

Dec 11th, 11:20 AM - 12:40 PM

Modification of Navigation Locks for upstream fish migration

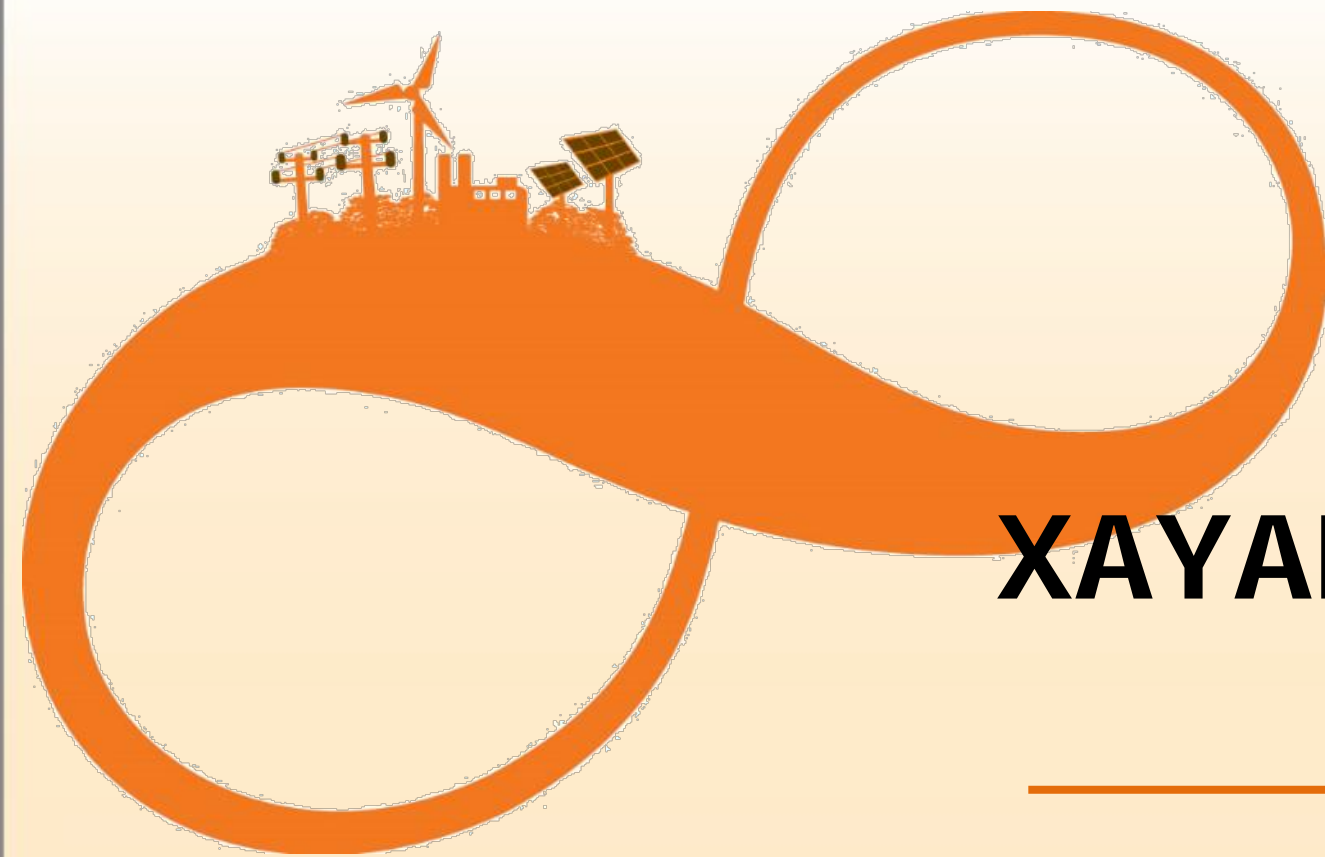
Thanasak Poomchaivej
CK Power Company Limited

Jedniti Supachokepanich
Xayaburi Power Company Limited

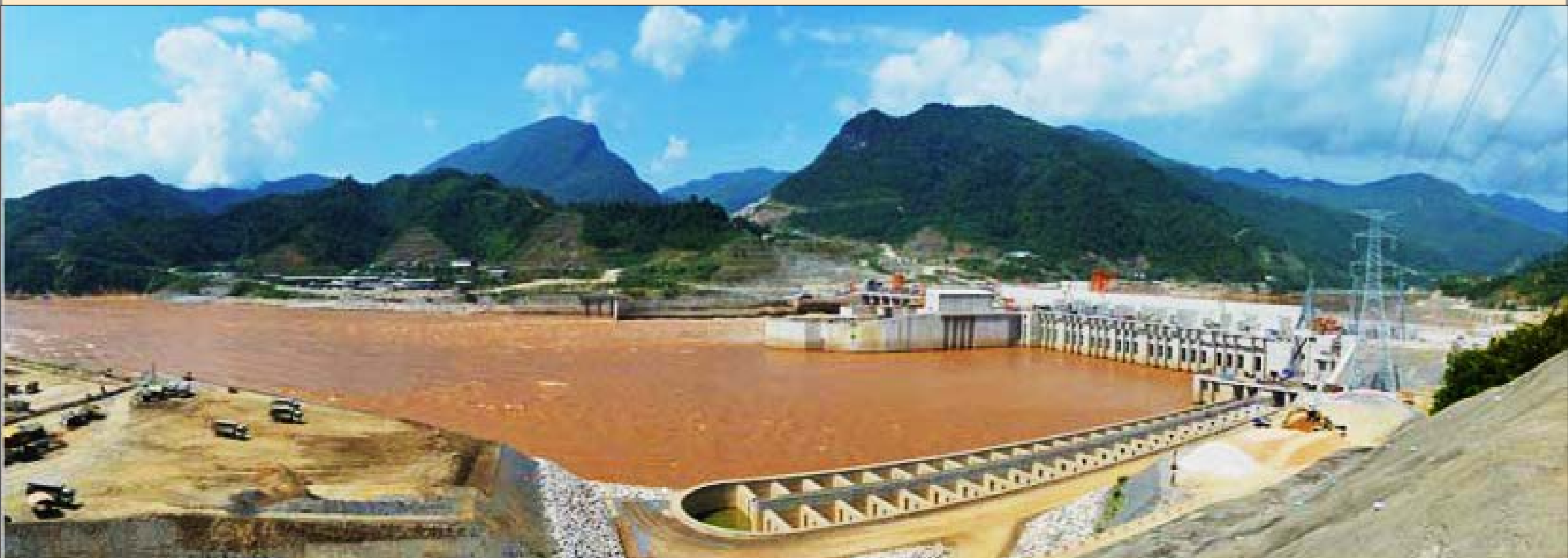
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Poomchaivej, Thanasak and Supachokepanich, Jedniti, "Modification of Navigation Locks for upstream fish migration" (2018).
International Conference on Engineering and Ecohydrology for Fish Passage. 5.
https://scholarworks.umass.edu/fishpassage_conference/2018/December11/5

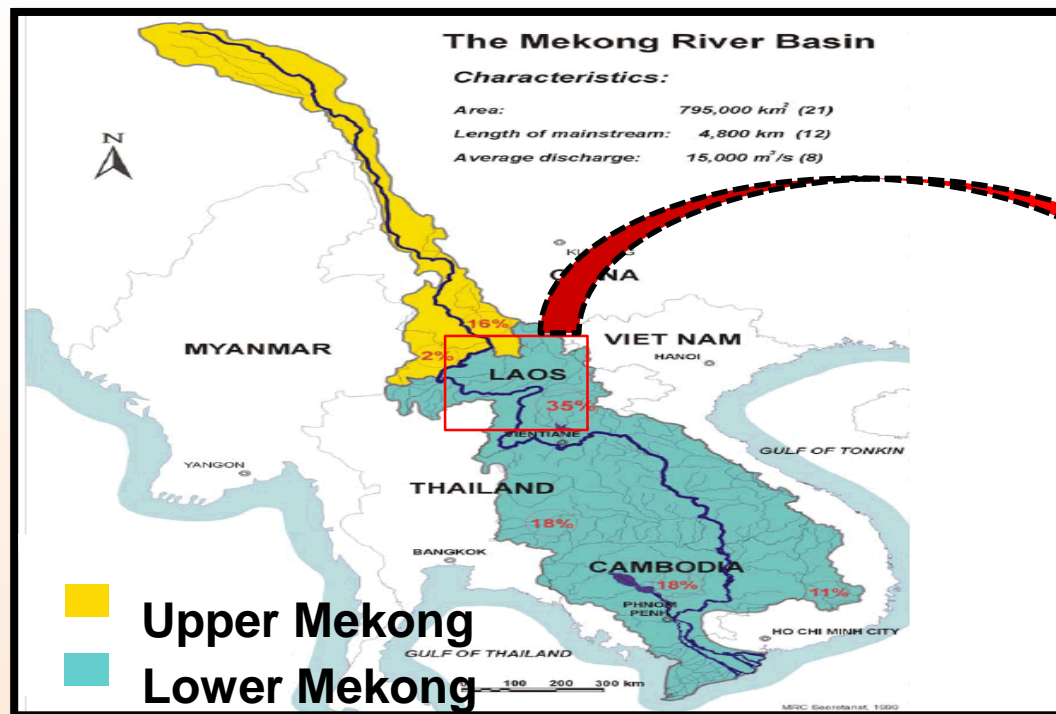
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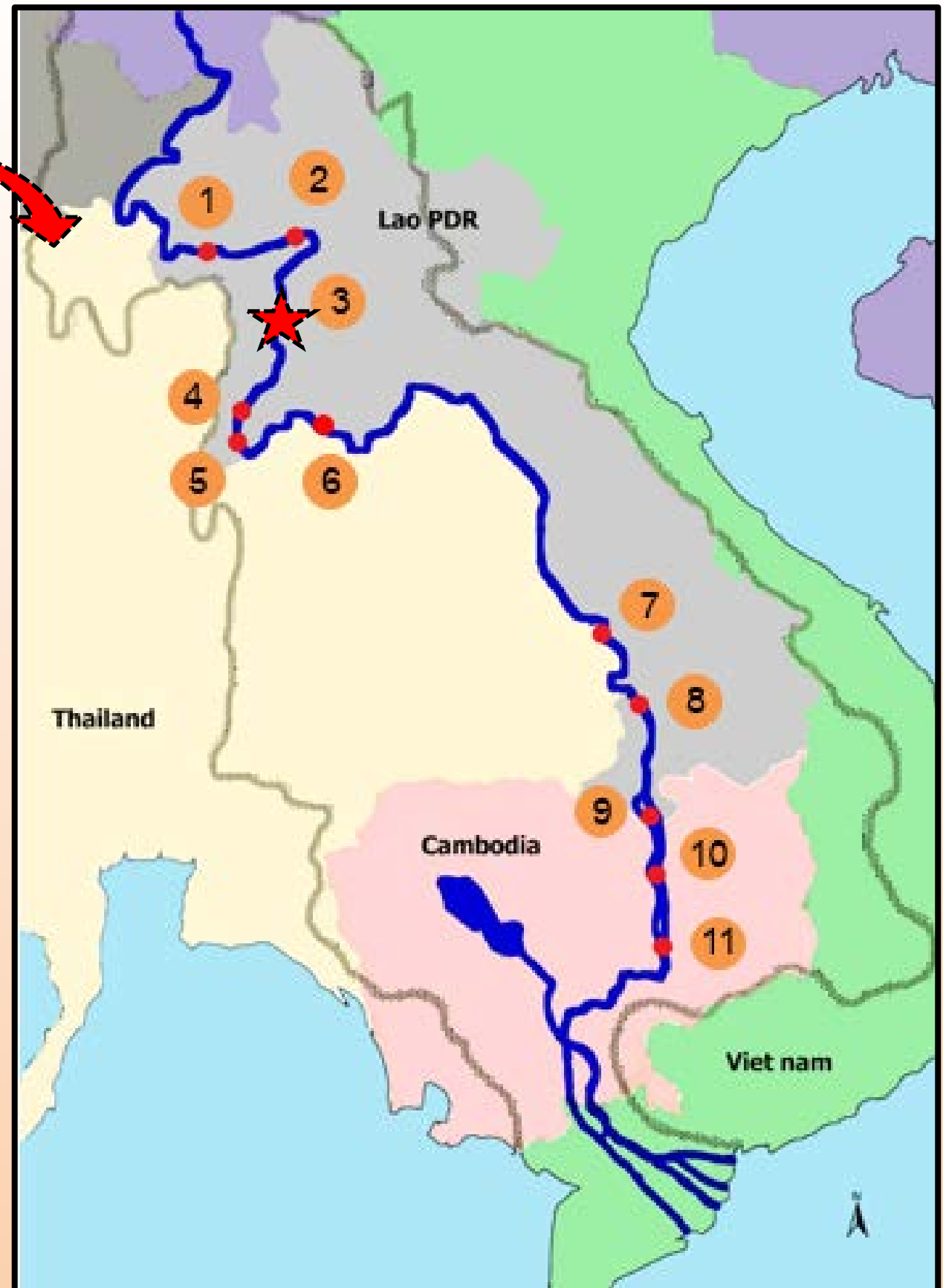
XAYABURI HYDROELECTRIC POWER PROJECT



Project Location



1. Pak beng	1,230 MW
2. Luang Prabang	1,410 MW
3. Xayaburi	1,285 MW
4. Pak Lay	1,320 MW
5. Sanakham	570 MW
6. Pak Chom	1,079 MW
7. Ban Khoum	2,000 MW
8. Lat Sua	800 MW
9. Don Sahong	360 MW
10. Stung Treng	980 MW
11. Sambor	460 MW
Total	10,394 MW





