No.2
Water Quality and Turbidity

THE STUDY ON
COUNTERMEASURES FOR SEDIMENTATION
IN
THE WONOGIRI MULTIPURPOSE DAM RESERVOIR
IN
THE REPUBLIC OF INDONESIA

FINAL REPORT

VOLUME-VI DATA BOOK

No.2: Water Quality and Turbidity

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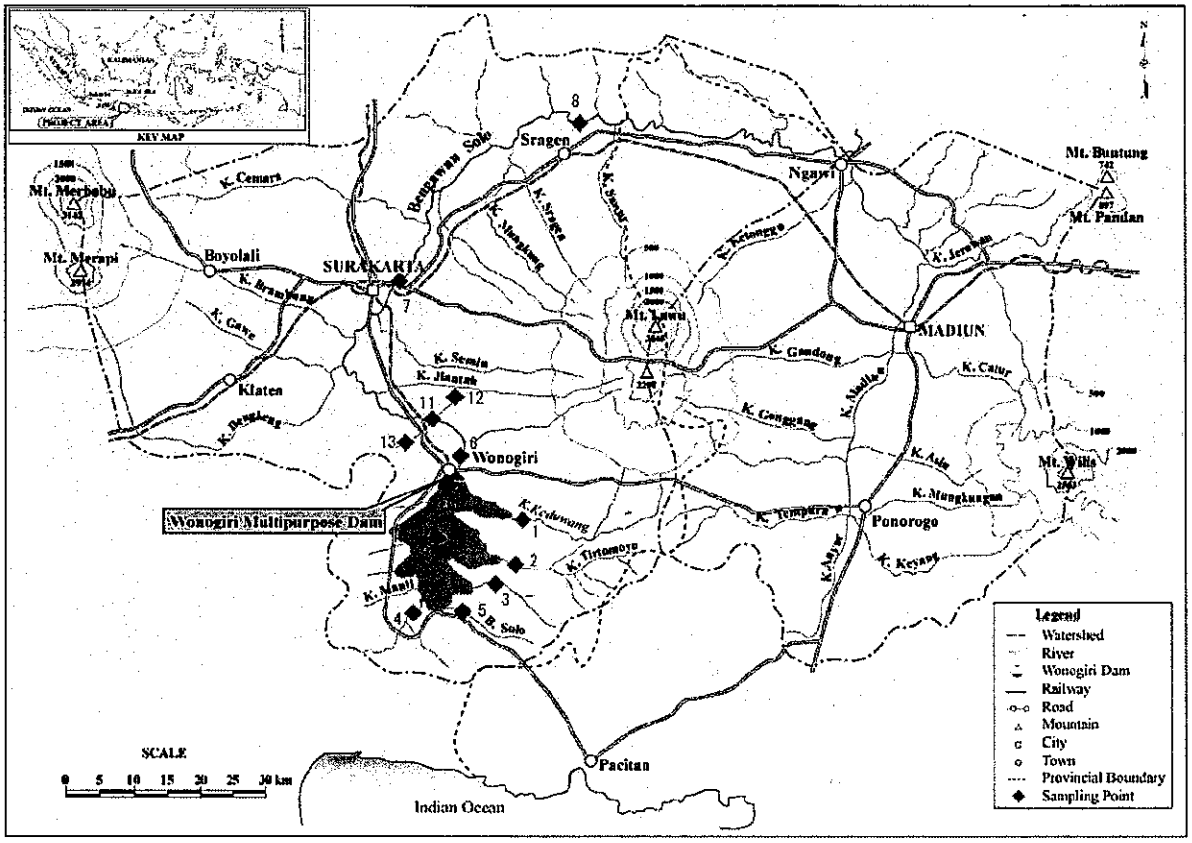
Sampling Location for Water and Bed Material Quality Analysis



Item	No.	Location
Rivers	No.1	Keduang River : Outlet point to Wonogiri reservoir
	No.2	Tirtomoyo River : Outlet point to Wonogiri reservoir
	No.3	Temon River : Outlet point to Wonogiri reservoir
	No.4	Alang River : Outlet point to Wonogiri reservoir
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Reservoir	No.9	Central point of Wonogiri reservoir
	No.10	Vicinity (some 100 m) of the intake point of Wonogiri reservoir
	No.11	Vicinity (some 100 m) of the intake point of Colo weir
Irrigation Canal	No.12	East channel (some 10 km downstream point from the intake) of Colo irrigation canal
	No.13	West channel (some 5 km downstream point from the intake) of Colo irrigation canal

The Result of Water Quality Analysis - Wet Season - (Analysed by BPKL)

December 2004

No.	Parameters	Unit	Standard Class II	Location												
				No.1	No.2	No.3	No.4	No.5	No.6	No.7	No.8	No.9	No.10	No.11	No.12	No.13
1	Temperature	℃	±3	28	28	30	31	31	29	30	31	30	29	29	30	30
2	Turbidity	NTU	---	312	136	50	138	26	198	101	123	120	342	209	262	288
3	Electric conductivity	µmhos/cm	---	166	127	364	356	232	152	370	306	160	155	128	129	139
4	Total Solids	mg/L	1,050	466	229	300	355	185	296	342	330	266	451	288	347	370
5	Total Suspended Solids	mg/L	50	357	145	60	123	32	196	98	128	160	349	203	261	278
6	pH	-	6-9	7.1	7.0	7.2	7.2	7.0	7.0	7.0	7.0	7.1	7.1	7.1	7.1	7.1
7	Hardness	mg/L	—	56	64	191	171	102	66	117	115	76	74	4	62	60
8	Iron (Fe)	mg/L	(0.3)	1.05	0.51	0.50	0.13	0.57	0.68	0.44	0.72	0.83	0.45	1.03	0.46	1.03
9	Manganese (Mn)	mg/L	(0.1)	1.08	0.46	0.64	0.12	0.63	1.20	0.64	0.93	0.66	0.41	1.10	0.61	0.49
10	Copper (Cu)	mg/L	0.02	0.08	0.01	0.01	nd	0.01	0.01	nd	nd	0.02	0.01	nd	nd	nd
11	Zinc (Zn)	mg/L	0.05	0.136	0.049	0.029	0.008	0.033	0.012	0.187	0.062	0.028	0.160	0.043	0.012	0.038
12	Chromium (VI) (Cr6+)	mg/L	0.05	0.339	0.270	0.309	0.246	0.536	0.458	0.294	0.397	0.398	0.784	0.658	0.464	0.664
13	Cadmium (Cd)	mg/L	0.01	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
14	Total Mercury (T-Hg)	mg/L	0.002	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
15	Lead (Pb)	mg/L	0.03	nd	nd	0.008	nd	0.008	0.006	nd	0.016	nd	0.003	0.016	0.015	0.014
16	Arsenic (As)	mg/L	1	0.017	0.001	nd	0.001	0.004	0.004	nd	0.006	0.011	0.006	0.007	0.003	0.009
17	Cyanide (CN)	mg/L	(0.02)	0.071	0.009	0.002	0.001	0.007	0.027	0.002	0.007	0.019	0.030	0.034	0.033	0.022
18	Ammonia (NH_3)	mg/L	(0.5)	2.63	0.45	0.22	0.20	0.21	1.55	0.65	1.42	1.10	1.15	1.26	1.22	0.84
19	Nitrate (NO_3)	mg/L	10	1.438	0.674	0.631	0.787	0.235	nd	nd	nd	nd	nd	nd	nd	nd
20	Nitrite (NO_2)	mg/L	0.06	0.115	0.109	0.114	0.098	0.110	0.123	0.174	0.452	0.117	0.116	0.144	0.225	0.220
21	Total Phosphorus (T-P)	mg/L	0.2	0.150	0.010	0.067	0.041	0.090	0.116	0.290	0.313	0.068	0.259	0.198	0.223	0.174
22	Dissolved Oxygen (DO)	mg/L	4	6.4	6.8	6.4	6.4	6.8	6.4	5.1	4.4	6.4	6.4	6.8	6.6	6.2
23	Biochemical Oxygen Demand (BOD)	mg/L	3	13.5	1.4	4.5	3.7	1.4	3.6	14.8	14.3	8.2	4.5	4.0	4.5	7.9
24	Chemical Oxygen Demand (COD)	mg/L	25	58	17	48	50	19	52	24	43	53	43	58	19	29
25	Detergent	mg/L	200	0.130	0.095	0.024	0.056	0.228	0.011	0.092	nd	0.111	0.121	nd	nd	nd
26	Phenol	mg/L	---	0.014	0.011	0.010	0.014	0.013	0.012	0.013	0.011	0.011	0.011	0.011	0.011	0.014
27	Oil and fat	mg/L	1,000	22	18	13	8	7	5	2	8	9	2	13	zero	1
28	Coliform group	JPT/100ml	5,000	2.4×10^5	2.4×10^3	4.6×10^5	1.1×10^6	2.3×10^4	2×10^4	9.3×10^4	zero	4×10^3	2.4×10^5	7.5×10^4	9×10^3	2.4×10^5
29	Coliform feces	JPT/100ml	1,000	9×10^4	2.4×10^5	1.5×10^5	4.6×10^5	2.3×10^4	zero	1.5×10^4	zero	zero	7×10^3	7.5×10^4	4×10^3	2.4×10^5
30	Aldrin	ppb	(17)	0	0	0	0	0	0	0	0	0	0	0	0	0
31	Dieldrin	ppb	(17)	0.034	0	0	0	0	0	0.057	0	0	0	0.015	0.022	0.015
32	DDT	ppb	2	0	0	0	0	0	0	0	0	0	0	0	0	0
33	Lindane	ppb	(56)	0.015	0	0.001	0	0	0	0	0	0	0	0	0	0.001
34	Endrin	ppb	4	0	0	0	0	0	0	0	0	0	0	0	0	0

Note) "nd" means not detected.

Standard value: Class II of Government Regulation No.82/2001 (Class I in case a vakue of class II is not provided)

The Result of Water Quality Analysis - Dry Season - (Analysed by BPKL)

May 2005

No.	Parameters	Unit	Standard Class II	Location												
				No.1	No.2	No.3	No.4	No.5	No.6	No.7	No.8	No.9	No.10	No.11	No.12	No.13
1	Temperature	℃	±3	31.0	31.5	29.5	34.5	32.0	31.0	29.0	30.5	31.0	30.5	31.0	31.0	31.0
2	Turbidity	NTU	---	6	6	12	7	8	1	9	7	4	1	8	8	22
3	Electric conductivity	µmhos/cm	---	248	238	404	402	260	180	492	475	179	178	181	178	180
4	Total Solids	mg/L	1,050	175	169	279	273	182	124	342	326	126	122	134	129	132
5	Total Suspended Solids	mg/L	50	9	12	12	8	10	5	18	11	8	5	15	12	13
6	pH	-	6-9	7.3	7.1	7.3	7.2	7.3	7.1	7.1	7.1	7.1	7.2	7.1	7.2	7.1
7	Hardness	mg/L	---	94	93	179	153	100	75	137	145	70	72	72	75	75
8	Iron (Fe)	mg/L	(0.3)	1.50	0.96	1.89	0.75	0.82	0.64	1.28	1.14	0.28	0.42	1.82	3.66	2.07
9	Manganese (Mn)	mg/L	(0.1)	0.01	0.07	0.15	0.02	0.22	0.02	0.37	0.32	nd	0.20	0.11	nd	0.30
10	Copper (Cu)	mg/L	0.02	0.01	nd	nd	0.09	0.02	0.02	0.01	0.03	0.03	0.04	0.04	0.01	0.02
11	Zinc (Zn)	mg/L	0.05	0.164	0.002	0.405	0.098	0.033	0.069	0.088	0.201	0.091	0.078	0.024	0.072	0.094
12	Chromium (VI) (Cr6+)	mg/L	0.05	0.068	0.069	0.071	0.072	0.074	0.069	0.077	0.075	0.069	0.069	0.070	0.069	0.072
13	Cadmium (Cd)	mg/L	0.01	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
14	Total Mercury (T-Hg)	mg/L	0.002	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
15	Lead (Pb)	mg/L	0.03	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
16	Arsenic (As)	mg/L	1	0.051	0.049	0.086	0.053	0.066	0.063	0.071	0.065	0.053	0.050	0.048	0.045	0.053
17	Cyanide (CN)	mg/L	(0.02)	0.008	0.001	0.000	0.000	0.001	0.005	0.000	0.001	0.002	0.004	0.006	0.001	0.002
18	Ammonia (NH_3)	mg/L	(0.5)	0.51	0.19	0.20	0.28	0.22	0.44	0.31	0.37	0.40	0.33	0.18	0.15	0.18
19	Nitrate (NO_3)	mg/L	10	0.781	nd	0.077	nd	nd	nd	0.109	nd	nd	nd	nd	nd	nd
20	Nitrite (NO_2)	mg/L	0.06	nd	nd	nd	nd	nd	nd	0.073	nd	nd	nd	nd	nd	nd
21	Total Phosphorus (T-P)	mg/L	0.2	nd	0.016	0.040	nd	nd	nd	0.334	0.448	nd	nd	0.017	nd	nd
22	Dissolved Oxygen (DO)	mg/L	4	7.6	6.3	5.8	5.9	7.8	7.8	5.1	3.7	6.6	6.8	6.8	7.4	7.8
23	Biochemical Oxygen Demand (BOD)	mg/L	3	2.5	4.2	5.9	2.9	3.8	1.5	10.9	11.3	2.2	2.1	7.7	2.5	1.0
24	Chemical Oxygen Demand (COD)	mg/L	25	21	31	31	21	21	13	62	103	31	16	26	16	21
25	Detergent	mg/L	200	0.063	0.055	0.070	0.071	0.108	0.008	0.245	0.113	0.015	nd	0.02	0.068	0.068
26	Phenol	mg/L	---	nd	nd	nd	0.019	nd	nd	nd	nd	0.018	nd	nd	nd	nd
27	Oil and fat	mg/L	1,000	27	21	13	11	27	18	3	18	2	2	nihil	2	2
28	Coliform group	JPT/100ml	5,000	4.3×10^3	4.6×10^4	4.6×10^4	1.1×10^5	2.3×10^3	9.0×10^2	2.4×10^4	1.5×10^4	9.0×10^2	9.0×10^2	9.3×10^3	2.0×10^3	1.1×10^5
29	Coliform feces	JPT/100ml	1,000	4.3×10^3	2.1×10^3	4.3×10^3	1.5×10^4	2.3×10^3	nihil	9.3×10^3	2.3×10^3	4.0×10^2	nihil	2.1×10^4	1.5×10^4	4.6×10^4
30	Aldrin	ppb	(17)	0	0	0	0	0	0	0	0	0	0	0	0	0
31	Dieldrin	ppb	(17)	0	0	0	0	0	0	0	0	0	0	0	0	0
32	DDT	ppb	2	0	0	0	0	0	0	0	0	0	0	0	0	0.002
33	Lindane	ppb	(56)	0.027	0	0	0.017	0.046	0	0	0	0	0.008	0.046	0	0
34	Endrin	ppb	4	0	0	0	0	0	0	0	0	0	0	0	0	0

Note) "nd" means not detected.

Standard value: Class II of Government Regulation No.82/2001 (Class I in case a vakue of class II is not provided)

The Result of Bed Material Quality Analysis - Wet Season - (Analysed by BATAN)

December 2004

No.	Parameters	Unit	Location							Test Methode
			No.1	No.2	No.3	No.4	No.5	No.6	No.7	
1	Temperature	°C	30.0	30.0	30.0	30.0	30.0	29.0	30.0	Termometry
2	Smell (Odor)	—	Organic smell	Organic smell	Odorless	Odorless	Odorless	Organic smell	Organic smell	Organoleptic
3	Ignition loss	%	4.525 ± 0.075	5.990 ± 0.100	6.755 ± 0.075	5.155 ± 0.075	4.370 ± 0.050	10.645 ± 0.075	8.085 ± 0.025	Gravimetry
4	pH	---	6.0	6.0	6.0	6.0	6.0	6.0	6.0	pH meter
5	Iron (Fe)	µg/g	81,600 ± 1900.000	25,600 ± 150.000	31,500 ± 40.000	24,400 ± 170.000	36,900 ± 100.000	55,200 ± 500.000	42,300 ± 100.000	F-AAS
6	Manganese (Mn)	µg/g	1538.800 ± 20.050	1137.920 ± 10.000	983.680 ± 13.000	2595.420 ± 70.050	1035.290 ± 50.050	1910.450 ± 30.500	975.950 ± 50.000	F-AAS
7	Copper (Cu)	µg/g	31.400 ± 0.560	43.060 ± 0.360	31.540 ± 0.760	27.520 ± 0.260	31.400 ± 1.000	40.710 ± 0.510	34.500 ± 0.300	F-AAS
8	Zinc (Zn)	µg/g	6.010 ± 0.032	5.660 ± 0.036	4.140 ± 0.031	3.210 ± 0.062	3.800 ± 0.033	3.690 ± 0.017	11.010 ± 0.130	F-AAS
9	Chromium (VI) (Cr6+)	µg/g	20.770 ± 2.400	14.930 ± 0.310	21.630 ± 1.600	16.790 ± 2.100	23.840 ± 0.390	16.420 ± 2.400	15.810 ± 0.800	F-AAS
10	Cadmium (Cd)	µg/g	1.170 ± 0.040	0.830 ± 0.046	0.680 ± 0.032	1.030 ± 0.021	14.120 ± 0.220	0.820 ± 0.014	0.580 ± 0.018	F-AAS
11	Total Mercury (T-Hg)	µg/g	0.106 ± 0.065	0.044 ± 0.003	0.132 ± 0.020	0.056 ± 0.025	0.106 ± 0.002	0.102 ± 0.033	0.068 ± 0.002	SS-AAS
12	Lead (Pb)	µg/g	32.420 ± 1.430	32.400 ± 1.430	23.150 ± 0.910	33.210 ± 2.143	21.570 ± 2.400	26.870 ± 3.430	26.460 ± 0.670	F-AAS
13	Arsenic (As)	µg/g	0.038	0.005	0.043	0.038	0.025	0.038	0.005	Spectropho-tometry
14	Cyanide (CN)	ng/g	67.000 ± 1.000	35.000 ± 0.500	26.500 ± 0.500	18.500 ± 0.500	16.500 ± 0.500	27.900 ± 0.100	22.200 ± 0.400	ISE
15	Phosphate(PO4)	µg/g	579.217 ± 6.630	342.161 ± 16.012	391.727 ± 0.115	229.313 ± 5.382	283.961 ± 10.882	449.384 ± 3.713	398.557 ± 9.038	Spectropho-tometry
16	Organic matter	µg/g	179.430 ± 8.125	155.390 ± 8.075	139.360 ± 8.000	203.510 ± 0.000	123.310 ± 8.025	107.290 ± 8.150	75.220 ± 0.000	Titrimetry
17	Chemical Oxygen Demand (COD)	µg/g	37.000 ± 0.865	17.500 ± 0.500	15.500 ± 0.865	10.000 ± 0.500	47.000 ± 0.500	22.500 ± 0.865	40.500 ± 1.000	Spectropho-tometry

