

Taiwan Water Quality Standards, Available Data & Initial Analysis

Data Meeting with FoBB, 09/03/2022



Community-led monitoring to improve water quality
公民主導水質量測

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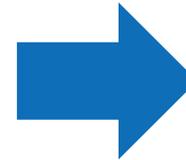
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1. TAIWAN'S POLLUTION INDICES & WQ STANDARDS

Taiwan's River Pollution Index (RPI)

- Defined in 2013 (102-Minguo) by Taiwan's EPA & partner organisations with the aim of having a single and integrated measure for river pollution categorisation.
- Considers four parameters:
 - Dissolved oxygen (DO)
 - Biochemical oxygen demand (BOD in 5 days)
 - Suspended solids (SS)
 - Ammonia (NH₃-N)
- Points are first assigned to each parameter, based on value ranges:

Parameter	Pollution Level			
	Not (very lightly) polluted	Lightly pollution	Moderately polluted	Heavily polluted
Dissolved oxygen (DO) [mg/L]	DO ≥ 6.5	6.5 > DO ≥ 4.6	4.5 ≥ DO ≥ 2.0	DO < 2.0
Biochemical oxygen demand (BOD ₅) [mg/L]	BOD ₅ ≤ 3.0	3.0 < BOD ₅ ≤ 4.9	5.0 ≤ BOD ₅ ≤ 15.0	BOD ₅ > 15.0
Suspended solids (SS) [mg/L]	SS ≤ 20.0	20.0 < SS ≤ 49.9	50.0 ≤ SS ≤ 100	SS > 100
Ammonia nitrogen (NH ₃ -N) [mg/L]	NH ₃ -N ≤ 0.50	0.50 < NH ₃ -N ≤ 0.99	1.00 ≤ NH ₃ -N ≤ 3.00	NH ₃ -N > 3.00
Points	1	3	6	10
Pollution index integral value (S)	S ≤ 2.0	2.0 < S ≤ 3.0	3.1 ≤ S ≤ 6.0	S > 6.0



- RPI is subsequently computed, as the average of the points assigned to each parameter (S_i):

$$RPI = \frac{1}{4} \sum_{i=1}^4 S_i$$

- RPI ranges from 1-10:
 - 1 -> not (very lightly) polluted
 - 10 -> heavily polluted

Source: https://wq.epa.gov.tw/EWQP/zh/Encyclopedia/NounDefinition/Pedia_37.aspx

Classification of surface water bodies and water quality standards

Category	Description	Required Standards						
		pH	DO (mg/L)	BOD (mg/L)	SS (mg/L)	CFU* (per100 ml)	NH3-N (mg/L)	Total P (mg/L)
A	<ul style="list-style-type: none"> Class 1 public water (drinking water source requiring disinfection only) Swimming 	6.5-8.5	>6.5	<1	<25	<50	<0.1	<0.02
B	<ul style="list-style-type: none"> Class 2 public water (drinking water source requiring conventional treatment – coagulation, sedimentation, filtration & disinfection) Class 1 aquaculture water (inland waters: for cultivation of trout, sweetfish and sea bass; in sea area, chia and laver) 	6.5-9.0	>5.5	<2	<25	<5,000	<0.3	<0.05
C	<ul style="list-style-type: none"> Class 3 public water (drinking water source requiring high treatment such – e.g. activated carbon adsorption, ion exchange, reverse osmosis) Class 2 aquaculture water Class 1 industrial water (for manufacturing) 	6.5-9.0	>4.5	<4	<40	<10,000	<0.3	-
D	Suitable for irrigation, Class 2 industrial water (for cooling) and environmental conservation (general watering)	6.0-9.0	>3	<8	<100	-	-	-
E	Suitable for environmental conservation (general watering)	6.0-9.0	>2	<10	No floating and no oil stains	-	-	-

Source: https://wq.epa.gov.tw/EWQP/zh/Encyclopedia/NounDefinition/Pedia_37.aspx

*CFU=Colony forming units.



