2.8 Myanmar

1 | Country Information

Table 2.8.1 Basic indicators

Land area (km²)		676,552 (2022)*
Total population		54.82 million (2021)*
GDP (current USD)		64.81 billion (2023)**
Per capita GDP (current USD)		1,187 (2023)**
Average annual rainfall (mm/year)		2,225 (2021)*
Total renewable water resources (km³)		1,168 (2021)***
Total annual freshwater withdrawals (billion m³)		33.39 (2021)***
Annual freshwater withdrawal by sector	Agriculture	89% (2021)***
	Industry	1% (2021)***
	Municipal (including domestic)	10% (2021)***

(Source: *CSO 2022, **World Bank 2023, ***FAO 2021)

Figure 2.8.1 Inle Lake in Shan State, Myanmar

2 | State of Water Resources

Myanmar has an abundance of water resources, which are distributed unevenly spatially and temporally. The annual precipitation in the southeastern area (i.e., Kayin, Mon, and Taninthayi Regions) and western area (i.e., Rakhine Region) is over 4,000 mm, while that in inland areas (Sagaing, Mandalay, and Nay Pyi Taw Regions) is around 1,000 mm (CSO 2022). Around 78% of rainfall falls between June and September (CSO 2022). Myanmar has eight river basins: Ayeyarwady, Thanlwin, Mekong, Bago, Sittaung, Bilin, Tanintharyi, and Rakhine. The Ayeywarwady basin accounts for 55% of Myanmar's land area and Thanlwin for 19% (IFC 2020). Lakes and reservoirs are also important freshwater resources as approximately 91% of the total water withdrawal is from surface water (ADB 2017), while populations in the dry zone depend on groundwater (Dury and Aqua Rock Konsultants 2017). Inle Lake and Indawgyi Lake are the two largest natural lakes, with respective areas of 116 km² and 123 km² (Mjelde et al. 2023).

3 | State of Ambient Water Quality

(1) Rivers

Myanmar is well endowed with freshwater resources, and the main sources of domestic, agricultural and industrial waters are inland surface waters. While the water quality of Hlaing River in Yangon was relatively good in 2018, with an average BOD concentration of 3.0 mg/L, water degradation caused by human activities has been a concern (JICA 2018; Eriksen 2021). Monitoring data for the Bago River, Shwegyin River, and Sittaung River has revealed that the water environment in these three rivers was generally in a good in condition in 2023. Respective annual average TSS, BOD, and Nitrate concentrations (all in mg/L) were for the Bago River: 18, 1.45, 0.11; Shwegyin River: 69, 1.69, 0.1; and Sittaung River: 69, 1.98, 0.09 (FD 2023).

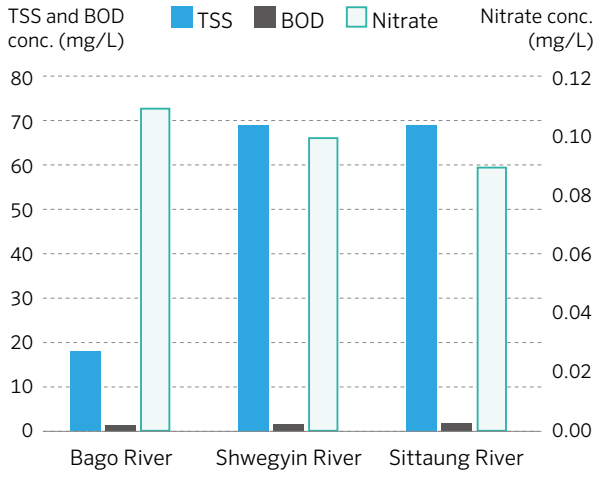

Figure 2.8.2 Water quality of selected rivers

(Source: FD 2023)