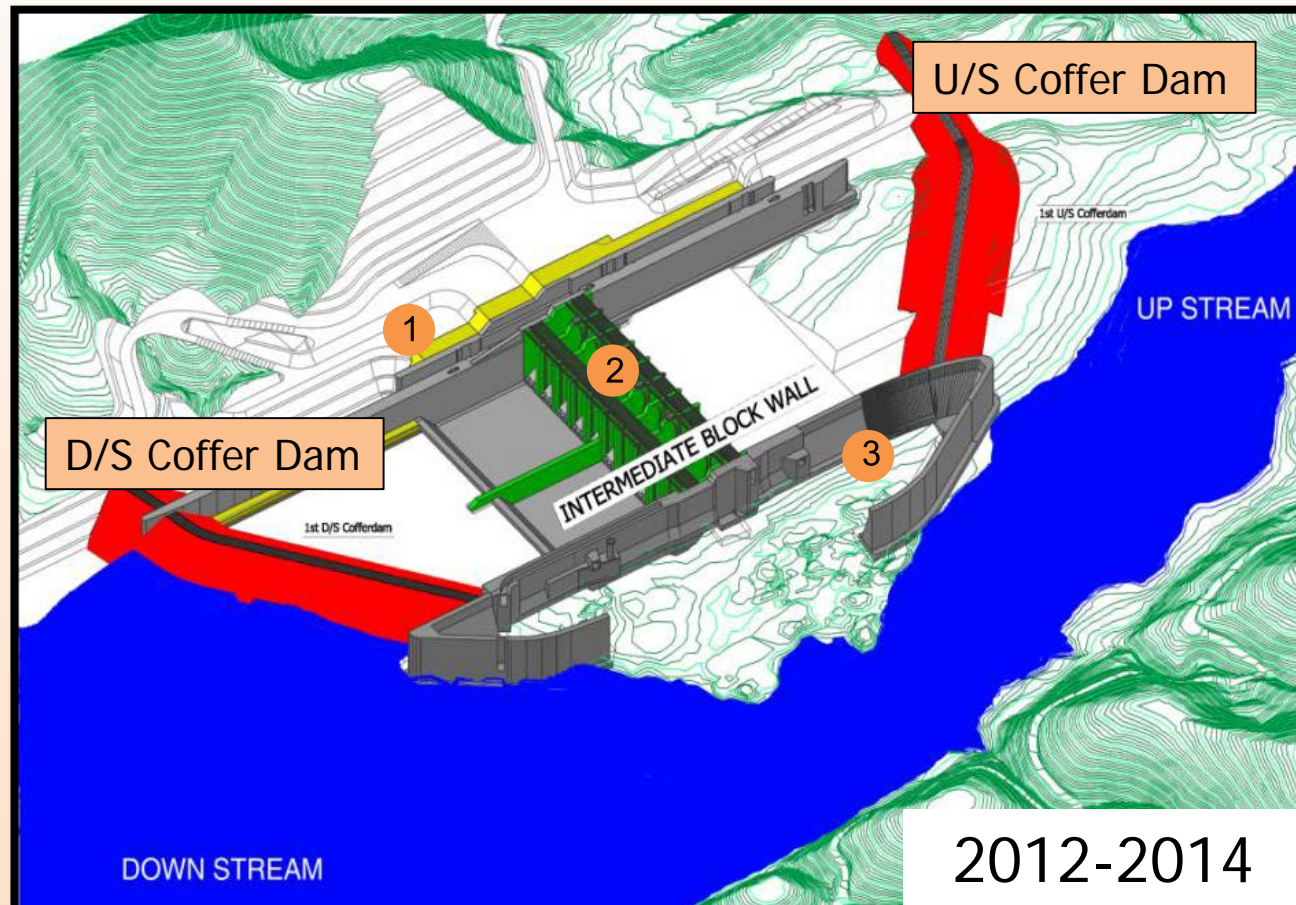
Xayaburi Project Features



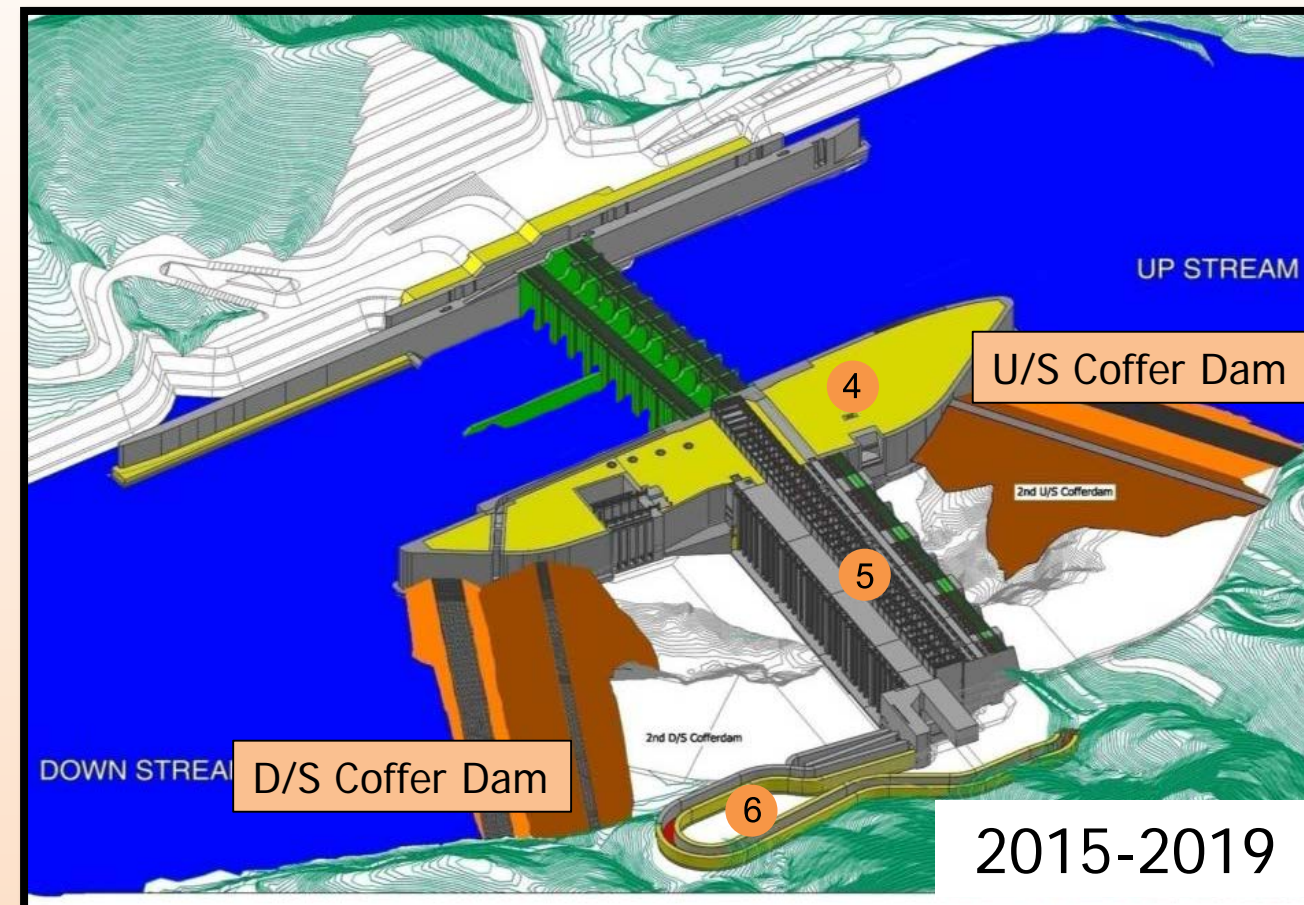
Component	Features
1. Navigation Lock	144 + 154 m length 12 m width for 500 tons ship
2. Spillway	7 Surface gates (19 m x 21 m) + 4 Low Level Outlets for Sediment (12 m x 16 m)
3. Intermediate Block	Fish pumps and passage + Powerhouse Erection Bay
4. Powerhouse	7 x 175 MW (EGAT) + 1 x 60 MW (EdL)
5. Fish Passage	Multi – system , U/S + D/S migration

