

# WAWA RIVER BASIN, MINDANAO ISLAND, PHILIPPINES

## Basic Design of Wawa No.1 Hydropower Project

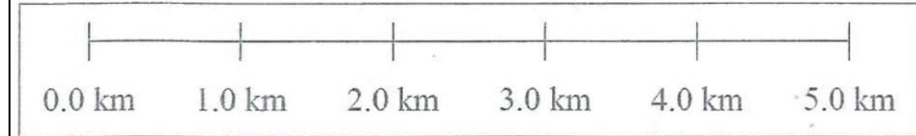
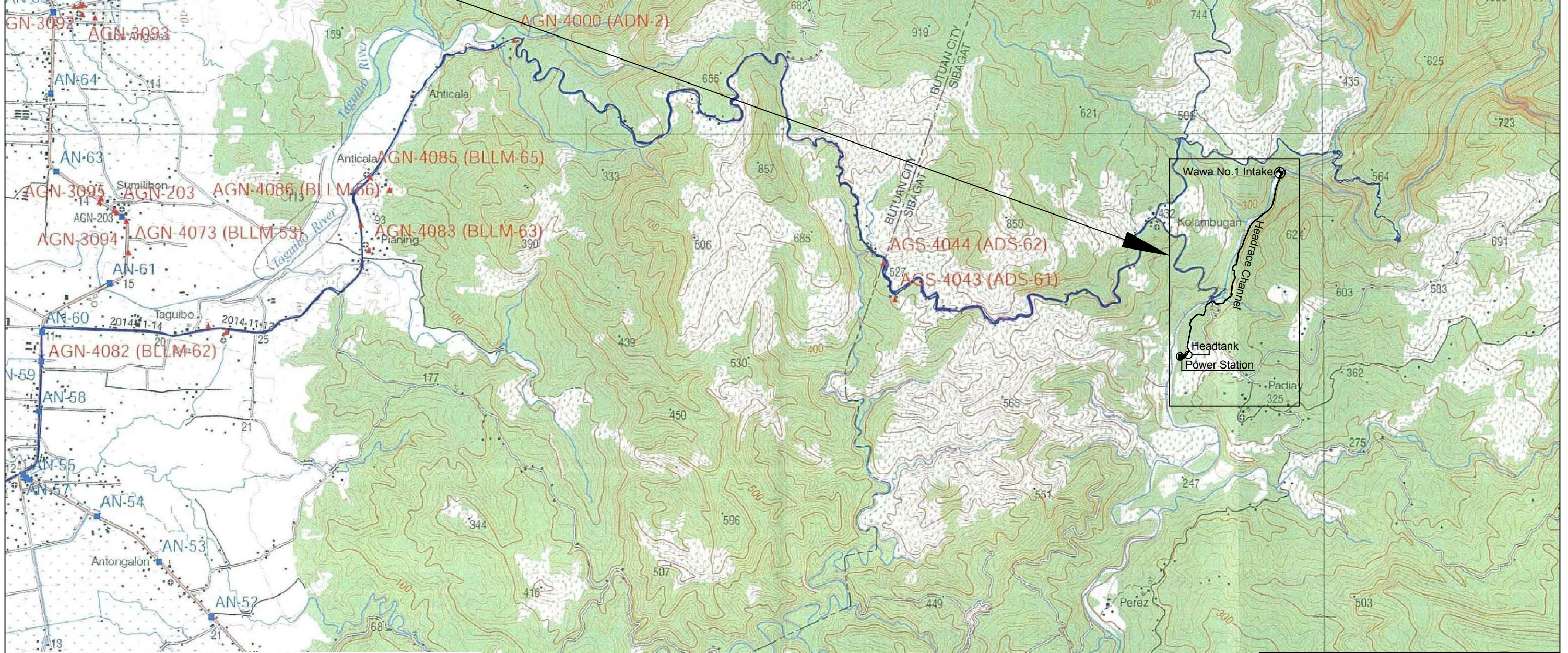
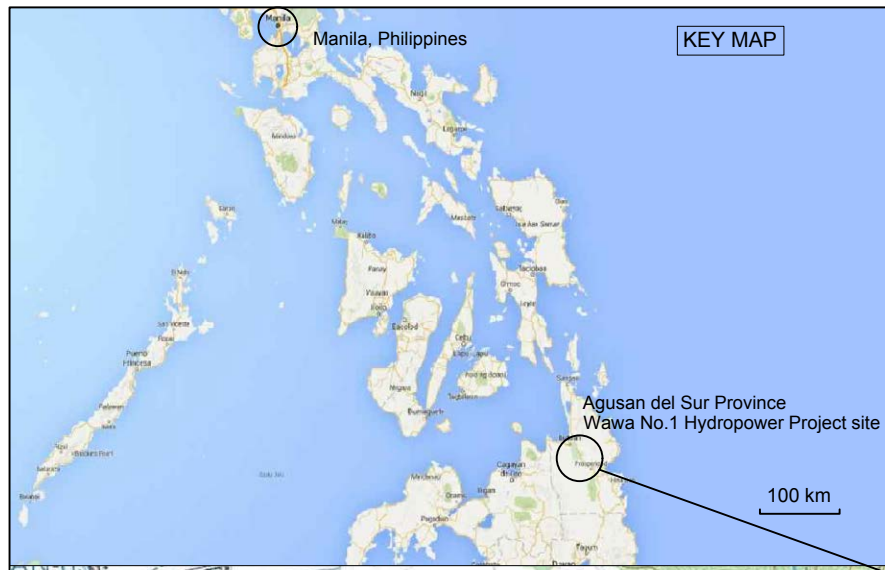
May 2016

Chodai Co.,Ltd.

Kiso-Jiban Consultants Co.,Ltd

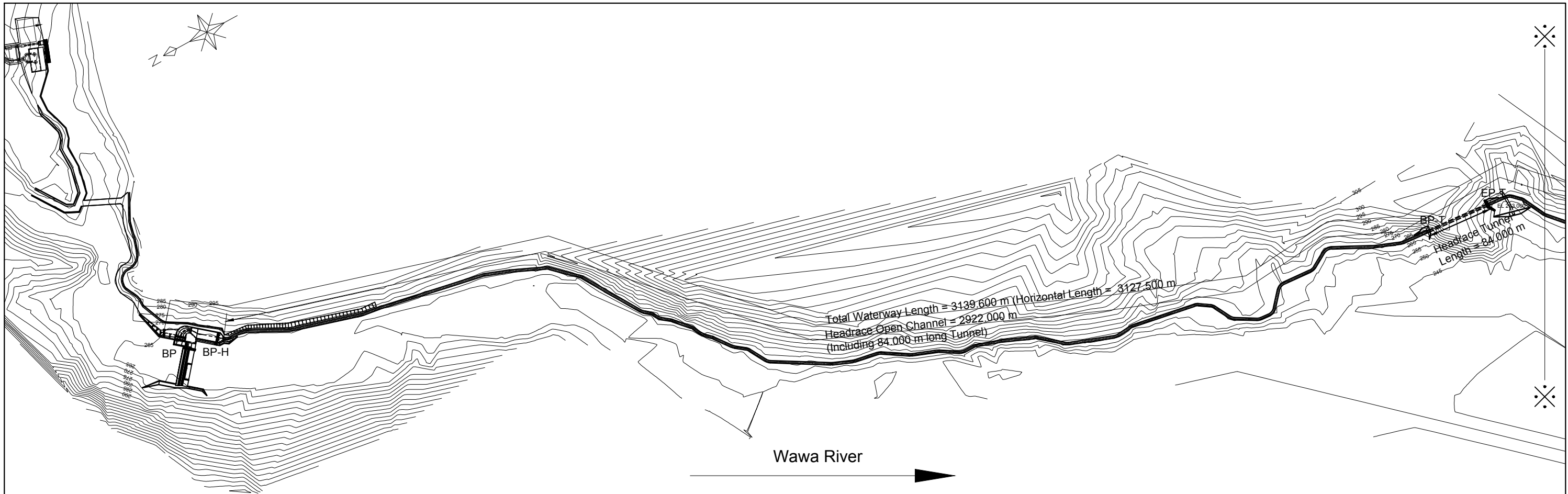
Industrial Disions,Inc.

Ernst & Young Shin Nihon LLC

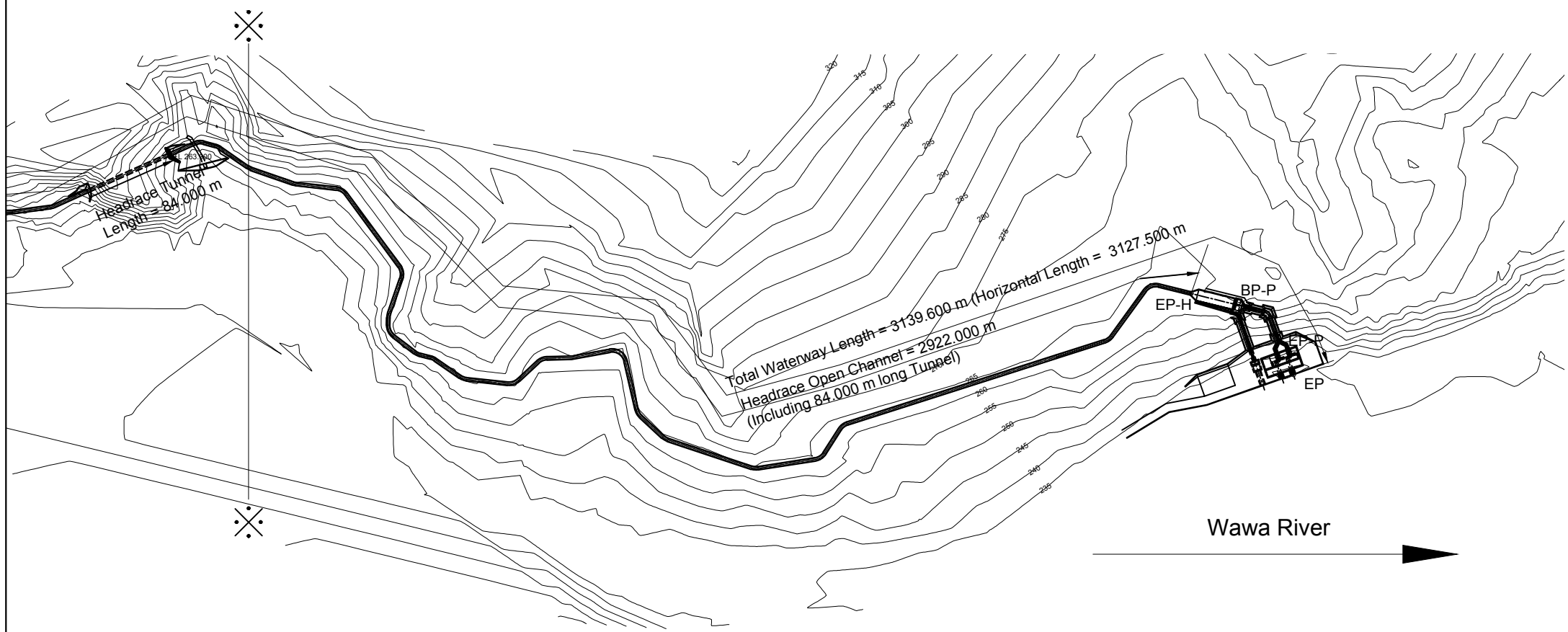


Elipsoide de Reference : WGS84  
Projection : UTM zone 29 N

<b>Wawa No.1 Hydropower Project</b>			
<b>Location Map</b>		Drawing No. 0-1	
Key Map & Location Map			
Scale	1:50000	Date	May 2016
Philippines Mini-Hydro Power Project Preparatory Study for the Wawa River in the Province of Agusan del Sur			
Drawn By : Dongol	Design By : Takase	Checked By : Takase	Approved By : Tsuda
Chodai Co.,Ltd. Kiso-Jiban Consultants Co.,Ltd		Industrial Dicions,Inc. Ernst & Young Shin Nihon LLC	



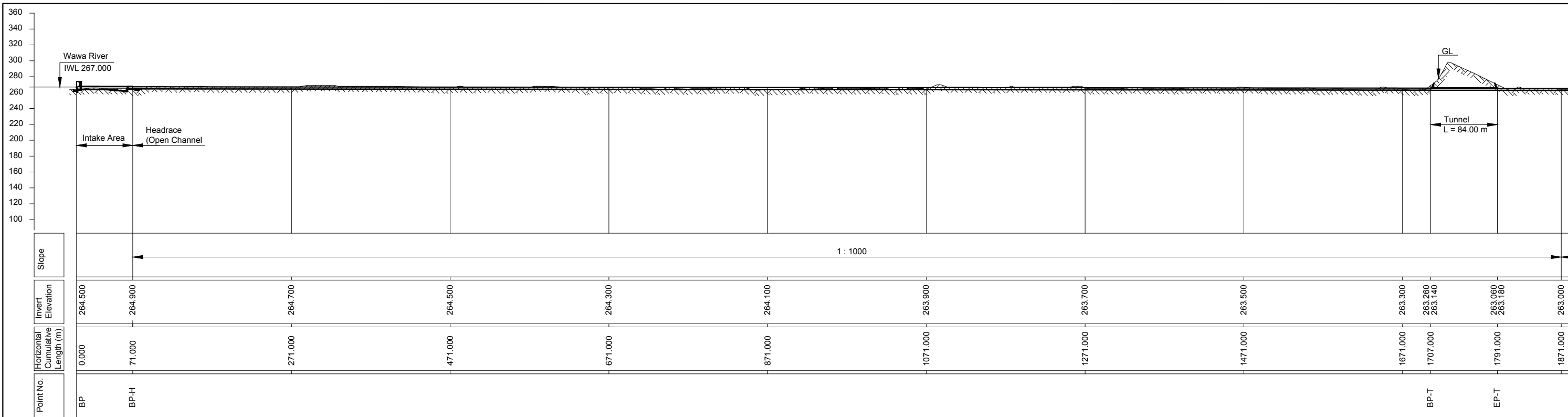
Waterway Plan upto Horizontal Distance +1871.000 m



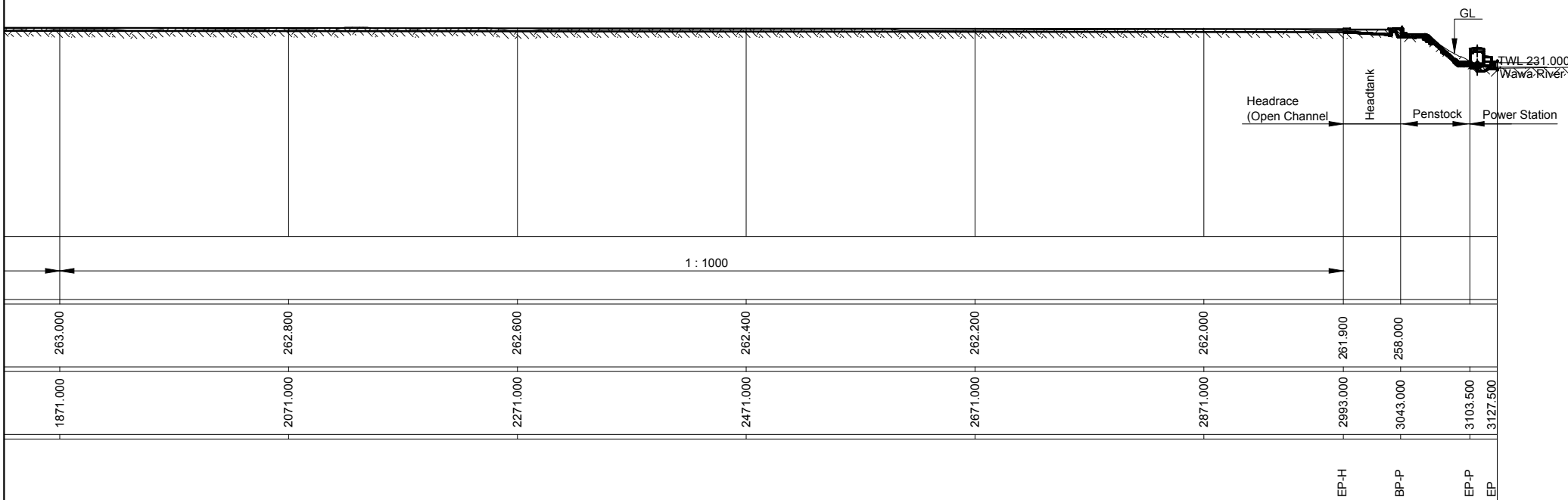
Waterway Plan from Horizontal Distance +1871.000 m

Point	Description	Coordinates	
		X-Coordinate	Y-Coordinate
BP	Beginning Point of Intake	581786.548	994814.602
BP-H	Beginning Point of Headrace	581760.391	994761.918
BP-T	Beginning Point of Tunnel	581151.606	993360.809
BP-E	End Point of Tunnel	581144.943	993277.074
EP-H	End Point of Headrace	580584.781	992515.803
BP-P	Beginning Point of Penstock	580551.087	992478.859
EP-P	End Point of Penstock	580497.725	992462.171
EP-P	End Point	580474.503	992468.935

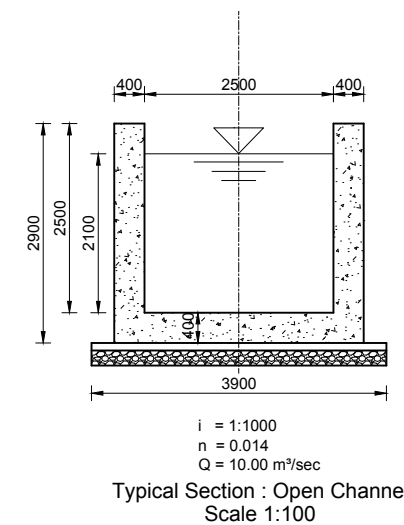
<b>Wawa No.1 Hydropower Project</b>			
<b>Waterway</b> General Plan		Drawing No. 1-1	
Scale	1:5000	Date	May 2016
Philippines Mini-Hydro Power Project Preparatory Study for the Wawa River in the Province of Agusan del Sur			
Drawn By :	Design By :	Checked By :	Approved By :
Dongol	Takase	Takase	Tsuda
Chodai Co.,Ltd.		Industrial Dicions,Inc.	
Kiso-Jiban Consultants Co.,Ltd		Ernst & Young Shin Nihon LLC	



Waterway Profile up to Horizontal Distance +1871.000 m

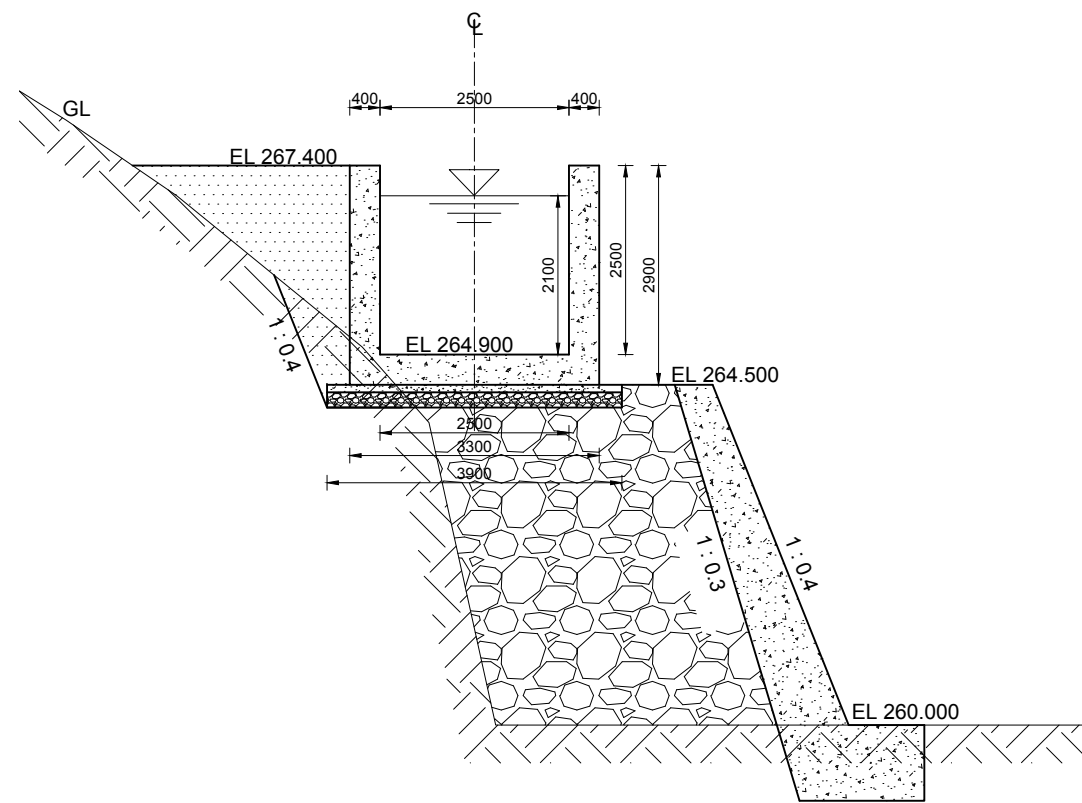


Waterway Profile from Horizontal Distance +1871.000 m

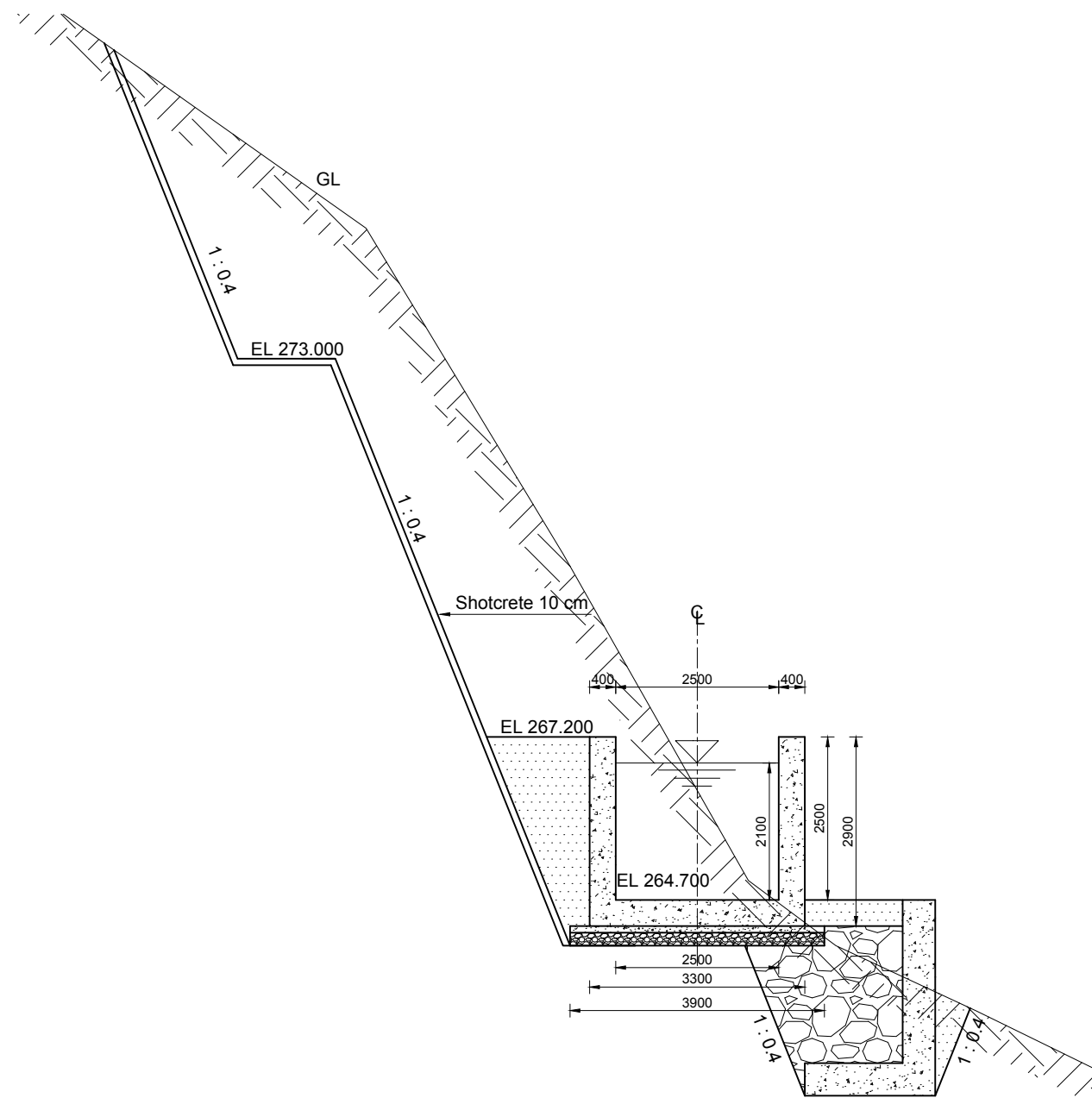


Typical Section : Open Channel  
Scale 1:100

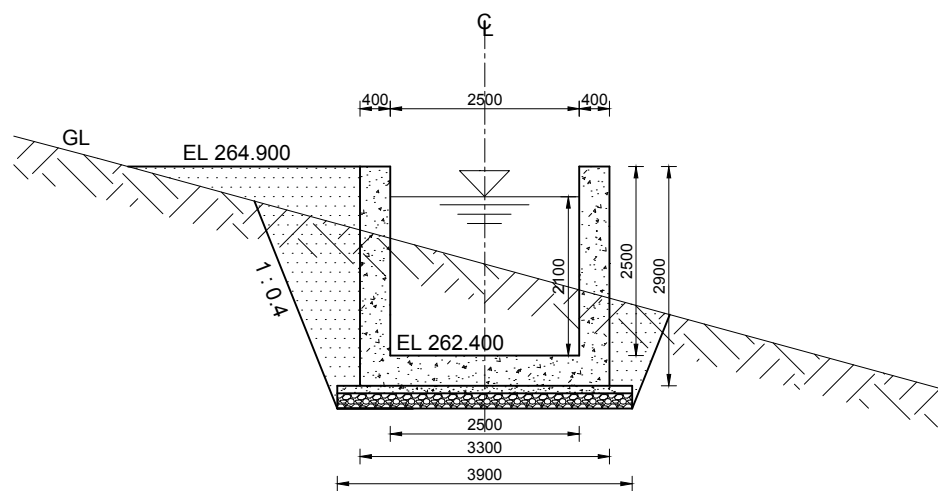
<b>Wawa No.1 Hydropower Project</b>			
<b>Waterway</b> Profile & Typical Section		Drawing No. 1-2	
Scale	1:5000	Date	May 2016
Philippines Mini-Hydro Power Project Preparatory Study for the Wawa River in the Province of Agusan del Sur			
Drawn By : Dongol	Design By : Takase	Checked By : Takase	Approved By : Tsuda
Chodai Co.,Ltd. Kiso-Jiban Consultants Co.,Ltd		Industrial Dicions,Inc. Ernst & Young Shin Nihon LLC	



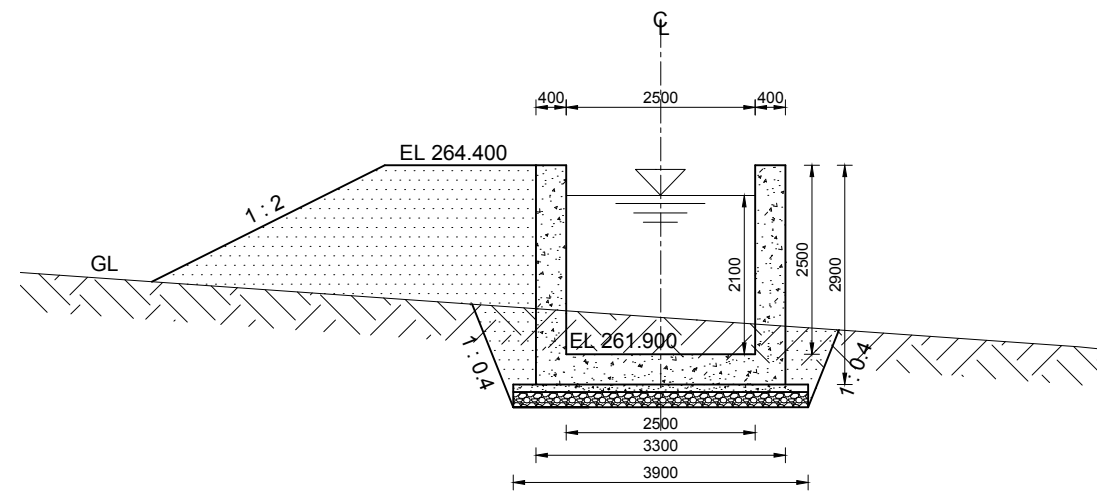
Cross Section at Hor. Distance 71.00 m  
Typical Section : Type A



Cross Section at Hor. Distance 271.00 m  
Typical Section : Type B



Cross Section at Hor. Distance 2471.00 m  
Typical Section : Type C



Cross Section at Hor. Distance 2993.00 m  
Typical Section : Type D

**Wawa No.1 Hydropower Project**

**Waterway**  
Cross-Sections

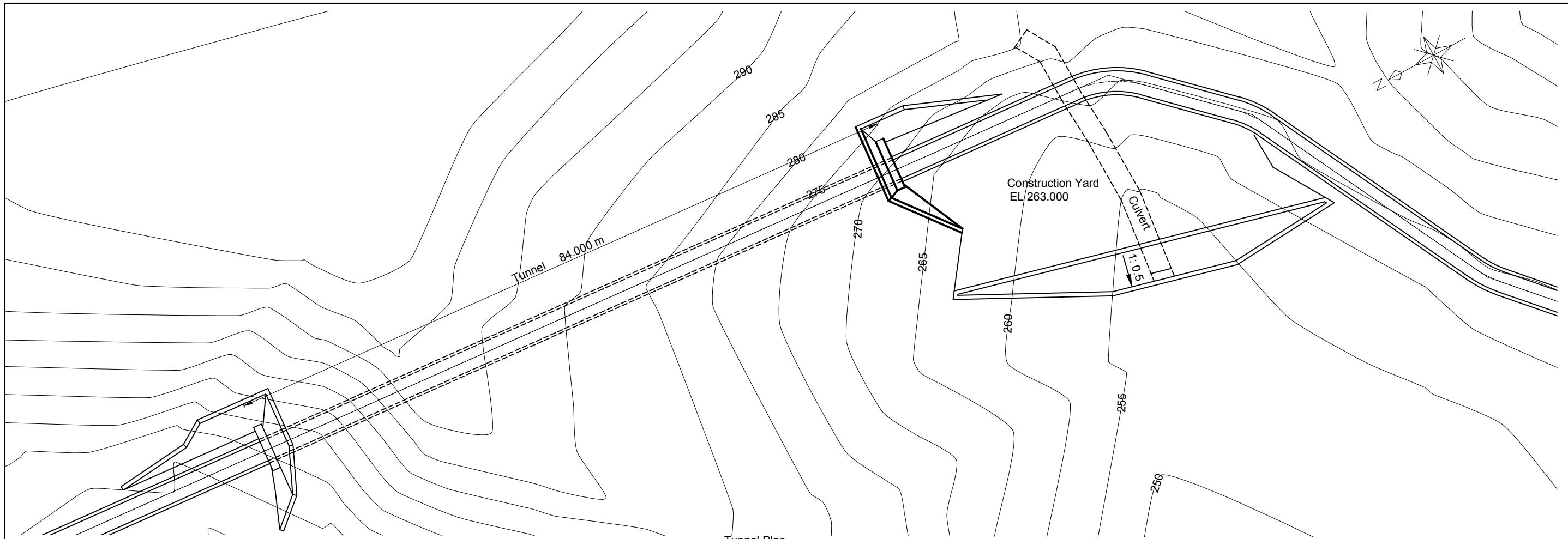
Drawing No. 1-3

Scale 1:100 Date May 2016

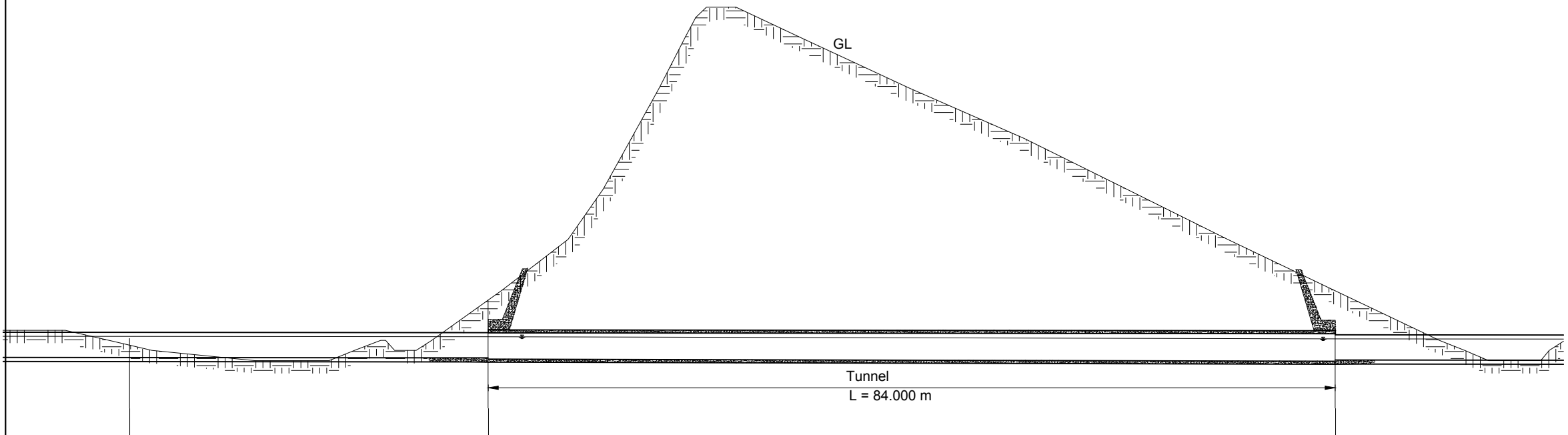
Philippines Mini-Hydro Power Project  
Preparatory Study for the Wawa River  
in the Province of Agusan del Sur

Drawn By : Dongol Design By : Takase Checked By : Takase Approved By : Tsuda

Chodai Co.,Ltd. Industrial Decisions, Inc.  
Kiso-Jiban Consultants Co.,Ltd Ernst & Young Shin Nihon LLC