No.	Parameters	Unit	Location							Test Methode
			No.8	No.9	No.10	No.11	No.12	No.13		
1	Temperature	°C	29.0	30.0	29.0	29.0	30.0	30.0		Termometry
2	Smell (Odor)	---	Organic smell	Organic smell	Organic smell	Drainage ditch smell	Drainage ditch smell	Organic smell		Organoleptic
3	Ignition loss	%	11.395 ± 0.075	22.230 ± 0.070	12.380 ± 0.050	14.685 ± 0.075	9.910 ± 0.050	9.875 ± 0.075		Gravimetry
4	pH	---	7.0	7.0	6.0	6.0	6.0	6.0		pH meter
5	Iron (Fe)	µg/g	33,100 ± 0.001	34,800 ± 30.000	50,900 ± 100.000	31,400 ± 800.000	32,500 ± 160.000	42,900 ± 100.000		F-AAS
6	Manganese (Mn)	µg/g	1249.700 ± 40.000	739.920 ± 0.830	1720.750 ± 60.500	1304.520 ± 17.000	1896.750 ± 50.050	1837.670 ± 10.000		F-AAS
7	Copper (Cu)	µg/g	43.430 ± 0.300	43.480 ± 0.500	36.080 ± 0.400	33.600 ± 0.200	36.980 ± 0.400	35.010 ± 0.400		F-AAS
8	Zinc (Zn)	µg/g	5.520 ± 0.012	4.580 ± 0.018	5.430 ± 0.016	4.010 ± 0.060	3.820 ± 0.018	4.440 ± 0.027		F-AAS
9	Chromium (VI) (Cr6+)	µg/g	16.570 ± 1.200	15.020 ± 1.520	15.470 ± 1.800	10.610 ± 1.700	12.240 ± 0.050	18.680 ± 0.200		F-AAS
10	Cadmium (Cd)	µg/g	0.790 ± 0.044	0.790 ± 0.054	0.830 ± 0.054	0.710 ± 0.018	0.690 ± 0.018	0.800 ± 0.050		F-AAS
11	Total Mercury (T-Hg)	µg/g	0.028 ± 0.008	0.033 ± 0.002	0.052 ± 0.015	0.068 ± 0.004	0.025 ± 0.007	0.050 ± 0.005		SS-AAS
12	Lead (Pb)	µg/g	30.370 ± 0.130	23.720 ± 0.052	25.280 ± 0.410	31.430 ± 1.300	22.560 ± 0.370	24.500 ± 0.310		F-AAS
13	Arsenic (As)	µg/g	0.018	0.025	0.043	0.043	0.018	0.038		Spectropho-tometry
14	Cyanide (CN)	ng/g	14.300 ± 0.300	26.800 ± 0.200	10.800 ± 0.200	19.500 ± 0.500	12.650 ± 0.050	9.000 ± 0.150		ISE
15	Phosphate(PO4)	µg/g	327.988 ± 7.475	331.941 ± 6.337	410.358 ± 0.546	292.417 ± 1.198	314.054 ± 7.208	435.008 ± 0.521		Spectropho-tometry
16	Organic matter	µg/g	75.220 ± 8.000	219.540 ± 8.000	179.430 ± 8.125	115.310 ± 8.025	99.270 ± 8.025	83.230 ± 8.000		Titrimetry
17	Chemical Oxygen Demand (COD)	µg/g	32.000 ± 0.865	5.500 ± 0.865	36.000 ± 1.000	65.500 ± 0.865	22.500 ± 0.865	40.000 ± 1.000		Spectropho-tometry

Note) F-AAS: Flame Atomic Absorption Spectrophotometry

SS-AAS: Solid Sampling Atomic Absorption Spectrophotometry

ISE: Ion Selective Electrode

The Result of Bed Material Quality Analysis - Dry Season - (Analysed by BATAN)

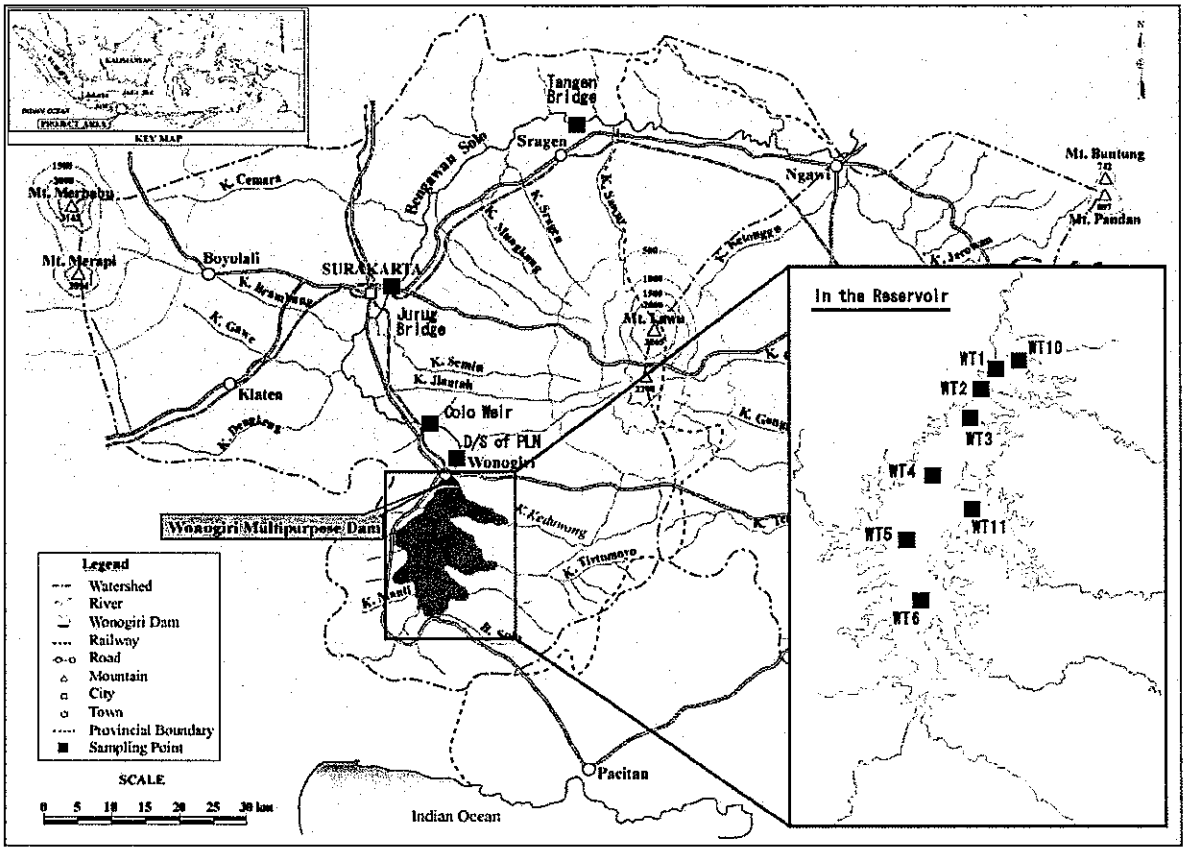
May 2005

No.	Parameters	Unit	Location							Test Methode
			No.1	No.2	No.3	No.4	No.5	No.6	No.7	
1	Temperature	℃	28.0	27.0	27.0	28.0	28.0	28.0	28.0	Termometry
2	Smell (Odor)	—	Soil smell	Soil smell	Soil smell	Organic smell	Soil smell	Soil smell	Drainage ditch smell	Organoleptic
3	Ignition loss	%	10.900 ± 0.000	7.410 ± 0.100	11.680 ± 0.100	12.525 ± 0.095	9.880 ± 0.000	12.130 ± 0.000	11.050 ± 0.000	Gravimetry
4	pH	—	7.0	6.5	7.0	6.0	6.0	6.0	7.0	pH meter
5	Iron (Fe)	%	2756.970 ± 5.650	3553.780 ± 9.150	2709.160 ± 5.440	2048.000 ± 32.410	1964.070 ± 11.220	2656.000 ± 10.050	4023.670 ± 23.030	F-AAS
6	Manganese (Mn)	µg/g	2041.830 ± 19.210	2041.830 ± 10.110	1603.590 ± 15.120	3140.000 ± 21.210	838.320 ± 9.230	2700.000 ± 31.500	1666.670 ± 7.120	F-AAS
7	Copper (Cu)	µg/g	25.700 ± 0.460	29.480 ± 0.310	28.090 ± 0.760	24.40 ± 0.260	18.360 ± 1.000	29.800 ± 0.320	32.740 ± 0.400	F-AAS
8	Zinc (Zn)	µg/g	91.630 ± 0.030	169.820 ± 2.350	90.640 ± 1.310	55.000 ± 0.230	67.370 ± 1.330	85.500 ± 0.170	995.860 ± 3.230	F-AAS
9	Chromium (VI) (Cr6+)	µg/g	16.930 ± 0.200	32.870 ± 0.310	34.860 ± 0.600	28.000 ± 1.000	13.970 ± 1.390	16.000 ± 0.210	31.560 ± 0.520	F-AAS
10	Cadmium (Cd)	µg/g	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	F-AAS
11	Total Mercury (T-Hg)	µg/g	0.076 ± 0.001	0.068 ± 0.005	0.050 ± 0.015	0.076 ± 0.017	0.082 ± 0.001	0.048 ± 0.004	0.159 ± 0.001	SS-AAS
12	Lead (Pb)	µg/g	42.830 ± 1.130	38.840 ± 1.410	28.880 ± 0.910	48.000 ± 0.140	32.930 ± 0.400	31.000 ± 0.430	37.480 ± 0.120	F-AAS
13	Arsenic (As)	µg/g	1.550	1.550	1.950	1.450	1.550	1.150	0.950	Spectropho-tometry
14	Cyanide (CN)	ng/g	1.550 ± 0.075	1.025 ± 0.038	0.075 ± 0.000	1.200 ± 0.050	3.175 ± 0.100	1.600 ± 0.025	12.525 ± 0.150	ISE
15	Phosphate(PO4)	µg/g	521.250 ± 23.750	465.000 ± 13.750	448.000 ± 5.250	323.750 ± 13.750	254.875 ± 17.125	397.500 ± 16.000	571.750 ± 7.000	Spectropho-tometry
16	Organic matter	µg/g	111.4	60.2	53.8	53.8	66.6	60.2	60.2	Titrimetry
17	Chemical Oxygen Demand (COD)	µg/g	65.300 ± 2.500	14.300 ± 2.100	160.000 ± 8.500	14.300 ± 2.100	85.700 ± 2.140	92.500 ± 2.370	180.700 ± 11.700	Spectropho-tometry

No.	Parameters	Unit	Location							Test Methode
			No.8	No.9	No.10	No.11	No.12	No.13		
1	Temperature	℃	28.0	27.5	27.0	28.0	28.0	28.0		Termometry
2	Smell (Odor)	—	Drainage ditch smell	Soil smell	Soil smell	Soil smell	Soil smell	Soil smell		Organoleptic
3	Ignition loss	%	15.520 ± 0.000	14.300 ± 0.000	13.600 ± 0.200	13.070 ± 0.000	14.070 ± 0.100	13.125 ± 0.095		Gravimetry
4	pH	—	6.0	7.0	6.0	6.0	7.0	6.0		pH meter
5	Iron (Fe)	%	2154.460 ± 23.210	2439.600 ± 23.240	2253.970 ± 16.000	2486.060 ± 12.210	2824.460 ± 12.100	2549.800 ± 12.230		F-AAS
6	Manganese (Mn)	µg/g	2198.020 ± 60.500	940.590 ± 11.000	2043.650 ± 52.050	1982.070 ± 10.120	3106.510 ± 45.120	2888.450 ± 43.000		F-AAS
7	Copper (Cu)	µg/g	35.250 ± 0.200	29.500 ± 0.110	28.370 ± 0.140	24.700 ± 0.120	25.640 ± 0.130	25.000 ± 0.230		F-AAS
8	Zinc (Zn)	µg/g	268.320 ± 3.210	69.310 ± 0.100	73.410 ± 0.180	71.710 ± 0.270	74.950 ± 0.430	75.700 ± 1.210		F-AAS
9	Chromium (VI) (Cr6+)	µg/g	22.770 ± 0.780	9.900 ± 0.120	13.890 ± 0.050	11.950 ± 0.210	13.810 ± 0.180	23.900 ± 0.120		F-AAS
10	Cadmium (Cd)	µg/g	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020		F-AAS
11	Total Mercury (T-Hg)	µg/g	0.155 ± 0.016	0.126 ± 0.031	0.067 ± 0.004	0.048 ± 0.007	0.112 ± 0.032	0.063 ± 0.011		SS-AAS
12	Lead (Pb)	µg/g	53.470 ± 0.410	48.510 ± 0.120	25.790 ± 0.310	22.910 ± 0.310	24.650 ± 0.670	32.870 ± 0.430		F-AAS
13	Arsenic (As)	µg/g	1.300	1.650	1.400	1.200	1.450	1.250		Spectropho-tometry
14	Cyanide (CN)	ng/g	8.800 ± 0.400	4.925 ± 0.050	1.650 ± 0.000	1.688 ± 0.013	1.475 ± 0.000	1.233 ± 0.003		ISE
15	Phosphate(PO4)	µg/g	561.250 ± 7.250	215.500 ± 5.563	296.750 ± 4.500	277.500 ± 11.250	311.250 ± 0.100	405.000 ± 1.500		Spectropho-tometry
16	Organic matter	µg/g	47.2	60.2	47.2	40.8	53.8	41.0		Titrimetry
17	Chemical Oxygen Demand (COD)	µg/g	230.000 ± 10.000	158.000 ± 14.800	132.200 ± 2.540	15.700 ± 4.040	207.000 ± 2.650	143.100 ± 7.560		Spectropho-tometry

Note) F-AAS: Flame Atomic Absorption Spectrophotometry
SS-AAS: Solid Sampling Atomic Absorption Spectrophotometry
ISE: Ion Selective Electrode

Sampling Location for Periodic Water Quality Monitoring



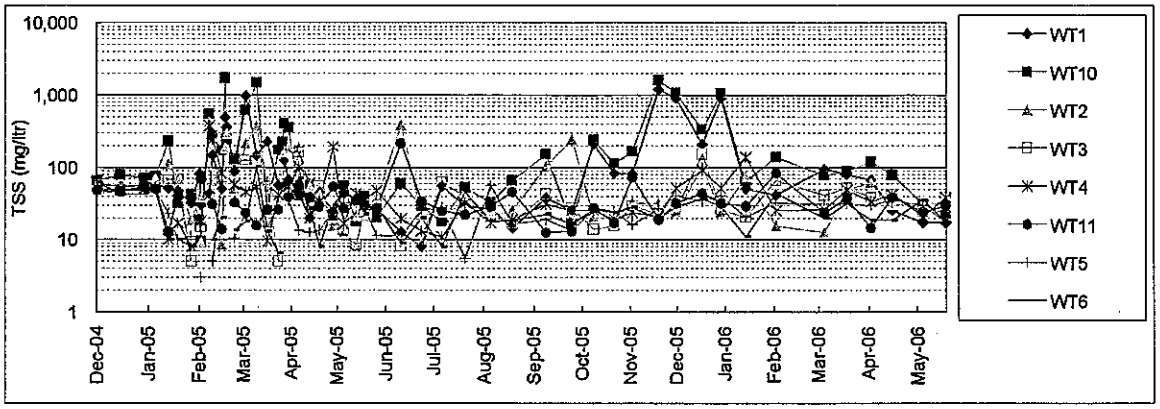
Monitoring Date and Result of TSS (Total Suspended Solids)

No.	Regular / Flood*	Date	Reservoir WL (El.m)	Average TSS (mg/ltr) at Respective Locations											
				WT1	WT10	WT2	WT3	WT4	WT11	WT5	WT6	D/S of PLN	Colo W.	Jurug B.	Tangen B.
1	R	December 7, 2004	132.60	59	65	56	55	51	48	44	62	75	70	59	83
2	R	December 21, 2004	132.40	54	79	51	50	48	46	47	42	63	76		
3	R	January 4, 2005	133.09	56	71	52	52	50	55	48	43	70	76	88	105
4	R	January 11, 2005	132.76	59	75	69	54	52	50	49	48	72	75	81	67
5	R	January 19, 2005	132.56	52	229	109	67	10	13	23	10	109	514	420	832
6	R	January 25, 2005	133.20	47	32	68	68	17	40	10	10	47	55	319	271
7	R	February 2, 2005	133.44	32	42	18	5	8	38	11	8	45	78	189	238
8	F	February 7, 2005	133.31	81	19	39									
9	R	February 8, 2005	133.27	31	10	9	15	18	68	3	29	9	17	139	191
10	F	February 13, 2005	133.37	44	545	418		376							
11	R	February 15, 2005	133.42	148	280	37	65	245	31	5	10	93	221	315	651
12	R	February 21, 2005	133.69	51	170	9	93	83	14	63	20	332	142	490	381
13	F	February 23, 2005	133.88	489	1,730	183									
14	F	February 24, 2005	134.00	361	243	295									
15	R	March 1, 2005	134.18	89	131	51	126	58	33	11	14	183	413	279	236
16	R	March 8, 2005	134.68	972	620	214	125	46	24	24	18	530	251	184	417
17	R	March 15, 2005	135.32	146	1,487	371	124	54	16	17	101	889	444	194	896
18	R	March 22, 2005	135.38	227	26	65	54	10	26	15	13	72	92	283	64
19	R	March 29, 2005	135.69	56	174	27	5	41	26	29	7	488	763	777	1,321
20	F	April 1, 2005	136.18	53	221	42									
21	F	April 2, 2005	136.44	125	401	162									
22	R	April 5, 2005	136.90	68	357	187	45	54	39	36	38	160	398	469	558
23	R	April 12, 2005	136.82	45	41	188	163	101	58	14	71	24	39	130	208
24	R	April 19, 2005	136.87	20	56	53	55	20	38	13	27	161	278	49	35
25	R	April 25, 2005	136.83	45	37	42	56	34	29	14	8	19	41	36	32
26	R	May 4, 2005	136.66	25	22	16	19	193	54	26	30	25	45	44	24
27	R	May 11, 2005	136.46	44	56	13	14	17	27	32	46	76	9	27	37
28	R	May 19, 2005	136.22	37	18	22	9	44	35	32	37	13	40	33	38
29	R	May 24, 2005	136.05	35	40	21	25	36	30	28	23	11	24	51	45
30	R	June 1, 2005	135.76	27	21	36	30	48	27	12	30	19	24	50	51
31	R	June 16, 2005	135.09	13	59	384	8	20	215	11	9	6	28	24	26
32	R	June 29, 2005	135.18	8	29	22	10	13	34	26	20	117	160	32	543
33	R	July 12, 2005	135.03	55	18	24	62	11	25	28	8	14	130	115	192
34	R	July 26, 2005	134.60	29	53	30	40	32	22	6	46	13	47	19	40
35	R	August 11, 2005	133.81	27	33	21	21	17	29	56	18	81	43	20	11
36	R	August 24, 2005	133.12	15	66	26	17	19	46	17	19	11	12	22	21
37	R	September 14, 2005	131.96	38	153	103	43	31	13	19	23	19	16	36	27
38	R	September 30, 2005	131.02	26	16	244	28	26	13	14	17	22	18	10	217
39	R	October 14, 2005	130.36	212	239	21	14	25	28	28	27	14	31	46	15
40	R	October 27, 2005	130.15	82	113	20	16	19	17	25	24	24	81	719	109
41	R	November 8, 2005	129.90	81	167	33	30	24	73	16	28	28	26	30	42
42	R	November 25, 2005	129.56	1,205	1,617	32	23	21	19	27	20	37	32	46	44
43	R	December 6, 2005	129.81	896	1,072	24	26	52	32	41	29	52	419	790	778
44	R	December 23, 2005	133.00	210	334	102	153	92	44	35	37	144	210	33	290
45	R	January 4, 2006	134.47	896	1,072	24	26	52	32	41	29	52	419	790	778
46	R	January 20, 2006	135.12	51	64	75	21	138	29	21	11	33	81	165	154
47	R	February 8, 2006	135.63	42	139	16	66	25	84	32	44	20	41	233	23
48	R	March 10, 2006	135.97	95	79	13	41	27	24	31	20	22	37	23	34
49	R	March 24, 2006	136.12	80	88	49	52	49	37	32	32	17	66	68	85
50	R	April 8, 2006	136.61	68	121	62	39	34	15	30	19	51	135	167	235
51	R	April 21, 2006	137.10	26	80	31	43	43	39	36	19	48	107	123	181
52	R	May 10, 2006	136.89	17	31	32	24	21	24	30	36	30	11	181	367
53	R	May 24, 2006	136.73	17	23	31	39	38	30	18	18	116	77	109	27

Note *: "R" means regular periodically monitoring, and "F" means ad-hoc monitoring just after flood occurrence.

