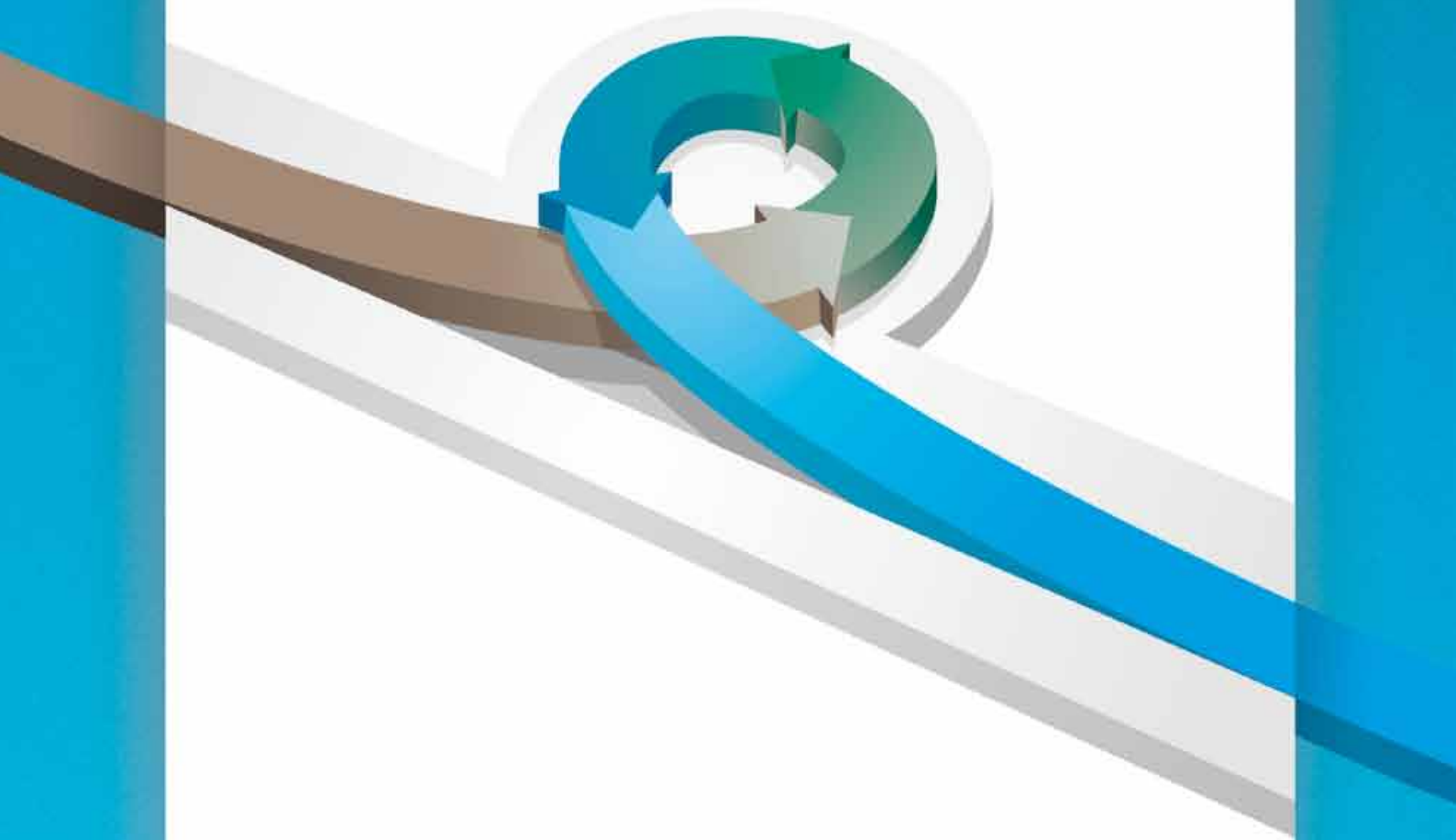
El Prat de Llobregat wastewater treatment plant & Llobregat desalination plant

# Educational Guide



Since 1987, the Metropolitan Water Services and Waste Treatment Authority (EMSHTR) —also known as the Barcelona Metropolitan Area (BMA) Environment Authority— has carried out its responsibilities regarding the municipal waste management and treatment, drinking water supply and wastewater treatment services of the 33 municipalities in the BMA covering a total population of more than three million people.

