m^3)	Free board (m)
2.97	25.106	1.707	0.649	16.30	0.27

(3) No.2+94.206(T-1) to No.2+790(T-2)

Q =	16.26	(m^3/sec)	
L =	695.794	distance (m)	
dh =	0.070	elevation difference of water surface	
I =	0.00010	= 1/10,000.00	
n_1 =	0.022	= roughness coefficient of side slope	
n_2 =	0.022	= roughness coefficient of canal bed	
n =	0.022		
B = p_1 =	4.0	m	= bottom width of canal
p_2 =	5.347	m	= wetted perimeter at side slope of canal
m =	1.50		= side slope (horizontal to vertical)

water depth h_1 (m)	A (m^2)	R (m)	V_1 (m/s)	Q (m^3)	Free board (m)
2.97	25.060	1.705	0.649	16.26	0.27

(4) No.2+790(T-2) to No.3+25(S-1)

Q =	16.20	(m^3/sec)	
L =	235	distance (m)	
dh =	0.024	elevation difference of water surface	
I =	0.00010	= 1/10,000.00	
n_1 =	0.022	= roughness coefficient of side slope	
n_2 =	0.022	= roughness coefficient of canal bed	
n =	0.022		
B = p_1 =	4.0	m	= bottom width of canal
p_2 =	5.338	m	= wetted perimeter at side slope of canal
m =	1.50		= side slope (horizontal to vertical)

water depth h_1 (m)	A (m^2)	R (m)	V_1 (m/s)	Q (m^3)	Free board (m)
2.96	24.992	1.703	0.648	16.20	0.27

(5) No.3+25(S-1)~No.5+545(T-3)

Q =	15.79	(m^3/sec)	
L =	2520	distance (m)	
dh =	0.252	elevation difference of water surface	
I =	0.0001	= 1/10,000.00	
n_1 =	0.022	= roughness coefficient of side slope	
n_2 =	0.022	= roughness coefficient of canal bed	
n =	0.022		
B = p_1 =	4.0	m	= bottom width of canal
p_2 =	5.271	m	= wetted perimeter at side slope of canal
m =	1.50		= side slope (horizontal to vertical)

water depth h_1 (m)	A (m^2)	R (m)	V_1 (m/s)	Q (m^3)	Free board (m)
2.92	24.521	1.686	0.644	15.79	0.27

(6) No.5+545(T-3)~No.6+142.765(Check structure)

Q =	15.75	(m^3/sec)	
L =	597.765	distance (m)	
dh =	0.060	elevation difference of water surface	
I =	0.0001	= 1/10,000.00	
n_1 =	0.022	= roughness coefficient of side slope	

n_2 = 0.022 = roughness coefficient of canal bed
n = 0.022
B = p_1 = 4.0 m = bottom width of canal
p_2 = 5.265 m = wetted perimeter at side slope of canal
m = 1.50 = side slope (horizontal to vertical)

water depth h_1 (m)	A (m^2)	R (m)	V_1 (m/s)	Q (m^3)	Free board (m)
2.92	24.475	1.684	0.644	15.75	0.27

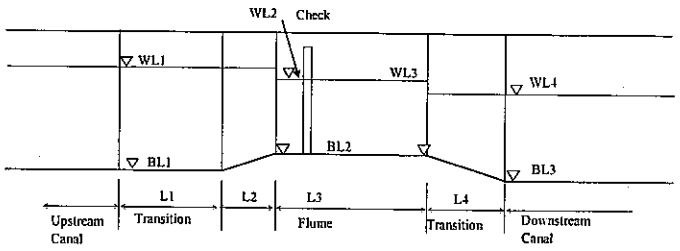
(7) No.6+142.765(Check structure)~No.9+382.169(End point)

Q = 15.66 (m^3/sec)
L = 3239.404 distance (m)
dh = 0.324 elevation difference of water surface
I = 0.00010 = 1/10,000.00
n_1 = 0.022 = roughness coefficient of side slope
n_2 = 0.022 = roughness coefficient of canal bed
n = 0.022
B = p_1 = 4.0 m = bottom width of canal
p_2 = 5.250 m = wetted perimeter at side slope of canal
m = 1.50 = side slope (horizontal to vertical)

water depth h_1 (m)	A (m^2)	R (m)	V_1 (m/s)	Q (m^3)	Free board (m)
2.91	24.371	1.681	0.643	15.66	0.27

Hydraulic Calculation of Check structure

Canal Name: Check structure Chainage No.6+142.765
Structure No. CH-1



1 Dimension and Hydraulic Conditions

Upstream Design Discharge Qu= 15.750 m3/sec
Downstream Design Discharge Qd= 15.750 m3/sec
Discharge per Flume q=Qd/N 5.250 m3/sec
Nof of Gates N= 3 nos

Pier Width Bp= 0.600
Gate Width B= 2.000
Total width Bc =N*B+(N-1)Bp= 7.20 m
Effective Width Be = N*B= 6.00 m

Approach Length to rectanglar section L2= 2.00 m
Length of Flume L3= 3.60 m

		Upstream channel		BP Rectangler Section		EP Rectangler Section		EP of D/s Transition		Downstream Canal		
Design Discharge per channel	(m3/sec)		15.75		15.75		15.75		15.75		15.75	
Bottom Width	(m)	B1 =	4.00	B2 =	6.00	B3 =	6.00	B4 =	4.00	B5 =	4.00	
Side Slope 1:m		m=	1.50	m=	0.00	m=	0.00	m=	1.50	m=	1.50	
Water Depth	(m)	H1 =	2.920	H2 =	2.871	H3 =	2.849	H4 =	2.863	H5 =	2.920	
Water Surface Width		W1 =	12.760	W2 =	6.000	W3 =	6.000	W4 =	12.588	W5 =	12.760	
Flow Area	(m2)	A1 =	24.470	A2 =	17.226	A3 =	17.093	A4 =	23.741	A5 =	24.470	
Velocity	(m/s)	V1 =	0.455	V2 =	0.914	V3 =	0.921	V4 =	0.663	V5 =	0.644	
Velocity Head	(m)	hv1 =	0.011	hv2 =	0.043	hv3 =	0.043	hv4 =	0.022	hv5 =	0.021	
Energy Head	(m)	E1 =	2.931	E2 =	2.914	E3 =	2.892	E4 =	2.885	E5 =	2.941	
Head losses	(m)			h1 =	0.0169	h2=	0.0216	h3=	0.0071			
dE = Eu - (Ea + hi)	(m)			ok	0.0000	ok	0.0000	ok	0.0000			0.0456
				target	0	target	0	target	0			
Wetted Perimeter P = B + 2H(m^2+1)^0.5	(m)	P1 =	14.5282	P2 =	11.7421	P3 =	11.6975	P4 =	14.3210	P5 =	14.5282	
Hydraulic Radius R = A/P	(m)	R1 =	1.6843	R2 =	1.4671	R3 =	1.4612	R4 =	1.6578	R5 =	1.6843	
Roughness Coefficient		n=	0.022	n=	0.015	n=	0.015	n=	0.015	n=	0.0220	
Roughness Coefficient K												
Hydraulic Gradient I =[n V/R ^(2/3)]^2		I1=	0.00005	I2 =	0.00011283	I3 =	0.000115215	I4 =	5.0469E-05	I5 =	0.0001	
Transition = 1.92098 (Wu-Wc)/2					6.4929			Transition =2.41421 (Wu-Wc)/2			7.952 m	
Length of Transition				say L1 =	7.00					say L4 =	8.00 m	
				Designed	10.00					Designed	10.00 m	

note: Vc shall be in between "Vu" and 3.0 m/sec.