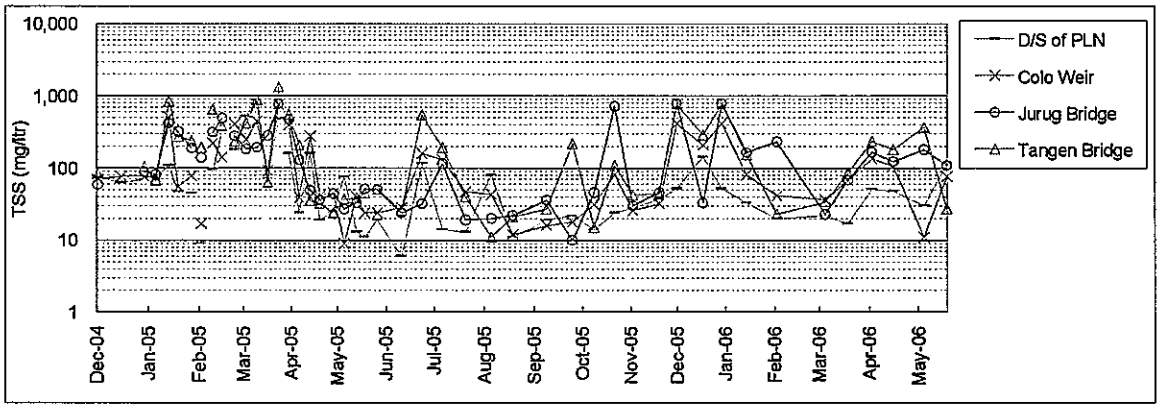
Source: JICA Study Team

Result of TSS Monitoring in the Wonogiri Reservoir

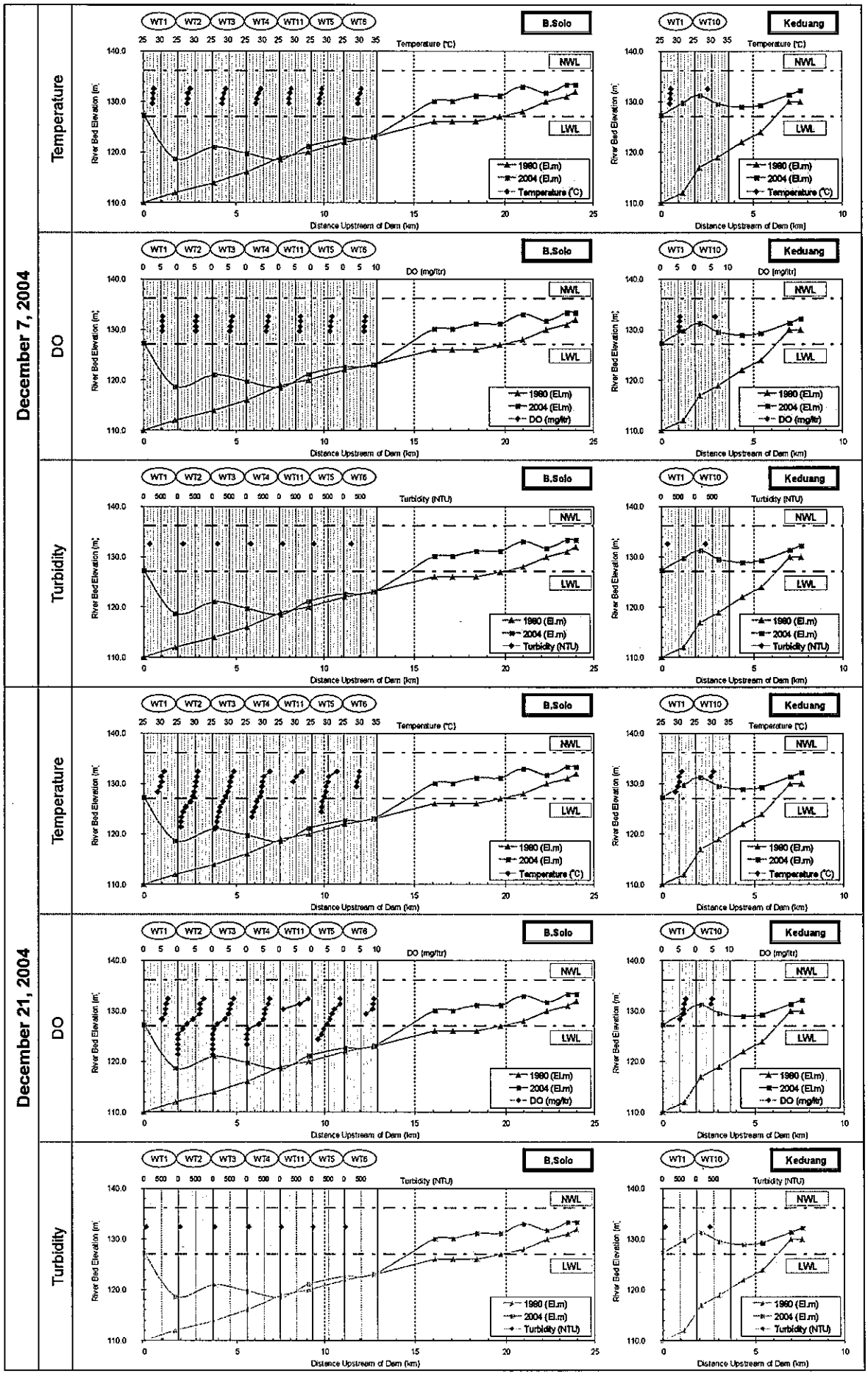


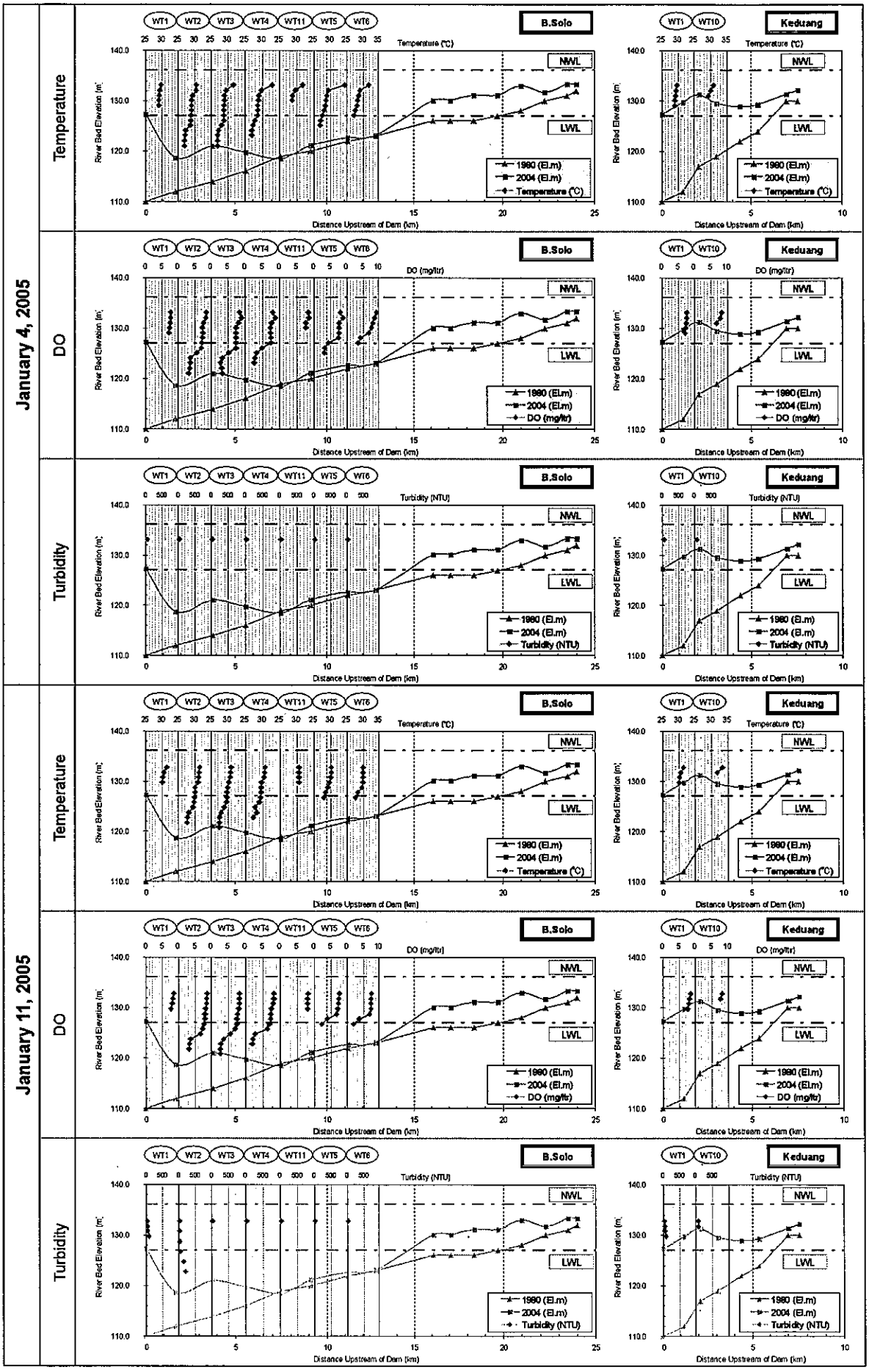
Source: JICA Study Team

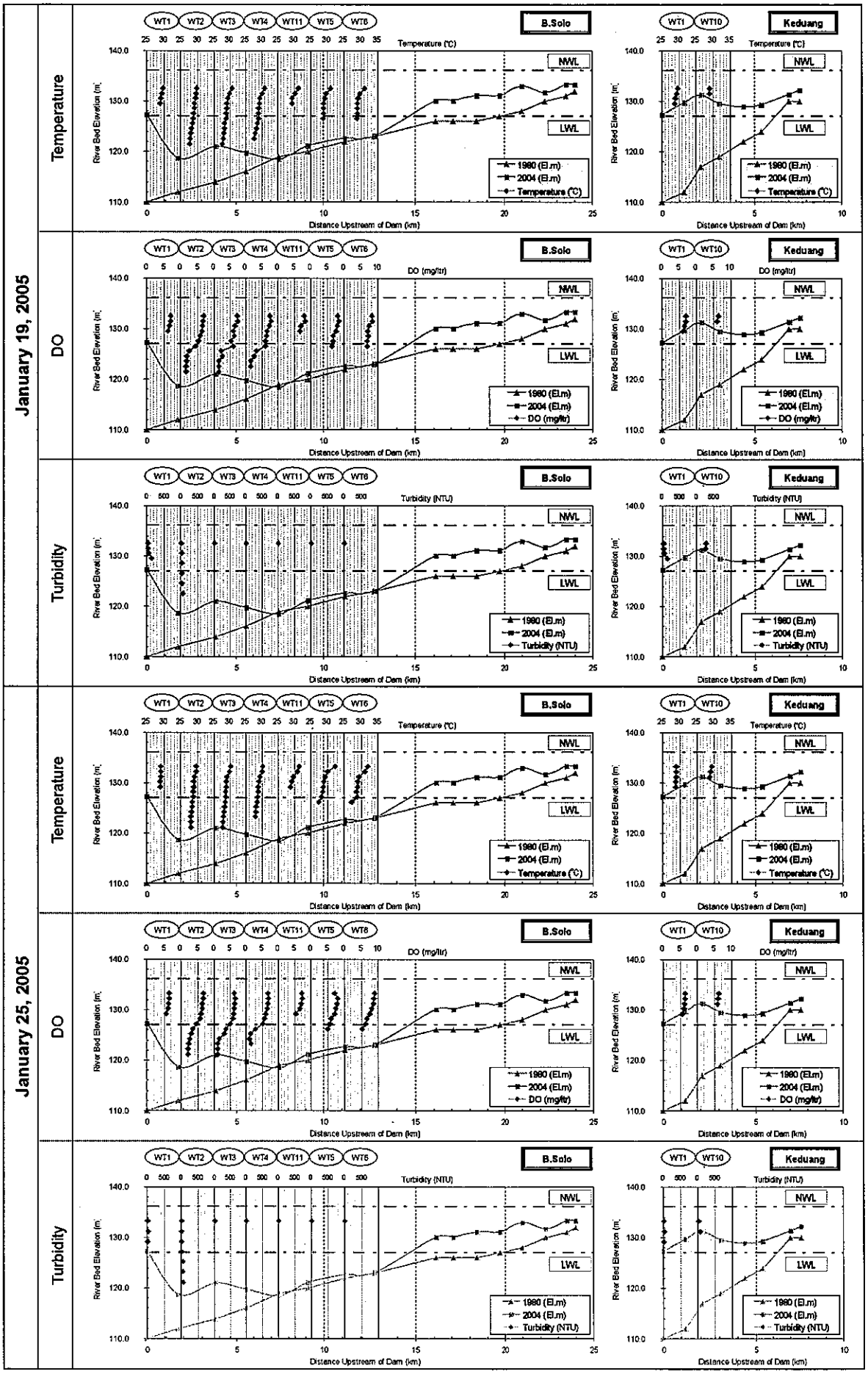
Result of TSS Monitoring in the Upper Solo River

