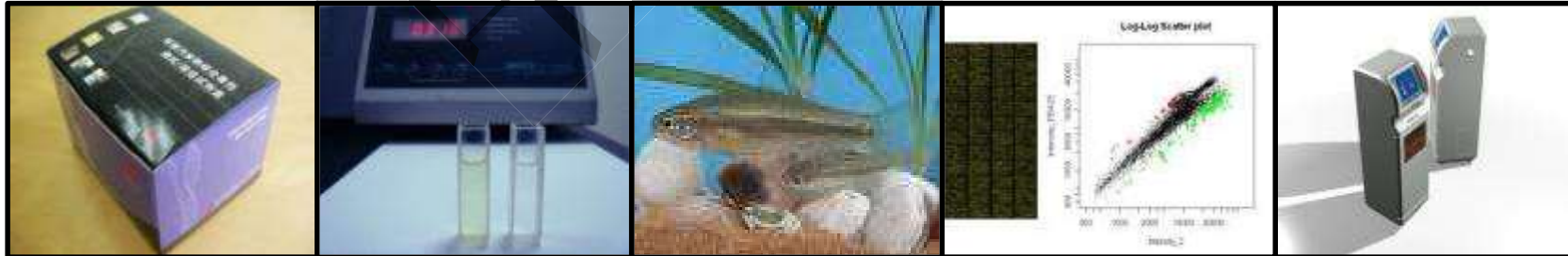


# 水质监测及其数据质量管理

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# 水体水质、流域水环境质量和水生态质量状态评价

**水体定义：**指以陆地为边界的天然水域所处空间环境，包括水、沉积物、悬浮颗粒物和水生生物

**水质评价：**依据水环境质量标准或适当的评价参数开展的物理、化学、微生物指标的监测，针对水、沉积物、水生生物质量分别评价/综合评分



从污染防治过渡到环境质量改善

**流域水环境：**流域指集(汇)水区水的形成、分布和转化所处空间的环境，水环境质量是不同景观格局、自然过程和人类活动和/或陆-水相互作用的结果

**水环境质量评价：**根据流域社会经济发展需要，综合评价人类活动导致用水资源短缺、洪涝灾害、水土流失、水污染、病虫害等环境要素的影响



从环境质量改善过渡到生态保护和修复

**水生生态系统：**水生生态系统是边界明确、由非生境和生境构成的一个整体，系统组成相互依存，通过能量流动和物质流动保持亚稳态平衡

**水生态完整性评价：**依据表征物理完整性、化学完整性、生物完整性的相关参数或生物指数进行评价，主要技术路线有先验性和经验性二种

## 不同法规中保护天然水体的主要目的

- (欧盟水框架指令) 为保护水生态系统直接相关的各种水资源利用、防止陆地生态系统和湿地进一步退化、提高水生态系统优良等级(article 1a)
- (美国清洁水法) 恢复和维持水体的化学、物理和生物完整性、消除污染物排放。阶段性水质保护目标是保护水生生物和景观娱乐(可渔可游), 禁止排放毒性剂量的有毒物质进入水体(101a)
- (中国水污染防治法) 防治水污染, 保护和改善环境, 保障饮用水安全, 保护水生态、推进生态文明、促进经济社会全面协调可持续发展(第一条)

消除污染物排放

改善流域水环境质量

保护/修复水生态系统

第一阶段: 污染治理  
污染源控制和减排

第二阶段: 改善水环境质量  
流域综合管理/山水林田湖

第三阶段: 水生态系统保护  
化学、生境和生物完整性

## 水质监测的基本概念和监测技术类型

### 水质监测类型：

- 按照监测目的性分为调查型监测、研究型监测和操作型(合规)监测
- 按照业务类型分为污染源监测、环境质量监测和污染物通量(负荷)监测
- 按照具体监测指标分为理化监测、生物监测和有毒物质/综合毒性监测
- 按照合规监测目的划分为执法监测、监视监测和工程项目跟踪监测

### 污染源监测位点：

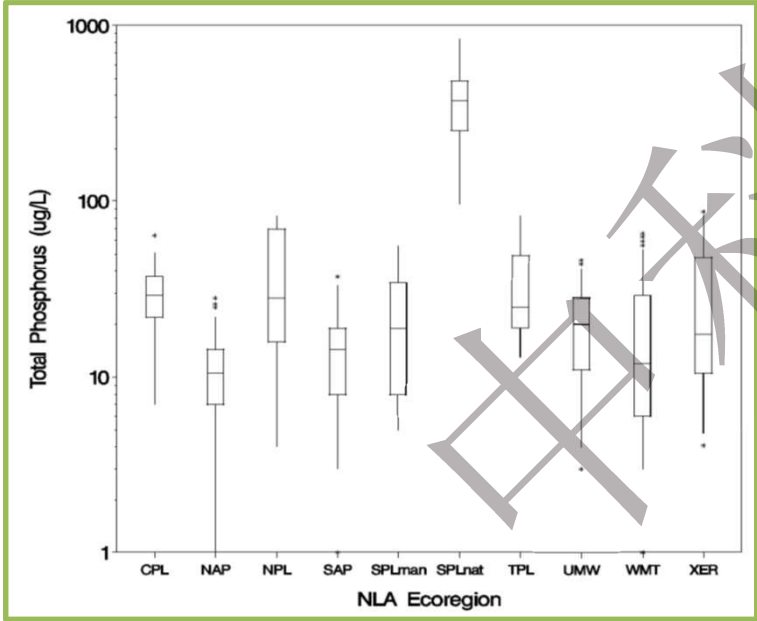
- 市政污水处理实施的排放标准达标监测(排污口)；
- 工业废水直接排放达标监测(工艺段出水口/排污口)；
- 工业废水间接排放监测(污水厂入水口)；
- 雨季溢流污水的高频度采样监测(溢流口或收集系统)；
- 雨季的城市雨水监测(排水口)；
- 非点源监测(入河/入湖排水口、地表径流和侧渗土壤剖面)；
- 大气干湿沉降污染源监测(气象站/观察站)；
- 污染物通量监测(河口/入海口/径流小区/流域代表性站点)。

### 污染源排放达水质标准的监测点位：

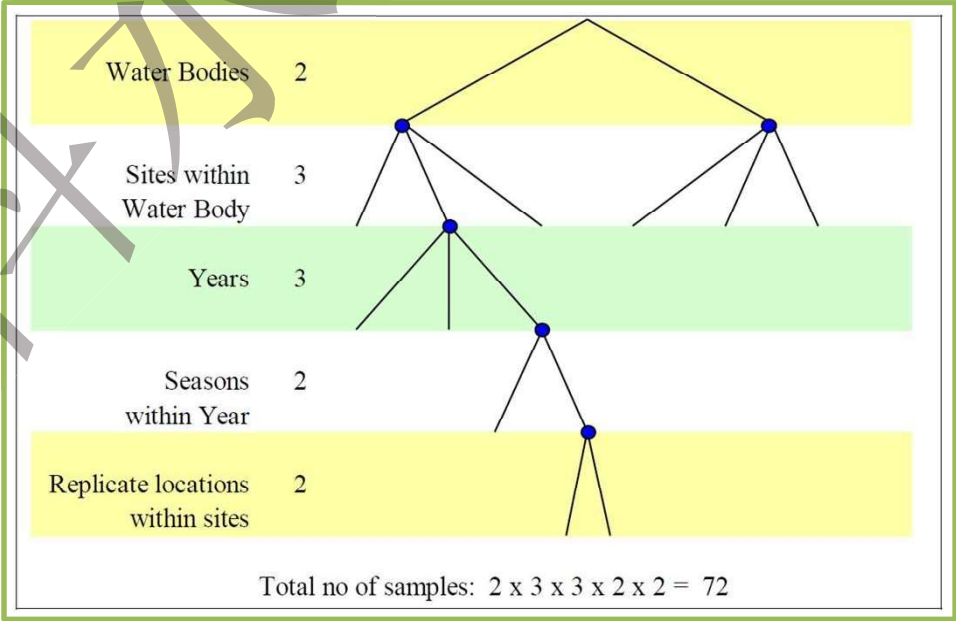
- 排污口附近的纳污水体混合区边缘。

# 水质监测数据的不确定性来源分析

- 背景值变异引起的不确定性：采用相对背景水平的倍数及其置信区间；
- 抽样空间差异性：通常用箱式图表述(如四分位和中值图)；
- 抽样时间差异性：通常用时间分辨的(超标)频度方式表述；
- 分析方法的误差：通常用绝对误差和相对误差表示；
- 监测数据的总体不确定性：通常采用监测数据及其置信度区间方式表述。