	At BP of Transition		At BP of Rectangular Section		At EP of Rectangler section	
Energy Level (m)	EL1 = WL1 + hv1 =	35.611	EL2 = EL1 - h1 =	35.594	EL3 = EL2 - h2 =	35.572
Water Level (m)	WL1 = EL1 - hv1 =	35.600	WL2 = EL2 - hv2 =	35.551	WL3 = EL3 -hv3 =	35.529
Floor Level (m)	BL1 = WL1 - H1=	32.680	BL2 = WL2 - H2=	32.680	BL3 = WL3 - H3=	32.680

	At BP of Downstream Channel			
Energy Level (m)	EL4 = EL3 - h3=	35.565		
Water Level (m)	WL4 = EL4-hv4=	35.543		
Floor Level (m)	BL4 = WL4 - H4=	32.680		

Transition Angle
U/stream 27'30
D/stream 22'30

2 Calculation of Head Loss

1) Loss at Transition Channel = h1
Gradual enlargement loss
hge = fge (hv1-hv2) 0.016044 m
fge = 0.5
Friction hfc=L1(I1+I2)/2 = 0.000814 m
h1=hfc + hdf 0.016858 m

2) Head loss due to pier =hp
hp=a[b/H2^2-c/(H2+hp)^2] 0.021205 m
a=Qd^2/19.6= 12.65625
b=1/(0.92^2*Bc^2)= 0.032819
c=1/Bc^2= 0.01929
hp'= 0.021205
hp-hp' = 1.11E-08 ok

Friction in Flume hf3=L3*(I2+I3)/2= 0.00041 m
head loss h2= 0.021615

3) Downstream transition
Gradual contraction hc = fc (hv4-hv3) =
hgc = fgc (hv4-hv3) 0.00626 m
fgc = 0.3
Friction in transition hf3=L4(I3+I4)/2= 0.000828 m
head loss h3=hfc+hf3= 0.007088 m

4) Total Head Loss

Δh=Σhi= 0.045562 m
check 0.0456

Hydraulic calculation of Check structure

Over flow weir

Over flow discharge

Q_t = 0.55 (m^3/sec) = 16.3 -15.75

$Q_1 = C \cdot B_1 \cdot H^{3/2}$

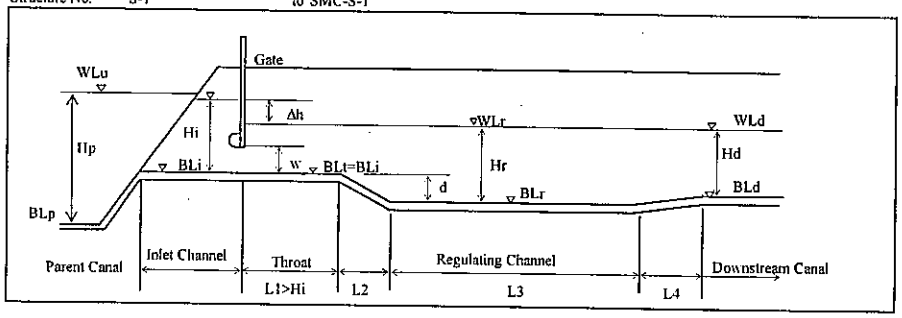
where,

C =	discharge coefficient =	1.80	
B_1 =	crest length (m) =	4.00	B =2.0m x 2
H =	over flow depth (m) =	0.18	

$Q_1 = C \cdot B_1 \cdot H^{3/2}$ = 0.550 (m^3/sec) 0.00005

Hydraulic Calculation of Intake Structure (to Secondary canal SMC-S-1)

Structure Type Intake Design Head Difference **0.96** m Existing structure
Structure No. S-1 to SMC-S-1



1 Demension and Hydraulic Conditions

Gate width Bg=	1.00 m	Parent Canal				Downstream Canal		
Design Discharge Q =	0.414 m3/sec	W Depth	Hp=	2.960 m		W Depth	Hd=	0.700 m
Min Discharge Qmin=	0.05 m3/sec	Floor EL	BLp=	32.460 m		Floor EL	BLd=	33.760 m
Water Depth above Gate Hg=	1.83 m		Blu-Blp=	1.130 m			WLd=	34.460 m
Nos of Gate N =	1		WLu=	35.420 m			BLd - BLr =	0.28 m
Slope to Regulating channel 1:	0		BLu =	33.590 m				
			Eo=	1.830 m				

		Inlet Channel				Regulating Channel			Downstream Canal		
		Q max		*Q min*		*Q max*		*Q min*	*Q max*		*Q min*
Water Surface		Qi=Q/N =	0.414	Qi=Q/N =	0.05						
Floor Level											
Bottom Width		Bi =	1.00	Bi =	1.00	Br =	1.00	1.00	Bd =	1.00	1.00
Side Slope 1:m		m=	0	m=	0	m=	0	0	m=	1	1
Energy Head	Eo = WLu-BLu	Eo =	1.830	Eo =	1.830						
Water Depth	H = Eo or H + dE	Hi =	1.8261	Hi =	1.8299	Hr=	0.8685	0.0946	Hd=	0.70	0.3388
Water Surface Width						Wr =Br	1.00	1.00	Wd=	2.40	1.68
Flow Area	A= H x B	Ai =	1.8261	Ai =	1.8299	Ar=	0.8685	0.0946	Ad=	1.1900	0.4536
Velocity	V= Q/A	Vi =	0.2267	Vi =	0.0273	Vr=	0.4767	0.5286	Vd=	0.3479	0.1102
Velocity Head	hv = V^2/19.6	hvi =	0.0026	hvi =	0.0000	hvr=	0.0116	0.0143	hvd=	0.0062	0.0006
Energy Head	E = H + hv	Ei =	1.8287	Ei =	1.8300				Ad*Vd =	0.414	
Inlet Loss	h = 0.5 hv	hi =	0.0013	hi =	0.0000						
dE = Eo - (Ei+hi)			ok 0.0000		ok 0.00000						
Wetted Perimeter P = B + 2H(m^2+1)^0.5		Pi =	4.6522	Pi =	4.6599	Pr =	2.7370	1.1892	Pd =	2.9799	1.9583
Hydraulic Radius R = A/P		Ri =	0.3925	Ri =	0.3927	Rr =	0.3173	0.0795	Rd =	0.3993	0.2316
Roughness Coefficient		n=	0.015	n=	0.015	n=	0.015	0.015	n=	0.025	.0.025
Hydraulic Gradient I =[n V/R ^(2/3)]^2		Ii =	4.024E-05	Ii =	5.84114E-07	Ir =	0.000236231	0.00183815	Id =	0.0002572	5.339E-05
Min Throat Length L1>=Hi, min 0.50 m		L1=	1.90 m	Length of Regulating Canal				L3=	5.00 m	ok	
L2>= Δh		L2=	0.00 m	Outlet Transition Length L4=				L4=	1.61 m		
				L4= 1.1499 (Wd-Wr)				say	2.00 m		