Project Construction Phase

1st Phase



2nd Phase



Navigation Lock

Spillway

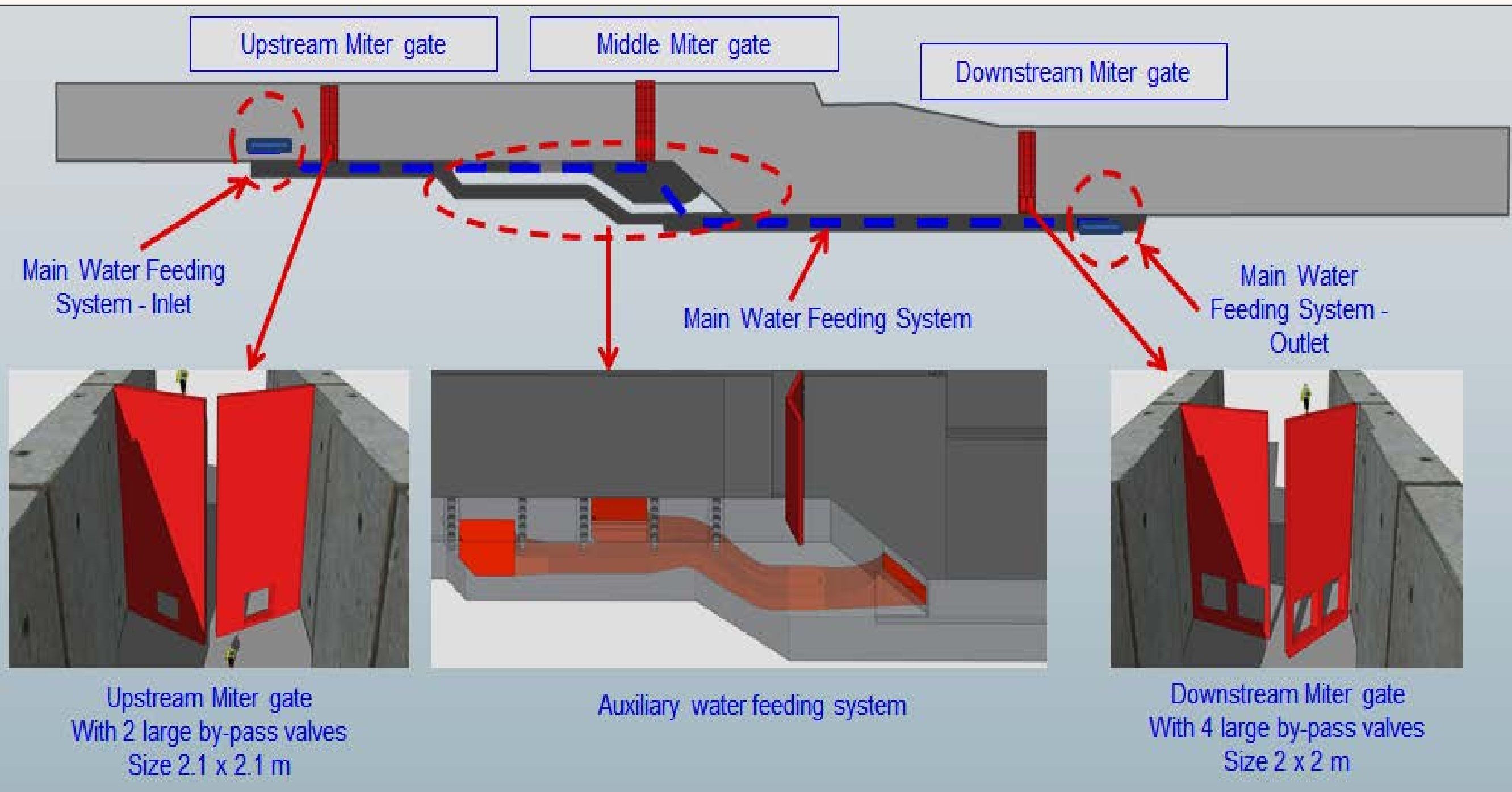
Intermediate Block Wall

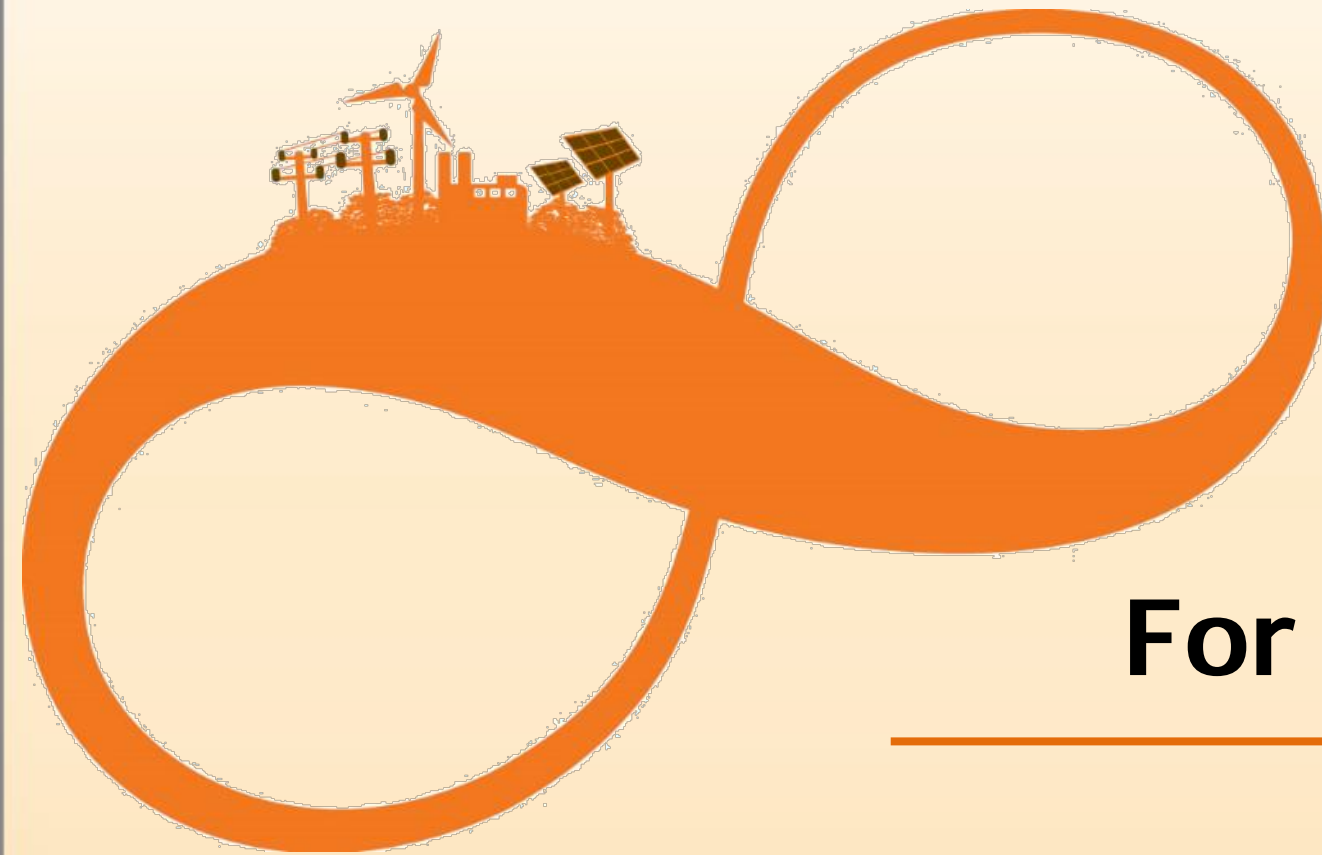
Intermediate Block

Powerhouse

Fish Passage Facility

Modification of Navigation Locks





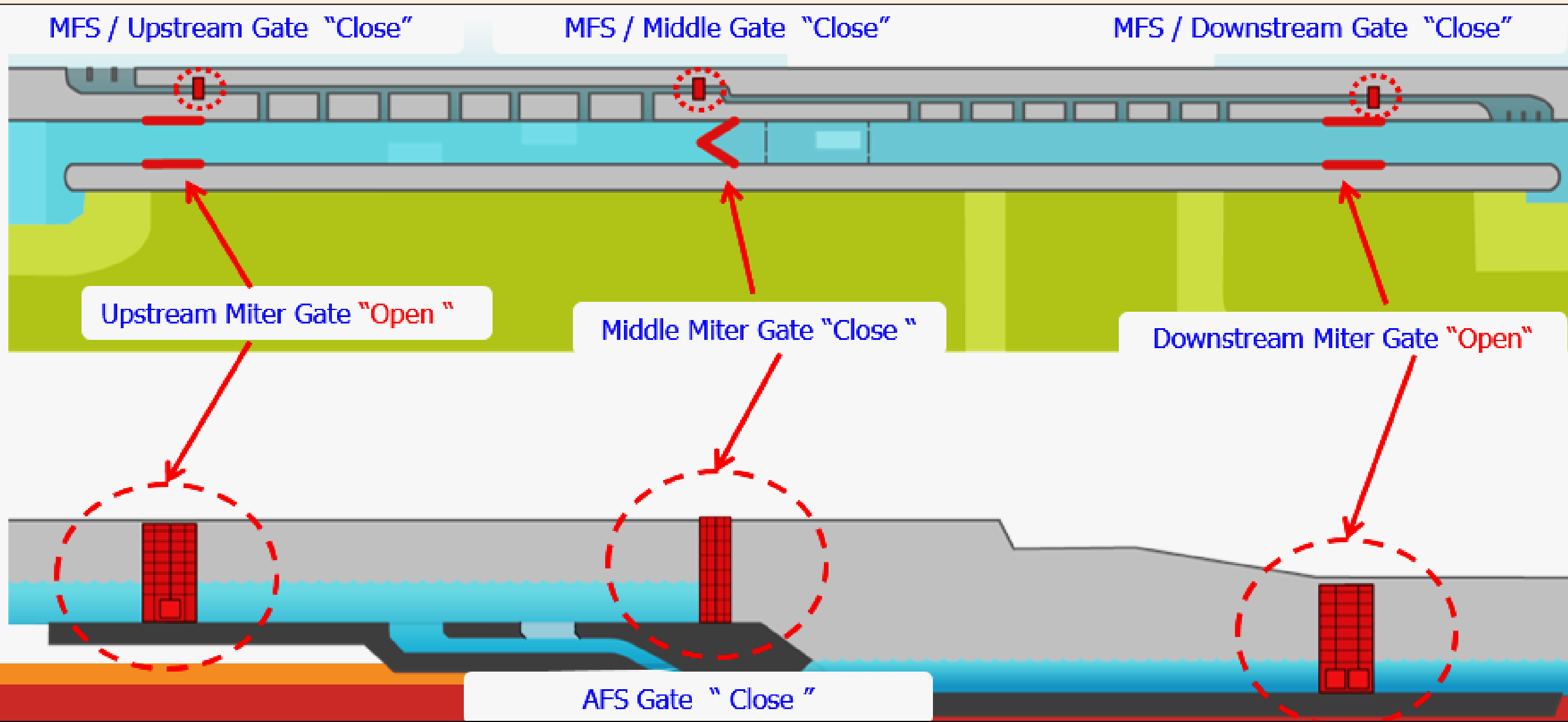
Operation Procedures For Upstream Fish Migration

1. Attraction Fish Phrase
2. Upstream passage
3. Fish upstream migration

Operation Procedure

- **Initial Condition**

- Water level in the upper lock is equal to the upstream water level, the upstream miter gate is opened.
- Middle miter gate is closed.
- Water level in the lower lock is equal to the downstream river water level, the downstream miter gate is opened.
- All gates of the Main Feeding and AFS System are closed.

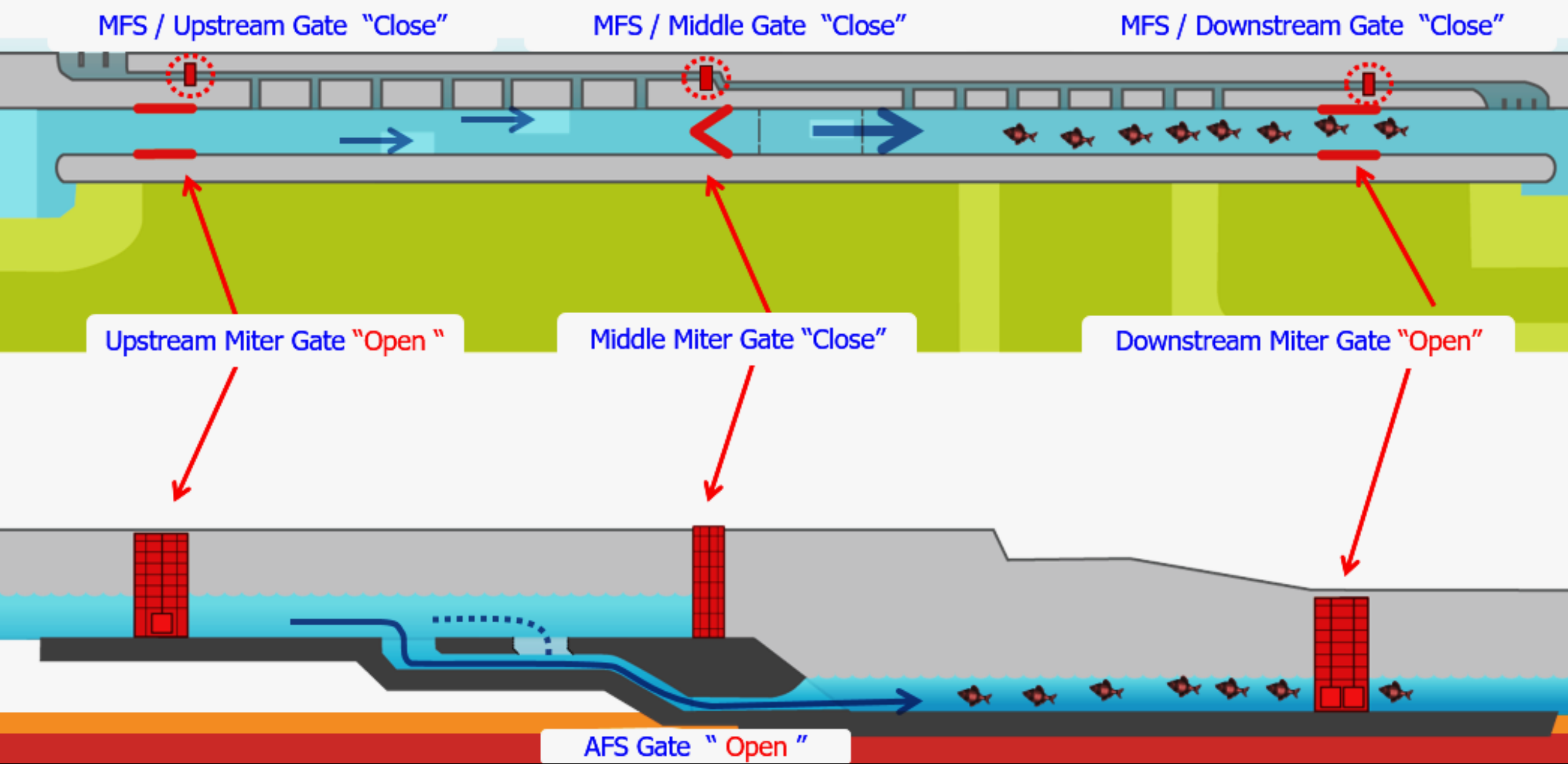


Operation Procedure

- **Attraction Fish Period**

- Open the gates of the Auxiliary Feeding System.

“This creates an attraction flow in the lower lock, attracting fish towards entering the downstream approach channel and into the lower lock chamber.”



Operation Procedure

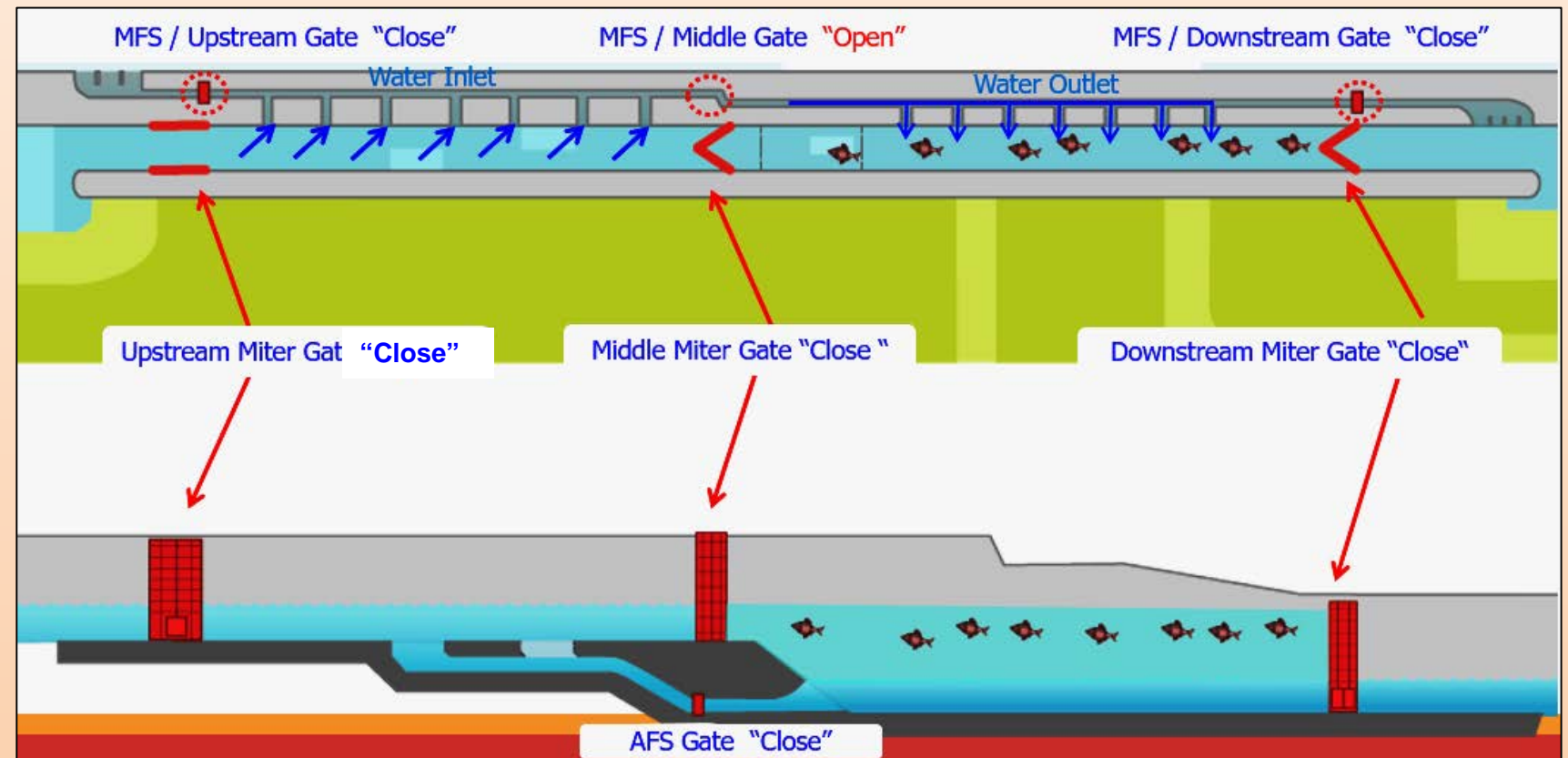
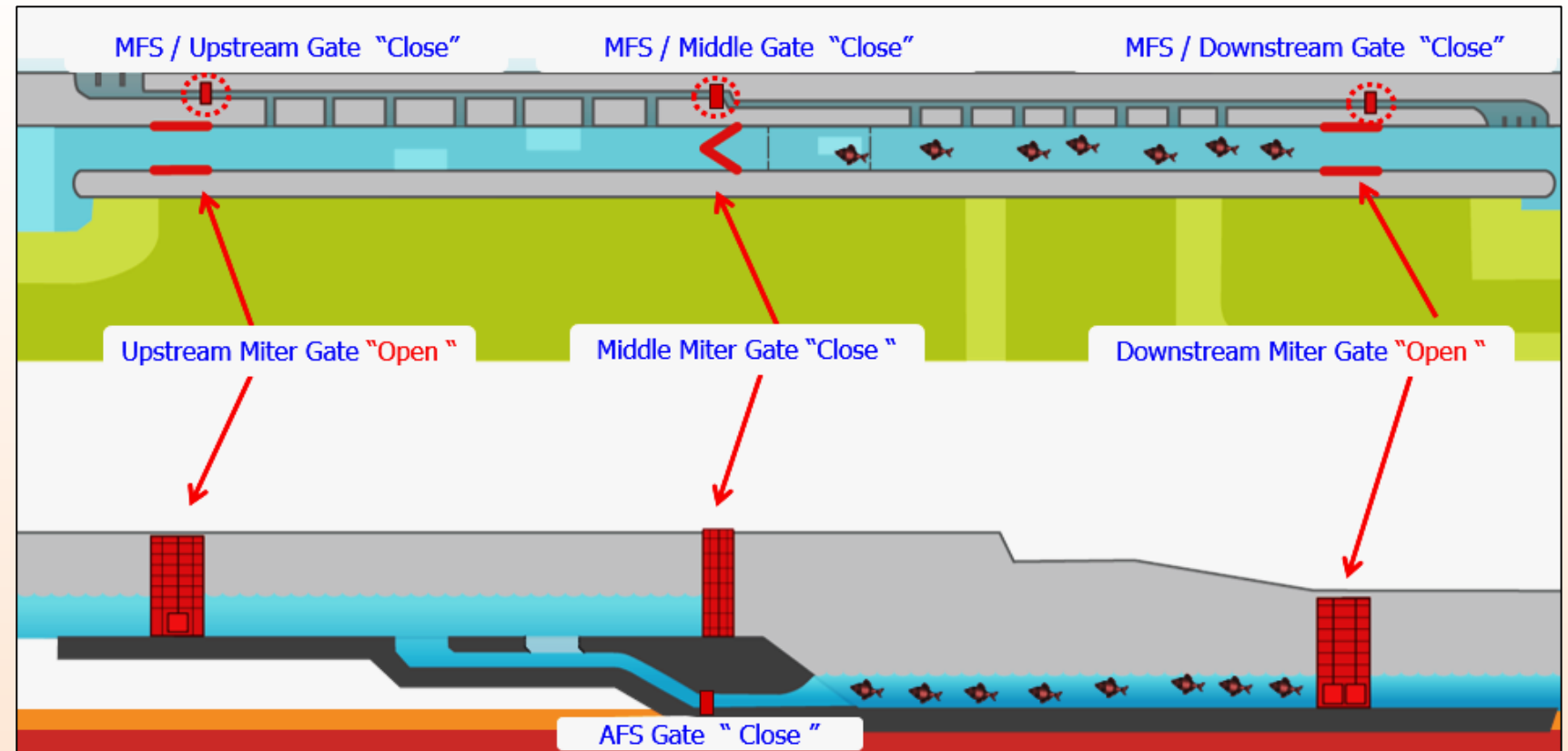
• Upstream Passage

