Science-Based Targets for Water

Taihu Pilot Case

科学水目标方法学与太湖案例进展

WWF China Shanghai Region Sep 2023

背景介绍

科学水目标框架

科学水目标应用

结论与后续讨论

流域数智化趋势

→

科学水目标是由WWF和CDP、TNC、TPI、WRI共同开发，旨在帮助企业根据流域条件制定可持续的水资源管理战略。

企业如何制订科学水目标

第一步：评估 (Assess)

- 评估企业价值链各环节，找出对水资源影响最大或者依赖性最大的环节和区域。

第二步：排列优先顺序 (Prioritize)

- 对筛选出的各区域及工厂作排列，参考的指标为所在流域的情况，企业内部考量，当地利益相关方的需求等。

第三步：测量，设立，和披露 (Measure, Set and Disclose)

- 对第二步中的优先区域和工厂制订科学水目标，并公开披露。

第四步：行动 (Act)

- 制订切实可行的行动计划以达成科学水目标，并付诸实施。

第五步：监测 (Track)

- 在执行科学水目标的过程中，监测所取得的阶段性成果并对外公开。

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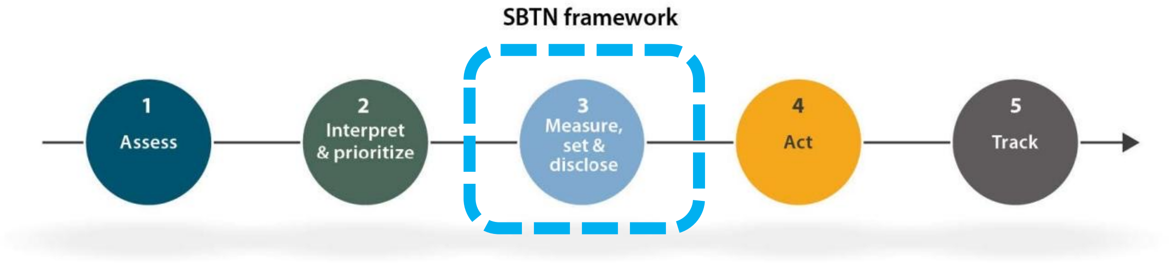
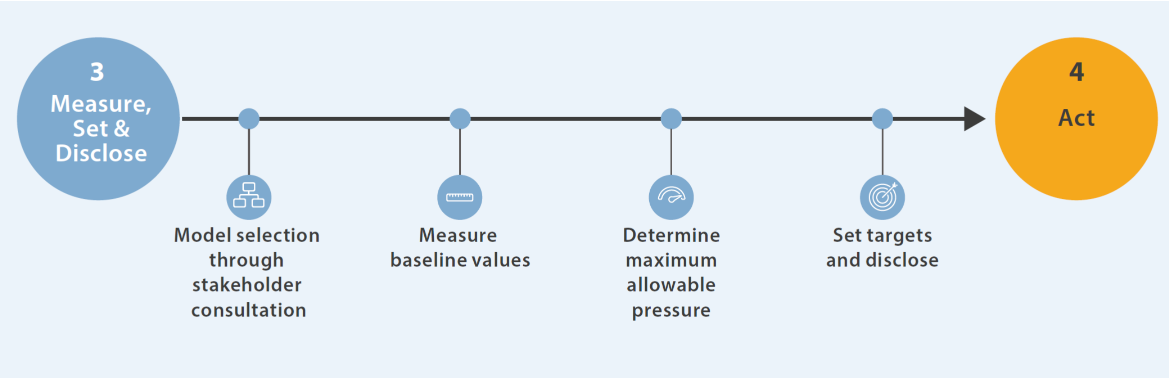
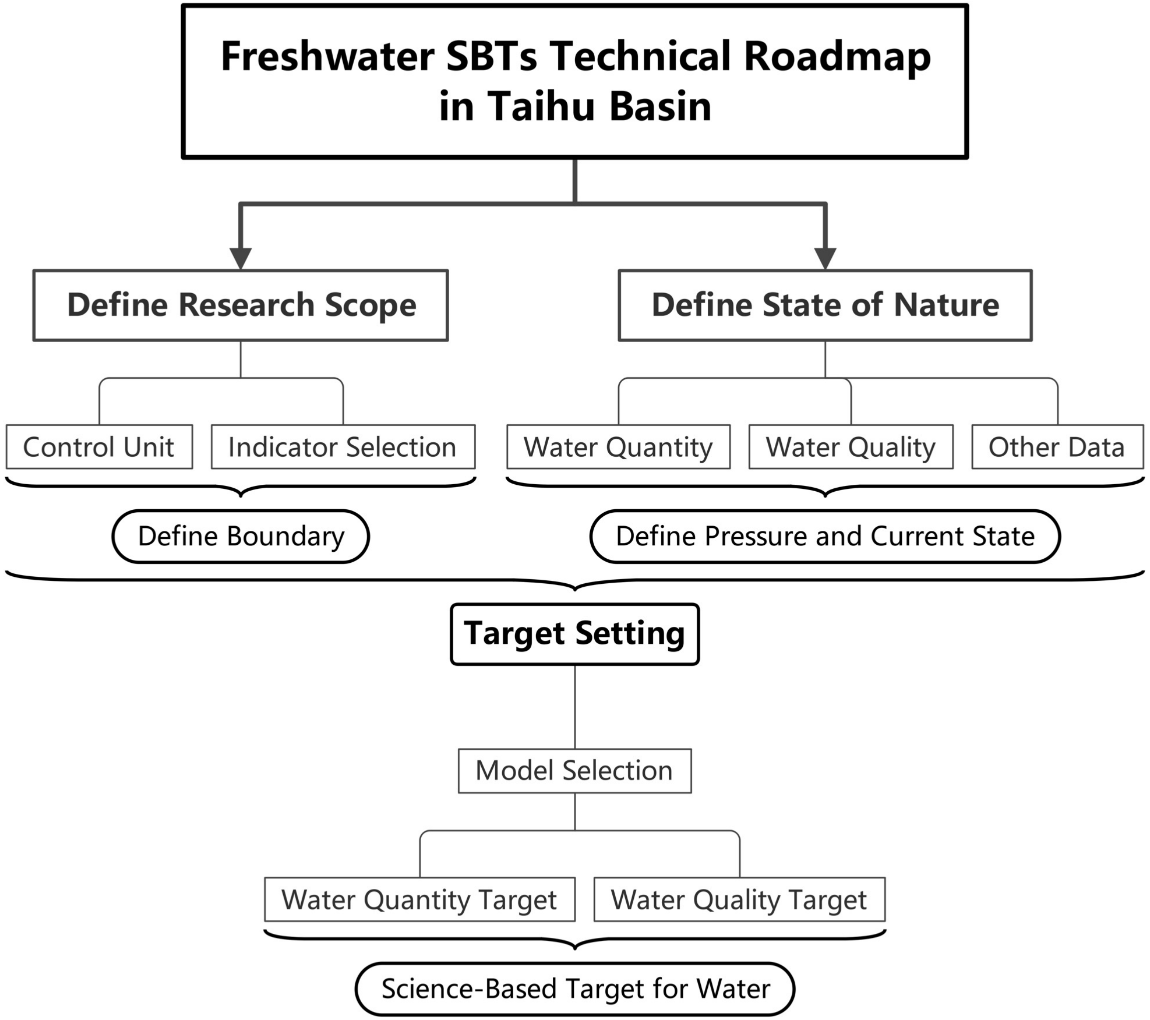
科学水目标太湖案例的框架，基于前面的工作基础，是从第三步（Step 3）开始进行。

