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Environmental Protection Agency

National Waste Water Quality Guidelines

MALDIVES

WASTE WATER QUALITY GUIDELINES

Final

Revision 1

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Prepared by:
Maldives Water and Sanitation Authority, Male' , Rep of Maldives
Tel:+ 960 3317562 Fax: +960 3317569

Environmental Protection Agency					ތަރައްގީ ކުރިޔަށް ގެންދިއުމުގެ ތަރުތީބު ބަލަހައްޓާ ދާއިރާ
Green Building, 3rd Floor HandhuvareeHingun					ގްރީން ބިލްޑިންގ، 3 ވަނަ ފަންގިފިލާ ހަންދުވަރެ ހިންގުން
Male', Rep. of Maldives, 20392					ދިވެހި ރާއްޖެ، 20392
Tel:	[+960] 333 5949 [+960] 333 5951	: ގުޅުއްވުން	Email:	secretariat@epa.gov.mv	: ބެލެހެއްޓުން
Fax:	[+960] 333 5953	: ފެކްސް	Website:	www.epa.gov.mv	: ވެބްސައިޓް

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Male', Rep. of Maldives, 20392					ދ. ކ. ، ދ. ސ. ، ގ. ، ٢٠٣٩٢
Tel:	333 5949 / 333 5951	: ގުޅުއްވުން	Email:	secretariat@epa.gov.mv	: ލިޔުންތަކ
Fax:	333 5953	: ފެކްސް	Website:	www.epa.gov.mv	: ވެބްސައިޓ

PREFACE

"Waste water is one of the by-products in households and many industries which use water in a non-consumptive manner. It is also perceived to have very little value. It is therefore easily discharges in a least cost manner, without considering the total impact, including the economic impact, on the environment in which it is discharged.

In many instances, the emphasis is places on low production cost with maximum profit. Developing countries are usually targeted for this approach because disposal of domestic and production waste is perceived not to be high on their priority list.

In the case of the Republic of Maldives will a two pronged approach in waste water management. On the one hand government has taken a deliberate decision to protect its natural resources and citizens against the irresponsible discharge of waste water. An example of government's attention is the signing of the Islamabad Declaration.

The government of the Republic of Maldives will follow a two pronged approach in waste water management. On the one hand government will set waste water guidelines for domestic and industrial waste. The purpose of guidelines is to guide individuals, organizations, licence holders, governments and regulators on the best way to achieve water quality goals for sustainability. On the other hand individuals, organizations and licence holders will have to prove to government and the regulator that they are following international best practice in terms of Cleaner Production."

The Guidelines were complied taking into account the complexity and the nature of waste water and its interaction with the different environments into which it is discharged. It was therefore decided to define guidelines for waste water discharge based on its origin, the environment into which it is discharged and its effect on the most sensitive user of that receiving environment.

In this regard an application to discharge waste water should not only be based on the competence of the applicant to comply with the prescribed maximum values in the guideline. The applicant will also have to prove to government that the production of waste water is according to best Clean Production principals and that the waste water will not jeopardise the sustainable use by the most sensitive water user in the receiving environment.

These waste water guidelines are therefore only guidelines. The guidelines will be used by government as one of the tools to protect its people and environment as well as to ensure sustainable use natural resources."

Minister of Energy, Environment and Water

Environmental Protection Agency					ތަރުގައްދަދާއި ކަންތައްތަކުގެ ރަށްރަށް
Min. of Housing & Environment Compound AmeeneeMagu					ހިދުމަތްތެރި ރާއްޖެގެ ތަރުގައްދަދާއި ކަންތައްތަކުގެ ވަޒާރާތް ތަކެއްޗާ ގުޅޭ
Male', Rep. of Maldives, 20392					ދަތުރު، ދިވެހިރާއްޖެ، 20392
Tel:	333 5949 / 333 5951	: ގުޅުއްވުން	Email:	secretariat@epa.gov.mv	: ބްރޮޝާ
Fax:	333 5953	: ފެކްސް	Website:	www.epa.gov.mv	: ވެބްސައިޓް

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Environmental Protection Agency
Min. of Housing & Environment Compound
AmeeneeMagu
Male', Rep. of Maldives, 20392
Tel: 333 5949 / 333 5951
Fax: 333 5953
Email: secretariat@epa.gov.mv
Website: www.epa.gov.mv

Abstract

Without water no life is possible. Water is used to sustain life. In the modern world water is also used for secondary activities, such as industry and agriculture. After any non-consumptive use of water, water is released back into the environment. This used water, referred to as waste water, contains many waste products at concentrations which could limit the fitness of use of the water by other users, such as for drinking or sustaining the natural environment. The purpose of the guideline is to assist all stakeholders in the water cycle to manage the discharge of waste water in such a way that it does not limit water's fitness for use by the different water users.

The guideline suggests specific values of the maximum concentration that can be tolerated by future users of each parameter potentially present in waste water. These values may not be exceeded when treated waste water is released back into surface water, ground water or into deep sea. The values are generic and should be used together with Environment al Impact Assessments and clean Production Protocols to finalise the licence for the discharge of specific waste water.

In addition, frequent monitoring of the receiving water body will assist the Regulator with evaluation of any unforeseen water quality impacts and changes needed in discharge licence conditions can readily be quantified where required.

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Male', Rep. of Maldives, 20392 — ދަނޑު، ދިވެހިރާއްޖެ، 20392

Tel: 333 5949 / 333 5951 : ގުޅުއްވުން — Email: secretariat@epa.gov.mv : ލިޔުންތަ

Fax: 333 5953 : ފެކްސް — Website: www.epa.gov.mv : ވެބްސައިޓް

Definitions

Technical terms, abbreviations and any other words that may cause confusion are explained in this section.

