Indicator Fact Sheet

4. Municipal Wastewater Management

Indicators:

4.1 Municipal wastewater collected and wastewater treated

4.2 Direct use of treated municipal wastewater

4.3 Release of nutrients from municipal wastewater

Indicator Specification

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Version History

Version	Date	Author	Status and description	Distribution
1.0	24.02.2018	EEA/ETC (Deltares), UNEP-MAP (M. Kayyal)	Specification sheet updated from SEIS I Ind 4 and included new indicators 4.2 and 4.3, which includes methodology proposed by M. Kayyal	SEIS Team
2.0	12.04.2018	EEA/ETC (Deltares), UNEP-MAP	Includes comments from UNEP-MAP	ENI South Countries (Athens Workshop)
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Indicator Specification

H2020 Indicators	
Thematic area **WATER**	**Date** 14.05.2018 **Author (s) EEA/ETC, UNEP/MAP**
Policy theme **4. Municipal Wastewater Management**	
Indicators: **4.1 Municipal wastewater collected and wastewater treated** **4.2 Direct use of treated municipal wastewater** **4.3 Release of nutrients from municipal wastewater** **Additional information:** Type of Treatment Total annual design capacity of functional WWTPs Number of functional MWWTPs	

This project is funded by the European Union

Rationale

Why is appropriate wastewater management crucial for the Mediterranean?

Wastewater generated from coastal cities is one of the major pollution problems and is therefore recognized as one of the Horizon 2020 Initiative priority areas. The discharge of untreated wastewater directly in freshwater, coastal and marine environments causes enormous health concern. It also represents a significant pressure on aquatic ecosystems as wastewater carries high loads of nutrients (nitrogen and phosphorus), contaminants (e.g. heavy metals, PAHs, halogenated compounds) and pathogenic microorganisms (including coliforms, faecal streptococcus, salmonella etc).

The polluting effect of wastewater discharge is variable and largely dependent on the initial composition, quantity, level of treatment of the collected wastewater, composition of the effluent and the capacity of the receiving water bodies. The initial composition of wastewater depends on factors connected to the standard of living, weather conditions, water supply systems, water quantities available and composition of industrial wastes. In coastal communities, seasonal variations may be affected by tourism.

Appropriate collection and treatment of urban wastewater not only prevents human health issues and pollution of aquatic environments but has also a large potential and benefits in the overall management of water resources. In a context of climate change and increased pressure on water availability, treated wastewater is an asset, as it helps to close the gap between supply and increasing demand, and is one of the most sustainable alternatives to cope with water scarcity.

This cluster of indicators assesses the complete cycle of wastewater management, in particular when combined with Indicator 3 ("access to sanitation") and Indicator 5 ("coastal and marine water quality"). It can help monitor the potential level of pollution from urban point sources entering the aquatic environment and pinpoint those areas where intervention may be most needed. Furthermore, these indicators capture also the potential and significance of reuse of treated wastewater and the progress towards a more sustainable and integrated water resource management.

Justification for indicator selection

4.1 Municipal wastewater collected and wastewater treated

The rate of wastewater collected and treated by public sanitation is very variable among Mediterranean countries, ranging from 7% to 90%. Many countries, particularly in the South, still discharge a significant portion of the collected wastewater into internal waterways or into the sea without prior treatment. A considerable part of the Mediterranean coastal cities in ENP-South countries are not served by wastewater treatment facilities, although reported data is inconsistent and limited. As the issue became higher on political agendas, large investments have been made in recent years in the region to improve the situation and therefore it becomes crucial to assess the effectiveness of such measures through appropriate data collection and management.

This indicator provides information on the collection and treatment level of wastewater in the region and can be considered as a "response" indicator. It helps identifying communities where wastewater treatment action is required, while helping to assess where progress has been made.

Indicator 4.1 was adopted as one of the H2020 Water Indicators during ENPI-SEIS Phase I and is closely linked to the MSSD Indicator 2.5. Furthermore, this indicator has been referenced by several countries in their updated National Action Plans, where it relates to specific operational targets put forward by Mediterranean countries under IMAP's Ecological Objective 5 (see more in Targets section below), being one of the proposed common indicators for the Mediterranean Action Plan.