In virtue of Law 31/2010 passed by the Catalan parliament on 3 August 2010 —the Barcelona Metropolitan Area Act— in July 2011 the responsibilities of the EMSHTR were taken over by the BMA Local Entity, which is responsible for 36 metropolitan municipalities. It has seven wastewater treatment plants (WWTPs) and three water regeneration stations (WRSs) run by the metropolitan sanitation company EMSSA.

Aigües Ter Llobregat (ATLL) is a public sector company under the Department of Territory and Sustainability of the Generalitat de Catalunya, the Catalan autonomous government. It is in charge of the potable water supply in more than 100 municipalities around Barcelona, which involves provi1ding fresh water for a population of nearly five million people.

ATLL has four drinking water production plants: the river Llobregat and the river Ter potable water treatment plants (PWTPs) and the Llobregat Basin and Tordera seawater treatment facilities (SWTFs).

# Water Framework Directive **WFD**

The Water Framework Directive (WFD) is a European Union (EU) regulation that has been in force since 2000. It seeks to define a common action framework for protecting and managing water for all EU member states, and its implementation is mandatory.

Water is no longer seen exclusively as a resource and is considered an indispensable part of life and the environment. Water's ecological and social function, and its role as a public good that needs to be protected and preserved, must be recognised.

The main aims of this directive are to:

- ensure that all Community waters achieve good ecological and chemical status by 2015
- prevent and reduce water pollution
- promote sustainable use of water through savings, re-use, etc.
- protect the environment
- improve water ecosystems
- reduce the effects of floods and droughts

Average water consumption per person in the Barcelona metropolitan area was 121 liters a day in 2005 and 107 litres a day in 2010.

- 2005 = 121 liters
- 2010 = 107 liters

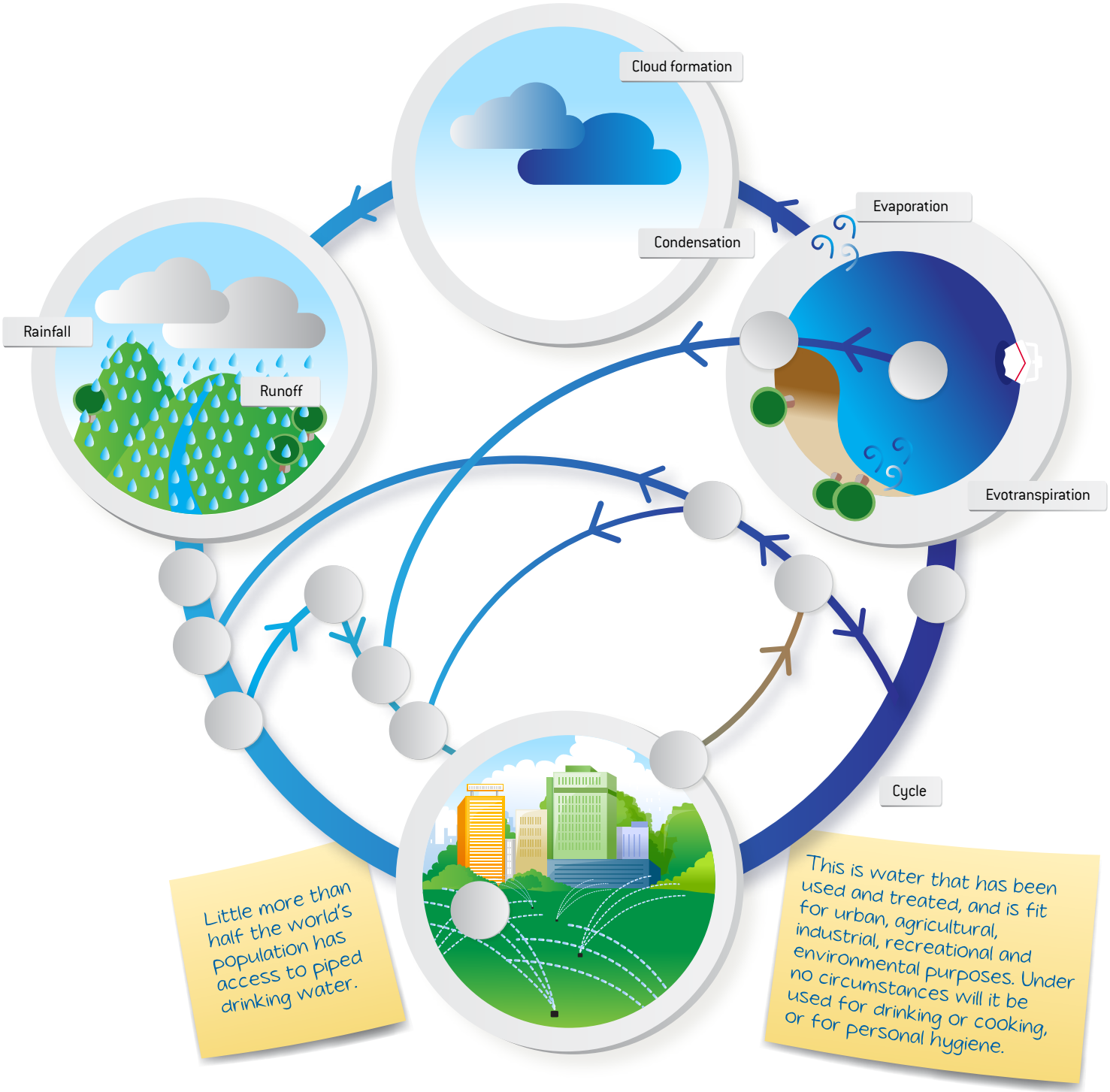
Think about it!