for Max Discharge

	At Inlet		BP of Regulating Channel		EP of Regulating Channel		Downstream Canal			
Energy Level	ELi = WLu - hi =	35.419	ELr = WLr + hvr =	34.470	Elr' = ELr - hrf =	34.469	ELd = Elr' - ho =	34.466		34.460
Water Level	WLi = ELi - hvi =	35.416	WLr = Wli - hg =	34.458	WLr' = Elr' - hvr =	34.457	WLd = ELd - hvd =	34.460	ok	0.0000
Floor Level	BLi = WLi - Hi=	33.590	BLr = WLr - Hr =	33.590	BLr' = WLr' - Hr =	33.589	BLd = WLd - Hd =	33.760		

for Min Discharge

	At Inlet		BP of Regulating Channel		EP of Regulating Channel		Downstream Canal		
Energy Level	ELi = WLu - hi =	35.420	ELr = WLr + hvr =	33.699	Elr' = ELr - hrf =	33.690	ELd = WLd + hvd =	33.688	
Water Level	WLi = ELi - hvi =	35.420	WLr = Wli - hg =	33.685	WLr' = Elr' - hvr =	33.675	WLd = BLm + Hd =	33.687	ok
Floor Level	BLi = WLi - Hi=	33.590	BLr = WLr - Hr =	33.590	BLr' = WLr' - Hr =	33.581	BLm = Blm max	33.760	

2 Paremeters for Max Discharge

1) Basic Dimensions
   Gate Width Bg= 1.00 m
   Water depth at Inlet Hi 1.826 m
   Q=0.65*Bg*w*[2g*(Δh+hvi]^0.5
2) Required Gate Opening Q'= 0.414 m3/s
   w= 0.1469 m ok
   Qd-Q'= 0 ok
3) Head Loss Δh = 0.9576 m

3 Paremeters for Min Discharge

1) Basic Dimensions
   Gate Width Bg= 1.00 m
   Water depth at Inlet Hi 1.830 m
   Q=0.65*Bg*w*[2g*(Hi-w/2)]^0.5
2) Gate Opening Check Q'= 0.0500 m3/s
   w= 0.01286643 m check
   Qd-Q'= 1.9149E-06 ok
   α: ratio for max Gate opening 0.94831288
   k: ratio for min gate opening 0.00703105
3) Head Loss Δh=α Hi= 1.7354 m

4 Check of Regulating Channel Water Depth

1) *for Max Discharge*
   Velocity at Gate end vg 2.8179 m
   Froud Number Fr=ve/[(g w)^0.5] 2.3485
   Conjugate depth hd'
   hd'=0.5[(1+8Fr^2)^0.5-1] w 0.4200 m
   Regulating Channel Length Ls =6.17 x hd' 2.5913 m
   say 2.60 m
2) *for Min Discharge*
   Velocity at Gate end vg 3.8861 m
   Froud Number Fr=ve/[(g w)^0.5] 10.9438
   Conjugate depth hd"
   hd"=0.5[(1+8Fr^2)^0.5-1] w 0.1928 m
   Regulating Channel Length Ls =6.17 x hd' 1.1896 m
   say 1.20 m
3) Throat end height d=
   d= Max(hd'-w max',h" -w min) 0.2731 m
   say 0.00 m

5 Calculation of Head Loss

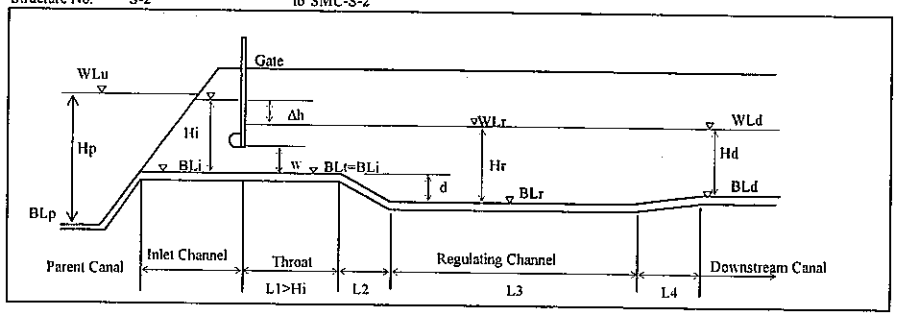
for Max Discharge
1) Inlet hi = 0.5 hvi = 0.0026 m
2) Head loss at Gate hg= Δh 0.9576 m
3) Regulating Channel hrf=Ir*L3 0.0012 m
4) Outlet Transition
   hor=(Ir+Id)/2*L4 0.0005 m
   Divergence hod = 0.4(hvr-hvd) = 0.0022 m
   sub-total ho= 0.0027 m

for Min Discharge
1) Inlet hi = 0.5 hvi = 0.0000 m
2) Head loss at Gate hg=α*Hi 1.7354 m
3) Regulating Channel hrf=Ir*L3 0.0092 m
4) Outlet Transition
   hor=(Ir+Id)/2*L4 0.0019 m
   Divergence hod = 0.4(hvr-hvd) = 0.0055 m
   sub-total ho= 0.0073 m

5) Total loss Max Q 0.9641 m
   Min Q 1.7519 m

Hydraulic Calculation of Intake Structure (to Secondary canal SMC-S-2)

Structure Type Intake Design Head Difference **1.65** m Existing structure
Structure No. S-2 to SMC-S-2



1 Demension and Hydraulic Conditions

Gate width Bg=	1.00 m	Parent Canal				Downstream Canal			
Design Discharge Q =	0.088 m3/sec	W Depth	Hp=	2.920	m	W Depth	Hd=	0.500	m
Min Discharge Qmin=	0.05 m3/sec	Floor EL	BLp=	31.380	m	Floor EL	BLd=	32.150	m
Water Depth above Gate Hg=	1.792 m		Blu-Blp=	1.128	m		WLd=	32.650	m
Nos of Gate N =	1		WLu=	34.300	m				
Slope to Regulating channel 1:	0		BLu =	32.508	m				
			Eo=	1.792	m				