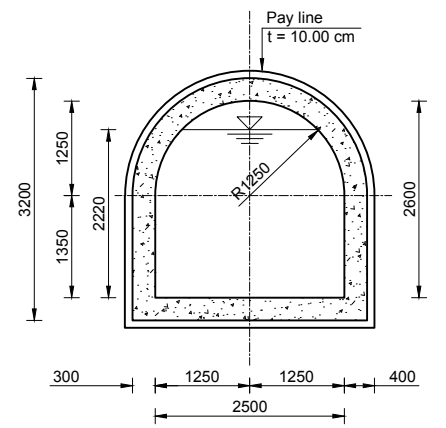


Tunnel Plan



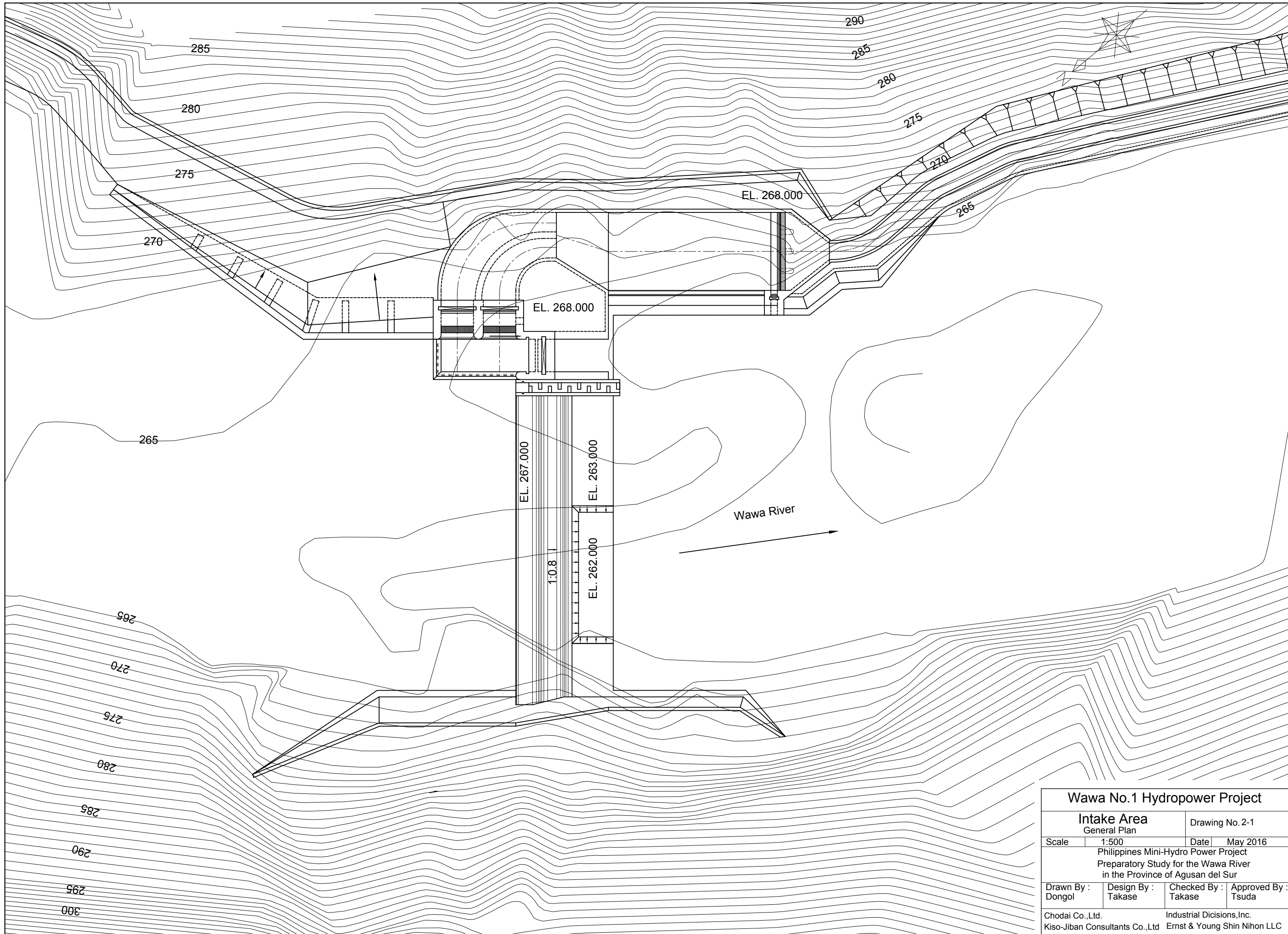
Tunnel Profile

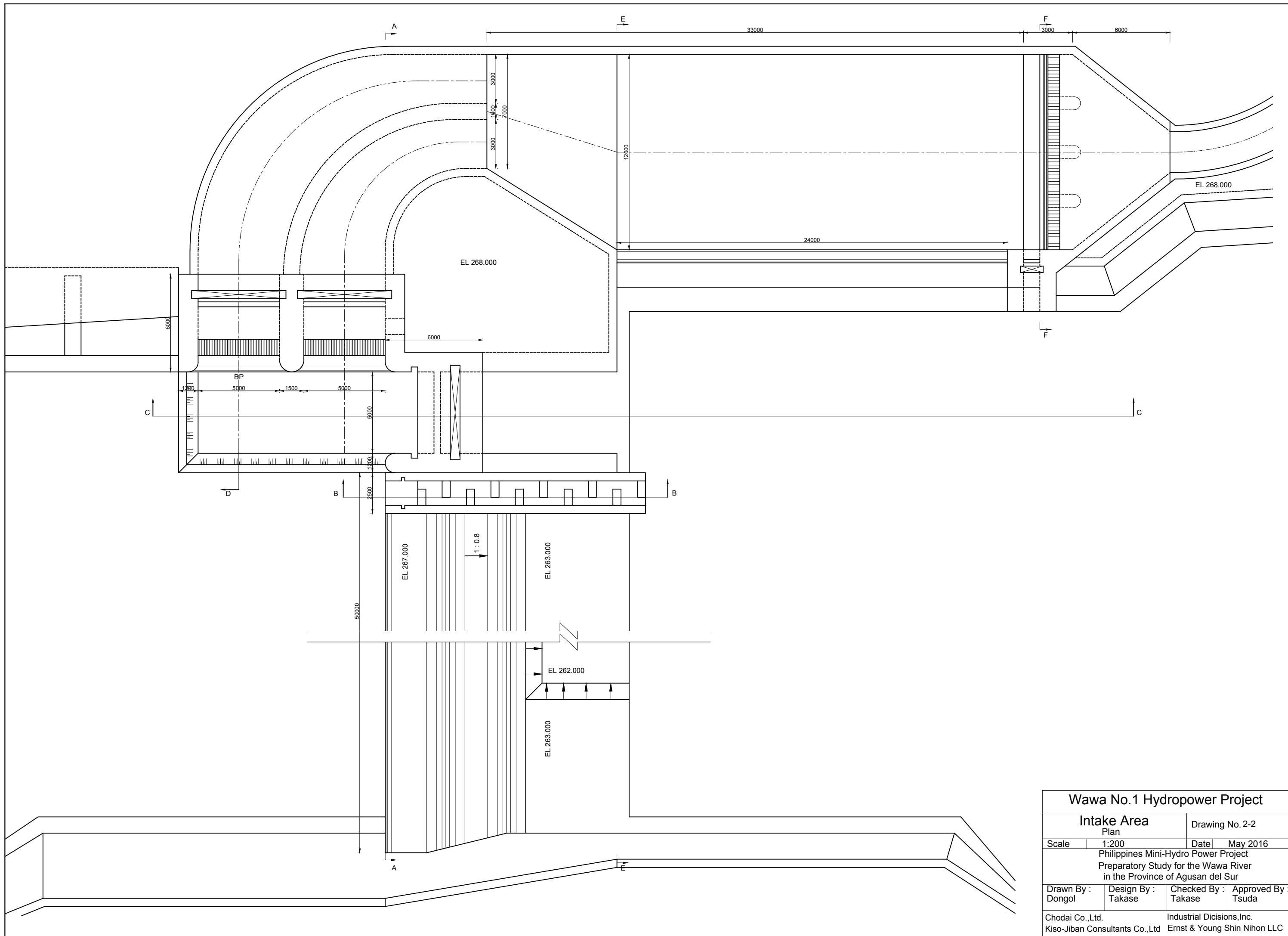
Point No.	Horizontal Cumulative Length (m)	Invert Elevation	Slope
	1671.000	263.300	
BP-T	1707.000	263.260 263.140	
			1: 1000
EP-T	1791.000	263.060 263.180	



$i = 1:1000$   
 $n = 0.014$   
 $Q = 10.00 \text{ m}^3/\text{sec}$   
 Tunnel Section  
 Scale 1:100

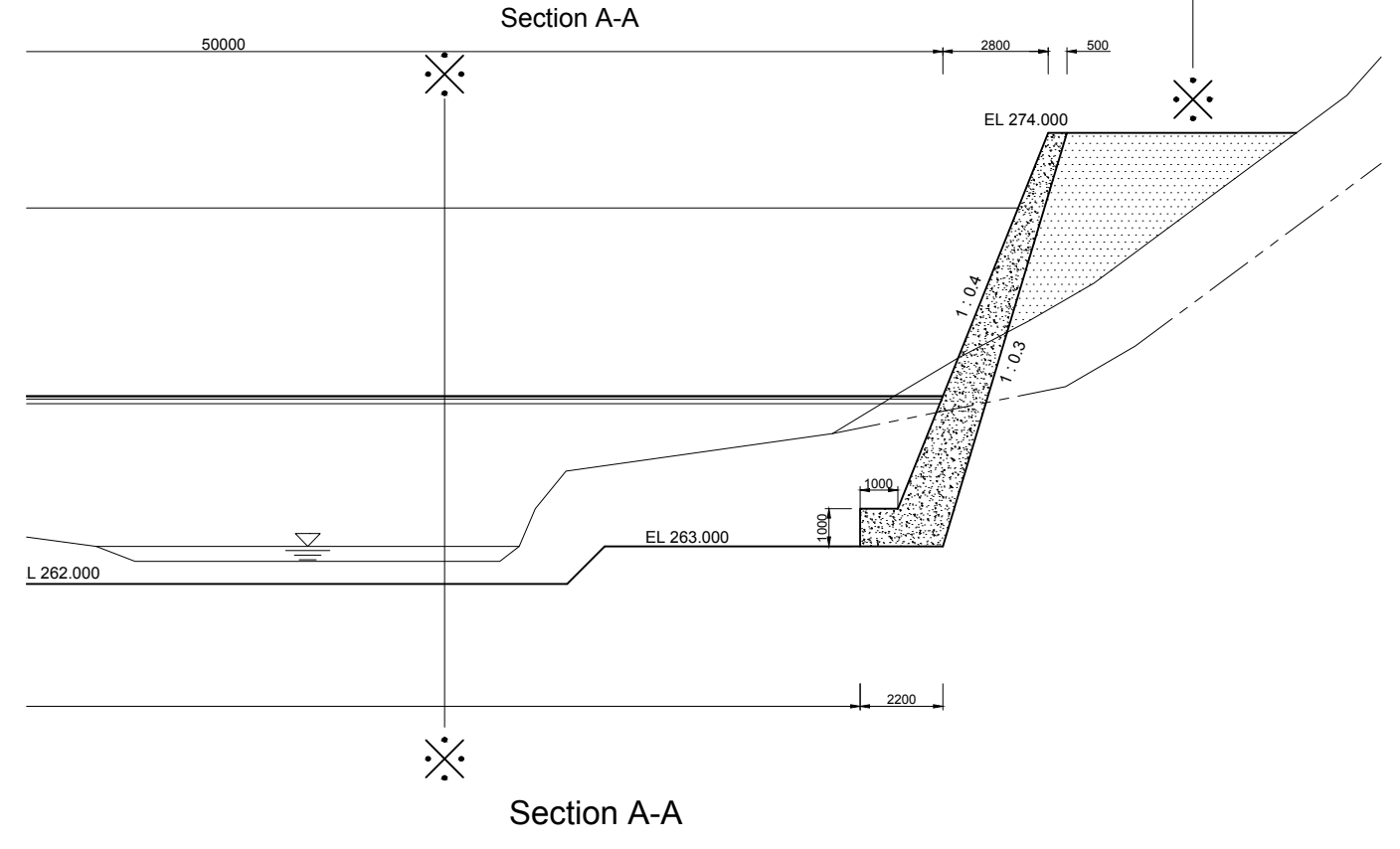
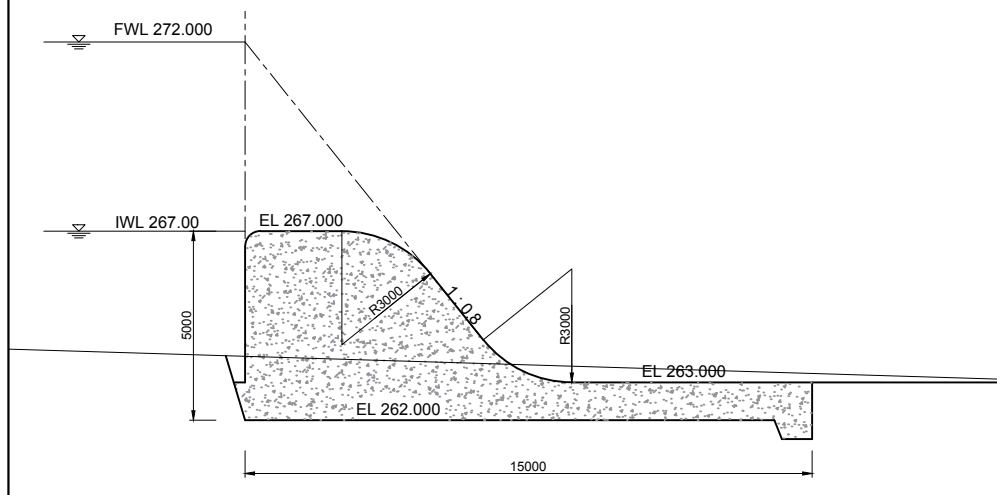
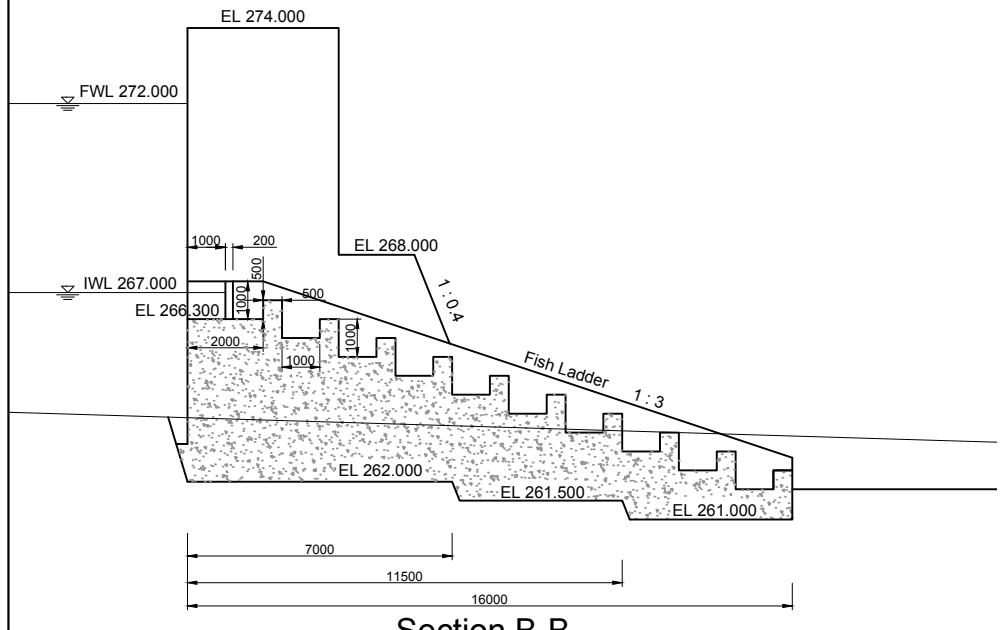
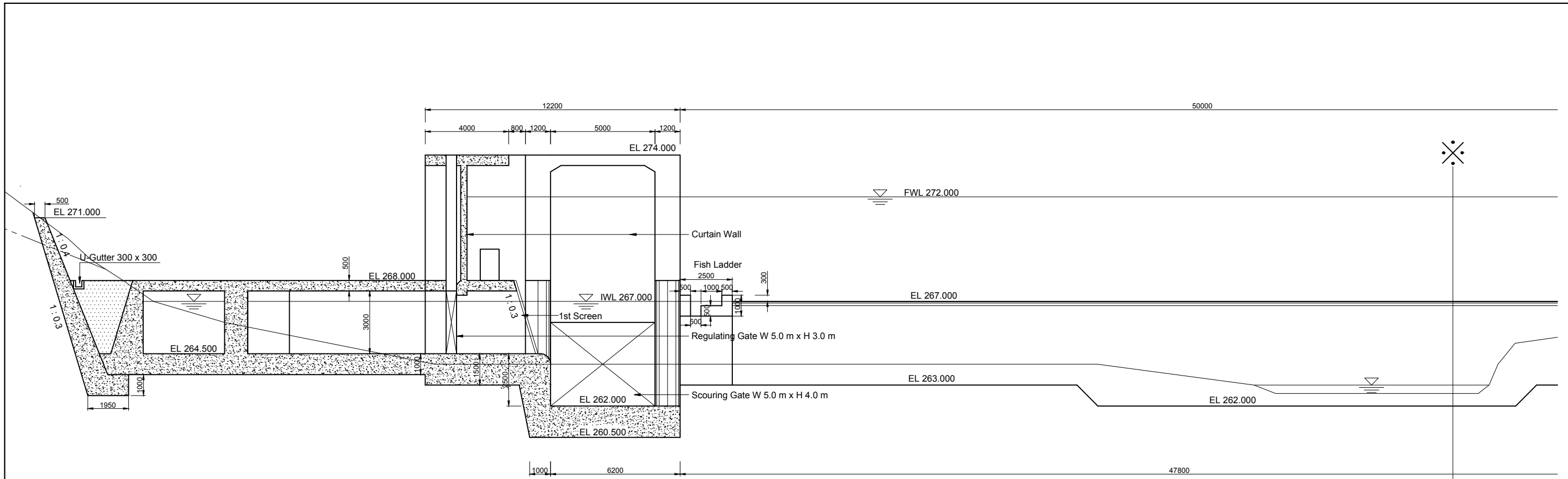
<b>Wawa No.1 Hydropower Project</b>			
<b>Waterway</b>		Drawing No. 1-4	
Tunnel Plan & Profile			
Scale	1:500	Date	May 2016
Philippines Mini-Hydro Power Project Preparatory Study for the Wawa River in the Province of Agusan del Sur			
Drawn By :	Design By :	Checked By :	Approved By :
Dongol	Takase	Takase	Tsuda
Chodai Co.,Ltd.		Industrial Dicions,Inc.	
Kiso-Jiban Consultants Co.,Ltd		Ernst & Young Shin Nihon LLC	





<b>Wawa No.1 Hydropower Project</b>			
<b>Intake Area</b>		Drawing No. 2-2	
Plan			
Scale	1:200	Date	May 2016
Philippines Mini-Hydro Power Project Preparatory Study for the Wawa River in the Province of Agusan del Sur			
Drawn By :	Design By :	Checked By :	Approved By :
Dongol	Takase	Takase	Tsuda
Chodai Co.,Ltd.		Industrial Dicions,Inc.	
Kiso-Jiban Consultants Co.,Ltd		Ernst & Young Shin Nihon LLC	





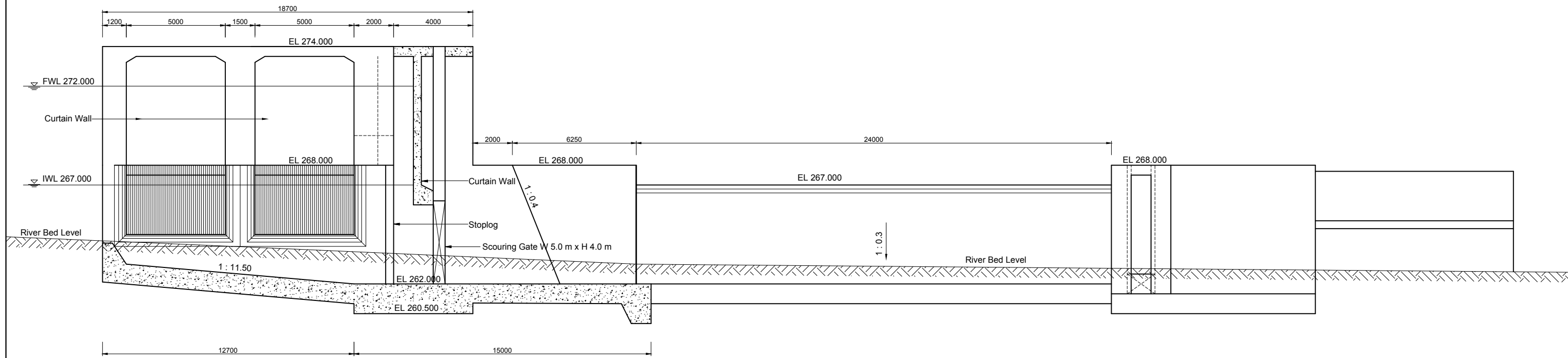
Section B-B

Section A-A

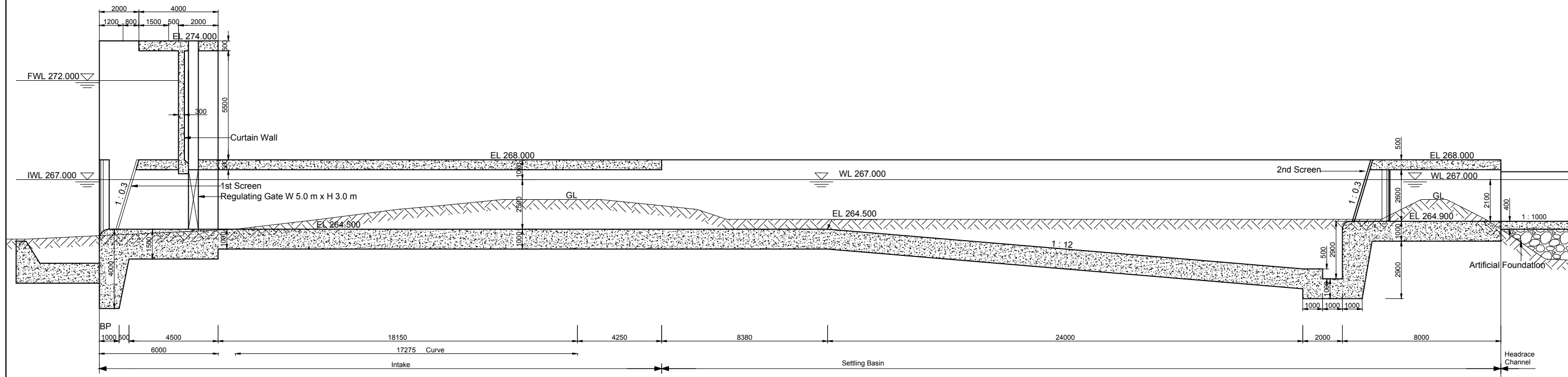
Section A-A

Typical Weir Section

<b>Wawa No.1 Hydropower Project</b>			
<b>Intake Area</b>		Drawing No. 2-3	
Weir, Intake & Settling Basin-1		Date	May 2016
Scale	1:200	Philippines Mini-Hydro Power Project Preparatory Study for the Wawa River in the Province of Agusan del Sur	
Drawn By :	Design By :	Checked By :	Approved By :
Dongol	Takase	Takase	Tsuda
Chodai Co.,Ltd.		Industrial Decisions, Inc.	
Kiso-Jiban Consultants Co.,Ltd		Ernst & Young Shin Nihon LLC	

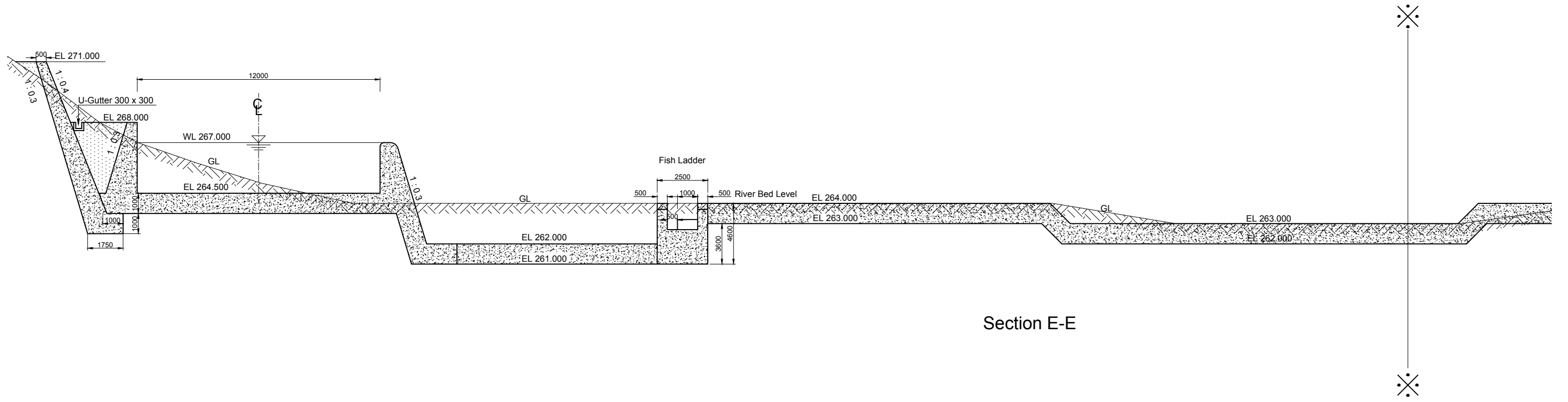


Section C-C

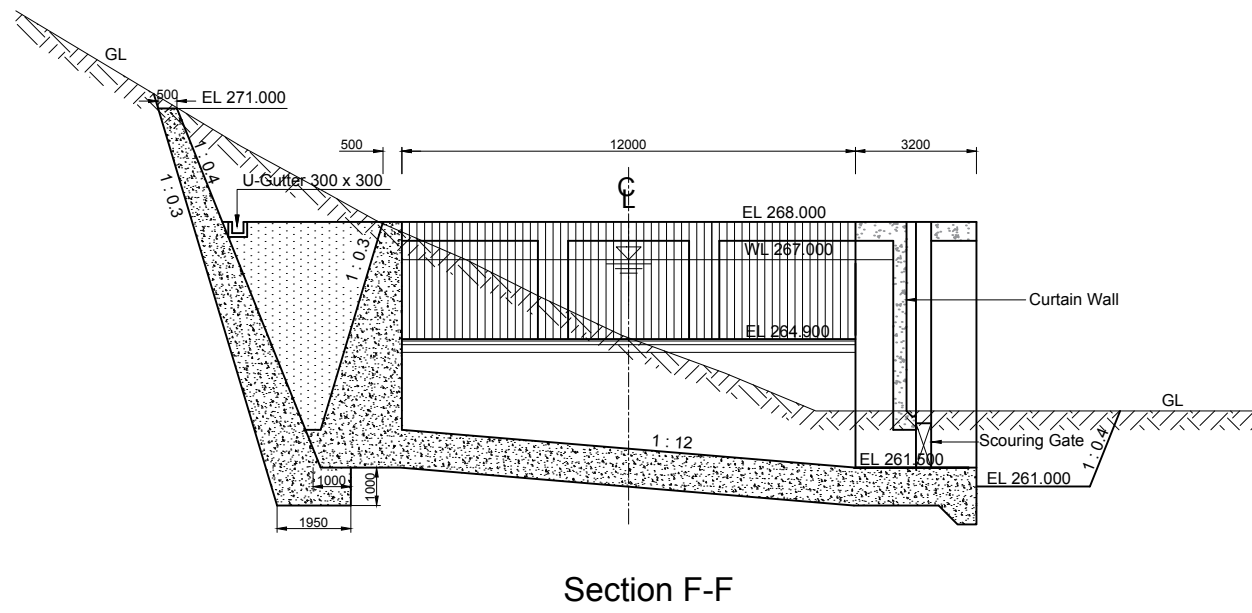


Section D-D

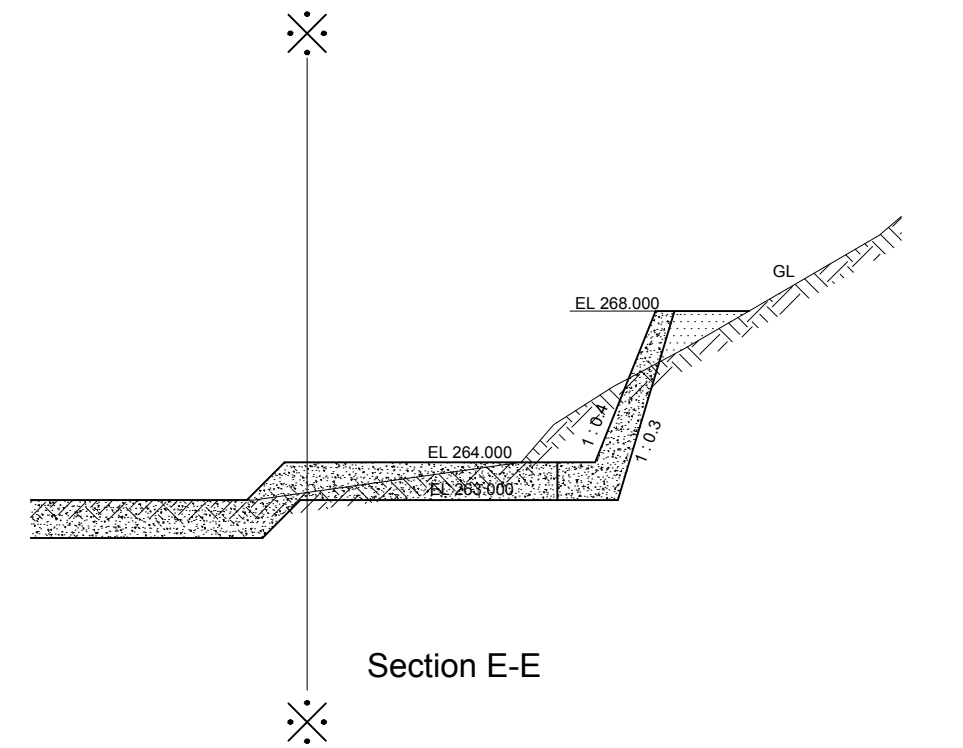
<b>Wawa No.1 Hydropower Project</b>			
<b>Intake Area</b>		Drawing No. 2-4	
Weir, Intake & Settling Basin-2		Date: May 2016	
Scale	1:200	Date	May 2016
Philippines Mini-Hydro Power Project Preparatory Study for the Wawa River in the Province of Agusan del Sur			
Drawn By : Dongol	Design By : Takase	Checked By : Takase	Approved By : Tsuda
Chodai Co.,Ltd. Kiso-Jiban Consultants Co.,Ltd		Industrial Dicions,Inc. Ernst & Young Shin Nihon LLC	