More detailed standards available for different water uses

[Examples for illustration only]

Human consumption

parameter	Limitation
temperature	-
Ammonia-Nitrogen	0.1(mg/L)
Nitrite-Nitrogen	0.1(mg/L)
Nitrate-Nitrogen	10.0(mg/L)
pH	6.0-8.5
conductivity	-

Reference: Environmental Protection Administration Executive Yuan, R.O.C.(Taiwan)
<http://cesh.dyu.edu.tw/law/lw/lw03.pdf>

Irrigation

parameter	Limitation(mg/L)	parameter	Limitation(mg/L)
temperature	35°C	Hg	0.002
pH	6.0-9.0	Mo	0.01
EC	750	Ni	0.2
SS	100	Se	0.02
DO	>3	V	0.1
Cl-	175	Zn	2.0
SO ₄ ⁻²	200	SAR	6.0
total nitrogen(TN)	3.0	RSC	2.5
anionic surfactant	5.0	Al	5.0
Grease	5.0	As	0.05
Co	0.05	Be	0.1
Cu	0.2	B	0.75
Pb	0.1	Cd	0.01
Li	2.5	Cr	0.1
Mn	0.2	Fe	5.0

Reference: Council of Agriculture, executive yuan
<https://law.coa.gov.tw/glsnewsout/LawContent.aspx?id=GL000066>

parameter		datum value (mg/L)	parameter		datum value (mg/L)
metal	Cd	0.005	mineral salt	CN-(Cyanide)	0.05
	Pb	0.01	volatile organic compounds	CCl ₄ (Carbon tetrachloride Tetrachloromethane)	0.005
	Cr ⁶⁺	0.05		C ₂ H ₄ Cl ₂ (1,2-Dichloroethane)	0.01
	As	0.05		CH ₂ Cl ₂ (Dichloromethane)	0.02
	total mercury	0.001		C ₇ H ₈ (Methylbenzene)	0.7
	Se	0.01		CH ₃ CCl ₃ (Trichloroethane)	1.0
	Cu	0.03		C ₂ HCl ₃ (Trichloroethylene, TCE)	0.01
	Zn	0.5		C ₆ H ₆ (Benzene)	0.01
	Mn	0.05	pesticide	organophosphate insecticide (the total amount of Parathion, Diazinon, Methamidophos, Dimethyl phosphate of 3-Hydroxy-N-methyl-cis-crotonamide, Dimethoate, Chlorpyrifos)	0.1
	Ag	0.05			
Ni	0.1				

2. AVAILABLE WQ DATASETS

TW – AVAILABLE WQ DATASETS

- 1. EPA (Environmental Protection Agency) monthly sampling** – dating back decades. Available via [API](#).
- 2. WRA (Water Resources Agency) quarterly (seasonal) sampling** for ecological characterisation – from 2021.
- 3. Community groups (Water Patrols)** – generally sample-based, but successful tests already conducted with WaterBox. Usually aimed at identifying major pollutants

Continuous monitoring not widespread; only performed at specific locations / during limited periods to inform particular investigations.

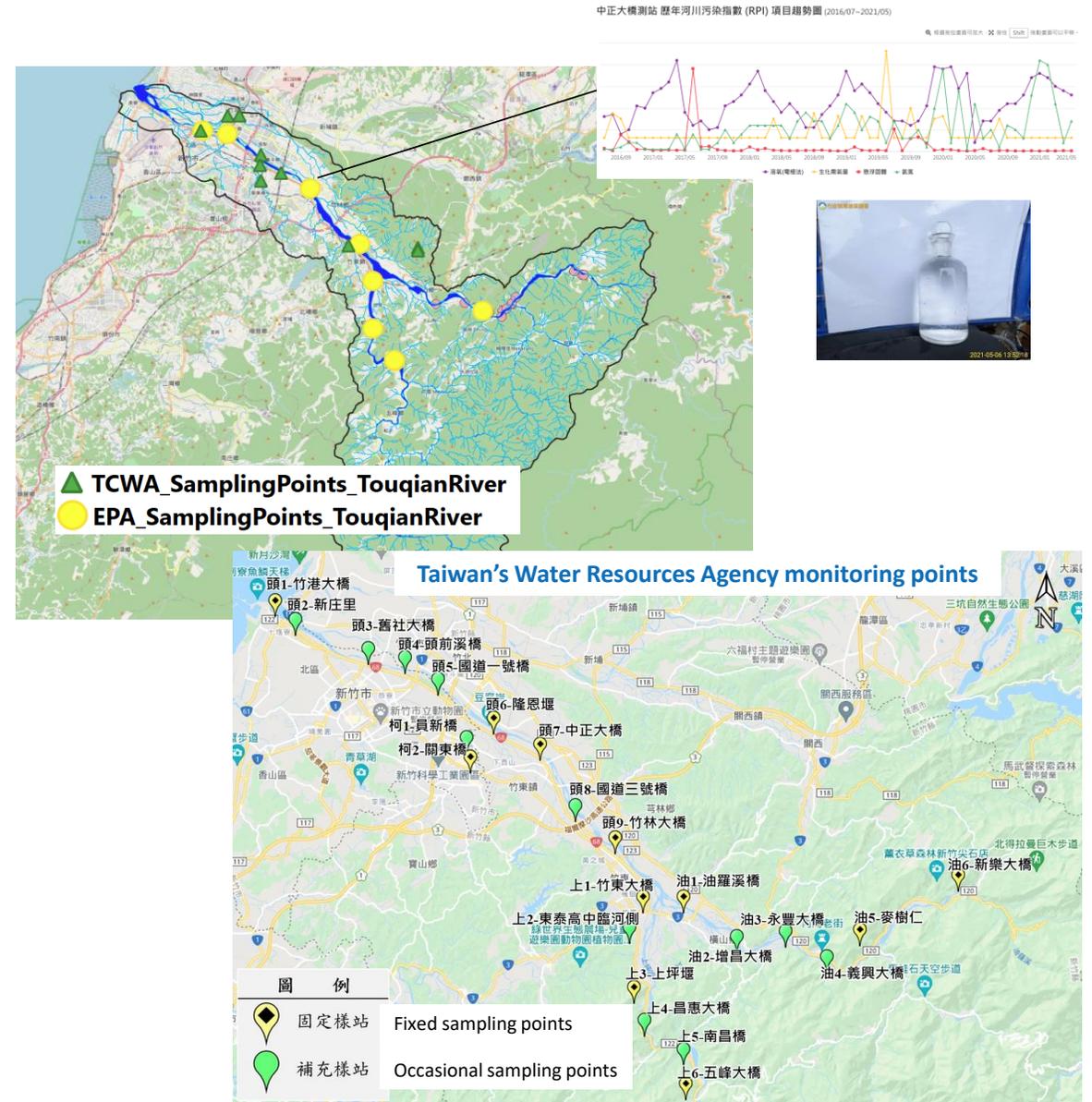
Parameters monitored by EPA,
available via API

