

Attachment 3

*Result of Sediment
Monitoring Forebay
of Intake*

Area : Approach channel and the forebay of the intake
Method : Echo Sounder (RAYTHEON COMPANY)
Schedule : Monthly basis

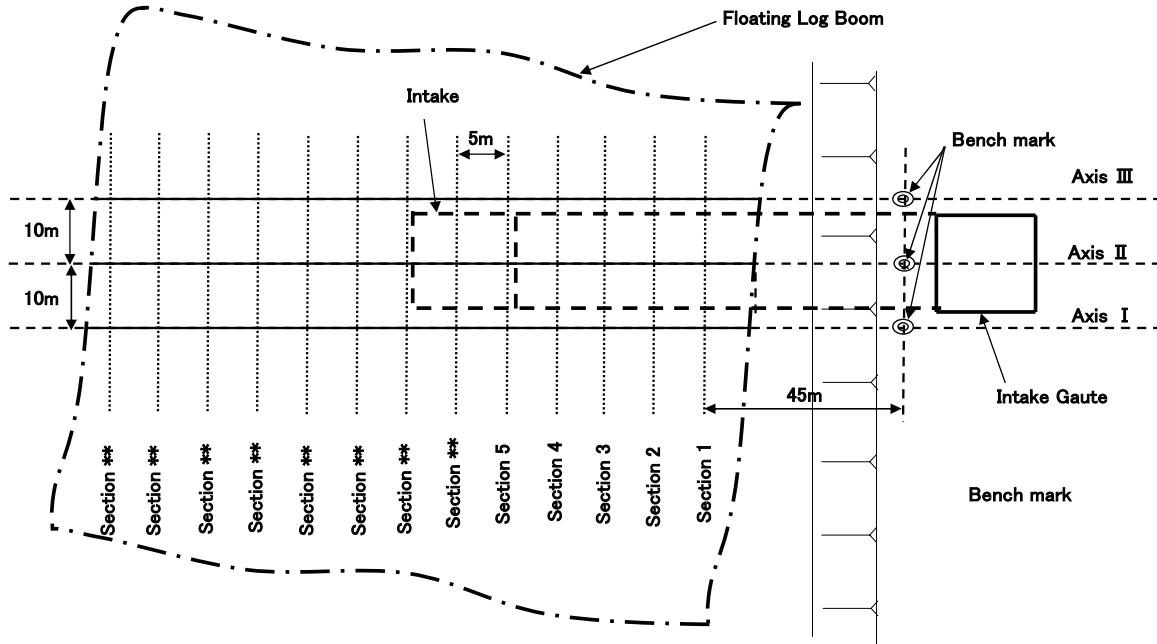


Figure Location Map of Sediment Monitoring Forebay of Intake

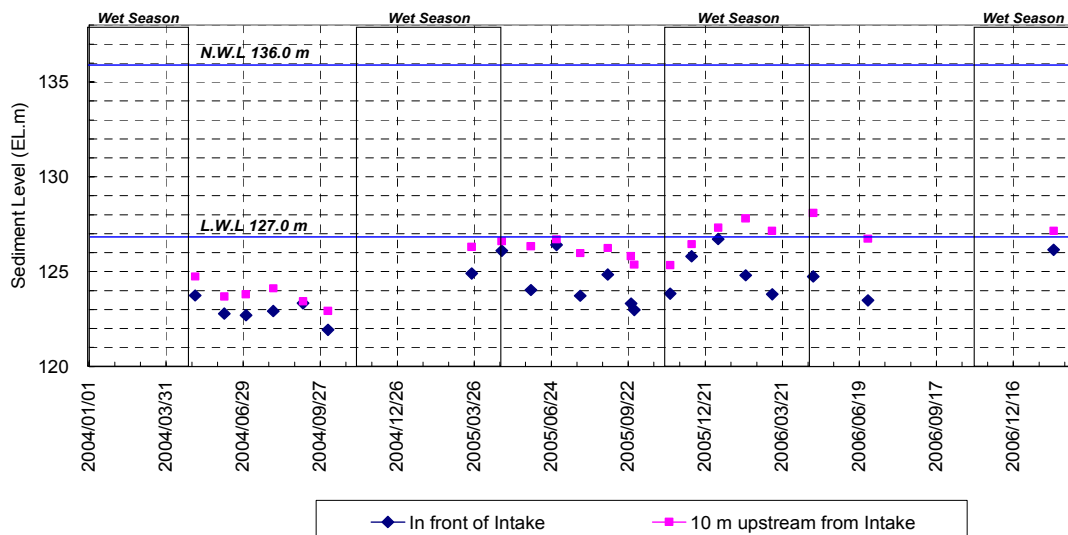
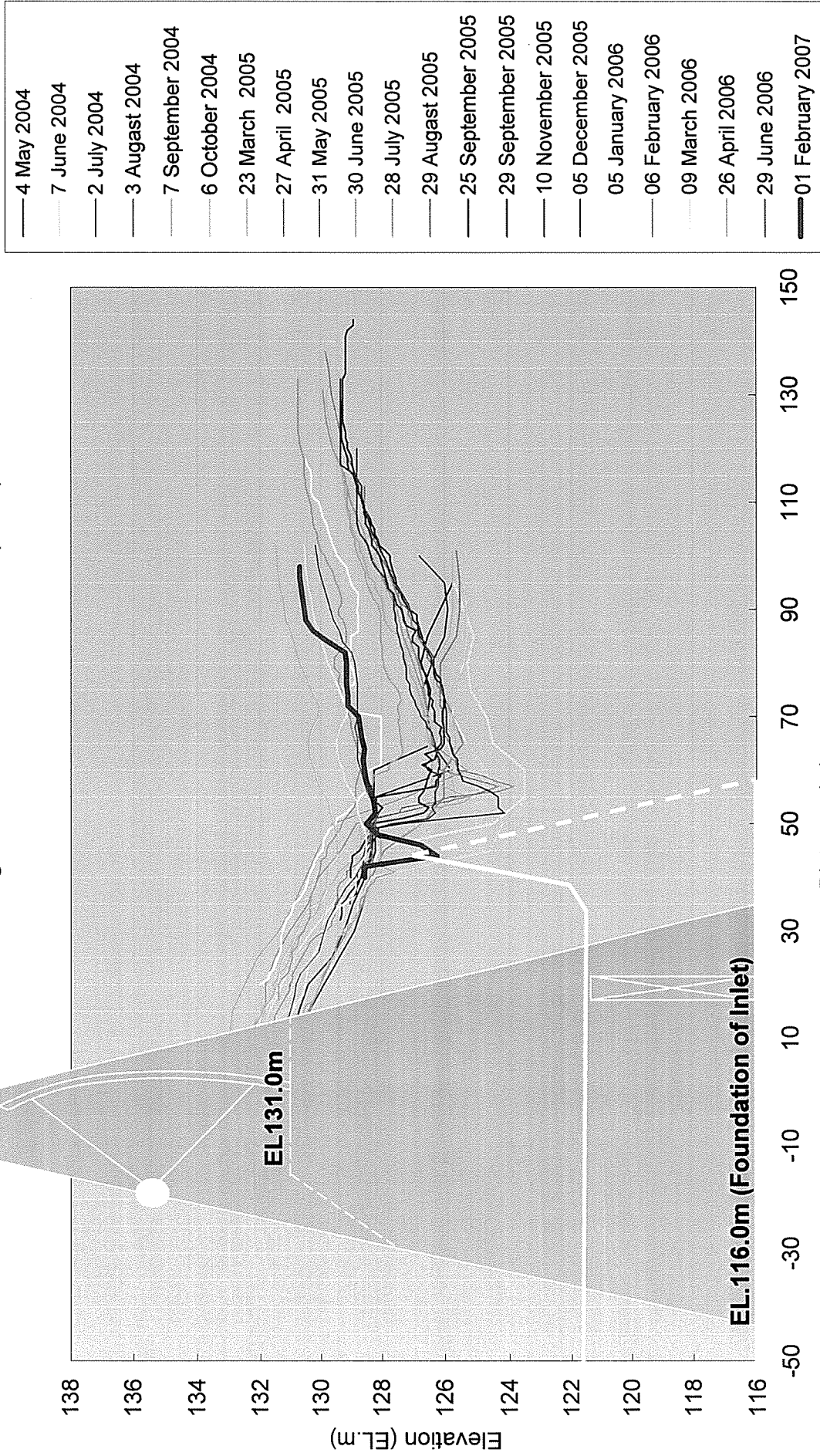