- **Waste Water:** Waste water is water produced and discharged by any water user as a result of the non-consumptive use of water, for example to flush the toilet or to wash clothes. The quality of the waste water has usually been changed as a result of the specific use of the water
- **Non-consumptive use of water:** No or very little water is lost due to the use of water for a specific purpose, for example toilet flush, bathing or washing dishes
- **Fit for Use:** Water quality has to be better than certain specified maximum physical characteristics (specific temperature, colour, smell and turbidity levels) and not exceed the particular prescribed maximum concentration of chemicals and organisms, to be fit for a specific use
- **Water user:** Not only humans need water to survive, any organism or activity that requires water can be regarded as a water user. The water quality requirements of the different water users also vary, with the requirement of drinking water for humans and specific sensitive organisms such as coral, being the most stringent
- **Waste Water Agency:** Any group of people, business, international aid organization, national or local government unit that is responsible for the treatment of any kind of waste water
- **Receiving environment:** Any place into which waste water can be discharged, for example the sea, river, lagoon, ground water and land surface.
- **Components:** In addition to Hydrogen and Oxygen, water is made up of different other components such as different metals, material from plant and animal origin and very small animals and plants.
- **User:** Any person, industry, organization or any part of the natural environment which depends on water to sustain its life or function.
- **Sustainable:** Maintain the present condition for a long period of time
- **Licence holder:** A person or institution which has been granted permission to discharge waste water in accordance with the National Waste Water Guidelines
- **Clean(er) Production:** International best practice used by industry during the production of goods, limiting pollution and its effect on the environment
- **Environmental Impact Assessment (EIA):** Formal assessment, in accordance with the prescriptions of international or local agencies, as appropriate, of the impact that development or the status quo may have on the natural and social environment, and identification of mitigation measures that have to be implemented

Introduction and Background to Quality of Waste Water

Water is the key building block for life in the universe. Life, as we know it today, cannot exist without water. Water has physical properties that support life, for example it cools down the human body during perspiration and washes impurities from the human body. It also contains specific chemicals that are critical for a healthy body.

During the non-consumptive use of water, the characteristic of water taken in by the human body or used to wash food or vehicles, are always changed. Water used in the human body flushes the body and through the kidneys removes waste products from the human body. This water excreted by the kidneys in the human body is known as urine and contains high concentrations of salts, nitrogen, phosphorus and many other chemicals. In modern society the urine and other human waste are usually removed from the household, using water. During this process the properties or quality of the water are changed to such an extent that the water will no longer be fit for all users of water.

Not only is water used to support life, but in the modern world, water is also used by industry during the manufacturing of goods or the production of food.

In the undeveloped pristine natural environment, biological, physical and chemical process can change the quality of used water back to its original quality. However, where there are high concentrations of people and industry, these natural processes cannot cope with the volumes and the degree to which the quality of the water has been altered. Modern science and engineering can provide biological, chemical and physical process to change the quality of the used water to its original condition or least to level will make it fit for a specific water user.

This water “product” produced by modern science and engineering is usually referred to as waste water. The extent to which the quality of this waste water has to be purified depends on its future use, the receiving environment into which it will be discharged and the needs of subsequent users. In an attempt to ensure sustainability for all water uses, experts have formulated maximum allowed levels, known as guidelines, for the different components present in water. If these guidelines are exceeded, water may not be fit for a specific use i.e. fish starts to die, water has an offensives odour, children and old people dehydrate and may die. These levels are often referred to as waste water quality guidelines or effluent quality guidelines.

From a water resource management perspective it is therefore of paramount importance to decide on, implement and adhere to specific Objectives (Figure 1.1) and Principles (Figure 1.2) that will steer all water resource activities to the desired outcome.

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Male', Rep. of Maldives, 20392 | މާލެ، ދިވެހިރާއްޖެ، 20392
Tel: 333 5949 / 333 5951 : ޓެލެފޯން | Email: secretariat@epa.gov.mv : އީމެއިލް
Fax: 333 5953 : ފެކްސް | Website: www.epa.gov.mv : ވެބްސައިޓް

The waste water quality guidelines presented in this document, support the above objectives and principles as set out in the Maldives National Waste Management Objectives and Principles Document (MEEW, 2006)

It is the intention of waste water quality guidelines, together with best international Clean Production practice and Environmental Impact Assessments, to ensure sustainable use of the available water resources.

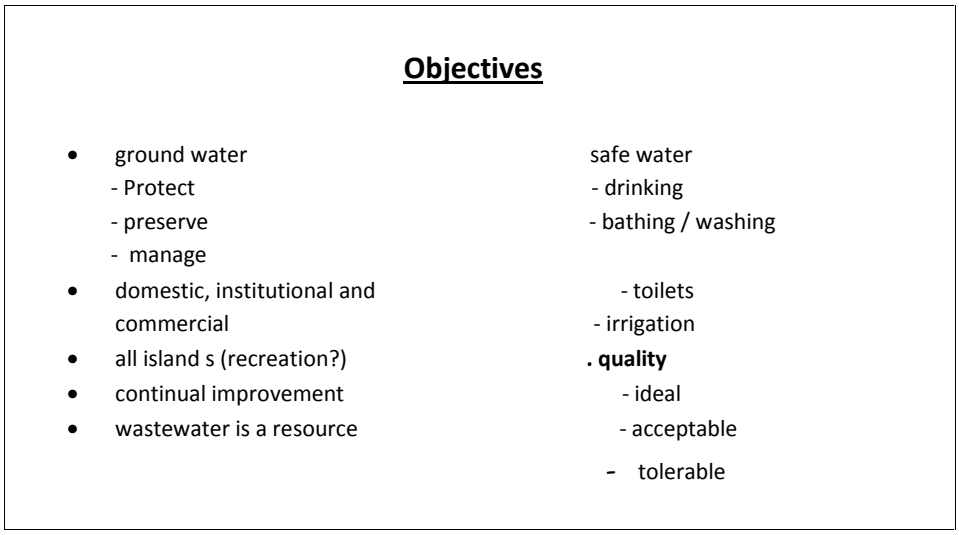

Figure 1.1: Objectives required for the management of water resources (Buckley, 2006)

Principles

. sustainability
. polluter pays
. precautionary principle
. equity
. public health
. environmental protection
- aquifer
- marine

. development
. improved quality of life
. scientific approach
To risk management
Permits
- limited duration?
tradeable?