1st Step

- Close the central gate of the Additional Feeding System

2nd Step

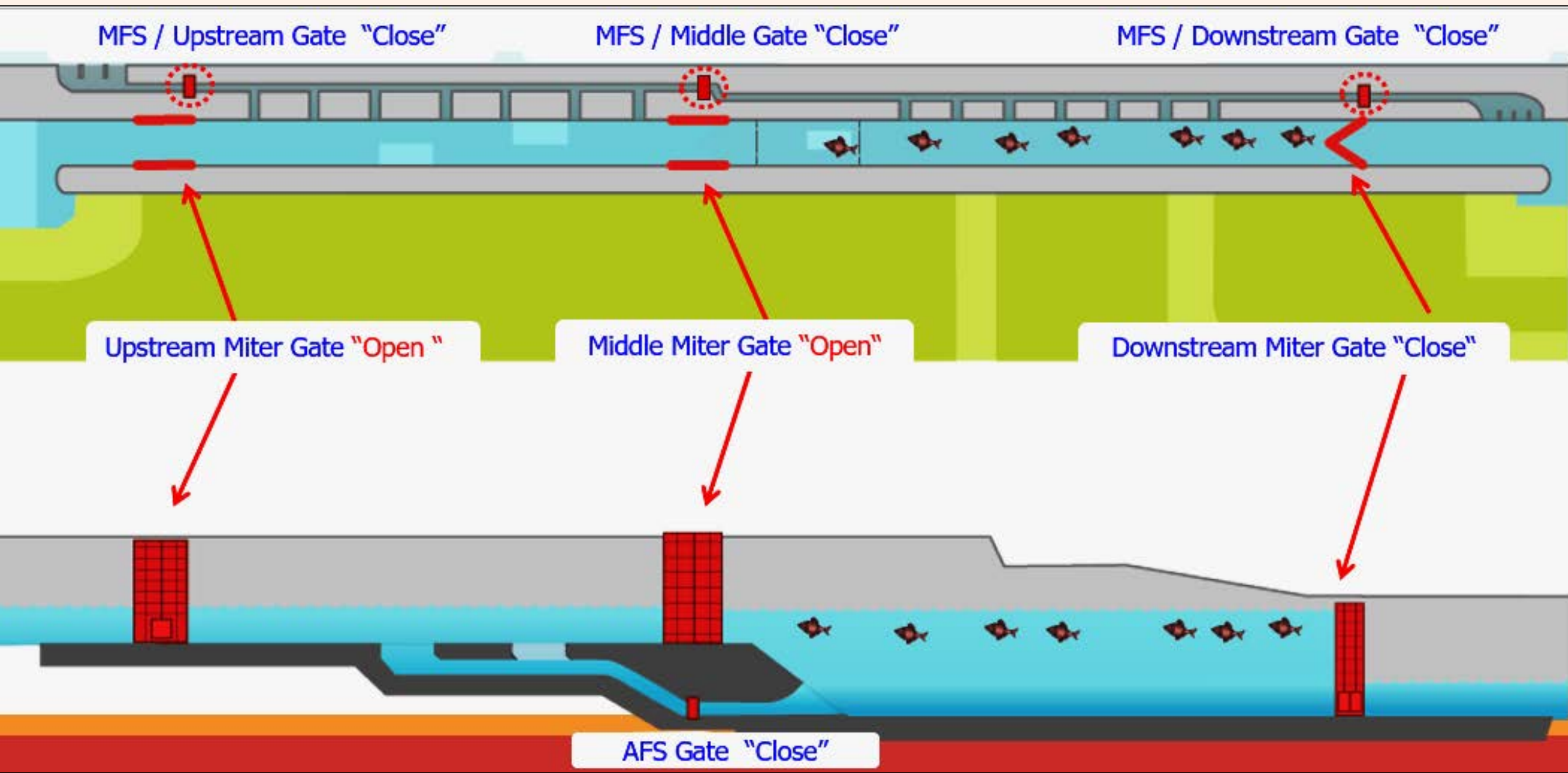
- Close downstream miter gate
- Open the central gate of the Main Feeding System for balance water level between two lock



Operation Procedure

- Upstream Passage
3rd Step

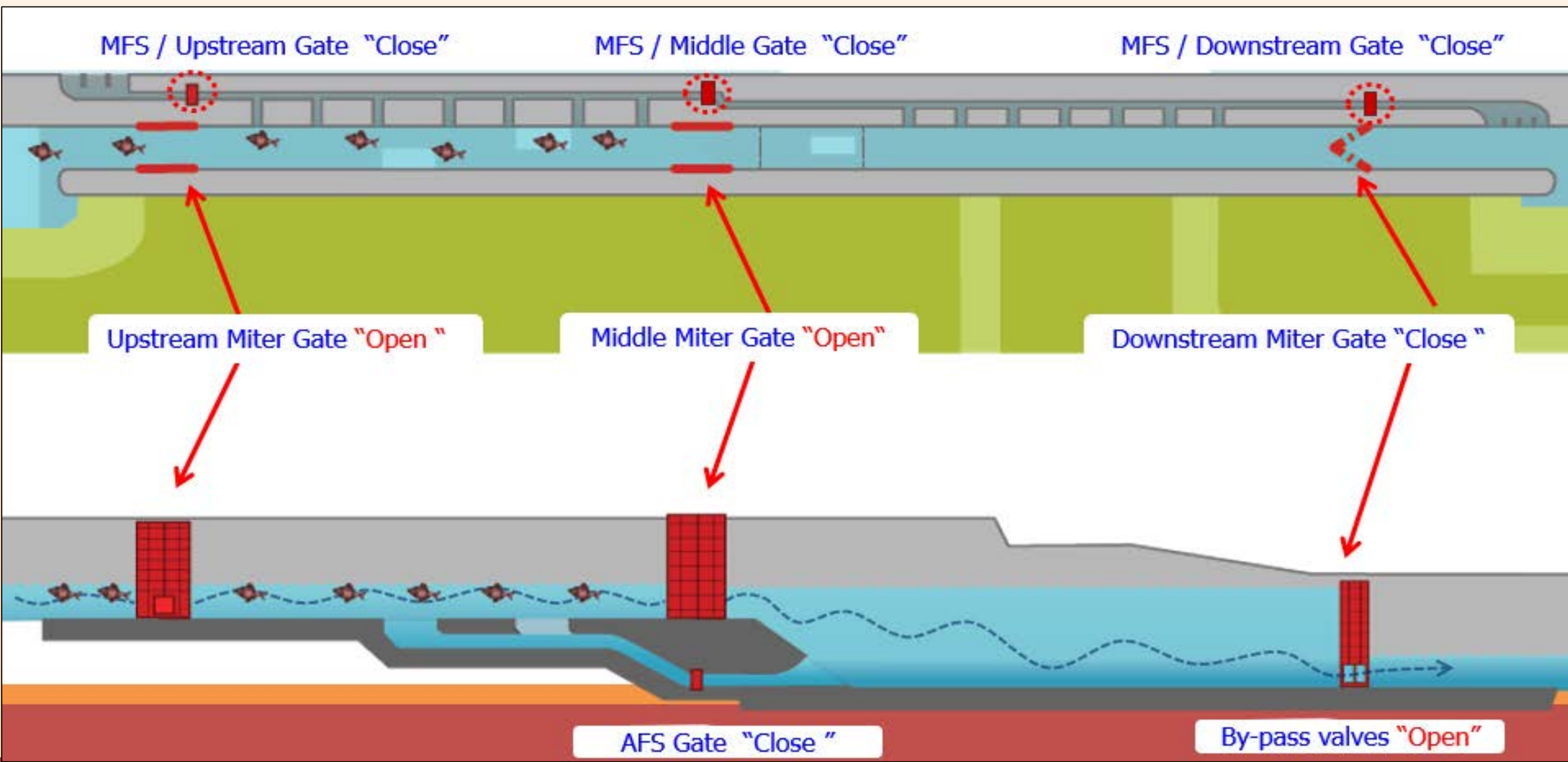
- Once the water level in the locks are equalized, open the Middle miter gate

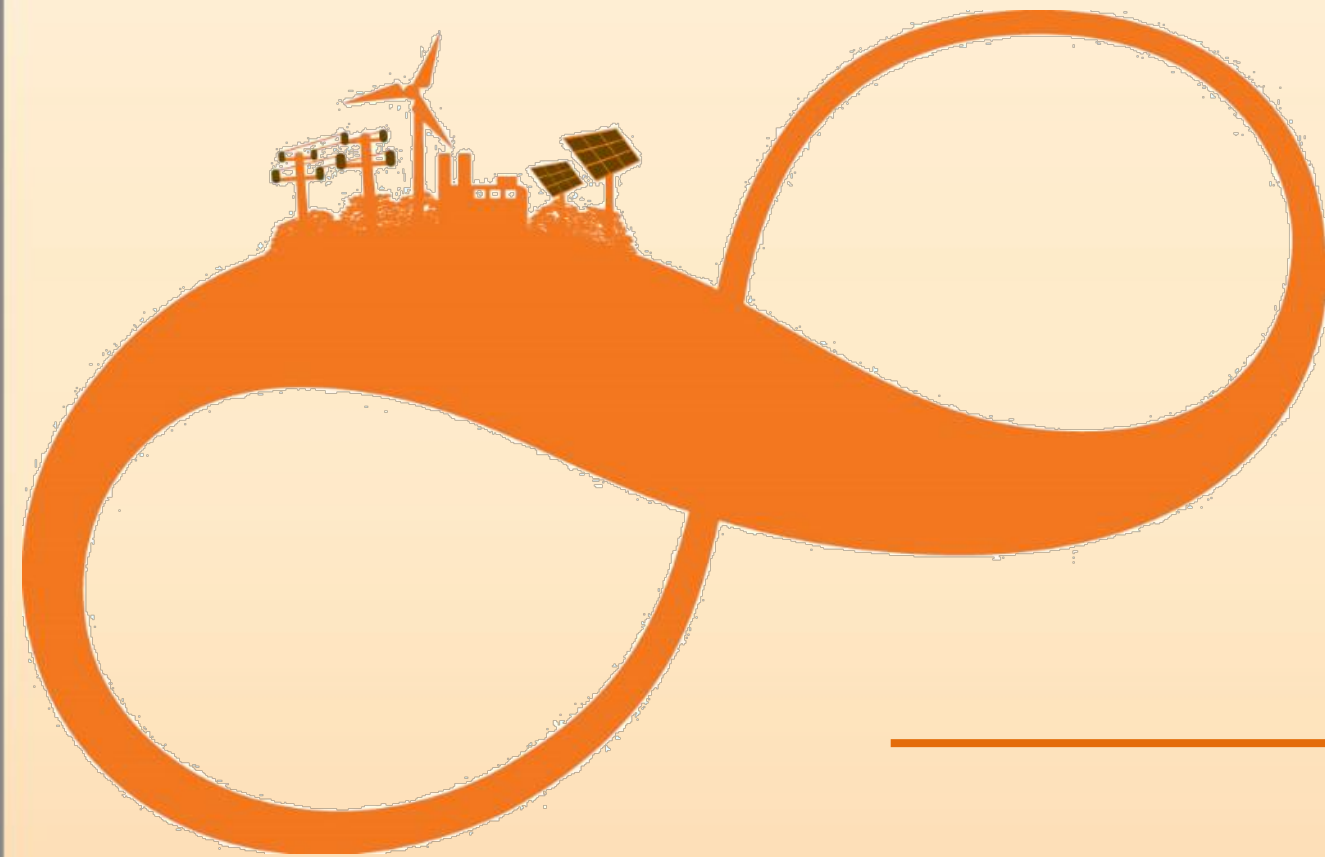


Operation Procedure

- **Fish Upstream Migration**

Open the by-pass gates of the downstream miter gate. This creates a flow from the entrance to the upper lock all the way to the exit of the downstream lock. Fish are attracted to move from the lower to the upper lock and further toward the reservoir.