Table 2.8.2 River basins in Myanmar

Basin	Total basin area (km^2)	Basin area within Myanmar (%)	Country sharing the basin	Land area of Myanmar (%)	Total main river length (km)	State/region
Ayeyarwady	412,500	90.4	China and India	55.5	2,170	Ayeyarwady, Bago, Chin, Kachin, Magway, Mandalay, Nay Pyi Taw, Rakhine, Sagaing, Shan, Yangon
Thanlwin	283,335	45	China and Thailand	19	2,400	Mon, Bago, Kachin, Kayah, Kayin, Shan
Mekong	824,000	2.7	Cambodia, China, Laos, Thailand, Vietnam	3.3	3,469	Shan
Sittaung	34,913	100	-	5.2	450	Mon, Bago, Kayah, Kayin, Magway, Mandalay, Nay Pyi Taw, Shan
Bago	10,261	100	-	1.5	220	Mon, Bago, Yangon
Bilin	3,056	100	-	0.5	160	Bago, Kayin, Mon
Tanintharyi	44,876	100	-	6.7	400	Mon, Kayin, Tanintharyi
Rakhine	71,700	77	Bangladesh and India	8.2	280	Ayeyarwady, Bago, Chin, Kachin, Magway, Mandalay, Nay Pyi Taw, Rakhine, Sagaing, Shan, Yangon

(Source: IFC 2020)

(2) Lakes and reservoirs

Myanmar has numerous natural lakes and reservoirs, which are important freshwater sources for various purposes as well as for their biodiversity and scenery, making them popular tourist attractions. Similar to the situation of rivers, these lakes have faced water degradation in recent years, due to increasing wastewater inflow, deforestation, and illegal dumping of garbage.

Inle Lake is the country's second largest natural lake. With a surface area of 116 km^2 and a volume of 1,132 million m^3, it is one of the key freshwater sources in the lake basin and a tourist attraction with over 0.3 million annual visitors (NIWR 2017). According to the water quality monitoring data for 2023 for Inle lake, TSS, BOD, and nitrate concentrations (all in mg/L) were 69, 1.98, and 0.09, respectively (FD 2023). Table 2.8.2 shows selected water quality parameter data for Inle Lake and Indawgyi Lake for 2023 and 2024. The high turbidity indicates that the water in both lakes was visibly cloudy, but the DO concentration was good in Inle Lake and moderate in Indawgy Lake.

Table 2.8.2 Water quality of Inle and Indawgyi Lakes 2023–2024

No.	Parameter	Inle Lake (2023 rainy season)	Inle Lake (2024 rainy season)	Indawgyi Liake (2023 rainy season)	Indawgyi Lake (2024 rainy season)
1	Turbidity (NTU)	4.18	6.24	8.1	7.54
2	Dissolved Oxygen (mg/L)	8.36	9.77	6.6	5.37
3	Arsenic (mg/L)	<0.0001	<0.0001	0.00074	0.000238

(Source: FD 2023)

(3) Coastal water

Myanmar has three distinct regions and nearly 3,000 km of coastline: one bordering the Bay of Bengal, another bordering the Andaman Sea, and the Ayeyarwady region between these two (Oo and Win 2024). Hotel development and increasing numbers of visitors have affected the water quality, and marine plastic debris has been a concern as concentrations of microplastics in Ayeyarwady coastline waters can rise to 28,000 particles/km^2. Further, the Ayeyarwady River transports about 119 tons of plastic pollution daily into the ocean from deep inland (Oo and Win 2024).

(4) Groundwater

Groundwater is a vital source of freshwater, particularly in the Dry Zone. According to a household survey conducted in the Magway Region in November and December 2009, 4% had access to piped water from surface water sources (WFP 2011), and Census 2014 found that 75% of people still depended on groundwater for drinking and other domestic uses (Dury and Aqua Rock Konsultants 2017). Of the groundwater, about 50% is used for domestic water, including drinking, and about 22% is used by industry (Smedley 2020; Pavelic at al. 2015).