科学水目标框架


SBTN framework
1
Assess
2
Interpret
& prioritize
3
Measure,
set &
disclose
4
Act
5
Track


3
Measure,
Set &
Disclose
Model selection
through
stakeholder
consultation
Measure
baseline values
Determine
maximum
allowable
pressure
Set targets
and disclose
4
Act


Freshwater SBTs Technical Roadmap
in Taihu Basin
Define Research Scope
Define State of Nature
Control Unit
Indicator Selection
Water Quantity
Water Quality
Other Data
Define Boundary
Define Pressure and Current State
Target Setting
Model Selection
Water Quantity Target
Water Quality Target
Science-Based Target for Water

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科学水目标太湖案例的应用，为全球的方法论本地化落地的重要案例。

方法论本地化可行性分析

- **Comparation in 5 Steps**

SBTW (Science-Based Targets for Water)	TMDL (Total Maximum Daily Loads)	WFD (Water Framework Directive)	AWS (Alliance for Water Stewardship)	China's conventional water environment management measures
Assess	Identification of damaged water body	WFD constraints the maximum emission values	Gather and understand	Division of control units (Water environment and water ecological function zoning)
Prioritize	Priority level determination in watershed level	WFD divides the water body into five grades	Commit and plan	Priority evaluation of different pollutants in the management and control unit in different water periods
Measure, Set and Disclose	TMDL plan formulation	WFD plan formulation	Implement	Develop control plan according to risk threshold
Act	Implementation of control measures	Implementation of control measures	Evaluate	Formulate corresponding safeguard measures to ensure the implementation of the plan
Track	Effect evaluation of control measures	Effect evaluation of control measures	Communicate and disclose	Post evaluation of project performance