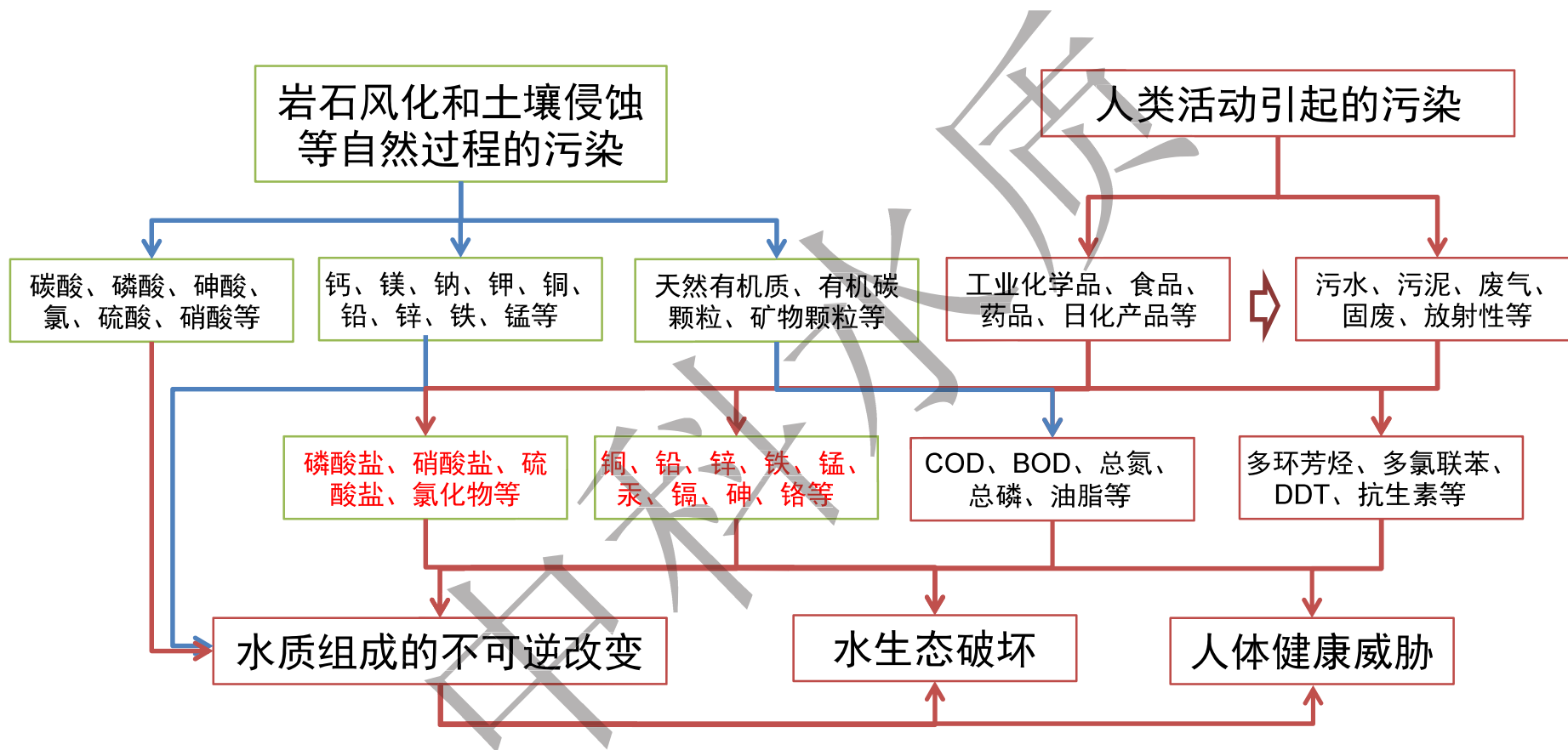


美国湖泊水质调查中不同生态分区总磷浓度的背景值



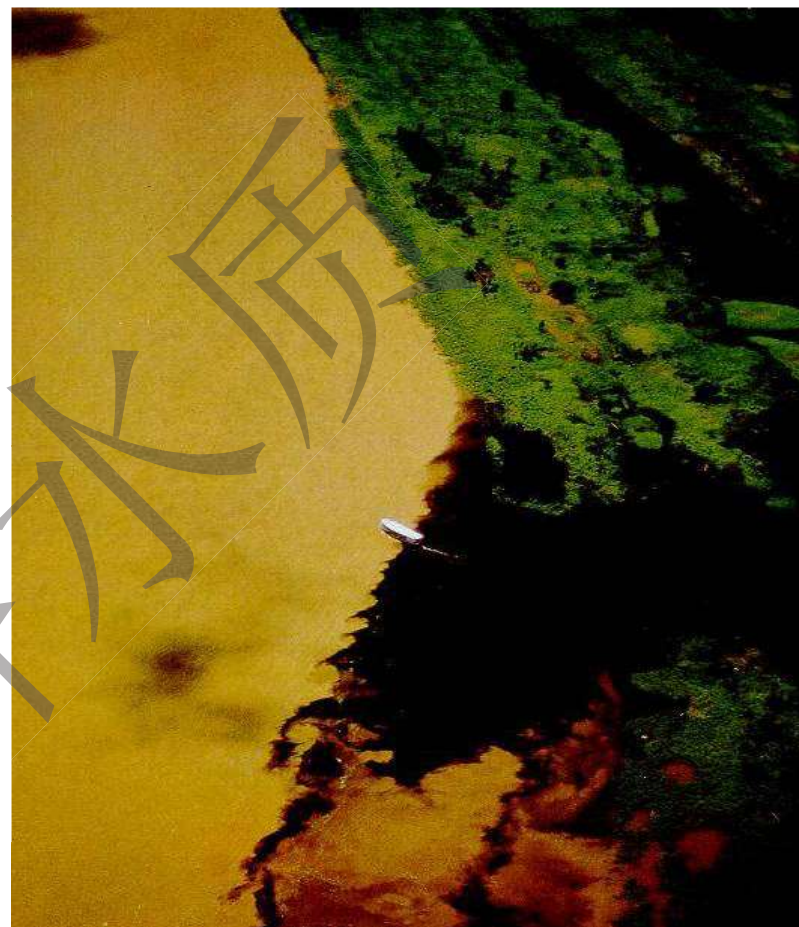
英国水框架指令合规监测中的采样点和样品数设计

## 流域尺度的污染源：自然源和人类活动引起的污染源



环境污染：自然背景污染(如高砷地质)和人类活动污染(如合成有机物)

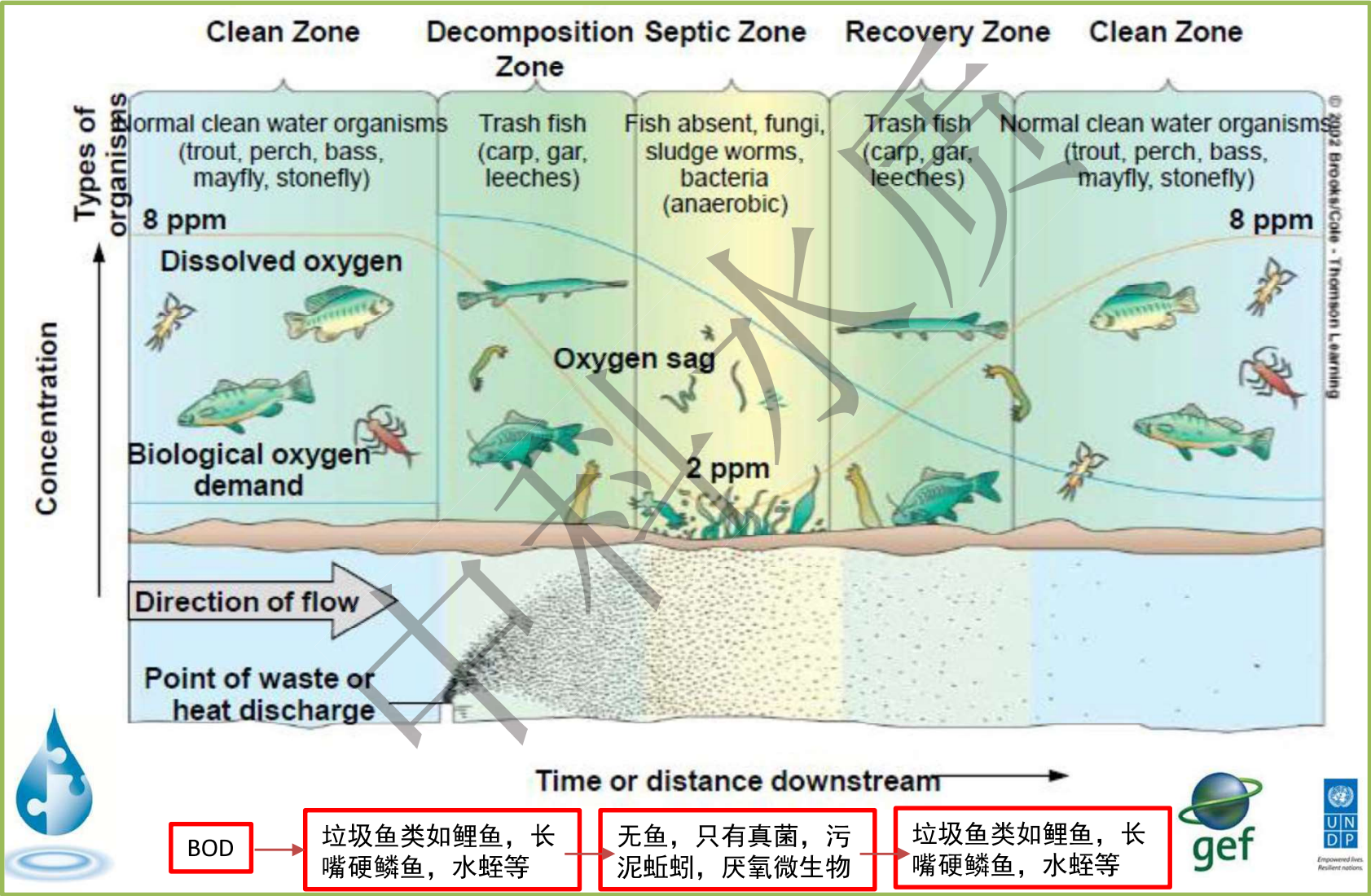
惰性有机碳：天然水体中有机物或COD(来源于森林/草甸土壤腐植酸类物质的淋溶)



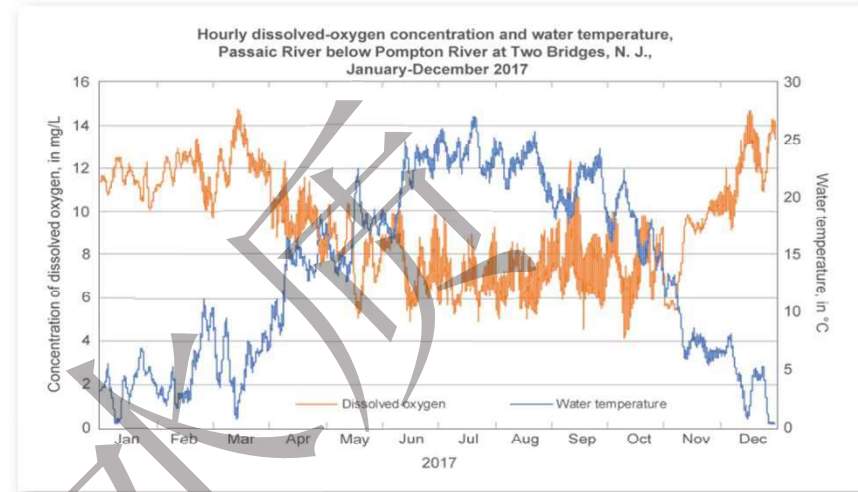
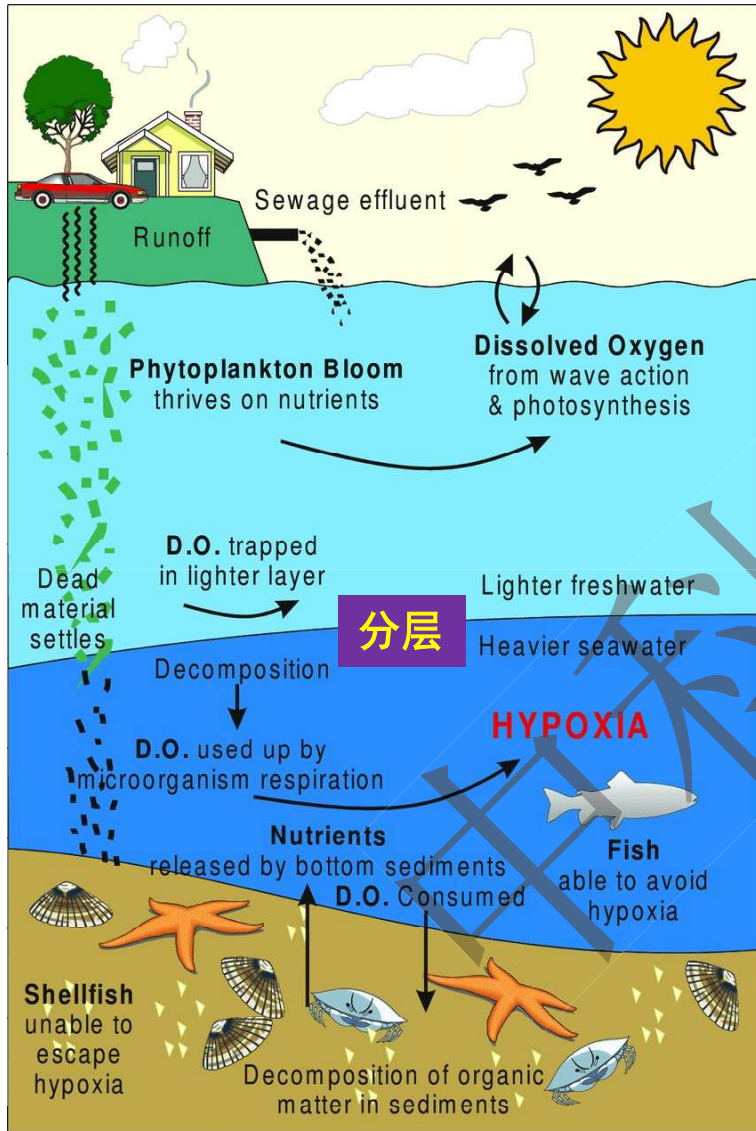
阿根廷的尼格罗河流入亚马逊河干流。由于携带了大量集水区的腐植酸物质，河水呈褐色，溶解有机碳含量非常高。

河流/湖泊水体中的有机碳主要来自泥炭盆地，湿地和沼泽，主要释放腐殖酸物质(Chapman, 1996).