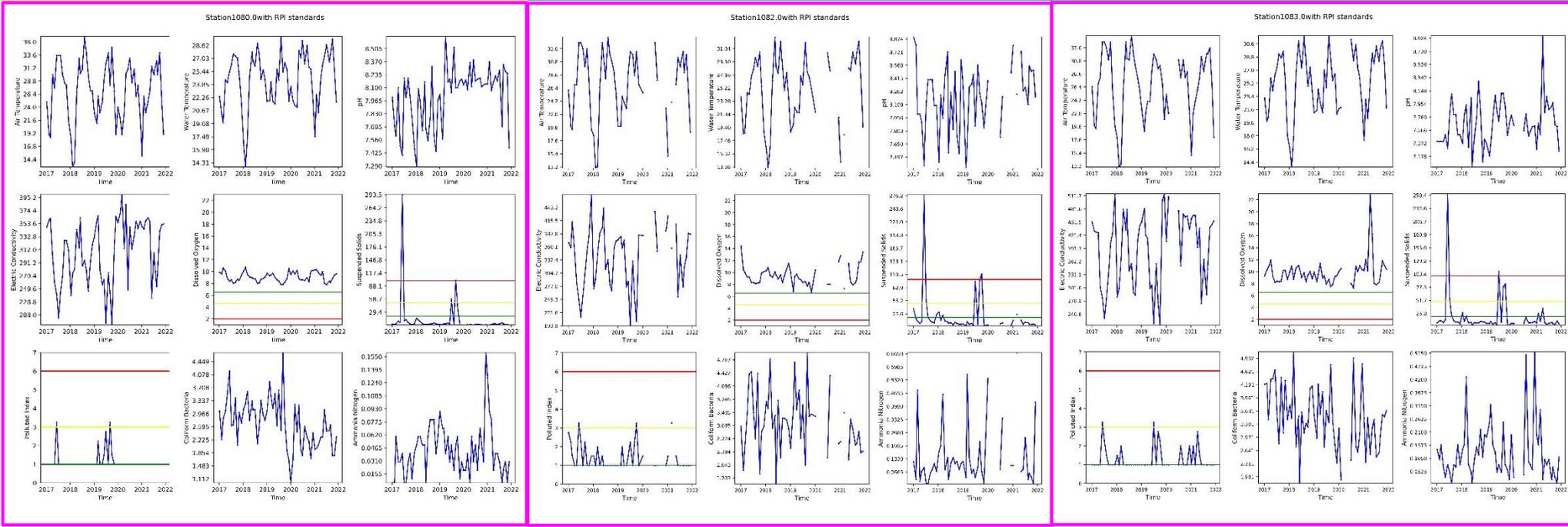
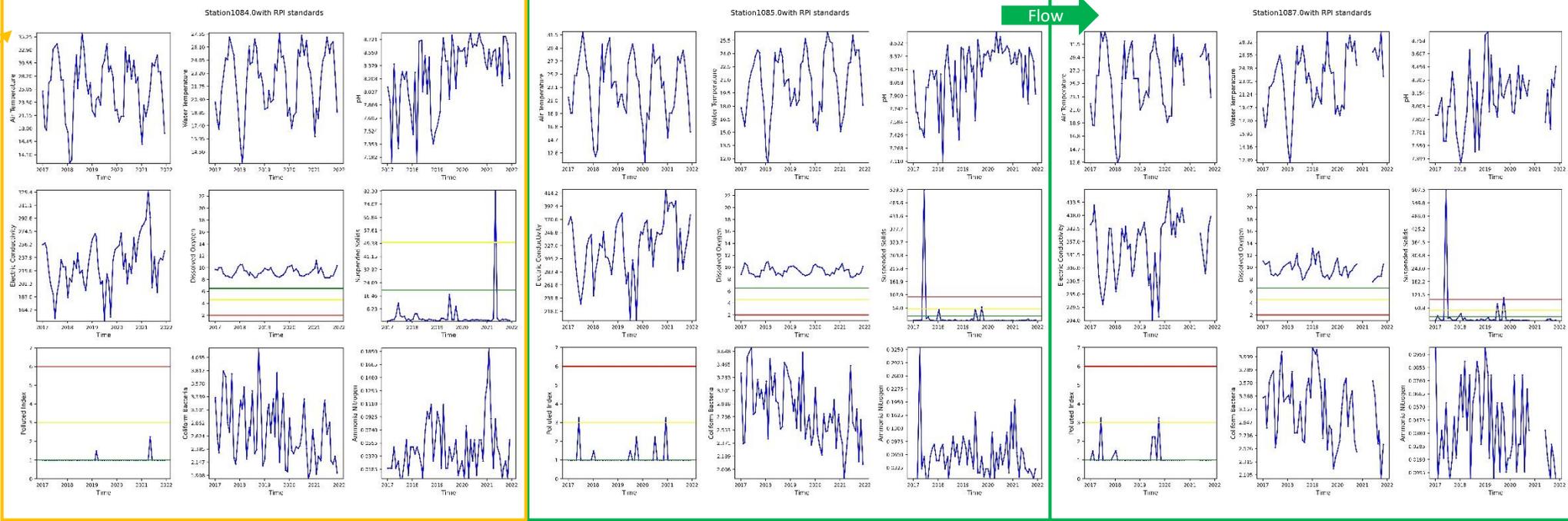
river polluted index	9
air temperature	8
water temperature	8
pH	9
EC	8
DO (titration)	359
DO (electrode method)	8
DO saturation	8
BOD	8
COD	8
SS	8
coliform bacteria	8
ammonia nitrogen	8
chloride	359
TP (total phosphate)	241
TOC (total organic carbon)	330
nitrate nitrogen	241
nitrite nitrogen	330
Cd	241
Pb	241
Cd+6 (hexavalent)	241
As	241
Hg	241
Cu	241
Zn	241
Mn	241
Ag	241
Ni	271
Se	330
Turbidity	359
Cr	359
TN(Total Nitrogen)	359
TKN(Total Kjeldahl nitrogen)	359