. resources based standards
. access to water and sanitation
. Millennium Development goals
. separation of powers and functions
. limited free potable water to poor people
. free community rain tanks
. free access to ground water (public good)
. discharge to lagoons-island Office

Figure 1.2: Principles that should be considered to ensure efficacious Water resources management (Buckley, 2006)

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Male', Rep. of Maldives, 20392 — ދަތުރު، ދިވެހިރާއްޖެ، 20392

Tel: 333 5949 / 333 5951 : ގުޅުއްވުން
Fax: 333 5953 : ފެކްސް
Email: secretariat@epa.gov.mv : ލިޔުންތެރިކަން
Website: www.epa.gov.mv : ވެބްސައިޓް

Guidelines

What is a "Guideline"?

To be successful in life and business today, including water cycle management, specific goals or wanted outcomes /end states have to be formulated. To assist with the achievement of the goals / reaching the desired end state, objectives and principles have to be decided upon. These objectives and principles help to project the future in terms of the what, why, when and where. Guidelines on the other hand direct, steer and channel action to ensure the achievement of the goals that were set. Guidelines also provide practical measurement tools towards controlling activities which may negatively influence the desired end state (goal).
Water related guidelines provide water quality measurements that support the water management goals, objectives and principles of any national authority. Guidelines provide quantifiable quality measurements to describe fitness of use for a specific water user (for example drinking water or water for diving). Guidelines furthermore also provide quantifiable quality measurements for substances that are released into the aquatic environment, thus ensuring the receiving aquatic environment does not become unfit for use as defined by the management goals.

1.1 What are Guidelines not?

Guidelines should not be confused with implementation plans. The application of the guidelines, in terms of how and under which conditions exemptions will be granted, how reports should be complied and many other practical implementation issues, should be separately addressed in an implementation strategy and plan.

The implementation plan defines procedures for exemptions, durations therefore, stricter quality conditions and many other practical issues that may be of an individual and or institutional nature.

> "A guideline is similar to a ruler; don't change or bend the ruler to fit a situation – it will break. Implement the yardstick with the necessary sensitivity and diligence to ensure the desired outcome"

2. Why do the Maldives need a national Waste Water Quality Guideline?

The water resources of the Maldives are unique in more than one respect. The marine environment with its unique fauna and flora, is responsible for main revenue earned by the Maldives. For many centuries the fresh water lense in the groundwater has supported human activities.

The increase in human and industrial activities in the Maldives has placed the quality of the marine and ground water resources under threat. This is due to increased volumes of non-consumptive water use, resulting in increased volumes of poor quality waste water being discharged into the water environment.

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Min. of Housing & Environment Compound AmeeneeMagu					ހިދާޔަތާއި ވާތావරణ ތަރުގައްދަދުންތަ ގުޅޭ ތަ ހިދާޔަތް ދެވޭ
Male', Rep. of Maldives, 20392					ދަތ، ދިވެހިރާއްޖެ، 20392
Tel:	333 5949 / 333 5951	: ގުޅުއްވުން	Email:	secretariat@epa.gov.mv	: ލިޔުންތ
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Given the anticipated developments in the Maldives, the Ministry of energy, Environment and Water (MEEW) has requested the Maldives Water and Sanitation Authority (MWSA) to develop waste water quality guidelines and to use these guidelines as part of a set of waste water management tools, to regulate waste water discharges into environment. This will be done in an attempt to manage the valuable water resources of the Maldives for a sustainable fitness for use.

3. Who will be using this Guideline?

The authority administering this guideline will be the Maldives Water and Sanitation Authority (MWSA). The MWSA shall base its assessment of the suitability and acceptability of waste water quality being discharged into the environment after consideration of its microbial content, and its physical and chemical properties as indicated in this guideline.

This guideline also be used by government agencies, private organizations and individuals who plan processing or upgrading projects, educational institutions, donors, NGOSs and other entries. The following is a brief description of how the guidelines can be used by various users.

Government agencies: To assess whether the waste water that is discharged will damage the environment or the intended use of the environment into which the waste water is being discharged.

Waste water Agencies: To ensure that waste water complies with the specified limits in the guideline or decide when the treatment process need adjustment.

The Public: To provide information for the public to decide if waste water is of acceptable quality in their neighborhood.

Donors and NGOs: Provide information on acceptable levels for waste water treatment in development and other aid projects. Applicants whishing to use, connect to or operate a sewage system will use this guideline prior to applying to the MWSA for the necessary permission or permit.

Schools and Other educational institutions: To build an understanding of waste water quality and how to assess the impact of poor quality waste water; and provide the right information on water and waste water quality.

4. Approach followed for waste Water Quality Component Selection

The non-consumptive use of water always results in the change in concentrations of different components of water. In some cases components can be added that were not present in the water before use. If these components are present in the waste water at concentrations exceeding specified levels, the water will not be fit for that specific use ®.

For the purpose of waste water quality management, the use of water and the resulting waste water can be divided into two major categories (domestic and commercial/ institutional /industrial). Water used by households and discharged after use differs significantly from waste

water discharged by industry. In addition the waste water quality discharged from different types of industries (tuna industry, canning and toilet paper industry) also can differ significantly from each other.