Fish Monitoring Activity At Navigation Locks

Objective and Equipments

Objective

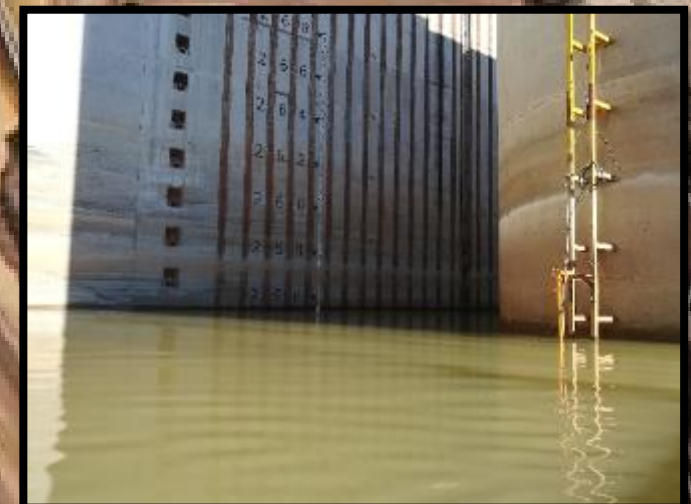
To collect background data of fish biomass and species pass through the Xayaburi Hydroelectric Power Project at upstream and downstream for estimating the efficiency of Navigation lock fish passage.

Processing Record Data

Hydro-Acoustic Camera (ARIS)



Point Location

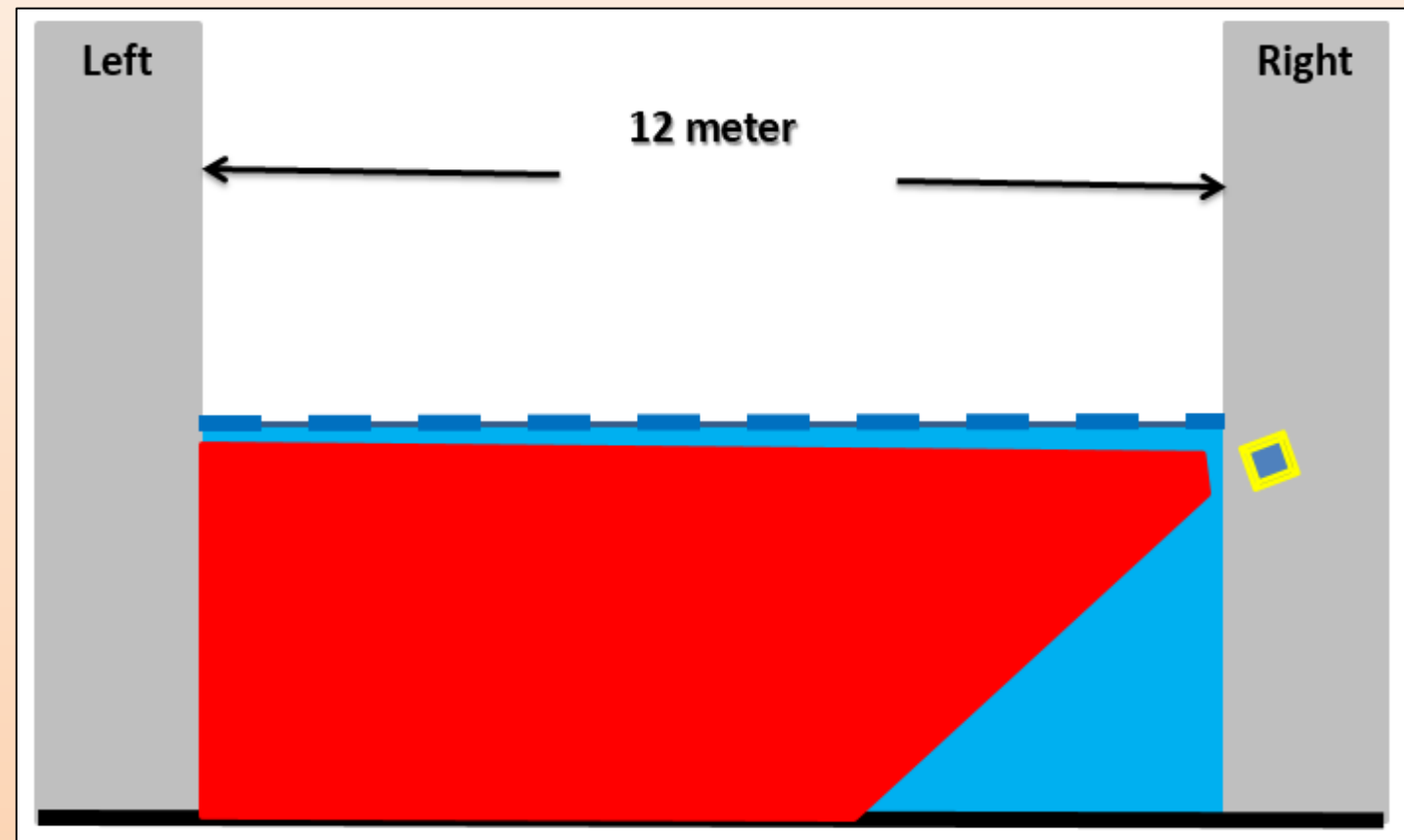
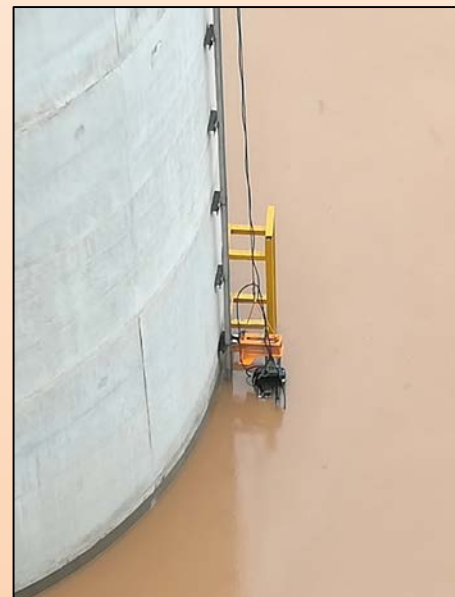
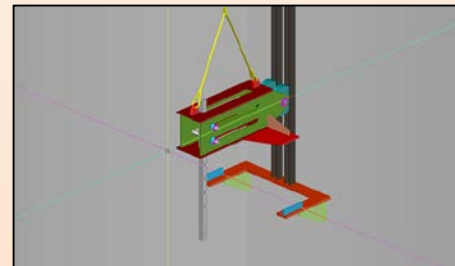
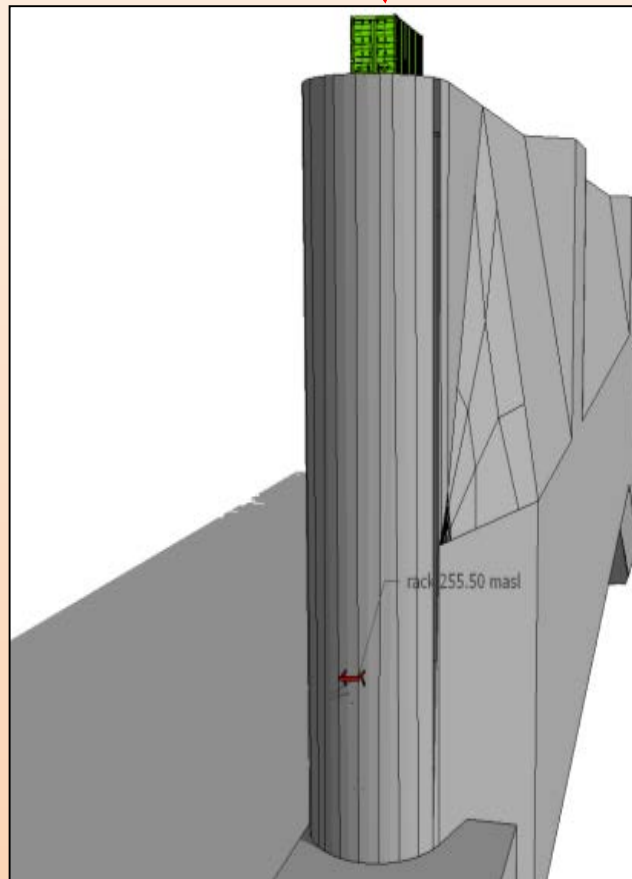
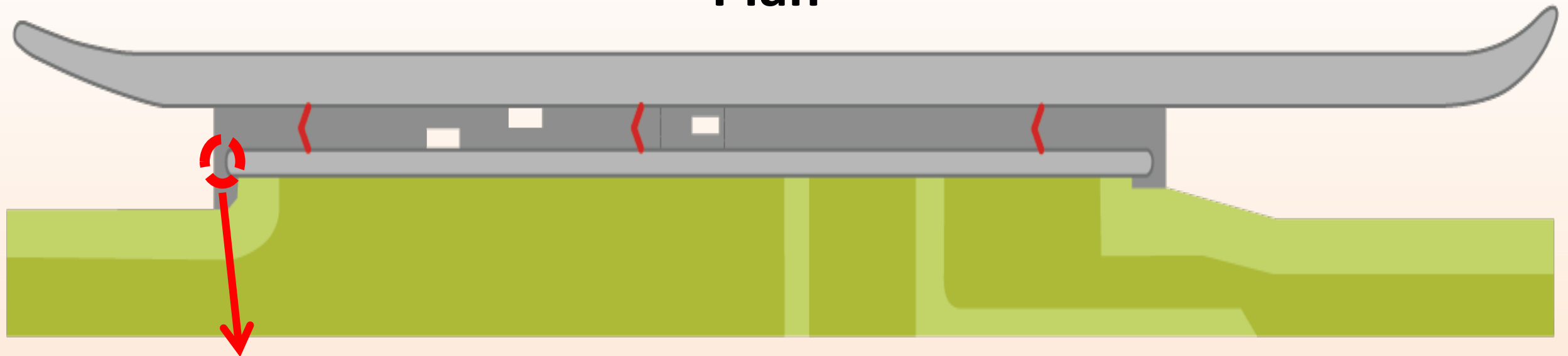


Camera Capacity: Beam Length Up to 50 m With 28° Angle



Camera Location Setting

Plan



Camera Setting and Control Room

Deployment Location



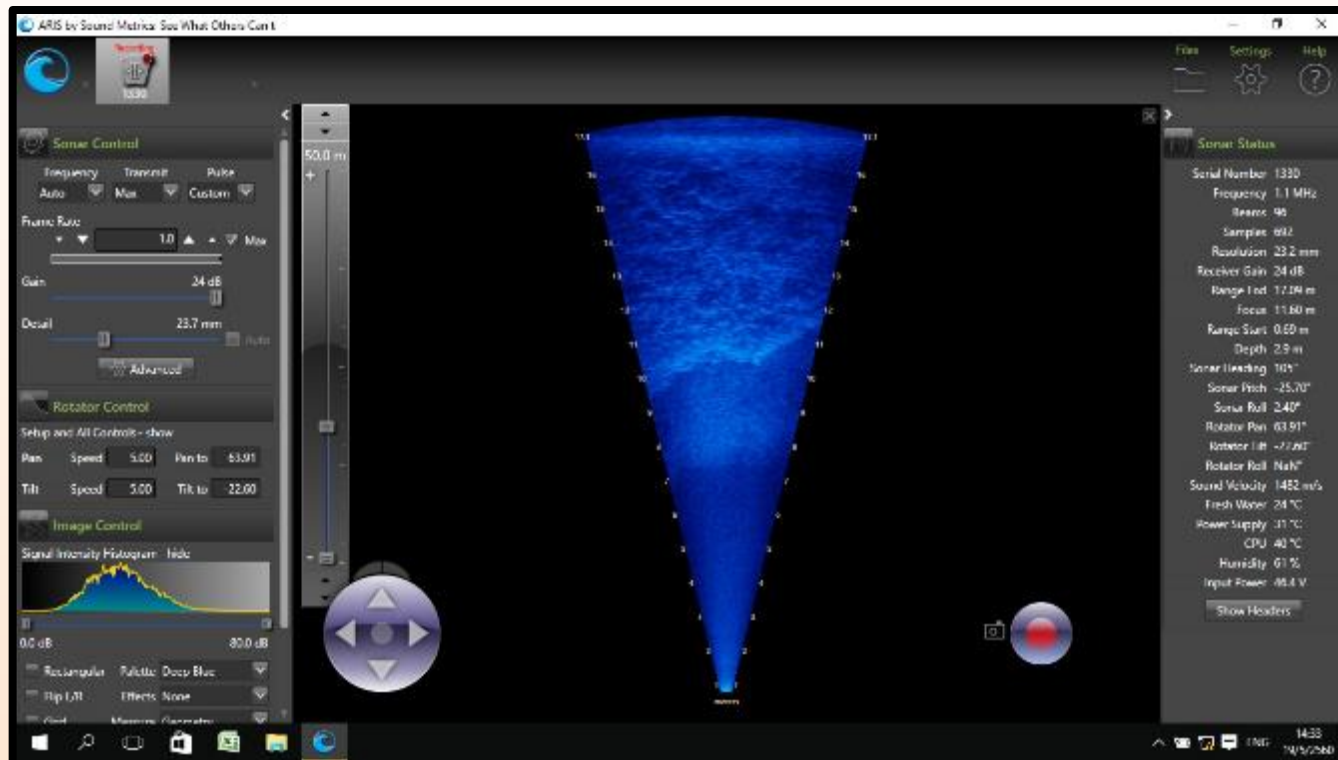
Operation Program in 2017



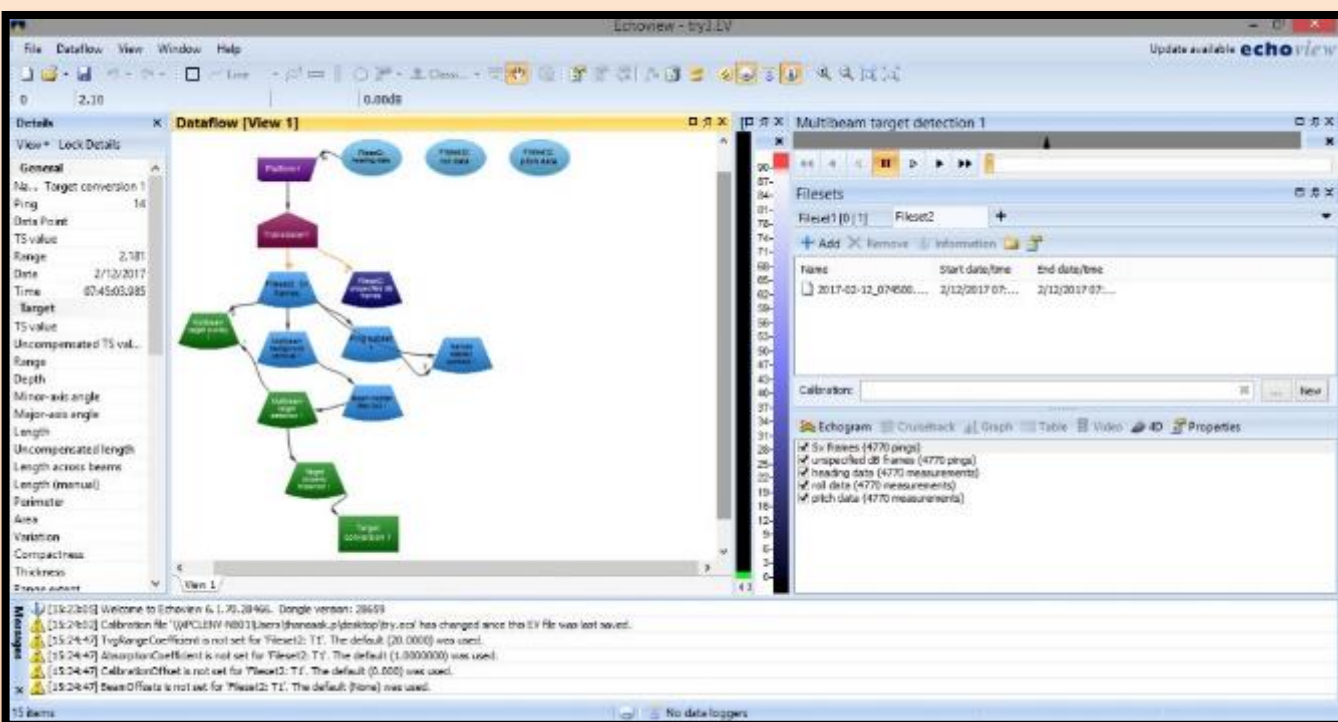
Month	Operation Cycles for Upstream Fish Migration in NL	
	Day Time	Night Time
January	3 Cycles	-
February	3 Cycles	-
March	4 Cycles	2 Cycles
April	4 Cycles	2 Cycles
May	4 Cycles	2 Cycles
June	4 Cycles	-
July	2 Cycles	-
August	2 Cycles	-
September	2 Cycles	-
October	2 Cycles	-
November	2 Cycles	-
December	3 Cycles	-