4.2 Direct use of treated municipal wastewater

Wastewater use is a widespread practice in the Mediterranean, mainly for agricultural and landscape irrigation, and groundwater recharge. The management, standards and enforcement of wastewater use, however, vary greatly across countries and in many cases raw or insufficiently treated wastewater is used, with serious health hazards and environmental risks. Water reuse is generally limited when

compared with the total water use but it is expected to increase significantly, due to water scarcity and increasing water demands (e.g. tourism) but also cost-effectiveness of water reclamation and gradually more demanding quality standards for wastewater discharges.
For treated municipal wastewater to be reused and to prevent health risks potentially associated with wastewater, quality standards for safe reuse need to be defined and met.

This indicator is relevant from a socio-economic viewpoint related to efficient use of water resources and the use of non-conventional sources of water, as well as an environmental perspective linked to water quality. It can therefore be considered as a "response" indicator.

4.3 Release of nutrients from municipal wastewater

Municipal wastewater can be an important source of input of nutrients and organic substances into aquatic bodies, directly impacting water quality. High nutrient loads entering the Mediterranean can lead to eutrophication events in an otherwise oligotrophic sea. The impact of eutrophication is detrimental to the environment from both from an ecological as well as a socio-economic perspective, considering its impact on marine biological resources and the risk of harmful algae blooms on public health.
This indicator is a "pressure" indicator, providing insight into the quality of discharged municipal effluents and the degree to which nutrients from treated municipal wastewater may contribute to the increased concentration of nutrients in certain areas of the Mediterranean Sea.
The indicator complements IMAP indicator 13 (on eutrophication) and is in line with the requirements of the Regional Plan on the reduction of BOD_5 from urban agglomerations [1]. It also provides data and information regarding the operational target identified by the Mediterranean countries with regards to reduction of BOD discharges to the Mediterranean Sea.

References

- Decision IG 21/10 of COP 19 of the Barcelona Convention on IMAP
- EEA, 2014. Horizon 2020 Mediterranean Report – Towards shared environmental information systems EEA-UNEP/MAP Joint Report. Luxembourg: Publications Office of the European Union.
- Loutfy, N.M., 2010. Reuse of Wastewater in Mediterranean Region, Egyptian Experience. In: Barceló D., Petrovic M. (eds) Waste Water Treatment and Reuse in the Mediterranean Region. The Handbook of Environmental Chemistry, vol 14. Springer, Berlin, Heidelberg.
- UNEP/MAP, 2005. Guidelines for Municipal Water Reuse in the Mediterranean Region.
- UNEP/MAP-Plan Bleu, 2009. State of the Environment and Development in the Mediterranean, UNEP/MAP-Plan Bleu, Athens.
- UNEP/MAP, 2017. Mediterranean Quality Status Report. Tirana, Albania.
- European Commission, 2016. Glossary of terms related to Urban Waste Water - Environment - European Commission. http://ec.europa.eu/environment/water/water-urbanwaste/info/glossary_en.htm
- European Commission, 2007. Terms and Definitions of the Urban Waste Water Treatment Directive 91/271/EEC.
- European Commission, 2016. EU-level instruments on water reuse Final report to support the Commission's Impact Assessment

1 The Directive 91/271/EEC concerning urban waste water treatment defines an agglomeration as "an area where the population and/or economic activities are sufficiently concentrated for urban waste water to be collected and conducted to an urban waste water treatment plant or to a final discharge point"

- EU, 2016. Guidelines on Integrating Water Reuse into Water Planning and Management in the context of the WFD.

Indicator definition

***4.1**Municipal wastewater collected and wastewater treated*

This indicator measures:

- Volume of municipal wastewater collected by public sewage networks and from storage tanks
- Volume of wastewater treated in wastewater treatment plants

Municipal wastewater is defined as domestic wastewater or the mixture of domestic wastewater with industrial wastewater and/or run-off rain water. Storage tanks and other types of contained systems can be considered as hermetic, do not have an overflow and the waste water is regularly collected and transported to a treatment plant. Wastewater treatment is defined as the process of removing contaminants from wastewater according to the established national standards on effluent quality, to allow for its discharge to the environment without adverse impact on public health and the ecosystem.

Additional information that supplements this Indicator

- Percentage of the treated wastewater according to the type of treatment (primary, secondary, tertiary)
- Total annual design capacity of functional facilities
- Total number of functional municipal wastewater treatment facilities

Treatment can comprise a wide range of processes including simple screening, sedimentation, biological-chemical processes, or appropriately designed marine discharge. Here reference is made to types of wastewater treatments defined according to the Mediterranean Regional Plan on BOD and the European Urban Wastewater Treatment Directive:

Primary treatment: physical and/or chemical process involving settlement of suspended solids, or other processes in which the BOD_5 of the incoming waste water is reduced by at least 20% before discharge and the total suspended solids of the incoming waste water are reduced by at least 50%;

Secondary (biological) treatment: uses biological process to decompose most of the organic matter, resulting in the reduction of 70-90% of BOD_5. and remove about 20 - 30 % of the nutrients. Primary treatment alone does not remove ammonium, whereas the removal rate of ammonium by secondary (biological) treatment is around 75 %.