3. DATA FOR THE TOUQIAN RIVER

Today's focus:

- EPA data for past 5 years.
- Focus on parameters of interest for community group / UpStream:
 - Ammonia
 - Conductivity – can help identify industrial pollution sources
 - pH
 - Temperature
 - DO





- Seasonal pattern particularly clear from temp & DO (EC also), but natural pattern becomes less clear as we move d/s.
- Apparent tendency of coliform bacteria concentration to have reduced over time, particularly at U/S locations.
- RPI highest d/s, around urban/industrial areas.

Upstream (u/s)

Flow Direction

Downstream (d/s)

Objectives & Next steps

- **Main objectives from analysis of monthly EPA data (before we get WaterBox data):**
 - Improve our understanding of WQ status and patterns along the river, including over time and space.
 - Set a 'baseline' of the current situation, for use as reference in future river status evaluations.
- **Next steps of the analysis (some ideas – would love feedback on this!):**
 - Detailed analysis of annual patterns over different periods (recent years, full period 1994-present) -> this can tell us what to expect from WB measurements across different seasons.
 - Statistical analysis of changes in WQ parameters over time:
 - Do apparent up/downward trends really exist? If so, how marked are changes and what can explain them (try to link to historical changes e.g. in urban population, expansion of semi-conductor industry, changes in regulations, sanitation infrastructure). This can help with engagement.
 - We can apply similar analyses to WB data later on?
 - Compare EPA data against TCWA
 - Trial different visualisations, to inform UpStream data visualisation.

THANK YOU! ANY QUESTIONS?

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