Figure A3-1 Comparison of Sediment Levels in front of Intake

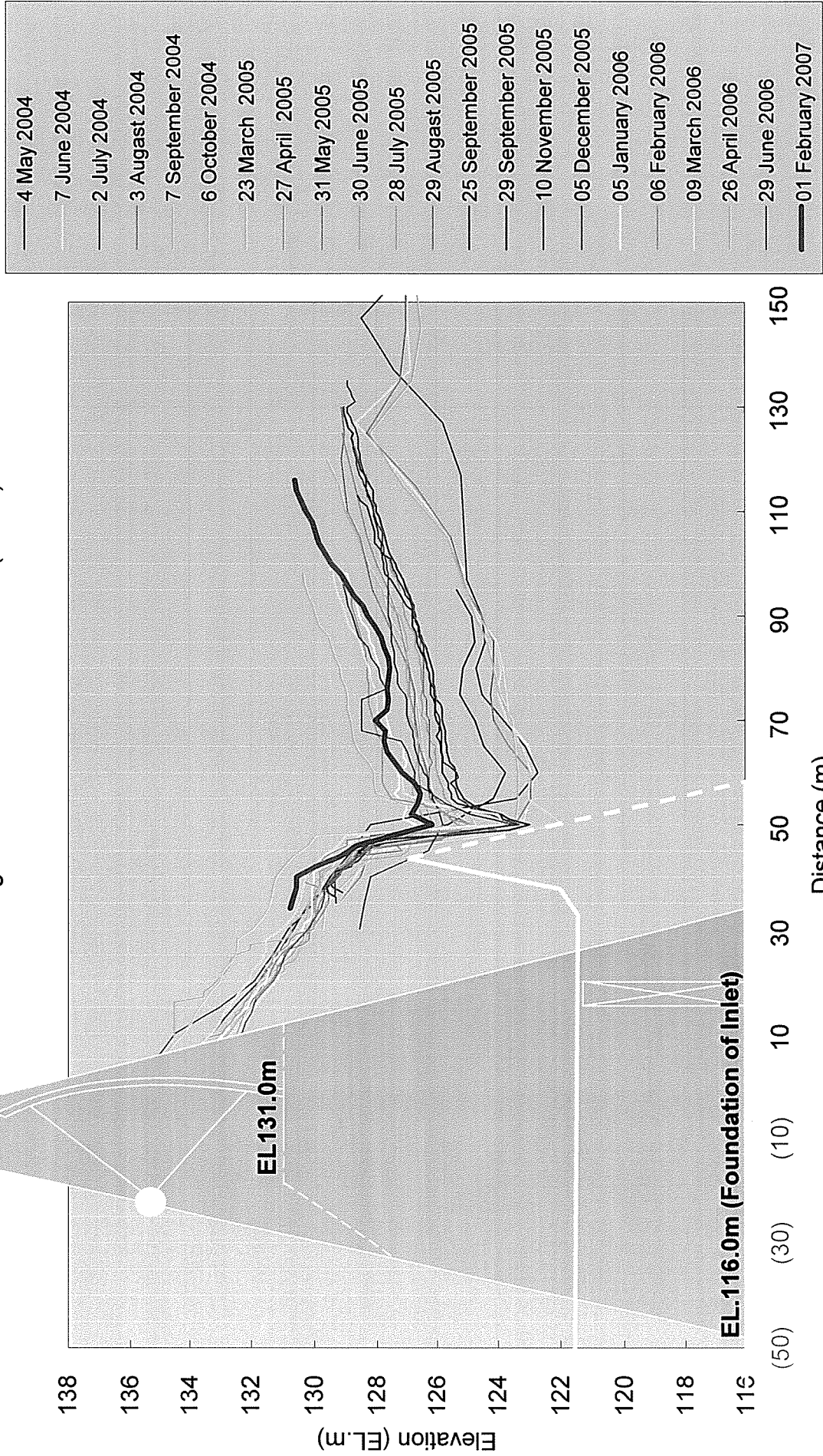
Monitoring on Sedimentation at Intake (Axis I)