Tertiary (advanced or more stringent) treatment: further removes nutrients (nitrogen and/or phosphorus) and/or any other pollutant affecting the quality or a specific use of water: microbiological pollution, colour, etc.

Units

- Volume of municipal wastewater collected in **million m^3 per year**
- Volume of municipal wastewater treated in wastewater plants in **million m^3 per year**

Additional information

- % wastewater treated by primary treatment
- % wastewater treated by secondary treatment
- % wastewater treated by tertiary treatment
- Total annual design capacity of functional facilities (10^9 m3/year or PE, if volume not available)
- Total number of functional municipal wastewater treatment facilities

This project is funded by the European Union

Geographical scope
Mediterranean.

Indicator definition

***4.2** Direct use of municipal wastewater*

This indicator encompasses the use of water which is generated from municipal wastewater or any other urban marginal water and treated to a standard that is appropriate for its intended use.

"Direct use" refers to the introduction of treated wastewater via pipelines and other necessary infrastructure directly from a water treatment plant to a distribution system. An example would be the distribution of treated wastewater to be used directly in agricultural irrigation.
This excludes reuse of treated wastewater which is placed into a water body source such as a lake, river, or aquifer and then some of it retrieved for later use. Treated wastewater stored in artificial water reclamation reservoirs prior to its use should be included in the indicator.

This indicator thus measures the volume of direct treated wastewater intended for reuse, with no or little prior dilution with freshwater during most of the year.

The applications of direct treated wastewater require quality standards and include:

- Irrigation water (agriculture, landscape, sport and recreation).
- Water for manufacturing and construction industry (cooling and process water).
- Dual water supply systems for urban non-potable use (toilet flushing and garden use).
- Firefighting, street washing, dust suppression and snowmaking.
- Water for restoration and recreation of existing or creating new aquatic ecosystems.
- Recreational water bodies (including land redevelopment1).
- Aquifer recharge through injection wells for saline intrusion control.
- Fish ponds.

Units
Million m^3 per year

Geographical scope
Mediterranean.

Indicator definition

***4.3** Release of nutrients from municipal wastewater*

This indicator is defined as the nutrients and organic matter loads from urban centres discharged to the Mediterranean per year, specified for biological oxygen demand (BOD), total phosphorus (TP), and total nitrogen (TN).
Municipal wastewater originating from urban agglomerations ≥ 2000 p.e. situated in coastal hydrological basin and those agglomerations with direct access to the Mediterranean is to be considered in the indicator

Thus the indicator estimates:
- The total BOD load from urban wastewater discharged in the Mediterranean per year
- The Total Phosphorus load from urban wastewater discharged in the Mediterranean per year

- The Total Nitrogen load from urban wastewater discharged in the Mediterranean per year

Biochemical Oxygen Demand (BOD): indicates the oxygen needed by aerobic microorganisms to breakdown the organic components present in a sample of wastewater. This sub-indicator therefore reflects the load of organic matter in wastewater effluents discharged into the Mediterranean Sea.
Total Nitrogen (TN): This indicator comprises the ions nitrate, nitrite and ammonium in the dissolved phase (DIN) and the organic forms of nitrogen (mostly proteins and other N-containing substances) existing in biota and other particulate materials and in dissolved organic matter.
Total Phosphorus (TP): This indicator comprises the dissolved ion phosphate and the organic forms of phosphorus existing in biota and other particulate materials (POP) and in dissolved organic matter (DOP).

Units
Tonnes of BOD/N/P per year.

Geographical scope
Mediterranean.

Policy context and targets

General context description

The safe treatment of wastewater to protect public health, improve and/or (re-)use limited resources and limit pollution is recognized as a priority by many different policy initiatives in the region.
In the Northern Mediterranean, the European Directive (91/271/EEC) concerning urban wastewater treatment (which prescribes as a minimum requirement the secondary treatment for urban areas (agglomerations) of size > 10,000 p.e.[2] discharging into coastal waters and for agglomerations of size ≥ 2000 p.e. discharging into freshwater and estuaries), has contributed to the significant increase of the population connected to wastewater treatment plants over the past two decades.