While groundwater is a vital resource for human consumption, its quality is a concern. Arsenic in the lower and middle Irrawady aquifer, salinity in the Pegu aquifer and delta and coastal areas, and microbiological contamination in dug wells are the major groundwater problems (Smedley 2020). Table 2.8.3 shows the analysis results of 132 samples from Kachin State.

Table 2.8.3 Arsenic concentration in groundwater of Kachin State

Region	Total samples	<0.05 mg/L
Kachin	16	0.000375

(Source: Baseline Data of ECD-2023-2024)

4 | State of Wastewater Treatment

In Myanmar, 35% of wastewater is not properly treated before being discharged into receiving waters, and Yangon, the largest city in Myanmar, has faced problems of wastewater management due to its increasing population and urbanization (Swan et al. 2023).

In Yangon, 7% of wastewater is managed by a centralized wastewater treatment system, 10% by decentralized wastewater treatment systems, 80% by septic tanks, and 3% by pit latrines (Swan et al. 2023). In Nay Pyi Taw, 1% of the population has access to improved sanitation, but this is lower in other main cities (Min 2018). Table 2.8.4 presents the domestic wastewater treatment capacity and existing systems in three major cities for 2023–2024.

The Government of Myanmar is also focusing on industrial wastewater with the aim of conserving the water environment. Currently, the following nine types of industry are selected as priority sectors targeted by the Environmental Management Plan: 1. alcohol, wine and beer production factories, 2. food and beverage processing facilities, 3. pesticide manufacturing, formulation and packaging, 4. cement and lime manufacturing, 5. textile and dying facilities, 6. foundries, 7. tanning and leather finishing, 8. pulp and paper mills, and 9. sugar manufacturing plants (ECD 2023).

Table 2.8.4 Domestic wastewater treatment practices in urban areas for 2023–2024

City name	Population (million)	Wastewater management practices
Yangon	6.2	• Centralized wastewater treatment (14,775 m^3/day, designed value) • Decentralized wastewater treatment (50 m^3/day) • Septic tank • Septic tank with upflow system • Aerobic biological system • Anaerobic biological system • Pit latrine
Nay Pyi Taw	0.37	• Centralized wastewater treatment (1,600 m^3/day) • Septic tank • Pit latrine
Mandalay	1.7	• Decentralized wastewater (sewage) treatment (227.30 m^3/day) • Domestic wastewater treatment (3,363.63 m^3/day) • *Johkasou* system (900 m^3) • Septic tank (about 164,438) • Pit latrine (about 102,716)

5 | Frameworks for Water Environmental Management

(1) Legislation

The current legislative framework for water environment management in Myanmar is shown in Fig. 2.8.3. Maintaining a healthy and clean environment and conservation of natural and cultural heritage for the benefit of present and future generations are the objectives of Environmental Conservation Law 2012. Article 7 stipulates that environmental impact assessments (EIA) and social impact assessments (SIA) must be carried out for projects that may cause significant impacts on the environment, the EIA process of which—according to EIA Procedure 2015—must start with submission of project proposals to the Environmental Conservation Department (ECD). The National Environmental Quality (Emission) Guidelines was approved in 2015, which provides the basis for regulation and control of noise and vibration, air emissions, and liquid discharges from various sources in order to prevent pollution for purposes of protection of human and ecosystem health, and includes industry-specific guidelines on air pollution, wastewater, noise and odour. The objectives of the Conservation of Water Resources and Rivers Law 2006 are to conserve and protect water resources and river systems for the benefit of public use, for smooth and safe navigation, and to contribute to

the state economy through improving water resources and mitigating environmental impacts.

(2) Institutional arrangement

In Myanmar, several ministries are involved in water environment management. Table 2.8.5 is a list of agencies and their responsibilities for water environment conservation.

Disposal of wastewater from residences, office buildings and factories is controlled by the Ministry of Natural Resources and Environmental Conservation (MONREC). The Ministry of Industry is responsible for regulating industrial water use and wastewater discharge, and the City Development Committee is responsible for water supply and sanitation in respective cities.