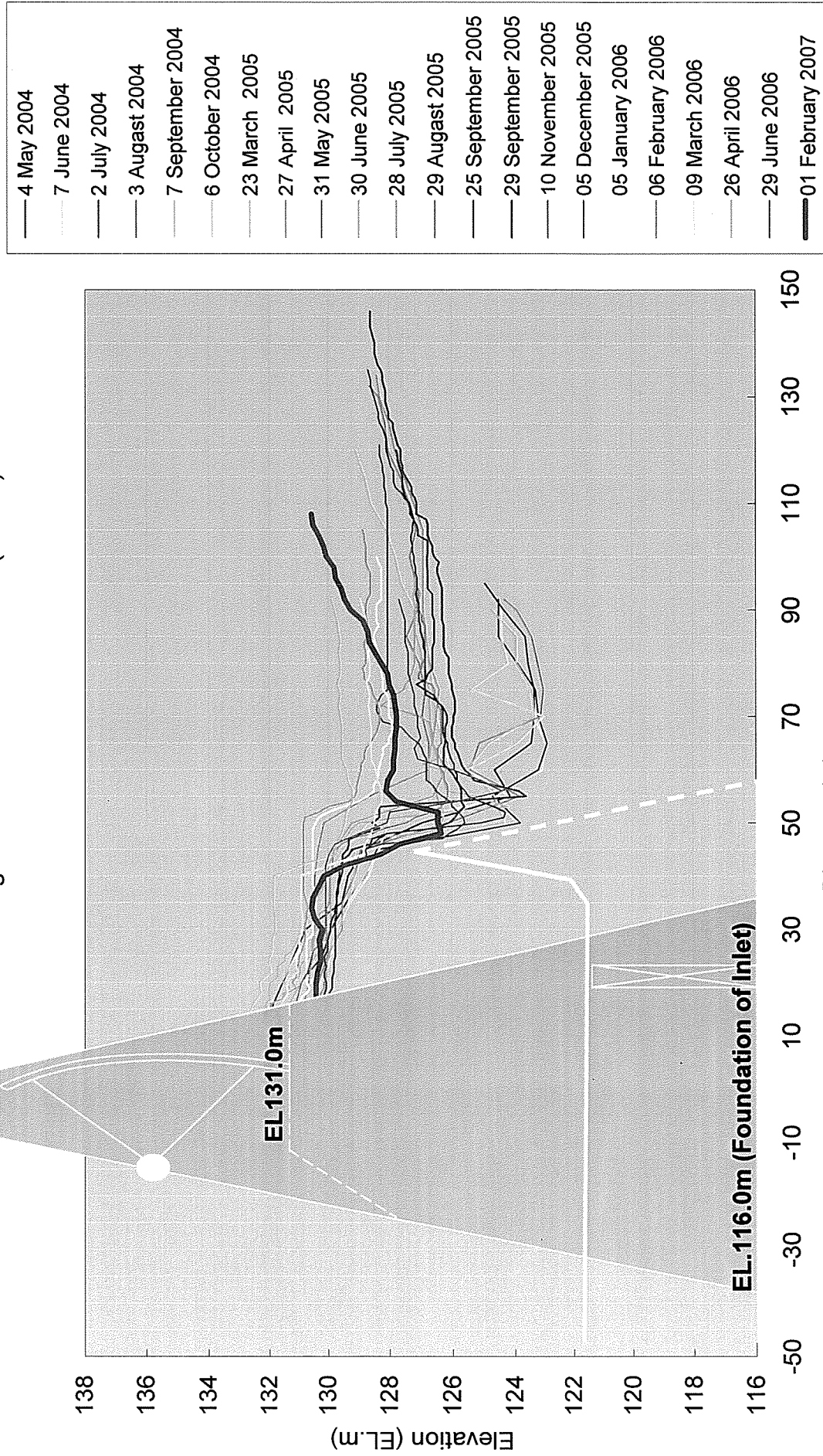
3-A3-2

A3-2 Sedimentation at Intake (Axis I)

Monitoring on Sedimentation at Intake (Axis II)



Monitoring on Sedimentation at Intake (Axis III)