Contracting parties to the Barcelona Convention adopted the Genoa Declaration in 1985, which included, as one of the priorities, the establishment of sewage treatment plants in all cities around the Mediterranean Sea with more than 100,000 inhabitants, appropriate outfalls and treatment plants for all cities with more than 10,000 inhabitants. This target was further reinforced in the framework of the Strategic Action Programme to combat pollution from land based sources in the Mediterranean (SAP-MED) adopted in 1997, where countries also committed to reduce 50% the nutrient inputs from industrial sources to the Mediterranean sea area by 2010 as well as reduce nutrient inputs from diffuse sources (agriculture and aquaculture) into areas they are likely to cause pollution.

In 2009, the Regional Plan on BOD emissions from municipal wastewater treatment facilities was adopted. This includes legally binding measures, programmes and timeframes based on Article 15 of the LBS Protocol. Countries should ensure that wastewater originating from all agglomerations of more than 2000 inhabitants are collected and treated before discharging them into environment.
In 2012, the Contracting Parties to the Barcelona Convention adopted Decision IG. 20/4 of the 17th Conference of the Parties on the ecosystem approach. Eleven ecological objectives were approved including EO5 on eutrophication. The Ecosystem Approach is the guiding principle to MAP Programme of Work and all policy implementation and development undertaken under the auspices of UNEP/MAP Barcelona Convention, with the ultimate objective of achieving the Good Environmental Status (GES) of the Mediterranean Sea and Coast. Following up on the latter, Decision IG. 21/3 on the ecosystems approach adopted definitions of Good Environmental Status (GES). The Decision provides details of the operational objectives, indicators, GES and proposed targets.

Specifically, on wastewater reuse, the Sustainable Development Goal on Water (SDG 6) mentions the use of non-conventional sources of water to increase substantially water-use efficiency by 2030. In Europe, water reuse is a top priority area in the Strategic Implementation Plan of the European Innovation Partnership on Water, and maximisation of water reuse is a specific objective in the Communication "Blueprint to safeguard Europe's water resources", the water milestone of EU's 2020 Strategy. It is expected that in 2018, the European Commission will propose legislation on minimum requirements for water reuse in irrigation and aquifer recharge.

Targets

Several targets that have been put forward in global and regional initiatives regarding urban wastewater management, reduction of pollution from wastewater and increase wastewater use.

SAP MED and Regional Plan Targets

By 2015 or 2019: National BOD_5 Emission Limit Values (ELVs) for urban wastewater after treatment in the:

2 The Directive 91/271/EEC defines one population equivalent (p.e.) as the organic biodegradable load having a five-day biochemical oxygen demand (BOD5) of 60 g of oxygen per day"

a) LBS Protocol Area less than 50 mg/l, assuming a performance of reduction of the influent load of 70-90 % (secondary treatment).
b) LBS Protocol Area – marine outfalls (ref. Art. 7 LBS Protocol) less than 200 mg/l, assuming a performance of reduction of the influent load of 20 % (primary treatment).

ELVs refer to mean maximum allowable pollutant concentration to be finally discharged to the receiving water environment. These ELVs should only be adopted considering local conditions and provided that total loads do not affect the receiving marine environment.

Other regional targets regarding nutrients in the framework of SAP-MED are laid on the Decision IG.20/8.2: "Regional Plan on the reduction of BOD_5 in the food sector"; and Decision IG. 21/3 on the ecosystems approach, which includes also targets on eutrophication for achieving GES.

By 2025: Disposal in in conformity with the LBS Protocol for all cities and agglomerations > 2,000 inhabitants.

NAP targets
National targets may also exist in some countries, for example in their National Action Plans (NAPs). Mediterranean countries presented similar national targets in the framework of SAP-MED and the regional plans. These targets do not include specific percentages yet but common operational targets in the NAPs related to nutrients are:

- *Provide XX% population with the connection to sewage networks by [2019 to 2025] –* (mentioned in the NAPs of 5 countries);
- *Provide XX% of agglomerations with more than 2000 inhabitants with appropriate wastewater collection and treatment by [2019 to 2025] –*(mentioned in the NAPs of 8 countries);
- *Reduce by XX% BOD_5 discharged to water bodies by [2019 to 2025] –* (mentioned in the NAPs of 7 countries);
- *Reduce by XX% nutrient input from agricultural activities discharged to water bodies by [2019 to 2020] –* (mentioned in the NAPs of 4 countries).

MSSD target
The Mediterranean Strategy for Sustainable Development 2016-2025 sets the target for the percentage of treated wastewater at 90% per country by 2025.