		Inlet Channel				Regulating Channel			Downstream Canal	
		Q max		*Q min*		*Q max*		*Q min*	*Q max*	*Q min*
Water Surface		Qi=Q/N =	0.088	Qi=Q/N =	0.05					
Floor Level										
Bottom Width		Bi =	1.00	Bi =	1.00	Br =	1.00	1.00	Bd = 0.60	0.60
Side Slope 1:m		m=	0	m=	0	m=	0	0	m= 1	1
Energy Head	Eo = WLu-BLu	Eo =	1.792	Eo =	1.792					
Water Depth	H = Eo or H + dE	Hi =	1.7918	Hi =	1.7919	Hr=	0.1617	0.0945	Hd= 0.50	0.242
Water Surface Width						Wr =Br	1.00	1.00	Wd= 1.60	1.08
Flow Area	A= H x B	Ai =	1.7918	Ai =	1.7919	Ar=	0.1617	0.0945	Ad= 0.5500	0.2038
Velocity	V= Q/A	Vi =	0.0491	Vi =	0.0279	Vr=	0.5442	0.5292	Vd= 0.1600	0.2454
Velocity Head	hv = V^2/19.6	hvi =	0.0001	hvi =	0.0000	hvr=	0.0151	0.0143	hvd= 0.0013	0.0031
Energy Head	E = H + hv	Ei =	1.7919	Ei =	1.7920				Ad*Vd = 0.088	
Inlet Loss	h = 0.5 hv	hi =	0.0001	hi =	0.0000					
dE = Eo - (Ei+hi)		ok	0.0000	ok	0.00000					
Wetted Perimeter P = B + 2H(m^2+1)^0.5		Pi =	4.5836	Pi =	4.5839	Pr =	1.3234	1.1890	Pd = 2.0142	1.2845
Hydraulic Radius R = A/P		Ri =	0.3909	Ri =	0.3909	Rr =	0.1222	0.0795	Rd = 0.2731	0.1586
Roughness Coefficient		n=	0.015	n=	0.015	n=	0.015	0.015	n= 0.025	0.025
Hydraulic Gradient I =[n V/R ^(2/3)]^2		Ii =	1.8987E-06	Ii =	6.12851E-07	Ir =	0.001099214	0.001844447	Id = 9.032E-05	0.0004382

Min Throat Length L1>=Hi. min 0.50 m L1= 1.80 m Length of Regulating Canal L3= 5.00 m ok
L2>= Δh L2= 0.00 m Outlet Transition Length L4= L4= 0.69 m
Ld= 1.1499 (Wd-Wr) say 1.00 m

for Max Discharge

	At Inlet		BP of Regulating Channel		EP of Regulating Channel		Downstream Canal		
Energy Level	ELi = WLu - hi =	34.300	ELr = WLr + hvr =	32.685	Elr' = ELr - hrf =	32.679	ELd = Elr' - ho =	32.673	
Water Level	WLi = ELi - hvi =	34.300	WLr = Wli - hg =	32.670	WLr' = Elr' - hvr =	32.664	WLd = ELd - hvd =	32.672	ok
Floor Level	BLi = WLi - Hi=	32.508	BLr = WLr - Hr =	32.508	BLr' = WLr' - Hr =	32.503	BLd = WLd - Hd =	32.172	

for Min Discharge

	At Inlet		BP of Regulating Channel		EP of Regulating Channel		Downstream Canal		
Energy Level	ELi = WLu - hi =	34.300	ELr = WLr + hvr =	32.617	Elr' = ELr - hrf =	32.608	ELd = WLd + hvd =	32.606	
Water Level	WLi = ELi - hvi =	34.300	WLr = Wli - hg =	32.602	WLr' = Elr' - hvr =	32.593	WLd = BLm + Hd =	32.603	ok
Floor Level	BLi = WLi - Hi=	32.508	BLr = WLr - Hr =	32.508	BLr' = WLr' - Hr =	32.499	BLm = Blm max	32.172	

2 Paremeters for Max Discharge

1) Basic Dimensions
Gate Width Bg= 1.00 m
Water depth at Inlet Hi 1.792 m
Q=0.65*Bg*w*[2g*(Hi-w/2)]^0.5
2) Required Gate Opening Q'= 0.088 m3/s
w= 0.0229 m ok
Qd-Q'= -3.431E-05 ok
α: ratio for max. Gate opening 0.9097595
k: ratio for min. gate opening 0.0127957
3) Head Loss Δh=α Hi= 1.6301 m

3 Paremeters for Min Discharge

1) Basic Dimensions
Gate Width Bg= 1.00 m
Water depth at Inlet Hi 1.792 m
Q=0.65*Bg*w*[2g*(Hi-w/2)]^0.5
2) Gate Opening Check Q'= 0.0495 m3/s
w= 0.012866 m check
Qd-Q'= 0.0005256 ok
α: ratio for max Gate opening 0.9472745
k: ratio for min gate opening 0.0071802
3) Head Loss Δh=α Hi= 1.6975 m

4 Check of Regulating Channel Water Depth

1) *for Max Discharge*
Velocity at Gate end vg 3.8382 m
Froud Number Fr=ve/[(g w)^0.5] 8.0972
Conjugate depth hd'
hd'=0.5[(1+8Fr^2)^0.5-1] w 0.2513 m
Regulating Channel Length Ls =6.17 x hd' 1.5507 m
say 1.60 m
2) *for Min Discharge*
Velocity at Gate end vg 3.8861 m
Froud Number Fr=ve/[(g w)^0.5] 10.9438
Conjugate depth hd"
hd"=0.5[(1+8Fr^2)^0.5-1] w 0.1928 m
Regulating Channel Length Ls =6.17 x hd' 1.1896 m
say 1.20 m
3) Throat end height d=
d= Max(hd'-w max',h" -w min) 0.2284 m
say 0.00 m

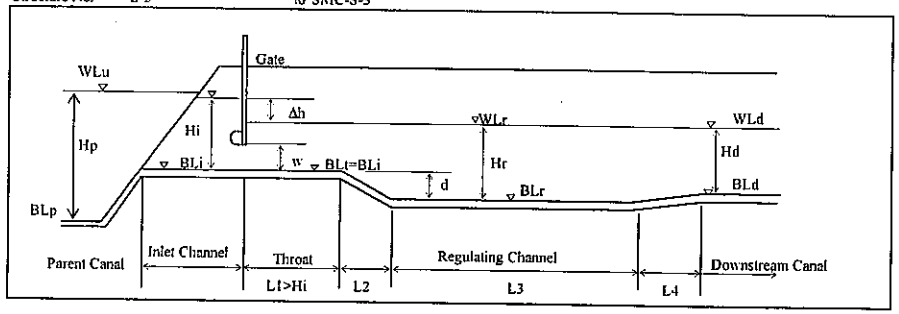
5 Calculation of Head Loss

for Max Discharge
1) Inlet hi = 0.5 hvi = 0.0001 m
2) Head loss at Gate hg=α*Hi 1.6301 m
3) Regulating Channel hrf=Ir*L3 0.0055 m
4) Outlet Transition
hor=(Ir+Id)/2*L4 0.0006 m
Divergence hod = 0.4(hvr-hvd) = 0.0055 m
sub-total ho= 0.0061 m
for Min Discharge
1) Inlet hi = 0.5 hvi = 0.0000 m
2) Head loss at Gate hg=α*Hi 1.6975 m
3) Regulating Channel hrf=Ir*L3 0.0092 m
4) Outlet Transition
hor=(Ir+Id)/2*L4 0.0011 m
Divergence hod = 0.4(hvr-hvd) = 0.0045 m
sub-total ho= 0.0056 m