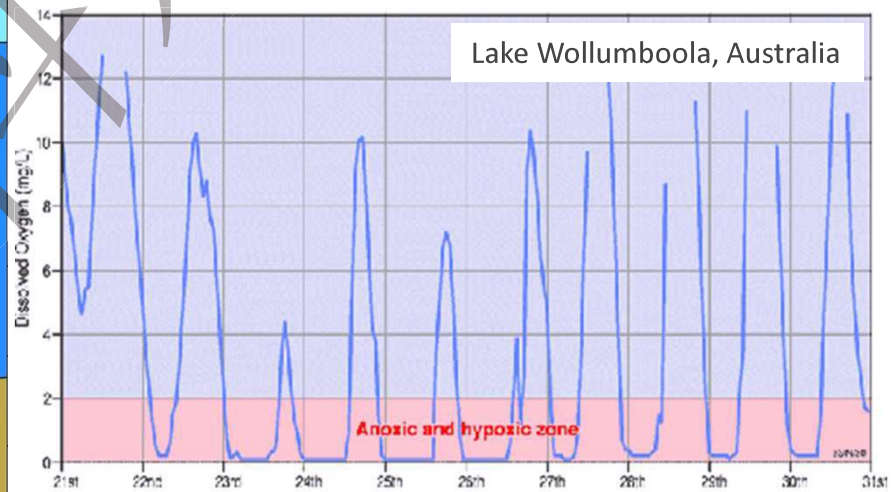
污水排放口下游河道溶解氧含量和生物多样性改变的的压力-响应关系



# 水生生态系统中的溶解氧：产生和消耗之间的内稳态调节

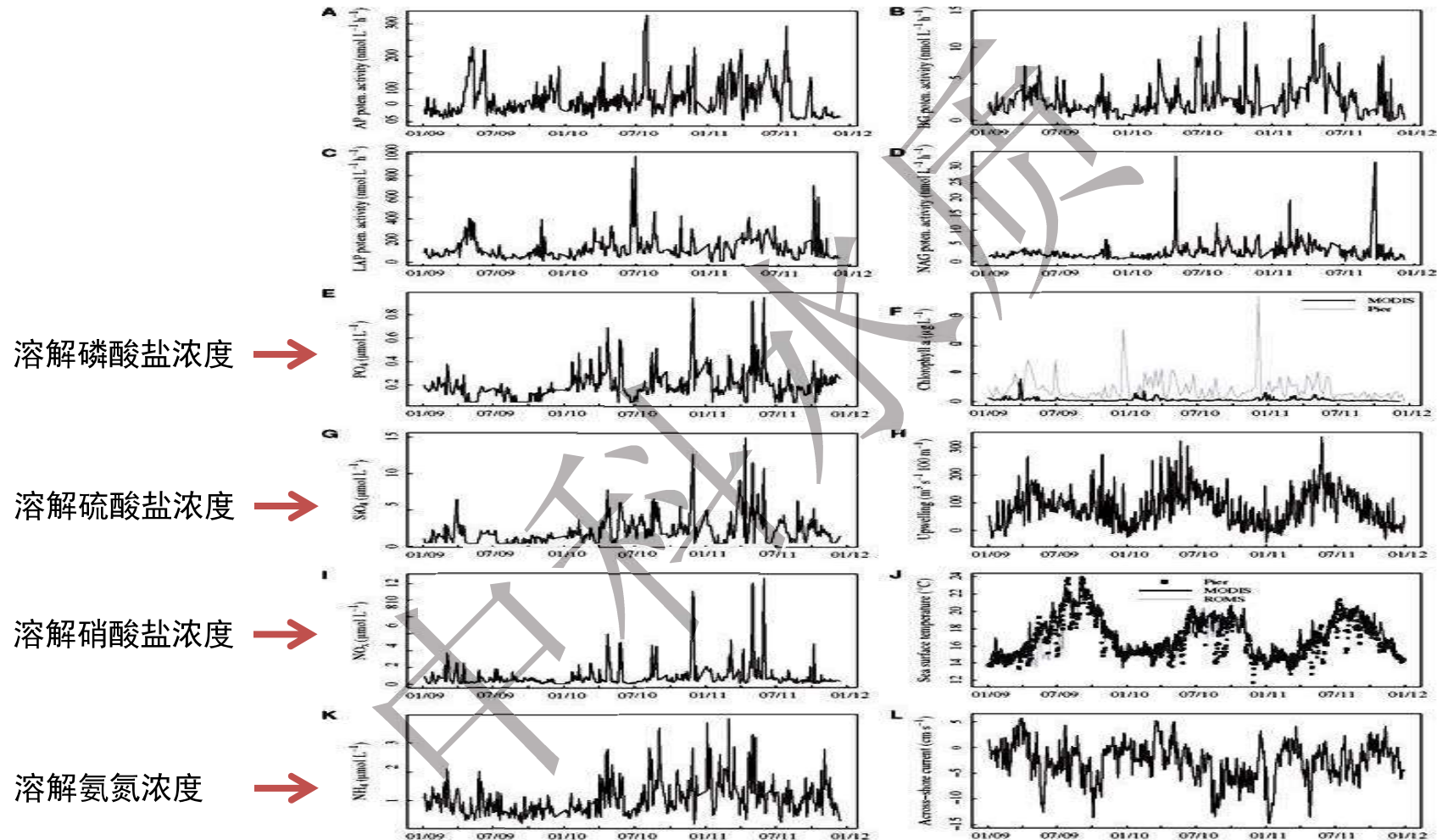


溶解氧是温度、大气压、盐度、流速、风浪等的函数



溶解氧浓度：日均值/最低值/24h变化幅度/持续时长

# 天然水体中水质参数的高分辨时间序列 (2009~2012)



水质标准：指标、限值(日平均-月平均-年平均)、采样频度、超标频度、置信度区间.....

# 富营养化水体演化中水化学变化的时空数据系列(黑河水库)

水温升高是初级生产开始的信号，叶绿素增加

叶绿素增加伴随底部DO下降，出现D0分层

溶氧降低伴随底部TP升高、而表层水的磷耗竭

藻华期间出现的高TN，预示底泥氮释放增强

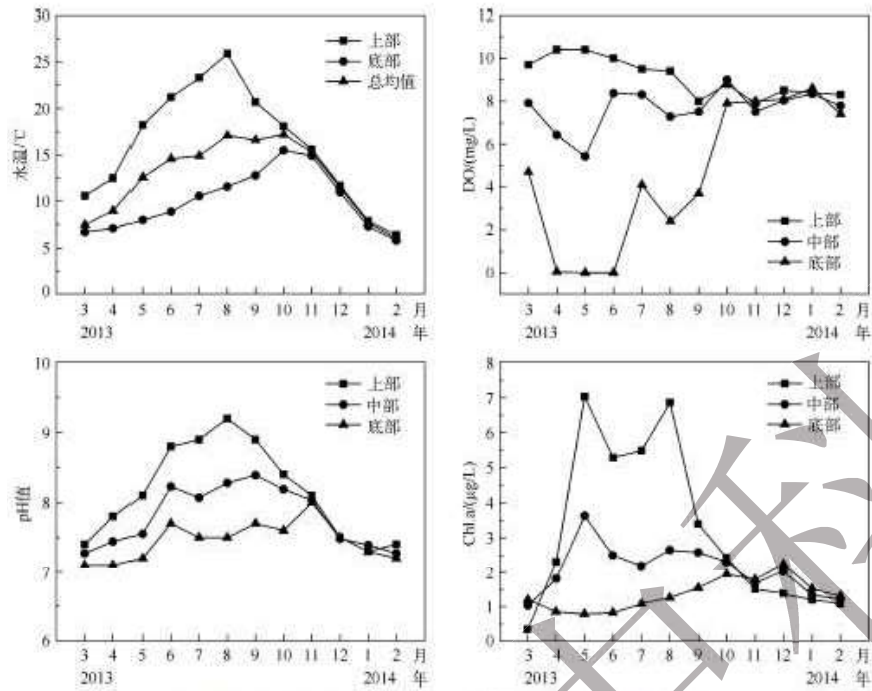


图3 黑河水库S1点位水温、DO、pH值和Chl a浓度的时空分布  
Fig.3 Spatial and temporal distribution of water temperature, DO, pH and chlomphyll-a concentration in the water column of S1 site of Heihe Reservoir

叶绿素增加伴随顶部pH明显高于底部pH

水体表层叶绿素的增加与温度、TP基本一致

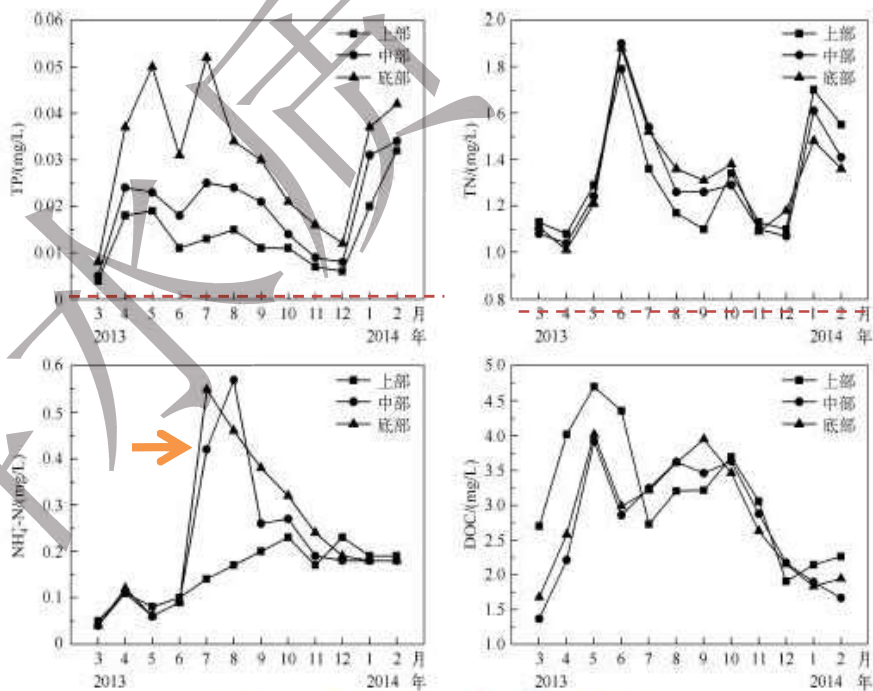


图4 黑河水库S1点位水体TP、TN、NH<sub>4</sub><sup>+</sup>-N和DOC浓度的时空分布  
Fig.4 Spatial and temporal distribution of TP, TN, NH<sub>4</sub><sup>+</sup>-N and DOC concentrations in the water column of S1 site of Heihe Reservoir