Attachment 4

*Topographic Map of
Intake Forebay on
October 2006*

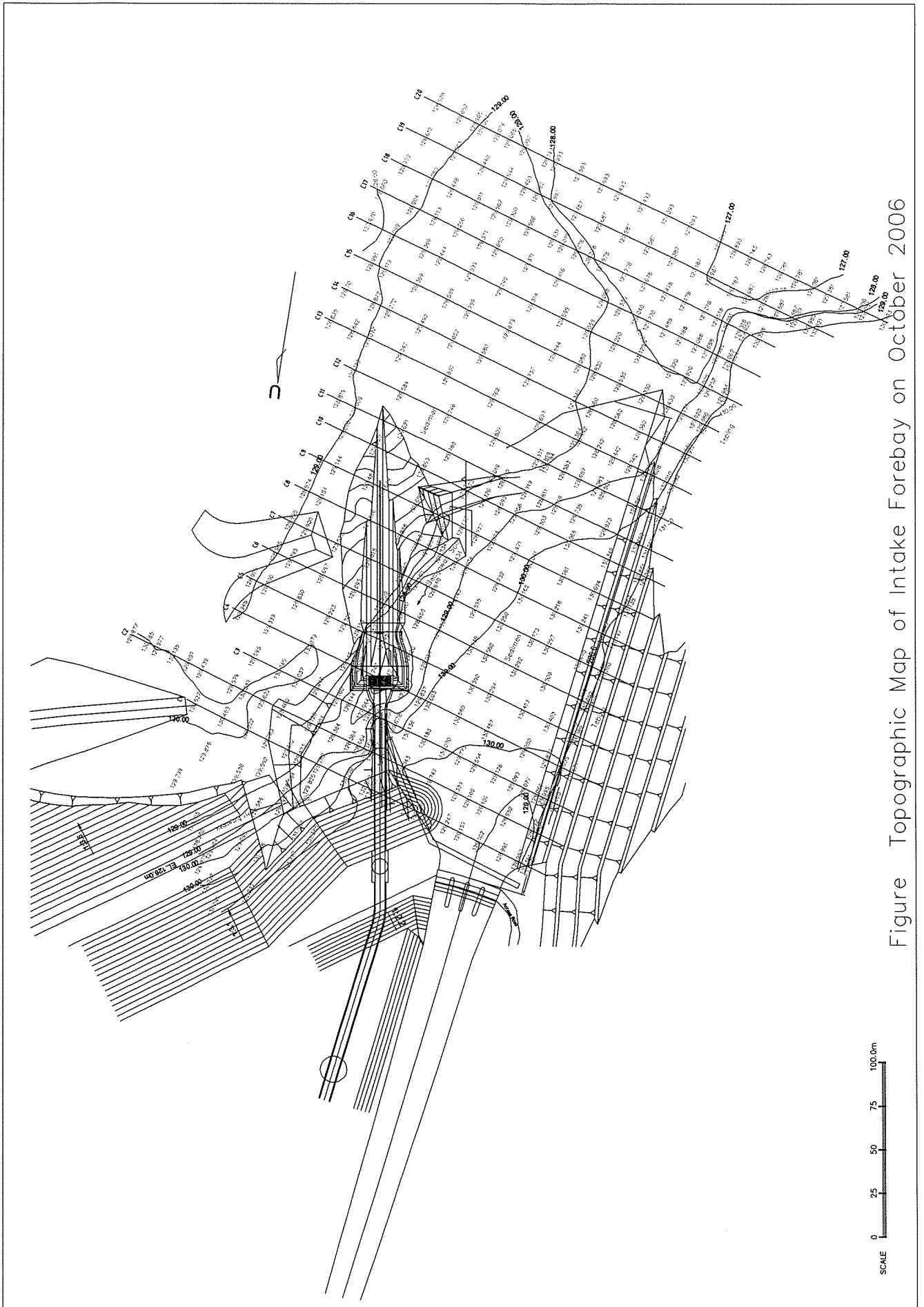


Figure Topographic Map of Intake Forebay on October 2006

Attachment 5

Calculation on Bed Load Transportation in the Intake

Bed load transportation in the Intake

<Condition>

1. Shape of intake channel

<u>Section 1</u>		shape:	bellmouth
Inlet (Bellmouth)	W=	11.60	m
	H=	11.00	m
	A=	127.6	m ²
<u>Section 2</u>		shape:	calash
Inside of Water Channel	W=	5.50	m
	H=	2.75	m
	R=	2.75	m
	A=	27.00	m ²

2. Discharge

Maximum		75	m ³ /s
Average	approx,	30	m ³ /s

3. Sedimentation

deposit level	assumed to be from EL.116 m to EL.126 m		
deposition material	d60=	0.00001 m	=0.01mm