确定项目的最小控制单元

该案例的工厂排放河流和排水并非同一水体，最小控制单元的划分综合考虑了HydroBasin对于流域的划分结果、生态环境部对于控制单元划分的成功等。

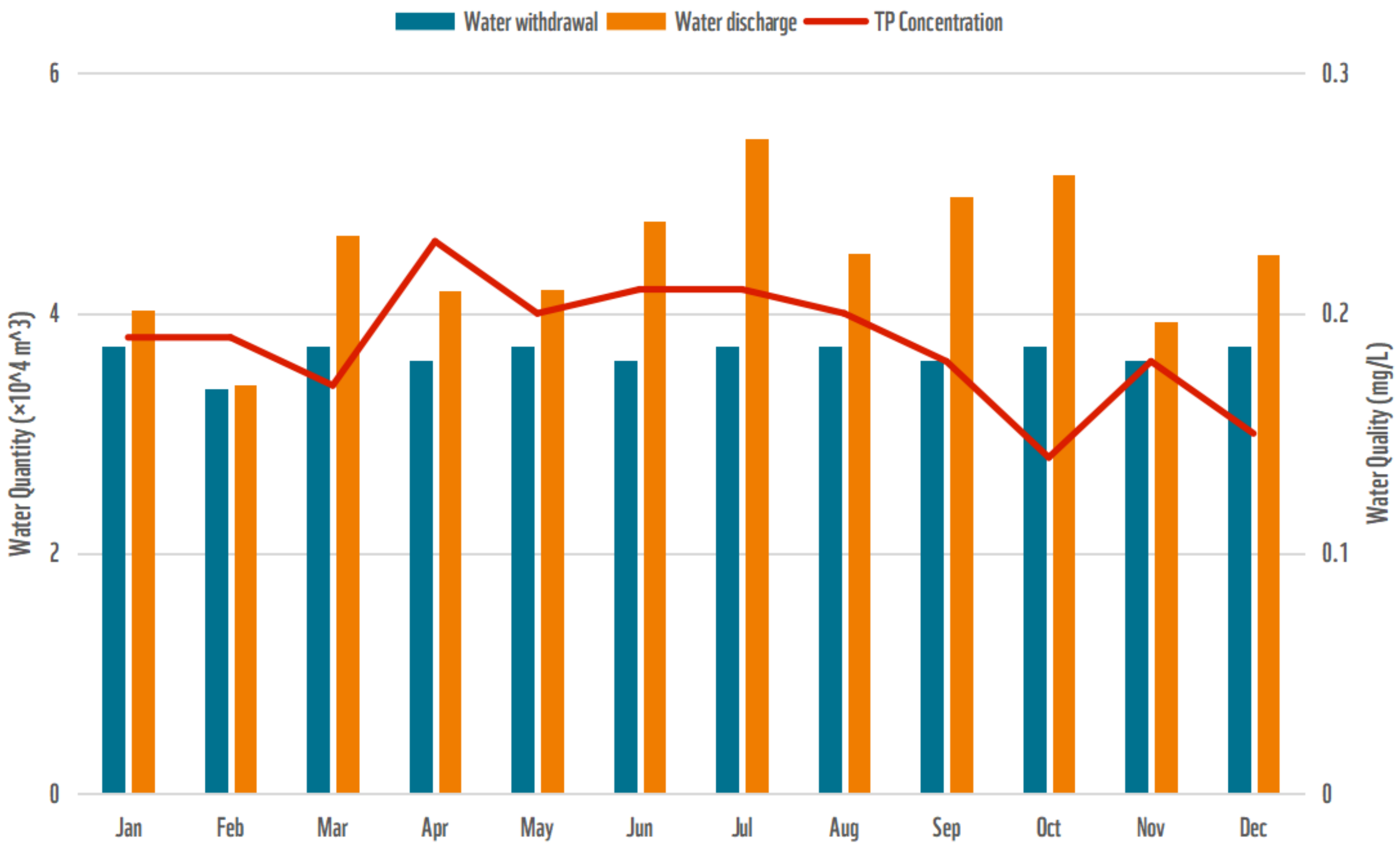
模型选择

“模型的选择需要同时考虑科学严谨性和实用性的需求。”

通过改进Tennant法，本土化的水文模型：
-通过环境流和生态流的动态追踪来保护流域生态系统；
-考虑了人为对地表径流的干扰；
-考虑了如何合理分配水资源使用权以及当地居民获取水资源的情况。

适用于本土特征的水质模型：
作为水质分析模型，基于SPARROW-Qual2k联用的模型：
-考虑了富营养污染物的国家或国际水质标准；
-分析了流域内富营养物污染物的主要人为来源。

数据采集（工厂层面）



收集工厂的逐月取水量、排水量及排水中的总磷浓度数据；图示为2022年全年的数据收集情况。

数据采集（流域层面）

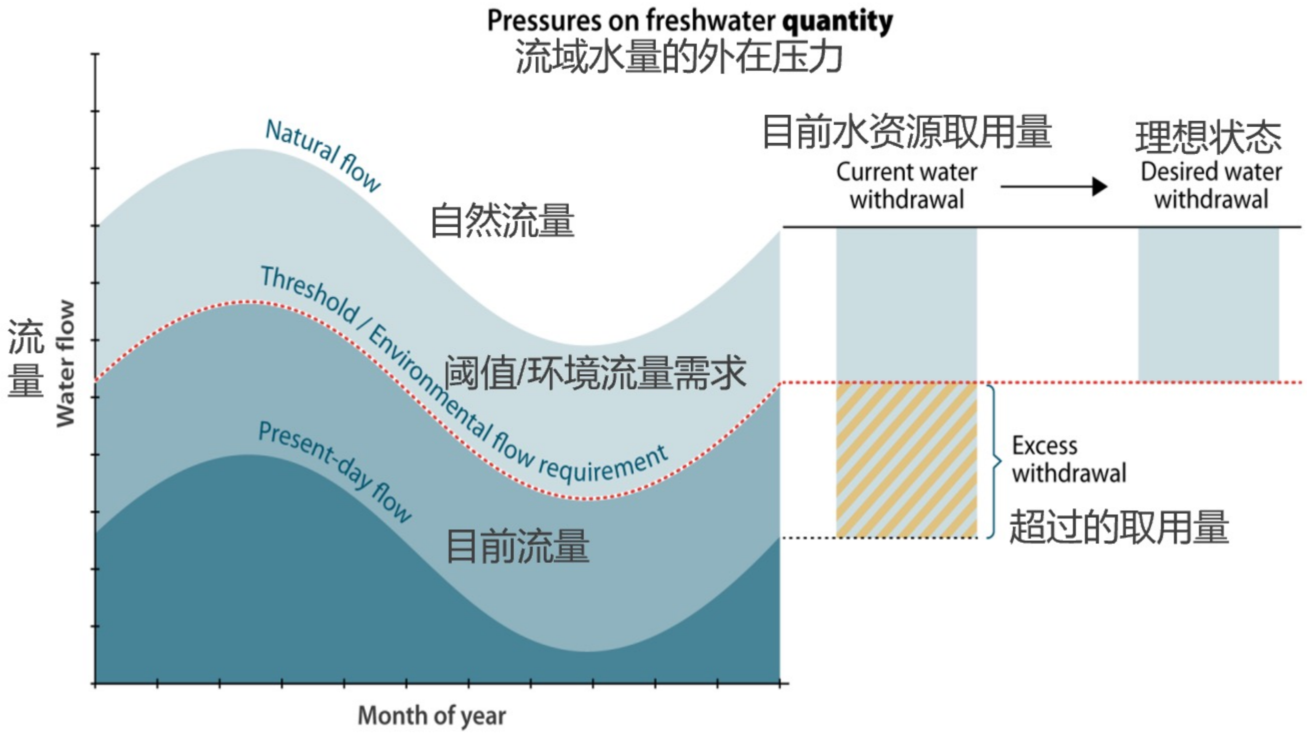
Data of monthly flow and total Phosphorus (TP) concentration of Discharge River (Year 2022)