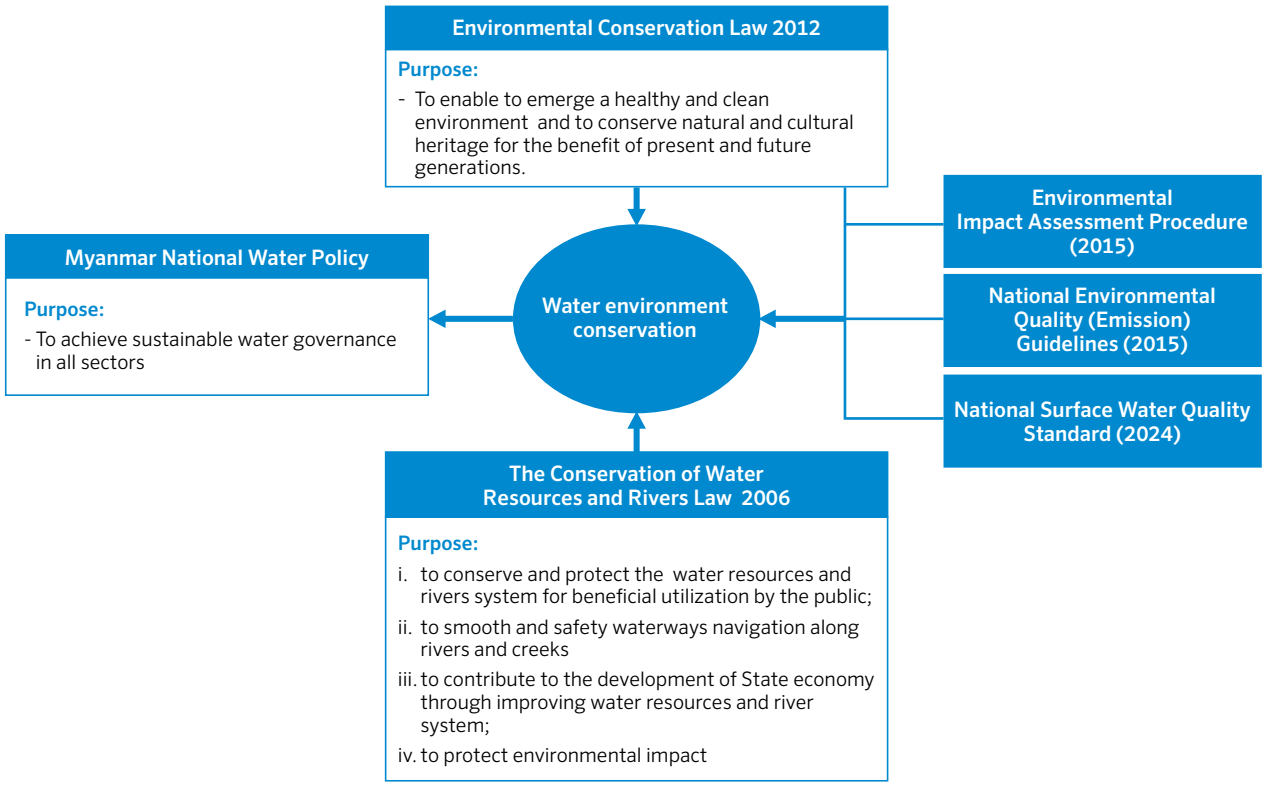

Figure 2.8.3 Legislative framework of water environment management in Myanmar

Table 2.8.5 Institutional arrangement for water environment management in Myanmar