- This target is specifically linked to indicator 4.1

Related policy documents

- UNEP/MAP (2012). Existing targets and EQO regarding pollution in the framework of UNEP/MAP MEDPOL programme UNEP(DEPI)/MED WG.372/Inf.3
- http://www.themedpartnership.org/med/pfpublish/p/doc/ef0de1181e589046cafa4cedac9ddf23
- COP16 Report (2009). Regional Plan on the reduction of BOD5 from urban waste water in the framework of the implementation of Article 15 of the LBS Protocol.
- UNEP/MAP (2005). Mediterranean Strategy for Sustainable Development. Athens, MAP.
- Implementation of Council Directive 91/271/EEC of 21 May 1991 concerning urban wastewater treatment, as amended by Commission Directive 98/15/EC of 27 February 1998 (COM(2004) 248 final)
- Agenda 21. Chapter 18: Protection of the Quality and Supply of Freshwater Resources:

Application of Integrated Approaches to the Development, Management, and Use of Water Resources.

- UNEP/MAP, 2016. Mediterranean Strategy for Sustainable Development 2016-2025. Valbonne. Plan Bleu, Regional Activity Centre.
- UNEP/MAP, 2016. Synopsis of updated NAPS: hotspots, sensitive areas, targets, measures and indicators. Marseille, France.
- WHO, 2016. Annex 3: Wastewater Safely Treated. http://www.who.int/water_sanitation_health/monitoring/coverage/explanatory-note-sdg-6-3-1-wastewater-treatment.pdf?ua=1

Methodology
4.1Municipal wastewater collected and wastewater treated
Methodology for indicator calculation This indicator gives the volume of municipal wastewater collected by public sewage networks and storage tanks; and the volume of municipal wastewater treated by the wastewater treatment plants (in Million m3 per year). The volume of wastewater treated is the proportion of collected water that is returned to the environment according to national criteria and standards to ensure minimal impact on the aquatic environment. This indicator also includes additional information on the type of treatment (primary, secondary, tertiary). The following datasets are required for the calculation of the indicator. This information is required both at the country level and at the coastal hydrological basin level (see Geographical Units below). - Volume of municipal wastewater collected - Volume of municipal wastewater treated - Volume of municipal wastewater subject to primary treatment - Volume of municipal wastewater subject to secondary treatment - Volume of municipal wastewater subject to tertiary treatment In case wastewater collected and treated is available only in BOD5 population equivalent, volume population equivalent 1 p.e. = 200 l should be used for conversion. Most of data on water are available at the administrative unit level, generally for communes. If data are available for all communes in a given country, these can be aggregated (i.e. summed) to estimate the indicator at the country level. For the computation of the indicator at the level of hydrological basin (catchment) of the coastal area, the following methodological approaches are proposed. Data for those communes that fall within the hydrological basin (catchment) of coastal areas have to be aggregated. The difficulty arises when a commune is partly inside and partly outside the limit of the hydrological basin. In this case several methods can be applied.