<Formula>

(i) shear stress

$\tau = \rho g R i_e$

where; τ	shear stress (kg/m ²)	=	1000 (kg/m ³)
ρ :	density of water (kg/m ³)	=	9.8 (m/s ²)
g :	gravitational acceleration (m/s ²)	=	
R :	hydraulic radius (m)		
i_e :	energy slope		

(ii) energy slope

$i_e = n^2 v^2 / R^{4/3}$

where; n :	roughness parameter (manning's n)	=	0.015 (concrete lining)
v :	uniform velocity (m/s)		
R :	hydraulic radius (m)		

(iii) shear velocity

$u_* = (g R i_e)^{0.5}$

(iv) non-dimensional critical shear stress

Iwagaki formula

$d \geq$	0.303 cm	u_{*c}^2	=	80.9d
$0.118 \leq d \leq$	0.303 cm	u_{*c}^2	=	134.6d ^{31/32}
$0.0565 \leq d \leq$	0.118 cm	u_{*c}^2	=	55.0d
$0.0065 \leq d \leq$	0.0565 cm	u_{*c}^2	=	8.41d ^{11/32}
$d \leq$	0.0065 cm	u_{*c}^2	=	226d

Section 1: Inlet (Bellmouth)

Sediment Level	Area	Hydraulic Radius	Maximum Discharge						bed condition	Average Discharge					bed condition
			V	i_e	τ	u^*	u_{*c}	V		i_e	τ	u^*	u_{*c}		
EL.	m ²	m	m/s	-	N/m ²	m/s	m/s		m/s	-	N/m ²	m/s	m/s		
116	127.6	2.8	0.588	1.95E-05	0.539	0.023	0.009	move	0.235	3.12E-06	0.086	0.009	0.009	move	
117	116.0	2.7	0.647	2.52E-05	0.663	0.026	0.009	move	0.259	4.03E-06	0.106	0.010	0.009	move	
118	104.4	2.5	0.718	3.36E-05	0.835	0.029	0.009	move	0.287	5.38E-06	0.134	0.012	0.009	move	
119	92.8	2.4	0.808	4.66E-05	1.081	0.033	0.009	move	0.323	7.45E-06	0.173	0.013	0.009	move	
120	81.2	2.2	0.924	6.78E-05	1.450	0.038	0.009	move	0.369	1.08E-05	0.232	0.015	0.009	move	
121	69.6	2.0	1.078	1.05E-04	2.040	0.045	0.009	move	0.431	1.68E-05	0.326	0.018	0.009	move	
122	58.0	1.7	1.293	1.79E-04	3.061	0.055	0.009	move	0.517	2.86E-05	0.490	0.022	0.009	move	
123	46.4	1.5	1.616	3.46E-04	5.047	0.071	0.009	move	0.647	5.54E-05	0.808	0.028	0.009	move	
124	34.8	1.2	2.155	8.27E-04	9.660	0.098	0.009	move	0.862	1.32E-04	1.546	0.039	0.009	move	
125	23.2	0.9	3.233	2.91E-03	24.299	0.156	0.009	move	1.293	4.65E-04	3.888	0.062	0.009	move	
126	11.6	0.5	6.466	2.65E-02	119.379	0.346	0.009	move	2.586	4.23E-03	19.101	0.138	0.009	move	

Section 2: Inside of Water Channel

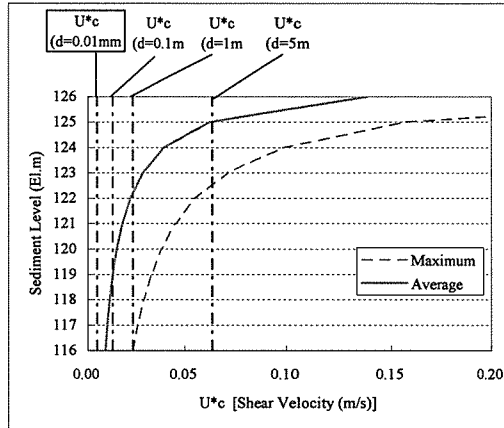
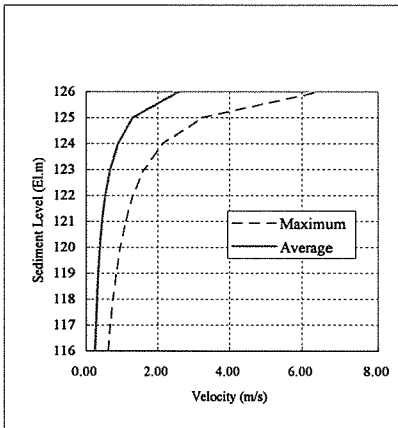
Sediment Level	Area	Hydraulic Radius	Maximum						bed condition	Average					bed condition
			V	i_e	τ	u^*	u_{*c}	V		i_e	τ	u^*	u_{*c}		
EL.	m ²	m	m/s	-	N/m ²	m/s	m/s		m/s	-	N/m ²	m/s	m/s		
116	27.0	1.4	2.777	1.14E-03	15.296	0.124	0.009	move	1.111	1.82E-04	2.447	0.049	0.009	move	