底、中部出现的高氨氮，表明厌氧藻腐败和氨化

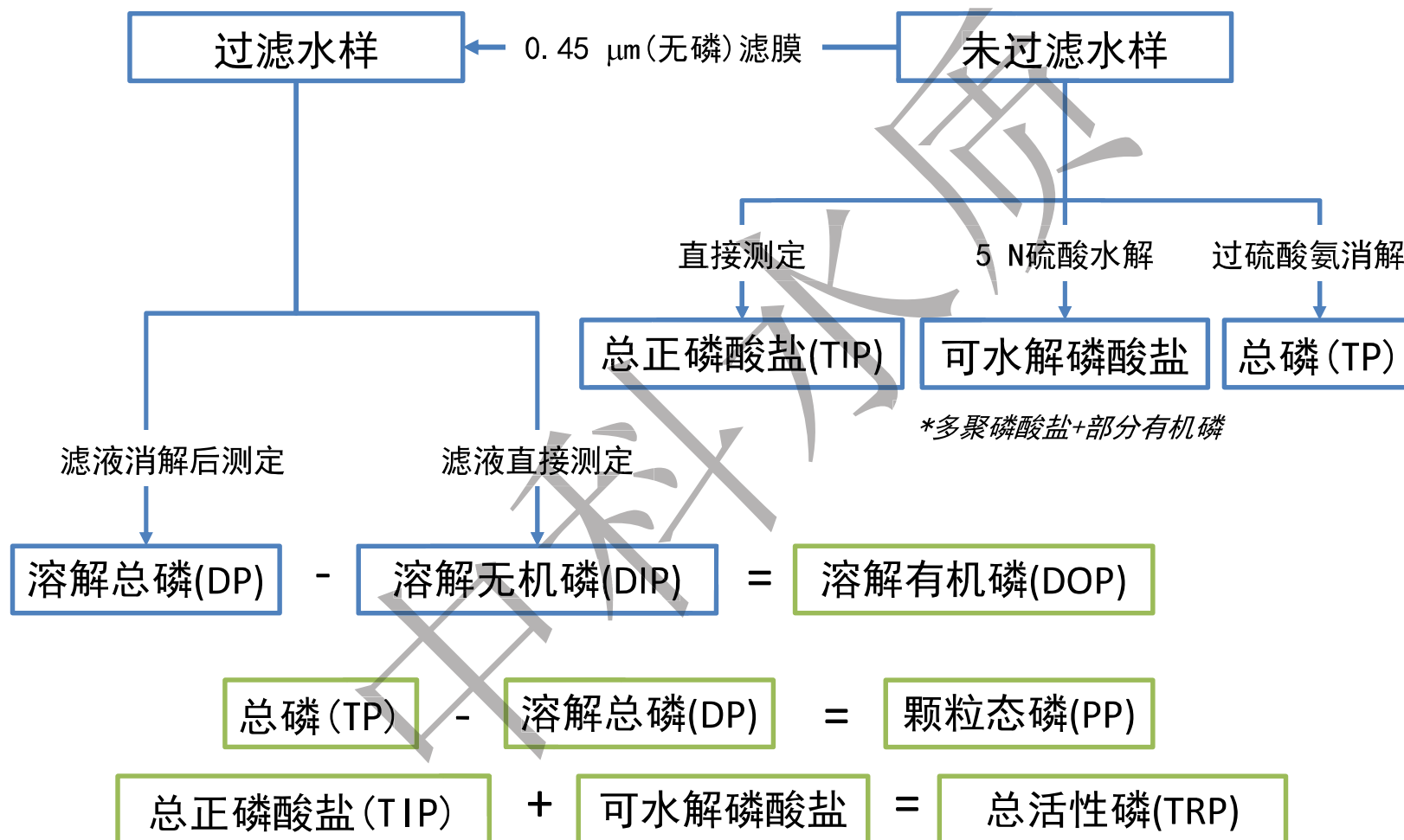
藻华中高DOC是胞外分泌物，后期是藻腐败产物

# 加州Pajoro河富营养化控制中的营养盐参数及其(分河段)执行水质标准

Stream Reaches Assigned Nitrate (as N) and Orthophosphate Water Quality Targets						
Waterbody Type	Geomorphology & Stream Characteristics	Stream Reaches	Allowable Nitrate as N (mg/L)	Allowable Orthophosphate as P (mg/L)	Methodology for Developing Numeric Target	Notes Pertaining to Development of Targets
Alluvial Floodplain River – Pajaro River	Generally low gradient alluvial basin floor and floodplains. Moderate ambient turbidity (9–21 NTU). Generally moderate canopy cover (20-25%). Substrates variable, but generally characterized by finer-grained material such as loams, clay loams, and fine- sandy loams.	Pajaro River, all reaches including the Pajaro River estuary.	<b>3.9</b> Dry Season Samples (May 1-Oct. 31)  <b>8.0</b> Wet Season Samples (Nov. 1-Apr. 30)	<b>0.14</b> Dry Season Samples (May 1-Oct. 31)  <b>0.3</b> Wet Season Samples (Nov. 1-Apr. 30)	Statistical Analysis (USEPA percentile-based approaches) Supplemented by Calif. NNE approach (NNE benthic biomass model tool) Wet-season targets based on Central Coastal Basin Plan nitrate objective and State of Nevada phosphate criteria for streams	Relatively finer-grained substrates and local soil conditions, such as loams, and clay loams likely result in relatively higher ambient turbidity (9–21 NTU) which limits good sunlight penetration of water column; risk of biostimulation thus occurs at relatively higher nutrient concentrations. Orthophosphate water quality targets in the dry season are based on background, reference conditions (USEPA 75 <sup>th</sup> percentile reference approach) for the Santa Cruz Mountains and Watsonville Plains level IV ecoregions.
Pajaro Valley –Alluvial Fan & Plains Tributary Creeks	Alluvial fans and alluvial plain tributary reaches. Generally low ambient turbidity (0.1–2 NTU). Generally moderate to higher canopy cover (40-50%). Substrates variable, with finer grained material such as clay loams and sandy loams in lower reaches of these tributaries, and coarser grained material such as gravelly loams and sand in middle reaches of these tributaries.	Corralitos Creek, all reaches	<b>1.8</b> Dry Season Samples (May 1-Oct. 31)	<b>0.14</b> Dry Season Samples (May 1-Oct. 31)	Statistical Analysis (USEPA percentile-based approaches) Supplemented by Calif. NNE approach (NNE benthic biomass model tool) Wet-season targets based on Central Coastal Basin Plan nitrate objective and State of Nevada phosphate criteria for streams	<div style="border: 1px solid blue; padding: 5px; color: red; text-align: center;">                     枯水期无机磷控制目标值                      根据IV级分区75<sup>th</sup>分位数                 </div> Orthophosphate water quality targets in the dry season are based on background, reference conditions (USEPA 75 <sup>th</sup> percentile reference approach) for the Santa Cruz Mountains and Watsonville Plains level IV ecoregions.
		Salsipuedes Creek, all reaches	<b>8.0</b> Wet Season Samples (Nov. 1-Apr. 30)	<b>0.3</b> Wet Season Samples (Nov. 1-Apr. 30)		
Pajaro Valley – Agricultural Ditches	Agricultural ditches located on the basin floor and coastal flood plain of the Pajaro Valley. Low canopy cover (0% to 15%). Substrates expected to be fine-grained mud and clay.	Beach Road Ditch, all reaches	<b>3.3</b> Dry Season Samples (May 1-Oct. 31)	<b>0.14</b> Dry Season Samples (May 1-Oct.31)	Statistical Analysis (USEPA percentile-based approaches) Supplemented by Calif. NNE approach (NNE benthic biomass model tool) Wet-season targets based on Central Coastal Basin Plan nitrate objective and State of Nevada phosphate criteria for streams	Substrates expected to be muddy and fine-grained substrates based on local soil conditions which contribute to relatively higher ambient turbidity (up to 19 NTU) which could preclude good sunlight penetration of water column; risk of biostimulation occurs at relatively higher nutrient concentrations.
		McGowan Ditch, all reaches	<b>8.0</b> Wet Season Samples (Nov. 1-Apr. 30)	<b>0.3</b> Wet Season Samples (Nov. 1-Apr. 30)		

水体类型
物理生境
河段范围
硝酸盐
总正磷酸盐
制定标准依据
营养盐水质基准定值方式说明

# 不同磷形态的测定方法(EPA Method 365.1/365.3)



# 总磷水质背景值：长江三峡及宜昌段磷背景浓度及其与三峡水库建设的关系

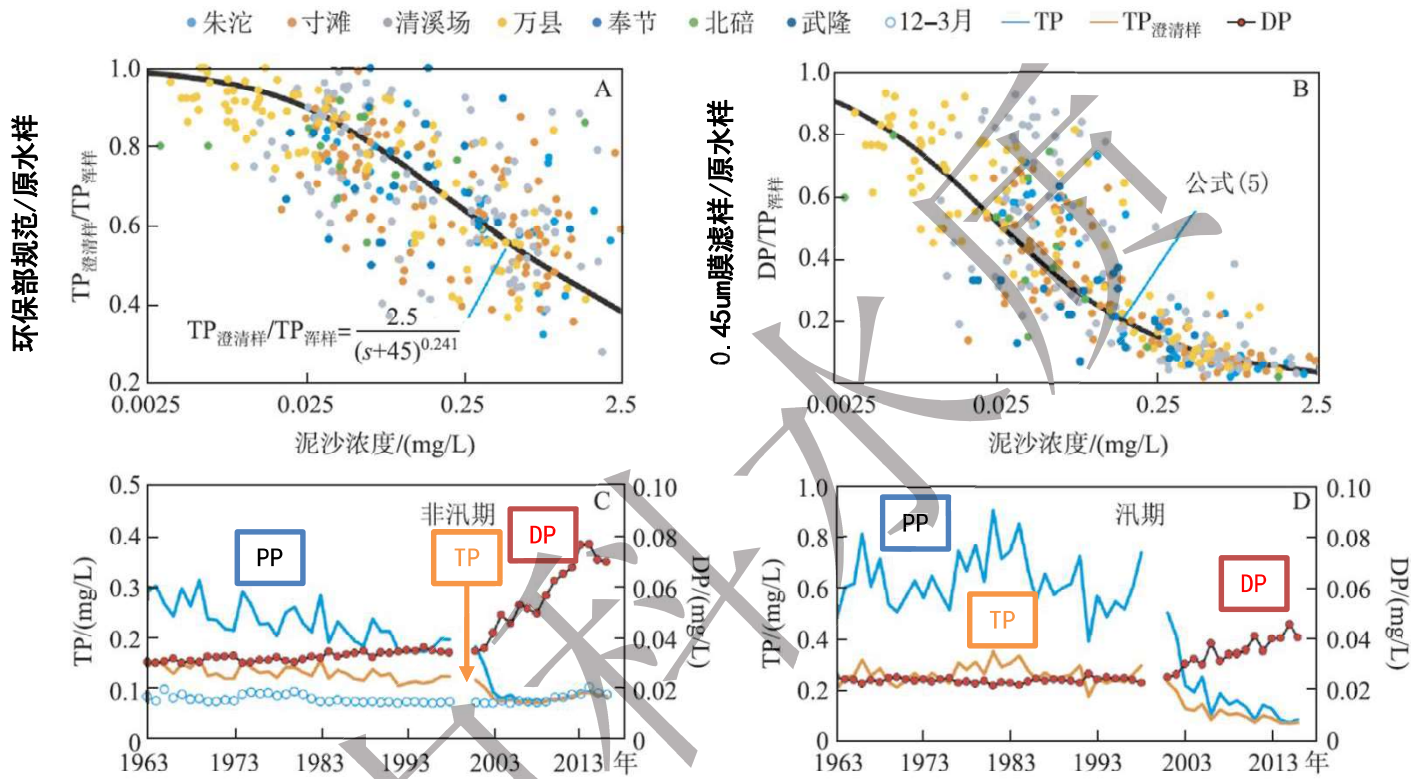


图4 根据三峡库区多断面采样资料得到长江澄清样总磷( $TP_{\text{澄清样}}$ )(A)、溶解磷(DP)(B)占全沙总磷( $TP_{\text{浑样}}$ )比例与泥沙浓度之间关系和根据模型3计算1963年以来宜昌非汛期(C)和汛期(D)下泄全沙总磷、澄清样总磷和DP浓度变化情况

总磷的监测数据与样品前处理方式有关；三峡建库后TP降低伴随DP升高，与外源输入关系不密切；引长江水的总磷相对于沿江湖泊是营养盐负荷(周建军等, 湖泊研究, 2018)。美国EPA磷及其形态分析标准方法(Method 365.3)中采用未过滤水样测定TP。

# 欧美成员国不同水体类型水质评价中采用的营养盐参数和监测方式调查

Nutrient parameters used by member states (number of countries and percentage of countries). CW-coastal waters, TW – transitional waters (estuaries, coastal lagoons etc.)