5) Total loss Max Q 1.6419 m
Min Q 1.7123 m

Hydraulic Calculation of Intake Structure (to Secondary canal SMC-S-3)

Structure Type Intake Design Head Difference **0.80** m Existing structure **0.05**
Structure No. S-3 to SMC-S-3



1 Demension and Hydraulic Conditions

Gate width Bg=	0.60 m	Parent Canal			Downstream Canal		
Design Discharge Q =	0.103 m3/sec	W Depth	Hp=	2.910 m	W Depth	Hd=	0.387 m
Min Discharge Qmin=	0.05 m3/sec	Floor EL	BLp=	31.250 m	Floor EL	BLd=	32.974 m
Water Depth above Gate Hg=	1.00 m		Blu-Blp=	1.910 m		WLd=	33.360 m
Nos of Gate N =	1		WLu=	34.160 m			
Slope to Regulating channel 1:	0		BLu =	33.160 m			
			Eo=	1.000 m			

		Inlet Channel				Regulating Channel			Downstream Canal	
		Q max		*Q min*		*Q max*		*Q min*	*Q max*	*Q min*
Water Surface		Qi=Q/N =	0.103	Qi=Q/N =	0.05					
Floor Level										
Bottom Width		Bi =	0.60	Bi =	0.60	Br =	0.60	0.60	Bd = 0.50	0.50
Side Slope 1:m		m=	0	m=	0	m=	0	0	m= 1.5	1.5
Energy Head	Eo = WLu-BLu	Eo =	1.000	Eo =	1.000					
Water Depth	H = Eo or H + dE	Hi =	0.9978	Hi =	0.9995	Hr=	0.1968	0.1844	Hd= 0.387	0.187066
Water Surface Width						Wr =Br	0.60	0.60	Wd= 1.66	1.06
Flow Area	A= H x B	Ai =	0.5987	Ai =	0.5997	Ar=	0.1181	0.1107	Ad= 0.4173	0.1460
Velocity	V= Q/A	Vi =	0.1720	Vi =	0.0834	Vr=	0.8723	0.4518	Vd= 0.2468	0.3424
Velocity Head	hv = V^2/19.6	hvi =	0.0015	hvi =	0.0004	hvr=	0.0388	0.0104	hvd= 0.0031	0.0060
Energy Head	E = H + hv	Ei =	0.9993	Ei =	0.9998				Ad*Vd = 0.103	
Inlet Loss	h = 0.5 hv	hi =	0.0008	hi =	0.0002					
dE = Eo - (Ei+hi)		ok	-0.0001	ok	-0.00001					
Wetted Perimeter	P = B + 2H(m^2+1)^0.5	Pi =	2.5956	Pi =	2.5990	Pr =	0.9936	0.9689	Pd = 1.8935	1.1745
Hydraulic Radius	R = A/P	Ri =	0.2307	Ri =	0.2307	Rr =	0.1188	0.1142	Rd = 0.2204	0.1243
Roughness Coefficient		n=	0.015	n=	0.015	n=	0.015	0.015	n= 0.025	0.025
Hydraulic Gradient	I =[n V/R ^(2/3)]^2	Ii =	4.7082E-05	Ii =	1.10518E-05	Ir =	0.002930163	0.000828734	Id = 0.000286	0.0011809
Min Throat Length L1>=Hi, min 0.50 m		L1=	1.00 m	Length of Regulating Canal				L3= 5.00 m	ok	
L2>= Δh		L2=	0.00 m	Outlet Transition Length L4=				L4= 1.22 m		
				L4= 1.1499 (Wd-Wr)				say 2.00 m		

for Max Discharge

	At Inlet		BP of Regulating Channel		EP of Regulating Channel		Downstream Canal		
Energy Level	ELi = WLu - hi =	34.159	ELr = WLr + hvr =	33.396	Elr' = ELr - hrf =	33.381	ELd = Elr' - ho =	33.363	
Water Level	WLi = ELi - hvi =	34.158	WLr = Wli - hg =	33.357	WLr' = Elr' - hvr =	33.342	WLd = ELd - hvd =	33.360	ok 33.360
Floor Level	BLi = WLi - Hi=	33.160	BLr = WLr - Hr =	33.160	BLr' = WLr' - Hr =	33.145	BLd = WLd - Hd =	32.974	0.0003

for Min Discharge

	At Inlet		BP of Regulating Channel		EP of Regulating Channel		Downstream Canal		
Energy Level	ELi = WLu - hi =	34.160	ELr = WLr + hvr =	33.355	Elr' = ELr - hrf =	33.351	ELd = WLd + hvd =	33.349	
Water Level	WLi = ELi - hvi =	34.159	WLr = Wli - hg =	33.344	WLr' = Elr' - hvr =	33.340	WLd = BLm + Hd =	33.343	ok
Floor Level	BLi = WLi - Hi=	33.160	BLr = WLr - Hr =	33.160	BLr' = WLr' - Hr =	33.156	BLm = Blm max	32.974	

2 Paremeters for Max Discharge

1) Basic Dimensions
Gate Width Bg= 0.60 m
Water depth at Inlet Hi 0.998 m
Q=0.65*Bg*w*|2g*(Δh+hvi|^0.5
2) Required Gate Opening Q'= 0.103 m3/s
w= 0.0666 m ok
Qd-Q'= 0 ok
3) Head Loss Δh = 0.8010 m

3 Paremeters for Min Discharge

1) Basic Dimensions
Gate Width Bg= 0.60 m
Water depth at Inlet Hi 0.999 m
Q=0.65*Bg*w*|2g*(Hi-w/2)|^0.5
2) Gate Opening Check Q'= 0.0500 m3/s
w= 0.02917828 m ok
Qd-Q'= 2.6491E-06 ok
α: ratio for max Gate opening 0.81545768
k: ratio for min gate opening 0.02919337
3) Head Loss Δh=α Hi= 0.8150 m

4 Check of Regulating Channel Water Depth

1) *for Max Discharge*
Velocity at Gate end vg 2.5767 m
Froud Number Fr=ve/[(g w)^0.5] 3.1889
Conjugate depth hd'
hd'=0.5[(1+8Fr^2)^0.5-1] w 0.2690 m
Regulating Channel Length Ls =6.17 x hd' 1.6596 m
say 1.70 m
2) *for Min Discharge*
Velocity at Gate end vg 2.8560 m
Froud Number Fr=ve/[(g w)^0.5] 5.3409
Conjugate depth hd"
hd'=0.5[(1+8Fr^2)^0.5-1[w 0.2063 m
Regulating Channel Length Ls =6.17 x hd' 1.2728 m
say 1.30 m
3) Throat end height d=
d= Max(hd'-w max',h" -w min) 0.2024 m
say 0.00 m