Section E-E

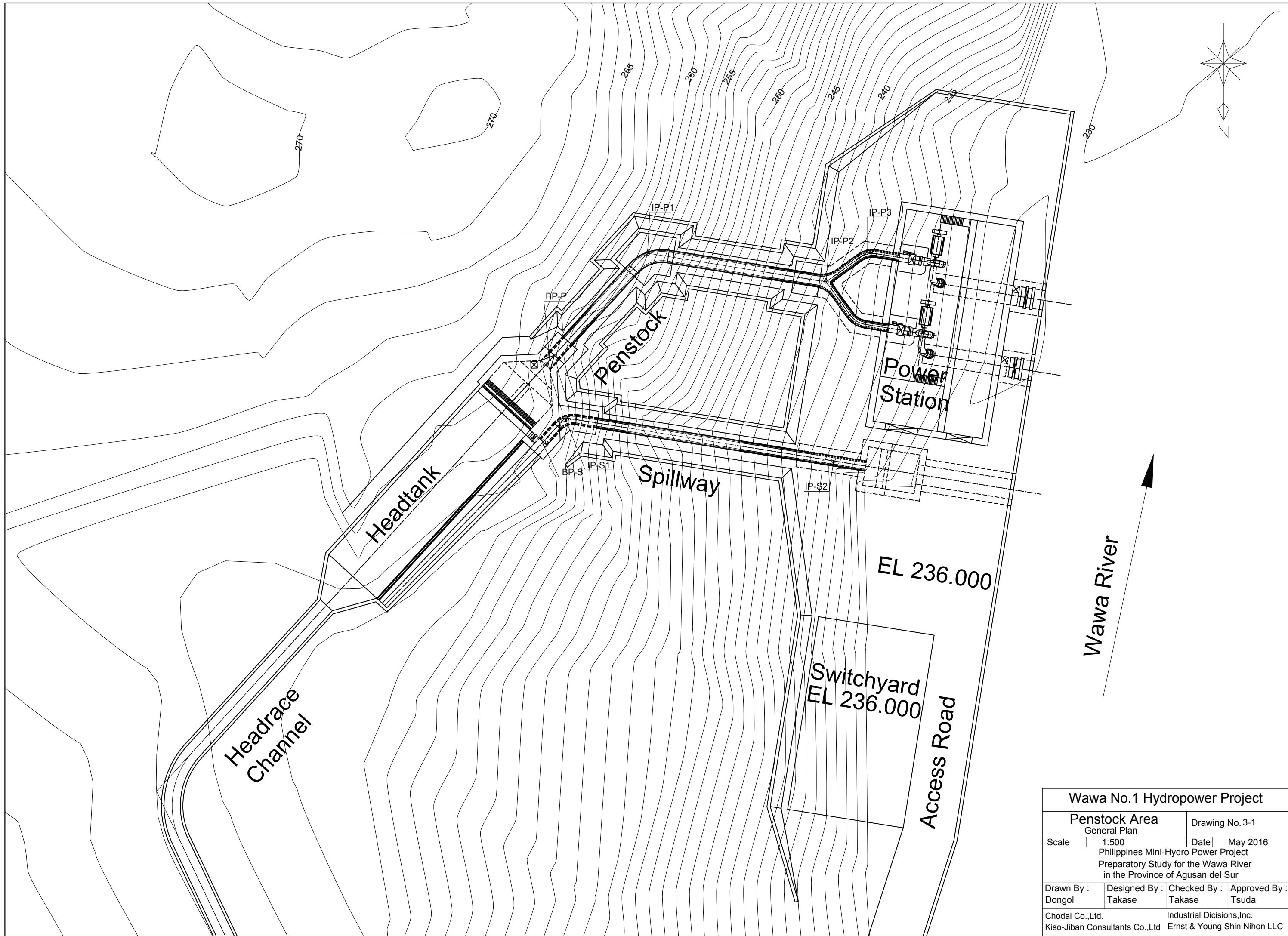


Section F-F



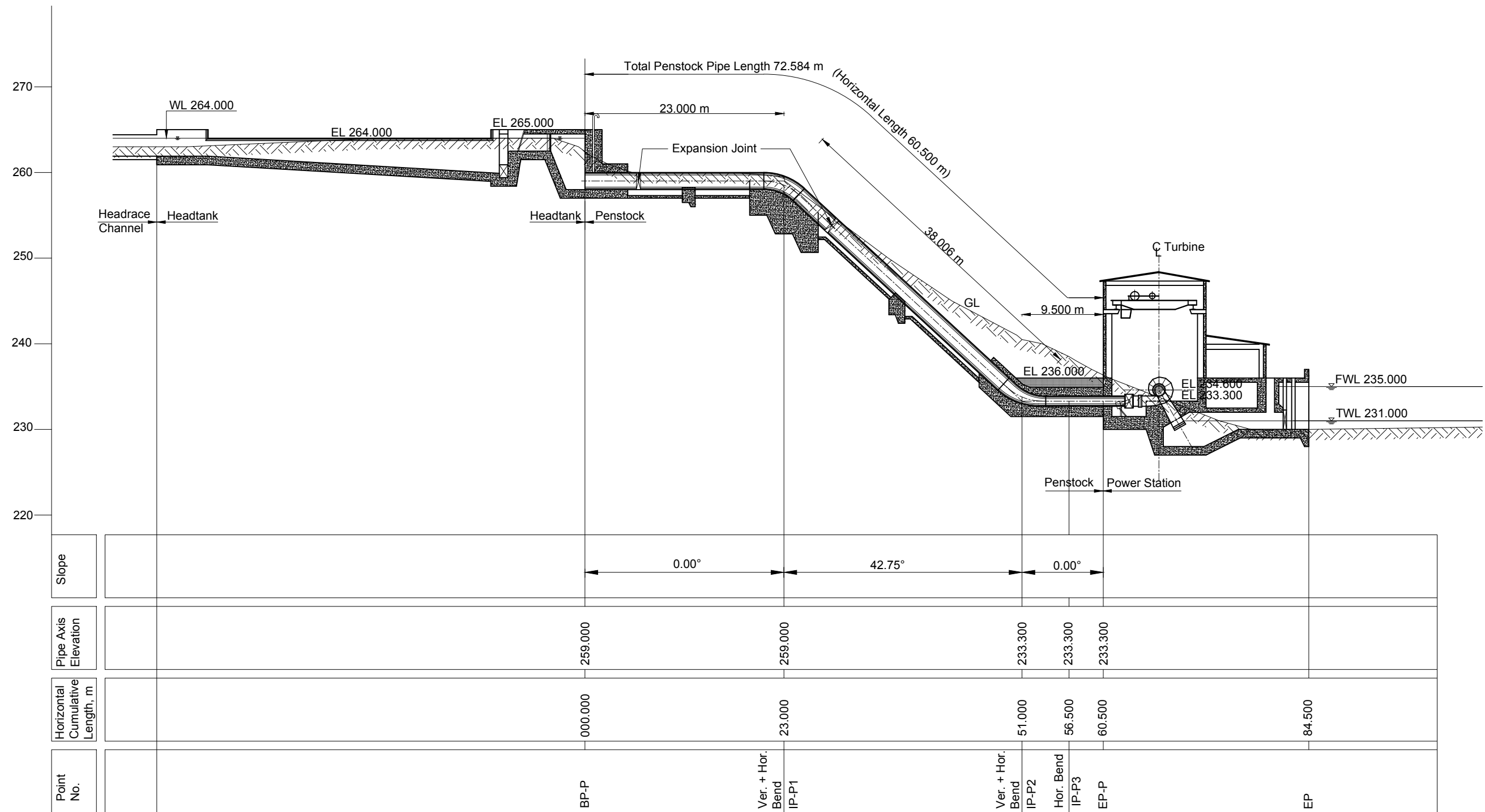
Section E-E

<b>Wawa No.1 Hydropower Project</b>			
<b>Intake Area</b>		Drawing No. 2-5	
Weir, Intake & Settling Basin-3			
Scale	1:200	Date	May 2016
Philippines Mini-Hydro Power Project Preparatory Study for the Wawa River in the Province of Agusan del Sur			
Drawn By : Dongol	Design By : Takase	Checked By : Takase	Approved By : Tsuda
Chodai Co.,Ltd. Kiso-Jiban Consultants Co.,Ltd		Industrial Dicions,Inc. Ernst & Young Shin Nihon LLC	



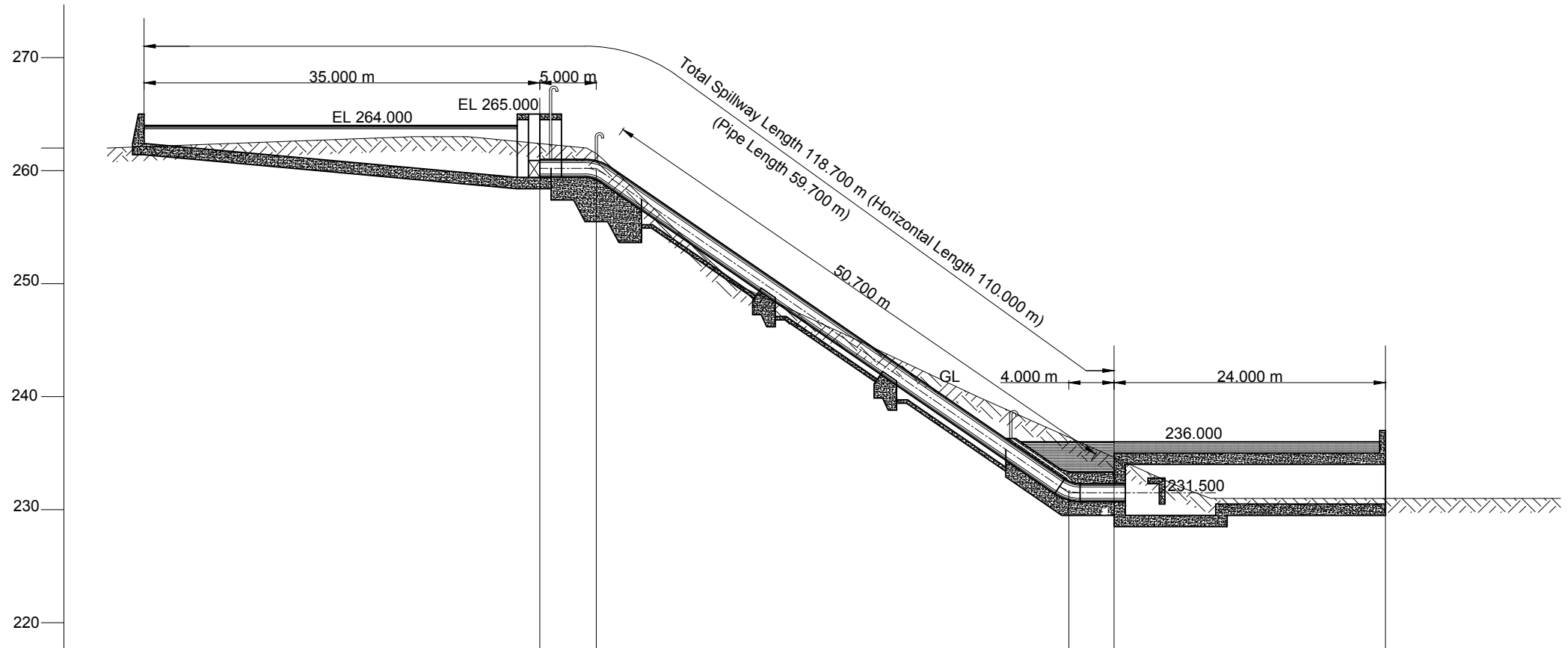
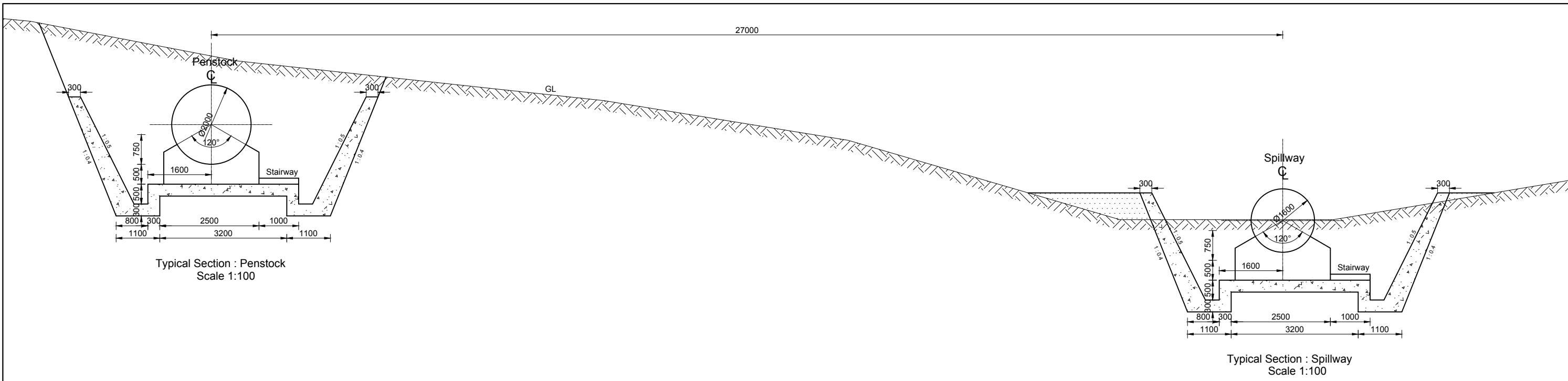
<b>Wawa No.1 Hydropower Project</b>			
<b>Penstock Area</b> General Plan		Drawing No. 3-1	
Scale	1:500	Date	May 2016
Philippines Mini-Hydro Power Project Preparatory Study for the Wawa River in the Province of Agusan del Sur			
Drawn By :	Designed By :	Checked By :	Approved By :
Dongol	Takase	Takase	Tsuda
Chodai Co.,Ltd. Kiso-Jiban Consultants Co.,Ltd		Industrial Dicions,Inc. Ernst & Young Shin Nihon LLC	

Combined Internal Angle (CIA) Table					
S.N.	Bend Identification	Angle made by first tangent with horizontal, $\beta_1$	Angle made by second tangent with horizontal, $\beta_2$	Deviation angle in Plan, $\alpha$	Combined Internal Angle (CIA), $\alpha_0$
1	IP-P1	0.00°	42.75°	56.75°	66.26°
2	IP-P8, Bifurcation	42.75°	0.00°	45.00°	58.72°
3	IP-P3	0.00°	0.00°	45.00°	45.00°



Penstock Profile

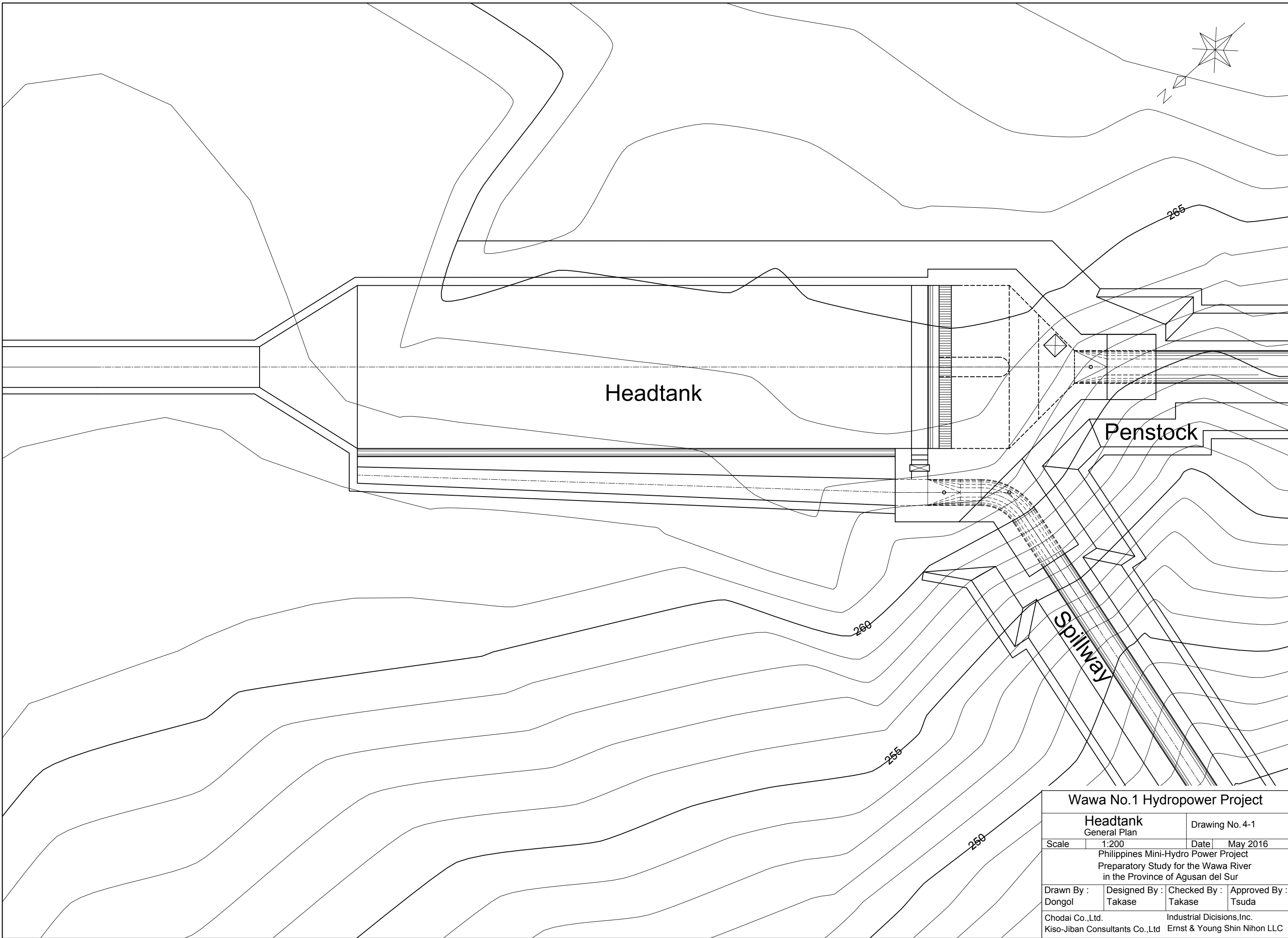
<b>Wawa No.1 Hydropower Project</b>			
<b>Penstock Area</b> Penstock Profile		Drawing No. 3-2	
Scale	1:500	Date	May 2016
Philippines Mini-Hydro Power Project Preparatory Study for the Wawa River in the Province of Agusan del Sur			
Drawn By :	Designed By :	Checked By :	Approved By :
Dongol	Takase	Takase	Tsuda
Chodai Co.,Ltd. Kiso-Jiban Consultants Co.,Ltd		Industrial Dicions,Inc. Ernst & Young Shin Nihon LLC	



Slope		0.00°	34.47°	0.00°		
Pipe Axis Elevation		260.200	260.200	231.500	231.500	
Horizontal Cumulative Length, m		000.000	5.000	47.000	51.000	75.000
Point No.		BP-S	Ver. + Hor. Bend IP-S1	Ver. Bend IP-S2	EP-S	EP

Spillway Profile

<b>Wawa No.1 Hydropower Project</b>			
<b>Penstock Area</b>		Drawing No. 3-3	
Spillway Profile			
Scale	1:500	Date	May 2016
Philippines Mini-Hydro Power Project			
Preparatory Study for the Wawa River			
in the Province of Agusan del Sur			
Drawn By :	Designed By :	Checked By :	Approved By :
Dongol	Takase	Takase	Tsuda
Chodai Co.,Ltd.		Industrial Dicions,Inc.	
Kiso-Jiban Consultants Co.,Ltd		Ernst & Young Shin Nihon LLC	

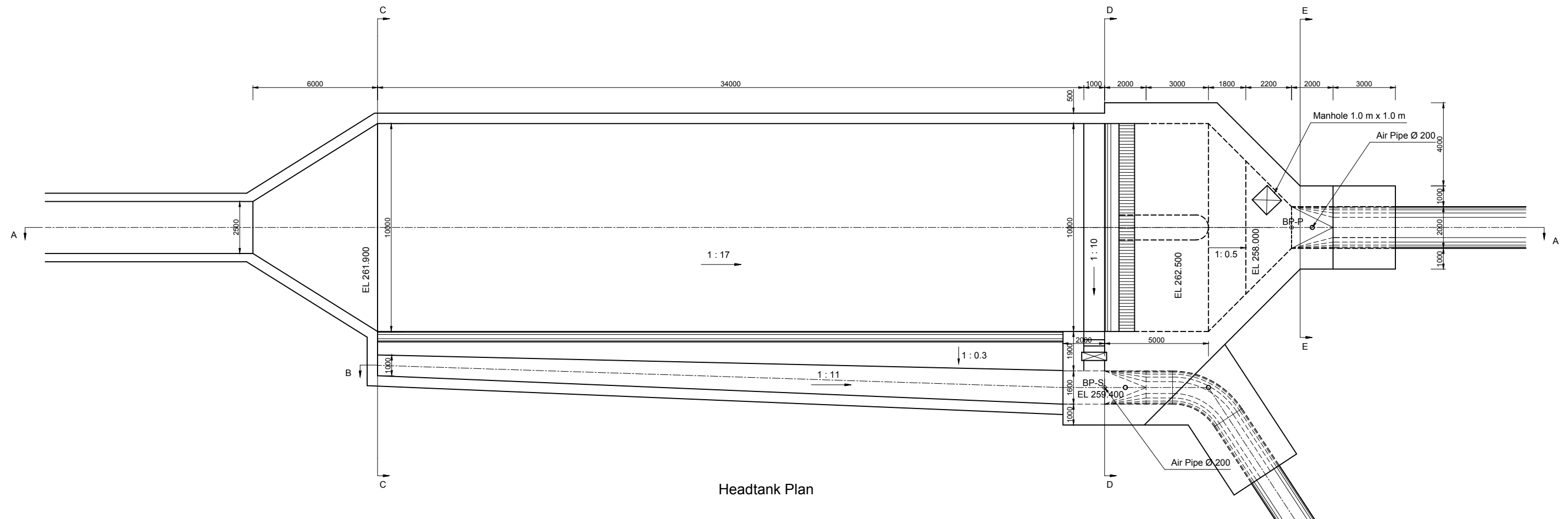


Headtank

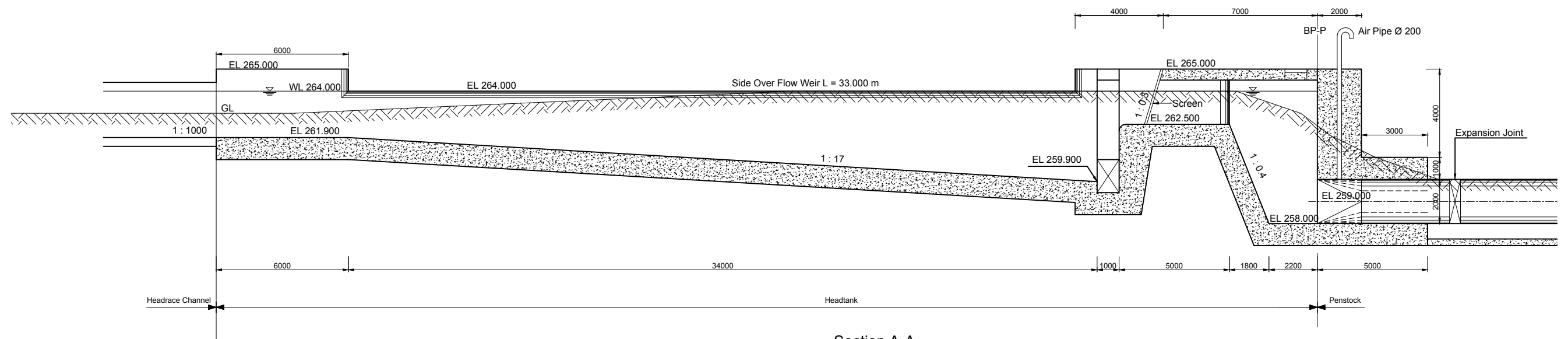
Penstock

Spillway

<b>Wawa No.1 Hydropower Project</b>			
<b>Headtank</b> General Plan		Drawing No. 4-1	
Scale	1:200	Date	May 2016
Philippines Mini-Hydro Power Project Preparatory Study for the Wawa River in the Province of Agusan del Sur			
Drawn By :	Designed By :	Checked By :	Approved By :
Dongol	Takase	Takase	Tsuda
Chodai Co.,Ltd. Kiso-Jiban Consultants Co.,Ltd		Industrial Dicions,Inc. Ernst & Young Shin Nihon LLC	



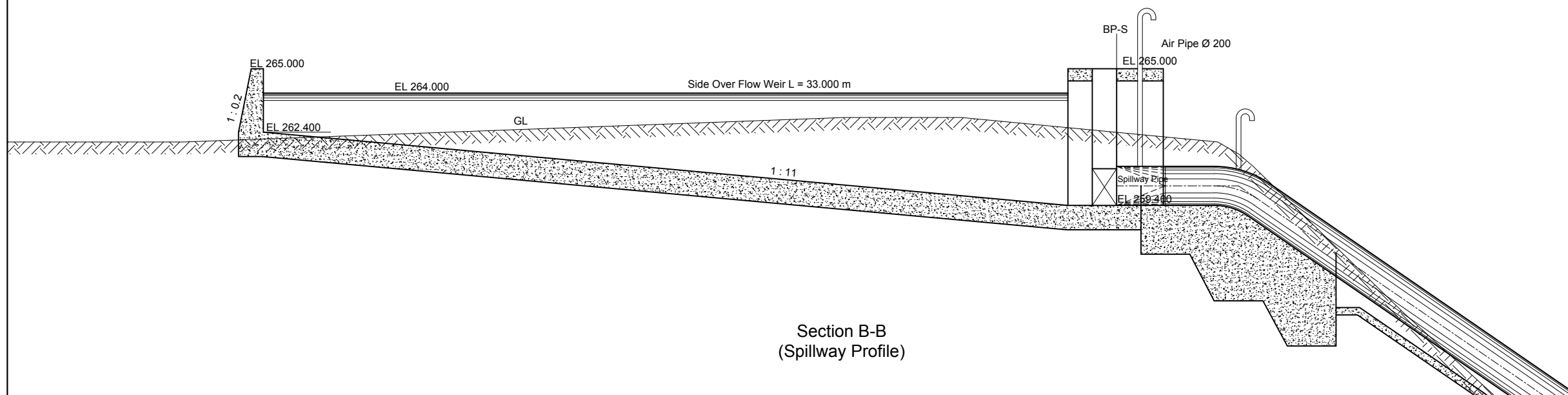
Headtank Plan



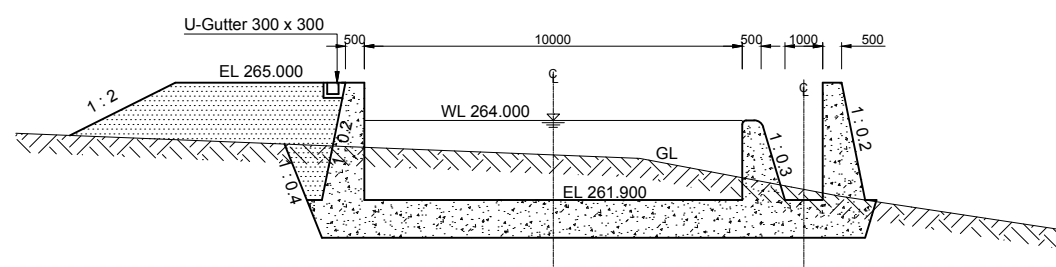
Section A-A  
(Headtank Profile)

<b>Wawa No.1 Hydropower Project</b>			
<b>Headtank</b> Plan & Profile		Drawing No. 4-2	
Scale	1:200	Date	May 2016
Philippines Mini-Hydro Power Project Preparatory Study for the Wawa River in the Province of Agusan del Sur			
Drawn By :	Designed By :	Checked By :	Approved By :
Dongol	Takase	Takase	Tsuda
Chodai Co.,Ltd. Kiso-Jiban Consultants Co.,Ltd		Industrial Dicions,Inc. Ernst & Young Shin Nihon LLC	

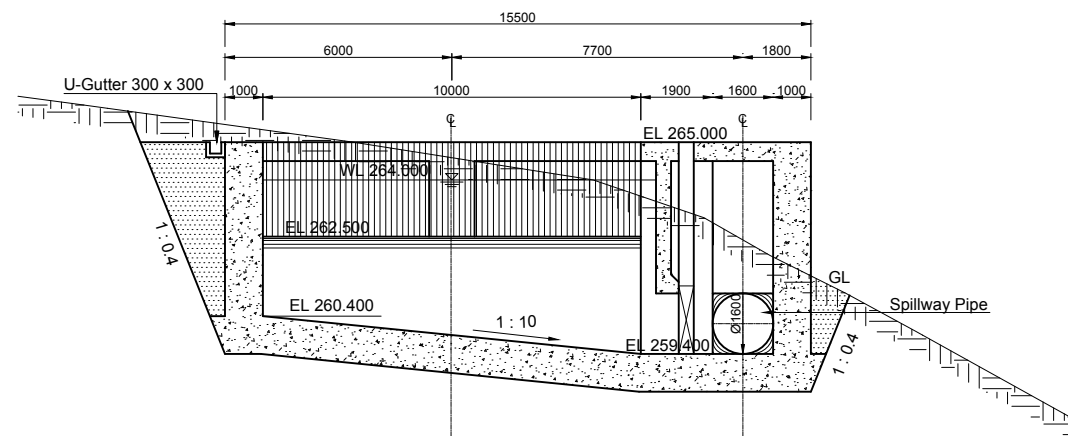




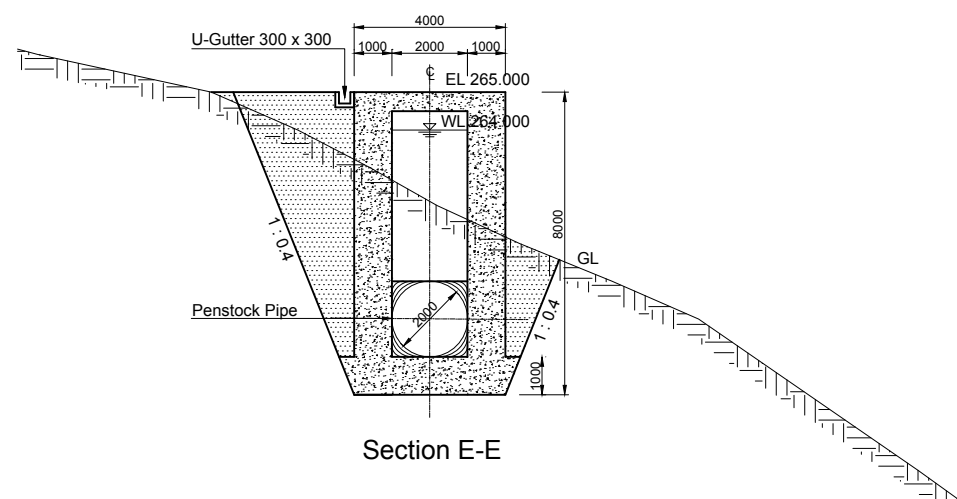
Section B-B  
(Spillway Profile)



Section C-C

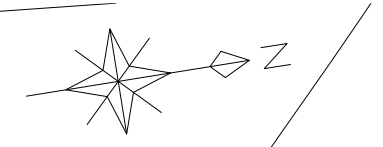


Section D-D



Section E-E

<b>Wawa No.1 Hydropower Project</b>			
<b>Headtank</b> Profile & Section		Drawing No. 4-3	
Scale	1:200	Date	May 2016
Philippines Mini-Hydro Power Project Preparatory Study for the Wawa River in the Province of Agusan del Sur			
Drawn By :	Designed By :	Checked By :	Approved By :
Dongol	Takase	Takase	Tsuda
Chodai Co.,Ltd.		Industrial Dicions,Inc.	
Kiso-Jiban Consultants Co.,Ltd		Ernst & Young Shin Nihon LLC	

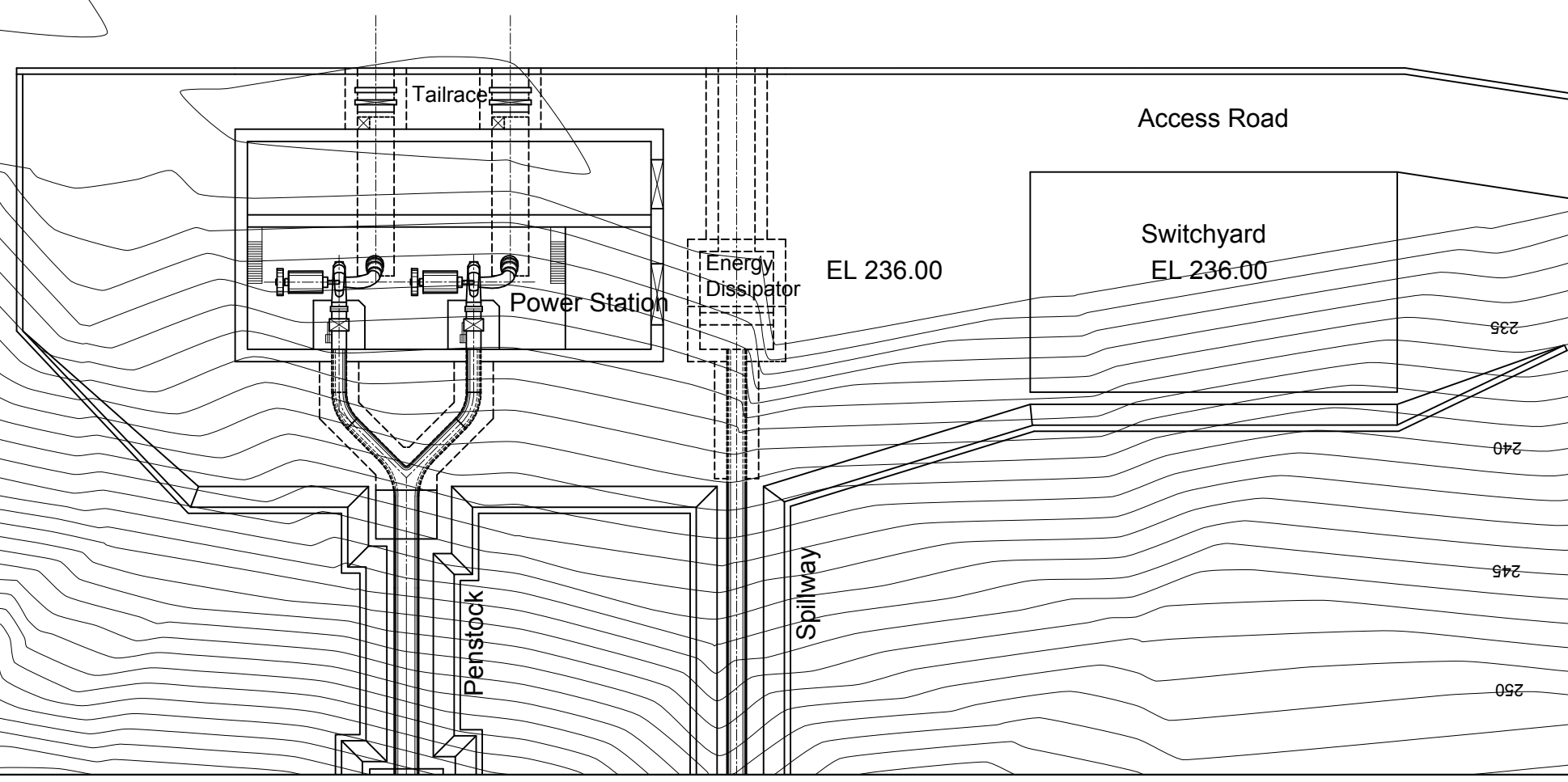


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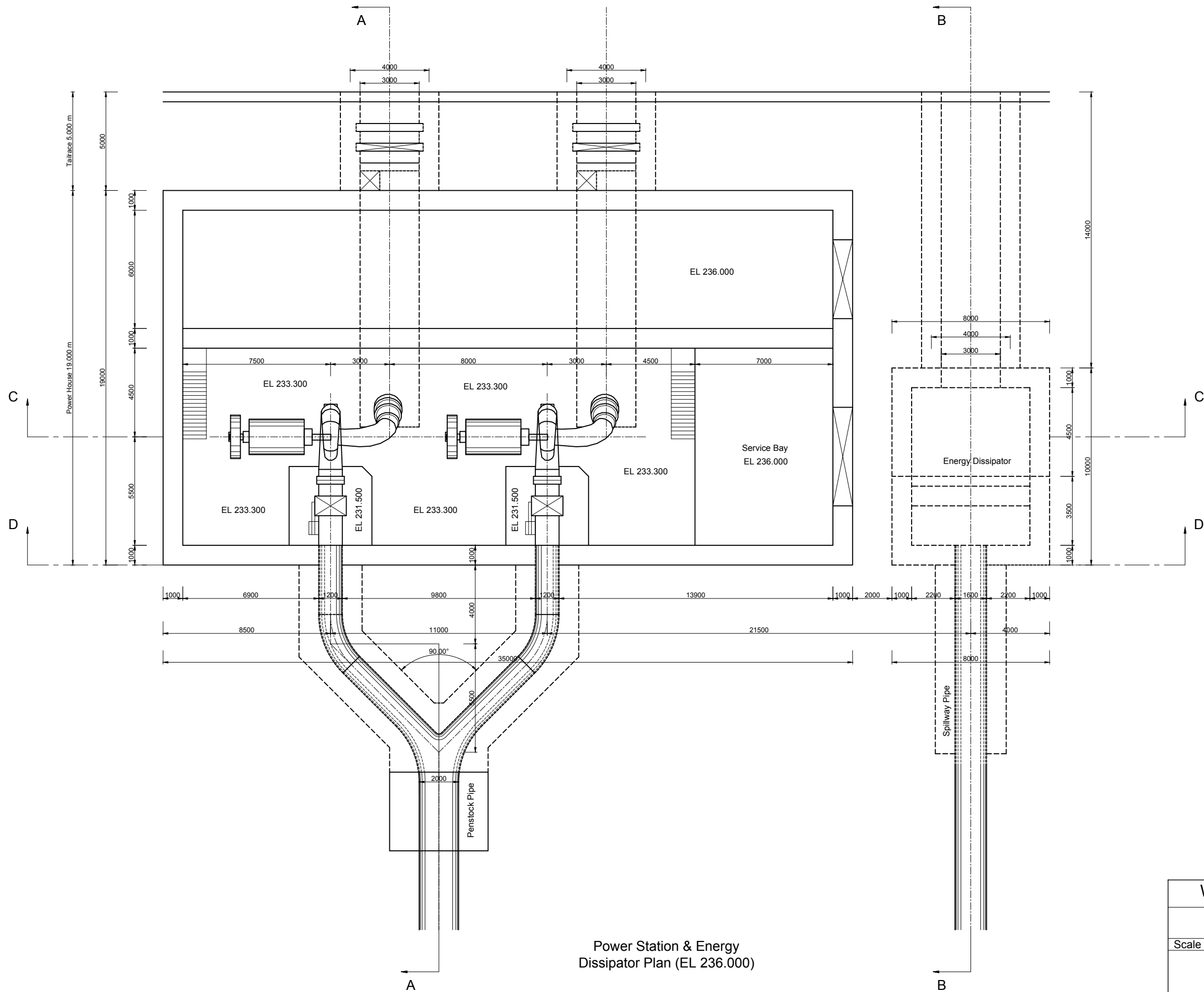
Wawa River