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
Present stream Flow （$\times10^4m^3$）	15	20	23	30	32	48	50	55	38	32	24	16	Total 383
TP Concentration (mg/L)	0.15	0.11	0.12	0.13	0.15	0.14	0.12	0.13	0.11	0.12	0.12	0.11	Avg 0.13

Data source: Suzhou Water Conservancy Engineering Management Office and the Ecological Environment Bureau of Taicang City

The present stream flow of the Yangtze River in Taicang section was from $3.5\sim10.2\times10^4m^3/s$ in 2022, according to data from local water resources statistical yearbooks and the Liujing Hydrological Observation Station.

方法论核心步骤：设定水量目标



第三步: 测量，设定，和披露

3.1 利益相关方讨论和咨询

3.2 设定流域边界并进行本底调研

3.3 制定流域层面和工厂层面的水量目标

3.4 制定流域层面和工厂层面的水质目标

$$\%\ Reduction\ in\ Basinwide\ Withdrawal\ Required = 100\times\frac{(Excess\ Withdrawal\ = Environmental\ Flow\ Requirement - \ PresentDay\ Stream\ Flow)}{(PresentDay\ Withdrawal\ = Natural\ Flow\ - \ PresentDay\ Stream\ Flow)}$$

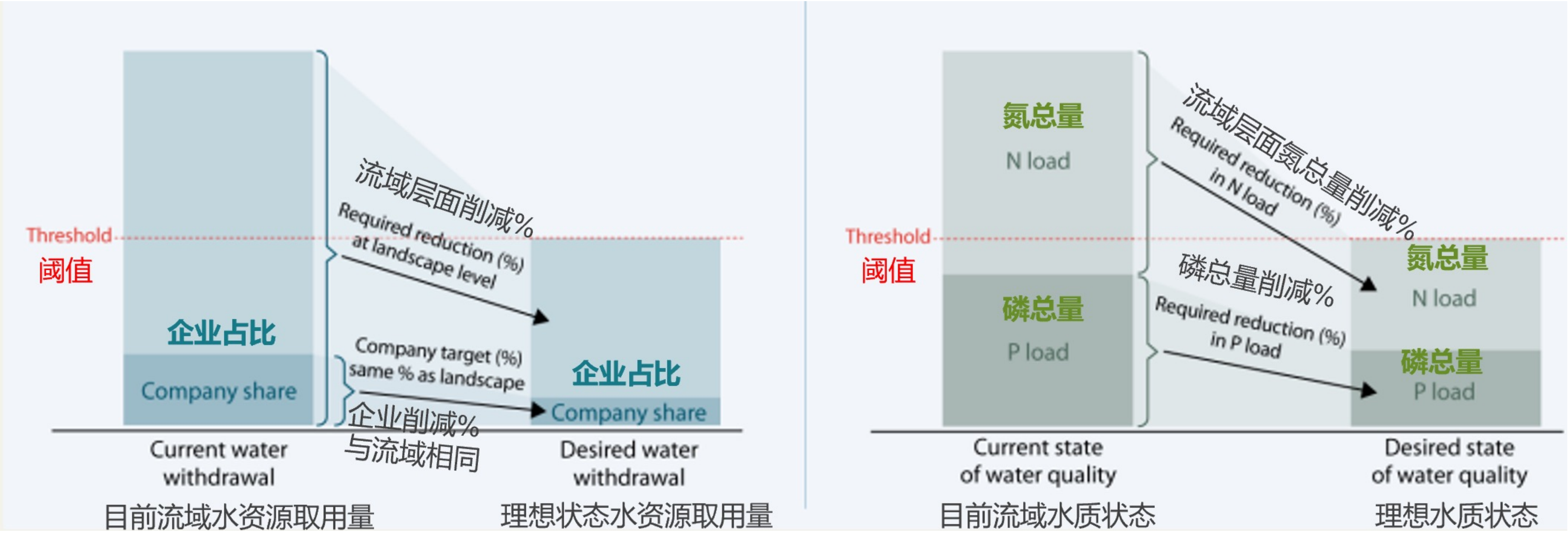
方法论核心步骤：设定水质目标

The necessary reduction in water nutrient load within the basin can be calculated from the following two factors:

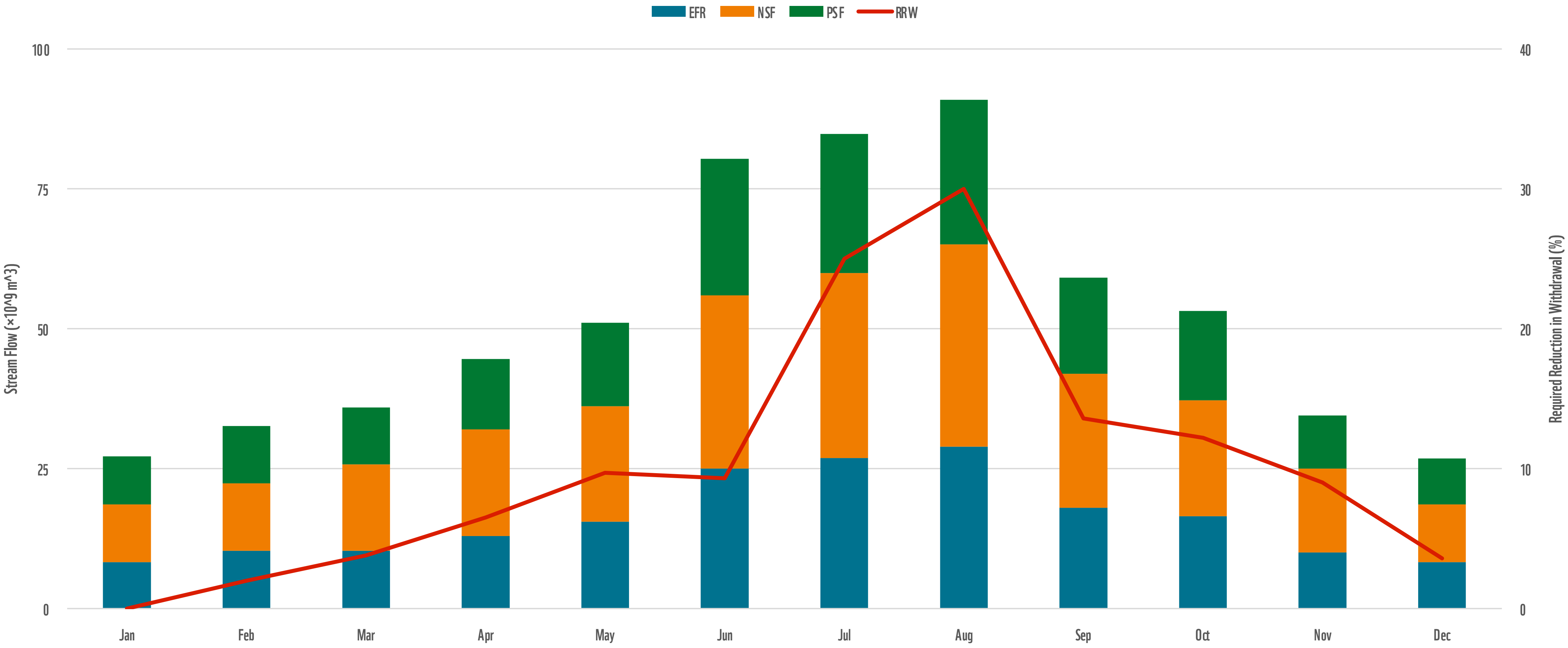
- **Present-day nutrient concentration in the watershed**
- **Threshold nutrient concentration**

$$\%Reduction\ in\ Basinwide\ Load\ Required = \frac{PresentDay\ Nutrient\ Concentration - Threshold\ Nutrient\ Concentration}{PresentDay\ Nutrient\ Concentration}$$