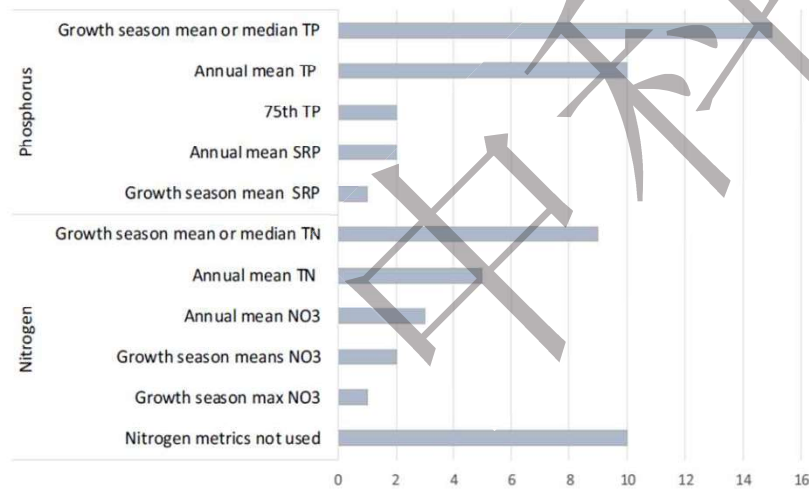
Nutrient parameters used in ecological classification	# of countries				% of all countries reported			
	Lakes <sup>a</sup>	Rivers <sup>b</sup>	CW <sup>c</sup>	TRW <sup>c</sup>	Lakes	Rivers	CW	TRW
<b>Phosphorus parameters</b>								
Total phosphorus (TP)	26	24	12	10	100%	82.8%	46.2%	52.6%
Total reactive phosphorus (TRP)	0	2	0	0	0	6.9%	0	0
Soluble reactive phosphorus (SRP)	3	14	14	12	11.5%	48.3%	53.9%	63.2%
Not using P parameters	0	1	5	3	0	3.4%	19.2%	15.8%
<b>Nitrogen parameters</b>								
Total nitrogen (TN)	14	13	10	8	53.9%	44.8%	38.5%	42.1%
Dissolved inorganic nitrogen (DIN)	0	0	9	11	0	0	32.1%	57.9%
Nitrate (NO <sub>3</sub> )	6	20	10	7	23.1%	69.0%	38.5%	36.8%
Not using N metrics	10	4	1	1	38.5%	13.8%	3.9%	5.3%
	26	29	23	19				

<sup>a</sup> Countries with no lakes (Belgium-Wallonia, Luxembourg, Slovakia) and Malta not included.

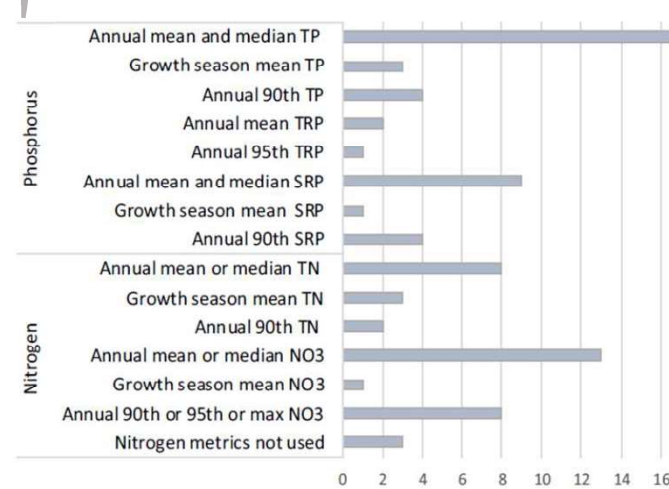
<sup>b</sup> Belgium-Flanders and Belgium-Wallonia counted separately, Malta not included.

<sup>c</sup> Countries may report criteria for more than one region (e.g., France - Mediterranean Sea Region and France - North East Atlantic Sea region).

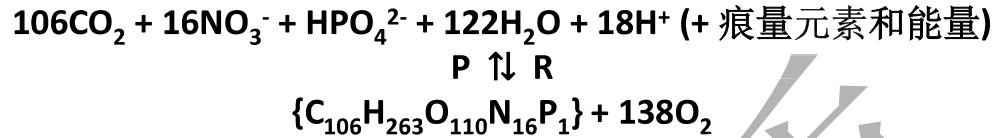
Nutrient metrics used in lakes



Nutrient metrics used in rivers



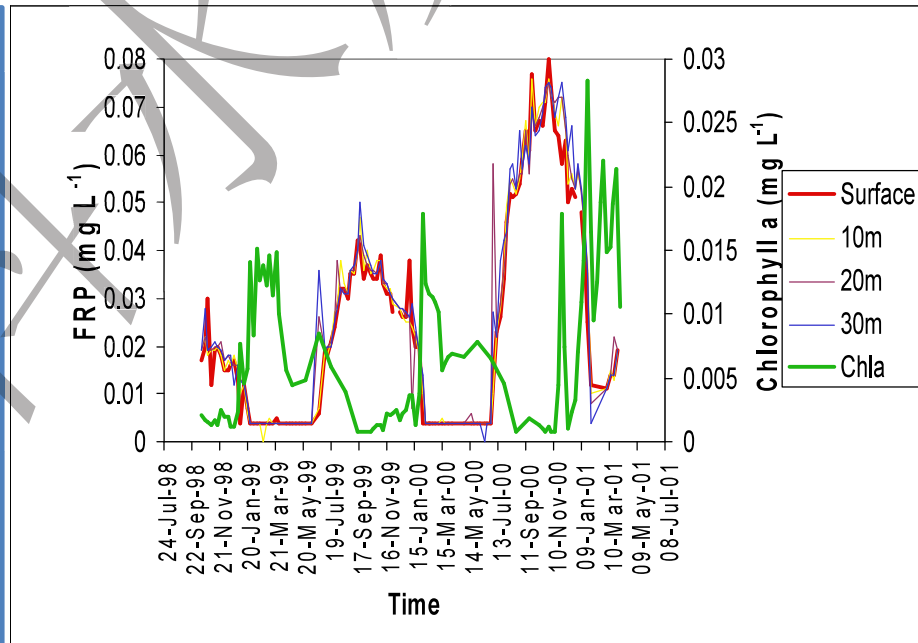
## 淡水湖泊中营养盐随初级生产率的变化关系：营养盐耗竭过程



在中国东部浅水湖泊(3米水深), 某个磷原子一旦进入水环境, 将不断在水体和沉积物之间巡游(无机磷-有机磷-无机磷), 吸收大气中的 $\text{CO}_2$ 和部分吸收 $\text{N}_2$ , 使得湖泊系统由于光合作用需要而不断累积C、N营养物质。

浮游植物的个体寿命在若干小时和数十日之间, 生长周期内可以多次繁殖, 吸收了大量营养物质。

CNP营养物质中, 只有磷是必须重复利用的, 碳和氮则可以来自大气并重新回到大气。



\* 微囊藻在最佳生长条件下的分裂周期大约是10天, 生命周期一般在30天, 磷的重复利用率应该是4~10次/a。

## 氨氮：美国EPA地面水水质基准中保护水生生物基准

Criterion Duration	1999 AWQC Update Criteria Magnitude		2009 Draft AWQC Update Criteria <sup>c</sup> Magnitude		2013 AWQC Update Criteria Magnitude
	pH 8.0, (mg TAN/L)	pH 7.0, T=20°C (mg TAN/L)	pH 8.0, T=25°C (mg TAN/L)	pH 7.0, T=20°C (mg TAN/L)	pH 7.0, T=20°C (mg TAN/L)
Acute (1-hr average)	5.6 <sup>a</sup>	24 <sup>a</sup>	2.9	19	17 <sup>a</sup>
Chronic (30-d rolling average)	1.2	4.5 <sup>b</sup>	0.26	0.91	1.9*
*Not to exceed 2.5 times CCC or 4.8 mg TAN/L (at pH 7, 20°C) as a 4-day average within the 30-days, more than once in three years on average.					

EPA水质基准中的保护水生生物基准：急性或短期暴露基准(CMC)适用于具有急性毒性的化学物质，以7d内24h平均浓度不多于一次为超标；慢性或长期暴露基准(CCC)适用于具有慢性毒性的化学物质，以30d内4日的平均浓度不多于一次为超标。上标a表示水质标准适用于鲑鱼游鱼的水体；上标c表示敏感生物中有贻贝类。

上标\*号表示：由于氨氮的长期标准是根据4-d亚急性毒性数据推导得到的，因此在用于30-d长期水质标准时的变异系数为2.5倍或实际按照4.8 mg TAN/L执行。

## 分析方法误差: 六个实验室分析结果的平行比较(EPA Method 365.1)

### 13.0 METHOD PERFORMANCE

□ 6个实验室采用半自动方法分析相同浓度梯度的一组天然水样....

- 13.1 Six laboratories (using Technicon AAI equipment) participating in an EPA Method Study, analyzed four natural water samples containing exact increments of orthophosphate, with the following results:

Increment as Orthophosphate mg P/L	Precision as Standard Deviation mg P/L	Accuracy As	
		Bias %	Bias mg P/L
—	—		
0.04	0.019	+16.7	+0.007
0.04	0.014	-8.3	-0.003
0.29	0.087	-15.5	-0.05
0.30	0.066	-12.8	-0.04

- 13.2 In a single laboratory (EMSL), using surface water samples at concentrations of 0.04, 0.19, 0.35, and 0.84 mg P/L, standard deviations were  $\pm 0.005$ ,  $\pm 0.000$ ,  $\pm 0.003$ , and  $\pm 0.000$ , respectively.

□ 任何一个实验室的分析误差<0.005 mg/L

- 13.3 In a single laboratory (EMSL), using surface water samples at concentrations of 0.07 mg and 0.76 mg P/L, recoveries were 99% and 100%, respectively.

□ 任何一个实验室的回收率>99%

- 13.4 The interlaboratory precision and accuracy data in table 1 were developed using a reagent water matrix. Values are in mg PO<sub>4</sub>-P/L.