For the purpose of the First Edition of this waste water guideline the most common components of waste water were selected. **Appendix A1** lists some selected components, indicating the main user source, potential pubic health or waste water impact and the typical concentration expected in waste water from that source.

4.1 Differentiation between Domestic and Industrial waste water

Household waste water consists mainly of human excreta. The urine is referred to as yellow waste water and faeces are referred to as black waste water. The human wash water and wash water from the laundry and the kitchen are referred to as grey water. The domestic waste water is therefore higher in bacterial / virus/ pathogen –concentrations and lower in metal concentration than industrial waste water. The industrial waste water may be dominated by pharmaceutical by-products, synthetic or organic, and high levels of dissolved organic and/ or inorganic contaminants – all depending on the nature of the industry.

In terms of human health, human excreta contains a large variety of micro-organisms of which specific pathogens, bacteria and viruses can cause severe community epidemics if this waste is not treated properly. Cholera is a good example of the consequences suffered as a result of lack of control over human waste disposal. Human waste also contains high concentrations of nitrogen, phosphorous and organic material that are known to cause major environmental problems (e.g. eutrophication of fresh and sea water, oxygen depletion, bad odours) if not treated properly before discharge.

The contents of industrial waste waters will differ significantly depending on the nature of the industry. Waste water from metal / mechanical industries tends to have much higher metal and inorganic salts than human waste. Food processing industries such as the tuna industry tend to have high bacterial content, very high nitrogen and phosphorous concentrations as well as organic components that will deplete oxygen rapidly during the natural break down process.

In setting guidelines for waste waters it is therefore evident that the nature of each type of waste water and its origin has to be known before the regulator can set waste water quality guidelines that will protect the different water users in the environment into which the waste waters are being discharged.

Due to the complexity and the nature of waste waters and the interaction between the treated or non-treated water and the different environments into which it is discharged, it was decided to define guidelines for wastewater discharge based on its origin, the environment into which it is discharged and the effect the waste water could have on the most sensitive user of that receiving environment.

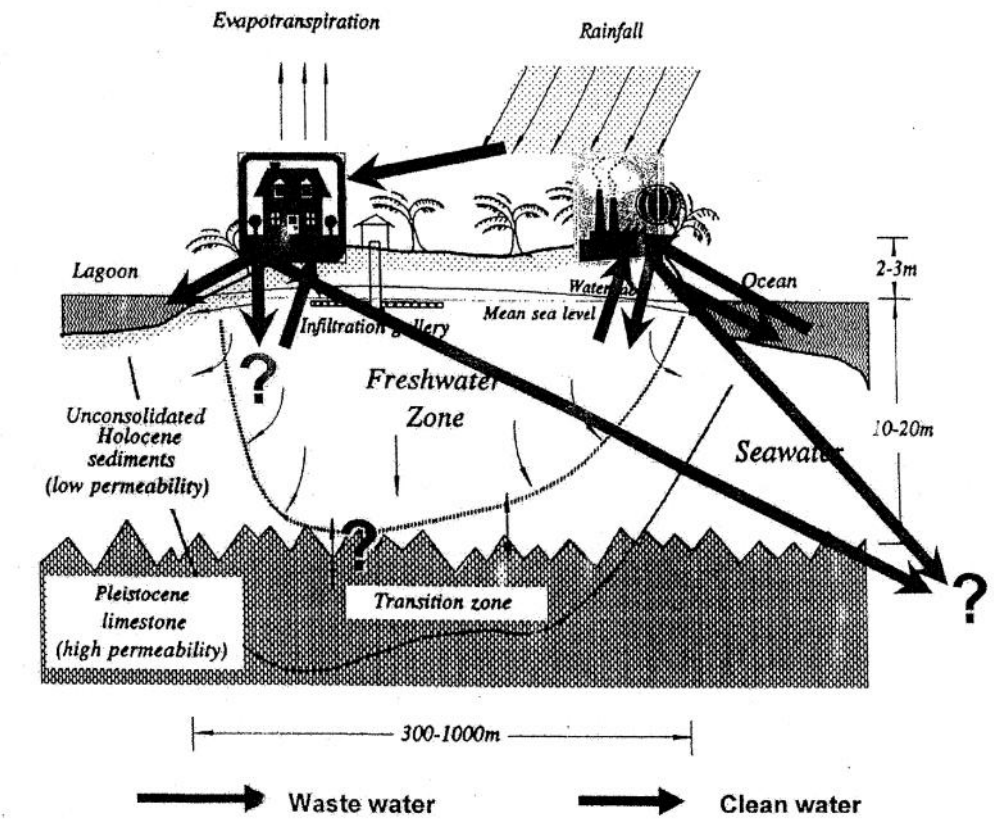

Figure 5.1: Main sources of water pollution and receiving areas of waste water

4.2 Exemptions and Special permits:

Before the 1900s, very governments were concerned about the effect of waste water discharge on the receiving environments and on the users of these receiving environments. The volumes of waste generated and the amount of non-biodegradable material did not warrant attention at the onset. It was only after deaths associated with polluted water or once people objected about unbearable odours that government officials, politicians and scientists started to actively manage waste water discharge by means of guidelines /regulations. The high number of diarrhoeal cases amongst young children and old people a few decades ago in the Maldives and the water quality history of the Thames River in the United Kingdom are prime examples of pressures for action, directly related to growing populations, in recent times.

For several decades now the impact on the environment of specific concentrations of pollutants and chemicals present in waste water has been recorded. The study of potential hazards inherent in waste water has internationally been instrumental in deriving and quantifying relationships between causes and effect, that can benefit users in a large range of settings.