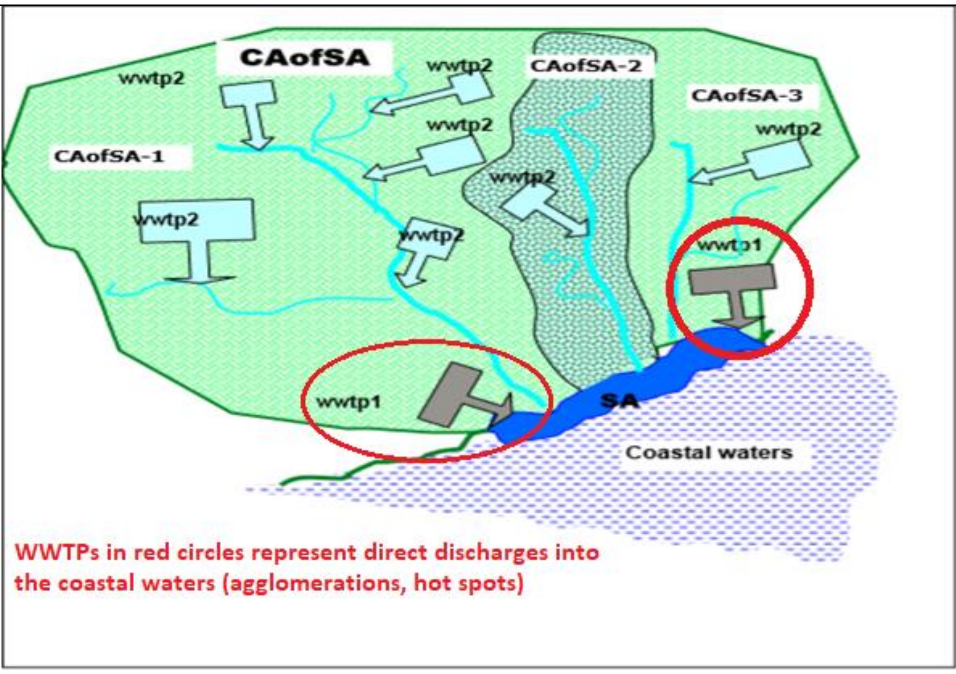

Figure 1: Schema of delineated hydrological catchments of coastal areas

Method	Example	Comments
1. Using the location of the centre of the commune	If the centre of the commune is inside the hydrological basin, then 100 % of the waste water is considered. If it is outside, 0% of the waste water is considered	Easy but very rough
2. Using the share of the area of the commune within the coastal hydrological basin limit	If, for example, 30 % of the area of the commune falls within the hydrological basin, then 30% of the volume of waste water is considered	Need to compute the area using GIS
3. Using the share of the population living within the limit	If, for example, 70 % of the population of the commune is living in the hydrological basin, then 70% of the volume of waste water is considered	The spatial distribution of the population in the commune must be available and analysed
4.Using GIS layer of disaggregated data on individual wastewater treatment plants and collecting systems	Geo-analysis using overlay and intersect with the GIS layer of delineated hydrological basin (catchment) of coastal area	Most precise calculation. The approach for calculating the indicator at the level of hydrological basin (catchment) of coastal areas depends primarily on the availability of GIS layer of basin delineation. In case the

		layer is not available, a temporary approach is recommended (see Methodology for gap filling)

Data sources
National sources:

At the national level, data are available from national water authorities and water supply utilities. At the commune-level (see Methodology for indicator calculation above) data may be obtained from:

- meter readings from water authorities;
- data on the capacity of the serviced area;
- performance of wastewater treatment facilities;
- information from wastewater laboratories;
- number of house connections to the sewerage system.

Other data may be available from water authorities, water service companies, municipal authorities, field project evaluation reports and GIS databases.

International sources:

UNEP/MAP MEDPOL and FAO Aquastat information system.

Geographical units
This indicator is calculated at two geographical levels:
- National level
- Hydrological basin (catchment) of coastal areas. In case it is not possible to provide data at this level, then data should be provided for the main coastal cities or the coastal area.

Temporal units
Annual

Temporal coverage
2003-2016

Methodology for gap filling

Data gaps are filled by supplementing national data with international sources, such as UNEP/MAP MEDPOL and FAO Aquastat data. Note, however, that combining data collected through different sources and methodologies can lead to discrepancies and inconsistencies.

Other data gaps may include missing data at the commune-level. One way of gap filling could include estimations based on communes with comparable size, population, level service etc. for which data is available for a given period.

An approach to calculation of indicators at the level of hydrological basin (catchment) of coastal areas depends primarily on the availability of GIS layer of basin delineation. In case the layer is not available, a temporary approach (until the delineation is completed) is recommended, consisting in collecting and aggregating data from the coastal areas/main coastal cities, possibly following the coastal units as defined by the Mediterranean ICZM protocol Art 3/b).

Methodological references

- Agenda 21. Chapter 18: Protection of the Quality and Supply of Freshwater Resources: Application of Integrated Approaches to the Development, Management, and Use of Water Resources.
- http://www.un.org/esa/sustdev/natlinfo/indicators/indisd/english/chapt18e.htm
- EEA CSI 024 (Urban waste water treatment) Indicator factsheet
- http://www.eea.europa.eu/data-and-maps/indicators/urban-waste-water-treatment/
- Methodological sheets of the 34 priority indicators for the "Mediterranean Strategy for Sustainable development" Follow up. Plan Bleu, 2006.
- UNEP/ROWA, Regional Workshop on Priority Environmental Indicators 13 – 15 October 2003
- WHO, 2000. Environmental health indicators: Development of a methodology for the WHO European region

Methodology

4.2 Direct use of treated municipal wastewater

Methodology for indicator calculation

This indicator gives the measure (in volume, Million m^3 per year) of treated municipal wastewater (primary, secondary, tertiary effluents) intended to be reused, i.e. with no or little prior dilution with freshwater during most of the year.

The volume of direct reuse of wastewater (measured at the outlet of WWTP) can be divided into different categories of use, such as:

- Irrigation water (agriculture, landscape, sport and recreation).