230

231

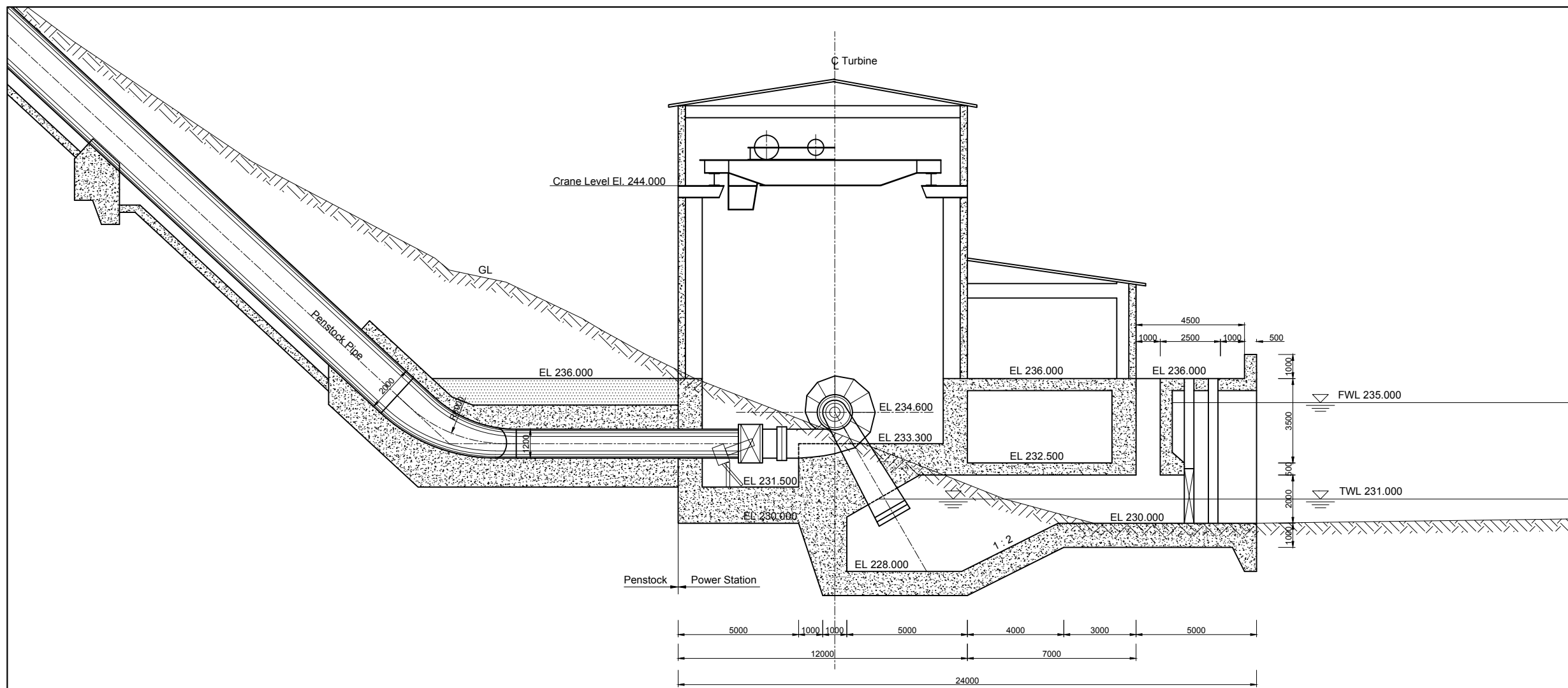


<b>Wawa No.1 Hydropower Project</b>			
<b>Power Station</b> General Plan		Drawing No. 5-1	
Scale	1:500	Date	May 2016
Philippines Mini-Hydro Power Project Preparatory Study for the Wawa River in the Province of Agusan del Sur			
Drawn By :	Designed By :	Checked By :	Approved By :
Dongol	Takase	Takase	Tsuda
Chodai Co.,Ltd. Kiso-Jiban Consultants Co.,Ltd		Industrial Dicions,Inc. Ernst & Young Shin Nihon LLC	

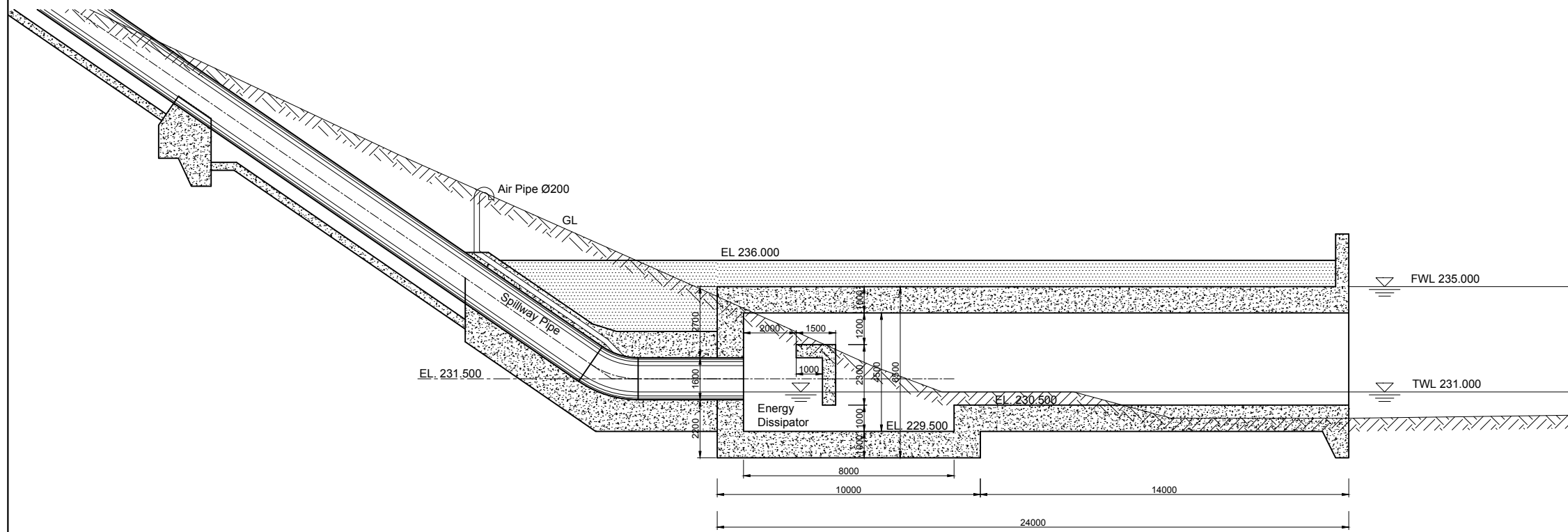


Power Station & Energy  
Dissipator Plan (EL 236.000)

<b>Wawa No.1 Hydropower Project</b>			
<b>Power Station</b> Plan (EL 236.000)		Drawing No. 5-2	
Scale	1:200	Date	May 2016
Philippines Mini-Hydro Power Project Preparatory Study for the Wawa River in the Province of Agusan del Sur			
Drawn By :	Designed By :	Checked By :	Approved By :
Dongol	Takase	Takase	Tsuda
Chodai Co.,Ltd.		Industrial Dicions,Inc.	
Kiso-Jiban Consultants Co.,Ltd		Ernst & Young Shin Nihon LLC	

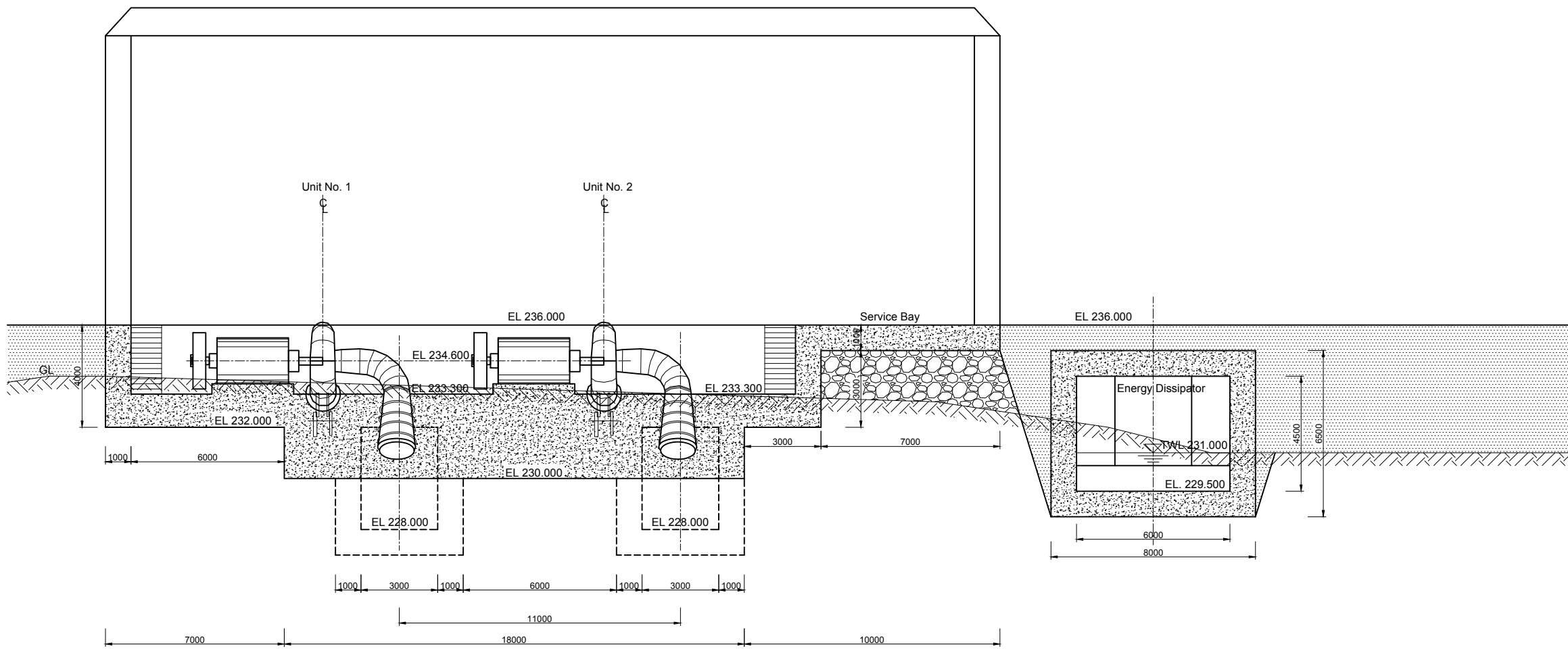


Section A-A  
(Power Station Profile)

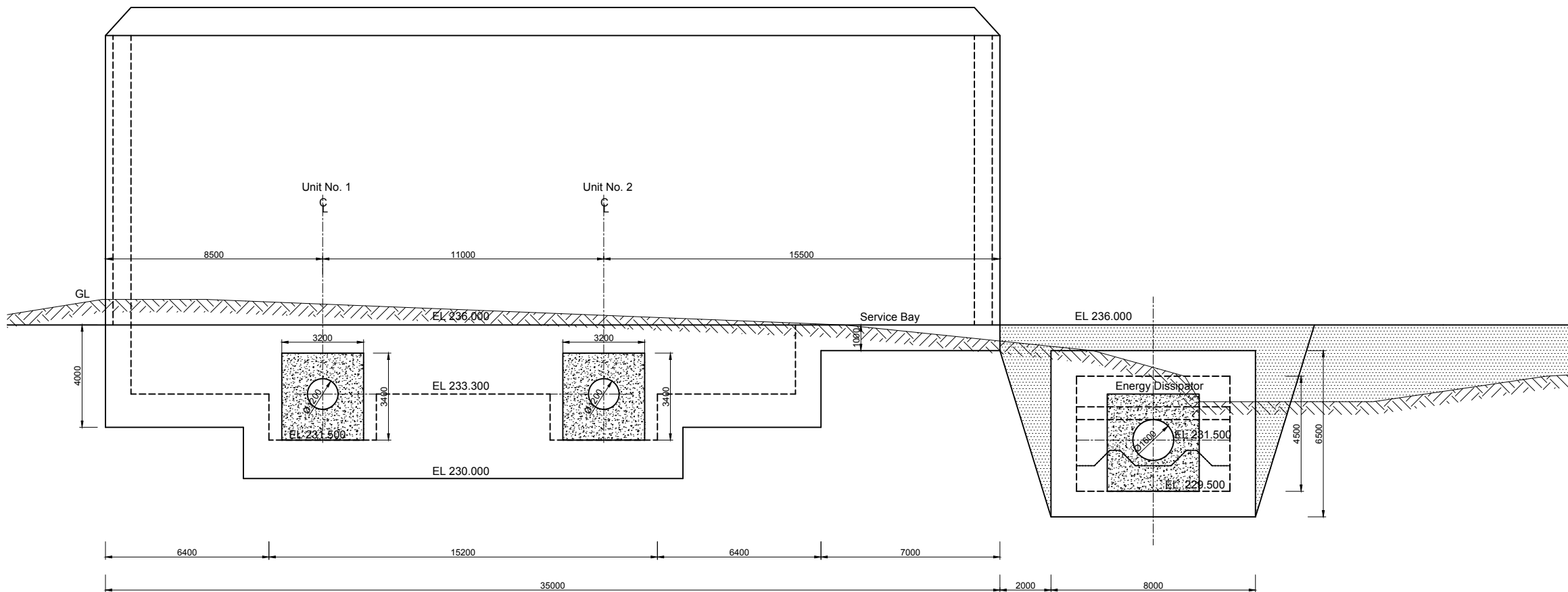


Section B-B  
(Energy Dissipator Profile)

<b>Wawa No.1 Hydropower Project</b>			
<b>Power Station</b> Section-1		Drawing No. 5-3	
Scale	1:200	Date	May 2016
Philippines Mini-Hydro Power Project Preparatory Study for the Wawa River in the Province of Agusan del Sur			
Drawn By :	Designed By :	Checked By :	Approved By :
Dongol	Takase	Takase	Tsuda
Chodai Co.,Ltd. Kiso-Jiban Consultants Co.,Ltd		Industrial Dicions,Inc. Ernst & Young Shin Nihon LLC	



Section C-C



Section D-D

<b>Wawa No.1 Hydropower Project</b>			
<b>Power Station</b>		Drawing No. 5-4	
Section-2			
Scale	1:200	Date	May 2016
Philippines Mini-Hydro Power Project Preparatory Study for the Wawa River in the Province of Agusan del Sur			
Drawn By :	Designed By :	Checked By :	Approved By :
Dongol	Takase	Takase	Tsuda
Chodai Co.,Ltd.		Industrial Dicions,Inc.	
Kiso-Jiban Consultants Co.,Ltd		Ernst & Young Shin Nihon LLC	

# WAWA RIVER BASIN, MINDANAO ISLAND, PHILIPPINES

## Basic Design of Wawa No.2 Hydropower Project

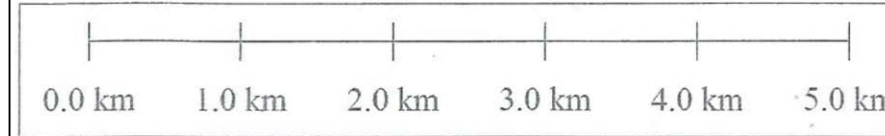
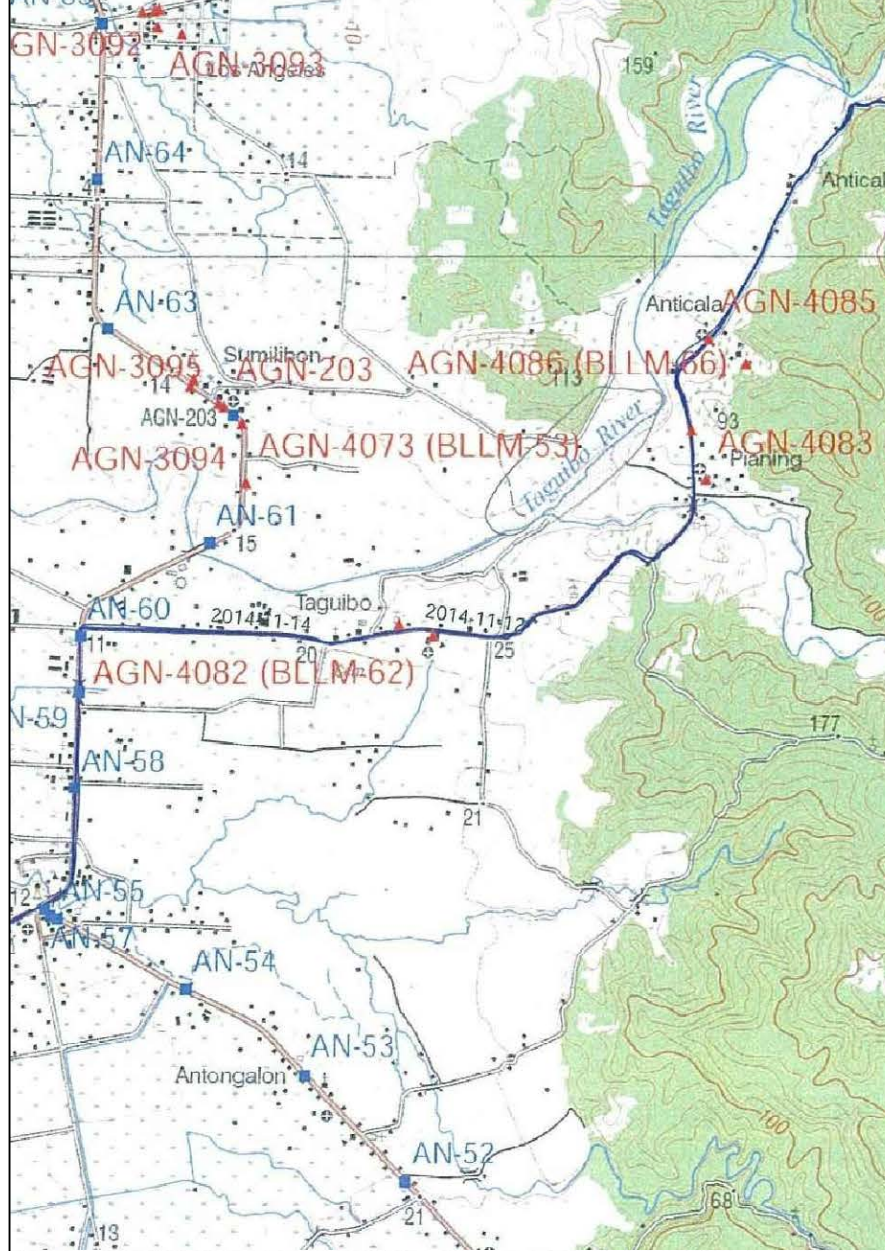
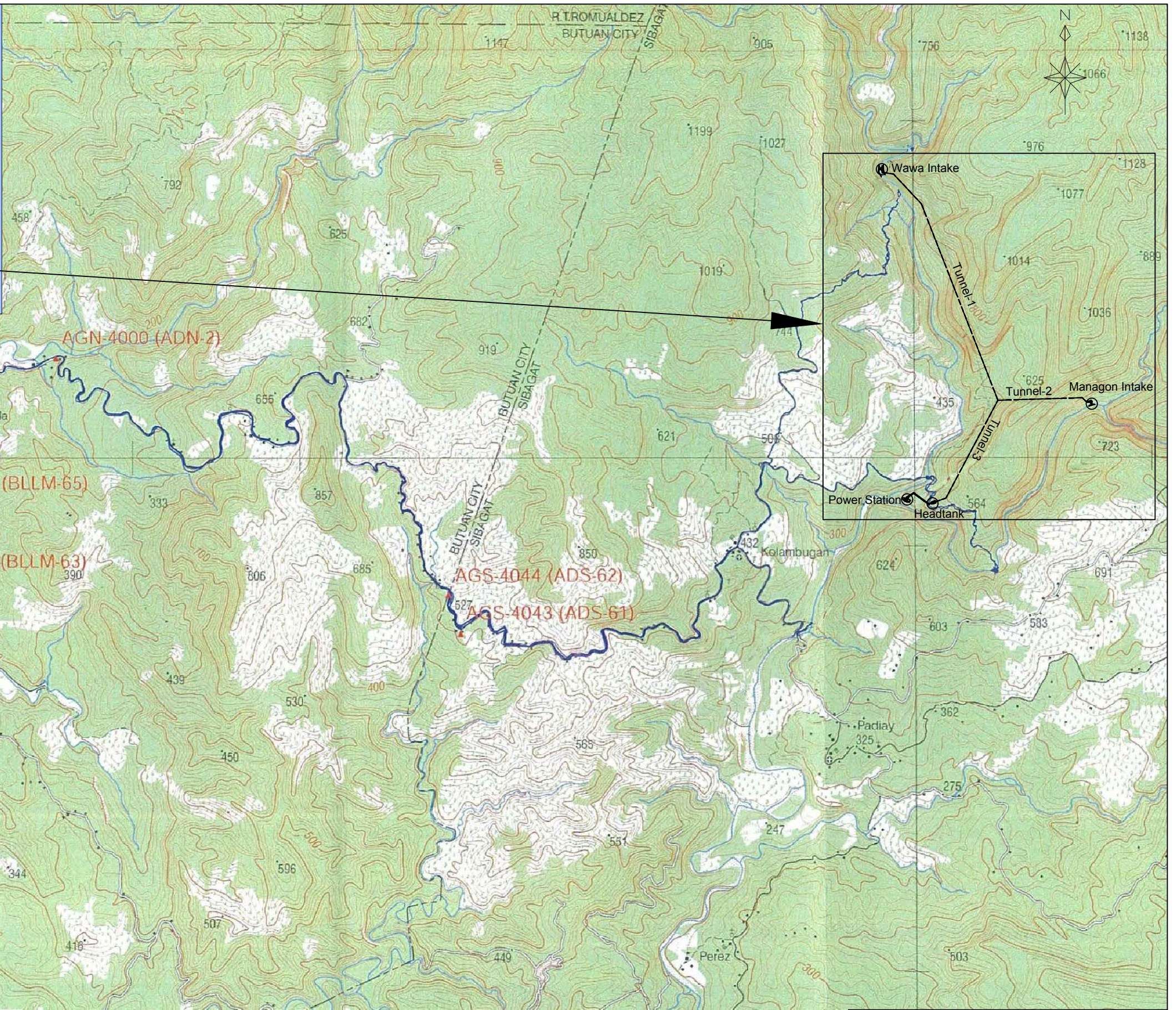
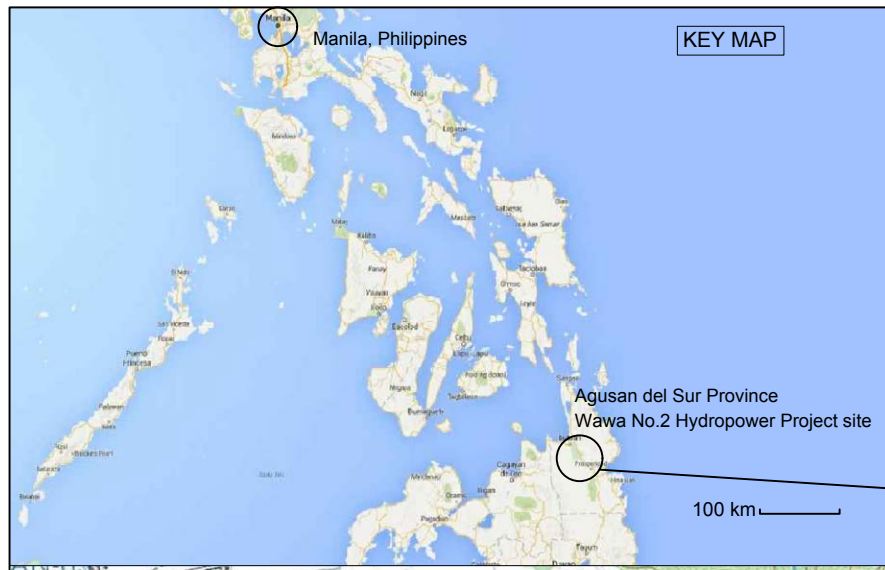
May 2016

Chodai Co.,Ltd.

Kiso-Jiban Consultants Co.,Ltd

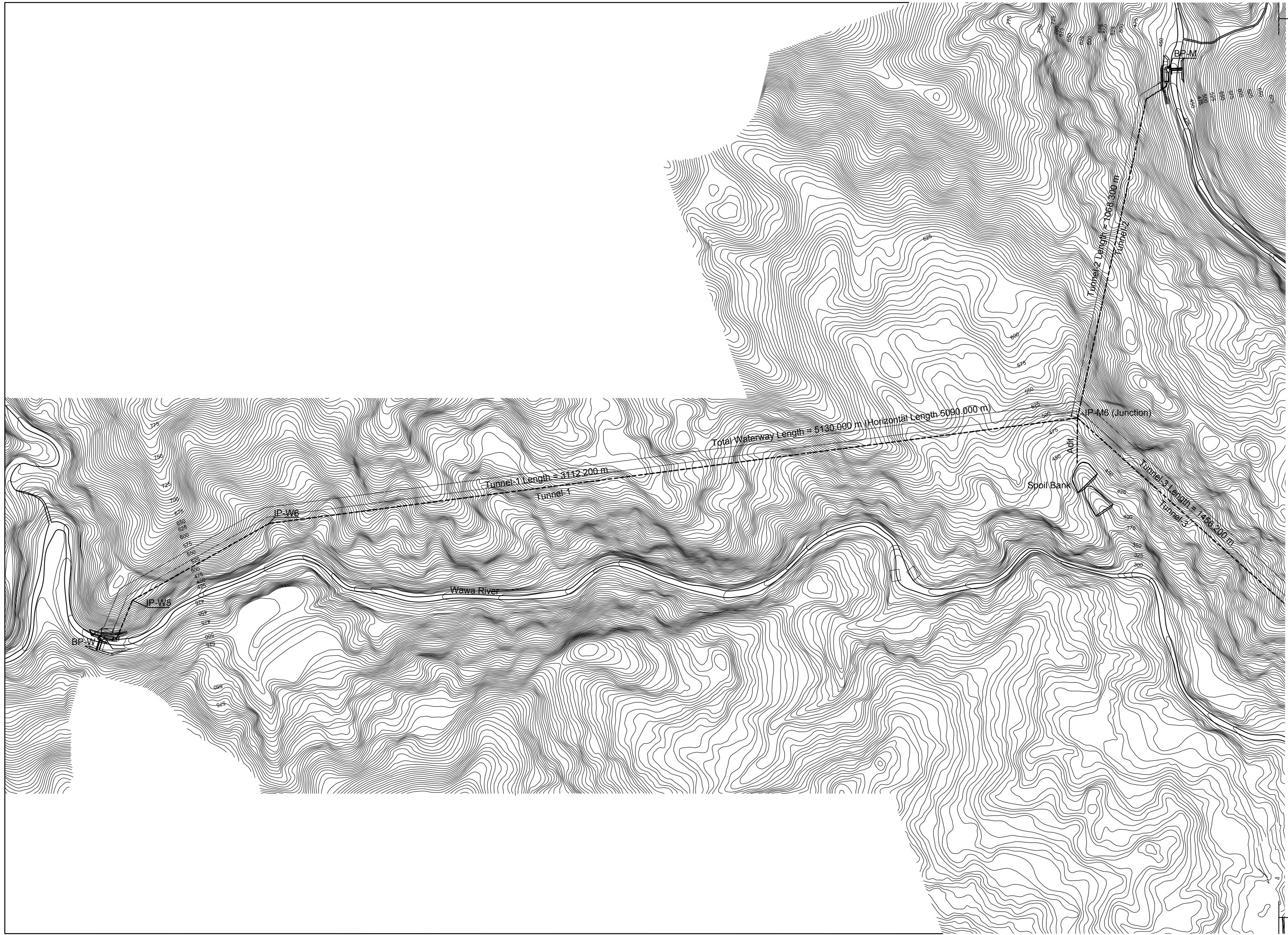
Industrial Disions, Inc.