Department	Ministry/organization	Responsibilities
Environmental Conservation Department	Ministry of Natural Resources and Environmental Conservation	Formulating national environmental quality standards including water quality standards, water quality monitoring, enforcement
Forest Department	Ministry of Natural Resources and Environmental Conservation	Reforestation and conservation of forests including watershed areas
Irrigation and Water Utilization Management Department	Ministry of Agriculture, Livestock and Irrigation	Supplying irrigation water and controlling floods
Water Resources Utilization Department	Ministry of Agriculture, Livestock and Irrigation	Irrigation and rural water supply
Department of Meteorology and Hydrology	Ministry of Transport and Communication	Flood early warning for major rivers
Directorate of Industrial Supervision and Inspection	Ministry of Industry	Regulating industrial water use and wastewater discharge
Department of Public Health	Ministry of Health	Drinking water quality assessments
Department of Rural Development	Ministry of Cooperatives and Rural Development	Rural water supply and sanitation
Department of Research and Innovation	Ministry of Science and Technology	Formulating national standards
Engineering Department (Water Supply and Sanitation)	City Development Committees (Yangon, Mandalay, Nay Pyi Taw)	Water supply and sanitation in city areas

(3) Ambient water quality standards

a. Ambient water quality standards

The ECD, in cooperation with other line ministries and international experts, made efforts to develop the National Surface Water Quality Standards (NSWQS), which were approved on 8 February, 2024. Standards were set for five classes of water use categories (Table 2.8.6), and include 36 parameters with threshold values for protecting aquatic ecosystems and human health (Tables 2.8.7 and 2.8.8).

Table 2.8.6 Water use classification

Water Class	Water use
Class I	(1) Conservation of the natural environment (2) Water supply Grade 1 (3) Water uses listed in Class II to V
Class II	(1) Water supply Grade 2 (2) Fisheries Grade 1 (3) Bathing & swimming (4) Water uses listed in Class III to V
Class III	(1) Water supply Grade 3 (2) Fisheries Grade 2 (3) Industrial water Grade 1 (4) Agricultural water Grade 1 (5) Water uses listed in Class IV to V
Class IV	(1) Industrial water Grade 2 (2) Agricultural water Grade 2 (3) Water uses listed in Class V
Class V	(1) Navigation/Transportation (2) Environmental Conservation

Note:
Water supply Grade 1: Applicable for water supply with sedimentation, filtration and other comparable means
Water supply Grade 2: Applicable for water supply with pre-treatment, sedimentation, filtration, and other comparable means
Water supply Grade 3: Applicable for water supply with pre-treatment and other advanced means
Fisheries Grade 1: Applicable for fisheries of oligotrophic species
Fisheries Grade 2: Applicable for fisheries of semi-eutrophic species
Industrial water Grade 1: Applicable for industrial use with sedimentation and other comparable means
Industrial water Grade 2: Applicable for industrial use with chemical additives and other advanced means
Agricultural water Grade 1: Applicable for agricultural use with ordinary means
Agricultural water Grade 2: Applicable for agricultural use with advanced means
Environmental conservation: Maintained to the extent of not causing discomfort to citizens

(Source: MMS 44:2024 National Surface Water Quality Standard, National Standard and Quality Department)

Table 2.8.7 National surface water quality standard (Standard values: Human health)

Parameter	Unit	Class I	Class II	Class III	Class IV	Class V
Chemical parameters						
Boron	mg/L	2.4				
Cyanide	mg/L	0.07				
Fluoride	mg/L	1.5				
Nitrate nitrogen	mg/L	10				
Nitrite nitrogen	mg/L	1				
Organics						
Benzene	mg/L	0.01				
Phenol	mg/L	0.05				
Polychlorinated biphenyls (PCB)	µg/L	0.5				
Heavy metals						
Arsenic	mg/L	0.05				
Cadmium	mg/L	0.003				
Chromium (hexavalent)	mg/L	0.05				
Lead	mg/L	0.01				
Mercury	mg/L	0.001				
Nickel	mg/L	0.07				
Selenium	mg/L	0.04				

* Standard values are expressed as annual average concentrations

(Source: MMS 44:2024 National Surface Water Quality Standard, National Standard and Quality Department)

Table 2.8.8 National surface water quality standard (Standard values: Environmental conservation)