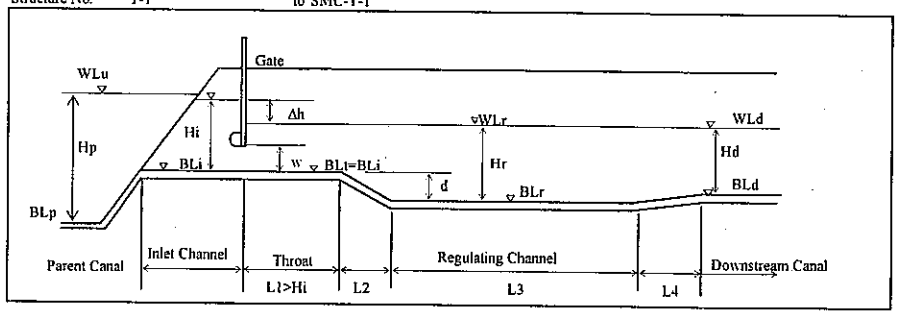
5 Calculation of Head Loss

for Max Discharge
1) Inlet hi = 0.5 hvi = 0.0015 m
2) Head loss at Gate hg= Δh 0.8010 m
3) Regulating Channel hrf=Ir*L3 0.0147 m
4) Outlet Transition
hor=(Ir+Id)/2*L4 0.0032 m
Divergence hod = 0.4(hvr-hvd) = 0.0143 m
sub-total ho= 0.0175 m
for Min Discharge
1) Inlet hi = 0.5 hvi = 0.0002 m
2) Head loss at Gate hg=α*Hi 0.8150 m
3) Regulating Channel hrf=Ir*L3 0.0041 m
4) Outlet Transition
hor=(Ir+Id)/2*L4 0.0020 m
Divergence hod = 0.4(hvr-hvd) = 0.0018 m
sub-total ho= 0.0038 m

5) Total loss Max Q 0.8347 m
Min Q 0.8231 m

Hydraulic Calculation of Turnout (to Tertiary canal)

Structure Type Turnout Design Head Difference 0.80 m Existing structure 0.05
Structure No. T-1 to SMC-T-1



1 Demension and Hydraulic Conditions

Gate width Bg=	0.50 m	Parent Canal				Downstream Canal			
Design Discharge Q =	0.033 m3/sec	W Depth	Hp=	2.970 m		W Depth	Hd=	0.200 m
Min Discharge Qmin=	0.05 m3/sec	Floor EL	BLp=	32.550 m		Floor EL	BLd=	34.520 m
Water Depth above Gate Hg=	0.80 m		Blu-Blp=	2.170 m			WLd=	34.720 m
Nos of Gate N =	1		WLu=	35.520 m				
Slope to Regulating channel 1:	0		BLu =	34.720 m				
			Eo=	0.800 m				

		Inlet Channel				Regulating Channel			Downstream Canal		
		Q max		*Q min*		*Q max*		*Q min*	*Q max*		*Q min*
Water Surface		Qi=Q/N =	0.033	Qi=Q/N =	0.05						
Floor Level											
Bottom Width		Bi =	0.50	Bi =	0.50	Br =	0.40	0.40	Bd =	0.50	0.50
Side Slope 1:m		m=	0	m=	0	m=	0	0	m=	1.5	1.5
Energy Head	Eo = WLu-BLu	Eo =	0.800	Eo =	0.800						
Water Depth	H = Eo or H + dE	Hi =	0.7995	Hi =	0.7989	Hr=	0.0644	0.2208	Hd=	0.200	0.0968
Water Surface Width						Wr =Br	0.40	0.40	Wd=	1.10	0.79
Flow Area	A= H x B	Ai =	0.3998	Ai =	0.3994	Ar=	0.0258	0.0883	Ad=	0.1600	0.0625
Velocity	V= Q/A	Vi =	0.0826	Vi =	0.1252	Vr=	1.2809	0.5661	Vd=	0.2063	0.8006
Velocity Head	hv = V^2/19.6	hvi =	0.0003	hvi =	0.0008	hvr=	0.0837	0.0164	hvd=	0.0022	0.0327
Energy Head	E = H + hv	Ei =	0.7999	Ei =	0.7997				Ad*Vd =	0.033	
Inlet Loss	h = 0.5 hv	hi =	0.0002	hi =	0.0004						
dE = Eo - (Ei+hi)		ok	0.0000	ok	-0.00006						
Wetted Perimeter P = B + 2H(m^2+1)^0.5		Pi =	2.0990	Pi =	2.0977	Pr =	0.5288	0.8416	Pd =	1.2211	0.8490
Hydraulic Radius R = A/P		Ri =	0.1904	Ri =	0.1904	Rr =	0.0487	0.1049	Rd =	0.1310	0.0736
Roughness Coefficient		n=	0.015	n=	0.015	n=	0.015	0.015	n=	0.025	0.025
Hydraulic Gradient I =[n V/R ^(2/3)]^2		Ii =	1.3993E-05	Ii =	3.21844E-05	Ir =	0.020748742	0.001456639	Id =	0.0003995	0.012996

Min Throat Length L1>=Hi, min 0.50 m	L1=	0.80 m	Length of Regulating Canal	L3=	5.00 m	ok	
L2>= Δh	L2=	0.00 m	Outlet Transition Length L4=	L4=	0.80 m		
			L4= 1.1499 (Wd-Wr)	say	1.00 m		

for Max Discharge

	At Inlet		BP of Regulating Channel		EP of Regulating Channel		Downstream Canal			
Energy Level	ELi = WLu - hi =	35.520	ELr = WLr + hvr =	34.868	Elr' = ELr - hrf =	34.764	ELd = Elr' - ho =	34.721		
Water Level	WLi = ELi - hvi =	35.519	WLr = Wli - hg =	34.784	WLr' = Elr' - hvr =	34.681	WLd = ELd - hvd =	34.719	impossible	34.720
Floor Level	BLi = WLi - Hi=	34.720	BLr = WLr - Hr =	34.720	BLr' = WLr' - Hr =	34.616	BLd = WLd - Hd =	34.519		(0.0010)

for Min Discharge

	At Inlet		BP of Regulating Channel		EP of Regulating Channel		Downstream Canal		
Energy Level	ELi = WLu - hi =	35.520	ELr = WLr + hvr =	34.957	Elr' = ELr - hrf =	34.950	ELd = WLd + hvd =	34.943	
Water Level	WLi = ELi - hvi =	35.519	WLr = Wli - hg =	34.941	WLr' = Elr' - hvr =	34.933	WLd = BLm + Hd =	34.910	impossible
Floor Level	BLi = WLi - Hi=	34.720	BLr = WLr - Hr =	34.720	BLr' = WLr' - Hr =	34.713	BLm = Blm max	34.519	