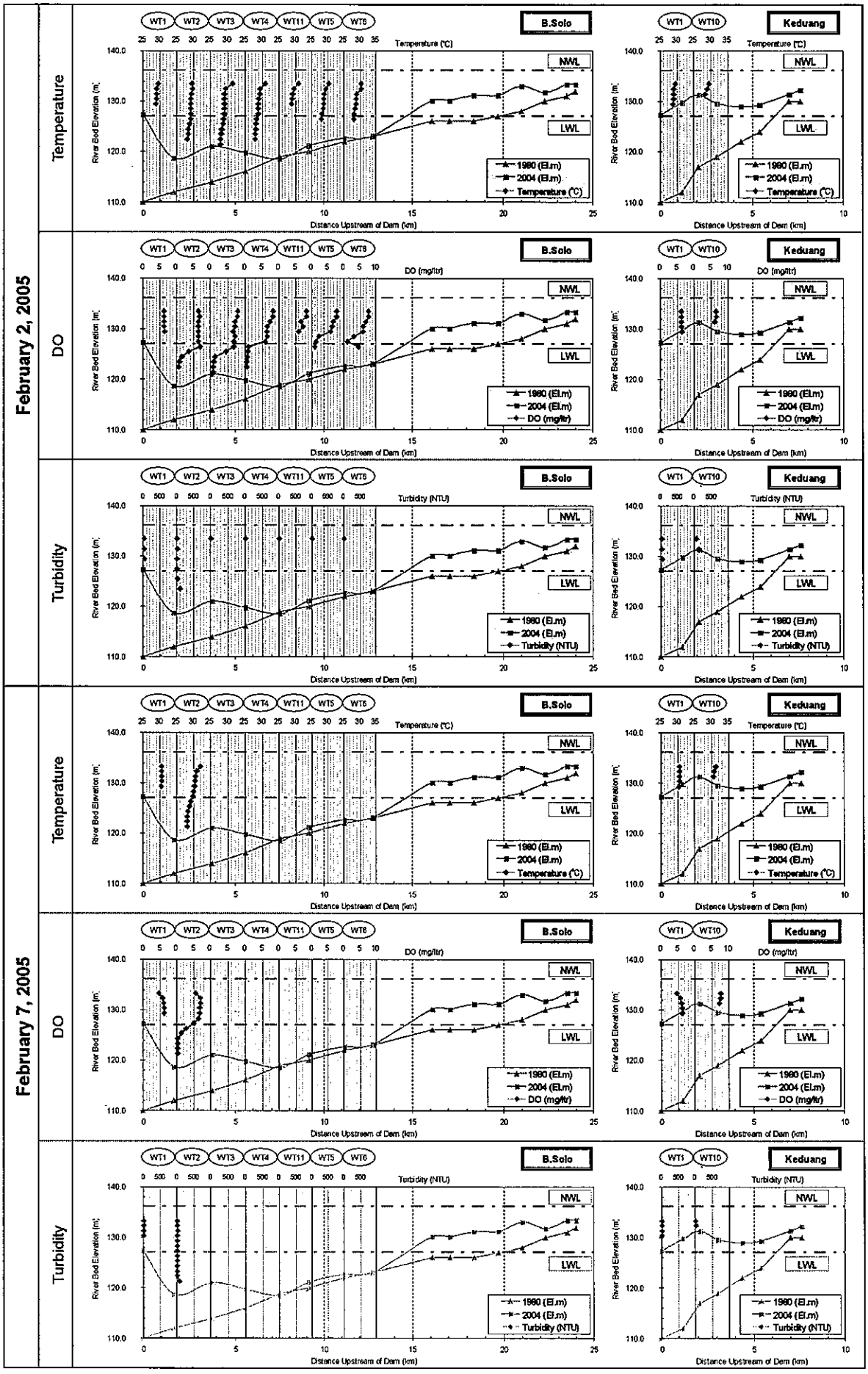


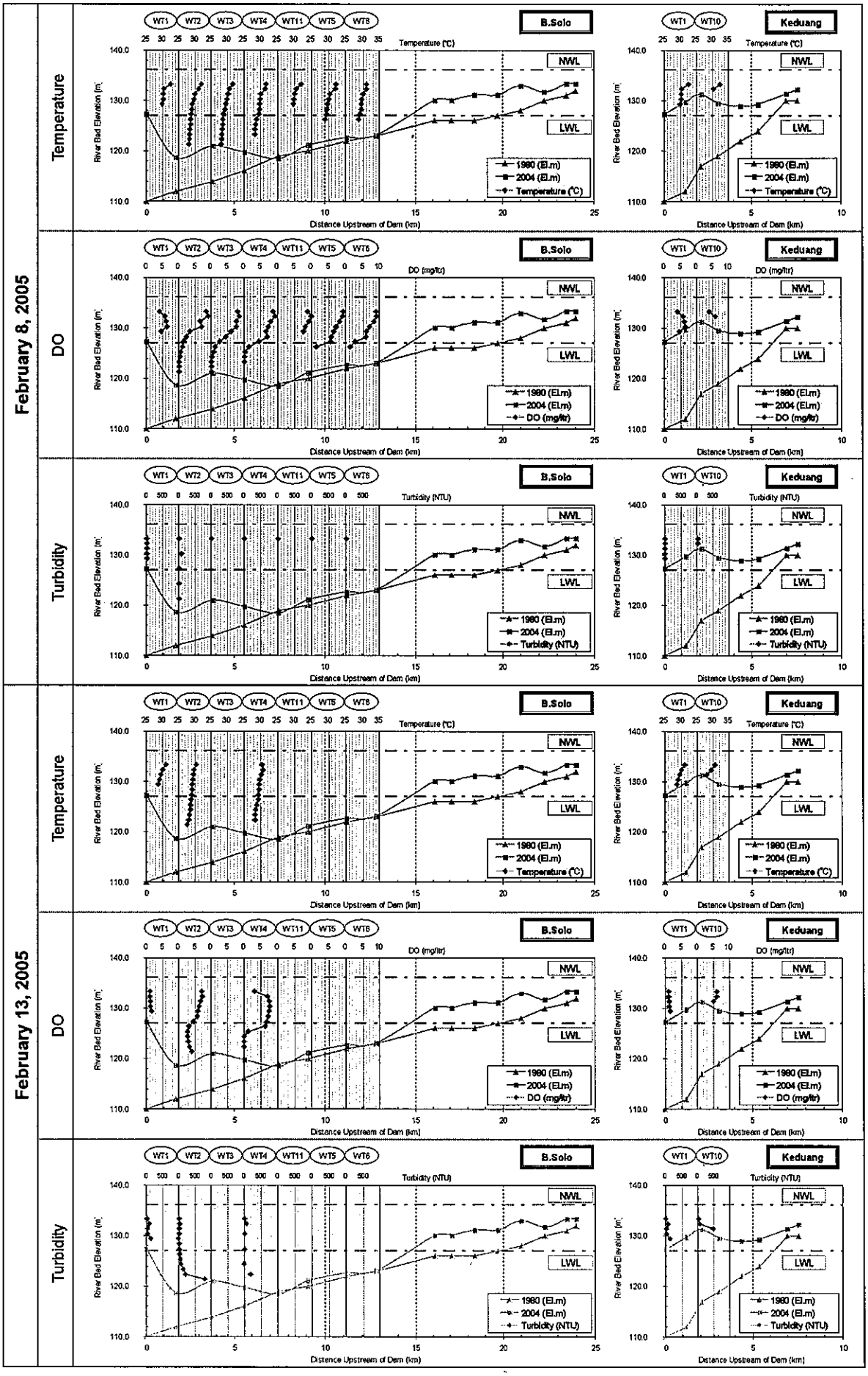
Source: JICA Study Team

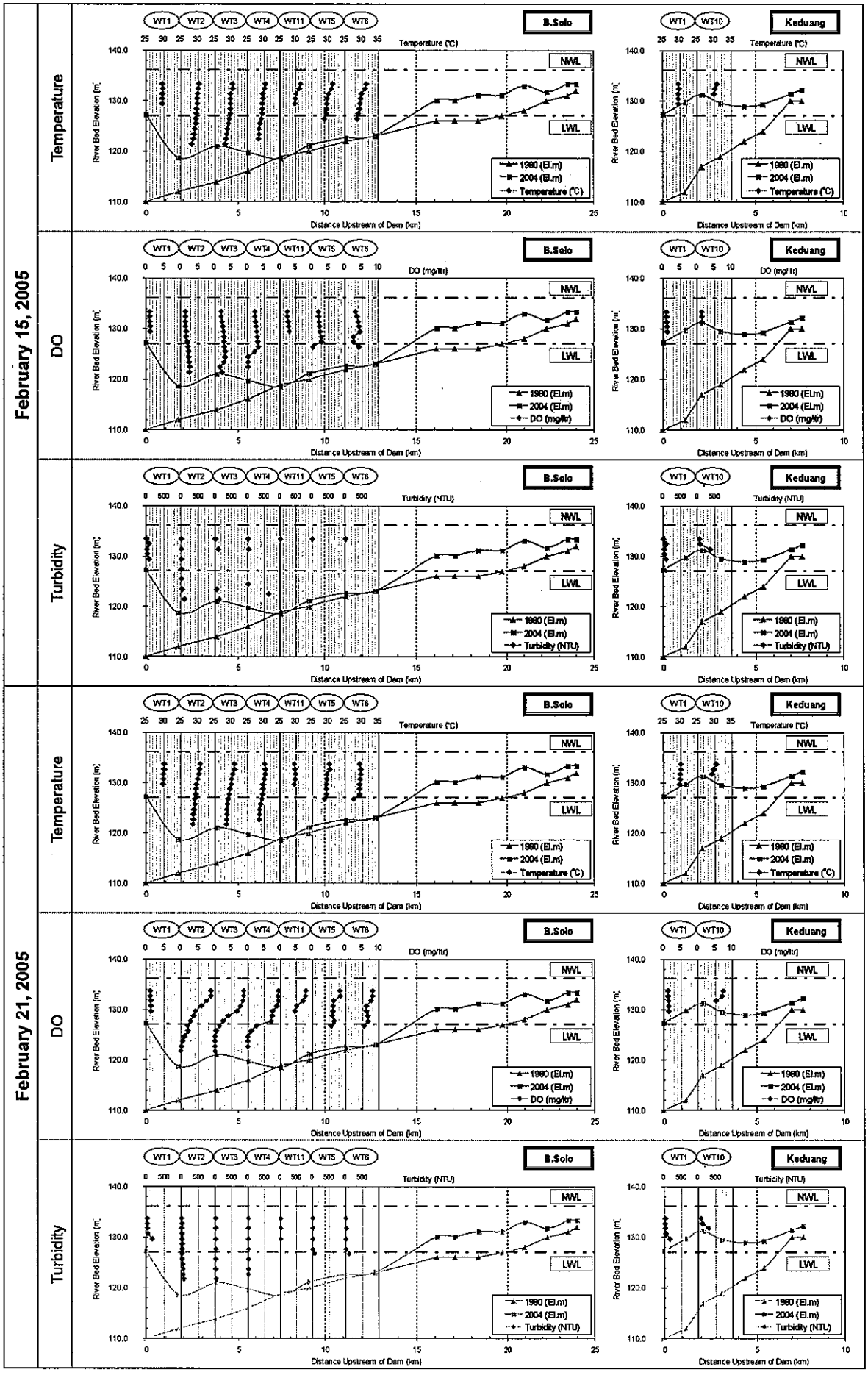

December 7, 2004
December 21, 2004
Temperature
DO
Turbidity
B.Solo
Keduang
WT1
WT2
WT3
WT4
WT11
WT5
WT6
WT10
NWL
LWL
River Bed Elevation (m)
Distance Upstream of Dam (km)
Temperature (℃)
DO (mg/ltr)
Turbidity (NTU)
1980 (El.m)
2004 (El.m)

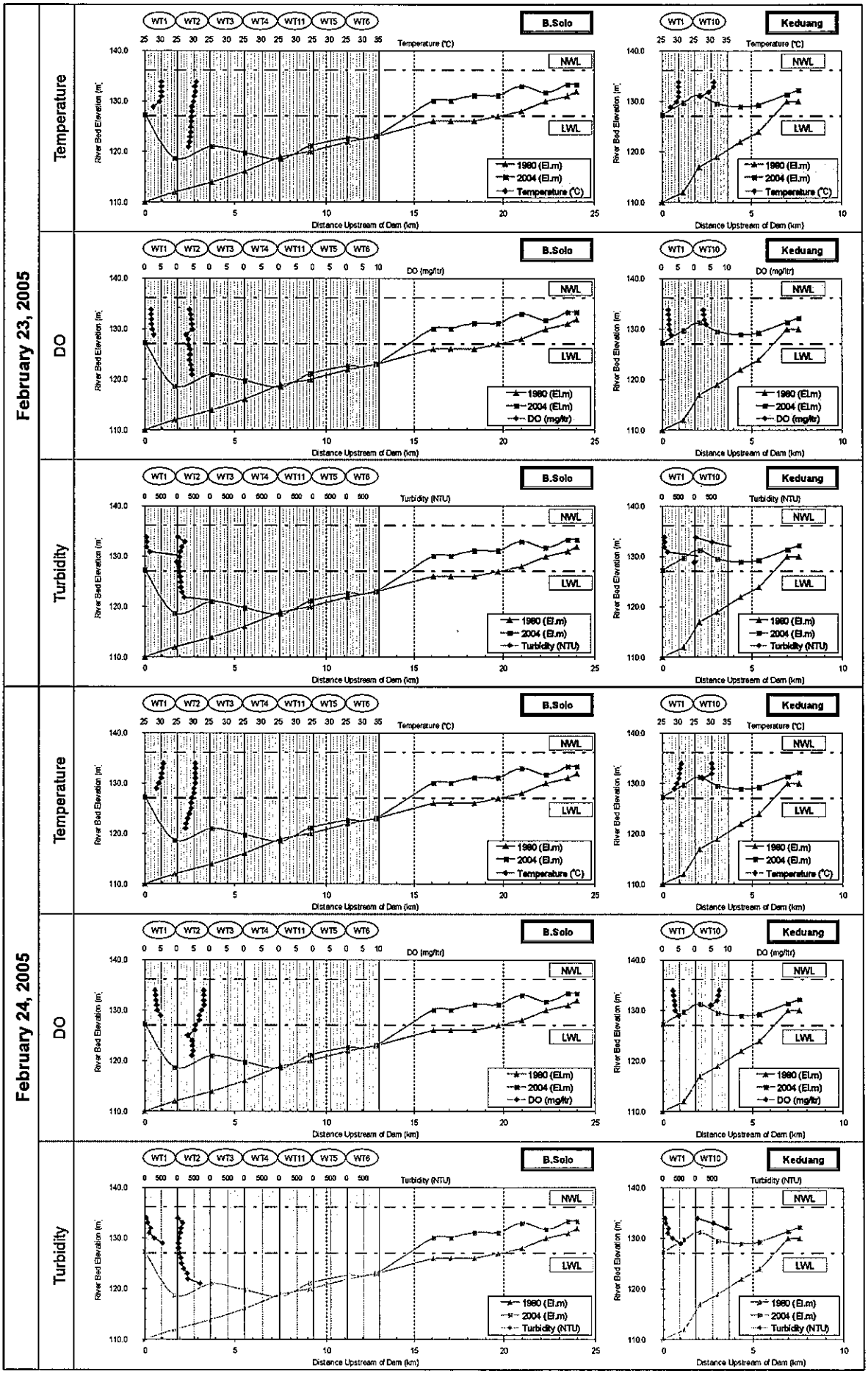

January 4, 2005
January 11, 2005
Temperature
DO
Turbidity
B.Solo
Keduang
WT1 WT2 WT3 WT4 WT11 WT5 WT6
WT1 WT10
Temperature (°C)
DO (mg/ltr)
Turbidity (NTU)
River Bed Elevation (m)
Distance Upstream of Dam (km)
NWL
LWL
1980 (El.m)
2004 (El.m)
Temperature (°C)
DO (mg/ltr)
Turbidity (NTU)

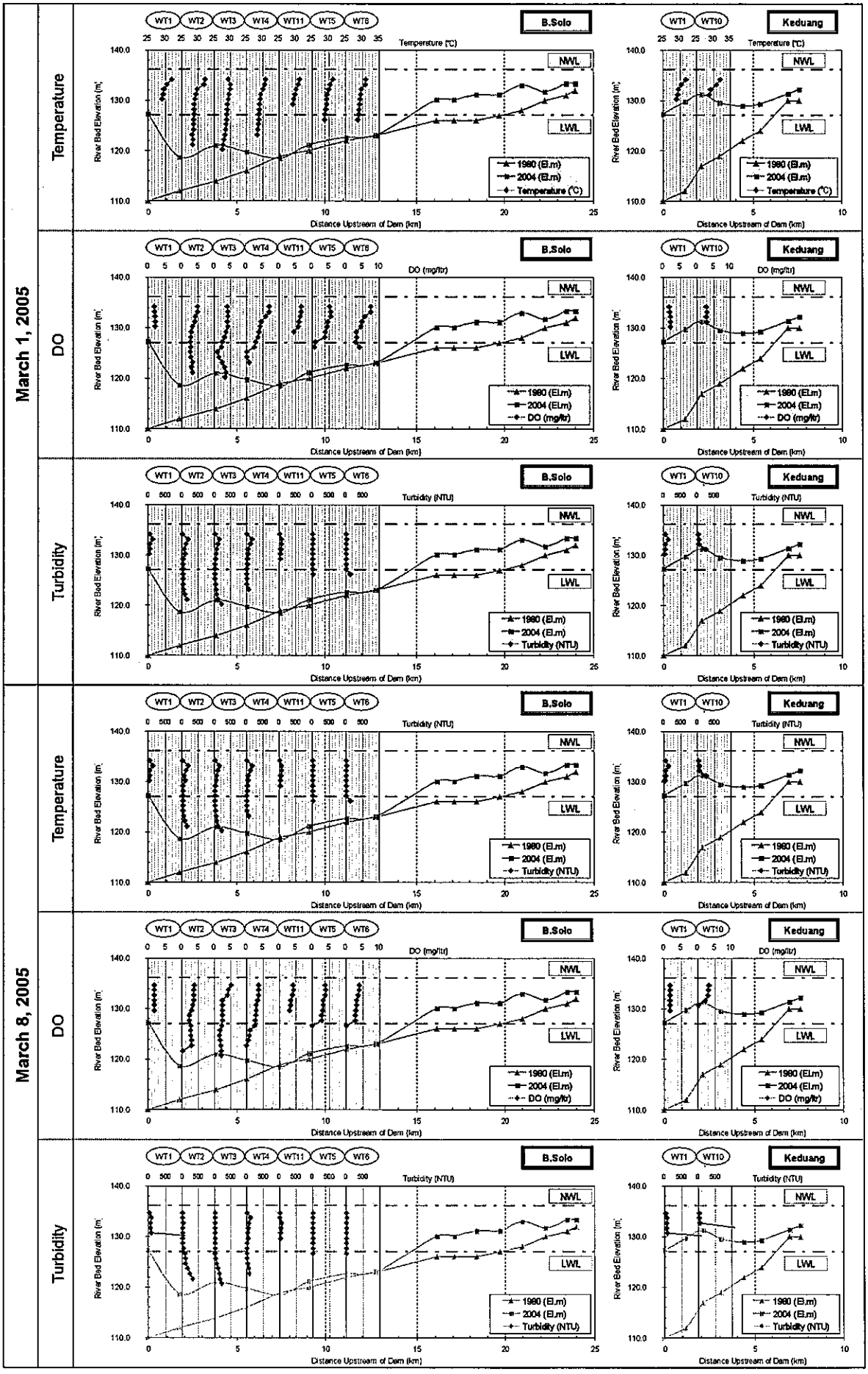

January 19, 2005
Temperature
DO
Turbidity
January 25, 2005
Temperature
DO
Turbidity
WT1 WT2 WT3 WT4 WT11 WT5 WT6
WT1 WT10
B.Solo
Keduang
Temperature (°C)
DO (mg/ltr)
Turbidity (NTU)
River Bed Elevation (m)
Distance Upstream of Dam (km)
NWL
LWL
1980 (El.m)
2004 (El.m)
Temperature (°C)
DO (mg/ltr)
Turbidity (NTU)

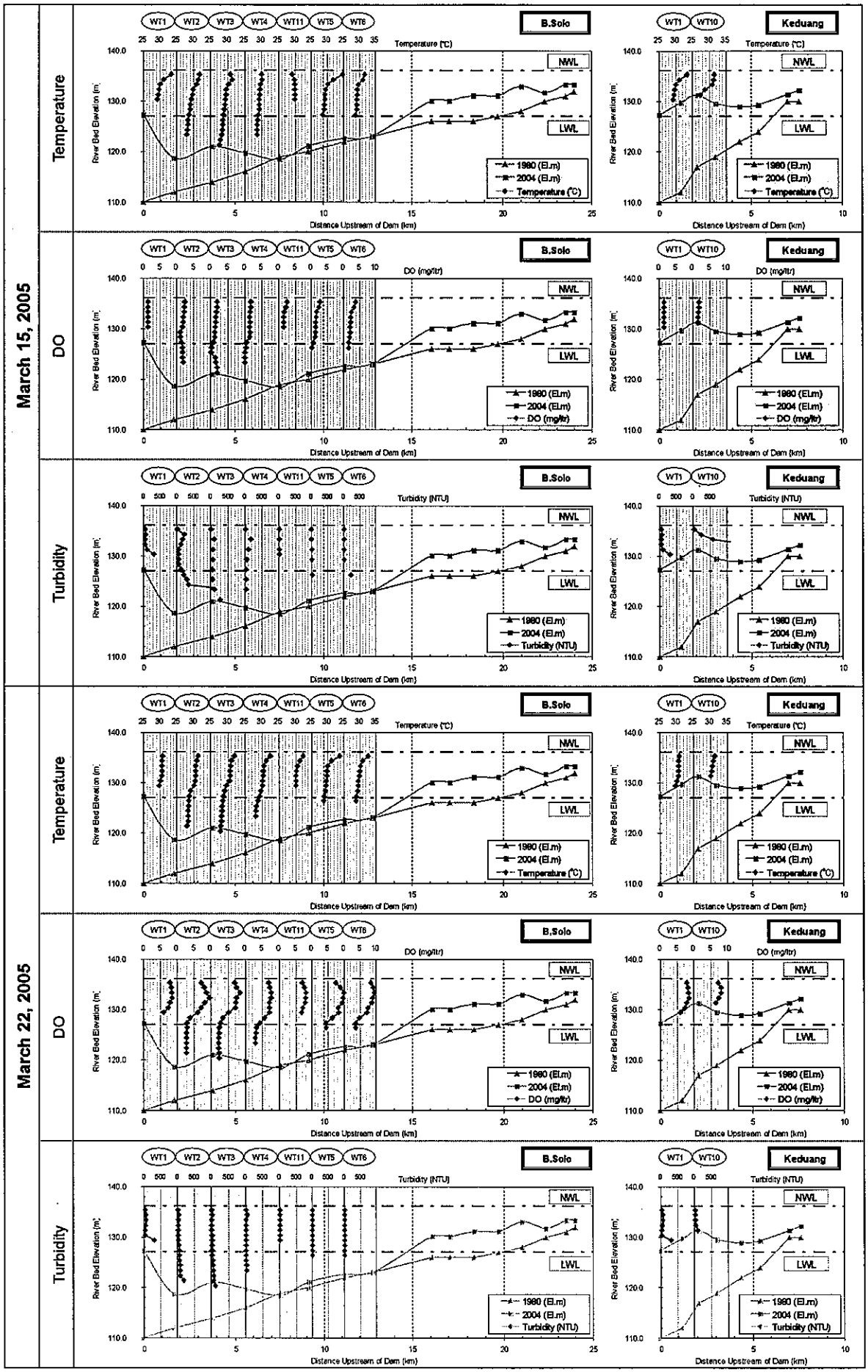

February 2, 2005
February 7, 2005
Temperature
DO
Turbidity
B.Solo
Keduang
WT1
WT2
WT3
WT4
WT11
WT5
WT6
WT10
NWL
LWL
River Bed Elevation (m)
Distance Upstream of Dam (km)
Temperature (°C)
DO (mg/ltr)
Turbidity (NTU)
1980 (El.m)
2004 (El.m)