Data Record and Analysis

Software Data Recorder



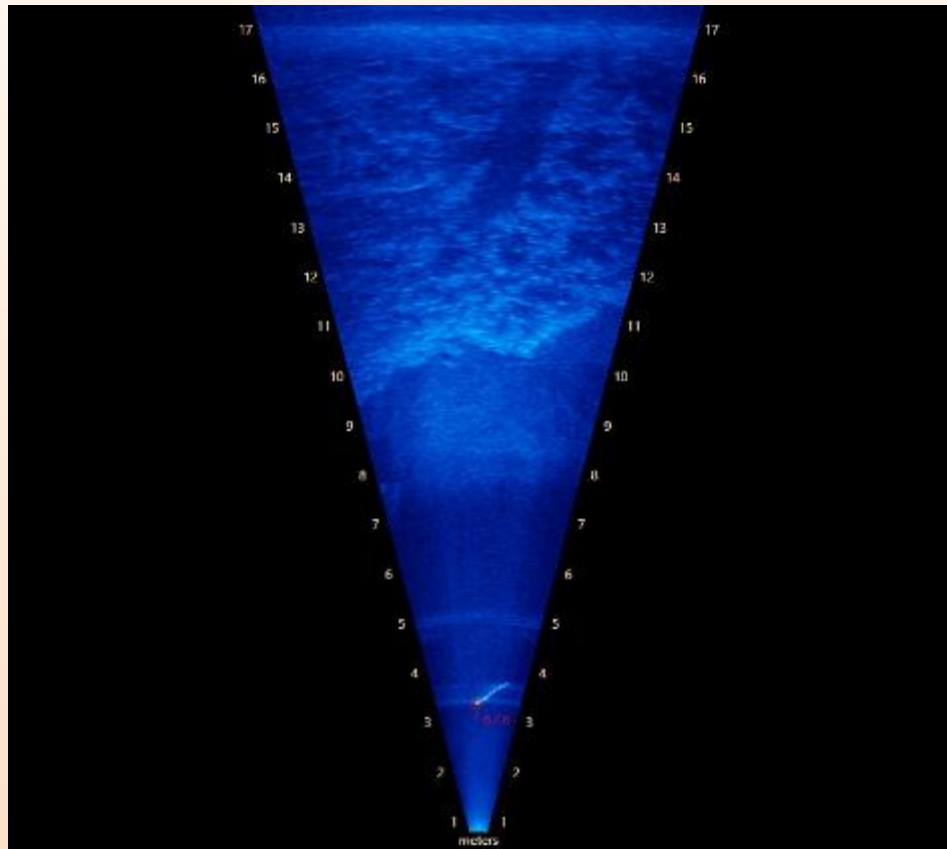
Echoview Program



Example : Preliminary Data analyzed by Echoview

	A	B	C	D	E
1	Ping_date	Ping_time	Ping_millisecond	Target_length	Target_thickness
2	10/4/2017	03:30:20	748.2	9.120142	7.106016
3	10/4/2017	03:30:21	70	11.155936	7.106016
4	10/4/2017	03:30:21	214.2	11.113069	7.106016
5	10/4/2017	03:30:21	401.2	13.792736	7.106016
6	10/4/2017	03:30:21	712.5	11.525614	7.106016
7	10/4/2017	03:30:21	890.5	11.318757	7.106016
8	10/4/2017	03:30:22	211.6	11.877406	7.106016
9	10/4/2017	03:30:22	368.9	9.645594	4.737344
10	10/4/2017	03:30:22	536	14.17691	7.106016
11	10/4/2017	03:30:22	693.8	12.092813	7.106016
12	10/4/2017	03:30:22	861.5	12.681682	9.474688
13	10/4/2017	03:30:23	20.6	17.83377	9.474688
14	10/4/2017	03:30:23	187.1	12.860833	7.106016
15	10/4/2017	03:30:23	343.2	13.984847	9.474688
16	10/4/2017	03:30:23	516.5	12.689002	9.474688
17	10/4/2017	03:30:23	672.5	14.700936	11.84336
18	10/4/2017	03:30:23	824.5	15.725619	9.474688
19	10/4/2017	03:30:23	982.8	18.642561	11.84336
20	10/4/2017	03:30:24	166.5	18.289094	9.474688
21	10/4/2017	03:30:24	312.5	13.994546	9.474688
22	10/4/2017	03:30:24	495.9	15.637625	11.84336
23	10/4/2017	03:30:24	634.8	16.708694	11.84336
24	10/4/2017	03:30:24	809.5	16.928366	11.84336
25	10/4/2017	03:30:24	971.6	16.219692	9.474688
26	10/4/2017	03:30:25	143.6	18.020936	9.474688
27	10/4/2017	03:30:25	300.9	21.48068	11.84336
28	10/4/2017	03:30:25	455.1	20.05496	9.474688
29	10/4/2017	03:30:25	630.5	16.827898	9.474688
30	10/4/2017	03:30:25	786.1	16.349915	11.84336
31	10/4/2017	03:30:25	954.9	16.113531	9.474688
32	10/4/2017	03:30:26	116.2	16.150775	9.474688
33	10/4/2017	03:30:26	284.6	15.311675	11.84336
34	10/4/2017	03:30:26	442.5	14.239156	9.474688
35	10/4/2017	03:30:26	607.4	13.338223	9.474688
36	10/4/2017	03:30:26	753.7	13.211152	9.474688
37	10/4/2017	03:30:26	934.6	13.085362	11.84336
38	10/4/2017	03:30:27	81.5	8.406473	9.474688

Re-check all of the preliminary data manually



Count the number and measure the size of fishes manually

Complete Data

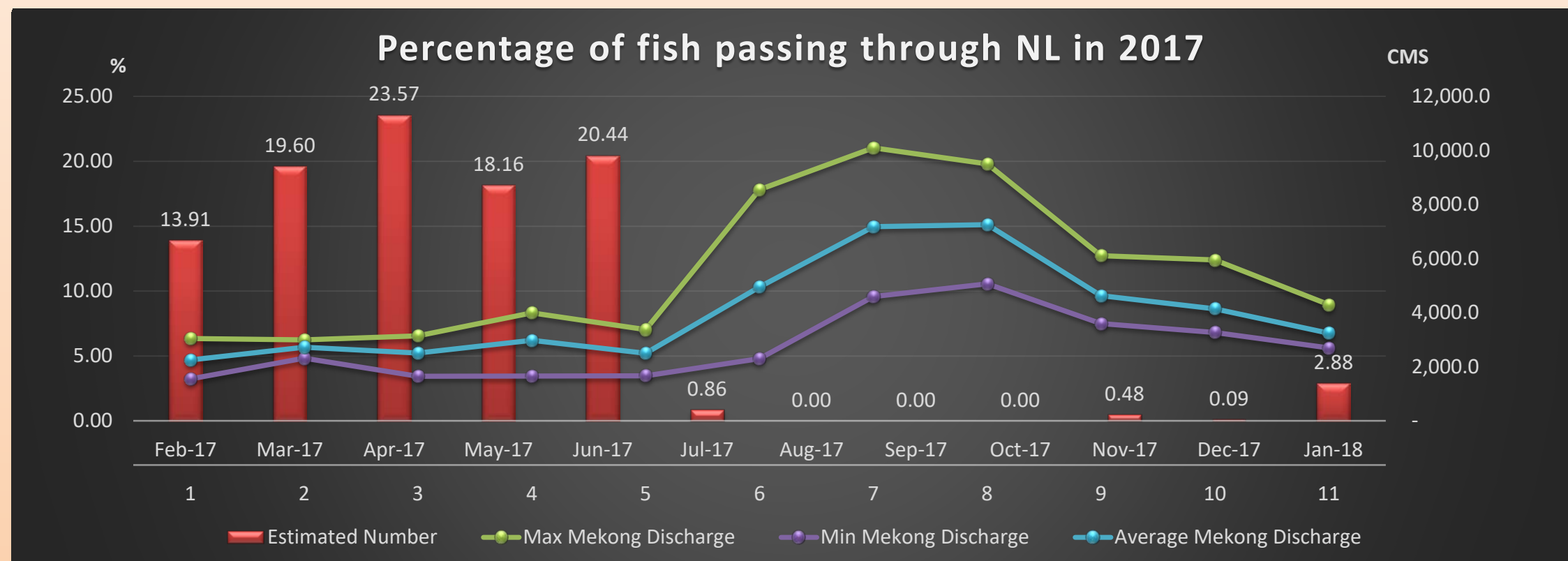
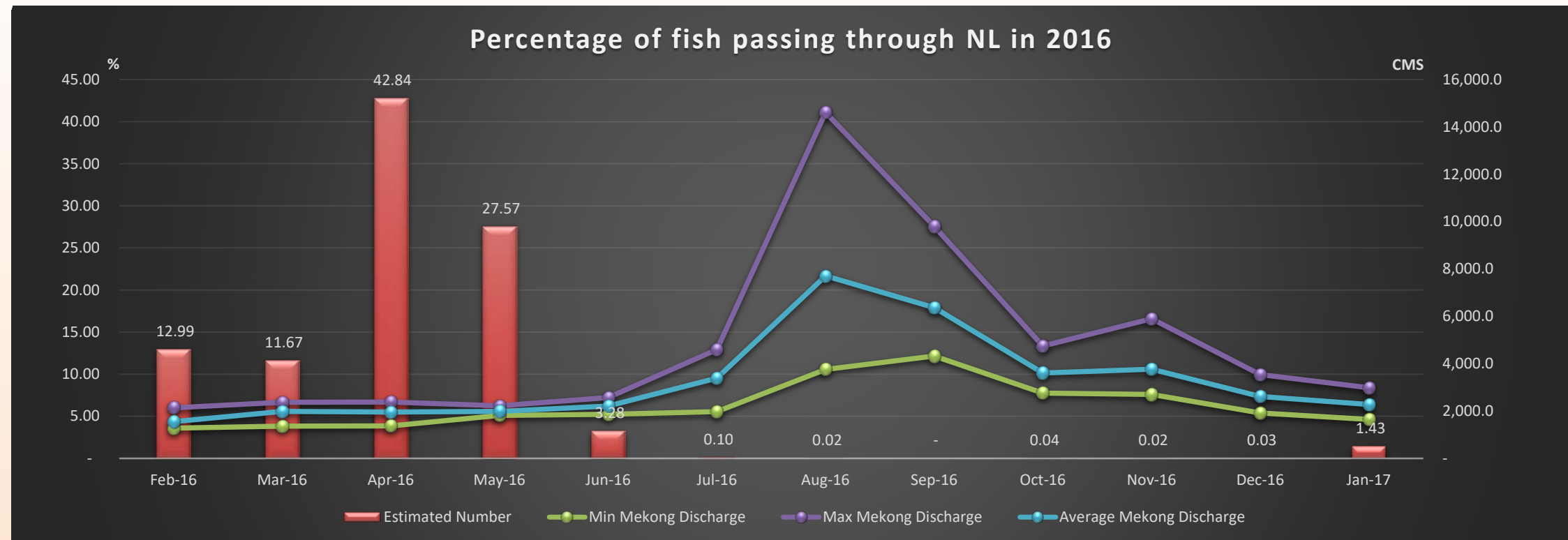
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	Table 1: Results of fish that pass through NL in May 2018 from Echoview Auto Count																		
2	No	Date	No. of Fish	Weight of Fish	Size of Fish (cm)								U/S Miter Gate		Fish Time			Max	
3					0 - 10	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60	60-70	70-100	Total	Open	Close	Start	End	Total (hr)	Length(c
4	1	25-may (afternoon1)	127	8.13	71	52	3	0	1	0	0	0	127	13:40	14:22	13:31	13:32	0:01	54.9
5	2	25-may (afternoon2)	897	51.63	183	700	14	0	0	0	0	0	897	16:09	16:27	16:17	16:29	0:12	
6	3	26-may (morning1)	279	23.95	32	224	20	2	1	0	0	0	279	7:49	8:41	8:08	8:42	0:34	
7	4	26-may (morning2)	1693	110.32	74	1594	21	2	2	0	0	0	1693	10:23	10:40	10:33	10:45	0:12	
8	5	26-may (afternoon1)	6	0.35	1	5	0	0	0	0	0	0	6	13:52	14:15	14:15	14:16	0:01	
9	6	26-may (afternoon2)	1757	89.18	278	1472	6	1	0	0	0	0	1757	15:50	16:20	16:01	16:25	0:24	
10	7	27-may (morning1)	339	37.02	149	161	10	9	9	1	0	0	339	7:57	8:40	8:06	8:38	0:32	
11	8	27-may (morning2)	5566	925.18	56	3187	2323	0	0	0	0	0	5566	10:09	10:33	10:20	10:31	0:11	
12	9	27-may (afternoon1)	2643	131.02	261	2372	10	0	0	0	0	0	2643	13:19	13:43	13:33	13:45	0:12	
13	10	28-may (morning1)	587	60.12	51	509	11	11	4	1	0	0	587	8:28	9:08	8:15	9:13	0:58	
14	11	28-may (morning2)	3621	308.22	111	3508	1	1	0	0	0	0	3621	10:23	11:08	10:35	11:11	0:36	
15	12	28-may (afternoon1)	72	3.39	46	24	1	1	0	0	0	0	72	14:21	14:37	14:30	14:45	0:15	
16	13	28-may (afternoon2)	818	29.50	292	525	1	0	0	0	0	0	818	16:00	16:38	16:11	16:40	0:29	
17	14	29-may (morning2)	516	27.56	128	378	9	0	1	0	0	0	516	10:15	10:48	10:28	10:56	0:28	
18	15	29-may (afternoon1)	455	43.11	31	401	16	5	2	0	0	0	455	13:47	14:23	14:00	14:28	0:28	
19	16	29-may (afternoon2)	173	10.13	16	155	2	0	0	0	0	0	173	16:04	16:43	16:17	16:31	0:14	
20	17	30-may (afternoon1)	290	27.16	17	252	16	4	1	0	0	0	290	14:07	14:48	14:20	14:42	0:22	
21	18	30-may (afternoon2)	32	1.77	9	23	0	0	0	0	0	0	32	16:30	16:51	16:42	16:45	0:03	
22	19	31-may (morning1)	276	89.15	8	188	12	44	16	8	0	0	276	7:59	8:38	8:12	8:39	0:27	
23	20	31-may (morning2)	574	44.14	46	515	7	2	3	1	0	0	574	10:16	11:03	10:28	10:55	0:27	
24	21	31-may (afternoon1)	445	33.66	7	432	3	0	3	0	0	0	445	14:02	14:37	14:16	14:28	0:12	
25	22	31-may (afternoon2)	387	25.75	10	374	0	2	1	0	0	0	387	16:14	16:42	16:25	16:33	0:08	
26		Total	21553	2080.47	1877	17051	2486	84	44	11	0	0	21553						
27		%			8.71	79.11	11.53	0.39	0.20	0.05	0.00	0.00	100.00						