Deriving scientifically sound values as tools to assess the hazardousness of waste water and then guide decisions regarding action and prevention, is not easy process and is a costly exercise. To draft a custom made guideline for every scenario is hardly practical. Because the international values are based on case studies, from dose-response models and from risk assessment research, their results are robust to other applications. The guideline values have stood the test of time and are being used by various institutions such as the World Health Organization, World Bank and Asian Development Bank.

Waste water guideline values used for this Maldives Waste Water Quality Guidelines were derived from the abovementioned international values.

Situations everywhere are however not identical. Certain international guideline values may be effective in protecting users of water. In the case where there are no downstream users, wastewater treatment works may be exempted from such a standard or the standard may be relaxed. In other cases, the specific guideline value may not be effective in protecting the most sensitive user of water, for example when the user is rare species of coral in the wake of a potential outlet of a manufacturing plant. In order to relax guidelines, grant exemptions or impose stricter values, a sound Environmental Impact Assessment is necessary and proof has to be submitted to government that best international Clean Production principles followed (see reference list). The guideline value can therefore only be changed when based on scientific site specific analysis.

Where a country adopts waste water quality guidelines for the first time or updates to more rigorous standards, existing waste water treatment plants be unable to comply with the new guidelines due to the nature of the technology used. In such cases the administrating authority or regulator may, after consultation with operators of such waste water treatment plants, consider a transitional period during which new licences can be issued and applicable technology be implemented.

In addition to the above, the regulating authority may decide to exempt a waste water licence holder or to apply the waste water guidelines less stringently, given the volume of waste water produced on a specific island and the intended discharge into deep sea. The following tables serves to illustrate pragmatic use of guideline values:

Table 5.1: Application of Waste Water Guidelines (Deep Sea Discharge) given volumes produced and minimum technology prescribed

Island Type	Estimated Waste Water Volume Produced		
	<0.1M1	0.1 1MI-0.5 MI	>0.5 MI
1. Island only residential with <1000 people See Notes 1 and 2 below	Removes solids only. Total exemption	n/a	n/a
2. Focus Islands: Residential only See note 1 below	n/a	Septic Tank only. Apply solid and Micro-biological Domestic waste water guidelines only (Table 6.1)	Primary and secondary treatment. Domestic waste water guidelines applied (Table 6.1)

3. Focus Islands: Residential and Industrial See note 1 below	n/a	Primary and secondary treatment Apply domestic and industrial waste water guidelines (Table 7.1)
4. Other major islands See note 1 below	n/a	Primary and secondary treatment Apply domestic and industrial waste water guidelines (Table 7.1)

n/a = given the number of people and volume of waste water produced these conditions are unlikely to occur.
Note 1: In the case of tourist islands, impact assessments have to indicate clearly that waste water practices by the tourist island and neighboring island, do not affect the diving tourism or aesthetics of the environment. No acute toxicity or untreated hospital waste should be present at any waste water discharge

Note 2: In 2006 almost 80% of inhabited islands fell in this category

4.3 Additional requirements related to Waste Water Treatment and Discharge

4.3.1 Storm water:

During rain, a signifant amount of rain water may flow from the build-up areas. This is usually referred to as storm water. The quality of this water differs from that of other waste water and the nature of the peak flows usually results in wastewater treatment works not being able to perform to specification. It is therefore of paramount importance not to allow storm water to enter the waste water treatment works.

Storm water should be separately managed from industrial and domestic wastewater in terms of infrastructure required and discharge guidelines. This will be done according to:
National Waste Water Quality Guidelines: Storm Water Management Guideline
Ref: MWSA-SEQG 2006

4.3.2 Solid waste and sludge:

The solids in waste water are removed by allowing it to settle or by screening out from the waste water coming into the waste water treatment plant. These solids can negatively affect the environment into which they are dumped. The disposal of waste water solids should be done according to:
National Solids from Waste Water Treatment Guideline
Ref: MWSA-SWWTG 2006

4.3.3 Health Sector waste water:

Waste water produced by the health sector will not be allowed to be discharged to deep sea or via deep sea domestic pipelines if it has not been treated according to:
National guidelines for the treatment of health sector waste
Ref: MWSA-HSWG 2006

Waste Water produced (treated or untreated) by the health sector will not be allowed for ground water recharge.

5. Domestic Waste Water Quality Requirements

5.1 Introduction

In section 5.1 the quality of domestic waste water and its impact on the receiving environment was briefly discussed. Domestic waste water consists of human waste (referred to as yellow and black water) and wash water (shower, bath, laundry and kitchen waste water, referred to as grey water). Sometimes the definition of black water may include kitchen waste water.

In large geographical parts of the Maldives human waste water is managed differently from the rest of the domestic waste water. However, this guideline will consider domestic waste water to always include yellow, grey and black water. Further more, no storm water should be allowed to enter the sewerage system as it will affect the performance of the wastewater treatment works.

In addition the guideline will only consider discharge of domestic waste to deep sea or for surface recharge of ground water.

5.2 Domestic Waste Water Quality for discharge into Deep Sea

Discharge of waste water to deep sea is a world wide practice but is receiving progressively more criticism from the scientific community and general public (Swimming in sewage, 2004). Given the important role the marine environment plays in the economy of the Maldives, this waste water discharge practice should be done with the necessary care.

Deep sea discharge in context of the Maldives means discharge of waste water beyond the shallow reef and at a depth which will ensure proper dispersion and rapid dilution. Deep sea discharge does not imply discharge of waste water inside the atoll.

Table 6.1 provides the maximum concentration of listed components that has to be complied with at all times. If these maximum values are exceeded, one or more of the users of the marine environment will be affected.

The values presented in Table 6.1 assumed proper dispersion as well as thorough and instant mixing at the point of discharge to limit impact at the point of discharge.