Parameter	Unit	Class I	Class II	Class III	Class IV	Class V
Physical parameter						
Total Suspended Solids	mg/L	25	50	75	100	150
Chemical parameters						
BOD	mg/L	2	3	8	25	30
COD	mg/L	5	8	13	50	100
DO	mg/L	>6	>5	>4	>3	>2
pH	S.U.	6.5–8.5	6.5–8.5	6–9	5–9	-
Ammonium nitrogen	mg/L	0.2	0.3	0.5	0.8	0.9
Organics						
Oil & grease		Not detected				
Biological parameter						
Escherichia coli (E. coli)	MPN/100ml (or) CFU/100ml	20	300	1,000	1,000	-
Heavy metals						
Copper	0.1	0.3	0.5	-	-	-

* Standard values are expressed as annual average concentrations

(Source: MMS 44:2024 National Surface Water Quality Standard, National Standard and Quality Department)

b. Water quality monitoring framework

National surface water quality standards (NSWQS) were set in 2024, and ECD and the Forestry Department of MONREC are responsible for managing water quality monitoring. As such, ECD monitors river water quality at 154 sampling points, lake water quality at 78 monitoring points and groundwater quality at 30 monitoring points for 21 water quality parameters. The Department of Meteorology and Hydrology (DMH) under the Ministry of Transport and Communications (MOTC) monitors the quality of river water of four major rivers (Ayeyarwady, Chindwin, Thanlwin and Sittoung) for five water quality parameters, as appropriate. The Forestry Department monitors water quality for 30 parameters at 27 sampling points for rivers and nine monitoring points in dams.

Details of the water quality monitoring framework are shown in Table 2.8.9.

Table 2.8.9 Water quality monitoring framework of ECD and Forestry Department

Item	ECD	DMH	Forest Department
Monitoring parameters	On-site parameters: pH, temperature, dissolved oxygen, oxidation reduction potential, turbidity, salinity, total dissolved solids, electrical conductivity, water depth Laboratory parameters: mercury, arsenic, iron, nickel, boron, copper, aluminum, manganese, chromium, lead, biochemical oxygen demand	pH, electric conductivity, dissolved oxygen, temperature, turbidity	Turbidity, colour, conductivity, total suspended solids, pH, total alkalinity, bod, ortho-phosphate, total phosphorous, silicate, arsenic, lead, chromium, cadmium, mercury, copper, zinc, nickel
Number of sampling points	Rivers: 154 sampling points Lakes: 78 sampling points Groundwater: 30 sampling points	Rivers: 13 sampling points (Ayeyarwady: 9 points, Chindwin: 1 point, Thanlwin: 1 point, Sittoung: 2 points)	River: 27 points (Mekong and its tributaries) Dam: 9 points (Palaung, Sinthe, Ngalaik) Lake: 10 points (Inle)
Frequency of monitoring	Seasonal (quarterly or twice a year), monthly, bimonthly (if required)	As appropriate	Quarterly
Frequency of monitoring reports	Monthly	As appropriate (to National Water Resources Committee and Water Resources Research Group)	Quarterly

(4) Effluent standards

a. Effluent standards

The National Environmental Quality (Emission) Guidelines (NEQEG) were released on 29 December 2015. These guidelines provide the basis for regulation and control of noise and vibration, air emissions, and liquid discharges from various sources in order to prevent pollution and provide protection for human and ecosystem health. A total of 71 industry-specific effluent levels have been set out in the NEQEG. The guidelines for effluent levels cover thermal power, geothermal power, wind power, oil and gas, petroleum refining, natural gas processing, natural gas liquefaction, crude oil and petroleum product terminals, electric power transmission and distribution, gas distribution systems, petroleum-based organic chemicals manufacturing, plantation industrial/crop production, annual crop production, mammalian livestock production, poultry production, aquaculture, forest harvesting operations, meat processing, poultry processing, fish processing, food and beverage processing, dairy processing, vegetable oil production and processing, sugar manufacturing, breweries and distilleries, textiles manufacturing, tanning and leather finishing, sawmilling and manufactured wood products, board and particle-based products, pulp and/or paper mills, printing, large volume inorganic compounds manufacturing and coal tar distillation, petroleum-based polymers manufacturing, coal procession, nitrogen fertilizer manufacturing, phosphate fertilizer manufacturing, pesticide manufacturing, oleochemicals manufacturing, pharmaceuticals and biotechnology manufacturing, glass, and glass and mineral fiber manufacturing, ceramic tile and sanitary ware manufacturing, base metal smelting and refining, integrated steel mills, foundries, metal, plastic and rubber products manufacturing, semiconductors and other electronics manufacturing, solid waste management facilities, wastewater treatment facilities, health care facilities, and others (MONREC 2015).