Fish Passage Result



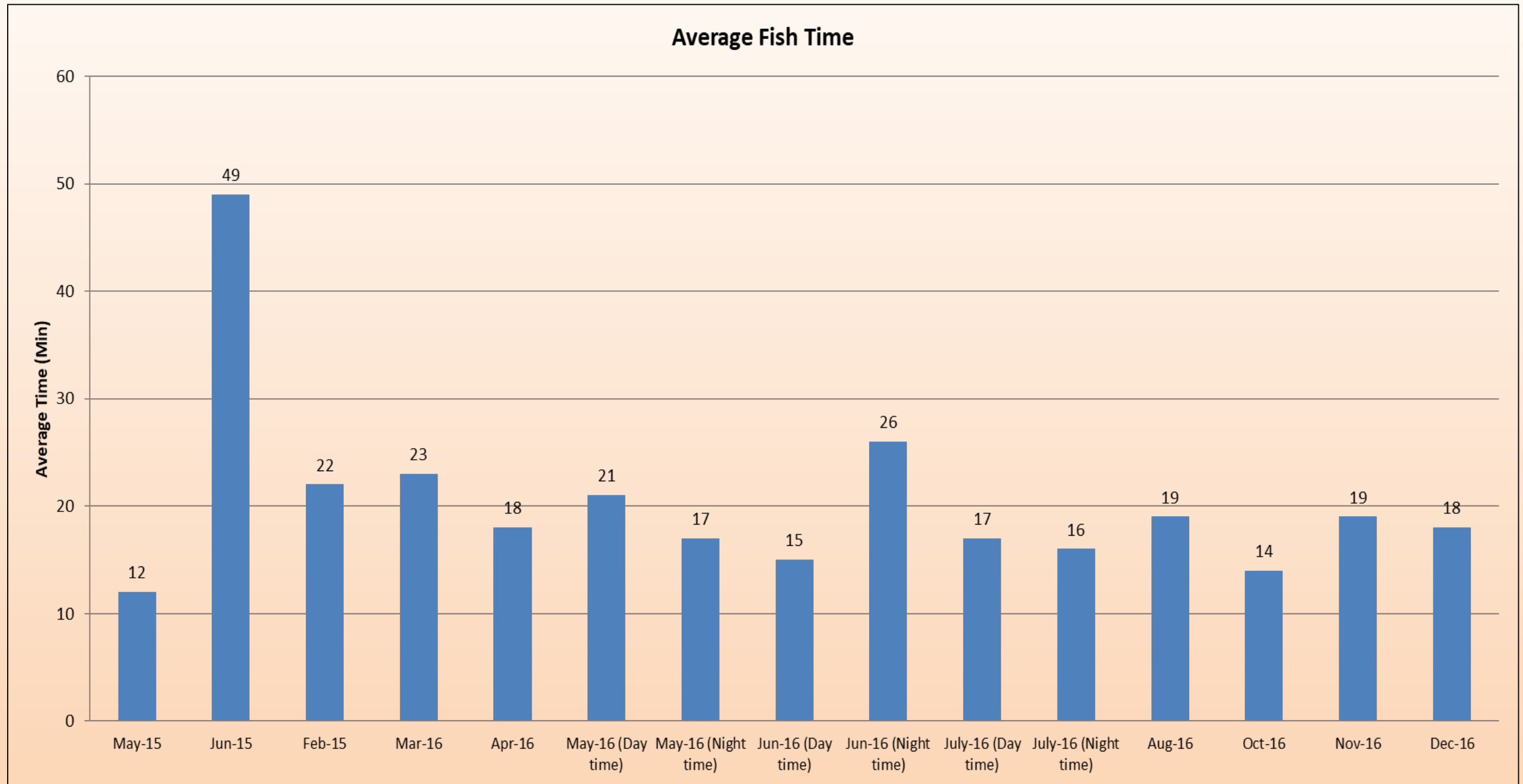
Annual Percentage of Fish Passing through Navigation Locks





Fish Passage Result

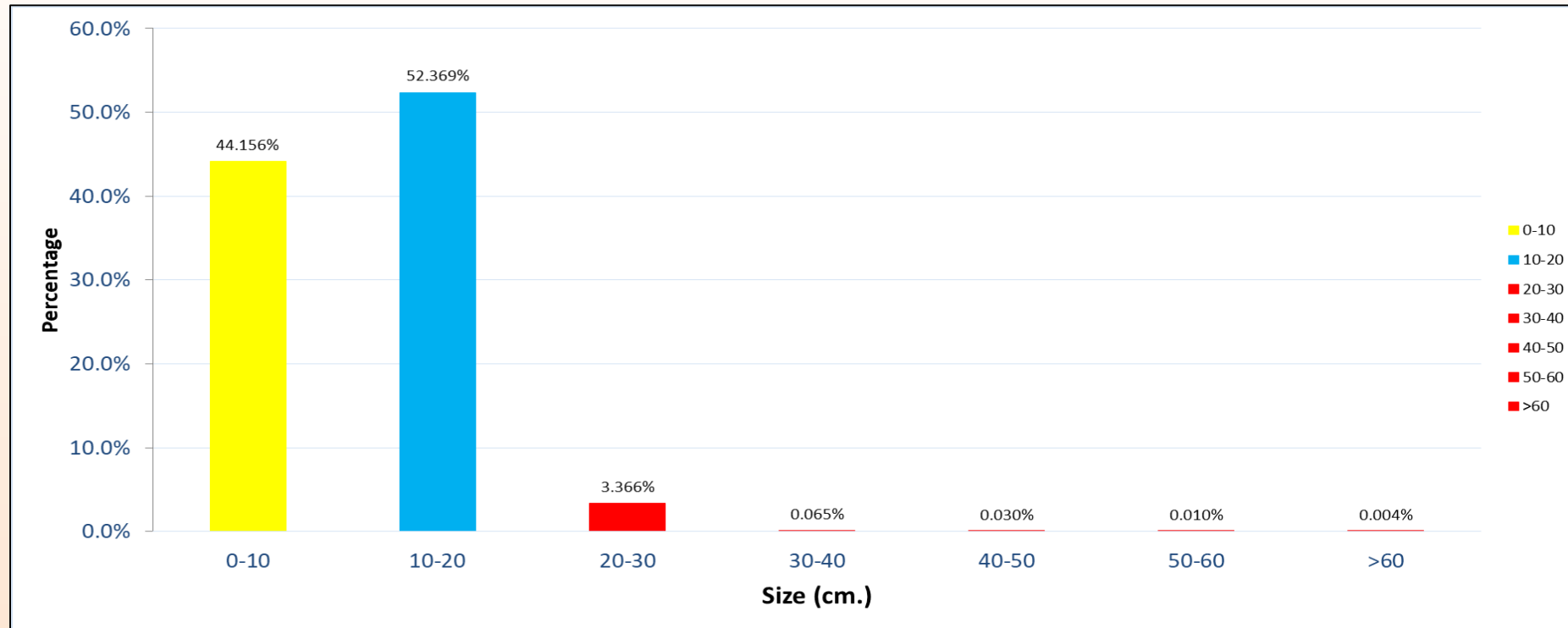
Average time for fish passing through Upper lock chamber for one cycle