<Summary>

Section 1: Inlet (Bellmouth)

Relation between Shear Velocity and Sediment Level

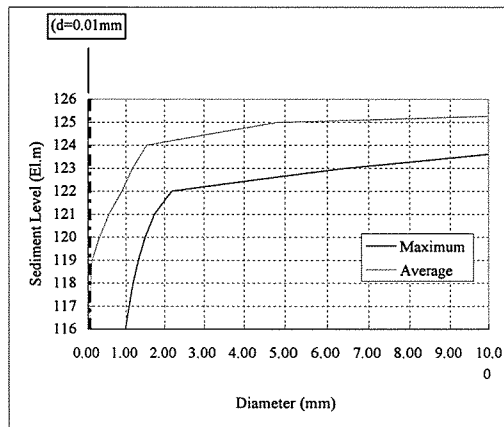
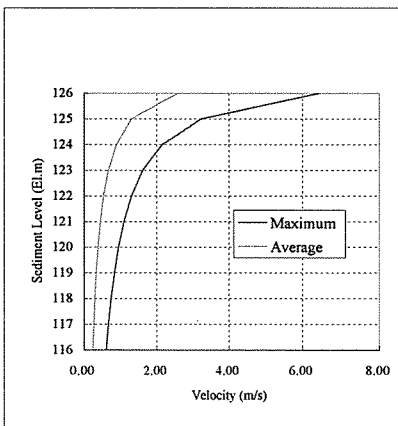
Sediment Level EL.	Area m ²	Maximum				Average			
		V m/s	u* m/s	u _c m/s	bed condition	V m/s	u* m/s	u _c m/s	bed condition
116	127.6	0.588	0.023	0.009	move	0.235	0.009	0.009	move
117	116.0	0.647	0.026	0.009	move	0.259	0.010	0.009	move
118	104.4	0.718	0.029	0.009	move	0.287	0.012	0.009	move
119	92.8	0.808	0.033	0.009	move	0.323	0.013	0.009	move
120	81.2	0.924	0.038	0.009	move	0.369	0.015	0.009	move
121	69.6	1.078	0.045	0.009	move	0.431	0.018	0.009	move
122	58.0	1.293	0.055	0.009	move	0.517	0.022	0.009	move
123	46.4	1.616	0.071	0.009	move	0.647	0.028	0.009	move
124	34.8	2.155	0.098	0.009	move	0.862	0.039	0.009	move
125	23.2	3.233	0.156	0.009	move	1.293	0.062	0.009	move
126	11.6	6.466	0.346	0.009	move	2.586	0.138	0.009	move



Section 1: Inlet (Bellmouth)

Relation between Maximum Diameter of Movable Sediment and Sediment Level

Sediment Level EL.	Area m ²	Maximum			Average		
		V m/s	u* m/s	d (mm)	V m/s	u* m/s	d (mm)
116	127.6	0.588	0.023	0.981	0.235	0.009	0.041
117	116.0	0.647	0.026	1.077	0.259	0.010	0.048
118	104.4	0.718	0.029	1.183	0.287	0.012	0.068
119	92.8	0.808	0.033	1.317	0.323	0.013	0.101
120	81.2	0.924	0.038	1.492	0.369	0.015	0.300
121	69.6	1.078	0.045	1.730	0.431	0.018	0.560
122	58.0	1.293	0.055	2.184	0.517	0.022	0.892
123	46.4	1.616	0.071	6.413	0.647	0.028	1.167
124	34.8	2.155	0.098	12.239	0.862	0.039	1.533
125	23.2	3.233	0.156	30.038	1.293	0.062	4.814
126	11.6	6.466	0.346	151.848	2.586	0.138	23.849