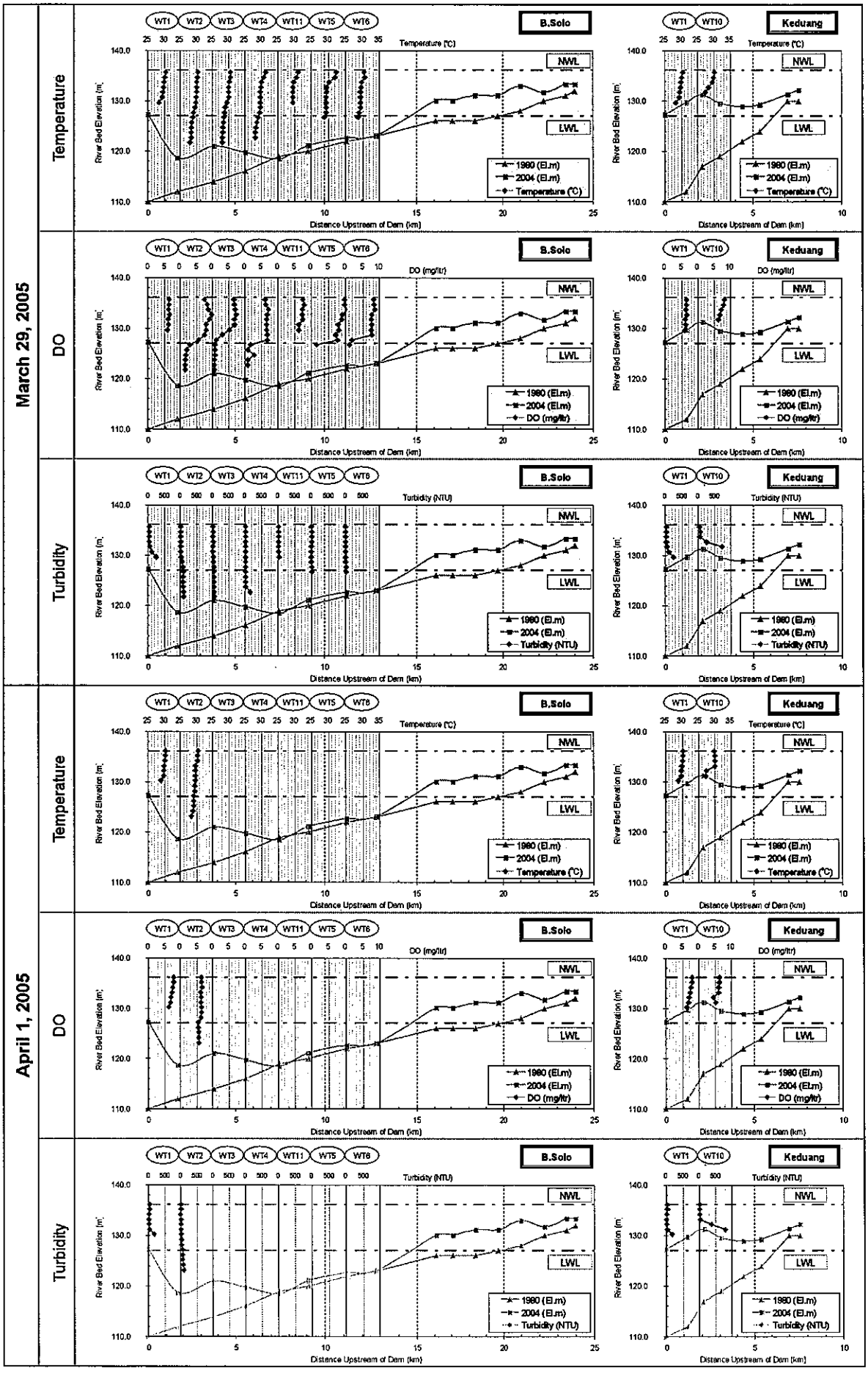

February 8, 2005
February 13, 2005
Temperature
DO
Turbidity
B.Solo
Keduang
WT1
WT2
WT3
WT4
WT11
WT5
WT6
WT8
WT10
NWL
LWL
River Bed Elevation (m)
Distance Upstream of Dam (km)
Temperature (℃)
DO (mg/ltr)
Turbidity (NTU)
1980 (El.m)
2004 (El.m)

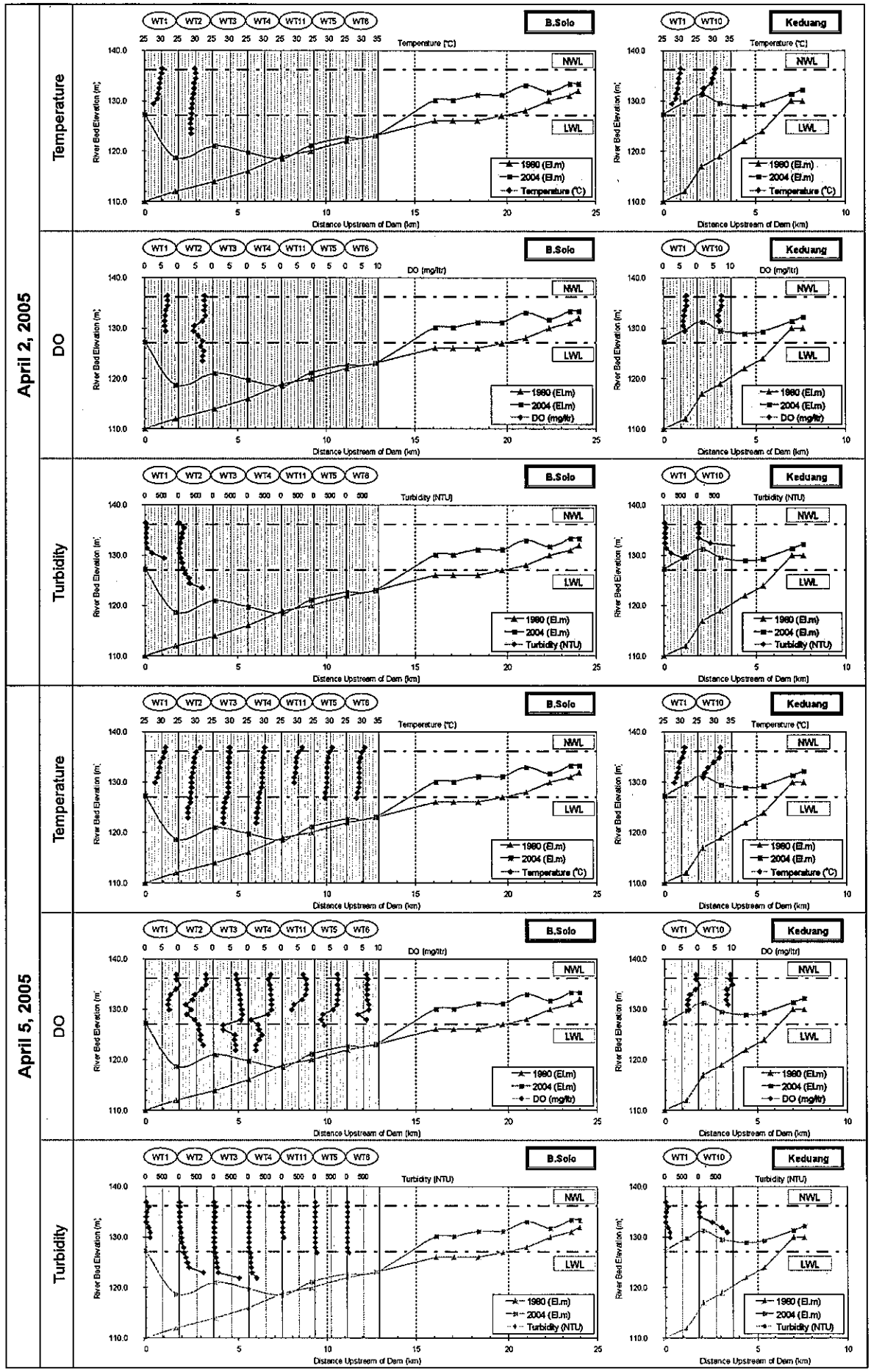

February 15, 2005
February 21, 2005
Temperature
DO
Turbidity
B.Solo
Keduang
WT1
WT2
WT3
WT4
WT11
WT5
WT6
WT10
NWL
LWL
River Bed Elevation (m)
Distance Upstream of Dam (km)
Temperature (℃)
DO (mg/ltr)
Turbidity (NTU)
1980 (El.m)
2004 (El.m)
Temperature (℃)
DO (mg/ltr)
Turbidity (NTU)


February 23, 2005
February 24, 2005
Temperature
DO
Turbidity
B.Solo
Keduang
WT1 WT2 WT3 WT4 WT11 WT5 WT6
WT1 WT10
Temperature (℃)
DO (mg/ltr)
Turbidity (NTU)
River Bed Elevation (m)
Distance Upstream of Dam (km)
NWL
LWL
1980 (El.m)
2004 (El.m)
Temperature (℃)
DO (mg/ltr)
Turbidity (NTU)


March 1, 2005
March 8, 2005
Temperature
DO
Turbidity
B.Solo
Keduang
WT1
WT2
WT3
WT4
WT11
WT5
WT6
WT10
NWL
LWL
River Bed Elevation (m)
Distance Upstream of Dam (km)
Temperature (°C)
DO (mg/ltr)
Turbidity (NTU)
1980 (El.m)
2004 (El.m)


March 15, 2005
March 22, 2005
Temperature
DO
Turbidity
B.Solo
Keduang
WT1
WT2
WT3
WT4
WT11
WT5
WT6
WT10
Temperature (°C)
DO (mg/ltr)
Turbidity (NTU)
River Bed Elevation (m)
Distance Upstream of Dam (km)
NWL
LWL
1980 (El.m)
2004 (El.m)
Temperature (°C)
DO (mg/ltr)
Turbidity (NTU)