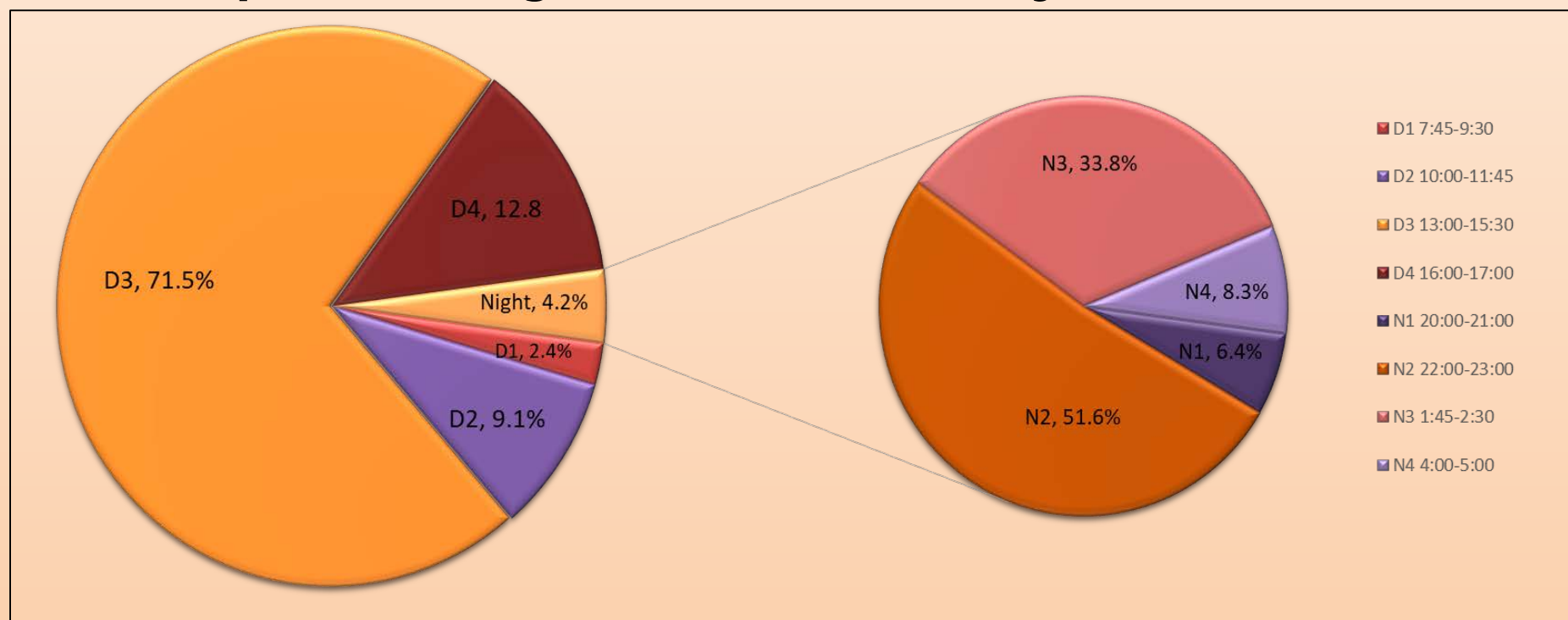


Fish Passage Result

Fish size percentage passing through navigation locks



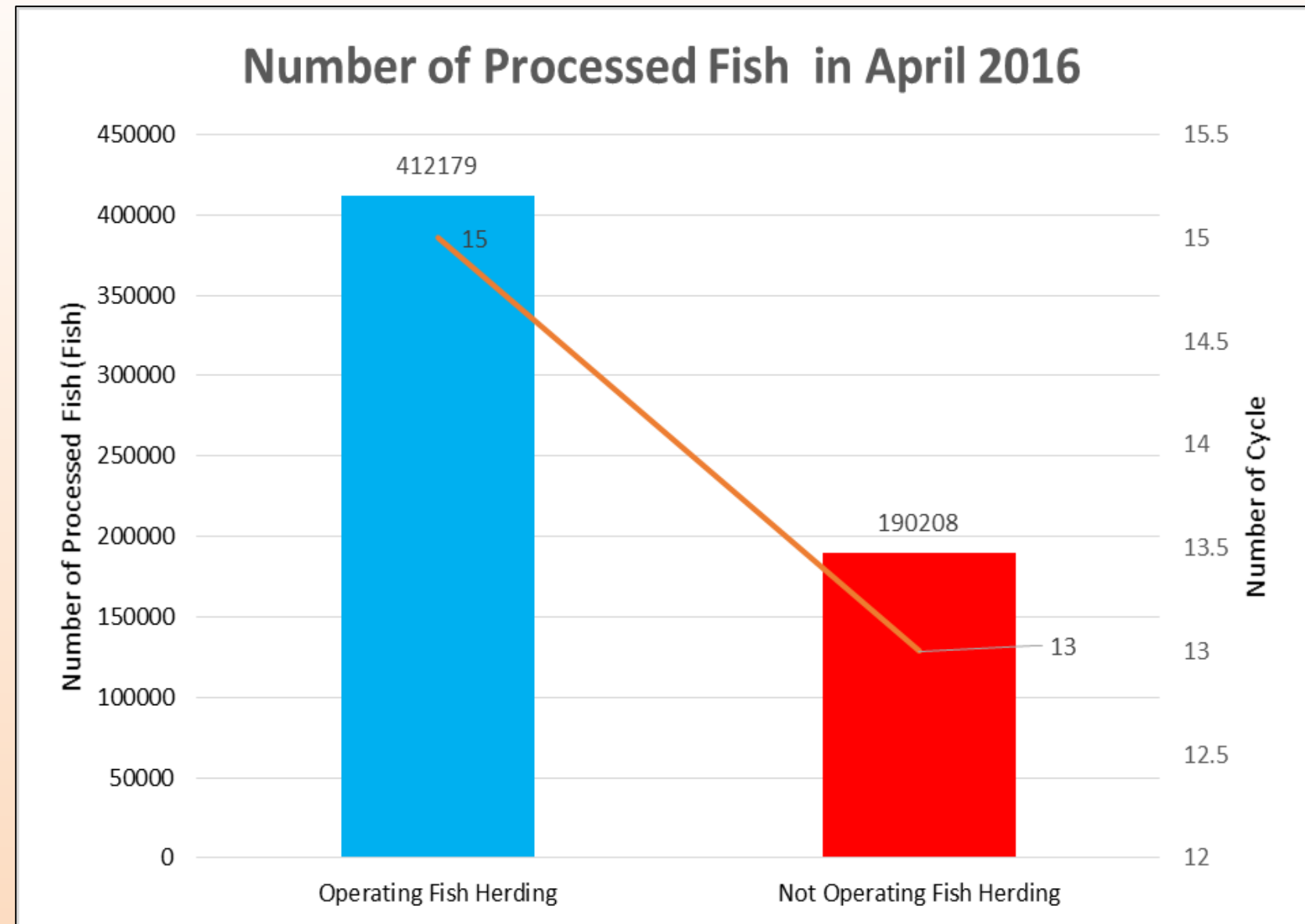
Percentage of fish pass during each time in a day





Data Comparison

Fish Herding (Pontoon)



**Comparison data of with and without
Fish Herding (Pontoon)**



Fish Catching in Navigation Locks





Fish Catching Operation Method

Fish attraction phase by Auxiliary water feeding system



Fish chasing from Lower lock to Upper lock chamber

Operated by Pontoon boat



Lower the water inside the Upper lock chamber

Approximately 251.0 m(a.s.l.)



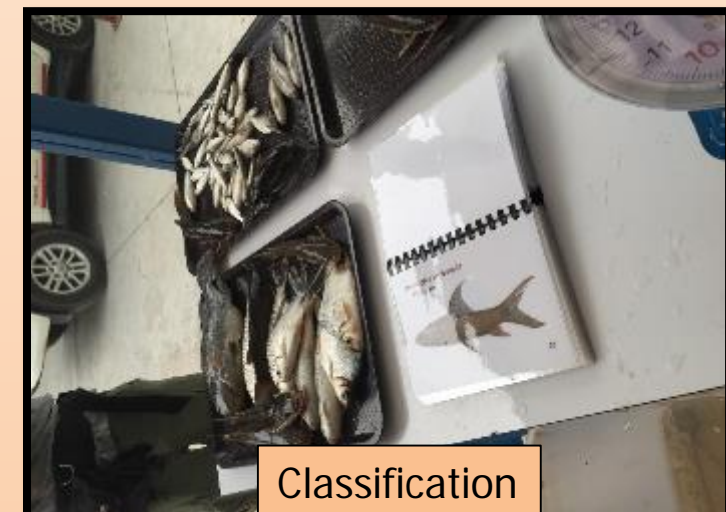
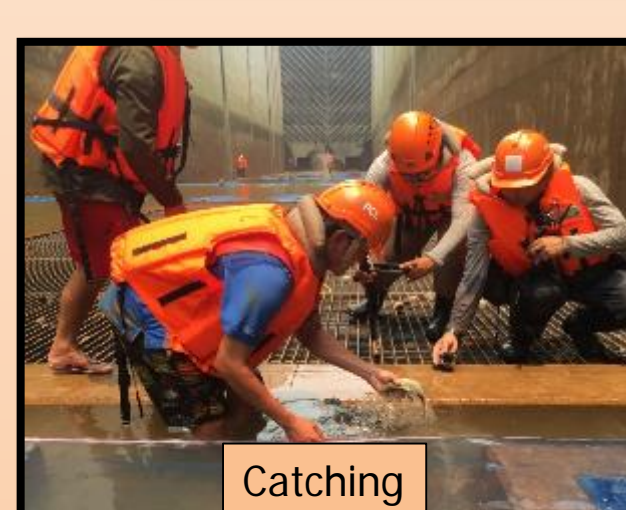
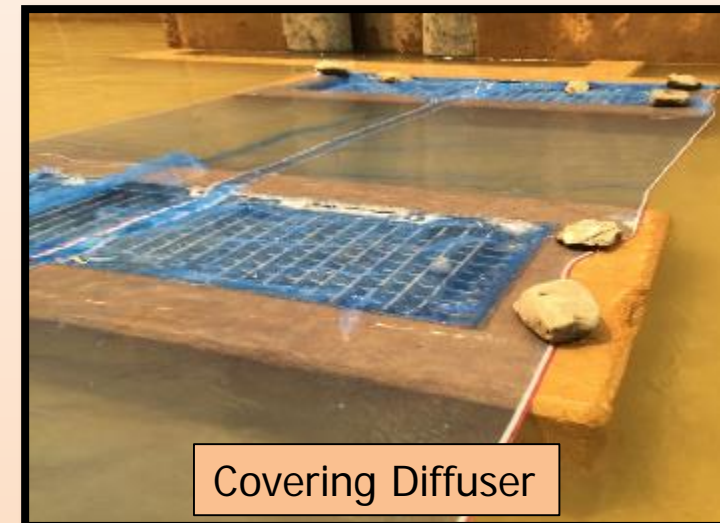
Diffuser covered by gill net to prevent fish escaped



Fish collecting by gill net



Fish counting and classification

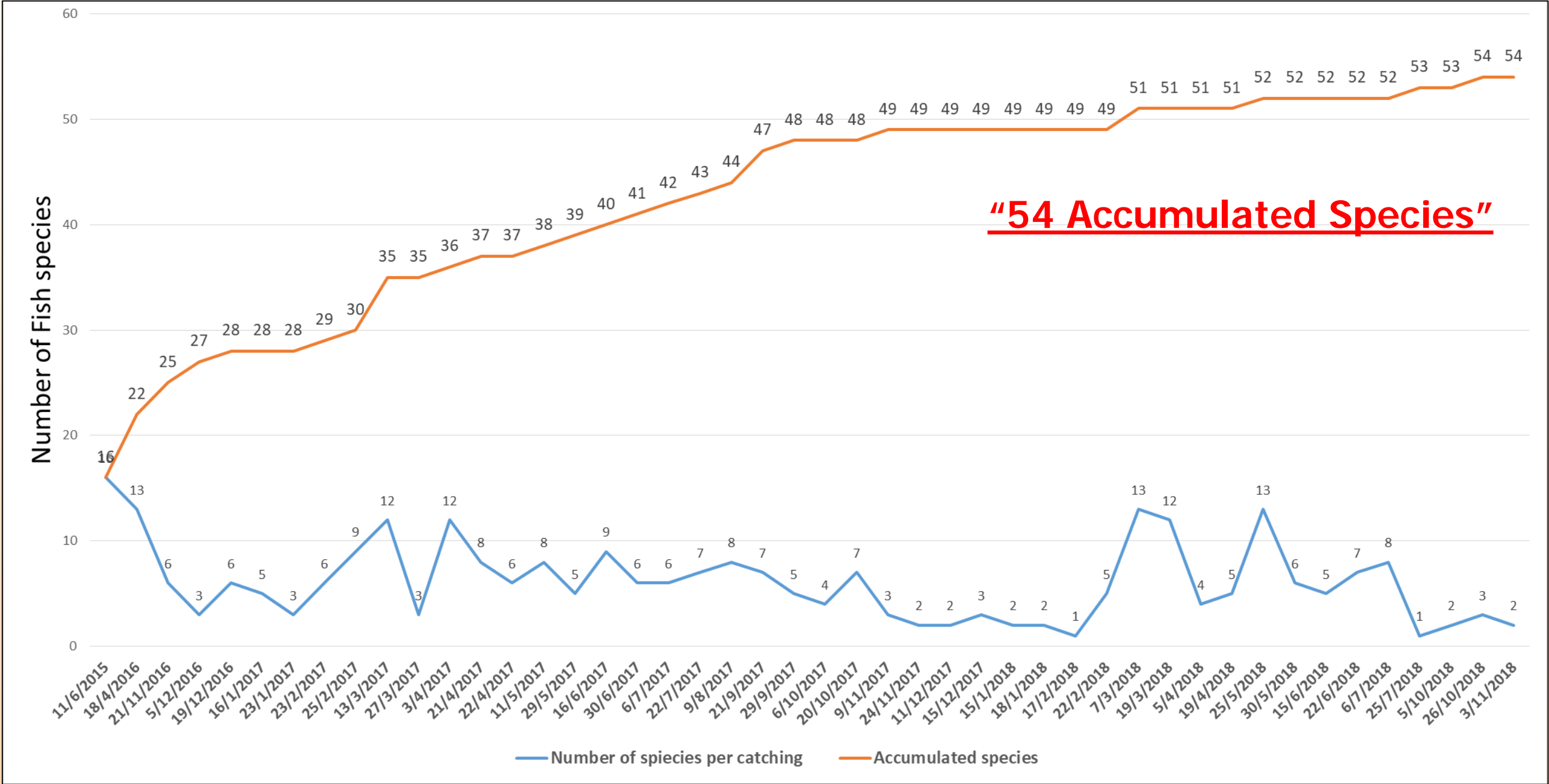




Fish Catching Result



The Accumulated Species of Fish Caught at Navigation Locks Result During 2015 – 2018.





Fish Catching Result

Example Pictures of Migratory Fish species were caught in Navigation Locks



Pangasius macronema



Chitala ornata



Hemibagrus filamentus



Pristolepis fasciata



Mekongina erythrospila



Cyclocheilichthys enoplos



Paralaubuca typus



Tenulosa thibaudeaui



Bagarius yarrelli



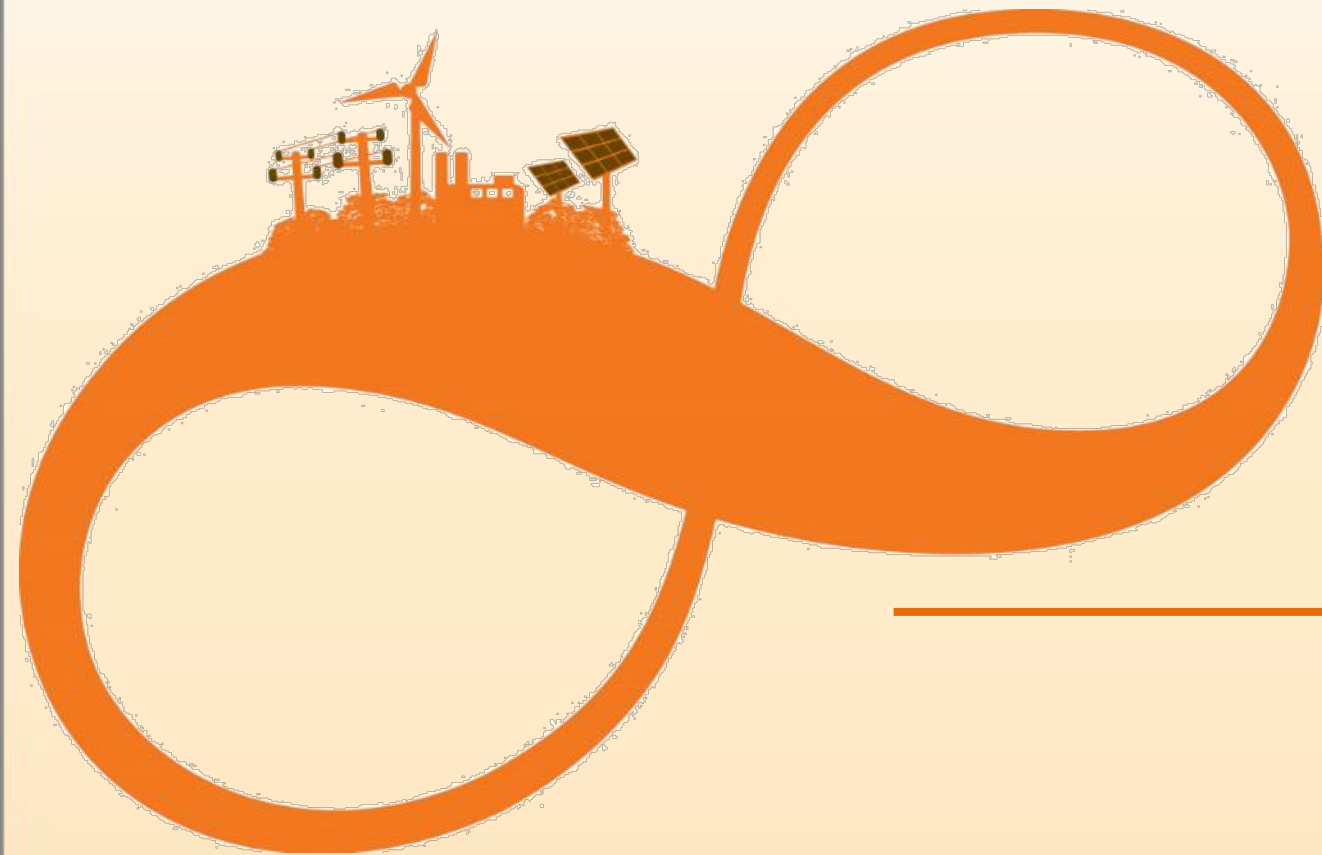
Hemisilurus mekongensis



Labeo chrysophekadion



Pangasianodon gigas



Question & Answer

Thank You for Attention