Ernst & Young Shin Nihon LLC

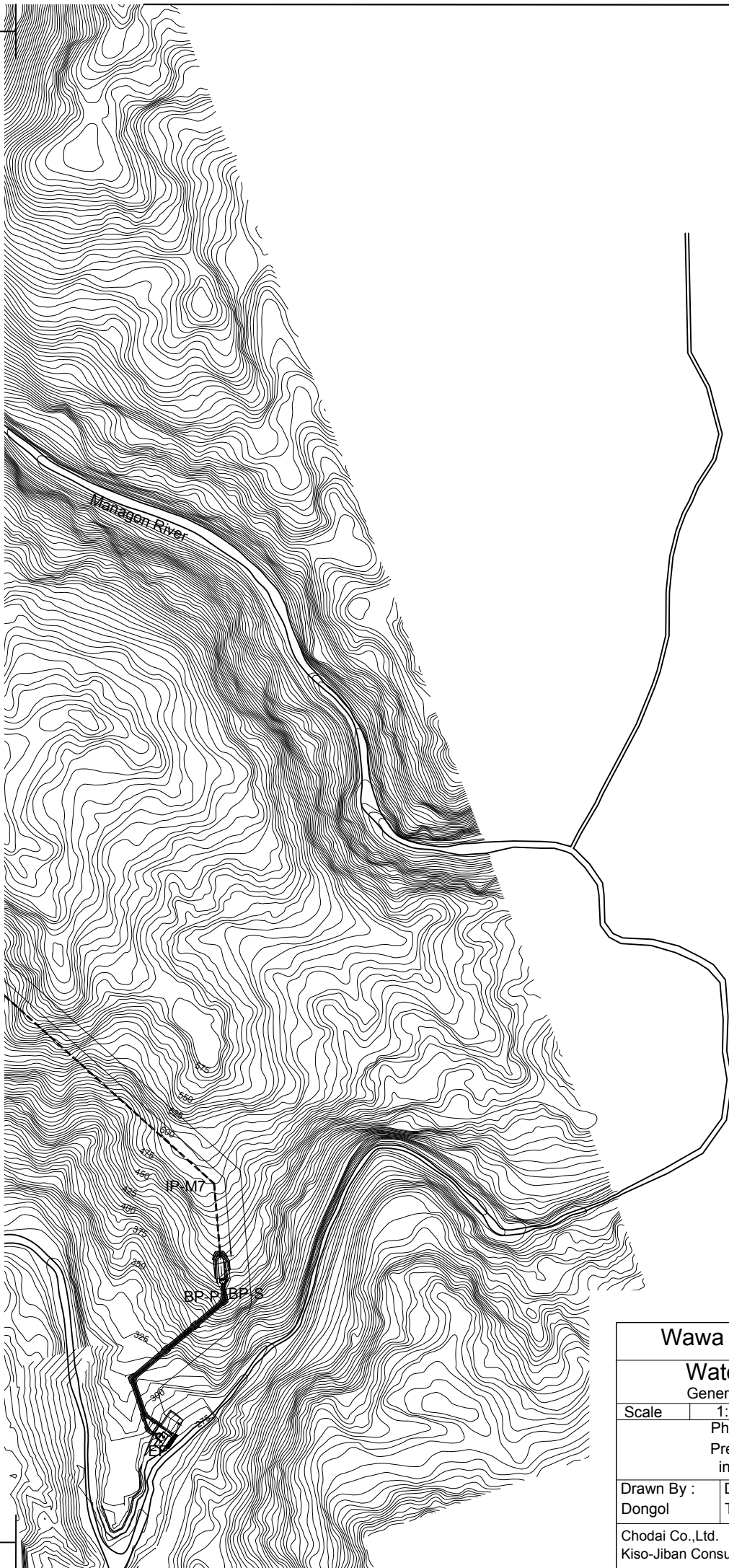


Elipsoide de Reference : WGS84  
Projection : UTM zone 29 N

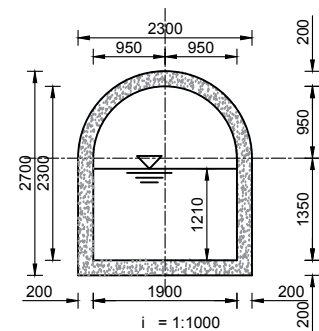
Wawa No.2 Hydropower Project			
Location Map		Drawing No. 0-1	
Key Map & Location Map			
Scale	1:50000	Date	May 2016
Philippines Mini-Hydro Power Project Preparatory Study for the Wawa River in the Province of Agusan del Sur			
Drawn By :	Designed By :	Checked By :	Approved By :
Dongol	Takase	Takase	Tsuda
Chodai Co.,Ltd.		Industrial Dicions,Inc.	
Kiso-Jiban Consultants Co.,Ltd		Ernst & Young Shin Nihon LLC	



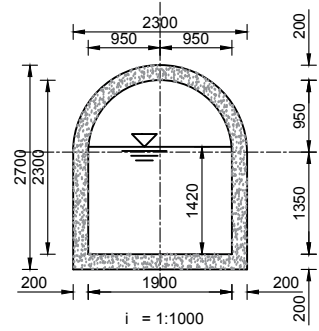




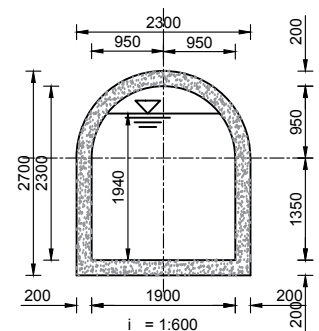
<b>Wawa No.2 Hydropower Project</b>			
<b>Waterway</b> General Plan		Drawing No. 1-1	
Scale	1:10000	Date	May 2016
Philippines Mini-Hydro Power Project Preparatory Study for the Wawa River in the Province of Agusan del Sur			
Drawn By :	Designed By :	Checked By :	Approved By :
Dongol	Takase	Takase	Tsuda
Chodai Co.,Ltd.		Industrial Dicions, Inc.	
Kiso-Jiban Consultants Co.,Ltd		Ernst & Young Shin Nihon LLC	



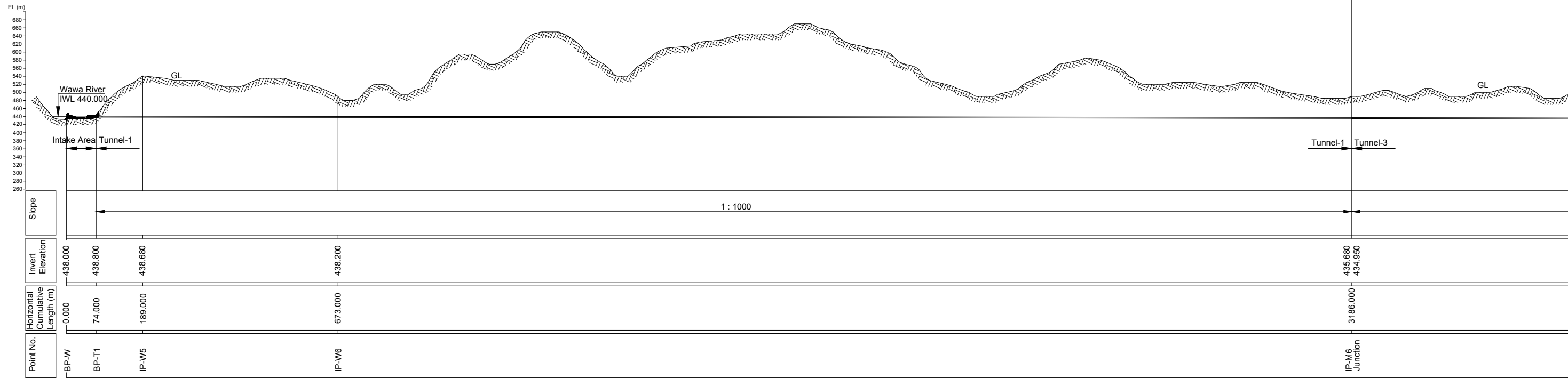
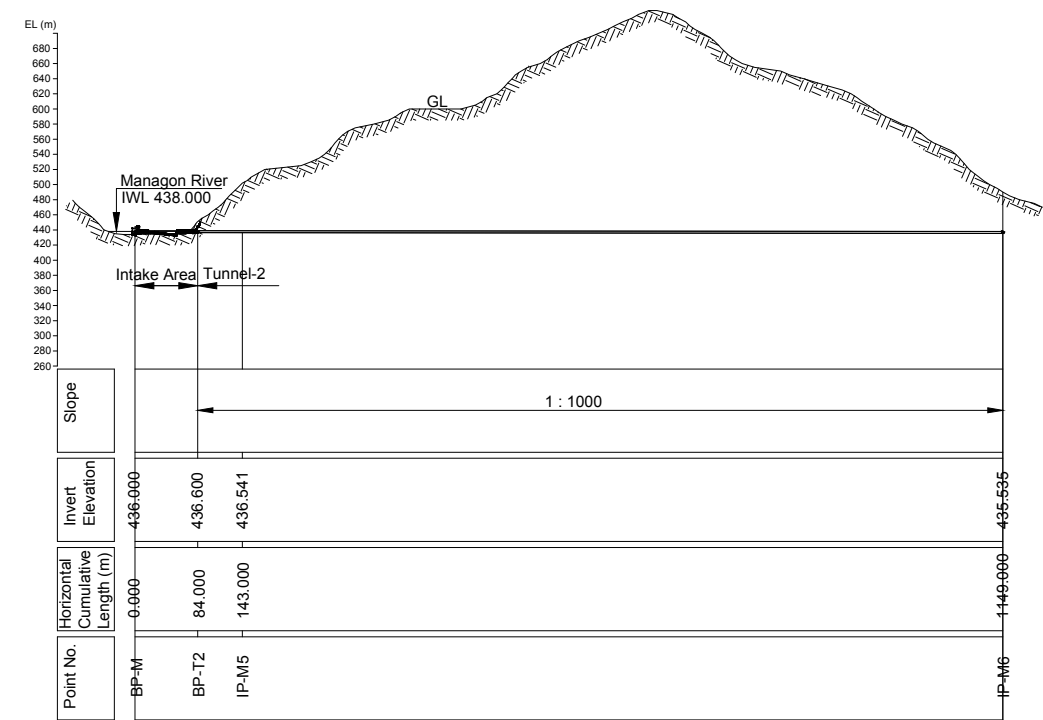
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 $n = 0.014$   
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**Tunnel-1 Section**  
 Scale 1:100



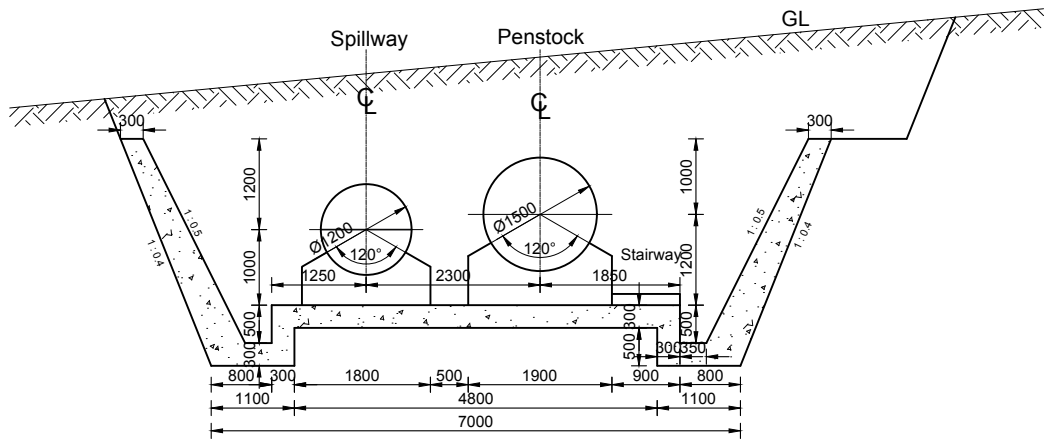
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**Tunnel-2 Section**  
 Scale 1:100



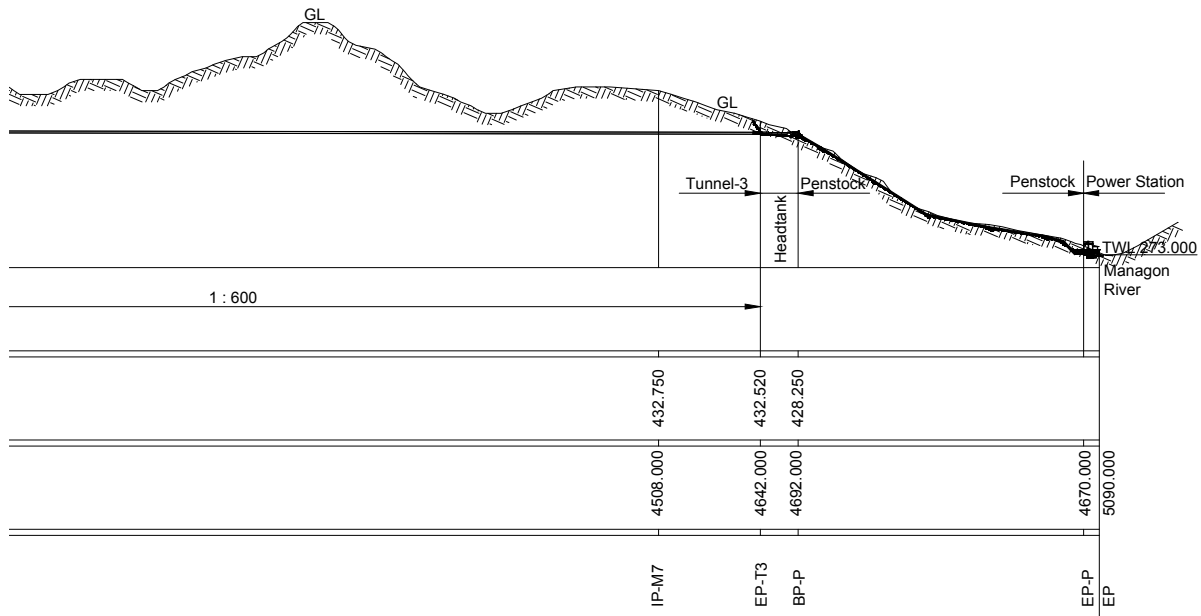
$i = 1:600$   
 $n = 0.014$   
 $Q = 7.60 \text{ m}^3/\text{Sec}$   
**Tunnel-3 Section**  
 Scale 1:100



Waterway Profile



Typical Section : Penstock and Spillway  
Scale 1:100



### Wawa No.2 Hydropower Project

**Waterway**  
Profile & Typical Section

Drawing No. 1-2

Scale 1:10000

Date May 2016

Philippines Mini-Hydro Power Project  
Preparatory Study for the Wawa River  
in the Province of Agusan del Sur

Drawn By :  
Dongol

Designed By :  
Takase

Checked By :  
Takase

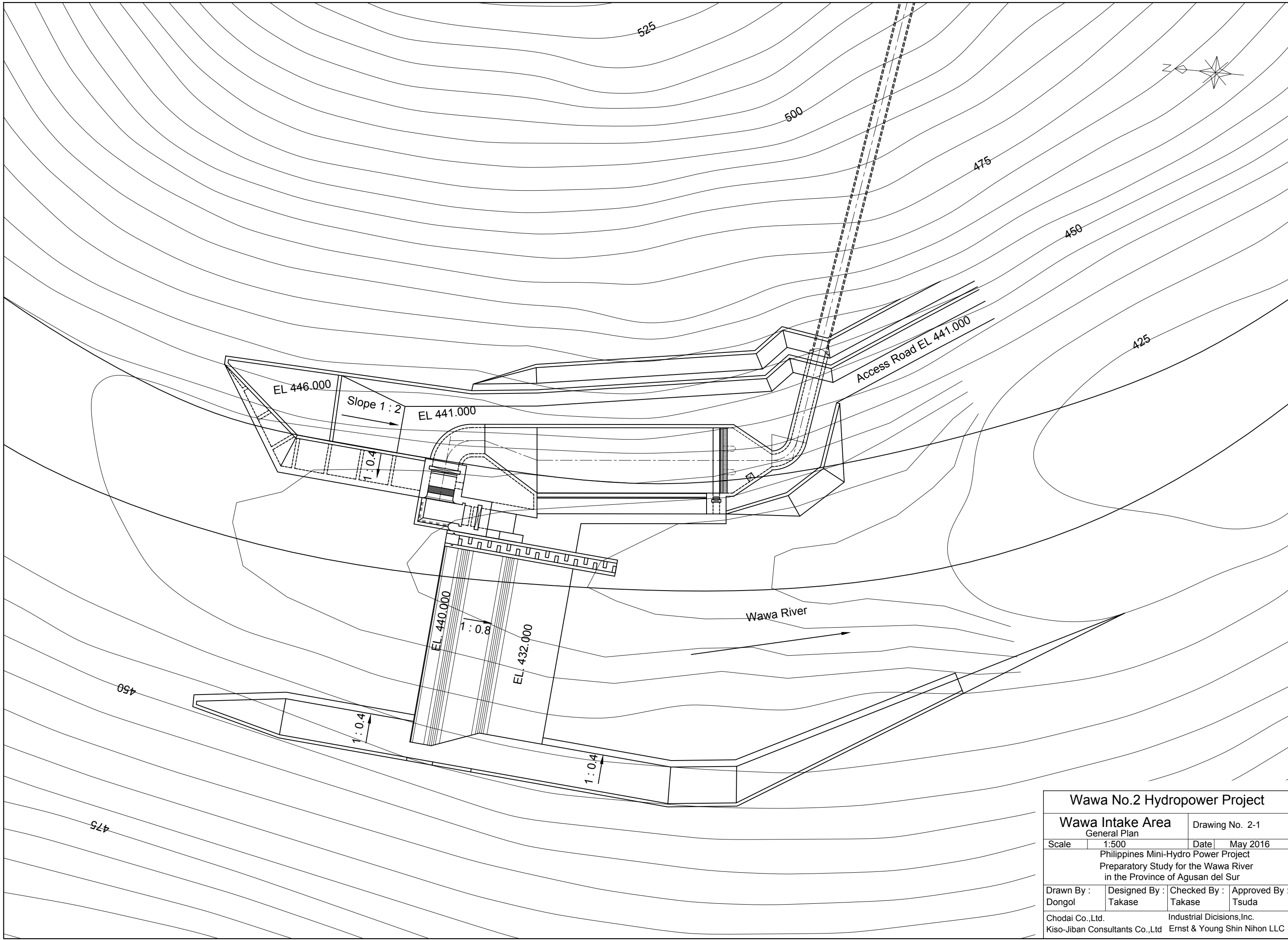
Approved By :  
Tsuda

Chodai Co.,Ltd.

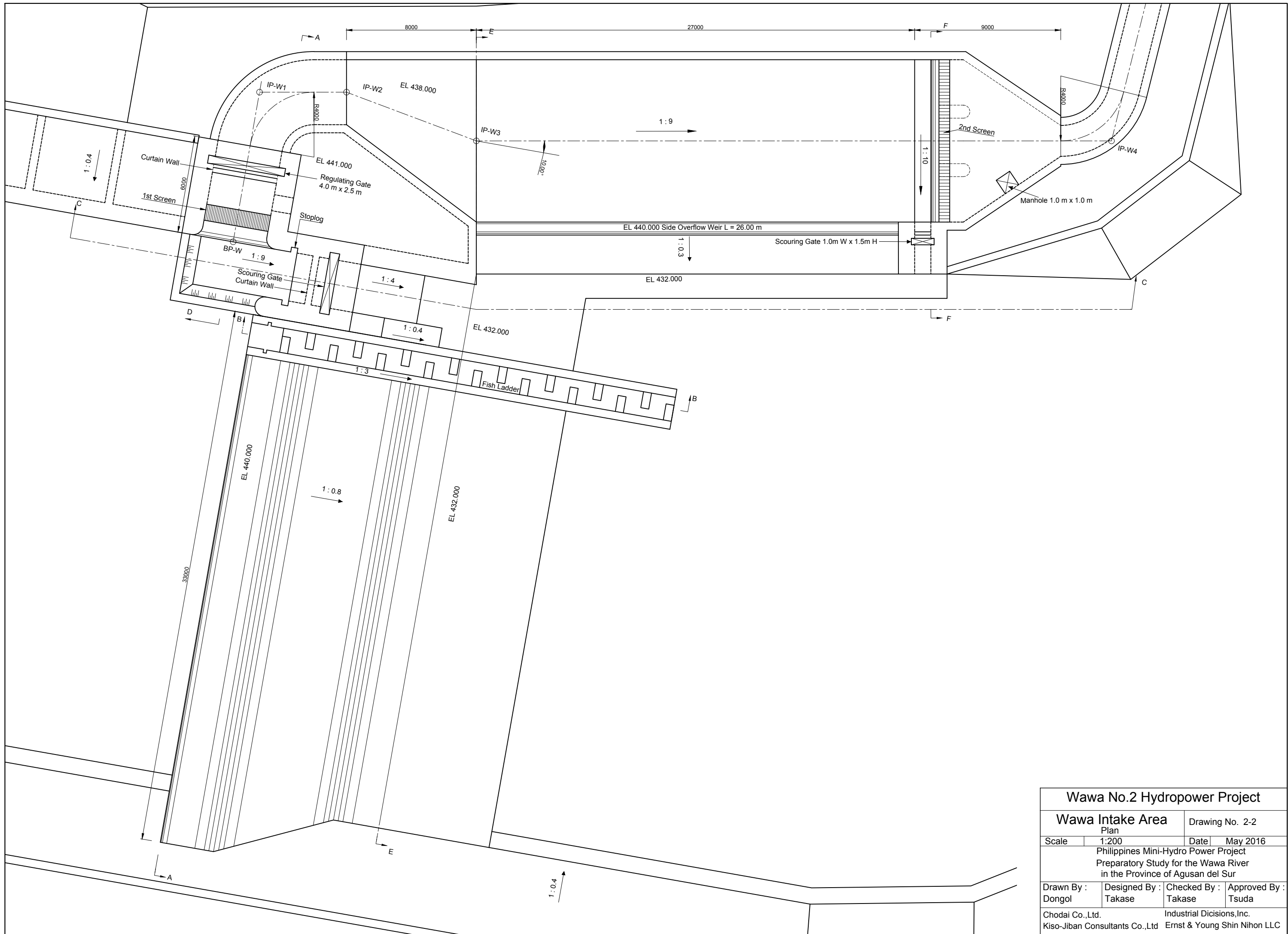
Industrial Disions,Inc.

Kiso-Jiban Consultants Co.,Ltd

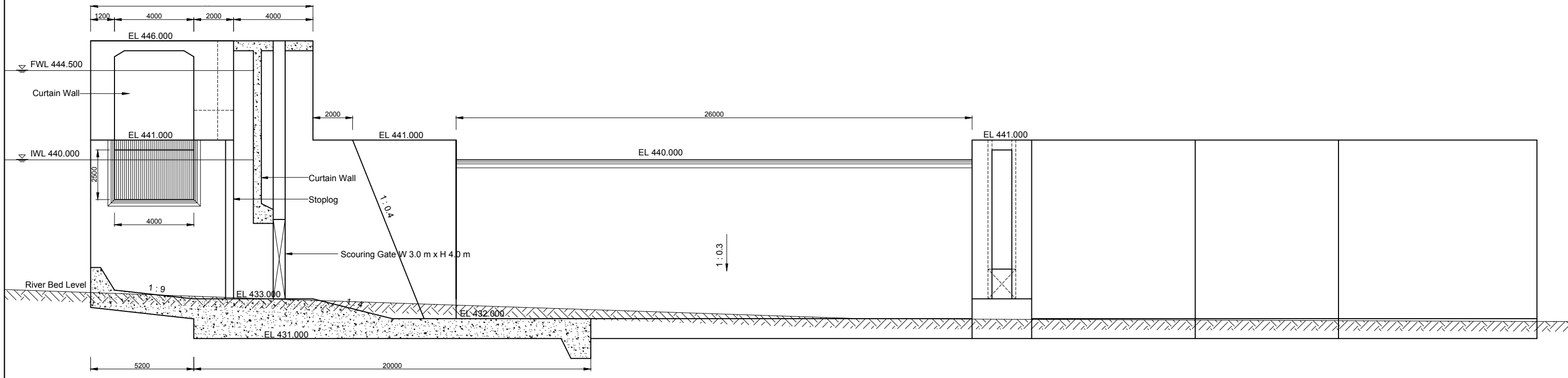
Ernst & Young Shin Nihon LLC



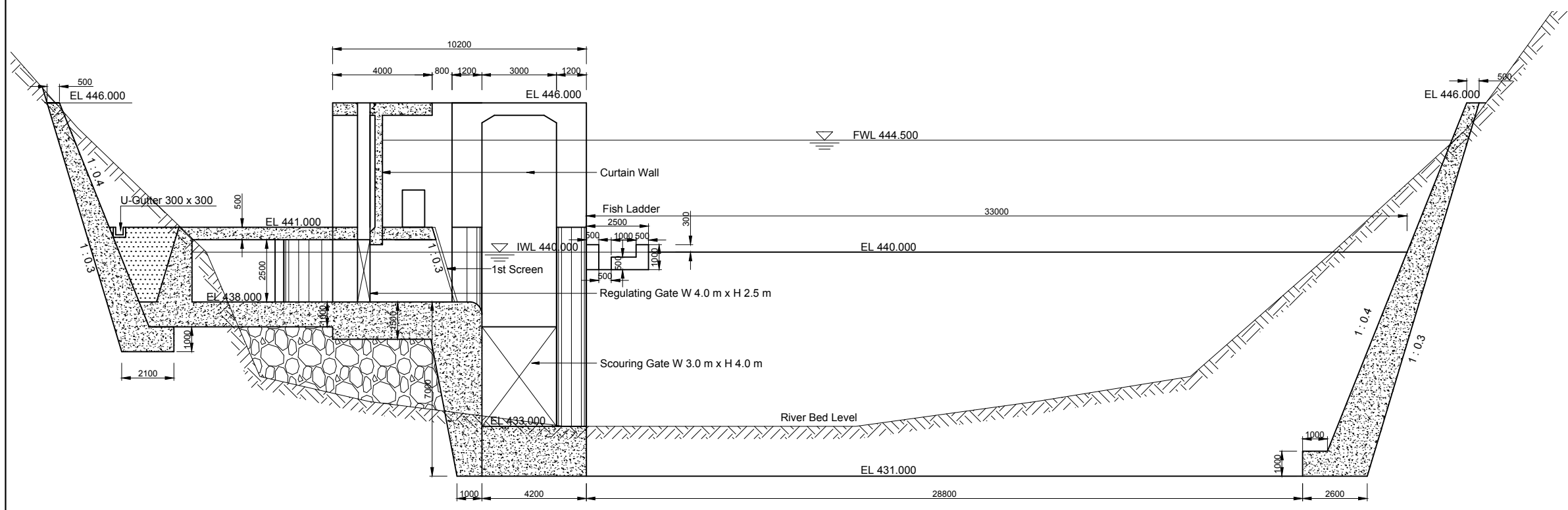
<b>Wawa No.2 Hydropower Project</b>			
<b>Wawa Intake Area</b>		Drawing No. 2-1	
General Plan			
Scale	1:500	Date	May 2016
Philippines Mini-Hydro Power Project Preparatory Study for the Wawa River in the Province of Agusan del Sur			
Drawn By :	Designed By :	Checked By :	Approved By :
Dongol	Takase	Takase	Tsuda
Chodai Co.,Ltd.		Industrial Dicions,Inc.	
Kiso-Jiban Consultants Co.,Ltd		Ernst & Young Shin Nihon LLC	



<b>Wawa No.2 Hydropower Project</b>			
<b>Wawa Intake Area</b>		Drawing No. 2-2	
Plan			
Scale	1:200	Date	May 2016
Philippines Mini-Hydro Power Project Preparatory Study for the Wawa River in the Province of Agusan del Sur			
Drawn By :	Designed By :	Checked By :	Approved By :
Dongol	Takase	Takase	Tsuda
Chodai Co.,Ltd.		Industrial Dicions,Inc.	
Kiso-Jiban Consultants Co.,Ltd		Ernst & Young Shin Nihon LLC	

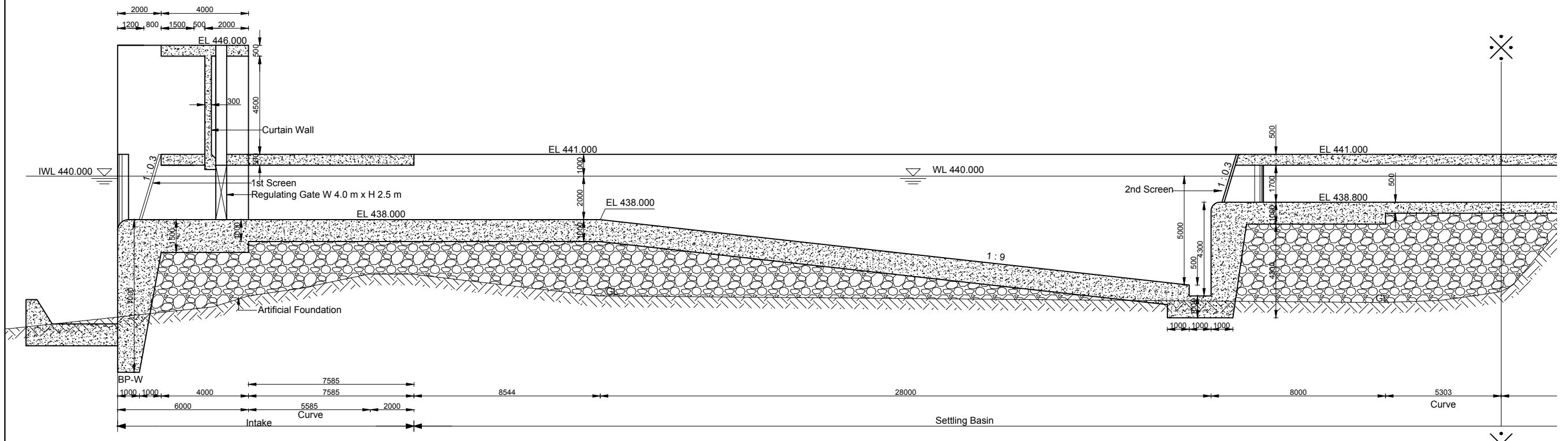


Section C-C

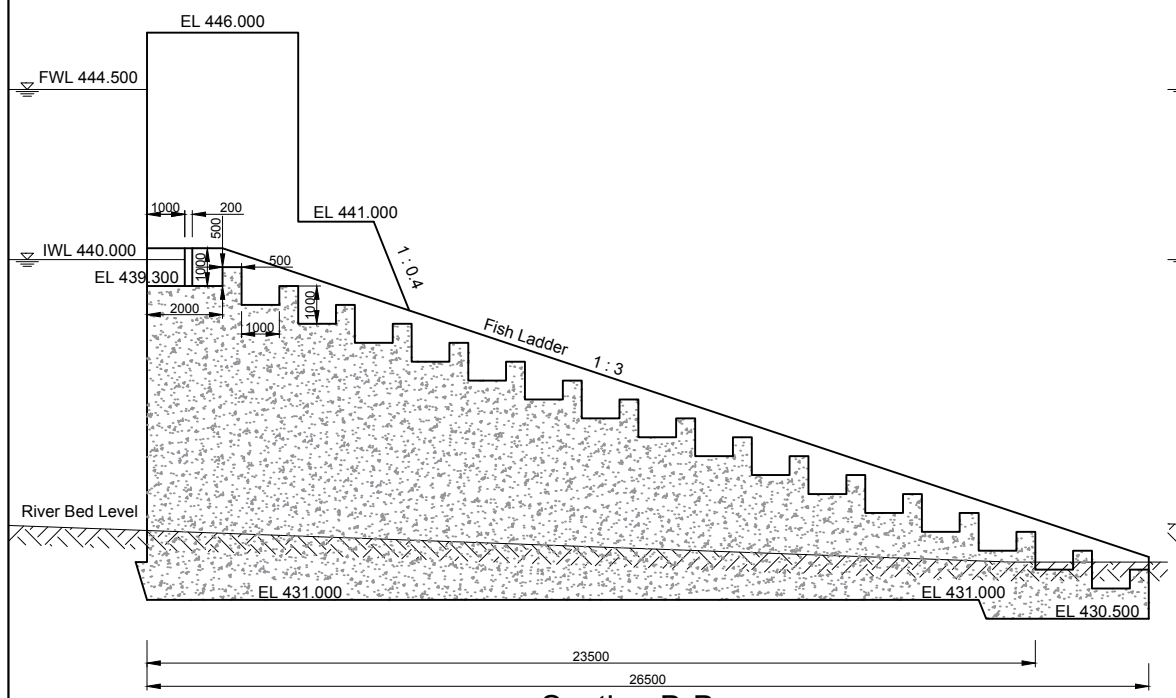


Section A-A

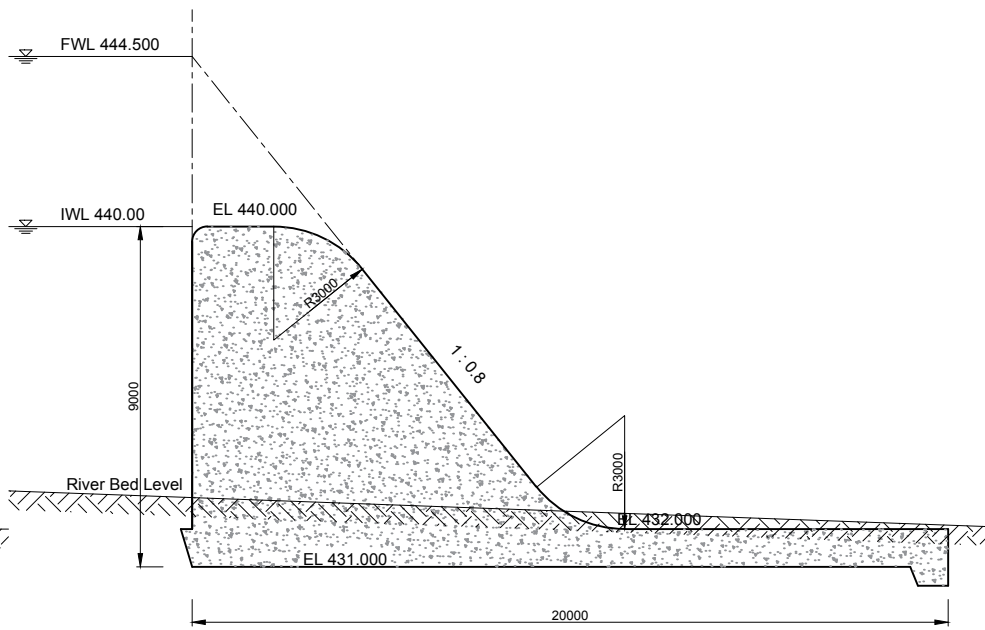
<b>Wawa No.2 Hydropower Project</b>			
<b>Wawa Intake Area</b>		Drawing No. 2-3	
Weir, Intake & Settling Basin-1		Date	May 2016
Scale	1:200	Philippines Mini-Hydro Power Project Preparatory Study for the Wawa River in the Province of Agusan del Sur	
Drawn By :	Designed By :	Checked By :	Approved By :
Dongol	Takase	Takase	Tsuda
Chodai Co.,Ltd.		Industrial Dicions,Inc.	
Kiso-Jiban Consultants Co.,Ltd		Ernst & Young Shin Nihon LLC	