### 14.0 POLLUTION PREVENTION

□ 跨实验室比对的偏差<16.7%

- 14.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous

# 污染物排放标准和合规监测的数据质量管理

## 水污染治理阶段：污染源控制和水污染物达标的组合管理方式

### 污染源管理

排放标准：通过污染控制手段  
削减点源和面源排放的污染物  
浓度/总量/去除率

### 水环境质量管理

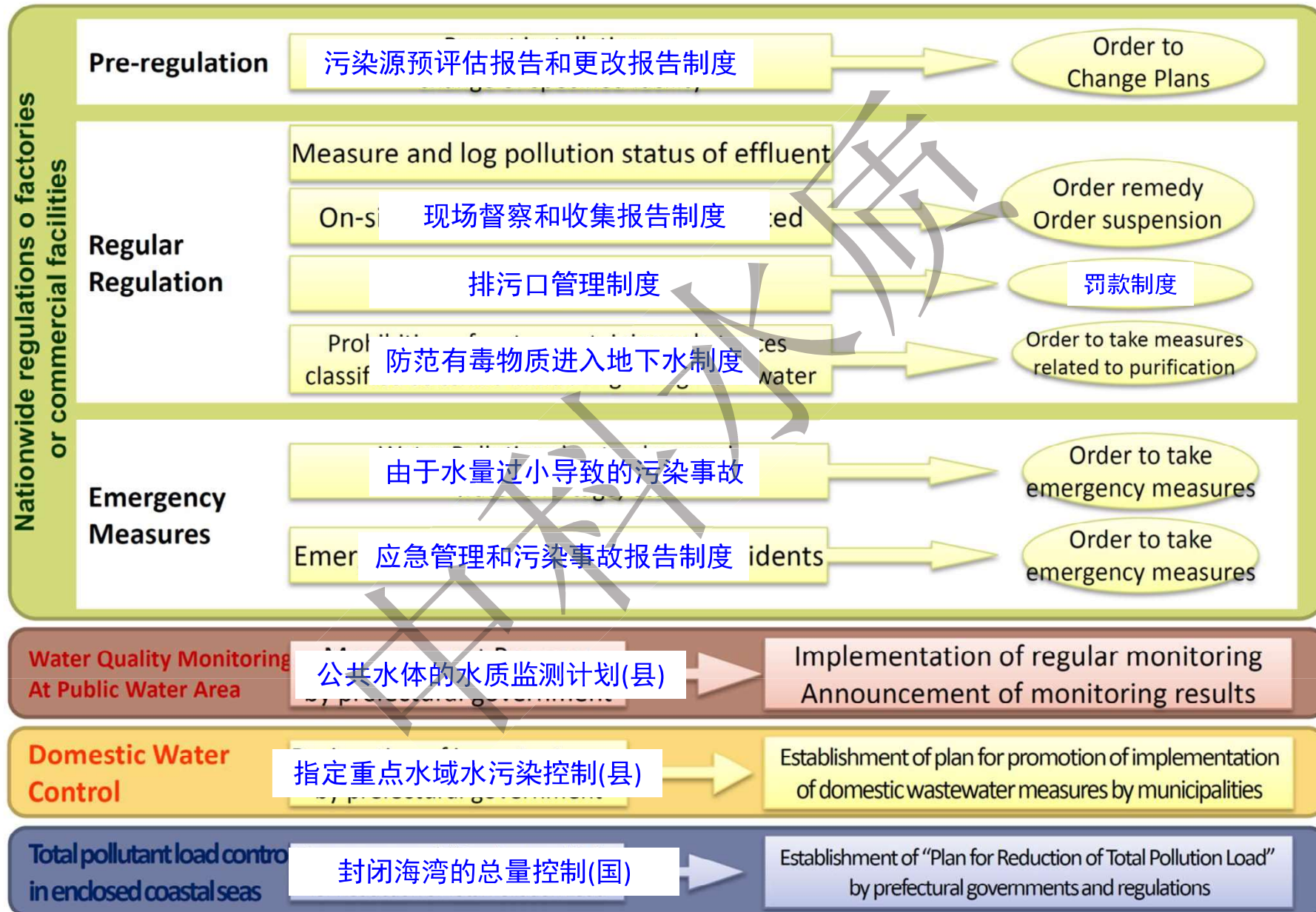
水质标准：不会对人类健康和  
环境产生影响的水、沉积物或  
生物体污染物浓度/频次/周期

许可证制度：同时符合排放标  
准(技术许可)和水质标准(水质  
许可)的最大排放浓度/负荷

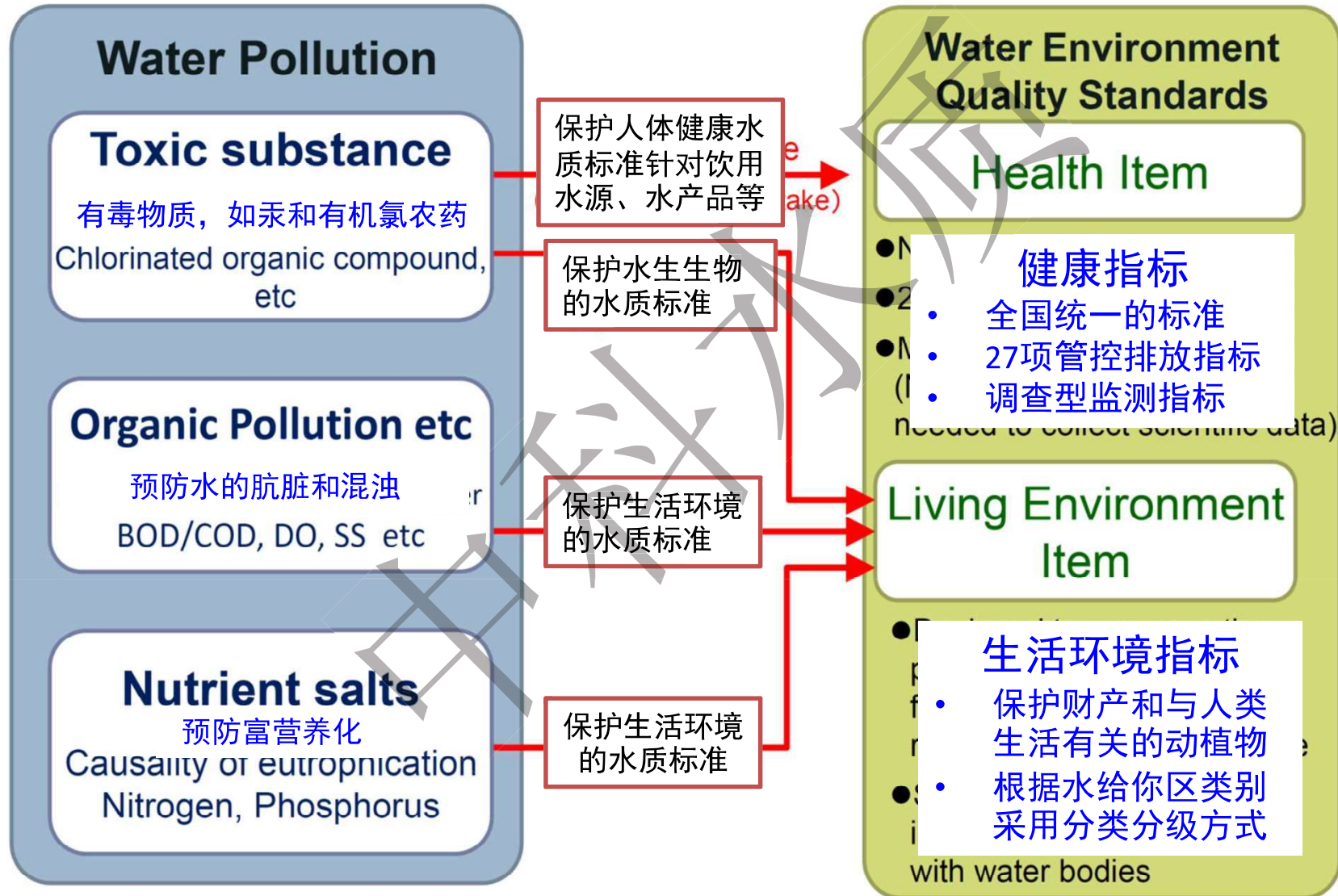
技术许可：点源和部分非点源  
管理重点：常规污染物  
基本措施：最佳实用技术(BAT)  
监测技术：排放标准/总量合规监测

水质许可：非点源和农业面源  
管理重点：特征污染物/有毒物质  
基本措施：水质标准  
监测技术：调查/研究/操作型监测

# How the Water Pollution Control Law Works



# Water Environment Quality Standards (EQS)



# 日本全国统一的污水和废水排放标准(排放标准仅针对指定实施)

## 保护生活环境的排放标准

Potential Hydrogen (pH)	Non-coastal areas : Coastal areas :	5.8-8.6 5.0-9.0
Biochemical Oxygen Demand (BOD)		160 mg/l (Daily Average 120 mg/l)
Chemical Oxygen Demand (COD)		160 mg/l (Daily Average 120 mg/l)
Suspended solids (SS)		200 mg/l (Daily Average 150 mg/l)
N-hexane Extracts (mineral oil)		5 mg/l
N-hexane Extracts (animal and vegetable fats)		30 mg/l
Phenols		5 mg/l
Copper		3 mg/l
Zinc		2 mg/l
Dissolved iron		10 mg/l
Dissolved manganese		10 mg/l
Chromium		2 mg/l
Coliform groups		Daily Average 3000/cm <sup>3</sup>
Nitrogen		120 mg/l (Daily Average 60 mg/l)
Phosphorus		16 mg/l (Daily Average 8 mg/l)

- BOD指标适用于排放进入河流;
- COD指标适用于排放进入海、湖;
- 总氮、总磷适用于指定的(潜在富营养化)湖泊或(潜在富营养化)海域;

## 保护人体健康的排放标准

Cadmium and its compounds		0.03 mg Cd/l
Cyanide compounds		1 mg CN/l
Organic phosphorus compounds (Parathion, Methyl Parathion, Methyl Demeton and EPN only)		1 mg/l
Lead		0.1 mg Pb/l
Chromium (VI)		5 mg Cr(VI)/l
Arsenic		0.1 mg As/l
Mercury		0.05 mg Hg/l
Alkyl mercury compounds		Not detectable
PCBs		0.003 mg/l
Trichloroethylene		0.1 mg/l
Tetrachloroethylene		0.1 mg/l
Dichloroethylene		0.1 mg/l
Carbon tetrachloride		0.1 mg/l
1, 1, 1-Trichloroethane		0.1 mg/l
1, 1, 2-Trichloroethane		0.1 mg/l
1, 1, 1-Trichloroethane		0.1 mg/l
1, 1, 2-Trichloroethane		0.00 mg/l
1, 3-Dichloropropene		0.02 mg/l
Thiram		0.06 mg/l
Selenium and its compounds		0.03 mg/l
TP		0.2 mg/l
Ammonia, Ammonium compounds, Nitrate and Nitrite compounds		0.1 mg/l
Selenium and its compounds		0.1 mg Se/l
Boron		0.1 mg B/l
Boron		0.1 mg B/l
Fluorine and its compounds		8 mg F/l
Fluorine and its compounds	Coastal areas :	15 mg F/l
Ammonia, Ammonium compounds, Nitrate and Nitrite compounds	Total of NH <sub>3</sub> -N multiplied by 0.4, NO <sub>2</sub> -N and NO <sub>3</sub> -N:	100 mg/l
1,4-Dioxane		0.5mg/l

- BOD单次采样160 mg/L;日均值120 mg/L;
- COD单次采样160 mg/L;日均值120 mg/L;
- SS单次采样200 mg/L;日均值150 mg/L;