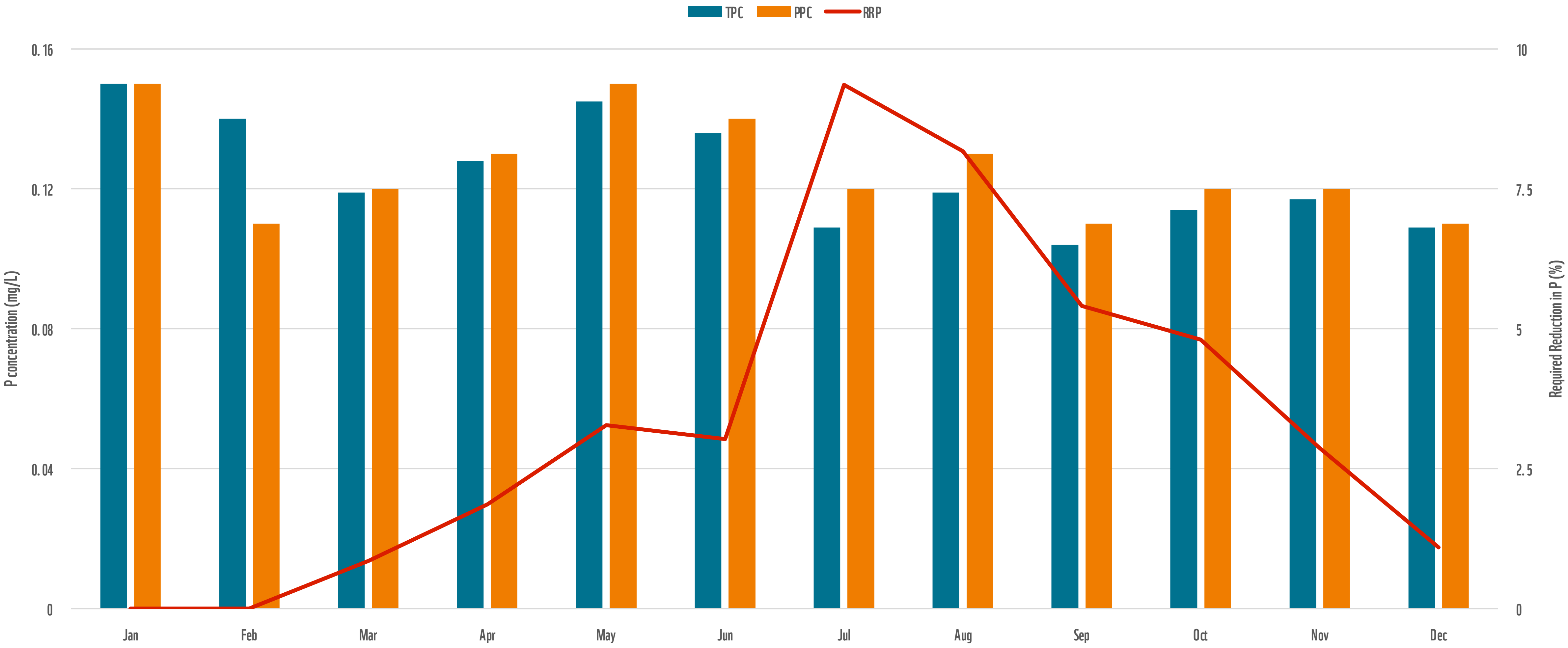
目标分配：从流域目标到个体目标



水量目标计算示例（2022年）



水质目标计算示例（2022年）



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结论包括水量目标和水质目标设立；讨论包括后续建议及本土化落地的探讨。

计算水量目标

75th percentile rank = 0.75 × (Number of years evaluated) + 1

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Rank	Required reduction in withdrawal (%)											
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	4.22	6.59	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	6.43	9.56	0.88	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	8.51	12.68	3.13	1.83	0.00	0.00
5	0.00	0.00	0.00	0.00	2.54	2.48	10.48	16.84	5.06	3.97	2.06	0.00
6	0.00	0.00	0.00	2.02	4.05	4.43	13.48	22.28	7.90	6.80	4.01	0.00
7	0.00	0.00	1.79	4.10	6.89	6.34	22.13	30.00	9.70	9.62	6.26	2.90
8	**0.00**	**1.97**	**3.78**	**6.45**	**9.72**	**9.28**	**25.02**	**34.13**	**13.63**	**12.24**	**9.01**	**3.55**
9	1.72	3.91	6.11	8.30	12.52	12.29	28.25	39.96	16.93	15.35	11.49	6.11
10	3.84	5.88	10.69	11.55	15.46	15.81	31.24	40.59	21.90	17.98	15.41	8.15

Rank the required reduction percentage by month and year. For the consecutive 10-year simulation, the 8th highest reduction percentage corresponds to the 75th percentile.