<Calculation for Shear Stress along the Intake forbay>

Q: intake discharge (40% of maximum) (m ³ /s) =		30
n: roughness parameter (mannings n) =		0.015
ρ: density of water (kg/m ³) =		1000 (kg/m ³)
g: gravitational acceleration (m/s ²) =		9.8 (m/s ²)

Original Condition

Station No.	Distance	Area	Hydraulic Radius	V	Maximum		
					Ie	τ	u*
	Inside of Water C	m ²	m	m/s	-	N/m ²	m/s
Section 20	-30.0	317.00	6.40	0.095	1.69E-07	0.011	0.003
Section 21	-20.0	350.95	6.83	0.085	1.27E-07	0.008	0.003
Section 22	-10.0	396.84	7.74	0.076	8.40E-08	0.006	0.003
Section 23	0.0	439.17	8.56	0.068	6.00E-08	0.005	0.002
Section C	0.0	127.60	1.90	0.235	5.29E-06	0.098	0.010
Section E	20.0	30.25	1.375	0.992	1.45E-04	1.950	0.044
Section F	40.0	27.00	1.375	1.111	1.82E-04	2.447	0.049
Section F'	70.0	27.00	1.375	1.111	1.82E-04	2.447	0.049

note : Area of each seciton was obtained from the As Built Drawing in 1982.

After Sediment Deposits (2003)

Station No.	Distance	Area	Hydraulic Radius	V	Maximum		
					Ie	τ	u*
	m	m ²	m	m/s	-	N/m ²	m/s
Section 20	-30.0	100.30	2.35	0.299	6.43E-06	0.148	0.012
Section 21	-20.0	191.61	4.29	0.157	7.92E-07	0.033	0.006
Section 22	-10.0	217.13	4.91	0.138	5.14E-07	0.025	0.005
Section 23	0.0	224.74	5.12	0.133	4.54E-07	0.023	0.005
Section C	0.0	34.57	0.93	0.868	1.87E-04	1.702	0.041
Section E	20.0	30.25	1.375	0.992	1.45E-04	1.950	0.044
Section F	40.0	27.00	1.375	1.111	1.82E-04	2.447	0.049
Section F'	70.0	27.00	1.375	1.111	1.82E-04	2.447	0.049

note : Area of each seciton was obtained from the drawings of intake sedimenation in 2004.

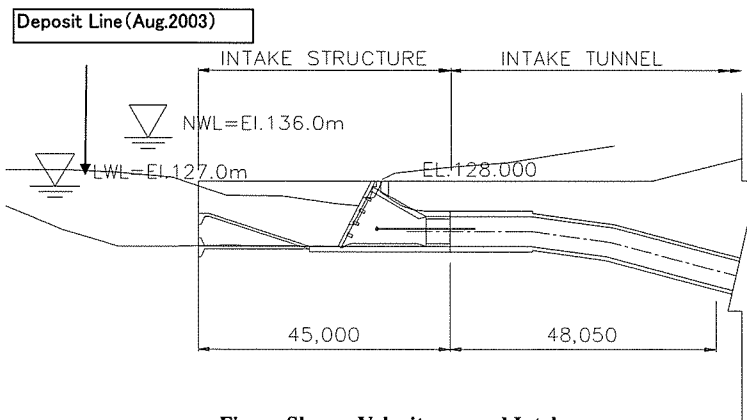
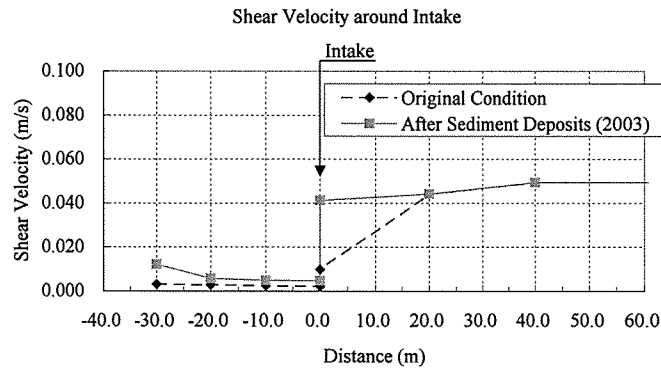


Figure Shear Velocity around Intake