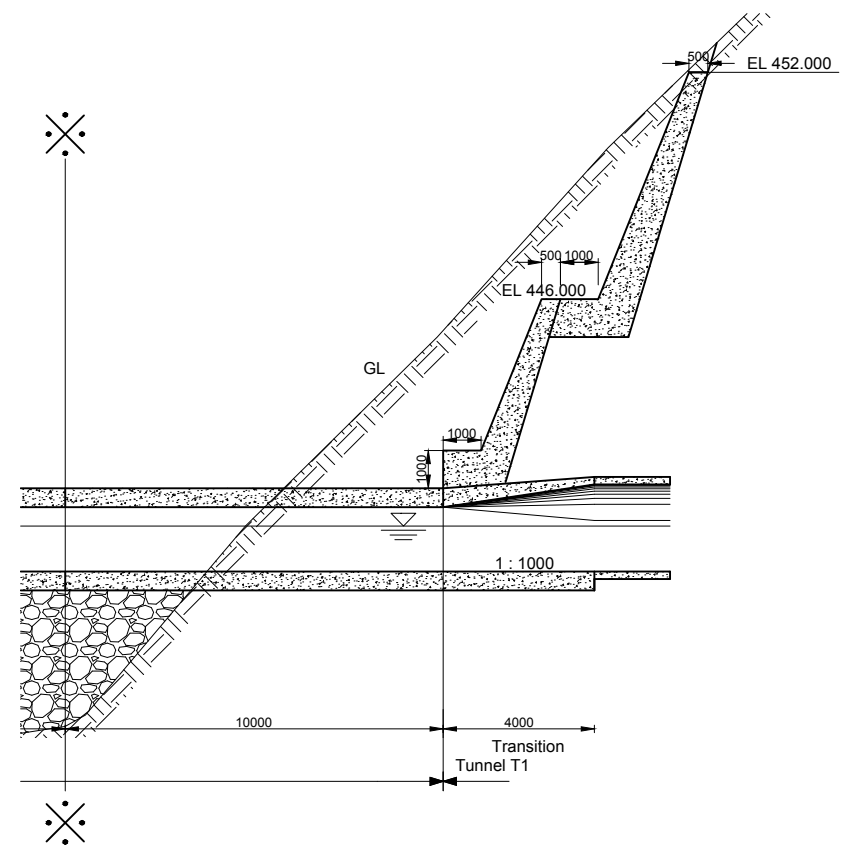
Section D-D



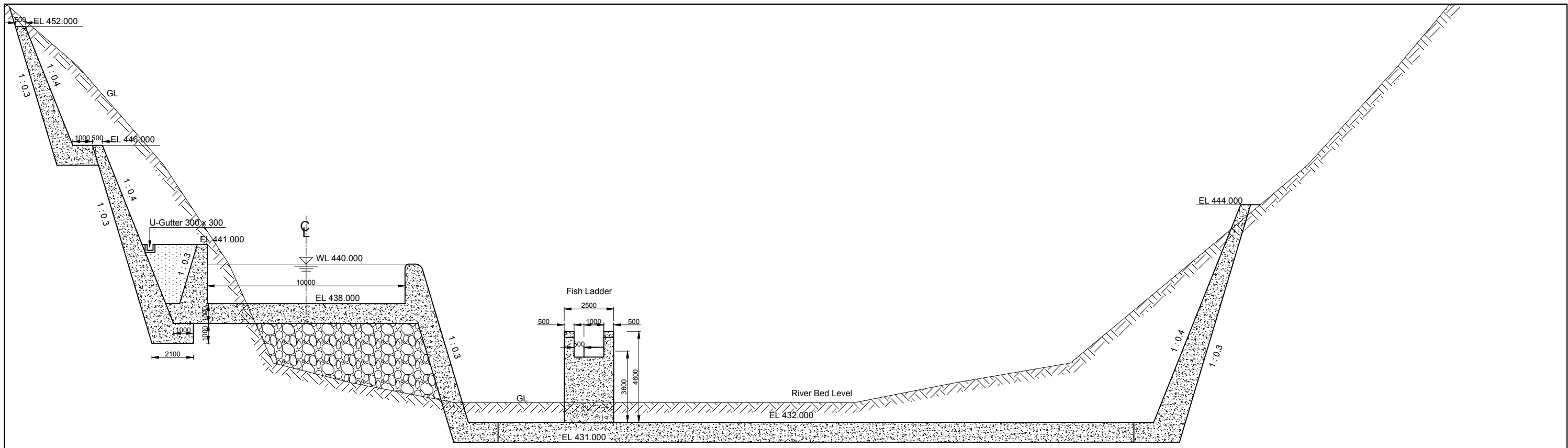
Section B-B



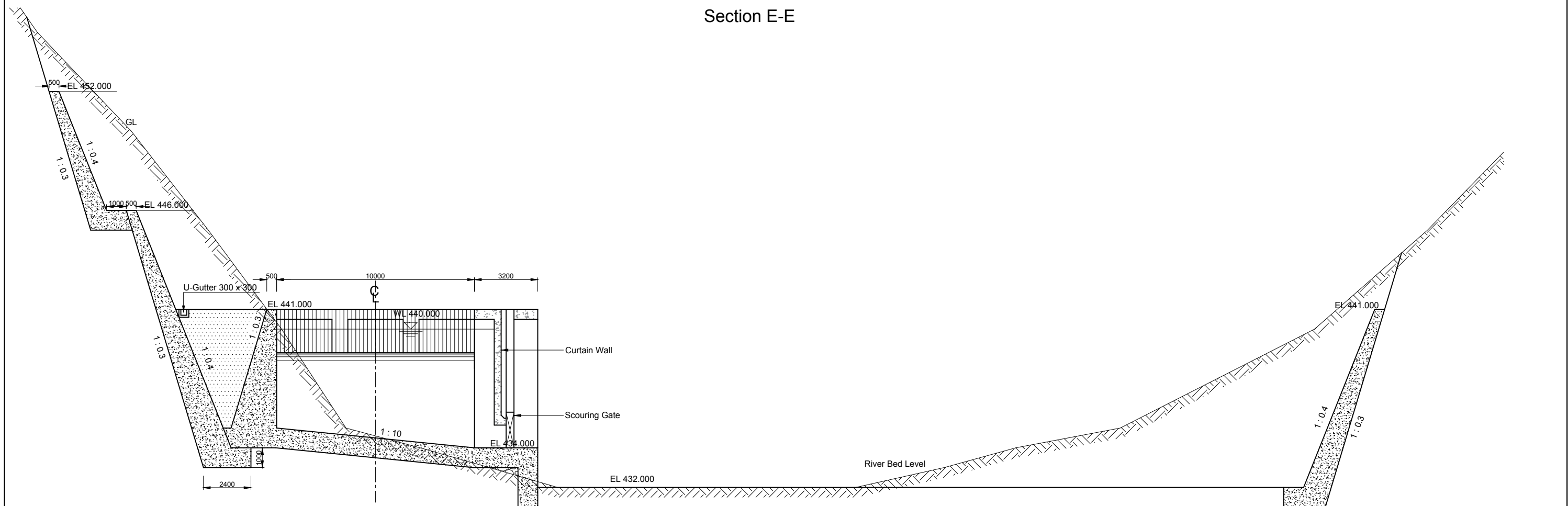
Typical Weir Section



<b>Wawa No.2 Hydropower Project</b>			
<b>Wawa Intake Area</b>		Drawing No. 2-4	
Weir, Intake & Settling Basin-2		Date	May 2016
Scale	1:200	Philippines Mini-Hydro Power Project Preparatory Study for the Wawa River in the Province of Agusan del Sur	
Drawn By :	Designed By :	Checked By :	Approved By :
Dongol	Takase	Takase	Tsuda
Chodai Co.,Ltd.		Industrial Decisions,Inc.	
Kiso-Jiban Consultants Co.,Ltd		Ernst & Young Shin Nihon LLC	



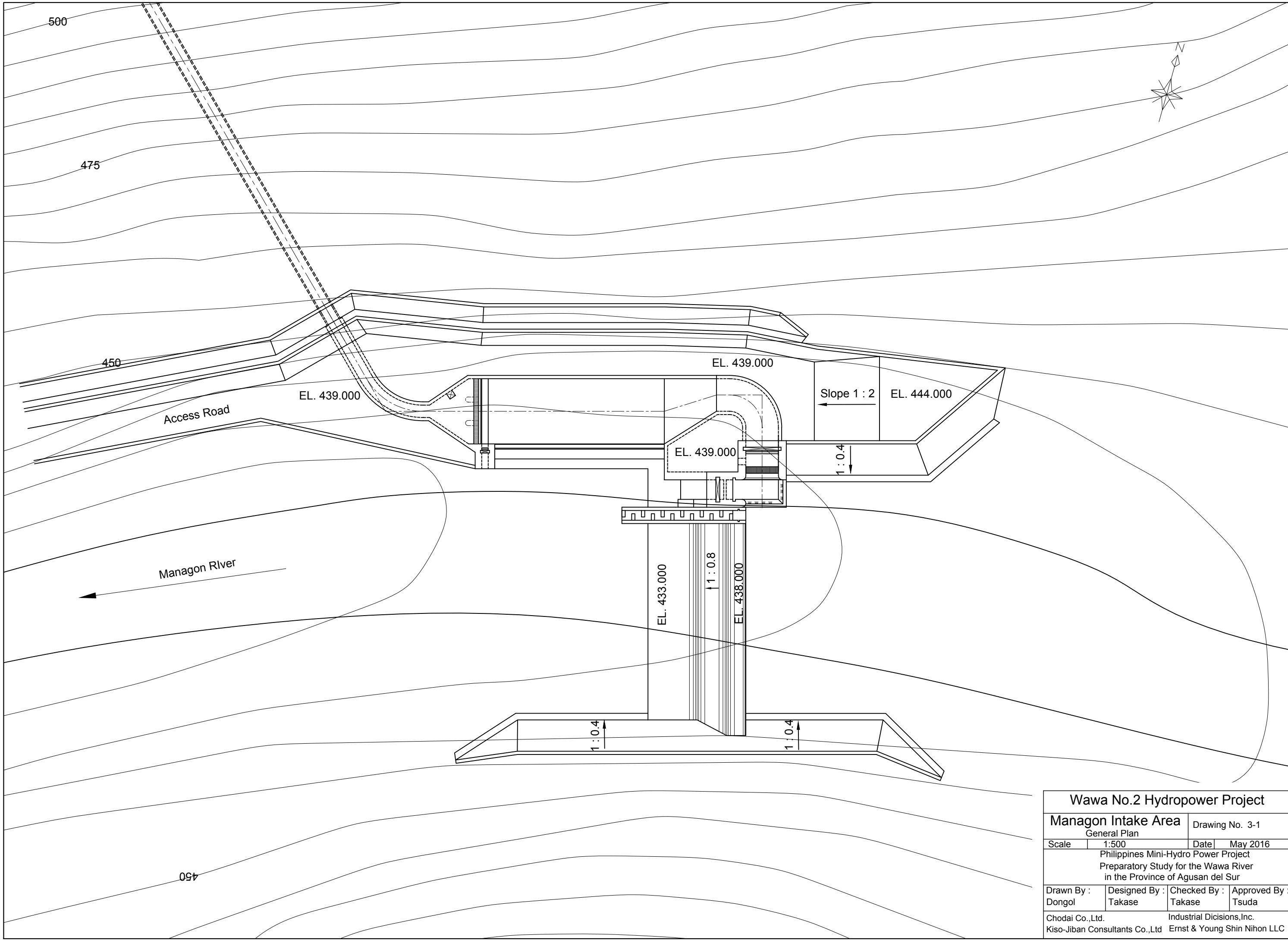
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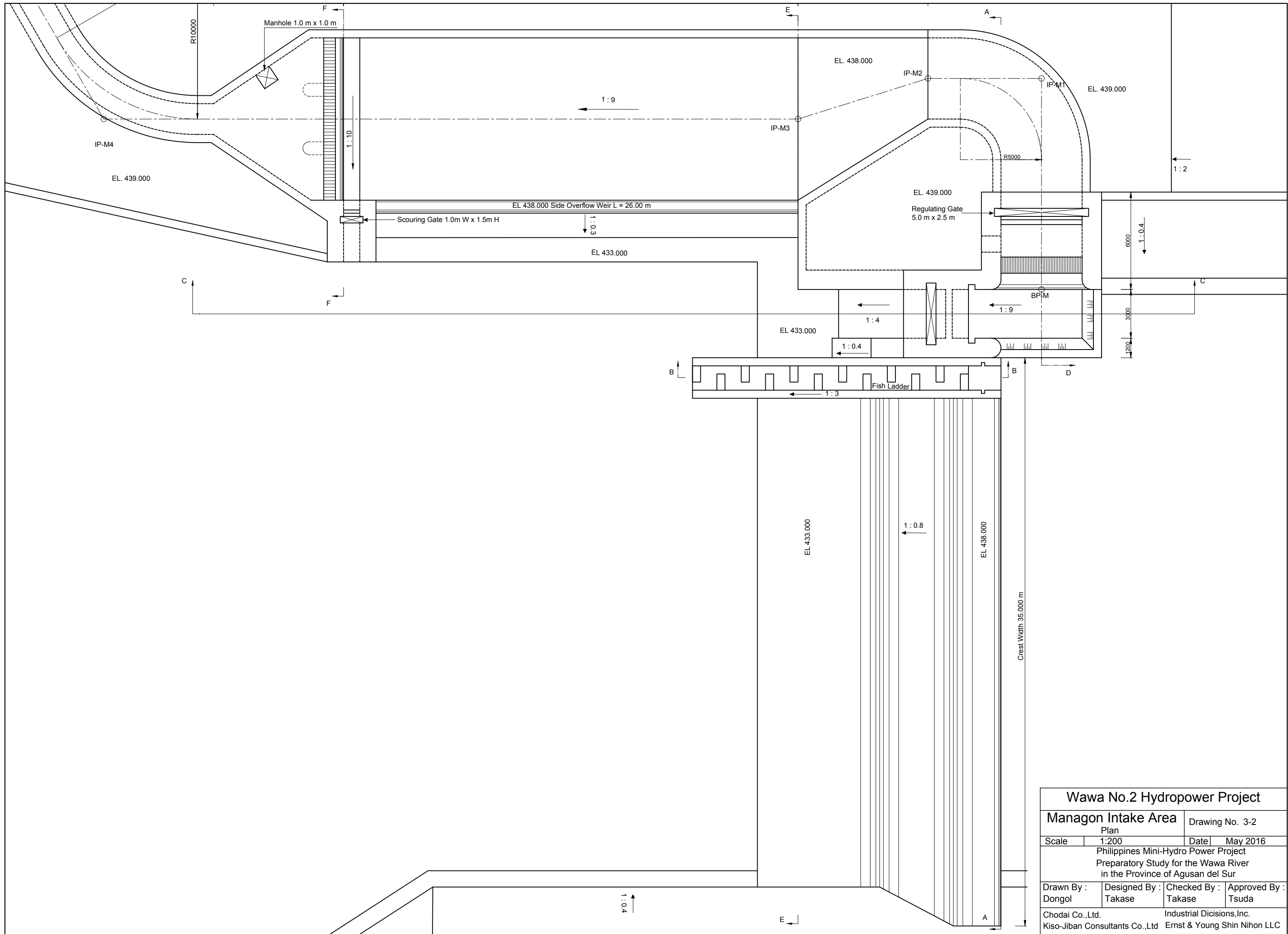
Section F-F

<b>Wawa No.2 Hydropower Project</b>			
<b>Wawa Intake Area</b>		Drawing No. 2-5	
Weir, Intake & Settling Basin-3		Date May 2016	
Scale	1:200	Date	May 2016
Philippines Mini-Hydro Power Project Preparatory Study for the Wawa River in the Province of Agusan del Sur			
Drawn By :	Designed By :	Checked By :	Approved By :
Dongol	Takase	Takase	Tsuda
Chodai Co.,Ltd.		Industrial Dicions,Inc.	
Kiso-Jiban Consultants Co.,Ltd		Ernst & Young Shin Nihon LLC	

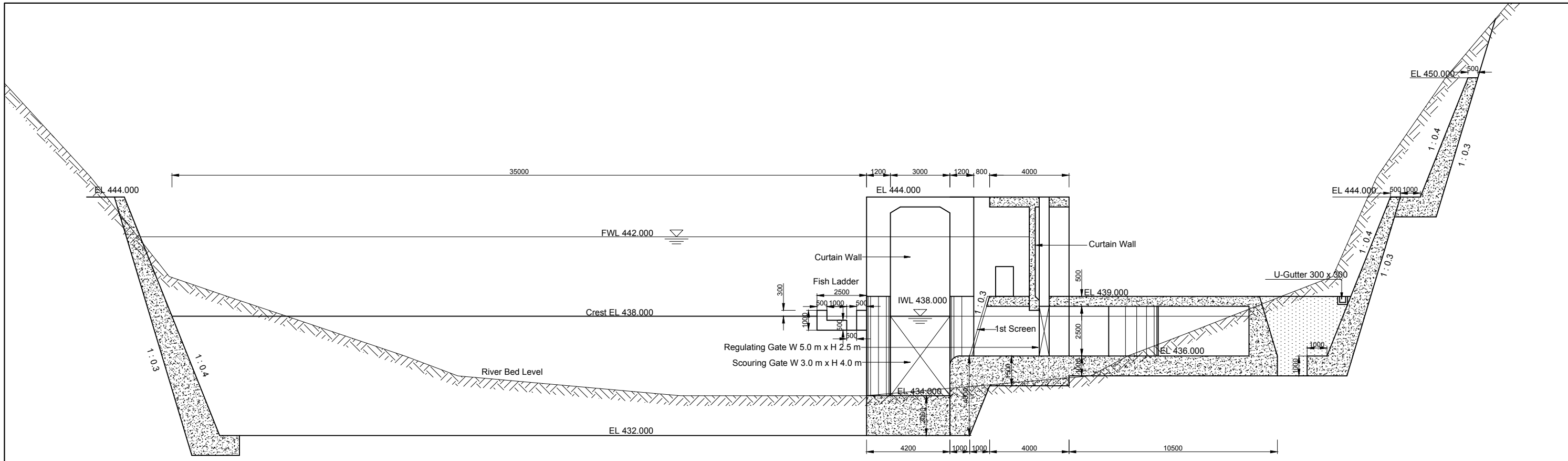




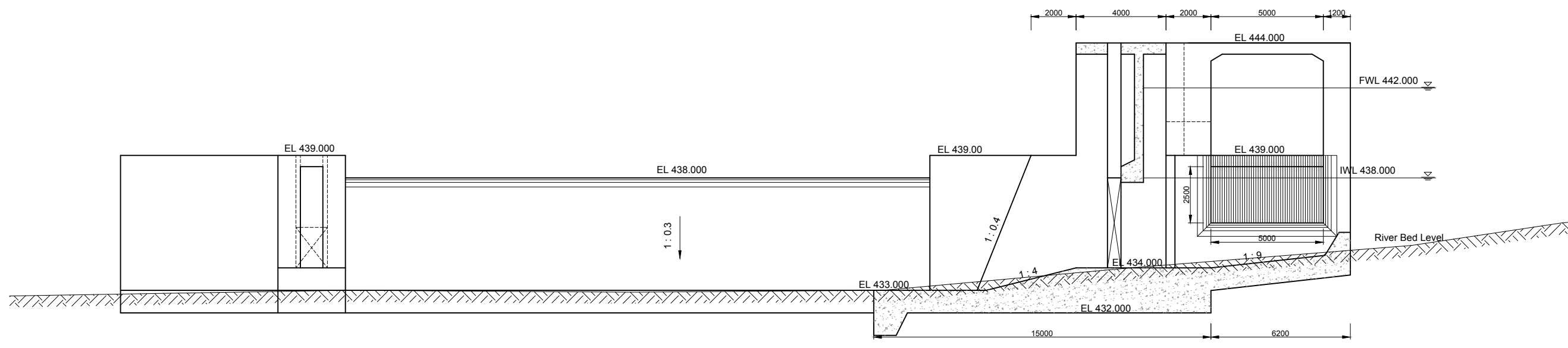
<b>Wawa No.2 Hydropower Project</b>			
<b>Managon Intake Area</b>		Drawing No. 3-1	
General Plan			
Scale	1:500	Date	May 2016
Philippines Mini-Hydro Power Project Preparatory Study for the Wawa River in the Province of Agusan del Sur			
Drawn By :	Designed By :	Checked By :	Approved By :
Dongol	Takase	Takase	Tsuda
Chodai Co.,Ltd.		Industrial Dicions,Inc.	
Kiso-Jiban Consultants Co.,Ltd		Ernst & Young Shin Nihon LLC	



<b>Wawa No.2 Hydropower Project</b>			
<b>Managon Intake Area</b>		Drawing No. 3-2	
Plan			
Scale	1:200	Date	May 2016
Philippines Mini-Hydro Power Project Preparatory Study for the Wawa River in the Province of Agusan del Sur			
Drawn By :	Designed By :	Checked By :	Approved By :
Dongol	Takase	Takase	Tsuda
Chodai Co.,Ltd.		Industrial Dicions,Inc.	
Kiso-Jiban Consultants Co.,Ltd		Ernst & Young Shin Nihon LLC	

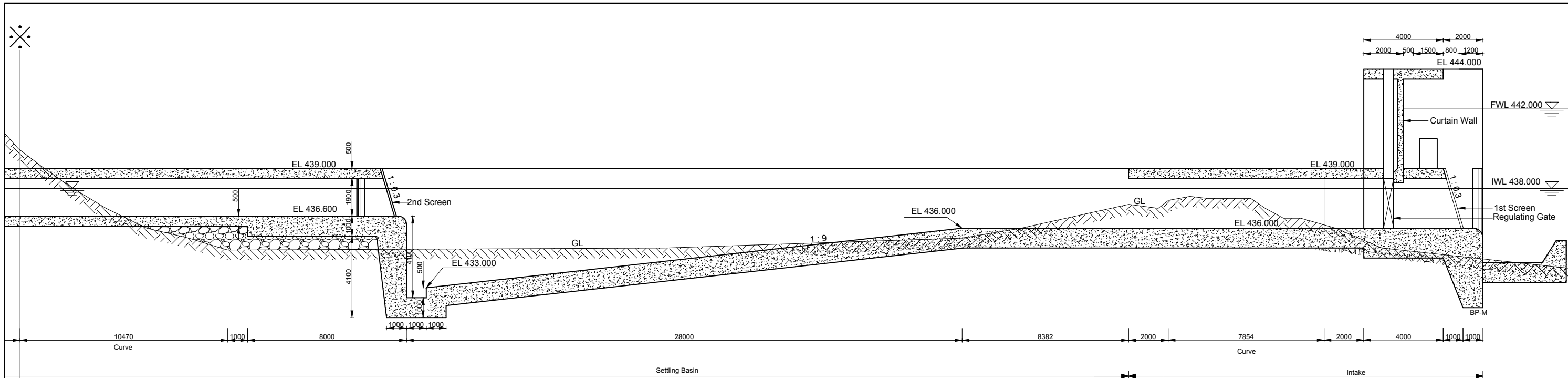


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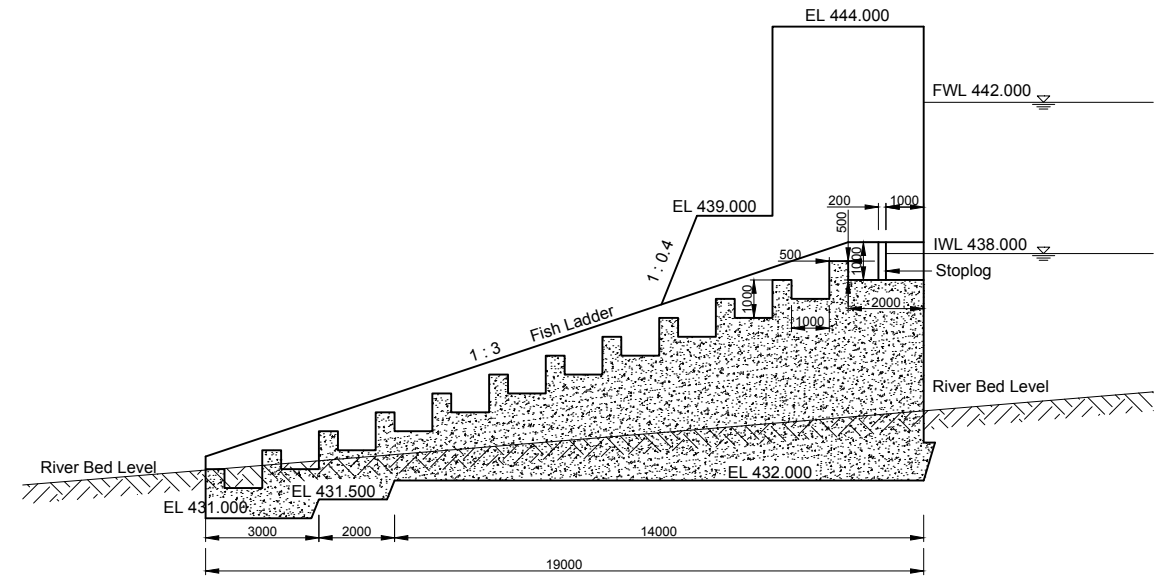
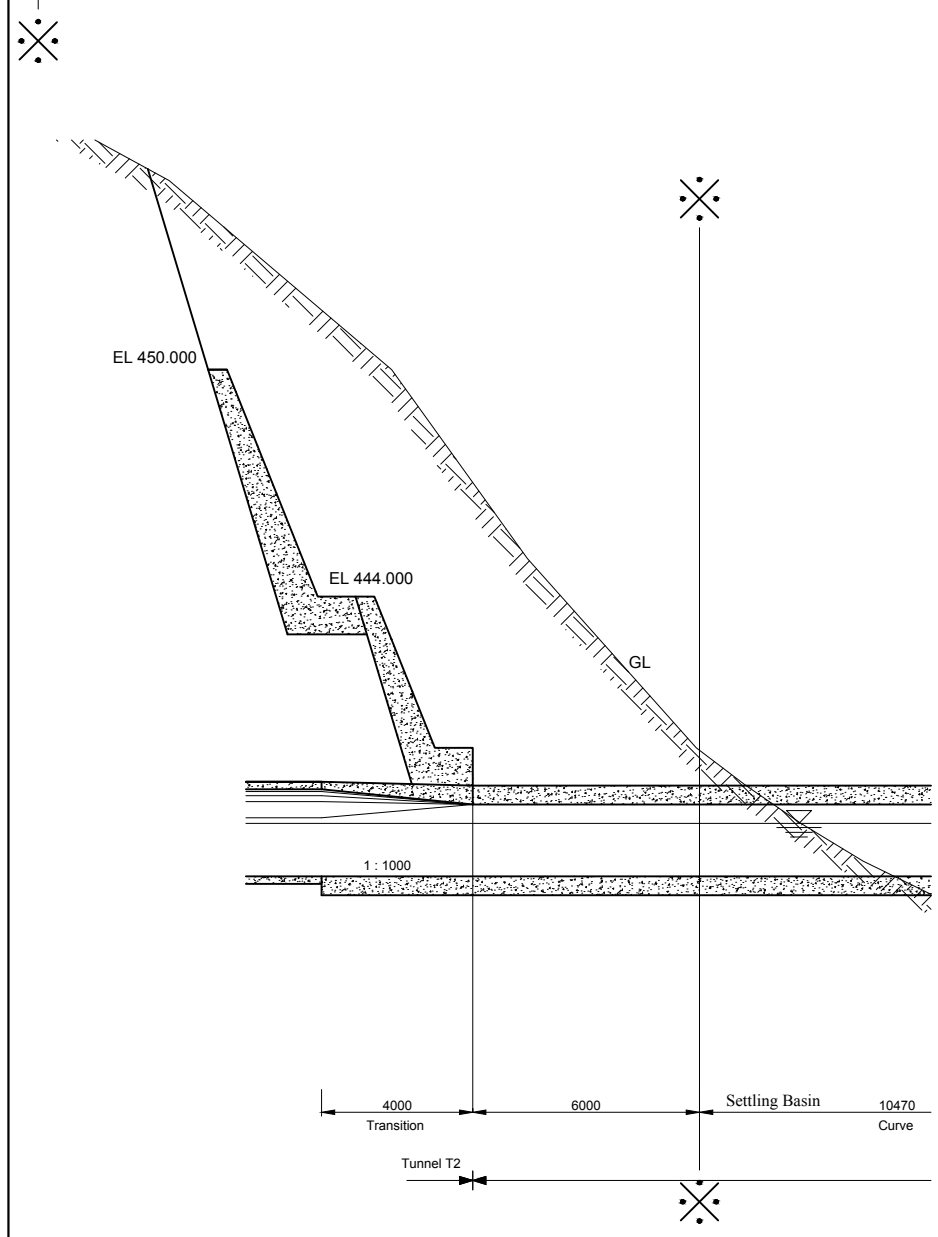


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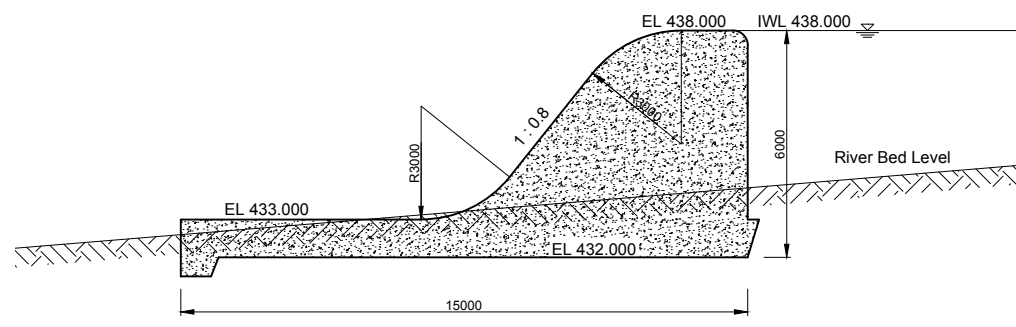
<b>Wawa No.2 Hydropower Project</b>			
<b>Managon Intake Area</b>		Drawing No. 3-3	
Weir, Intake & Settling Basin-1		Date May 2016	
Scale	1:200	Date	May 2016
Philippines Mini-Hydro Power Project Preparatory Study for the Wawa River in the Province of Agusan del Sur			
Drawn By :	Designed By :	Checked By :	Approved By :
Dongol	Takase	Takase	Tsuda
Chodai Co.,Ltd.		Industrial Dicions,Inc.	
Kiso-Jiban Consultants Co.,Ltd		Ernst & Young Shin Nihon LLC	



Section D-D

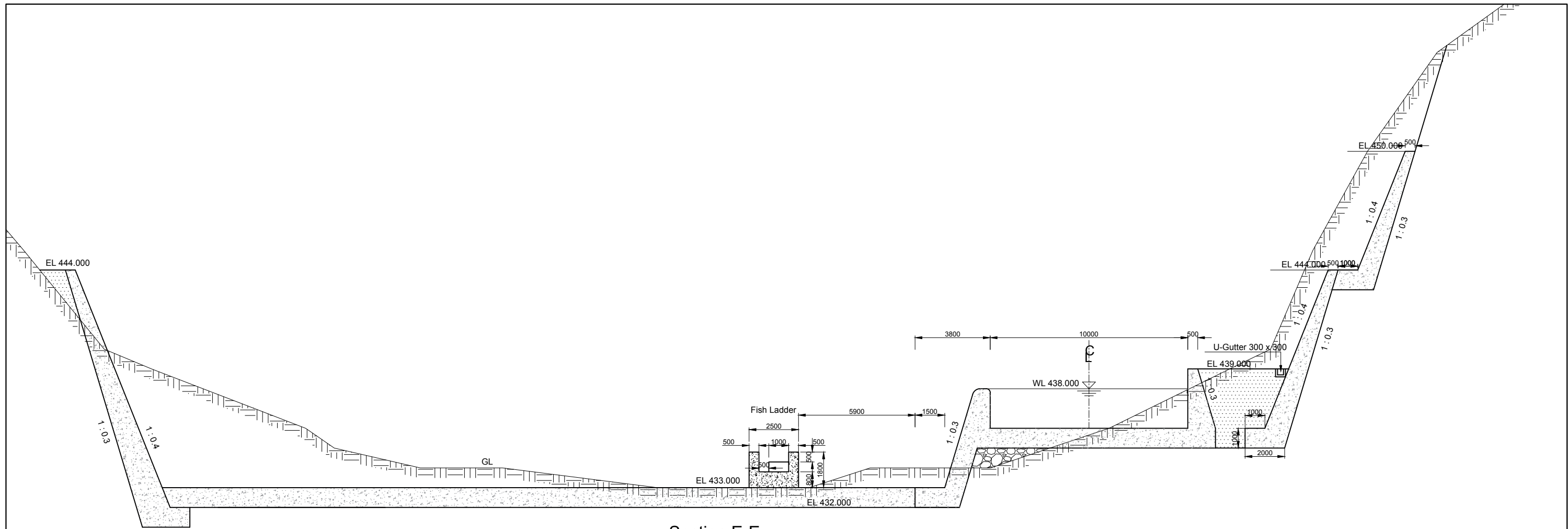


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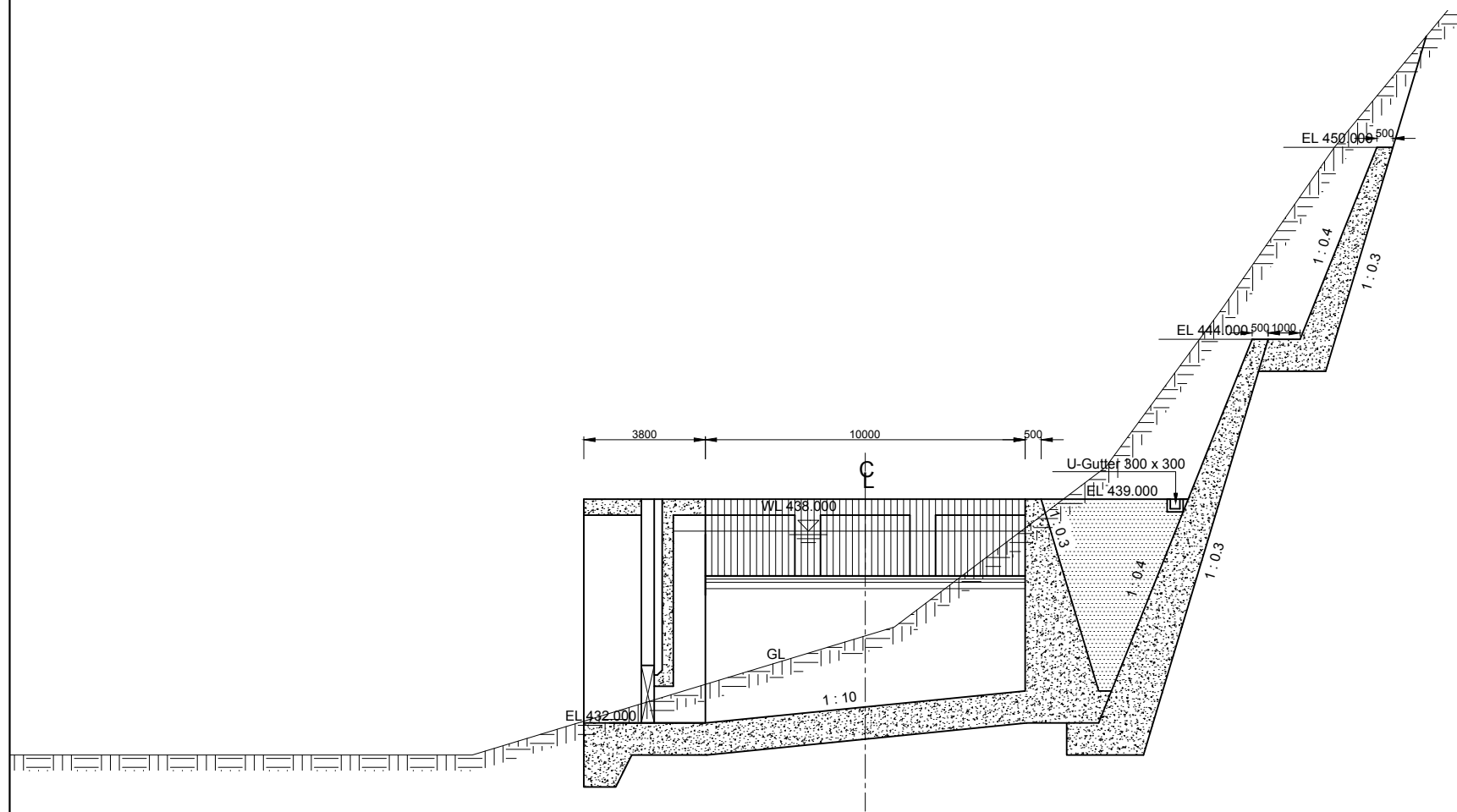


Typical Weir Section

<b>Wawa No.2 Hydropower Project</b>			
<b>Managon Intake Area</b>		Drawing No. 3-4	
Weir, Intake & Settling Basin-2		Date	May 2016
Scale	1:200	Philippines Mini-Hydro Power Project Preparatory Study for the Wawa River in the Province of Agusan del Sur	
Drawn By :	Designed By :	Checked By :	Approved By :
Dongol	Takase	Takase	Tsuda
Chodai Co.,Ltd.		Industrial Decisions, Inc.	
Kiso-Jiban Consultants Co.,Ltd		Ernst & Young Shin Nihon LLC	