计算水量目标

Monthly-basis Quantity SBTs

The reduction target for water withdrawal of Honda factory by the year 2027

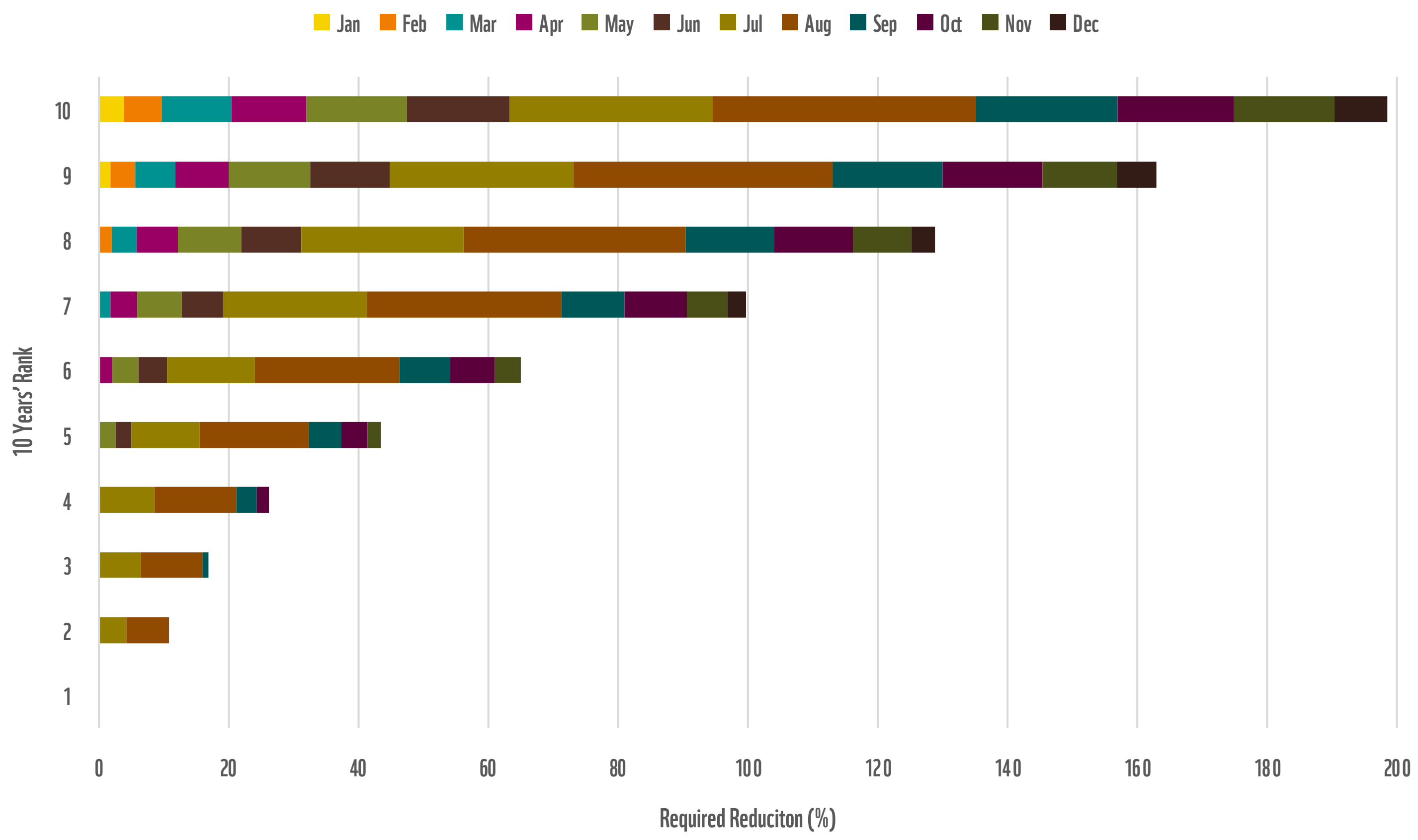
	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Required reduction in withdrawal (%)	0.00	1.97	3.78	6.45	9.72	9.28	25.02	**34.13**	13.63	12.24	9.01	3.55
Factory withdrawal ($\times10^4 m^3$)	3.73	3.30	3.59	3.38	3.37	3.27	2.80	2.46	3.12	3.27	3.28	3.60

Annual-basis Quantity SBTs

Should factory choose the single annual target, it would base it on the most stringent 75th percentile reduction in Table (**34.13%**). With a present-day pressure of $43.92\times10^4 m^3$/year (year 2022) and a required reduction of 34.13%, Hongda factory should reduce its water withdrawal to $28.93\times10^4 m^3$ annually by 2027.

结论

Freshwater Quantity SBTs



根据科学水目标方法论，若工厂以年为单位设定削减目标，则该目标需基于75分位数中削减量最大的月份，即5年后（2027年），工厂取水量较2022年需削减34.13%。

计算水质目标

Ranked seasonal reduction percentages by month for a 10-year period of record

75th percentile rank = 0.75 × (Number of years evaluated) + 1

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Rank	Required reduction in load (%)											
1	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	2.14	1.86	0	0	0	0
3	0	0	0	0	0	0	3.34	3.02	0.77	0	0	0
4	0	0	0	0	0	0	4.82	4.56	1.55	1.06	0	0
5	0	0	0	0	1.09	0.96	6.65	6.01	2.73	2.14	0.79	0
6	0	0	0	0.95	2.06	1.98	8.11	7.55	3.85	3.54	1.72	0
7	0	0	0.85	1.86	3.28	3.03	9.66	9.06	5.41	4.81	2.87	1.09
8	**0**	**0.87**	**1.83**	**2.81**	**4.48**	**4.72**	**11.26**	**11.12**	**6.68**	**6.23**	**3.52**	**2.02**
9	0.98	1.94	3.02	4.16	5.46	5.74	13.44	12.41	7.55	7.47	4.77	3.17
10	1.85	3.17	4.34	5.24	6.71	7.14	15.51	13.51	9.47	9.63	6.08	4.78

Repeat the calculations for each year in the period of simulation and rank the required reduction percentage by month and. This step uses the local assessment of consecutive 10-year TP concentration by Qual2k model. The dataset is used to obtain the ranking of the reduction rate of TP concentration in water discharge for the factory.