2 Paremeters for Max Discharge

1) Basic Dimensions
   Gate Width Bg= 0.50 m
   Water depth at Inlet Hi 0.800 m
   Q=0.65*Bg*w*[2g*(Δh+hvi]^0.5
2) Required Gate Opening Q'= 0.033 m3/s
   w= 0.0267 m ok
   Qd-Q'= 0 ok
3) Head Loss Δh = 0.7351 m

3 Paremeters for Min Discharge

1) Basic Dimensions
   Gate Width Bg= 0.50 m
   Water depth at Inlet Hi 0.799 m
   Q=0.65*Bg*w*[2g*(Hi-w/2)]^0.5
2) Gate Opening Check Q'= 0.0500 m3/s
   w= 0.03936506 m ok
   Qd-Q'= 3.2618E-06 ok
   α: ratio for max Gate opening 0.72359601
   k: ratio for min gate opening 0.04927627
3) Head Loss Δh=α Hi= 0.5781 m

4 Check of Regulating Channel Water Depth

1) *for Max Discharge*
   Velocity at Gate end vg 2.4675 m
   Froud Number Fr=ve/[(g w)^0.5] 4.8196
   Conjugate depth hd'
   hd'=0.5[(1+8Fr^2)^0.5-1] w 0.1694 m
   Regulating Channel Length Ls =6.17 x hd' 1.0454 m
   say 1.10 m
2) *for Min Discharge*
   Velocity at Gate end vg 2.5403 m
   Froud Number Fr=ve/[(g w)^0.5] 4.0900
   Conjugate depth hd"
   hd'=0.5[(1+8Fr^2)^0.5-1] w 0.2089 m
   Regulating Channel Length Ls =6.17 x hd' 1.2887 m
   say 1.30 m
3) Throat end height d=
   d= Max(hd'-w max',h" -w min) 0.1695 m
   say 0.00 m

5 Calculation of Head Loss

for Max Discharge
1) Inlet hi = 0.5 hvi = 0.0003 m
2) Head loss at Gate hg= Δh 0.7351 m
3) Regulating Channel hrf=Ir*L3 0.1037 m
4) Outlet Transition
   hor=(Ir+Id)/2*L4 0.0106 m
   Divergence hod = 0.4(hvr-hvd) = 0.0326 m
   sub-total ho= 0.0432 m

for Min Discharge
1) Inlet hi = 0.5 hvi = 0.0004 m
2) Head loss at Gate hg=α*Hi 0.5781 m
3) Regulating Channel hrf=Ir*L3 0.0073 m
4) Outlet Transition
   hor=(Ir+Id)/2*L4 0.0072 m
   Divergence hod = 0.4(hvr-hvd) = 0.0065 m
   sub-total ho= 0.0138 m

5) Total loss Max Q 0.8824 m
   Min Q 0.5995 m

Hydraulic calculation of Tertiary canal

1. Uniform flow calculation of main canal

Manning's formula

$V_1 = 1/n \cdot R^{2/3} \cdot I^{1/2}$

where, V_1 = flow velocity (m/sec)
n = roughness coefficient
R = hydraulic radius (m)
I = hydraulic gradient.

$Q = V_1 \cdot A$

where, Q = design discharge (m^3/sec)
A = flow area (m^2)

$n = \{1/\Sigma p\,(p_1 \cdot n_1^{3/2} + p_2 \cdot n_2^{3/2} + \cdots + pi \cdot ni^{3/2})\}^{2/3}$

pi = wetted perimeter (m)

Free board

$Fb = 0.05h + \beta \cdot hv + hw$

where, h = water depth (m)
β = coefficient = 1.0
hv = velocity head (m)
hw = free board for waving =0.10 m

(1) Tertiary-1

Q = 0.050 (m^3/sec)
I = 0.00040 = 1/2,500.00
n_1 = 0.025 = roughness coefficient of side slope
n_2 = 0.025 = roughness coefficient of canal bed
n = 0.025
B = p_1 = 0.5 m = bottom width of canal
p_2 = 0.382 m = wetted perimeter at side slope of canal
m = 1.00 = side slope (horizontal to vertical)

water depth h_1 (m)	A (m^2)	R (m)	V_1 (m/s)	Q (m^3)	Free board (m)
0.270	0.208	0.165	0.240	0.050	0.120

Height of canal = 0.40 m

(2) Tertiary-2

Q = 0.100 (m^3/sec)
I = 0.00040 = 1/2,500.00
n_1 = 0.025 = roughness coefficient of side slope
n_2 = 0.025 = roughness coefficient of canal bed
n = 0.025
B = p_1 = 0.5 m = bottom width of canal
p_2 = 0.551 m = wetted perimeter at side slope of canal
m = 1.00 = side slope (horizontal to vertical)

water depth h_1 (m)	A (m^2)	R (m)	V_1 (m/s)	Q (m^3)	Free board (m)
0.390	0.347	0.216	0.288	0.100	0.120

Height of canal = 0.51 m

(3) Tertiary-3

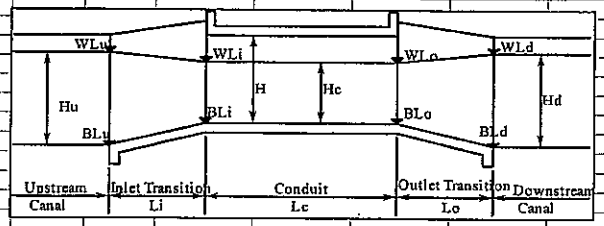
Q =	0.150	(m^3/sec)	
I =	0.00040	= 1/2,500.00	
n_1 =	0.025	= roughness coefficient of side slope	
n_2 =	0.025	= roughness coefficient of canal bed	
n =	0.025		
B = p_1 =	0.5	m	= bottom width of canal
p_2 =	0.677	m	= wetted perimeter at side slope of canal
m =	1.00		= side slope (horizontal to vertical)

water depth h_1 (m)	A (m^2)	R (m)	V_1 (m/s)	Q (m^3)	Free board (m)
0.479	0.469	0.253	0.320	0.150	0.130

Height of canal = 0.61 m

Hydraulic Calculation of Box Culvert at National road No.4

Canal Name:	South main canal	Existing flow capacity	Total discharge Q = 17.4m3/sec
Structure No.	Box culvert at National road No.4	Type	Box Single



1 Dimension and Hydraulic Conditions

Conduit width Bc=	3.00	m	Design Discharge Q=	4.69	m3/sec		
Nos. of Conduit N =	1	nos	Conduit length Lc =	15.00	m		