These guidelines are generic and conservative. There may also be cases where the capacity of the receiving environment to deal with additional waste water, has already been exceeded, or where the point of discharge does not meet the criteria for safe dispersal. In these cases the wastewater agency will be required to conduct an Environmental Impact Assessment (EIA), using accredited Assessors approved by MWSA and prove to government that best international Clean Production protocols are followed. Based on the recommendations of the EIA report, MWSA will issue site specific guidelines for the discharge of waste waters.

Table 6.1: Maximum allowable concentrations in Domestic Waste Water for discharge into Deep Sea

Domestic Waste Water Component	Maximum allowable concentration	Remarks
Faecal coliforms	100 org / 100 ml	For less than 95% of samples taken
E. coli	1 org / 100 ml	
pH	5 – 9.5	
Suspended solids	150 mg/l	To prevent sludge formation on corals
Residual chlorine	0.1 mg/l	
Nitrates as N	15 mg/l	
Free and saline Ammonia as N	10 mg/l	
Ortho-phosphate as P	10 mg/l	
Surfactants	10 mg/l	
Conductivity	< surrounding sea water	Should be less or equal to surrounding sea water
Soap, oils and grease (food related)	5 mg/l	
Oils, grease and waxes	5 mg/l	
Chemical Oxygen demand	50 mg/l	After applying chloride correction
Biological Oxygen demand	40 mg/l	Five-day test
Phenolic compounds as Phenol	1 mg/l	
Sum of metals	5 mg/l	Cadmium+Chromium+Copper+Mercury+Lead
Acute toxicity	Zero	No constituents allowed in concentrations which are poisonous or injurious to aquatic life

5.3 Domestic Waste Water Quality for Surface Recharge of Ground Water

The water quantity requirement for domestic purpose in the Maldives has increased significantly. In many cases domestic water users are using more water from the ground water than is being recharged through natural processes. This has resulted in the depletion of the freshwater lens leading to an increased salt concentration as well as the increase of other components in the ground water.

One option to assist the natural recharge processes is to allow treated domestic waste water to be discharged to the ground surface. In this way water will flow naturally to the fresh water lens.

In setting the guidelines for the discharge of treated domestic waste water to surface, it is assumes that:

- Untreated ground water will not be used for drinking or for food preparation, untreated ground water will only be used for bathing and laundry,
- The water will be fit for the user closet to recharge,
- The surface recharge area will not create environmental problems, and
- There is limited dilution / dispersion in the fresh water lens.

Table 6.2: Maximum allowable concentrations in Domestic waste water before Surface Recharge of ground water (not used for drinking water) will be allowed

	Maximum concentration	**Remarks**
Faecal coliforms	10 org / 100 ml	For less than 95% of samples taken. Clinical infections unlikely in healthy adults, but may occur in sensitive groups
E. coli	0 org / 100 ml	
Suspended solids	15 mg/l	Prevent sludge build-up in ground water sections

Domestic Waste Water Quality Component	**Maximum concentration**	**Remarks**
Residual chlorine	0.2-0.8 mg/l	Disinfection good; insignificant risk of health effects
Temperature	Not more than 3°C above the receiving water	
pH	5 – 9.5	
Nitrates as N	6 mg/l	May result in biological growth
Free and saline Ammonia as N	10 mg/l	
Ortho-phosphate as P	1 mg/l	
Surfactants	10 mg/l	
Conductivity	Equal or less than receiving ground water	To prevent salt build-up
Soap, oils and grease (food related)	5 mg/l	
Oils, grease and waxes (mineral origin)	1 mg/l	
Chemical Oxygen Demand	5 mg/l	After applying for chloride correction
Biological Oxygen Demand	5 mg/l	Five-day test

Dissolved Oxygen	75% saturation	
Phenolic compounds as Phenol	1 mg/l	
Arsenic as As	0.05 mg/l	i. These concentrations will be allowed given that real time studies do indicate that there is not an increase in the concentration of these metals over time. ii. Iron above 0.2 mg/l may result in the staining of white clothes iii. Magnesium in excess of 30 mg/l may impair lathering of soap
Calcium as Ca	80 mg/l	
Cyanides as Cn	0.5 mg/l	
Chloride as Cl	200 mg/l	
Sulphides as S	0.05 mg/l	
Sulphates	250 mg/l	
Fluoride as F	1 mg/l	
Sodium as Na	200 mg/l	
Zinc ad Zn	5 mg/l	
Cadmium as Cd	0.005 mg/l	
Mercury as Hg	0.02 mg/l	
Selenium as Se	0.05 mg/l	
Nickel		
Boron as B	0.5 mg/l	
Hexavalent Chromium as Cr	0.05 mg/l	
Total Chromium as Cr	0.5 mg/l	
Copper as Cu	1 mg/l	
Lead as Pb	0.1 mg/l	
Iron as Fe	1 mg/l	
Manganese as Mn	0.1 mg/l	
Magnesium as Mg	100 mg/l	
Aluminium as Al	0.3 mg/l	
Sum of metals	1 mg/l	Cadmium+Chromimun+Coppper+Mercury+Lead
Acute toxicity	Zero	No constituents in concentrations which are poisonous or injuries to aquatic or human life

Note: Groundwater samples should be taken at least every three months. If an increase of the components in Table 6.2 confirmed, the relevant guideline values have to be lowered and or the waste water volumes used for recharge have to be restricted

6. Combined Domestic and Industrial water requirements for Deep Sea Discharge:

The Marine environment is the one of the most valuable assets of the Maldives. It is the driving force for the ecotourism in the Maldives, supports the fish industry and supplies a major food source to the local population.