b. Effluent inspection procedure

The Pollution Control Division of ECD, General Administration Department, Directorate of Industrial Supervision Inspection (DISI), and Directorate of Industrial Collaboration are responsible for inspections of effluent quality. Table 2.8.10 describes the responsibilities of each agency. DISI performs monitoring using an online monitoring system for wastewater discharged from alcohol factories. Local and regional offices of ECD are tasked with regular monitoring of effluent quality, and ECD headquarters is directly involved in effluent monitoring upon notification of major environment pollution issues.

Table 2.8.10 Effluent quality control agencies and their responsibilities

Agency	Responsibilities
Pollution Control Division of ECD	Regular monitoring of effluent quality
General Administration Department	Management and issuance of liquor licenses
Directorate of Industrial Supervision Inspection (DISI)	Promoting development of private industrial enterprises in accordance with the Industrial Enterprise Law
Directorate of Industrial Collaboration	Formulating policies and laws to develop and promote industries

c. Measures against non-compliance

When violations of effluent standards are found, a written warning is sent to the company at fault notifying of the need to rectify current practices for compliance with the relevant laws, effluent guidelines and standards. If this fails to solve the pollution issue, an operation suspension notice is issued.

(5) Major policies on water environmental management

The Myanmar Sustainable Development Plan (MSDP) 2018–2030 is a document laying out the country's vision on sustainable development. Its Goal 5 emphasizes sound management of natural resources and the environment for a more prosperous nation. The National Environmental policy of Myanmar (2019) sets a vision for a clean environment with a healthy and functioning ecosystem to ensure inclusive development and wellbeing for all people in Myanmar. Myanmar National Water Policy (NWP) sets its vision as, "in 2040 Myanmar will become a water efficient nation with well-developed and sustainable water resources based on a fully-functional integrated water resources management system". The objectives of the NWP are to establish an Apex body for strengthening inter-ministerial coordination for water management, investing in water sector infrastructures, institutions and capacity building, improving efficiency of the water supply and demand sides, and enhancing water information, knowledge, technology and cooperation.

6 | Recent Developments in Water Environmental Management

The following developments in government policies are expected to have impacts on the country's water environment management:

i. Approval of the national surface water quality standard on 8 February 2024
ii. Implementation of project on capacity development in enforcement and promotion of environmental compliance
iii. Implementation of project for establishing a national water quality monitoring system and building a national laboratory to improve the national capacity for water quality management in Myanmar

7 | Challenges and Future Plans

Based on the current state of water quality management in Myanmar, some key management challenges are identified as follows:

Table 2.8.11 Key Management Challenges and Actions

	Description	Actions to be taken
Institutional challenge	Monitoring and inspection of water and effluent quality	Organize monitoring and inspection teams at national, state, regional, city and township levels, including relevant departments.
Enforcement challenges	Lack of capacities in regional offices Lack of incentive policy	Arrange capacity-building training. Formulate incentive policy for enforcement of environmental pollution.
Resource and financial challenges	Lack of human resources Lack of financial capacity to establish laboratory and technical training	Recruit human resources Enhancing cooperation with development partners to establish laboratory and capacity development training program on water and effluent quality monitoring.