	Upstream Canal		Conduit		Downstream Canal	
			Qi=Q/N =	4.694		
Bottom Width	Bu =	4.00	Bc =	3.00	Bd =	4.00
Side Slope 1:m	m=	1.5	m=	0	m=	1.5
Water Depth	Hu =	2.470	Hc =	2.4601	Hd=	2.470
Water Surface Width	Wu =	11.41	Wc =	3.000	Wd =	11.41
Flow Area	Au =	19.0314	Ac =	7.38025	Ad=	19.0314
Velocity	Vu =	0.5182	Vc =	0.63601	Vd=	0.5182
Velocity Head	hvu =	0.0137	hvc =	0.02064	hvd=	0.0137
Energy Head	Eu =	2.4837	Ec =	2.48072	Ed =	2.4837
Inlet loss in the transition (hi)			hi =	0.00298		
dE = Eu - (Ei + hi)				-2.86679E-08	ok	
Wetted Perimeter P = B + 2H(m^2+1)^0.5	Pu =	12.9057	Pc =	7.9202	Pd =	12.9057
Hydraulic Radius R = A/P	Ru =	1.4746	Rc =	0.9318	dd =	1.4746
Roughness Coefficient	n=	0.025	n=	0.015	n=	0.025
Hydraulic Gradient I =[n V/R ^(2/3)]^2	Iu =	0.0001	Ic =	0.0001	Id =	0.0001

Transition = 1.92098 (Wu-Wc)/2		8.078	Transition =2.41421 (Wu-Wc)/2		10.152		
Length of Transition	say Li =	9.00	m	say Lo =	11.00	m	
	designed	9.00	m		11.00	m	

Transition Angle: U/stream 27°30', D/stream 22°30'

note: Vc shall be in between "Vu" and 3.0 m/sec.

	At B.P. of Culvert		At B.P.of Conduit Inlet		At E.P.of Conduit Inlet		At E.P.of Culvert	
Energy Level (m)	ELu = WLu + hvu =	35.414	ELi = ELu - hi =	35.411	ELo = ELi - hf =	35.409	ELd = ELo-ho =	35.405
Water Level (m)	WLu = ELu - hvu =	35.400	WLi = ELi - hvc =	35.390	WLo = ELo - hvc =	35.389	WLd = ELd-hvd=	35.391
Floor Level (m)	BLu = WLu - Hu=	32.930	BLi = WLi - Hc =	32.930	BLo = WLo - Hc =	32.928	BLd = WLd - Hd	32.921

2 Calculation of Head Loss

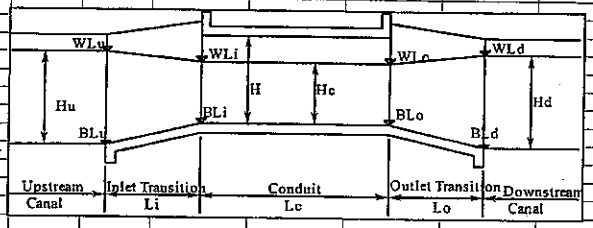
1)	Inlet transition		
	Friction hif=Li(Iu+Ic)/2 =	0.0009	m
	Gradual contraction hgc = fgc (hvc-hvu)		
	hgc = fgc (hvc-hvu)	0.00208	m
	fgc =	0.3	
	Energy loss factor is depend on shape		
2)	Culvert conduit		
	Friction hf = LcIc =	0.0015	m
3)	Outlet transition		
	Friction hof=Lo(Ic+Id)/2 =	0.0011	m
	Gradual enlargement loss		
	hge = fge (hvc-hvd)	0.00347	m
	fge =	0.5	
	sub-total	0.00905	m

3 Inner height of conduit

H = Hc/0.83 =	2.96395	
Design	2.750	m

Hydraulic Calculation of Box Culvert at National road No.4

Canal Name:	South main canal	New construction Box culvert	Total discharge Q = 17.4m3/sec
Structure No.	Box culvert at National road No.4	Type	Box Single



1 Dimension and Hydraulic Conditions

Conduit width Bc=	2.00	m	Design Discharge Q=	12.20	m3/sec	
Nos. of Conduit N =	2	nos	Conduit length Lc =	15.00	m	

	Upstream Canal		Conduit		Downstream Canal	
			Qi=Q/N =	6.098		
Bottom Width	Bu =	4.00	Bc =	2.00	Bd =	4.00
Side Slope 1:m	m=	1.5	m=	0	m=	1.5
Water Depth	Hu =	2.920	Hc =	2.864	Hd=	2.920
Water Surface Width	Wu =	12.76	Wc =	2.000	Wd =	12.76
Flow Area	Au =	24.4696	Ac =	5.7278	Ad=	24.4696
Velocity	Vu =	0.5662	Vc =	1.0646	Vd=	0.5662
Velocity Head	hvu =	0.0164	hvc =	0.0578	hvd=	0.0164
Energy Head	Eu =	2.9364	Ec =	2.9218	Ed =	2.9364
Inlet loss in the transition (hi)			hi =	0.0146		
dE = Eu - (Ei + hi)				5.86953E-06	ok	
Wetted Perimeter P = B + 2H(m^2+1)^0.5	Pu =	14.5282	Pc =	7.7278	Pd =	14.5282
Hydraulic Radius R = A/P	Ru =	1.6843	Rc =	0.7412	dd =	1.6843
Roughness Coefficient	n=	0.025	n=	0.015	n=	0.025
Hydraulic Gradient I = [n V/R^(2/3)]^2	Iu =	0.0001	Ic =	0.000380191	Id =	0.0001
Transition = 1.92098 (Wu-Wc)/2		8.4139	Transition =2.41421 (Wu-Wc)/2		10.5742	
Length of Transition	say Li =	9.00	m	say Lo =	11.00	m
	designed	9.00	m		11.00	m

Transition Angle
U/stream 27°30'
D/stream 22°30'

note: Vc shall be in between "Vu" and 3.0 m/sec.

	At B.P. of Culvert		At B.P.of Conduit		At E.P.of Conduit		At E.P.of Culvert	
Energy Level (m)	ELu = WLu + hvu =	35.416	ELi = ELu - hi =	35.402	ELo = ELi - hf =	35.396	ELd = ELo-ho =	35.373
Water Level (m)	WLu = ELu - hvu =	35.400	WLi = ELi - hvc =	35.344	WLo = ELo - hvc =	35.338	WLd = ELd-hvd=	35.356
Floor Level (m)	BLu = WLu - Hu=	32.480	BLi = WLi - Hc =	32.480	BLo = WLo - Hc =	32.474	BLd = WLd - Hd =	32.436

2 Calculation of Head Loss

1)	Inlet transition			
	Friction hif=Li(Iu+Ic)/2 =	0.00216	m	
	Gradual contraction hgc = fgc (hvc-hvu)			
	hgc = fgc (hvc-hvu)	0.01244	m	
	fgc =	0.3		
	Energy loss factor is depend on shape			
2)	Culvert conduit			
	Friction hf = LcIc =	0.0057	m	
3)	Outlet transition			
	Friction hof=Lo(Ic+Id)/2 =	0.00264	m	
	Gradual enlargement foss			
	hge = fge (hvc-hvd)	0.02073	m	
	fge =	0.5		
	sub-total	0.04368	m	

3 Inner height of conduit

H = Hc/0.9 =	3.182	
Design	3.200	m