March 29, 2005
April 1, 2005
Temperature
DO
Turbidity
B.Solo
Keduang
WT1 WT2 WT3 WT4 WT11 WT5 WT6
WT1 WT10
Temperature (°C)
DO (mg/ltr)
Turbidity (NTU)
River Bed Elevation (m)
Distance Upstream of Dam (km)
NWL
LWL
1980 (El.m)
2004 (El.m)
Temperature (°C)
DO (mg/ltr)
Turbidity (NTU)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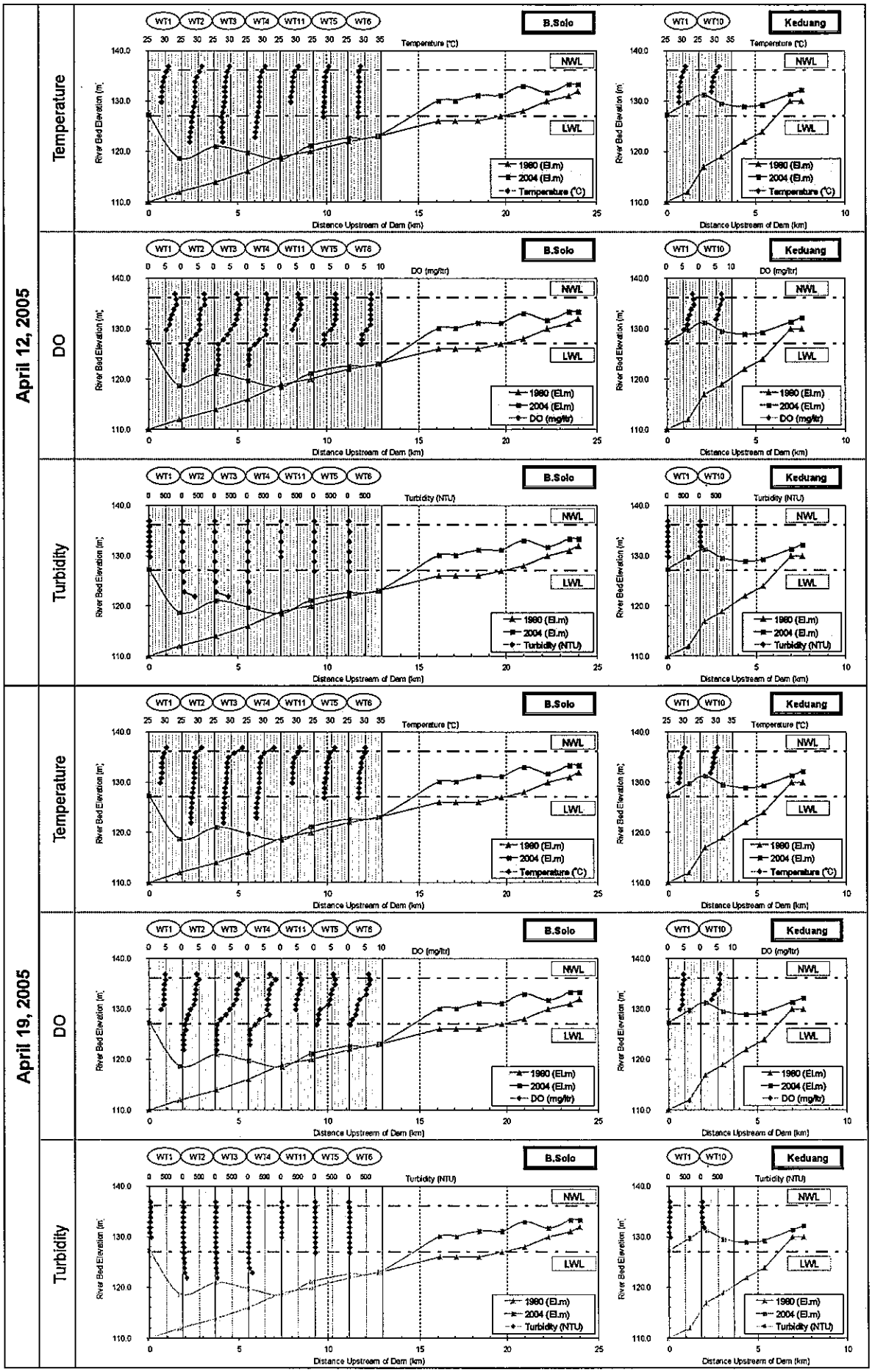
April 5, 2005
Temperature
DO
Turbidity
B.Solo
Keduang
WT1
WT2
WT3
WT4
WT11
WT5
WT6
WT10
NWL
LWL
River Bed Elevation (m)
Distance Upstream of Dam (km)
Temperature (°C)
DO (mg/ltr)
Turbidity (NTU)
1980 (El.m)
2004 (El.m)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April 19, 2005
Temperature
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Turbidity
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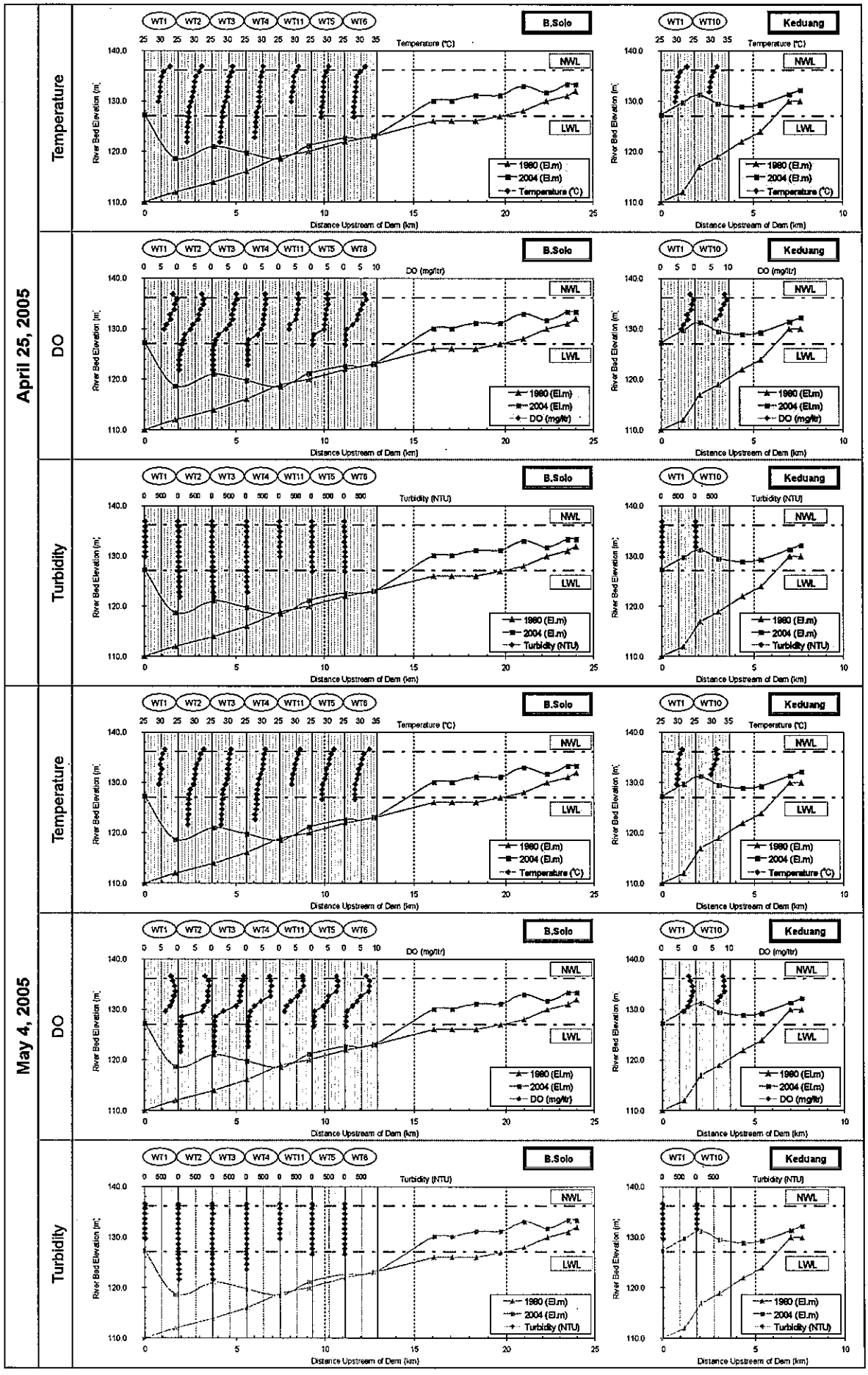
Keduang
WT1
WT2
WT3
WT4
WT11
WT5
WT6
WT10
NWL
LWL
River Bed Elevation (m)
Distance Upstream of Dam (km)
Temperature (°C)
DO (mg/ltr)
Turbidity (NTU)
1980 (El.m)
2004 (El.m)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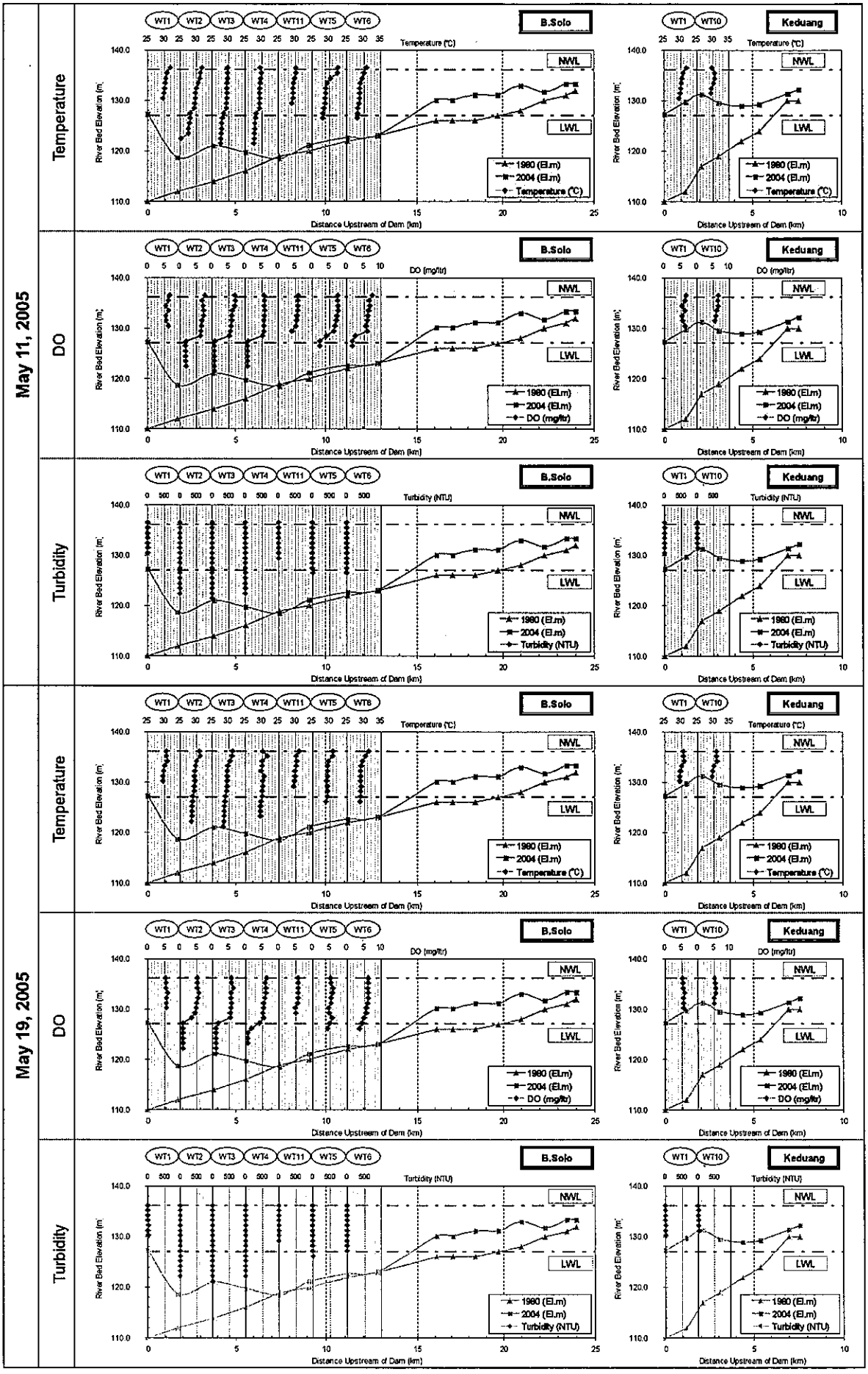
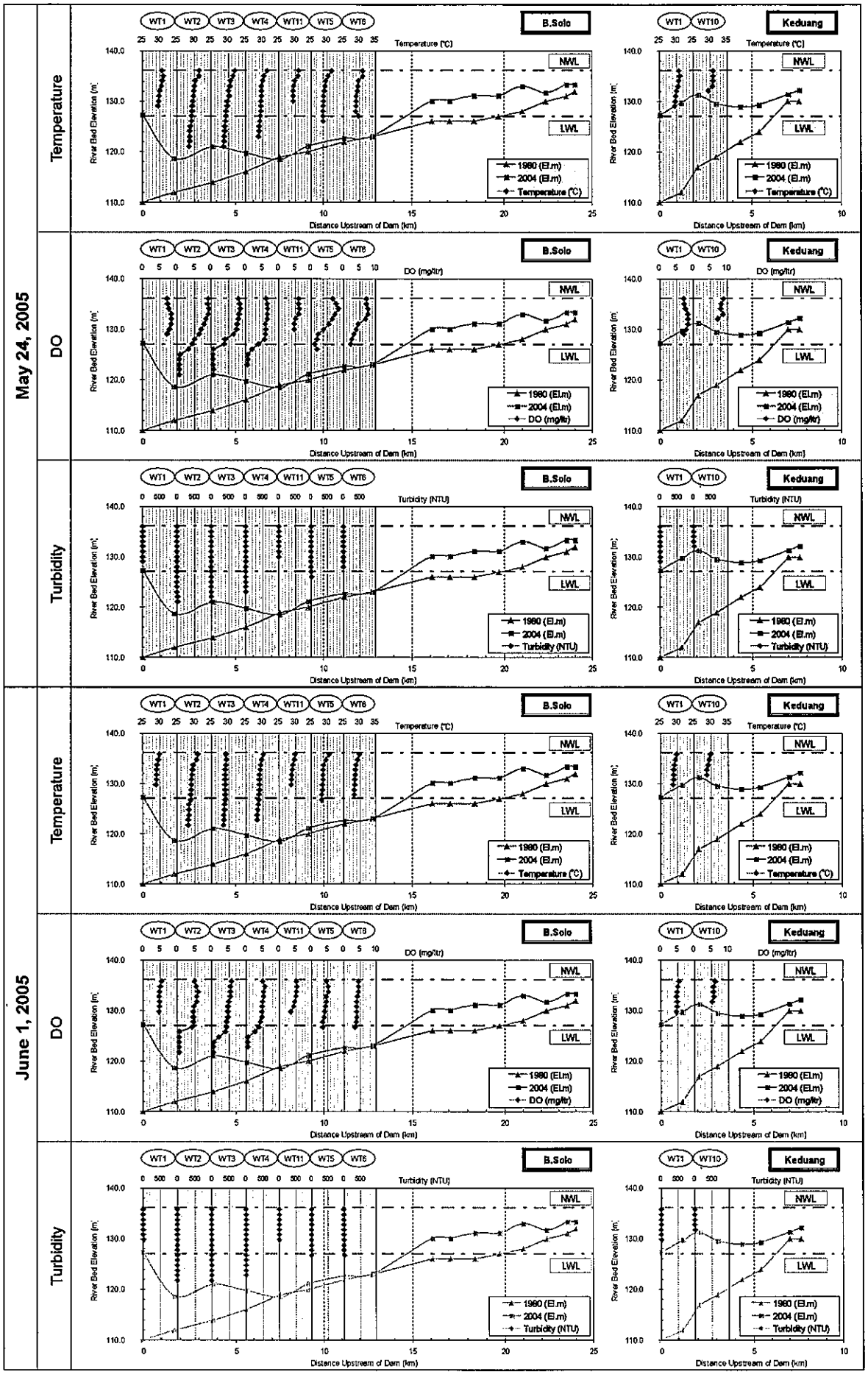
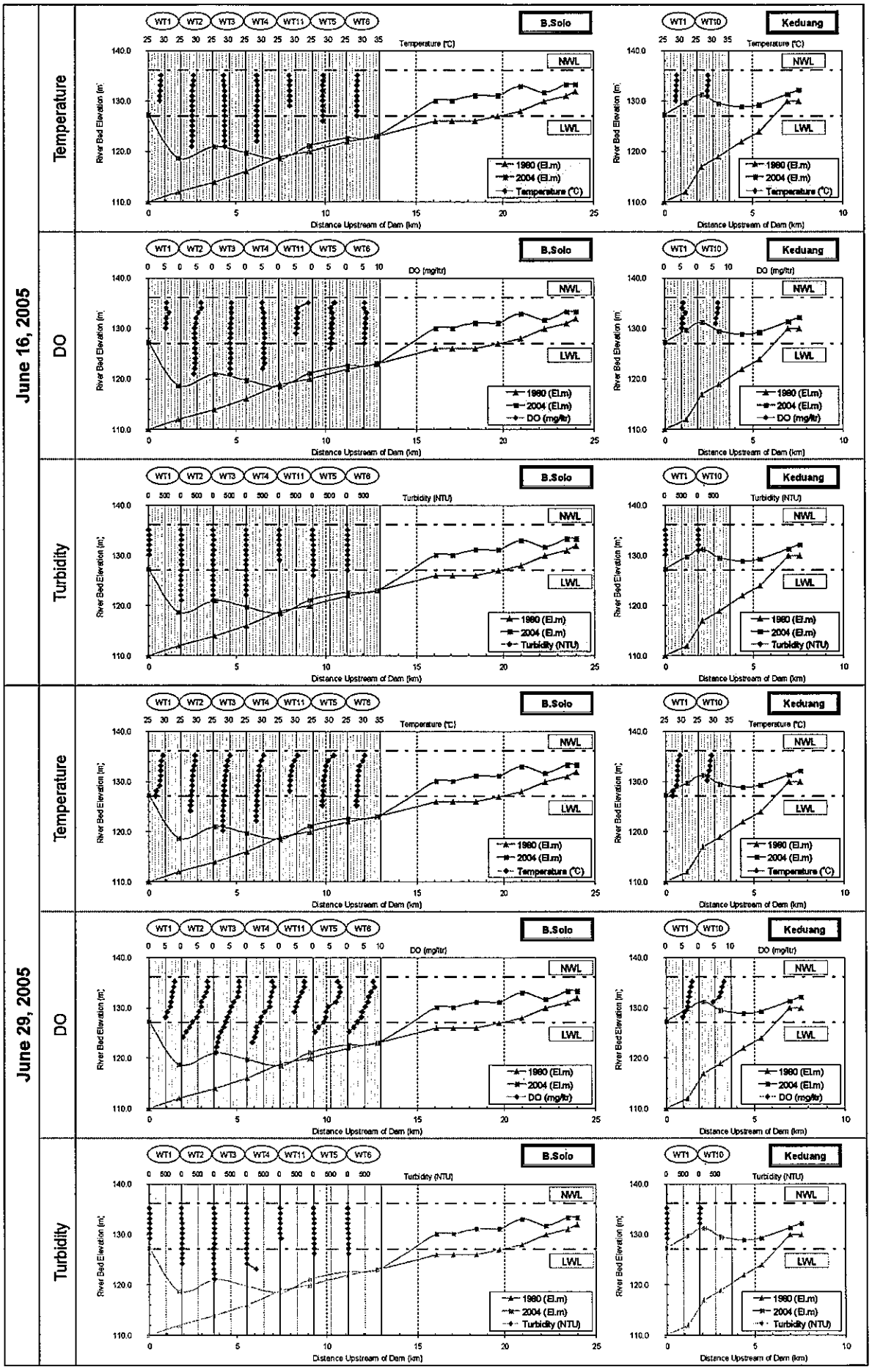
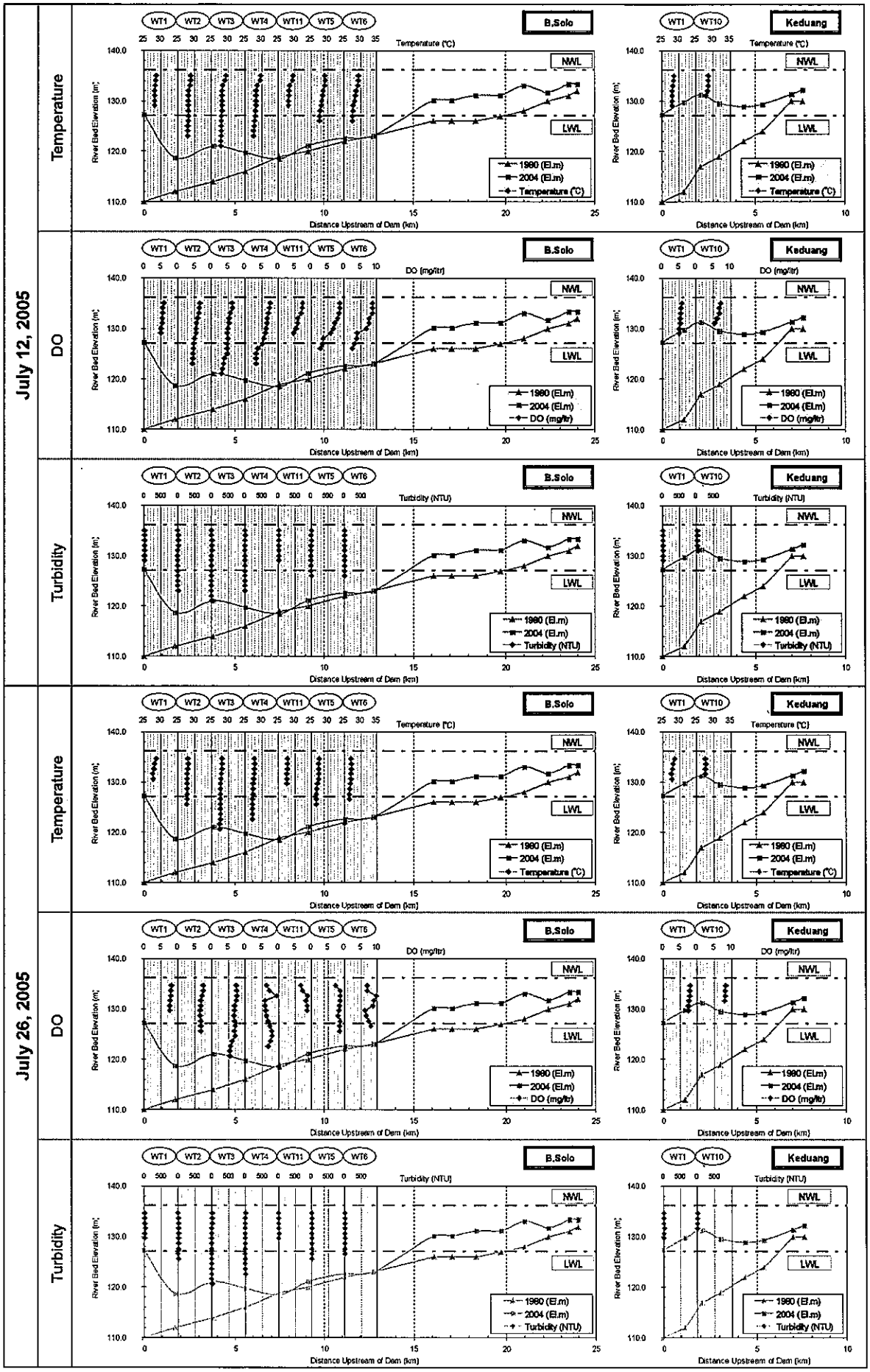
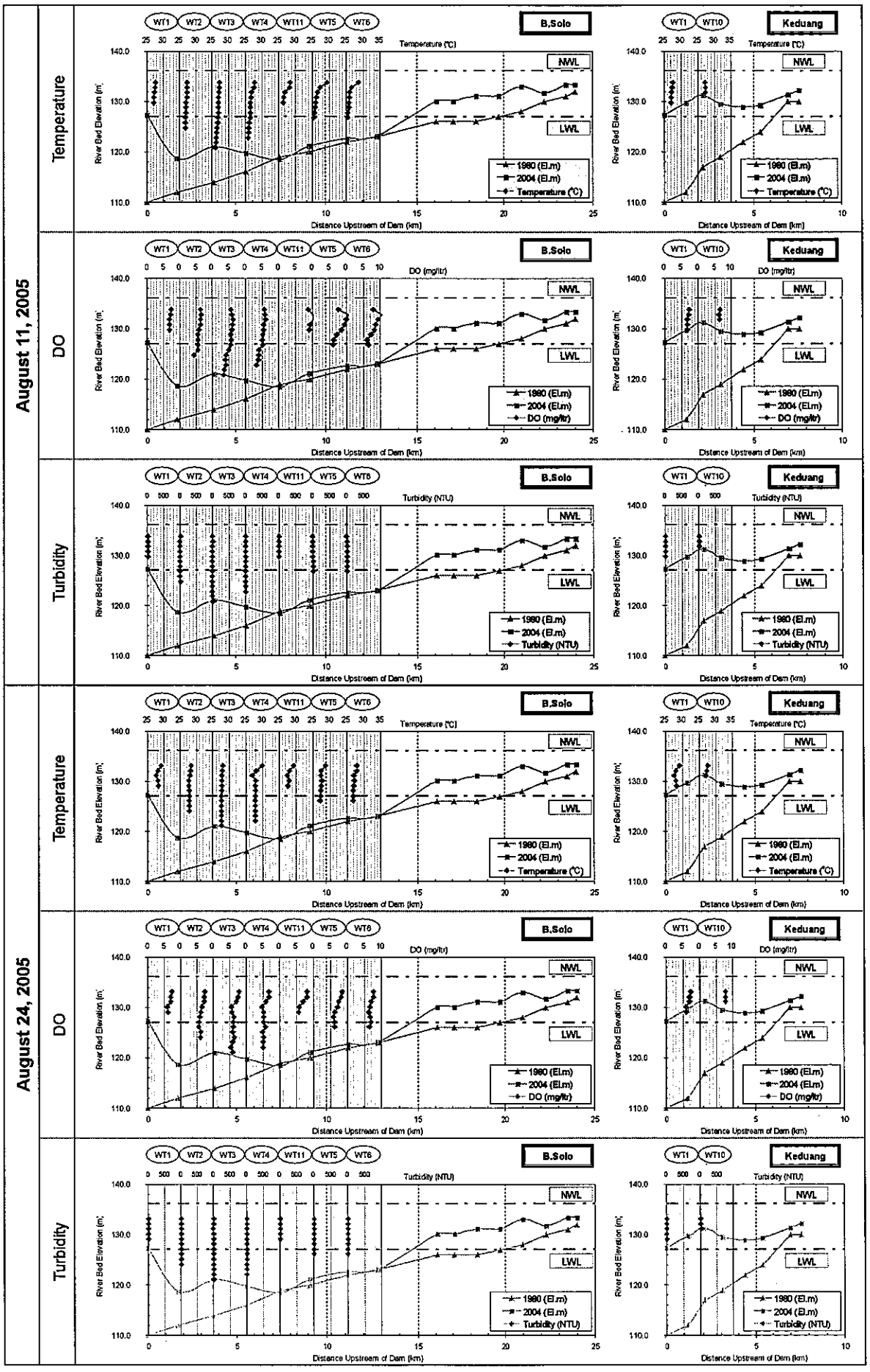
May 4, 2005
Temperature
DO
Turbidity
B.Solo
Keduang
WT1
WT2
WT3
WT4
WT11
WT5
WT6
WT10
WT8
Temperature (°C)
DO (mg/ltr)
Turbidity (NTU)
River Bed Elevation (m)
Distance Upstream of Dam (km)
NWL
LWL
1980 (El.m)
2004 (El.m)
Temperature (°C)
DO (mg/ltr)
Turbidity (NTU)