No trade effluent shall be accepted for discharge into the deep sea outfall unless:

- The industry has proven to government that it is following best international Clean Production practice
- An Environmental Impact Assessment has been submitted, and
- The trade effluent complies with the following conditions (except when EIA motivated for exemption or stricter values). The effluent shall not contain concentrations of substances in excess of those stated in Table 7.1:-

Table7.1: Maximum allowable concentrations in Domestic and Industrial waste water for Deep Sea Discharge

Industrial Waste Water Quality Component	Maximum concentration	Remarks
Faecal coliforms	100 org / 100 ml	For less than 95% of samples taken. Clinical infections unlikely in healthy adults, but may occur in sensitive groups If the waste water contains any hospital waste, the waste water should also be tested for other pathogens (Ref 1 & 2 and appendix A1).
E. coli	1 org / 100 ml	
Suspended solids	150 mg/l	Prevent sludge build-up in reef sections
Residual chlorine	0.2-0.8 mg/l	Disinfection good; insignificant risk of health effects
Temperature	Not more than 44°C	
pH	5 – 9.5	
Nitrates as N	15 mg/l	May result in biological growth
Free and saline Ammonia as N	10 mg/l	
Ortho-phosphate as P	10 mg/l	
Surfactants	10 mg/l	
Conductivity	Equal or less than receiving sea water	To prevent salt build-up
Soap, oils and grease (food related)	5 mg/l	
Oils, grease and waxes (mineral origin)	5 mg/l	
Chemical Oxygen demand	50 mg/l	After applying for chloride correction
Biological Oxygen demand	40 mg/l	Five-day test
Dissolved Oxygen	75% saturation	
Phenolic compounds as Phenol	1 mg/l	
Arsenic as As	2 mg/l	These concentrations will be allowed given that real time studies do indicate that there is not an increase in the concentration of these metals over time.
Calcium as Ca	80 mg/l	
Cyanides as Cn	10 mg/l	
Chloride as Cl	200 mg/l	
Sulphides as S	1 mg/l	
Sulphates as SO4	250 mg/l	
Fluorides as F	1 mg/l	
Sodium as Na	200 mg/l	
Zinc as Zn	20 mg/l	
Cadmium as Cd	0.05 mg/l	

Industrial Waste Water Quality Component	Maximum concentration	Remarks
Mercury as Hg	0.05 mg/l	
Selenium as Se	0.05 mg/l	
Nickel	10 mg/l	
Boron as B	0.5 mg/l	
Hexavalent Chromium as Cr	0.05 mg/l	
Total Chromium as Cr	3 mg/l	
Copper as Cu	3 mg/l	
Lead as Pb	5 mg/l	
Iron as Fe	5 mg/l	
Manganese as Mn	0.1 mg/l	
Magnesium as Mg	100 mg/l	
Aluminium as Al	0.3 mg/l	
Sum of metals	5 mg/l	i. Cadmium+Chromium+Copper+Mercury+Lead ii. Metals may be bio-accumulated and have a negative effect on the health of consumers of sea food
Acute toxicity	Zero	No constituents in concentrations which are poisonous or injurious to aquatic or human life

7. Monitoring

7.1 <u>Design of monitoring programmes</u>

For wastewater treatment plants to produce waste water that complies with this guideline, it is of paramount importance to monitor the waste water produced and the operational condition of the treatment works.

7.1.1 Waste Water:

Each Waste Water Agency or licence holders shall, as part of the application to MWSA to discharge waste water, submit a monitoring programme clearly indicating the following aspects:

7.1.1.1 Purpose of monitoring (should include aspects such as optisimisation, cost effective operation, compliance to assure protection of users).

7.1.1.2 Components to be monitored against guideline and operational requirements for each sample point

7.1.1.3 Sample point location as per Geographical positioning System (GPS) reading (after each unit treatment process, final waste water and at point of discharge)

7.1.1.4 Sampling frequency of final waste water and at point of discharge.

7.1.1.5 Sampling method, sample transport conditions

7.1.1.6 Laboratory and analytical methods used

7.1.1.7 Data and information management

Monthly compliance reports have to be submitted to MWSA indicating at least the minimum and maximum value for each guideline requirement. In addition, all analytical data from all sample points as indicated in paragraph 8.1.1.3, have to be submitted to MWSA monthly in an electronic format as prescribed by MWSA from time to time.
MWSA has the right to take samples at any time and will share the results with the Waste Water Treatment agency.

In cases of non-compliance to any guideline in this document, MWSA has to be informed immediately, indicating the components concerned and concentrations. A plan of action has to be submitted indicating responsibility for specific actions and expected date of compliance.

7.1.2 Infrastructure:

A maintenance plan has to be submitted annually. Results of maintenance inspections to be submitted

to MWSA within 30 days of inspection-to indicate results and plan of action in cases where infrastructure

has to be replaced.

7.2 Biological and Chemical analysis of waste water

In addition to requirements mentioned in section 8.1, sample analysis can be carried out by a laboratory approved by MWSA. The method of analysis should comply with the requirements of AWWA/APHA or Public
Health Laboratory of Maldives and the results reported as requested in guidelines.

8. Additional or site specific quality requirements for waste water

These guidelines are genetic and conservative. There may be cases where the wastewater agency does not need to be comply with the guideline values as set out in Table 6.1, Table 6.2 and/or Table 7.1. There may also be cases where the capacity of the receiving environment to deal with additional waste water, has been exceeded.

In both these cases the wastewater agency will be required to conduct an Environmental Impact Assessment (EIA), using accredited Assessors approved by MWSA.

In addition the applicant has to prove to government that best international Clean Production protocols are followed.

Based on the recommendations of the EIA report and proof of Clean Production practice, MWSA will issue site specific guidelines for the discharge of waste waters. No exemptions to the Guidelines will be allowed without site specific guidelines to that effect.