Section E-E

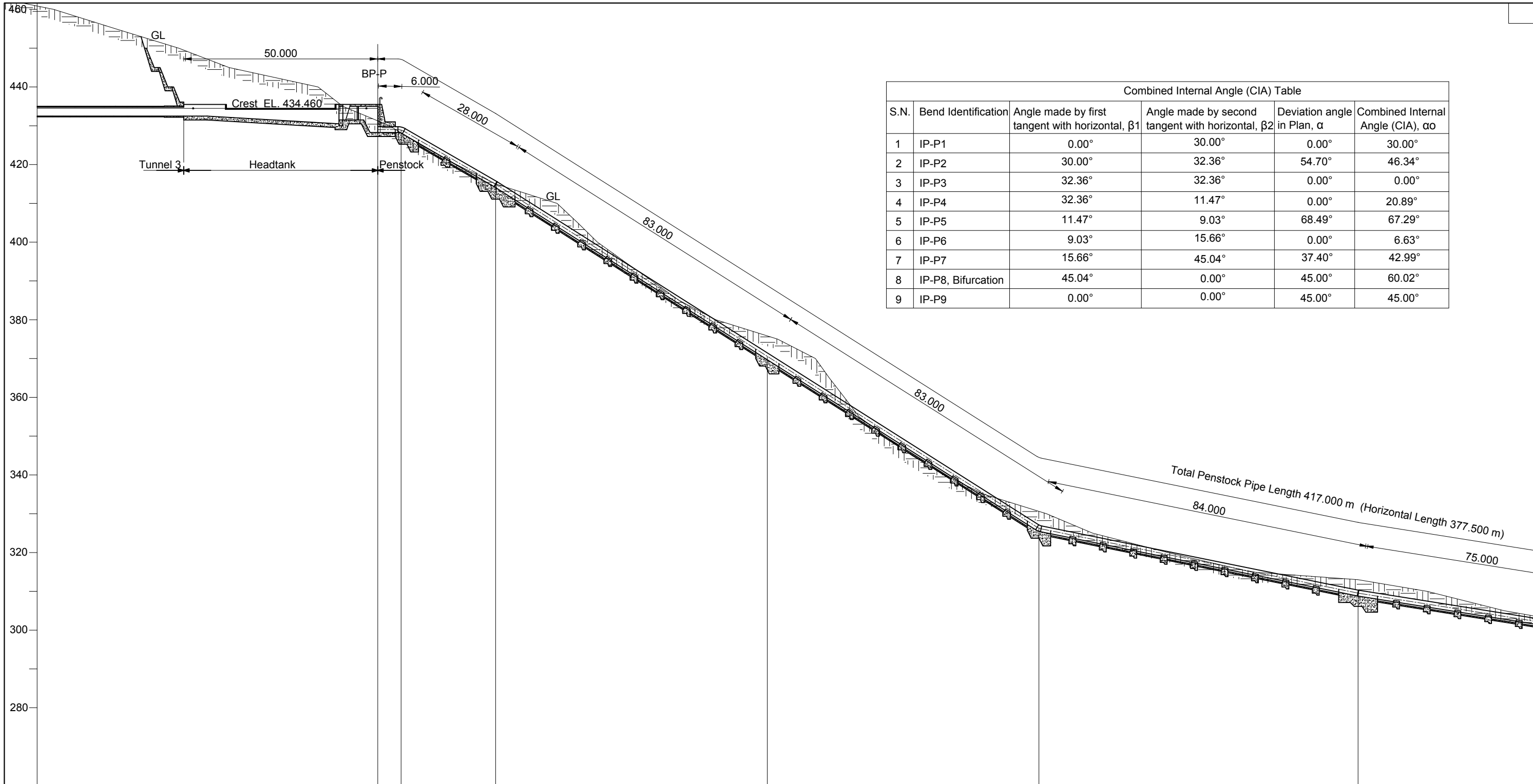


Section F-F

<b>Wawa No.2 Hydropower Project</b>			
<b>Managon Intake Area</b>		Drawing No. 3-5	
Weir, Intake & Settling Basin-3		Date	May 2016
Scale	1:200	Philippines Mini-Hydro Power Project Preparatory Study for the Wawa River in the Province of Agusan del Sur	
Drawn By :	Designed By :	Checked By :	Approved By :
Dongol	Takase	Takase	Tsuda
Chodai Co.,Ltd.		Industrial Decisions, Inc.	
Kiso-Jiban Consultants Co.,Ltd		Ernst & Young Shin Nihon LLC	

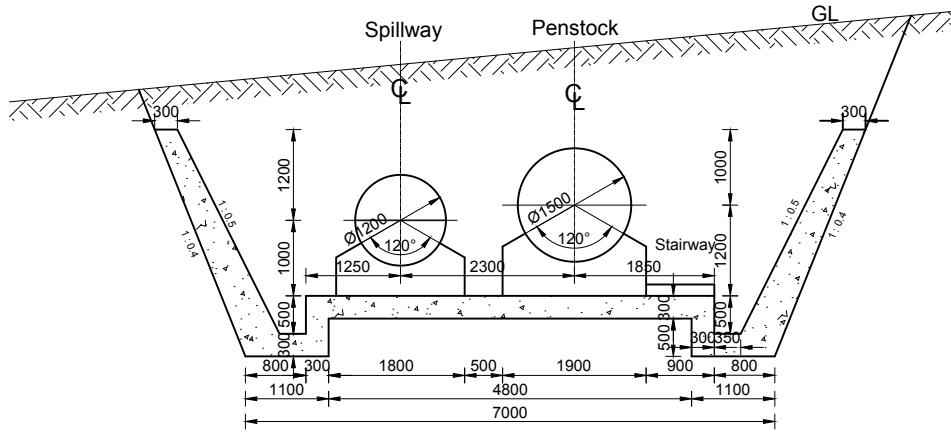


<b>Wawa No.2 Hydropower Project</b>			
<b>Penstock Area</b>		Drawing No. 4-1	
General Plan			
Scale	1:1000	Date	May 2016
Philippines Mini-Hydro Power Project Preparatory Study for the Wawa River in the Province of Agusan del Sur			
Drawn By :	Designed By :	Checked By :	Approved By :
Dongol	Takase	Takase	Tsuda
Chodai Co.,Ltd.		Industrial Dicions,Inc.	
Kiso-Jiban Consultants Co.,Ltd		Ernst & Young Shin Nihon LLC	

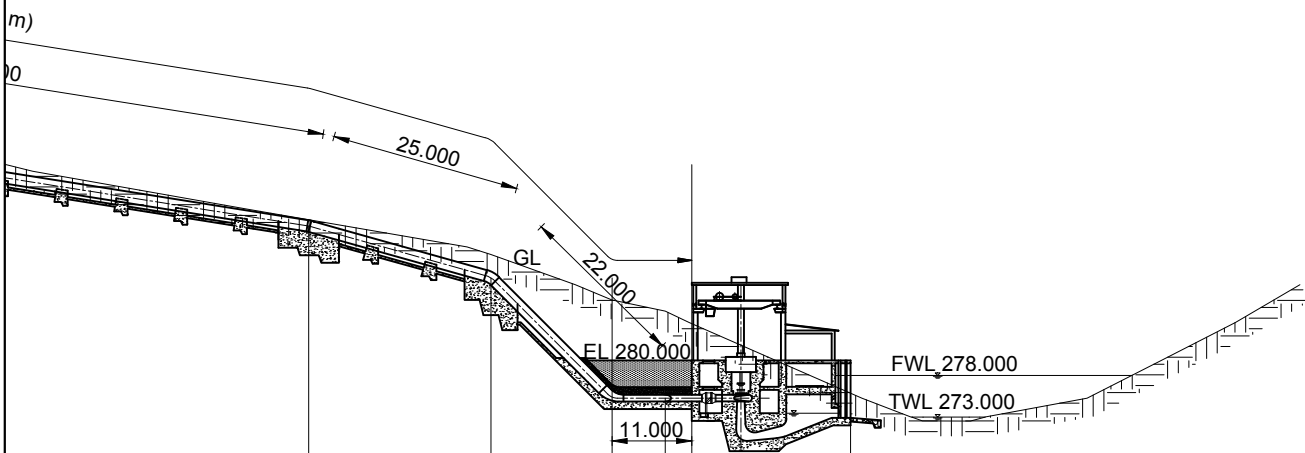


Combined Internal Angle (CIA) Table					
S.N.	Bend Identification	Angle made by first tangent with horizontal, $\beta_1$	Angle made by second tangent with horizontal, $\beta_2$	Deviation angle in Plan, $\alpha$	Combined Internal Angle (CIA), $\alpha_0$
1	IP-P1	0.00°	30.00°	0.00°	30.00°
2	IP-P2	30.00°	32.36°	54.70°	46.34°
3	IP-P3	32.36°	32.36°	0.00°	0.00°
4	IP-P4	32.36°	11.47°	0.00°	20.89°
5	IP-P5	11.47°	9.03°	68.49°	67.29°
6	IP-P6	9.03°	15.66°	0.00°	6.63°
7	IP-P7	15.66°	45.04°	37.40°	42.99°
8	IP-P8, Bifurcation	45.04°	0.00°	45.00°	60.02°
9	IP-P9	0.00°	0.00°	45.00°	45.00°

Slope		0.00°	30.00°	32.36°	32.36°	11.47°	9.03°
Pipe Axis Elevation		429.000	429.000	414.930	370.580	326.280	309.540
Horizontal Cumulative Length, m		0.000	6.000	30.000	100.000	170.000	253.000
Point No.		BP-P	Ver. Bend IP-P1	Ver. + Hor. Bend IP-P2	IP-P3	Ver. Bend IP-P4	Ver. + Hor. Bend IP-P5



Typical Section : Penstock and Spillway  
Scale 1:100



03°      15.66°      45.04°      0.00°

	397.760	390.880	275.000	275.000	275.000	275.000
	327.000	351.000	367.000	374.000	377.500	384.000
Ver. Bend IP-P6						
Ver. + Hor. Bend IP-P7						
Bifurcation IP-P8						
IP-P9						
EP-P						
CL						
EP						398.500

## Wawa No.2 Hydropower Project

Penstock Area  
Penstock Profile

Drawing No. 4-2

Scale 1:1000

Date May 2016

Philippines Mini-Hydro Power Project  
Preparatory Study for the Wawa River  
in the Province of Agusan del Sur

Drawn By :  
Dongol

Designed By :  
Takase

Checked By :  
Takase

Approved By :  
Tsuda

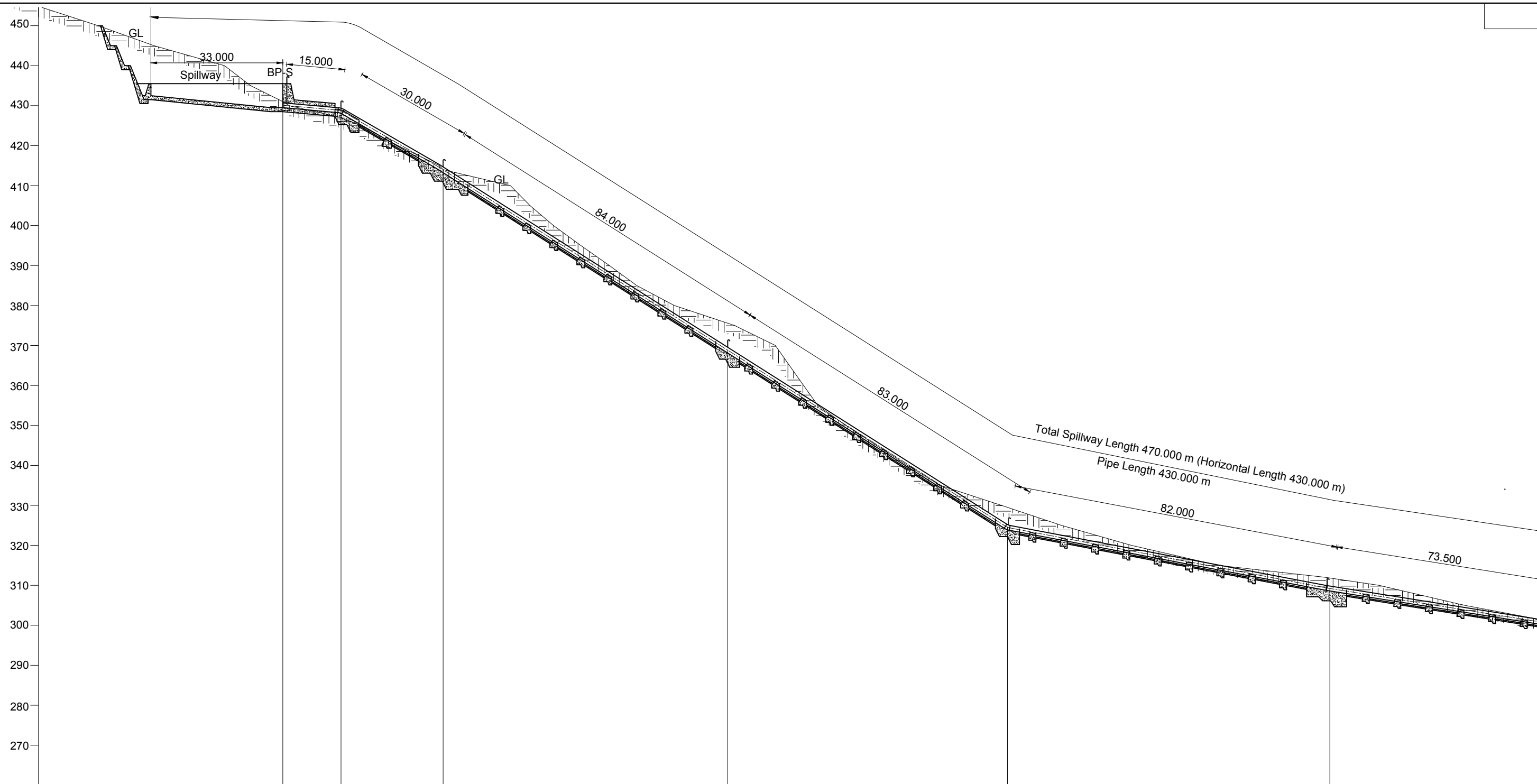
Chodai Co.,Ltd.

Industrial Disions, Inc.

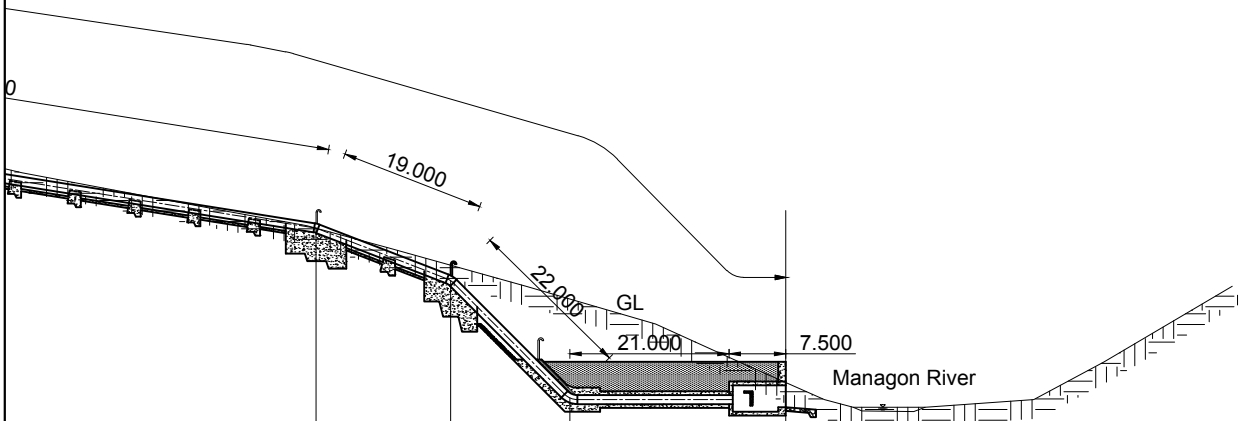
Kiso-Jiban Consultants Co.,Ltd

Ernst & Young Shin Nihon LLC



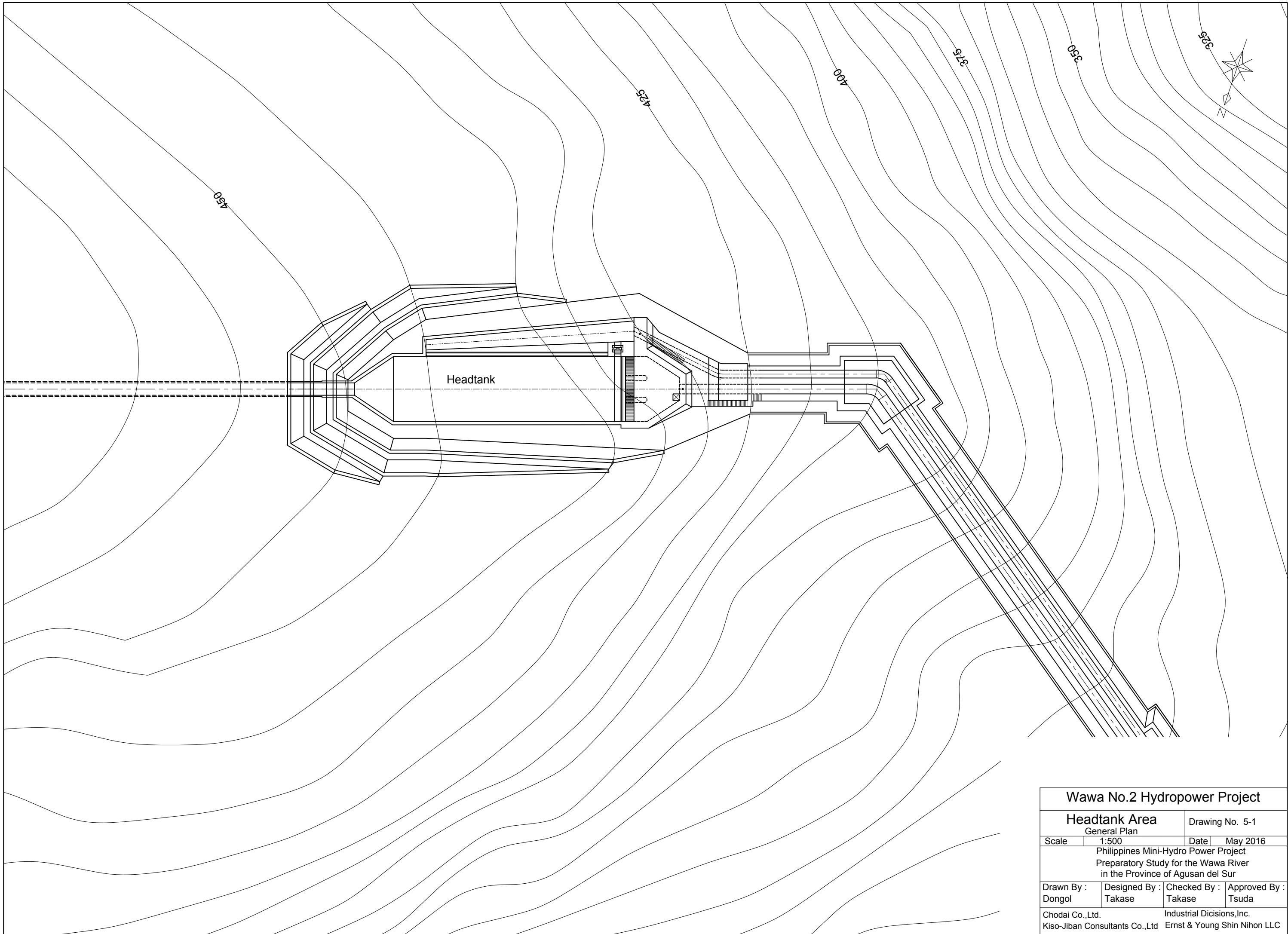


Slope	5.10°		30.00°		32.36°		32.36°		10.74°		9.03°	
Pipe Axis Elevation	430.100		428.800		413.940		368.83		324.540		309.210	
Horizontal Cumulative Length, m	0.000		15.000		40.000		111.000		181.000		262.000	
Point No.	BP-S		IP-S1		Ver. + Hor. Bend IP-S2		IP-S3		Ver. Bend IP-S4		Ver. + Hor. Bend IP-S5	

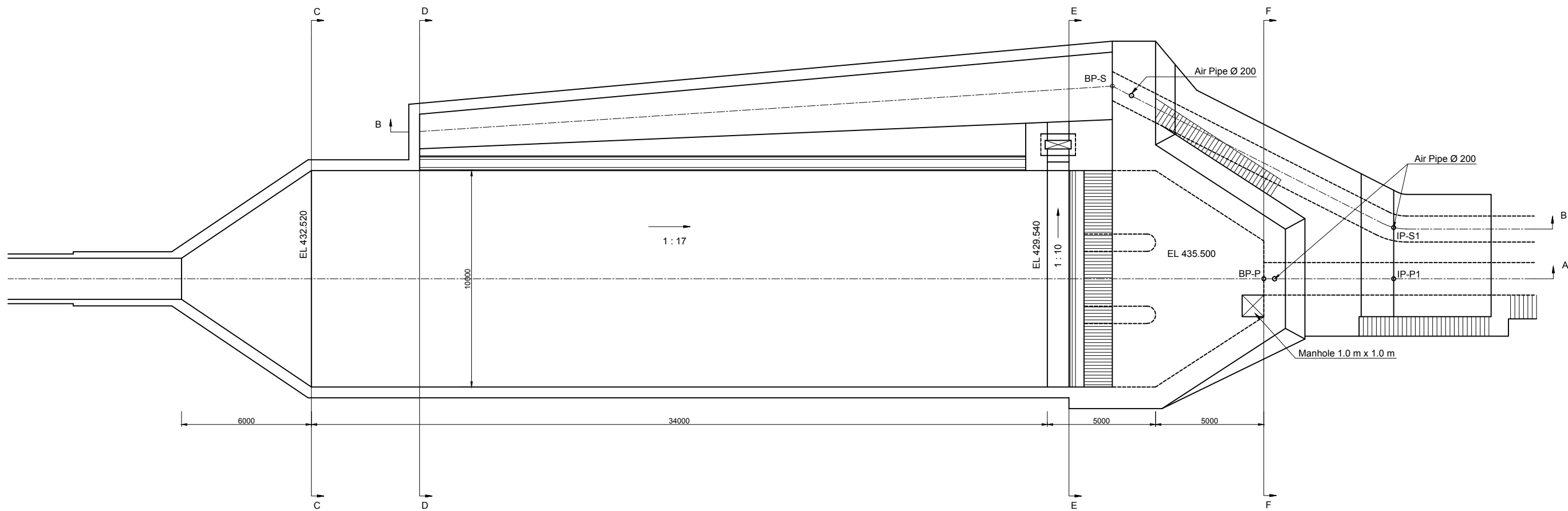


	21.17°	45.04°	0.00°	
	297.670	290.720	275.000	275.000
	335.000	352.000	368.000	390.000
				397.000
Ver. + Hor. Bend IP-S6		Ver. Bend IP-S7	Ver. Bend IP-S8	End-S EP

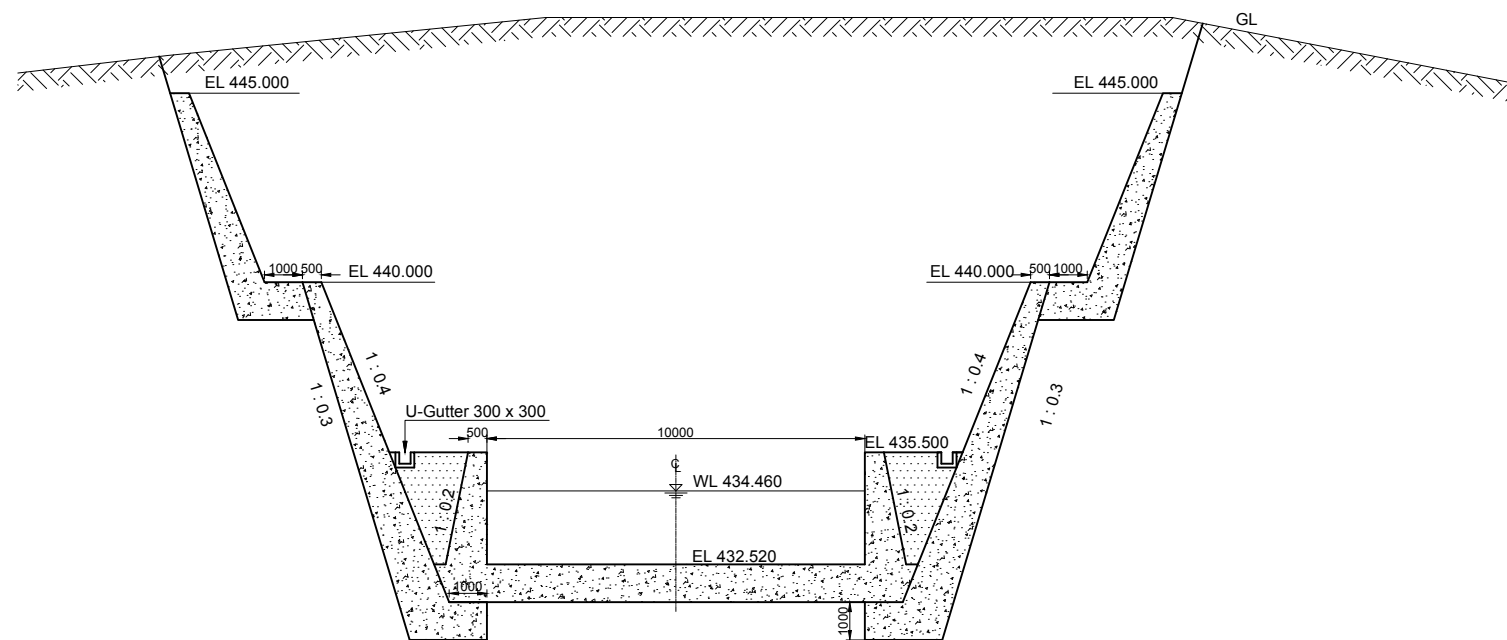
<b>Wawa No.2 Hydropower Project</b>			
<b>Penstock Area</b> Spillway Profile		Drawing No. 4-3	
Scale	1:1000	Date	May 2016
Philippines Mini-Hydro Power Project Preparatory Study for the Wawa River in the Province of Agusan del Sur			
Drawn By : Dongol	Designed By : Takase	Checked By : Takase	Approved By : Tsuda
Chodai Co.,Ltd.		Industrial Dicions, Inc.	
Kiso-Jiban Consultants Co.,Ltd		Ernst & Young Shin Nihon LLC	



<b>Wawa No.2 Hydropower Project</b>			
<b>Headtank Area</b>		Drawing No. 5-1	
General Plan			
Scale	1:500	Date	May 2016
Philippines Mini-Hydro Power Project			
Preparatory Study for the Wawa River			
in the Province of Agusan del Sur			
Drawn By :	Designed By :	Checked By :	Approved By :
Dongol	Takase	Takase	Tsuda
Chodai Co.,Ltd.		Industrial Dicions,Inc.	
Kiso-Jiban Consultants Co.,Ltd		Ernst & Young Shin Nihon LLC	

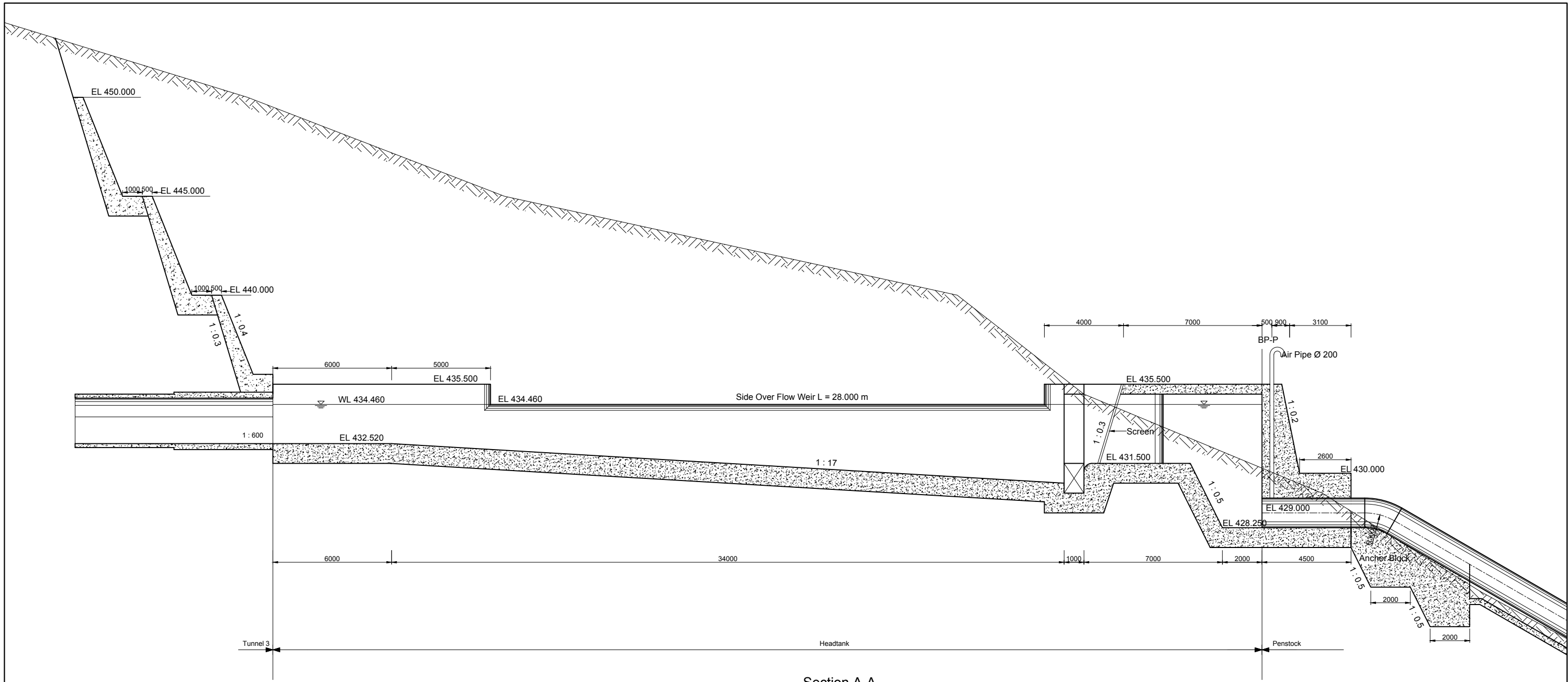


Headtank Plan

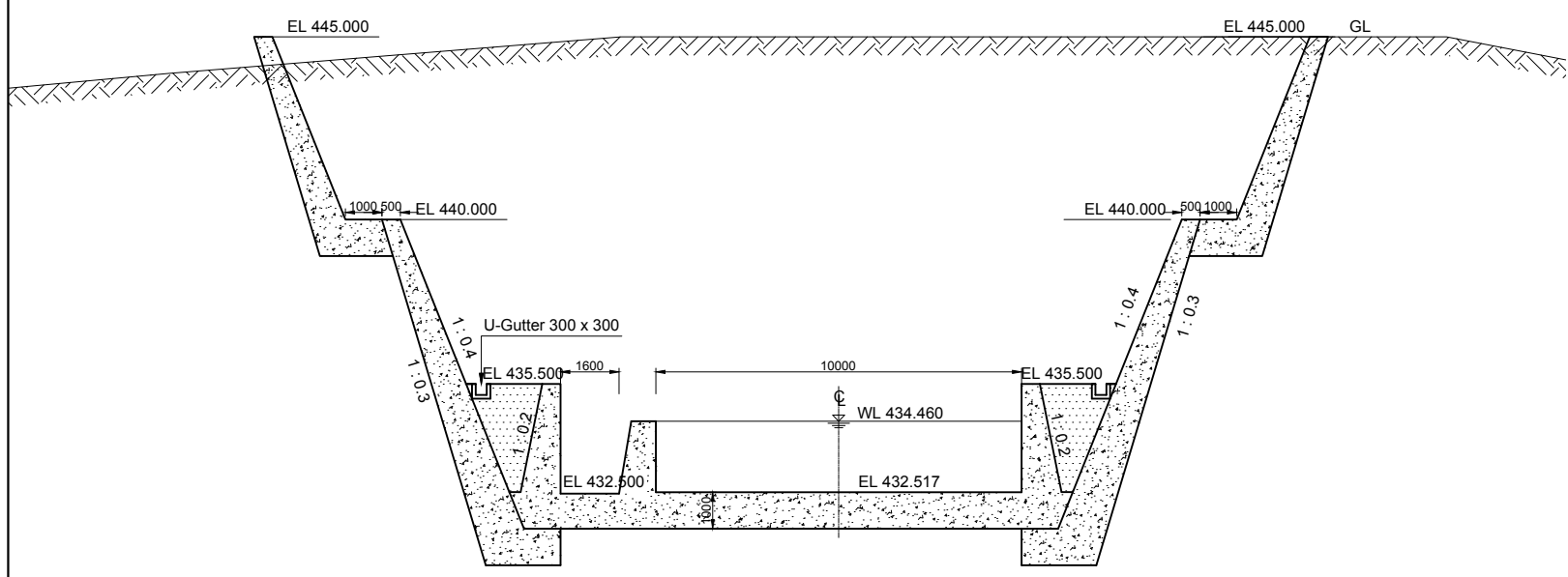


Section C-C

<b>Wawa No.2 Hydropower Project</b>			
<b>Headtank Area</b> Headtank & Spillway-1		Drawing No. 5-2	
Scale	1:200	Date	May 2016
Philippines Mini-Hydro Power Project Preparatory Study for the Wawa River in the Province of Agusan del Sur			
Drawn By :	Designed By :	Checked By :	Approved By :
Dongol	Takase	Takase	Tsuda
Chodai Co.,Ltd.		Industrial Dicions,Inc.	
Kiso-Jiban Consultants Co.,Ltd		Ernst & Young Shin Nihon LLC	