计算水质目标

Monthly-basis Quality SBTs

The reduction target of TP concentration in water discharge of Hongda factory by 2027

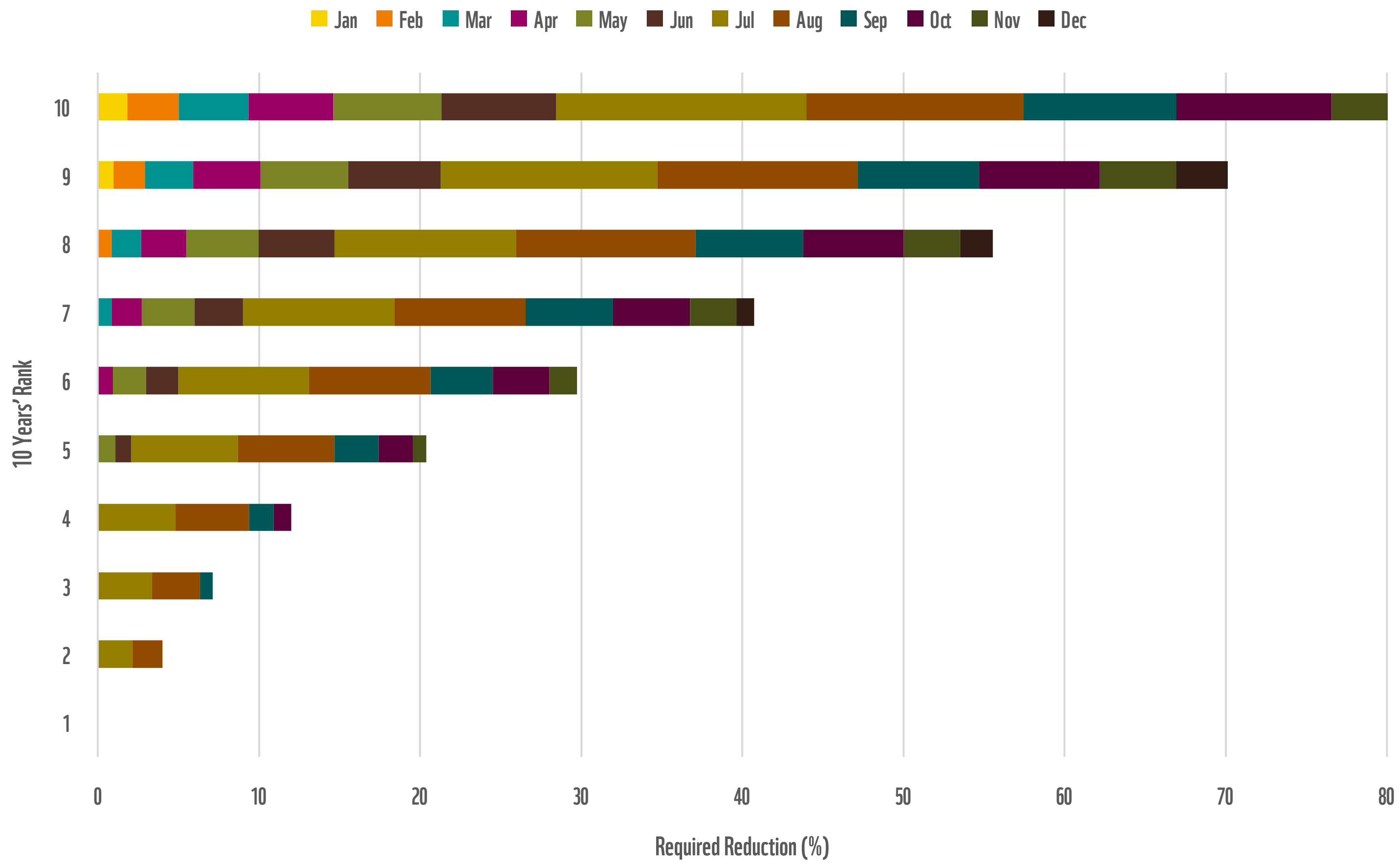
	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Required reduction of P concentration (%)	0.00	0.87	1.83	2.81	4.48	4.72	**11.26**	11.12	6.68	6.23	3.52	2.02
Company target load (mg/L)	0.190	0.188	0.167	0.224	0.191	0.200	0.186	0.178	0.168	0.131	0.174	0.147

Annual-basis Quality SBTs

Should factory choose the strictest annual target, calculations would be based on the most stringent 75th percentile reduction in the table (**11.26%**), i.e., factory should reduce its annual average TP concentration in water discharge to at most 0.168mg/L by 2027, considering the fact that the TP concentration in water discharge of factory in 2022 is 0.19mg/L.

结论

Freshwater Quality SBTs



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后续讨论

项目的示范作用

- 结合太湖流域水资源管理的实际情况，将方法论本土化，从流域层面设定了工厂的减排目标，为补充和完善当前全球通用的方法论起到了示范作用。

- 有助于推动整个太湖流域科学水目标的运用，并为其他流域提供范例和启发。

后续讨论

方法论的局限性

- 由于部分数据的缺失，需要通过机器学习的方式来拟合缺失的数据，同时这也造成了数据错误的可能性。
- 科学水目标是一个全球通用的方法论，然而，在不同的流域可能会显示出不同的流域特征，而建立本土化的模型往往具有一定难度。
- 方法论使用了过去年份的数据来模拟之后年份的水质、水量状况，然而，由于全球气候变暖等因素，该模拟方式可能会产生误差。

后续讨论

工厂采取行动的建议

- 工厂可以开发节水技术，以减少工厂的需水量和用水量。
- 工厂可以探索基于自然生态环境的解决方案，例如可以通过湿地恢复和湿地建设项目，从而恢复当地流域的生态系统，并使用项目所产生的水回馈来取代所需削减的取水量。

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以长三角流域治理为核心，用数据建立服务标准，打造卓越公正的科学共享和创新平台

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