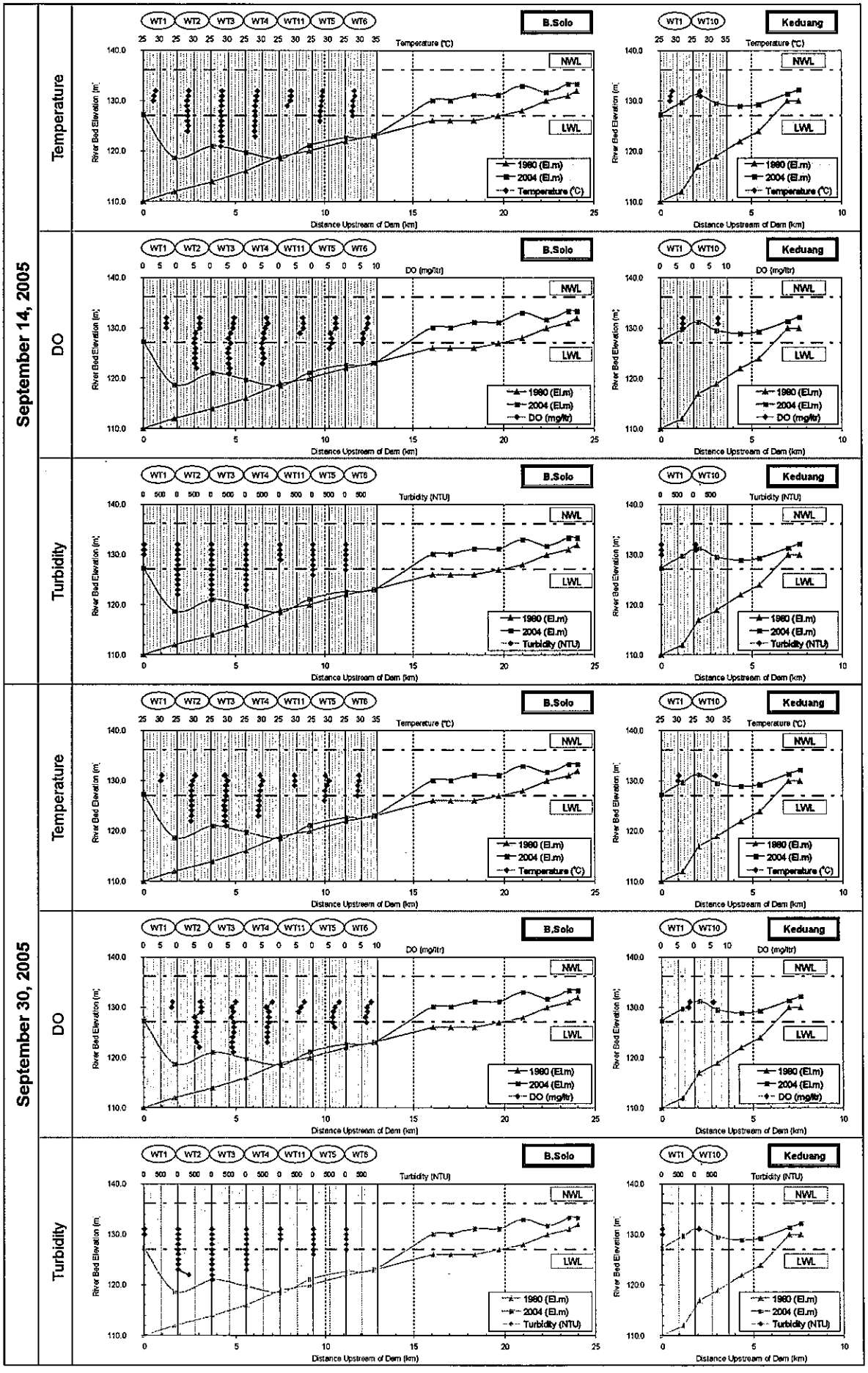

May 11, 2005
Temperature
DO
Turbidity
May 19, 2005
Temperature
DO
Turbidity
B.Solo
Keduang
WT1
WT2
WT3
WT4
WT11
WT5
WT6
WT10
NWL
LWL
River Bed Elevation (m)
Distance Upstream of Dam (km)
Temperature (°C)
DO (mg/ltr)
Turbidity (NTU)
1980 (El.m)
2004 (El.m)

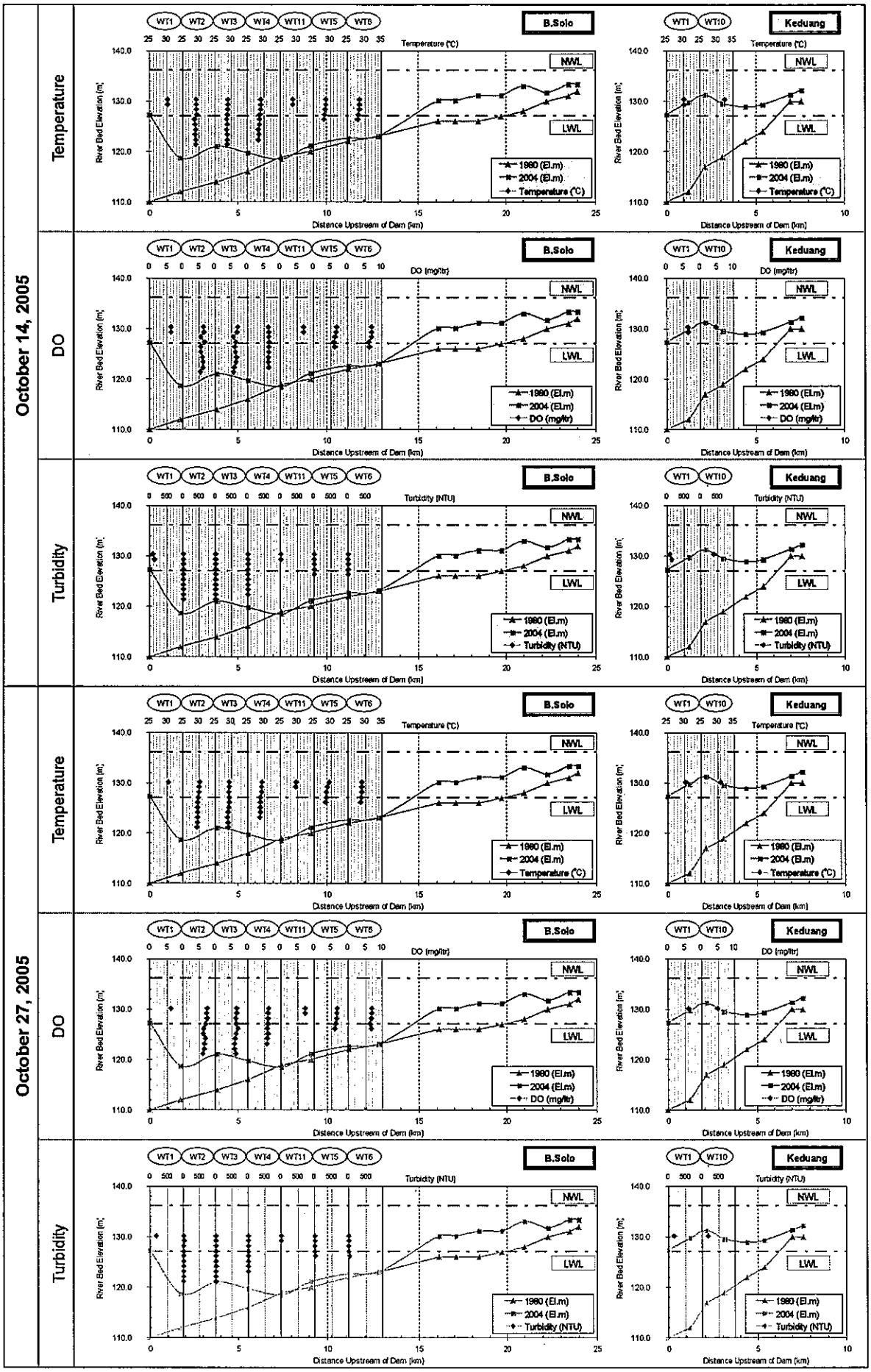

May 24, 2005
June 1, 2005
Temperature
DO
Turbidity
B.Solo
Keduang
WT1
WT2
WT3
WT4
WT11
WT5
WT6
WT10
NWL
LWL
River Bed Elevation (m)
Distance Upstream of Dam (km)
Temperature (°C)
DO (mg/ltr)
Turbidity (NTU)
1980 (El.m)
2004 (El.m)

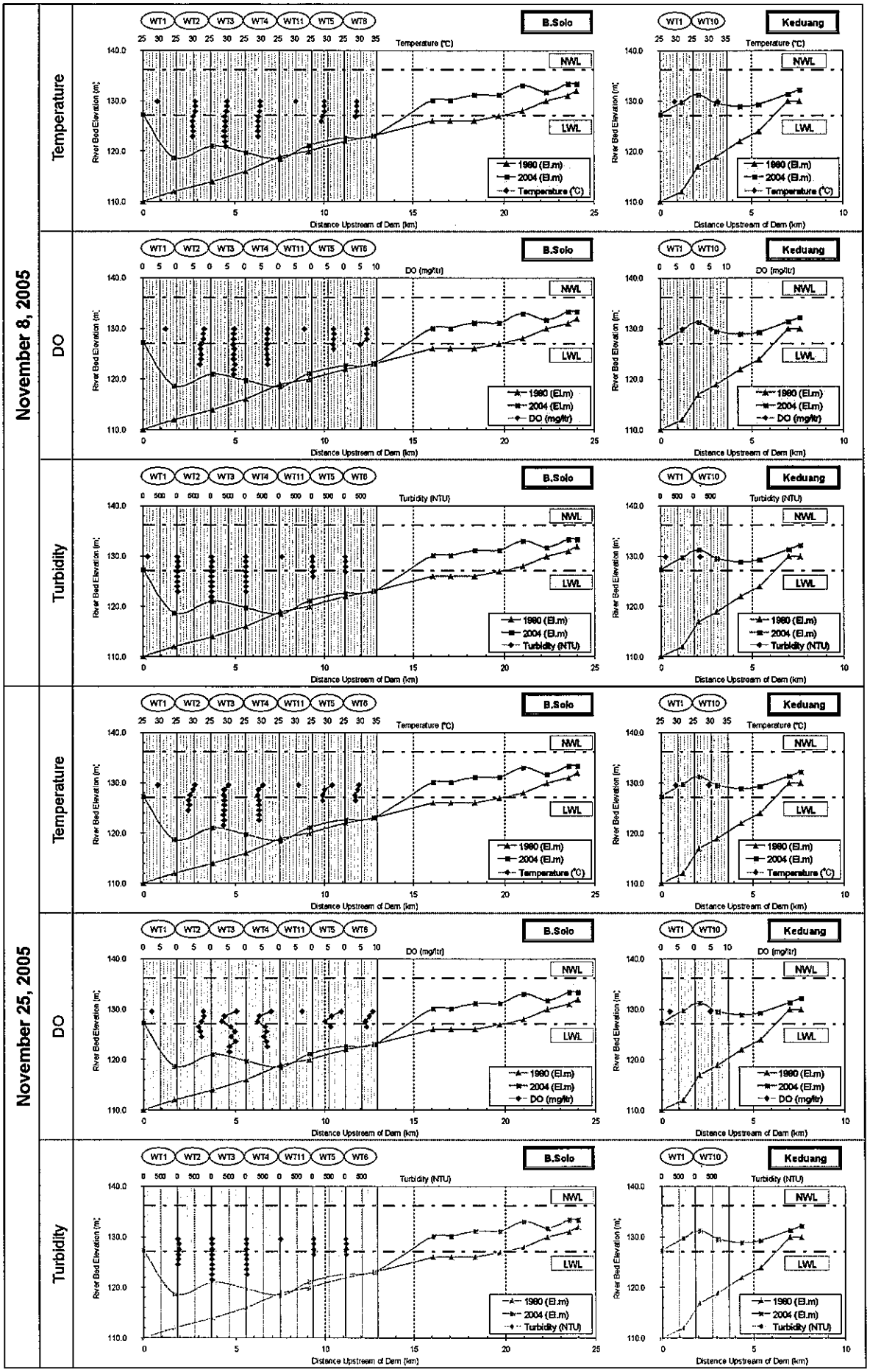

June 16, 2005
June 29, 2005
Temperature
DO
Turbidity
B.Solo
Keduang
WT1
WT2
WT3
WT4
WT11
WT5
WT6
WT10
NWL
LWL
1980 (El.m)
2004 (El.m)
Temperature (℃)
DO (mg/ltr)
Turbidity (NTU)
River Bed Elevation (m)
Distance Upstream of Dam (km)

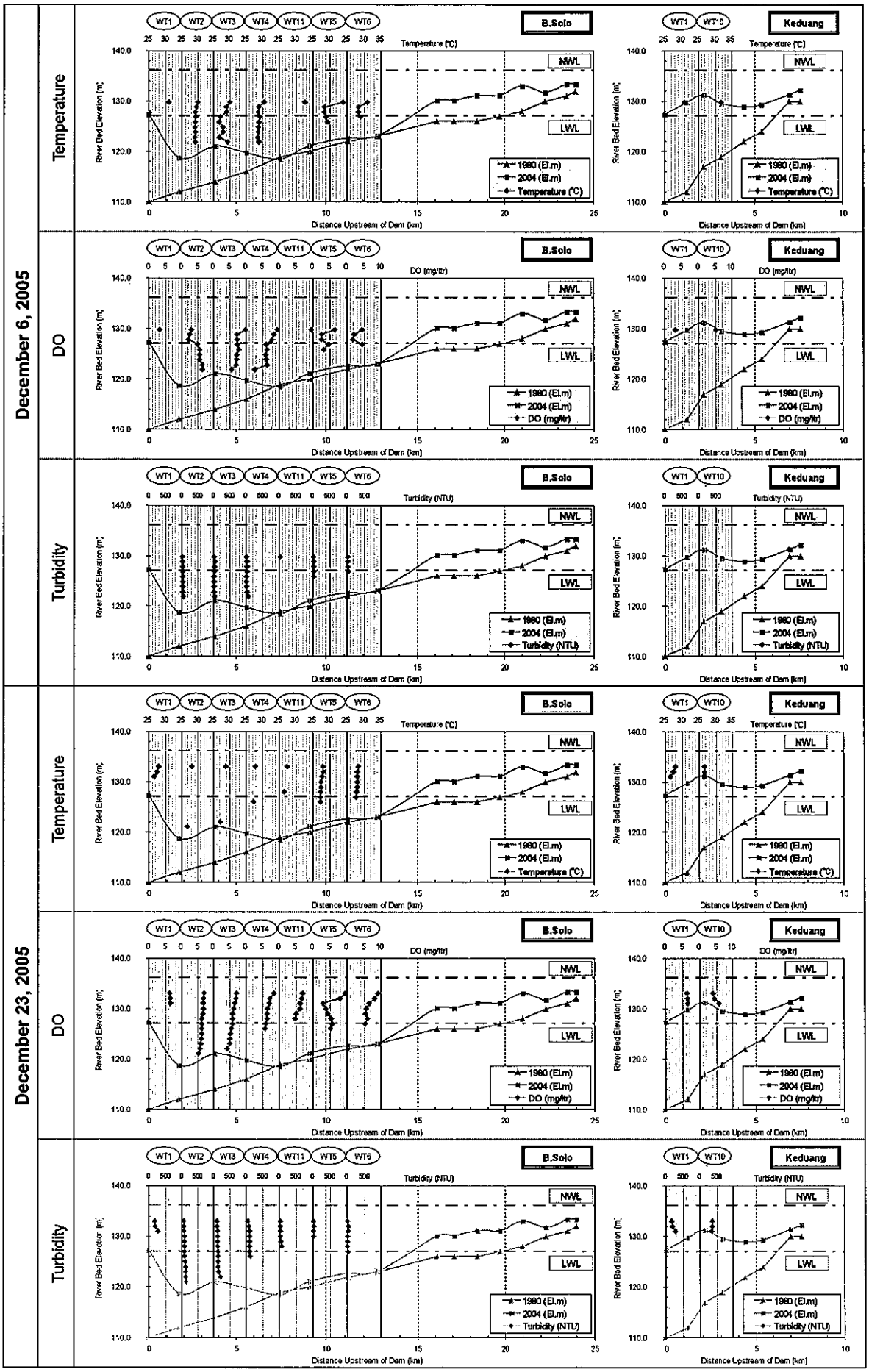

July 12, 2005
July 26, 2005
Temperature
DO
Turbidity
B.Solo
Keduang
WT1
WT2
WT3
WT4
WT11
WT5
WT6
WT10
NWL
LWL
1980 (El.m)
2004 (El.m)
Temperature (℃)
DO (mg/ltr)
Turbidity (NTU)
River Bed Elevation (m)
Distance Upstream of Dam (km)

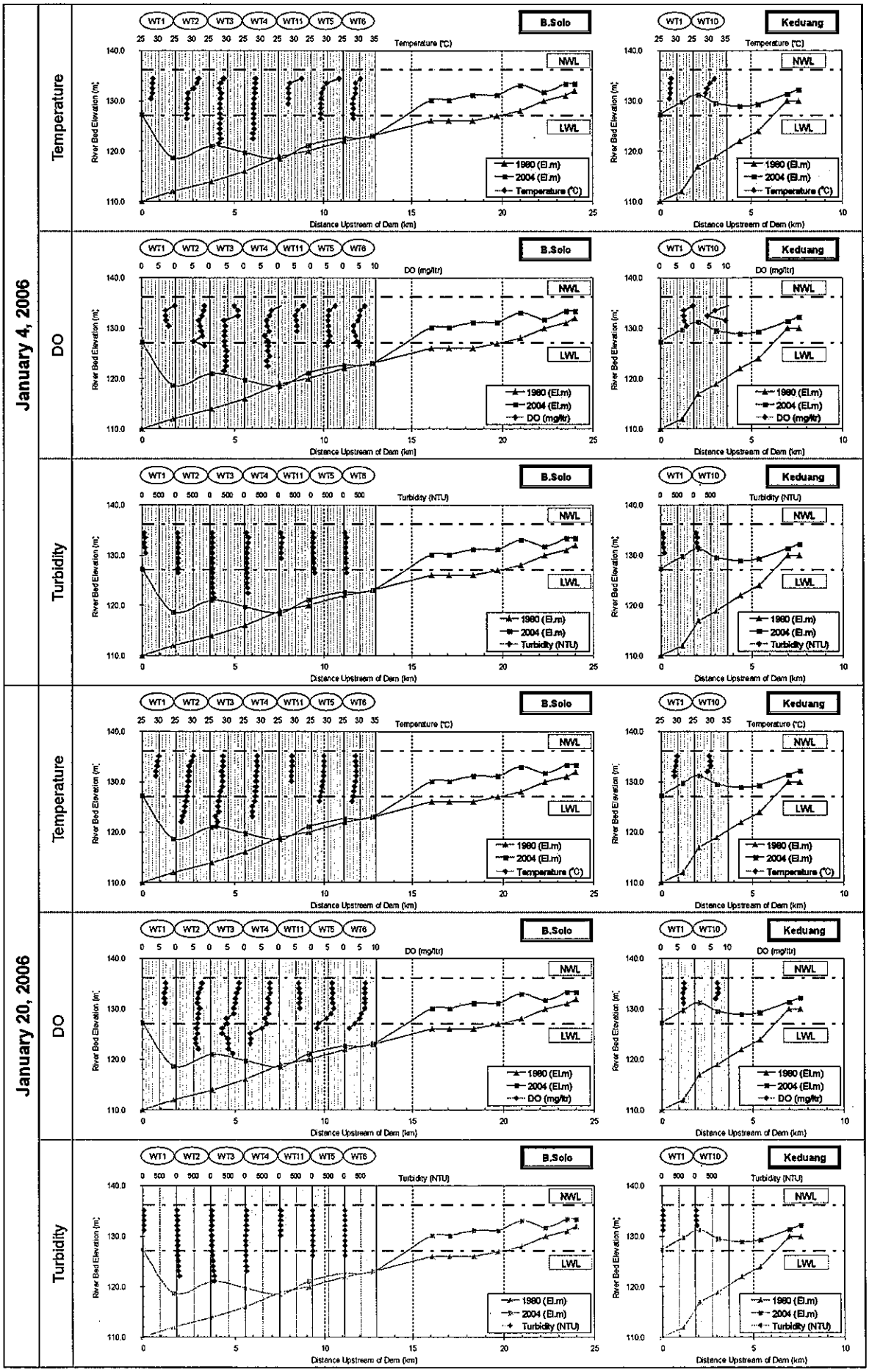

August 11, 2005
August 24, 2005
Temperature
DO
Turbidity
B.Solo
Keduang
WT1 WT2 WT3 WT4 WT11 WT5 WT6
WT1 WT10
Temperature (°C)
DO (mg/ltr)
Turbidity (NTU)
River Bed Elevation (m)
Distance Upstream of Dam (km)
NWL
LWL
1980 (El.m)
2004 (El.m)
Temperature (°C)
DO (mg/ltr)
Turbidity (NTU)