- Water for manufacturing and construction industry (cooling and process water).

- Dual water supply systems for urban non-potable use (toilet flushing and garden use).

- Firefighting, street washing, dust suppression and snowmaking.

- Water for restoration and recreation of existing or creating new aquatic ecosystems.

- Recreational water bodies (including land redevelopment1).

- Aquifer recharge through injection wells for saline intrusion control.

- Fish ponds.

Each specific application may require a certain level of treatment, according to national and/or regional standards.

Data sources

At the national level, data may be available from national water authorities and water supply utilities.
From International sources, some data exist at the FAO Aquastat information system:
http://www.fao.org/nr/water/aquastat/wastewater/index.stm

Geographical units

National

Temporal units

Annual

Temporal coverage

2003-2016

Methodology for gap filling

The FAO Aquastat database contains data on the direct use of treated municipal wastewater. However the data is not consistent and not available for all countries.

Methodological references

- Mediterranean EUWI Wastewater Reuse Working Group, 2007. Joint Mediterranean EUWI/WFD process - Mediterranean Wastewater Reuse Report.
- UNEP/MAP, 2005. Guidelines for municipal water reuse in the Mediterranean region. Athens, Greece.

Methodology

4.3 Release of nutrients from municipal wastewater

Methodology for indicator calculation (including description of data used)

The proposed sub-indicators are:

- Generated urban wastewater (in population equivalent) in the hydrological basins (catchments) of coastal areas and in the coastal agglomerations directly discharging into the coastal areas
- Total volume of urban wastewater discharged (Million m^3 per year) by WWTPs in the hydrological basin (catchment) of coastal area and directly in the coastal areas
- Total BOD load from urban wastewater discharged in the Mediterranean/year
- Total Nitrogen load from urban wastewater discharged in the Mediterranean/year
- Total Phosphorus load from urban wastewater discharged in the Mediterranean/year

1. Obtain figures on population numbers living in the agglomerations of size ≥2000 inhabitants i) located within the hydrological basins of coastal areas (P1) and ii) discharging (treated /or untreated) wastewater directly into the Mediterranean (P2) Determine the urban wastewater generated in the coastal hydrological basin and in the costal agglomerations in P.E.

2. Obtain data for the total treated and discharged volume of urban wastewater from existing Municipal WWTPs in the hydrological basin (catchments) of coastal areas and in the costal agglomerations

3. Obtain data on shares of treated wastewater (in P.E.) in the hydrological basin (catchments) of coastal areas and in the costal agglomerations, receiving :
   a. Primary treatment (20-30 % BOD, 15% N_{tot}, 10% P_{tot} reduction)
   b. Secondary treatment (85% BOD, 35% N_{tot}, 20% P_{tot} reduction)
   c. Tertiary treatment (99% BOD, 70% N_{tot}, 80% P_{tot} reduction)

4. Consider the following information to determine the figures in the next steps:

Person Load

BOD, g/person.d	15-80
COD, g/person.d	25-200
Nitrogen, g/person.d	2-15
Phosphorus, g/person.d	1-3
Wastewater, m^3/person.d	0.005-0.4

Person Equivalent (PE)

- 1 PE = 60 g BOD/d
- 1 PE = 200 l /d

Please note that regional plan for BOD calls for 60 g BOD load for each person per day.

5. Based on the treated wastewater in PE in the hydrological basin (catchments) of coastal areas and in the costal agglomeration, calculate:
   a. BOD, TN, and TP loads discharged after tertiary treatment
   b. BOD, TN, and TP loads discharged after secondary treatment
   c. BOD, TN, and TP loads discharged after primary treatment

6. Calculate BOD, TN, and TP loads for wastewater discharged without treatment in the hydrological basin (catchments) of coastal areas and in the costal agglomeration.

7. Add up the total discharged loads from all treated and untreated wastewater originating in agglomerations (of size ≥2000 p.e.) located in the hydrological basin of coastal areas and those directly discharging into the Mediterranean, in order to calculate:
8. Total BOD load from urban wastewater discharged in the Mediterranean/year
9. Total Nitrogen load from urban wastewater discharged in the Mediterranean/year
10. Total phosphorus load from urban wastewater discharged in the Mediterranean/year

If available, the data on discharged loads (BOD_5, TN, TP) for individual WWTPs should be used to calculate the total discharged loads and supplemented by the measured or estimated loads discharged from collecting systems without treatment.