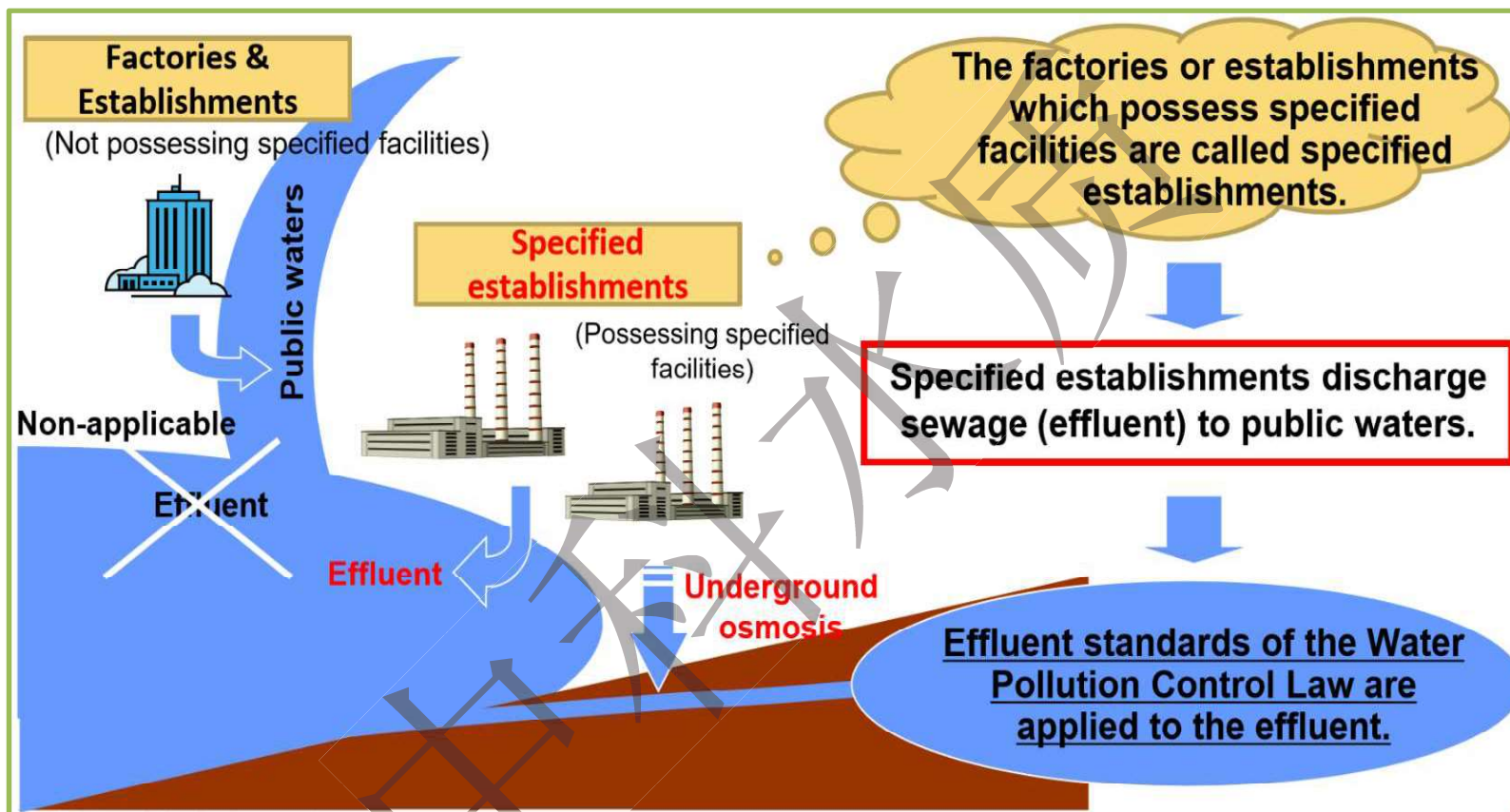
- 27项保护人体健康指标根据保护人体健康的水源水质标准和10倍稀释度计算排放指标;
- 保护人体健康的调查型监测指标主要来自日本化成法中的监视物质(Class I specified);
- 保护人体健康的排放和水质标准不分类分级。

- TN单次采样120 mg/L;日均值60 mg/L;
- TP单次采样160 mg/L;日均值8 mg/L;

•  $\Sigma 0.4 \times \text{氨氮} + \text{亚硝氮} + \text{硝氮} = 100 \text{ mg/L (健康)}$ ;

Ammonia, Ammonium compounds, Nitrate and Nitrite compounds

## 日本排放标准仅针对指定的工厂 (FACTORIES) 或实施 (ESTABLISHMENTS)



- 排放标准仅适用指定工厂和实施。例如2010年指定的工厂和实施为271242个；
- 是否属于指定工厂或实施取决于预评估报告、排放性质和纳污水体水质要求；
- 排放监测由排放源自行实施，采用定期报告制度(各县自行决定)；
- 合规监测采用抽查方式，例如2010年抽查了14260个指定工厂和实施，其中588个在夜间。

# 日本保护生活环境标准的案例分析(EQS-CLE)

## 河流

Item class	Water use	Standard value				
		Hydrogen-ion concentration (pH)	Biochemical oxygen demand (BOD)	Suspended solids (SS)	Dissolved oxygen (DO)	Total coliform
AA	Water supply class 1, conservation of natural environment, and uses listed in A-E	$6.5 \leq \text{pH} \leq 8.5$	$\leq 1 \text{ mg/L}$	$\leq 25 \text{ mg/L}$	$\geq 7.5 \text{ mg/L}$	$\leq 50 \text{ MPN/100mL}$
A	Water supply class 2, fishery class 1, bathing and uses listed in B-E	$6.5 \leq \text{pH} \leq 8.5$	$\leq 2 \text{ mg/L}$	$\leq 25 \text{ mg/L}$	$\geq 7.5 \text{ mg/L}$	$\leq 1,000 \text{ MPN/100mL}$
B	Water supply class 3, fishery class 2, and uses listed in C-E	$6.5 \leq \text{pH} \leq 8.5$	$\leq 3 \text{ mg/L}$	$\leq 25 \text{ mg/L}$	$\geq 5 \text{ mg/L}$	$\leq 5,000 \text{ MPN/100mL}$
C	Fishery class 3, industrial water class 1, and uses listed in D-E	$6.5 \leq \text{pH} \leq 8.5$	$\leq 5 \text{ mg/L}$	$\leq 50 \text{ mg/L}$	$\geq 5 \text{ mg/L}$	—
D	Industrial water class 2, agricultural water, and uses listed in E	$6.0 \leq \text{pH} \leq 8.5$	$\leq 8 \text{ mg/L}$	$\leq 100 \text{ mg/L}$	$\geq 2 \text{ mg/L}$	—
E	Industry water class 3 and conservation of environment	$6.0 \leq \text{pH} \leq 8.5$	$\leq 10 \text{ mg/L}$	Floating matter such as garbage should not be observed.	$\geq 2 \text{ mg/L}$	—

## 湖库湾

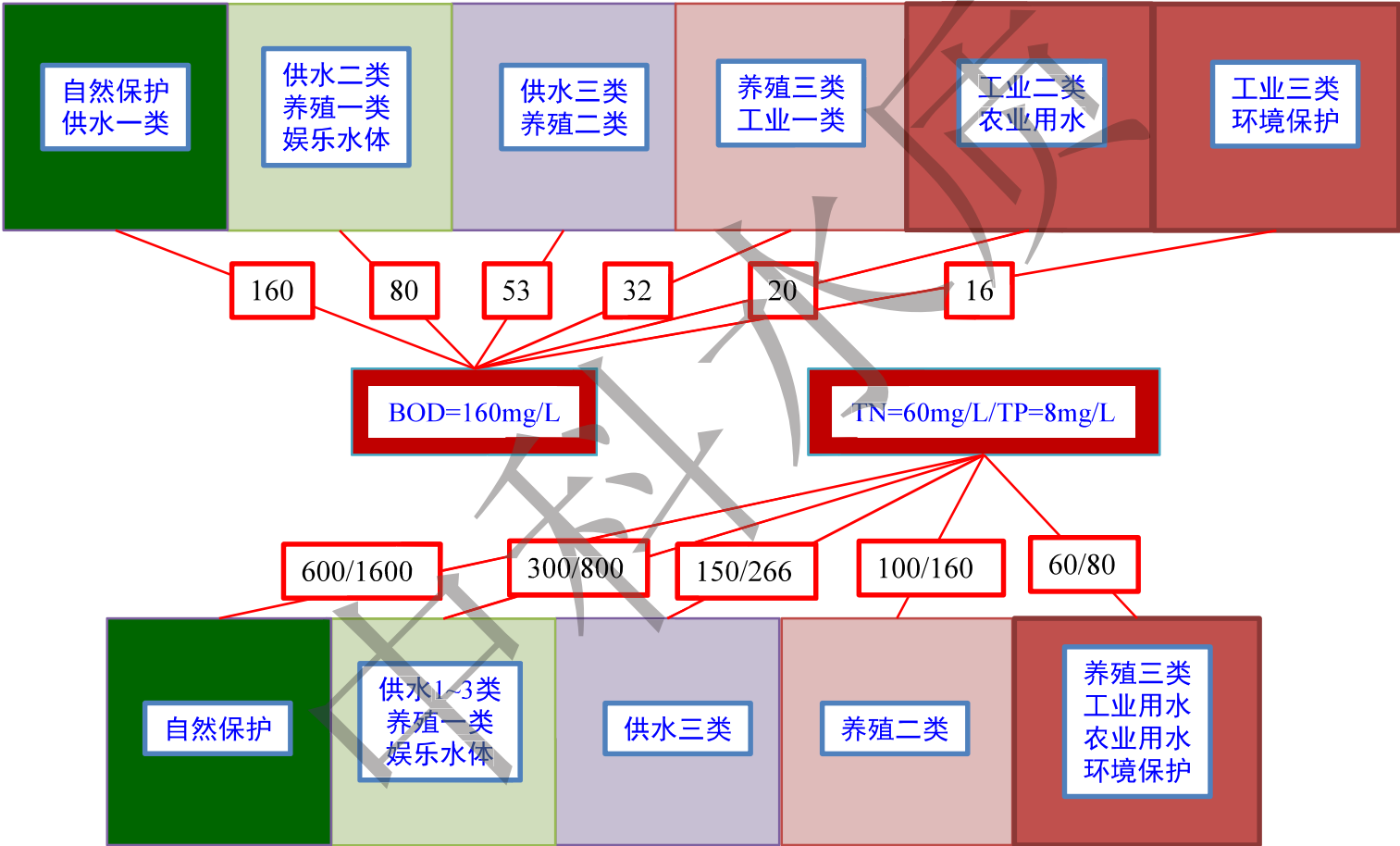
Item class	Water use	Standard value	
		Total nitrogen	Total phosphorus
I	Conservation of natural environment and uses listed in II-V	$\leq 0.1 \text{ mg/L}$	$\leq 0.005 \text{ mg/L}$
II	Water supply classes 1, 2, and 3 (except special types), fishery class 1, bathing, and uses listed in III-V	$\leq 0.2 \text{ mg/L}$	$\leq 0.01 \text{ mg/L}$
III	Water supply class 3 (special types) and uses listed in IV-V	$\leq 0.4 \text{ mg/L}$	$\leq 0.03 \text{ mg/L}$
IV	Fishery class 2 and uses listed in V	$\leq 0.6 \text{ mg/L}$	$\leq 0.05 \text{ mg/L}$
V	Fishery class 3, industrial water, agricultural water, and conservation of the environment	$\leq 1 \text{ mg/L}$	$\leq 0.1 \text{ mg/L}$

## 生境-锌

Item class	Adaptability of the habitat status of aquatic life	Standard value
		Total zinc
Class A organisms	Water areas inhabited by aquatic life	$\leq 0.02 \text{ mg/L}$
Special class A organisms	Of the water areas inhabited by Class A organisms, those that should be conserved as spawning/rearing areas of aquatic life	$\leq 0.01 \text{ mg/L}$