9. Consumer Issues

In order to protect the rights of all users, wastewater treatment agencies are required to maintain a register of complaints and record of analytical results and investigations associates with each compliant. It is also required to publish these results in an annual report which should be available to all the users and general public.

10. Amendments to this guideline

MWSA will regularly update the information in this guideline. These changes and amendments and any additional sections as and when required, will constitute the waste water quality guideline at any point in time.

Changes and amendments to this guideline will only be instituted by MWSA.

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References

1. SWIMMING IN SEWAGE: The Growing Problem of Sewage Pollution and How the Bush Administration Is Putting Our Health and Environment at Risk 2004, Natural Resources Defense Council Environmental Integrity Project

2. M. Taggart 2004 Heal the Bay, 3220 Nebraska Ave, Santa Monica, CA 90404 htt://www.healthebay.org

3. Quality of domestic water supplies Volume 1: Assessment Guide 1998 Water Research Commission No: TT 101/98 Pretoria, South Africa

4. NSW EPA Profits from Cleaner Production A Self help Tool for Small to Medium-Sized Business Sydney South NSW (www.epa.gov.au)

5. MEEW 2006 Maldives National Water Management Objectives and Principles Ministry of Energy, Environment and Water, Male'

6. USEPA 2002 Onsite Wastewater Treatment System Manual, Water office of Research & Development US Environmental Protection agency EPA/625/R-00/008I

7. BUCKLEY, C A 2006 The development of a framework to assist the government of the Maldives in dealing with sanitation and waste water, MWSA, Male' Maldives

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Tel:	333 5949 / 333 5951	: ގުޅުއްވުން	Email:	secretariat@epa.gov.mv	: ބްރޫދާ
Fax:	333 5953	: ފެކްސް	Website:	www.epa.gov.mv	: ވެބްސައިޓް

Annexure A 1: Supporting information

Waste Water Components	Source & Average Concentration		Reason for concern
	Domestic	Industrial	
1. Pathogen			Parasites, bacteria and viruses can cause communicable diseases by direct or indirect contact or digestion of contaminated water or shellfish. Pathogens can be transported for significant distances in ground water and surface waters
1.1 Total coliforms (org./100ml)	10^8-10^{10}	Industry specific	Gastroenteritis: Vomiting, diarrhea, death in susceptible populations
1.2 Faecal coliforms (org. /100 ml)	10^6-10^{10}		
2.Total suspended solids (mg/l)	150-330		Contributes to sludge that can fill up reticulation infrastructure, increase the chlorine demand as well as protect pathogens against disinfection. Sludge deposits smother benthic invertebrates and fish eggs can contribute to benthic enrichment, toxicity and sediment oxygen demand. Can limit light's penetration into water and lower the ability of aquatic plants to increase dissolved oxygen in the water column.
3. Nitrogen 3.1 Nitrates, Nitrites (mg/l) 3.2 Ammonia (mg/l) 3.3 Total nitrogen	 >1 >14 26-75	 >1 >14 >30	Nitrogen is a plant nutrient that contributes to excessive aquatic plant growth and oxygen loss in sea and fresh water. High nitrate concentrations in drinking water cause methemoglobinemia in infants and problems in pregnancy
4. Orthophosphate and Total Phosphate (mg/l)	6-12	>12	Phosphor is a plant nutrient that stimulates to excessive aquatic plant growth. This is accompanied by increases in populations of bacteria and reduced oxygen levels for fish and other organisms. In domestic waste orthophosphate forms a large portion of the total phosphate concentration.
5. Chemical Oxygen Demand (mg/l)	500-660	>660	A measure of oxygen required by strong chemical oxidizing agents to oxidize organic material. High chemical oxygen demand implies little oxygen available for aquatic life and the presence of chemicals that may be dangerous to health.
6. Fats, oils and grease (mg/l)	70-105	Industry specific	
7. Surfactants (mg/l)	9-18	Industry specific	
8. Heavy metals		Industry specific	Cause various health problems if present in drinking water
9. Dissolved inorganic components			Chlorine and Sulphide can cause taste and odour problems in drinking water. Boron, sodium, chlorides and sulphate and other solutes may limit reuse of waste water (e.g. irrigation)

Annexure B: Supporting Information

Other Discharge requirements for waste water discharge into Deep Sea:

To ensure that the above waste water quality guidelines protect the sea environment and the users thereof, other physical requirements are applicable at the point and area of discharge. Based on the EIA, the regulator may decide to specify site specific Dilution ration and Dispersion. The following may also be considered:

B1 Zone restriction

Any other activities will not be allowed within 1 km radius of the point of discharge. The point of discharge has to be clearly indicated at all locations from where users launch their activities.

B2 Impact assessment at point of discharge

An impact assessment of the point of discharge and a surrounding area with a 1 km radius has to be conducted on an annual basis by qualified Assessors approved of by MWSA. The report has to be submitted to MWSA before 1 July of each year.

In addition it will also be expected from the waste water discharge to publish the above findings in the public media before 1 August of each year.

Other discharge requirements for waste water discharge before Surface Recharge of Ground Water:

B3 Monitoring of surrounding ground water quality

The Regulator may request the licence holder to monitor the quality of the ground water closest to the point of waste water release. Samples should be taken once every two weeks for at least 3 months before the first releases of waste water and for at least a year after the first release.

Samples should be analyzed for those components that reflect the fitness of use as specified in Section 6.3. Data should be sent to the Regulator within two weeks of sampling.

B4 Regulating ground water abstraction

As part of the waste water licence conditions, the Regulator may decide to limit the volume of ground water abstracted by the licence holder. The Regulator may also request the licence holder to discharge its waste water as close as possible to its own point of abstraction.