In case real measurements for COD of raw municipal wastewater exist, these data can possibly be converted into BOD_5. Conversion factors can range between 0.4 and 0.8, depending, among others factors, on the contribution of industrial wastewater. National typical values of correlation between COD and BOD should be investigated and if not available, the average factor of 0.47 could be used: $BOD_5 = 0.47*COD$.

Data sources
Treated wastewater:
At the national level, data are available from national water authorities and water supply utilities (see also Data Sources of Ind. 4.1).

Geographical units
Hydrological basin of coastal areas (including agglomerations discharging directly into Mediterranean).

Temporal units
Annual

Temporal coverage
2003-2016

Methodology for gap filling
Data for Indicator 4.1 can be used if calculated for the hydrological basin of coastal areas.
In case of lack of data for all agglomerations ≥ 2000 p.e. located in the hydrological catchment of the coastal area a phased approach can be applied for Indicator 4.3 based on data on the various hotspots and sensitive areas in the particular catchment combined with the data from agglomeration with direct discharge into the Mediterranean.

Methodological references

- Kayyal, M., 2018. Methodology for computing nutrients from urban sources. Personal reference.

Uncertainties
***4.1** Municipal wastewater collected and wastewater treated*
Methodology uncertainty • The definition of primary, secondary and tertiary treatment depends on the set national standards on effluent quality. For a coherent regional assessment, these national standards should also be reported, if available. • Data based on WWTP nominal capacities may in reality be much higher than the actual/real capacities. In this case, it should be clearly indicated that the data does not reflect "real" measurements but is rather an estimation based on nominal capacities. • Data based on inflowing wastewater volume to WWTPs: In the case of malfunctioning and overflowing WWTPs, wastewater may go through the WWTPs without proper treatment. For this reason, information on effluent quality should also be considered. • Double counting of municipal wastewater generated and treated should be avoided in cases where a mix of domestic and industrial wastewater is first treated at industrial WWTP and then the effluent undergoes treatment at municipal WWTP. The approach to calculation of indicator 4.1 and 4.3 for municipal wastewater with a significant share of industrial wastewater and a pre-treatment at industrial WWTP should consider the specific WWTPs flow schema and where possible use measured flow and data on the concentration of nutrients rather than estimates based on population equivalents.
Data sets uncertainty • Composition of municipal wastewater. There are many types of wastewater collection systems, such as separated collection systems, in which rainwater and wastewater are collected in separate conducts versus combined collection systems, which collect rainwater and wastewater in one conduct. Municipal wastewater may contain a mixture of domestic, commercial, industrial wastewater. For this reason, it is recommended to document in detail the composition of municipal wastewater that is considered by (sub) national data.
Rationale uncertainty • This indicator provides information on the level of wastewater treatment but does not address the appropriate level of treatment required to safeguard specific ecosystems. It is therefore important to provide information on effluent quality and established standards on effluent composition aimed at protecting the receiving ecosystems.

***4.2** Direct use of treated municipal wastewater*
Rationale, Methodology and data sets uncertainties • Quality standards for different countries and the different uses may not specified. • There may be not a clear distinction between wastewater reused from municipal sources and other sources of wastewater. • Depending on the data source, there may be inconsistencies between the reported wastewater treated that is provided and the reported volume that is in fact used.
***4.3** Release of nutrients from municipal wastewater*
Methodology uncertainty • The indicator is partially based on estimations instead of real measurements (see more under data sets uncertainty). • Other sources rather than domestic households are not considered in the estimation of wastewater (based on population size). For example, seasonal tourism can have a large impact in terms of generation of urban wastewater.
Data sets uncertainty • Throughout the year there may be a large variability in terms of wastewater generated (e.g. seasonality of tourism), which may not be captured in the data. • The estimation of urban wastewater generated is based on population size, whereas other sources of wastewater (e.g. rainwater, non-households/domestic facilities) could contribute considerably to the total nutrient load as well. While this is not captured in this sub-indicator it may be contemplated in the data associated to the wastewater treated. The estimation of urban wastewater generated and the loads of nutrients from untreated wastewater discharged can be therefore underestimated, while the proportion of wastewater treated be overestimated. • The data on PE discharged from WWTPs can correspond to the capacity/design of WWTPs rather data on treated discharges.
Rationale uncertainty • This indicator intends to assess the contribution of urban agglomerations and households to the input of key nutrients in wastewater into aquatic bodies and ultimately the marine environment. It focuses on point-sources only and does not consider agglomerations smaller than 2000 inhabitants. Furthermore, the estimation nature of some of the sub-indicators may result in underestimation of wastewater generated in relation to the wastewater treated.