# 日本保护生活环境标准达标所需要的稀释倍数

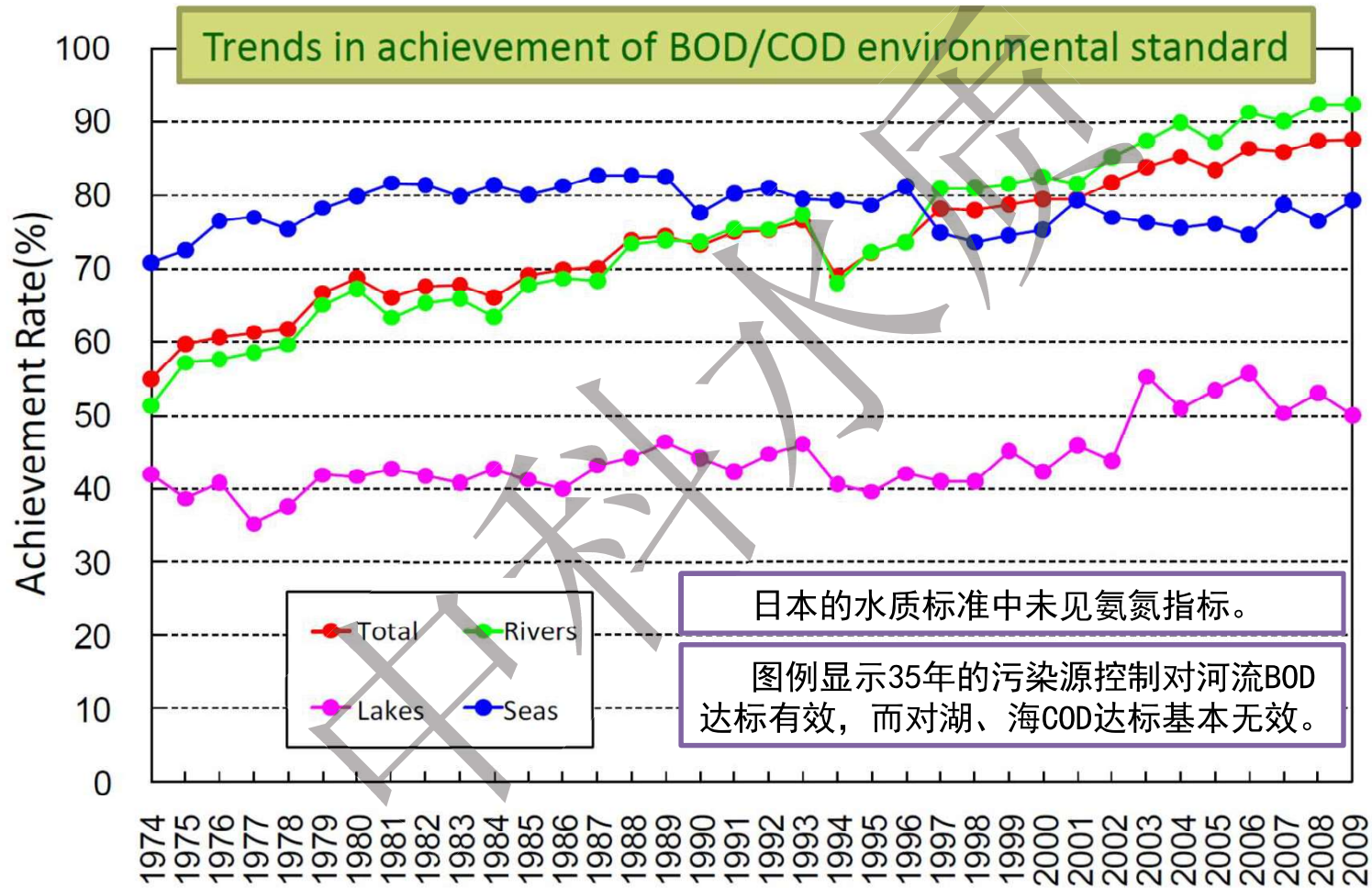
## 河流水质标准(BOD)



## 湖湾水质标准(TN/TP)

稀释度要求：当同时排放TN和TP时对稀释倍数要求最严酷的指标是TP。

# 日本保护生活环境的水质标准中COD/BOD达标率分析



# 日本保护人体健康的水质标准 (EQS-CLE)

## 水质标准项目及其标准值

Item	Standard values
Cadmium	≤ 0.01 mg/L
Total cyanide	Not detectable
Lead	≤ 0.01 mg/L
Hexavalent chromium	≤ 0.05 mg/L
Arsenic	≤ 0.01 mg/L
Total mercury	≤ 0.0005 mg/L
Alkyl mercury	Not detectable
PCBs	Not detectable
Dichloromethane	≤ 0.02 mg/L
Carbon tetrachloride	≤ 0.002 mg/L
1,2- Dichloroethane	≤ 0.004 mg/L
1,1-Dichloroethylene	≤ 0.02 mg/L
Cis 1,2-Dichloroethylene	≤ 0.04 mg/L
1,1,1- Trichloroethane	≤ 1 mg/L
1,1,2- Trichloroethane	≤ 0.006 mg/L
Trichloroethylene	≤ 0.03 mg/L
Tetrachloroethylene	≤ 0.01 mg/L
1,3-Dichloropropene	≤ 0.002 mg/L
Thiram	≤ 0.006 mg/L
Simazine	≤ 0.003 mg/L
Thiobencarb	≤ 0.02 mg/L
Benzene	≤ 0.01 mg/L
Selenium	≤ 0.01 mg/L
Nitrate nitrogen and nitrite nitrogen	≤ 10 mg/L
Fluoride	≤ 0.8 mg/L
Boron	≤ 1 mg/L

## 水质监测项目及其指导值

Categories	Guideline values
Chloroform	≤ 0.06 mg/L
trans1,2-Dichloroethylene	≤ 0.04 mg/L
1,2- Dichlor propane	≤ 0.06mg/L
p- Dichlor benzene	≤ 0.2 mg/L
Isoxathion	≤ 0.008 mg/L
Diazinon	≤ 0.005 mg/L
Fenitrothion (MEP)	≤ 0.003 mg/L
Isoprothiolane	≤ 0.04 mg/L
Oxine copper (organocopper)	≤ 0.04 mg/L
Chlorothalonil (TPN)	≤ 0.05 mg/L
Propyzamide	≤ 0.008 mg/L
EPN	≤ 0.006 mg/L
Dichlorvos (DDVP)	≤ 0.008 mg/L
Fenobucarb (BPMC)	≤ 0.03 mg/L
Iprobenfos (IBP)	≤ 0.008 mg/L
Chlornitrofen (CNP)	—
Toluene	≤ 0.6 mg/L
Xylene	≤ 0.4 mg/L
Diethylhexyl phthalate	≤ 0.06 mg/L
Nickel	—
Molybdenum	≤ 0.07 mg/L
Antimony	≤ 0.02 mg/L
Vinyl chloride monomer	≤ 0.002 mg/L
Epichlorohydrin	≤ 0.0004 mg/L
1,4-Dioxane	≤ 0.05 mg/L
Total manganese	≤ 0.2 mg/L
Uranium	≤ 0.002 mg/L

- 保护人体健康的水质标准采用年平均值，但是氰化物则采用最大值；
- “未检出”表示低于方法检出限；
- 硼和氟化物的水质标准不适用于海岸带水体。

## 日本重点湖泊环境保护特别措施(法)

内阁决定的湖泊水质保护基本原则

内阁根据各县申报情况确定了10个重点湖泊

10个重点湖泊分别制定湖泊水质保护计划后  
通过环境厅提交给环境污染防治会议审核

重点湖泊水污染防治和水质保护计划的核心措施：

- 污染负荷削减：依据水污染控制法要求控制湖泊区域内的小规模畜禽养殖、水产养殖 (指标包括BOD<sub>5</sub>、TN和TP)
- 水质控制计划：对影响湖泊水质的生活污水、化粪池、清淤底泥排放实行更严格的控制；实施污染源管制；对非点源排放控制提出改进建议；
- 划定湖周保护区：在湖周保护区内建设水质净化厂；
- (如果有必要)同步实施总量控制策略(COD、TN和TP)。

日本琵琶湖及其生态服务功能(定位=AA类/1级, TN=0.1 mg/L; TP=0.005 mg/L)

可渔



琵琶湖东岸是重要的野生动物栖息地

可喝



琵琶湖引水渠是京都1400万人的水源

可游

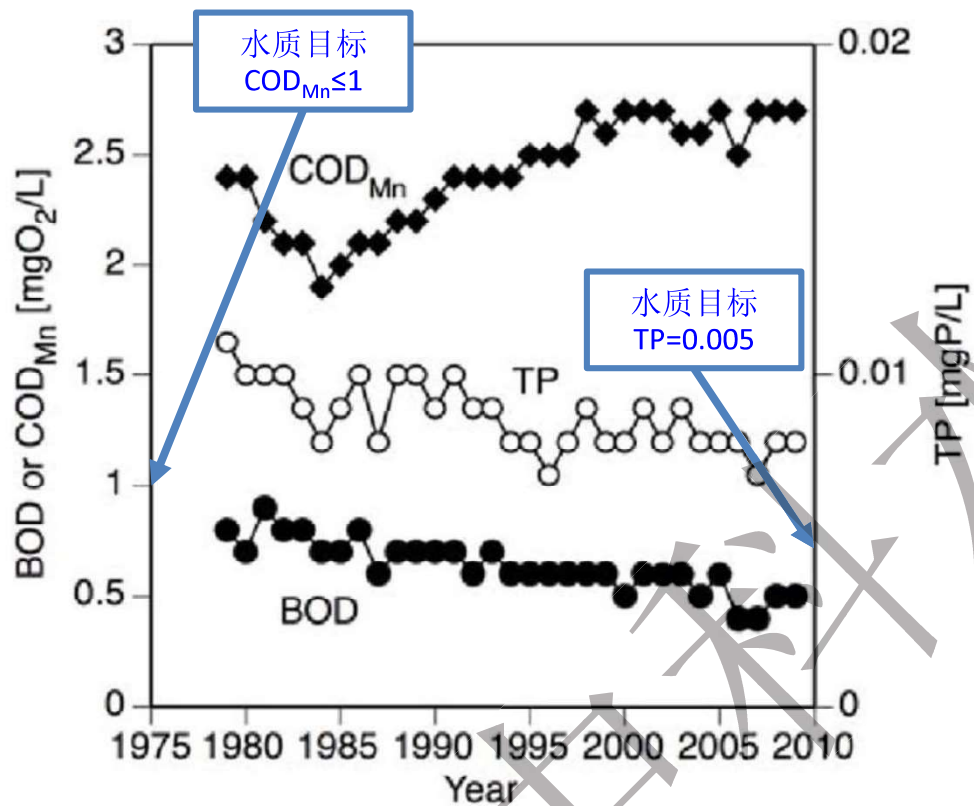


琵琶湖西岸有重要的湖滨沙滩和游泳场

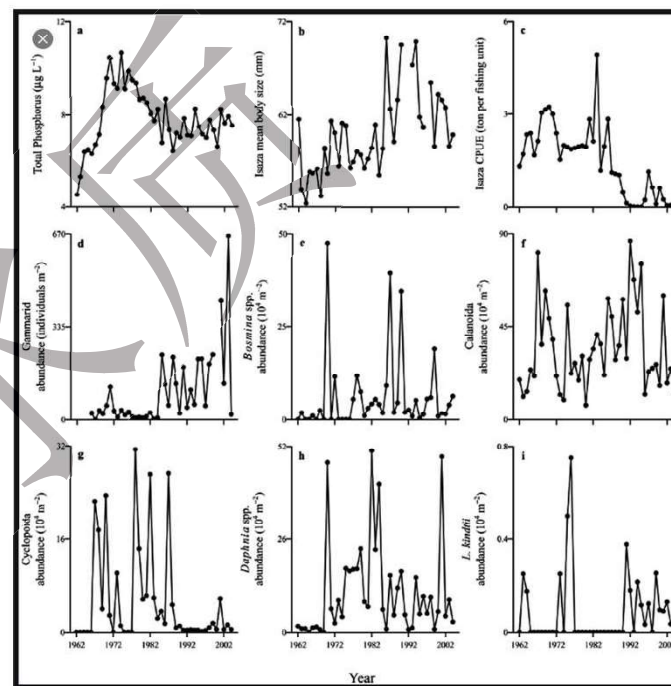


有世界先进水平的湖泊研究所和监测站

## 日本琵琶湖关键治理期间水质和水生生物相关指标的变化



琵琶湖治理关键时期水质指标的变化(共38年)



水生动物的体重指数

琵琶湖治理关键时期生物指标的变化

无论水质能否或是否达到AA类一级的水质标准要求，日本琵琶湖的生态服务功能已经基本恢复

此处有多个研究报告  
<http://www.casaet.com/>

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流域管理



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