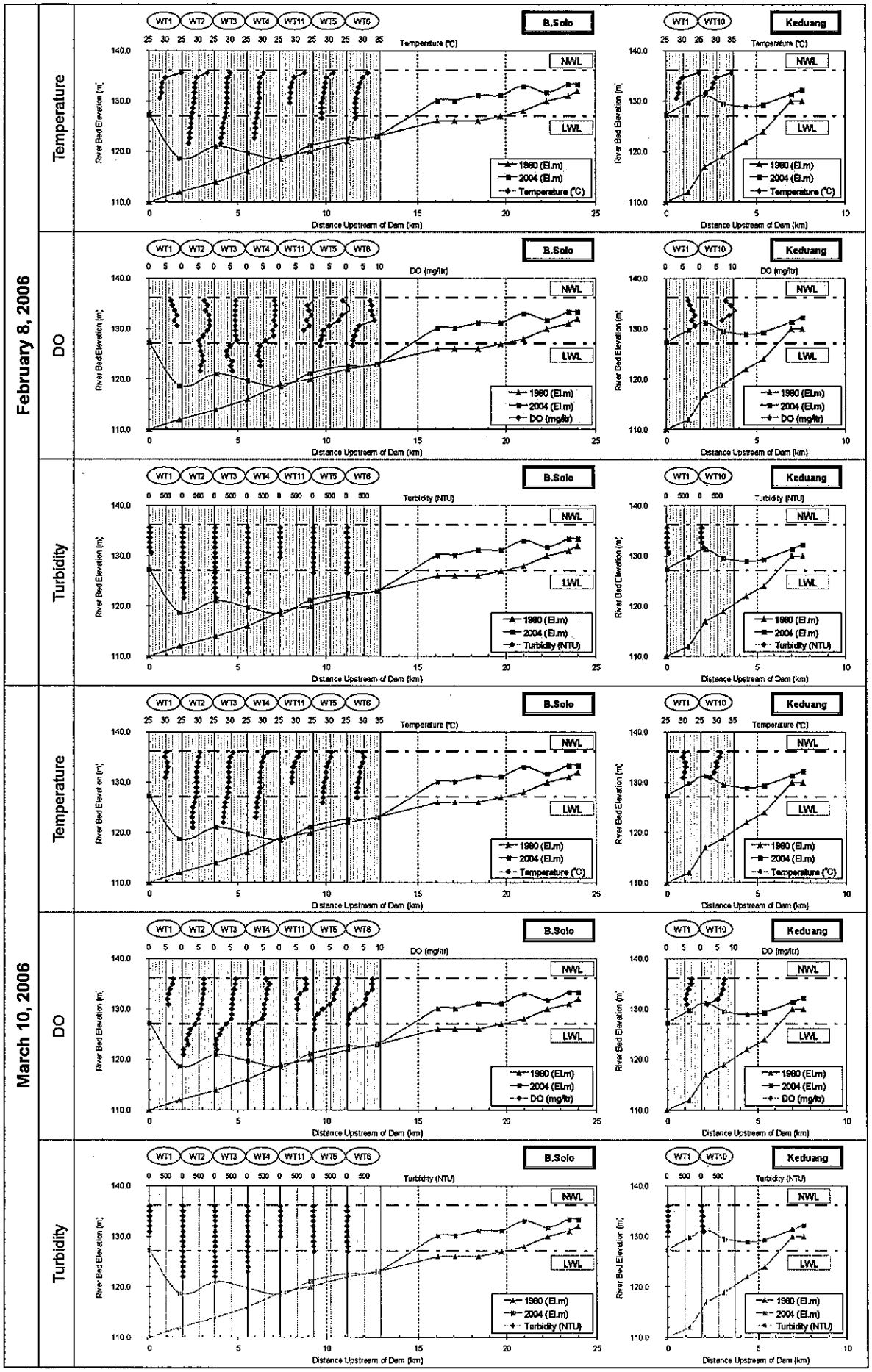

September 14, 2005
September 30, 2005
Temperature
DO
Turbidity
B.Solo
Keduang
WT1
WT2
WT3
WT4
WT11
WT5
WT6
WT10
Temperature (℃)
DO (mg/ltr)
Turbidity (NTU)
River Bed Elevation (m)
Distance Upstream of Dam (km)
NWL
LWL
1980 (El.m)
2004 (El.m)
Temperature (℃)
DO (mg/ltr)
Turbidity (NTU)

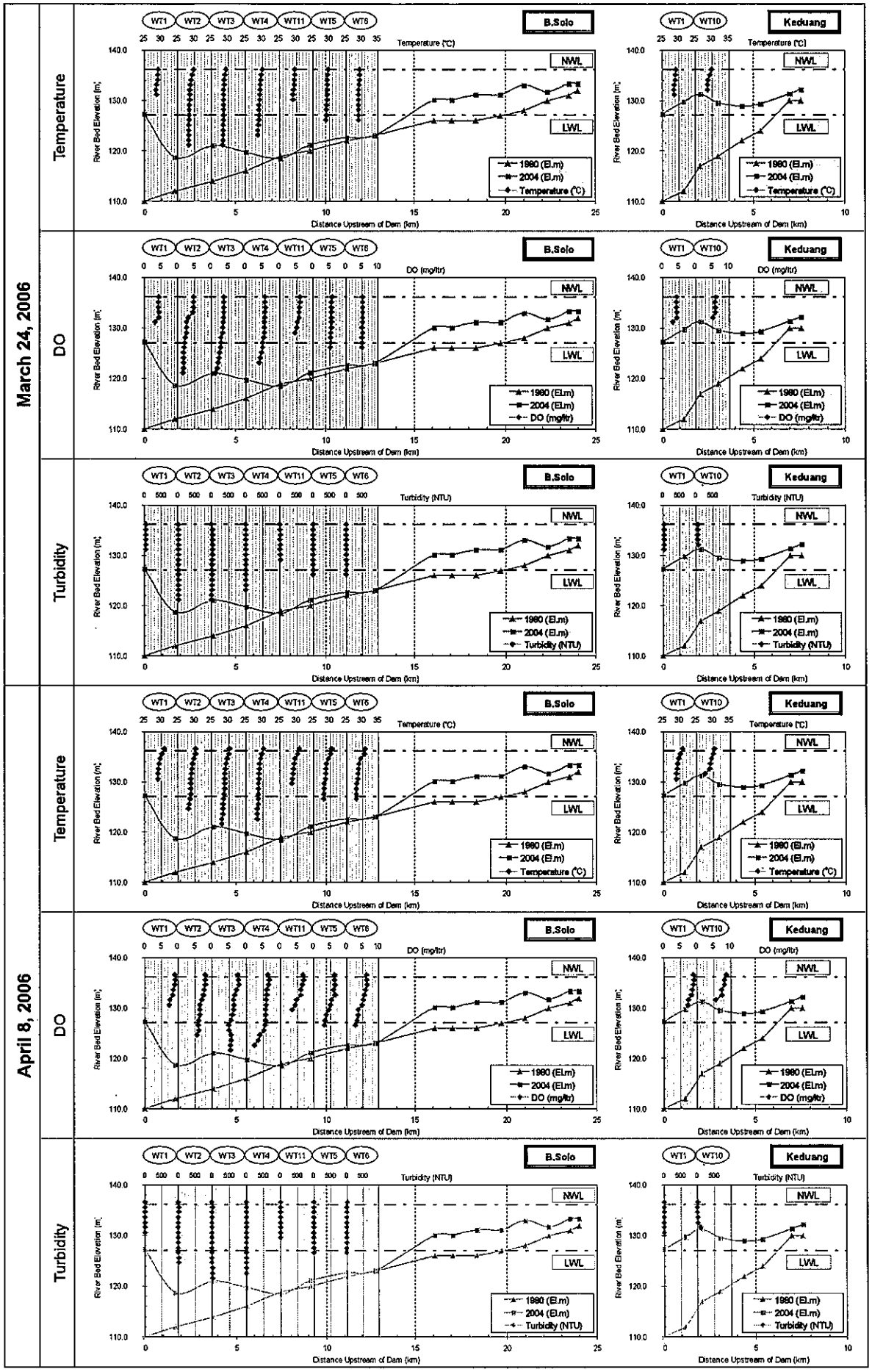

October 14, 2005
October 27, 2005
Temperature
DO
Turbidity
B.Solo
Keduang
WT1
WT2
WT3
WT4
WT11
WT5
WT6
WT10
NWL
LWL
River Bed Elevation (m)
Distance Upstream of Dam (km)
Temperature (°C)
DO (mg/ltr)
Turbidity (NTU)
1980 (El.m)
2004 (El.m)

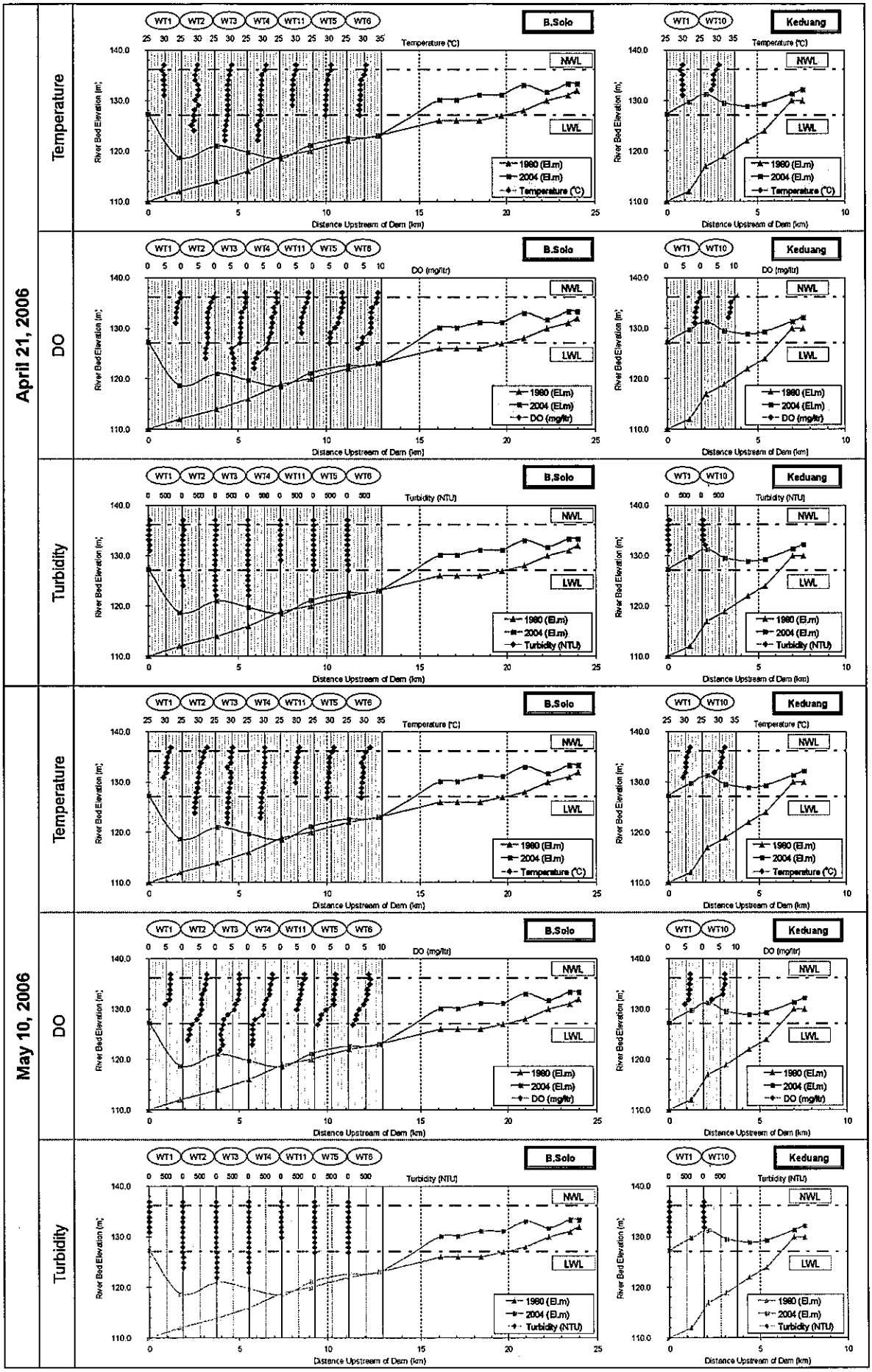

November 8, 2005
November 25, 2005
Temperature
DO
Turbidity
B.Solo
Keduang
WT1
WT2
WT3
WT4
WT11
WT5
WT6
WT10
Temperature (℃)
DO (mg/ltr)
Turbidity (NTU)
River Bed Elevation (m)
Distance Upstream of Dam (km)
NWL
LWL
1980 (El.m)
2004 (El.m)
Temperature (℃)
DO (mg/ltr)
Turbidity (NTU)

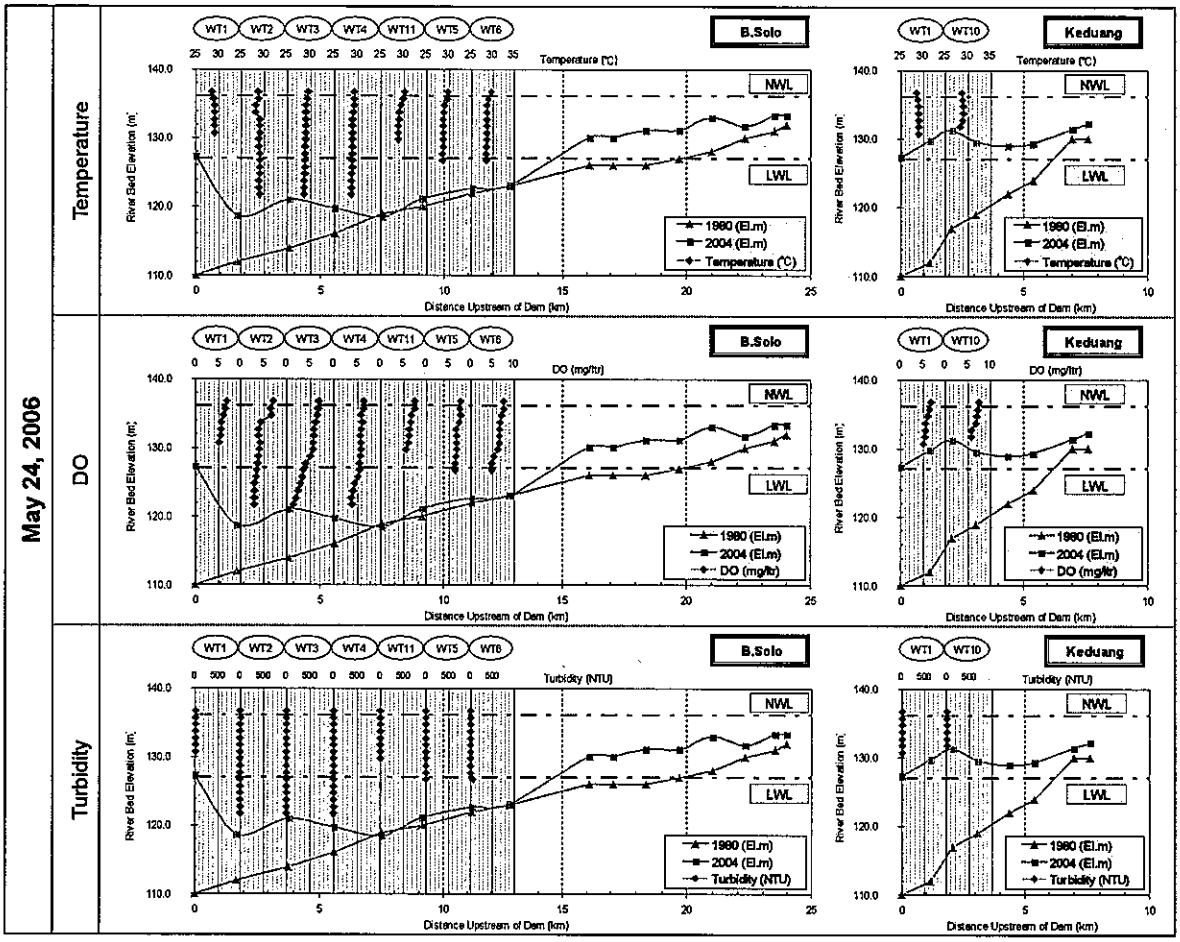

December 6, 2005
December 23, 2005
Temperature
DO
Turbidity
B.Solo
Keduang
WT1 WT2 WT3 WT4 WT11 WT5 WT6
WT1 WT10
Temperature (°C)
DO (mg/ltr)
Turbidity (NTU)
River Bed Elevation (m)
Distance Upstream of Dam (km)
NWL
LWL
1980 (El.m)
2004 (El.m)
Temperature (°C)
DO (mg/ltr)
Turbidity (NTU)


January 4, 2006
January 20, 2006
Temperature
DO
Turbidity
B.Solo
Keduang
WT1
WT2
WT3
WT4
WT11
WT5
WT6
WT10
NWL
LWL
River Bed Elevation (m)
Distance Upstream of Dam (km)
Temperature (°C)
DO (mg/ltr)
Turbidity (NTU)
1980 (El.m)
2004 (El.m)


February 8, 2006
March 10, 2006
Temperature
DO
Turbidity
B.Solo
Keduang
WT1
WT2
WT3
WT4
WT11
WT5
WT6
WT10
NWL
LWL
1980 (El.m)
2004 (El.m)
Temperature (℃)
DO (mg/ltr)
Turbidity (NTU)
River Bed Elevation (m)
Distance Upstream of Dam (km)


March 24, 2006
April 8, 2006
Temperature
DO
Turbidity
B.Solo
Keduang
WT1
WT2
WT3
WT4
WT11
WT5
WT6
WT10
NWL
LWL
1980 (El.m)
2004 (El.m)
Temperature (°C)
DO (mg/ltr)
Turbidity (NTU)
River Bed Elevation (m)
Distance Upstream of Dam (km)


April 21, 2006
May 10, 2006
Temperature
DO
Turbidity
B.Solo
Keduang
WT1
WT2
WT3
WT4
WT11
WT5
WT6
WT10
NWL
LWL
1980 (El.m)
2004 (El.m)
Temperature (°C)
DO (mg/ltr)
Turbidity (NTU)
River Bed Elevation (m)
Distance Upstream of Dam (km)



Source: JICA Study Team