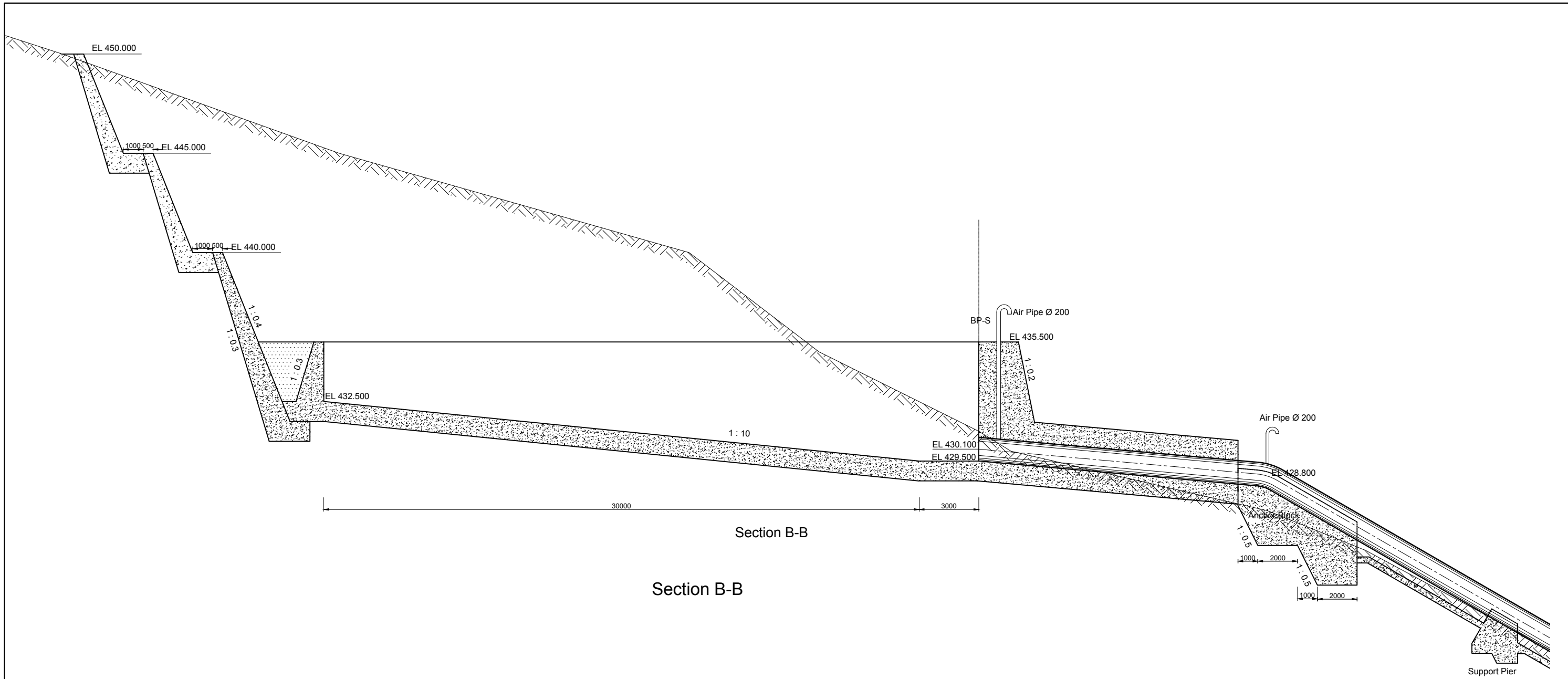


Section A-A

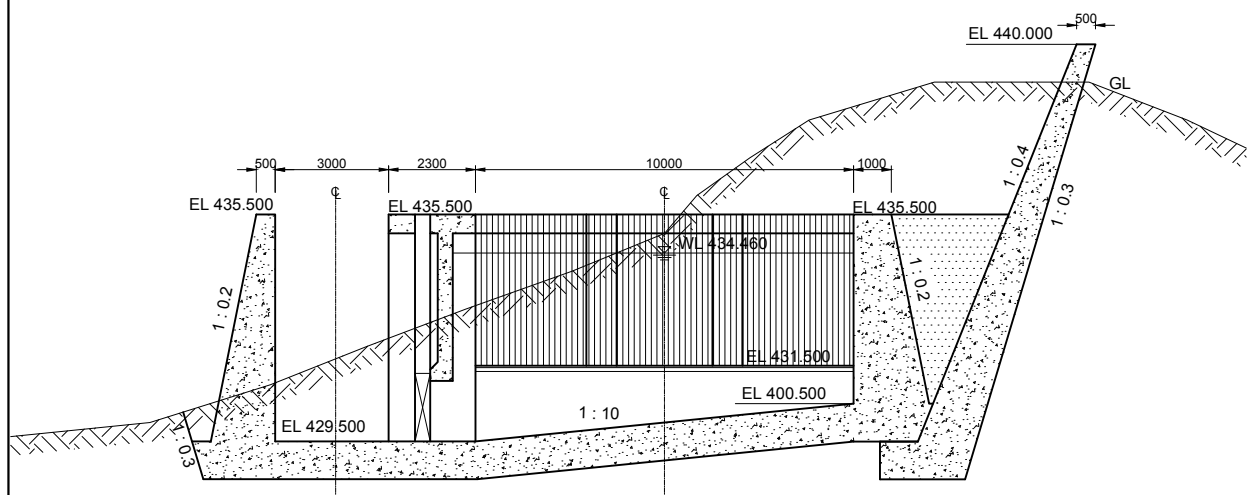


Section D-D

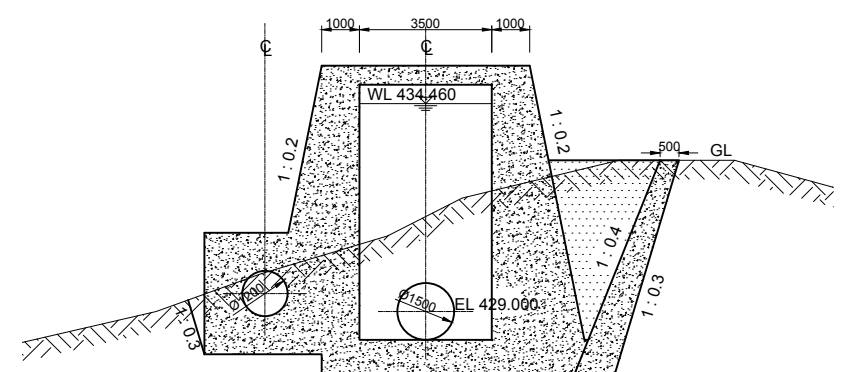
<b>Wawa No.2 Hydropower Project</b>			
<b>Headtank Area</b>		Drawing No. 5-3	
Headtank & Spillway		Date	May 2016
Scale	1:200	Philippines Mini-Hydro Power Project Preparatory Study for the Wawa River in the Province of Agusan del Sur	
Drawn By :	Designed By :	Checked By :	Approved By :
Dongol	Takase	Takase	Tsuda
Chodai Co.,Ltd.		Industrial Dicions,Inc.	
Kiso-Jiban Consultants Co.,Ltd		Ernst & Young Shin Nihon LLC	



Section B-B

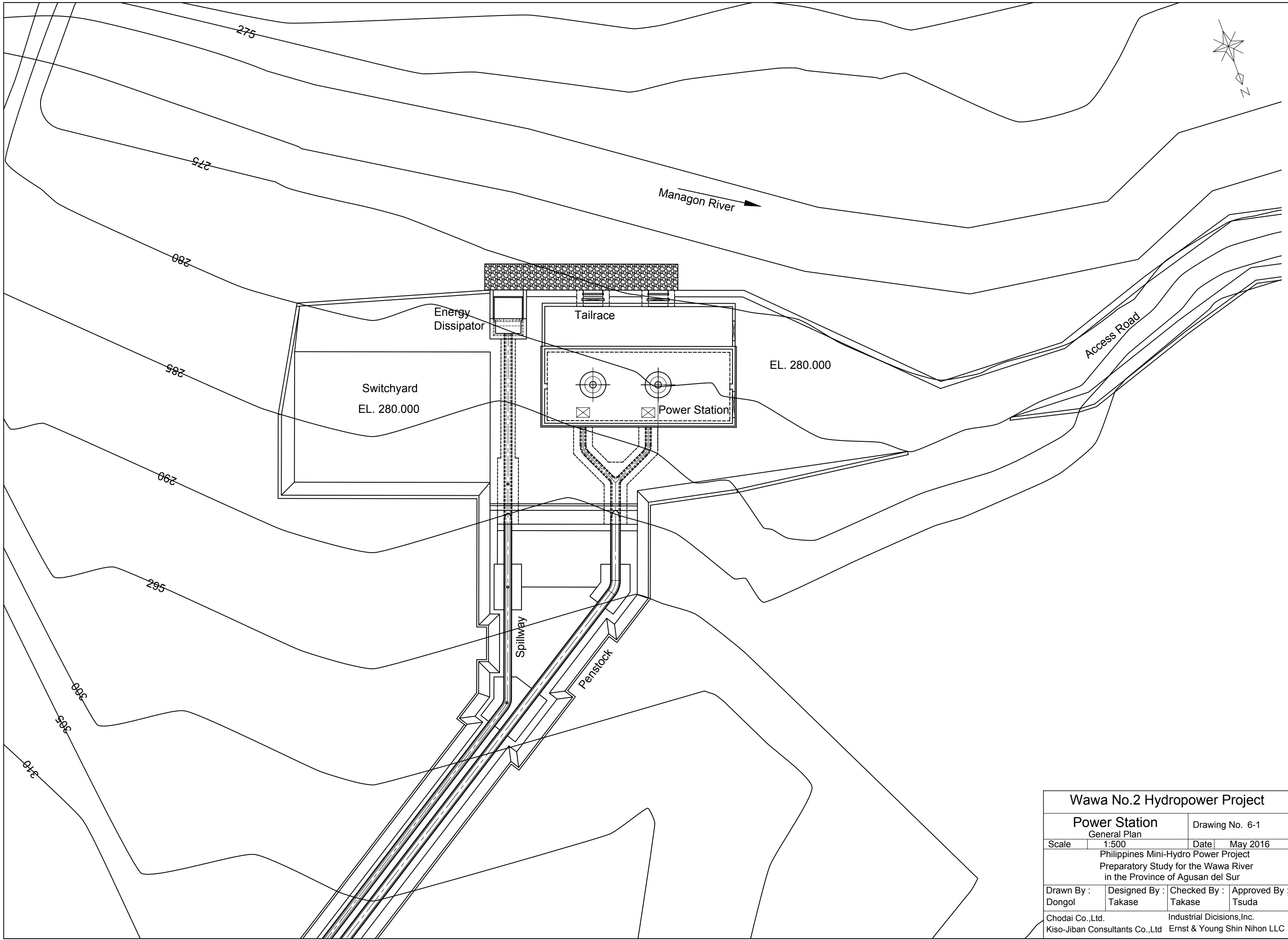


Section E-E

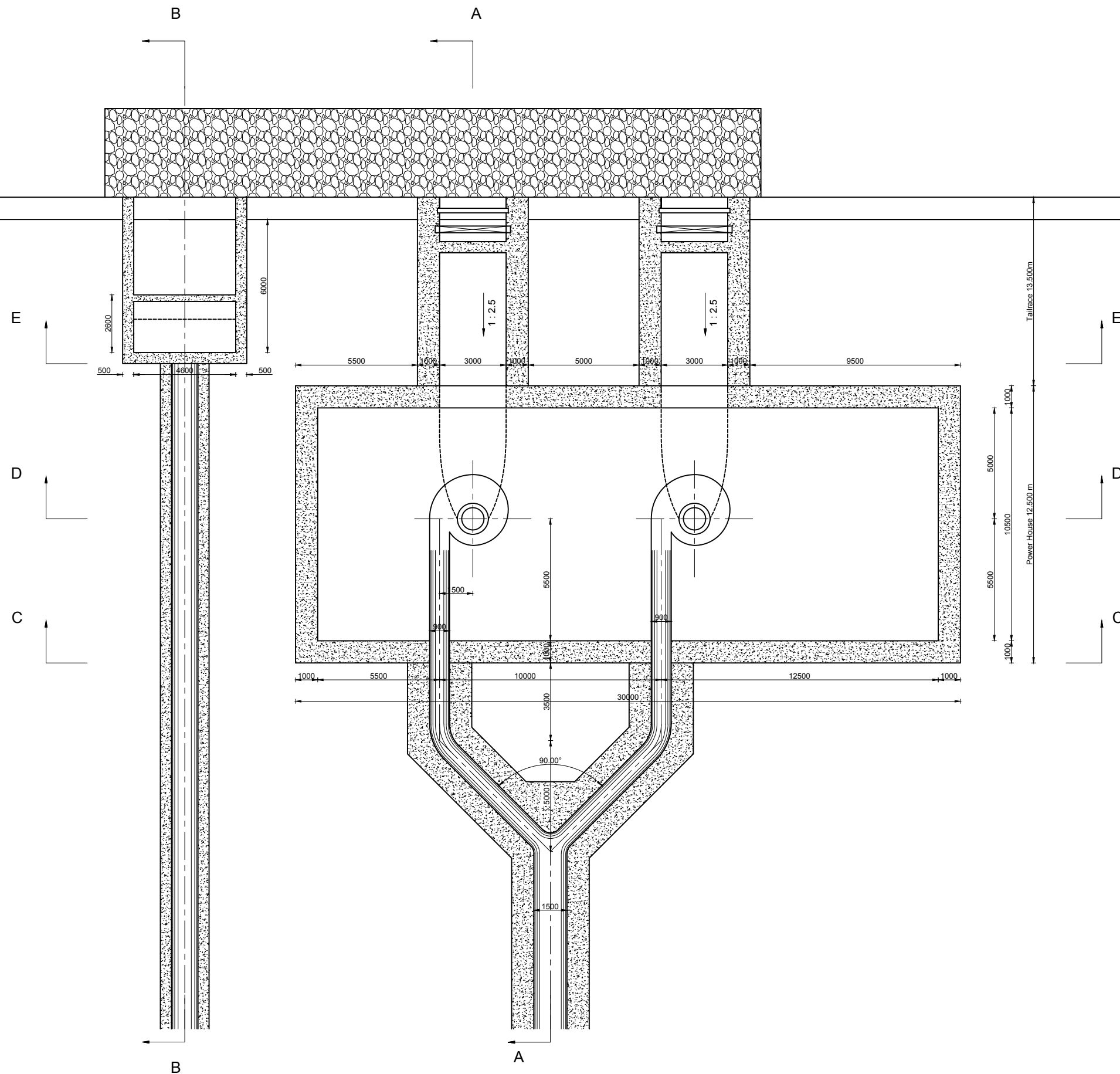


Section F-F

<b>Wawa No.2 Hydropower Project</b>			
<b>Headtank Area</b> Headtank & Spillway-3		Drawing No. 5-4	
Scale	1:200	Date	May 2016
Philippines Mini-Hydro Power Project Preparatory Study for the Wawa River in the Province of Agusan del Sur			
Drawn By :	Designed By :	Checked By :	Approved By :
Dongol	Takase	Takase	Tsuda
Chodai Co.,Ltd.		Industrial Dicions,Inc.	
Kiso-Jiban Consultants Co.,Ltd		Ernst & Young Shin Nihon LLC	



<b>Wawa No.2 Hydropower Project</b>			
<b>Power Station</b> General Plan		Drawing No. 6-1	
Scale	1:500	Date	May 2016
Philippines Mini-Hydro Power Project Preparatory Study for the Wawa River in the Province of Agusan del Sur			
Drawn By :	Designed By :	Checked By :	Approved By :
Dongol	Takase	Takase	Tsuda
Chodai Co.,Ltd.		Industrial Dicions,Inc.	
Kiso-Jiban Consultants Co.,Ltd		Ernst & Young Shin Nihon LLC	



**Wawa No.2 Hydropower Project**

**Power Station**  
Plan EL 275.000

Drawing No. 6-2

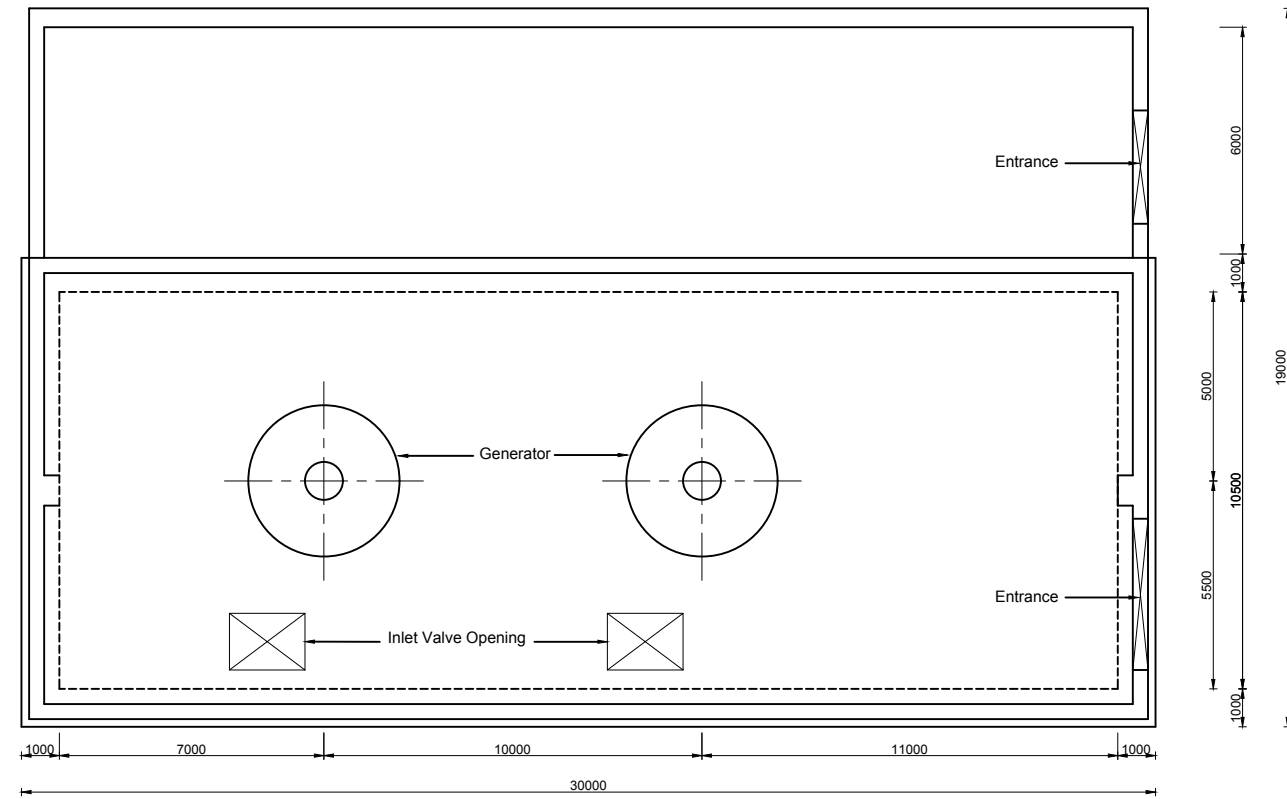
Scale 1:200 Date May 2016

Philippines Mini-Hydro Power Project  
Preparatory Study for the Wawa River  
in the Province of Agusan del Sur

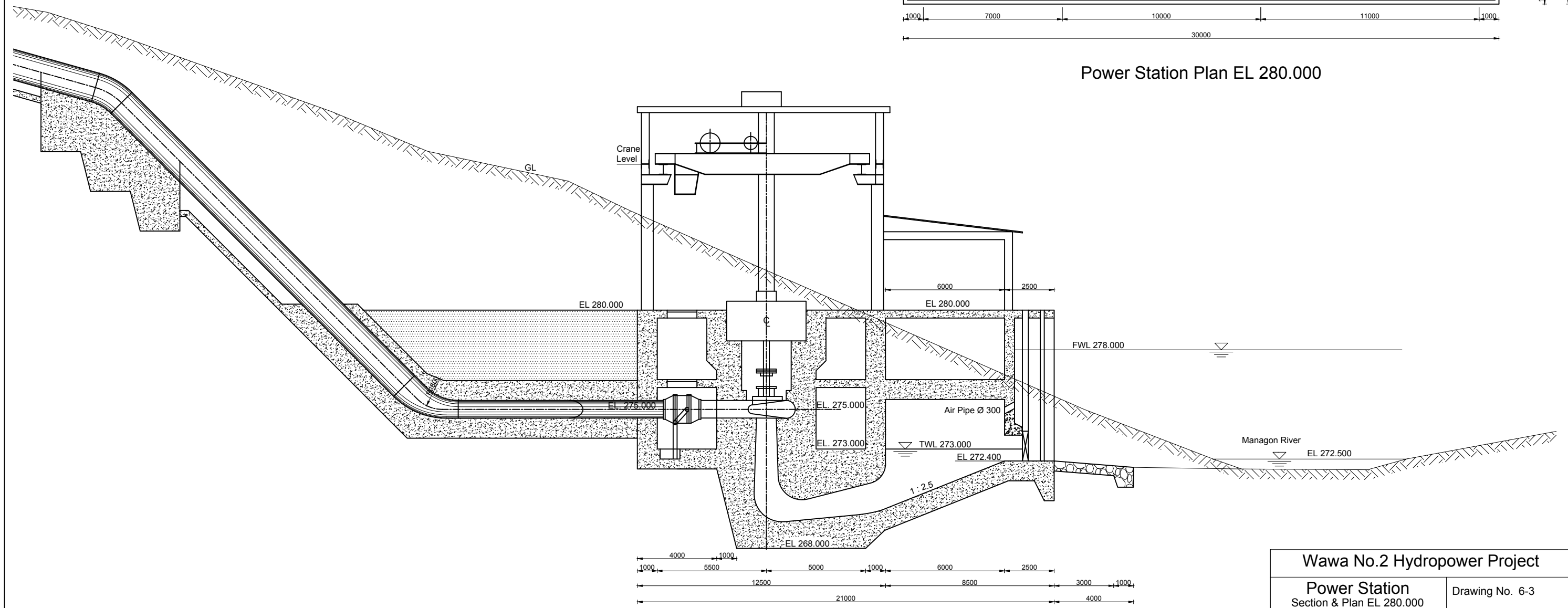
Drawn By : Dongol	Designed By : Takase	Checked By : Takase	Approved By : Tsuda
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Chodai Co.,Ltd. Kiso-Jiban Consultants Co.,Ltd	Industrial Dicions,Inc. Ernst & Young Shin Nihon LLC
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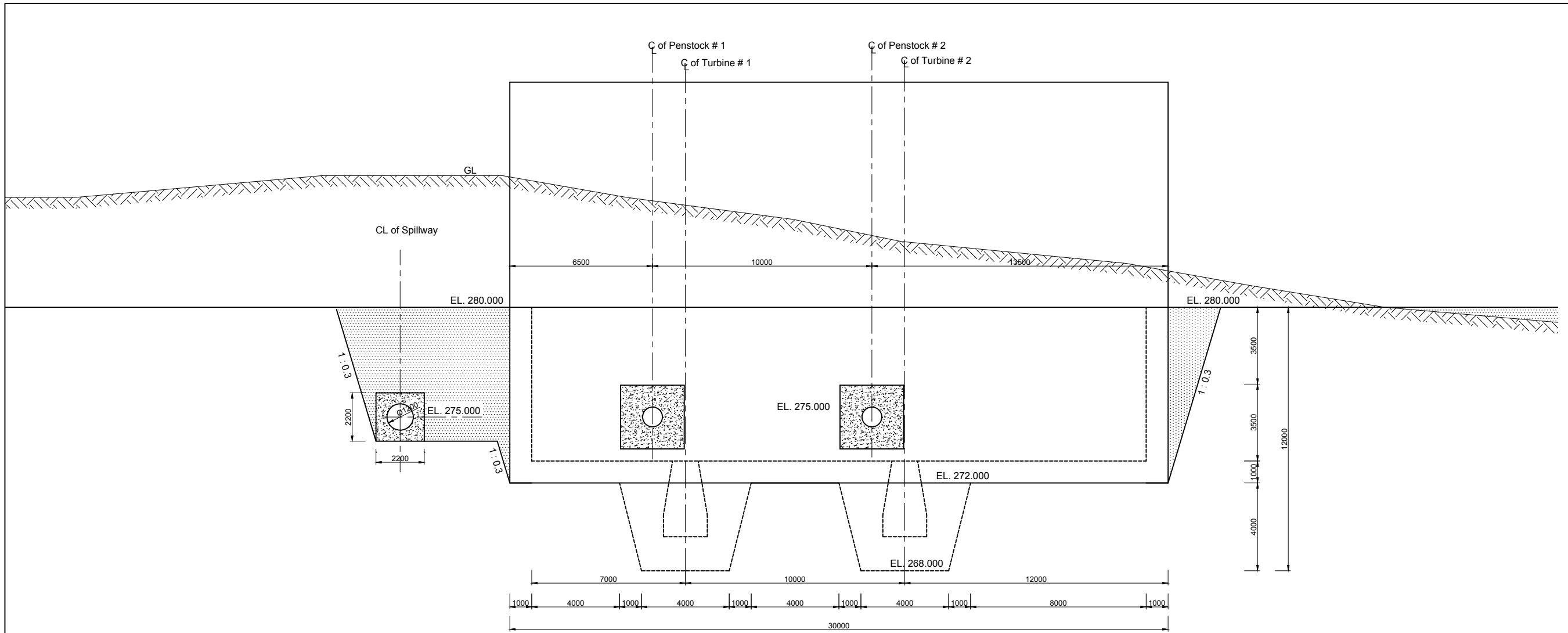


Power Station Plan EL 280.000

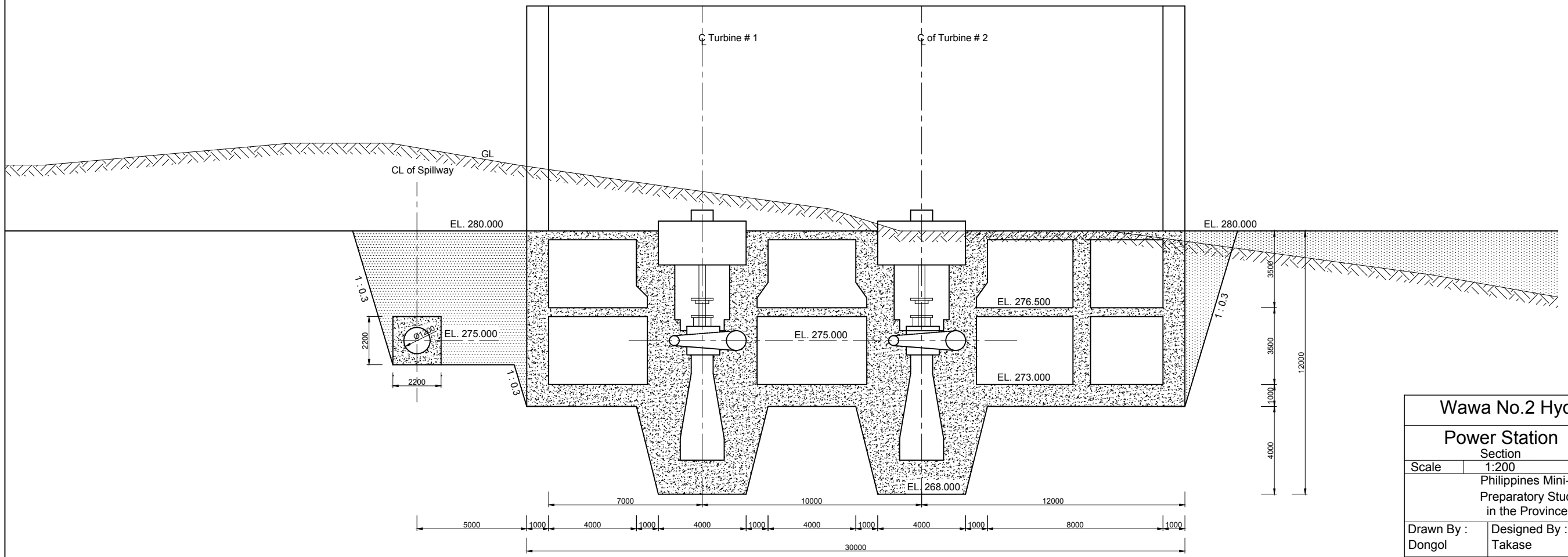


Section A-A

<b>Wawa No.2 Hydropower Project</b>			
<b>Power Station</b>		Drawing No. 6-3	
Section & Plan EL 280.000		Date May 2016	
Scale	1:200	Date	May 2016
Philippines Mini-Hydro Power Project Preparatory Study for the Wawa River in the Province of Agusan del Sur			
Drawn By :	Designed By :	Checked By :	Approved By :
Dongol	Takase	Takase	Tsuda
Chodai Co.,Ltd.		Industrial Dicions,Inc.	
Kiso-Jiban Consultants Co.,Ltd		Ernst & Young Shin Nihon LLC	

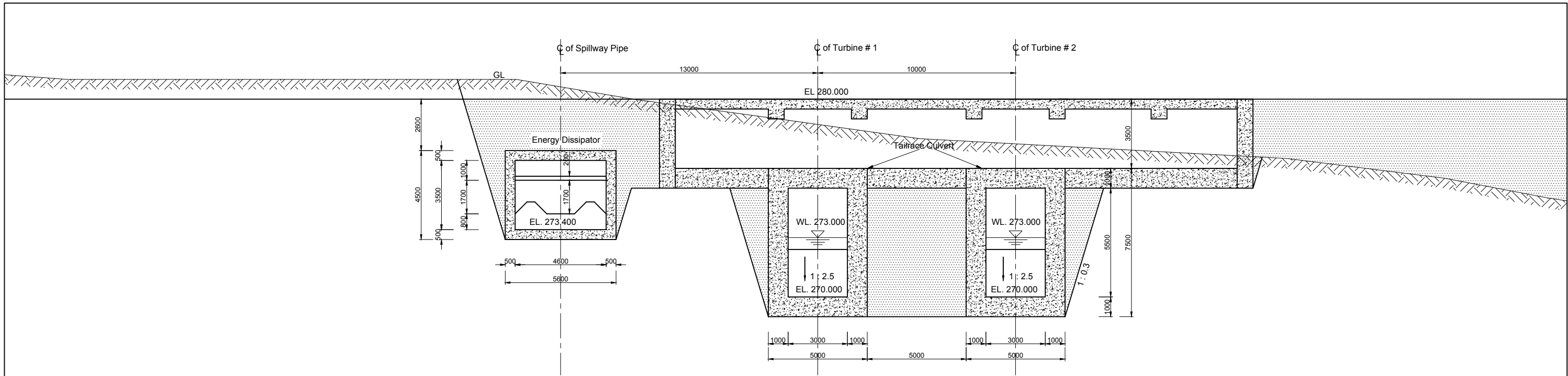


Section C-C

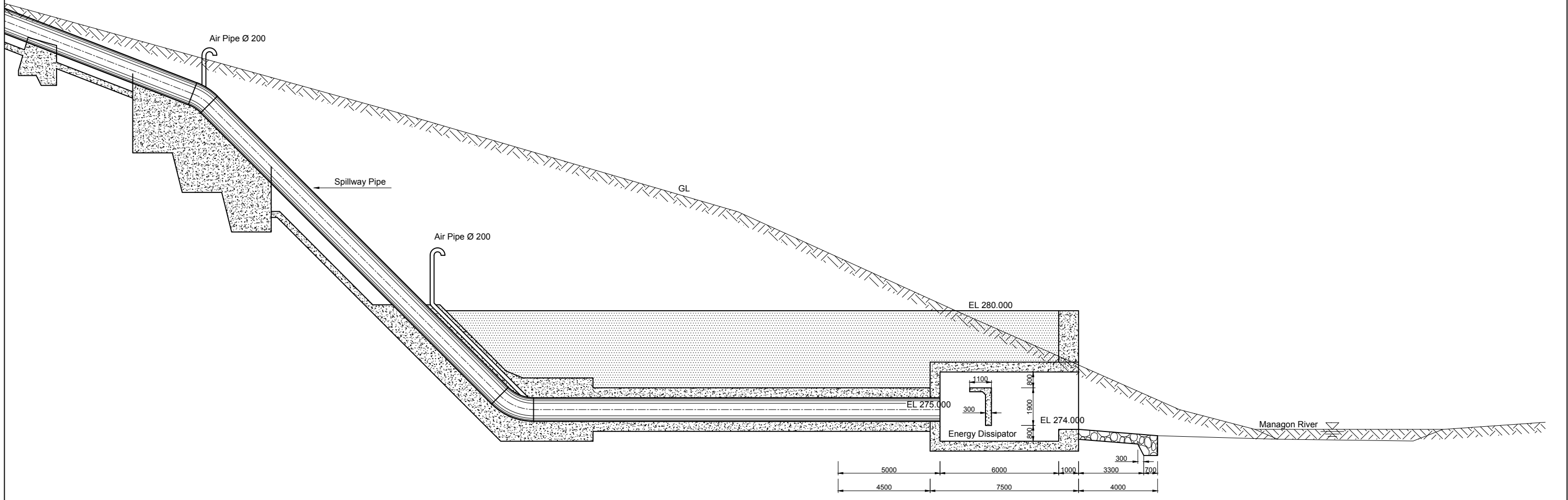


Section D-D

<b>Wawa No.2 Hydropower Project</b>			
<b>Power Station</b>		Drawing No. 6-4	
Section		Date	
Scale	1:200	May	2016
Philippines Mini-Hydro Power Project Preparatory Study for the Wawa River in the Province of Agusan del Sur			
Drawn By :	Designed By :	Checked By :	Approved By :
Dongol	Takase	Takase	Tsuda
Chodai Co.,Ltd.		Industrial Dicions,Inc.	
Kiso-Jiban Consultants Co.,Ltd		Ernst & Young Shin Nihon LLC	



Section E-E



Section B-B

<b>Wawa No.2 Hydropower Project</b>			
<b>Power Station</b>		Drawing No. 6-5	
Tailrace & Energy Dissipator		Date May 2016	
Scale	1:200	Date	May 2016
Philippines Mini-Hydro Power Project Preparatory Study for the Wawa River in the Province of Agusan del Sur			
Drawn By :	Designed By :	Checked By :	Approved By :
Dongol	Takase	Takase	Tsuda
Chodai Co.,Ltd.		Industrial Dicions,Inc.	
Kiso-Jiban Consultants Co.,Ltd		Ernst & Young Shin Nihon LLC	