**1** What is the connection between SWTFs and WWTPs and the WFD?

**2** Link each facility with one of the WFD's aims.

# Complete water cycle

The fact that people use this resources makes it necessary to incorporate other elements into the water cycle. Put them in the right places and fill in the circles.



1- Reservoir

5- Storage tanks

9- Treatment

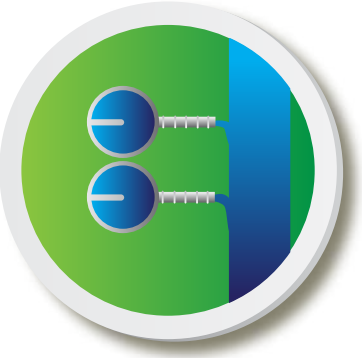
2- Abstraction

6- Distribution

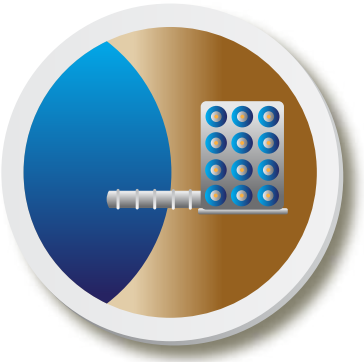
10- Regeneration

3- Potabilisation

7- Consumption



11- Return to the environment



4- Desalination

8- Sewers

Only 3% of our planet's water is fresh water. Most of it is frozen at the poles or trapped in the atmosphere and the ground. This means we can access only a small proportion of the fresh water, which is just 0.03% of all the water on the planet.

**Answers to the exercise**: in order, starting from the rainfall and runoff drawing:
1. Reservoir, 11. Return to the environment, 2. Abstraction, 3. Potabilisation, 5. Storage tanks, 6. Distribution, 7. Consumption, 8. Sewers, 9. Treatment, on the right, 11. Return to the environment, on the left, 10. Regeneration, in the middle of the drawing of the sea, 2. Capture, 4. Desalination

# El Llobregat Basin SWTF

4 Closed filtration:

5 Cartridge filters:

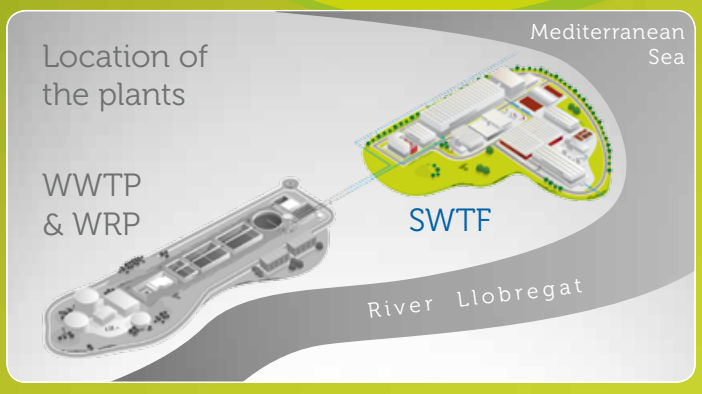
6 Reverse osmosis*:

A process whereby a semipermeable membrane retains the salts dissolved in the water. 45% of the water passes through the membrane and becomes fresh water. The remaining 55% of the water does not pass through the membrane and therefore has a high salt content; this is called brine.

8 Brine disposal:

7 Remineralisation and chlorination:

9 Sludge treatment:



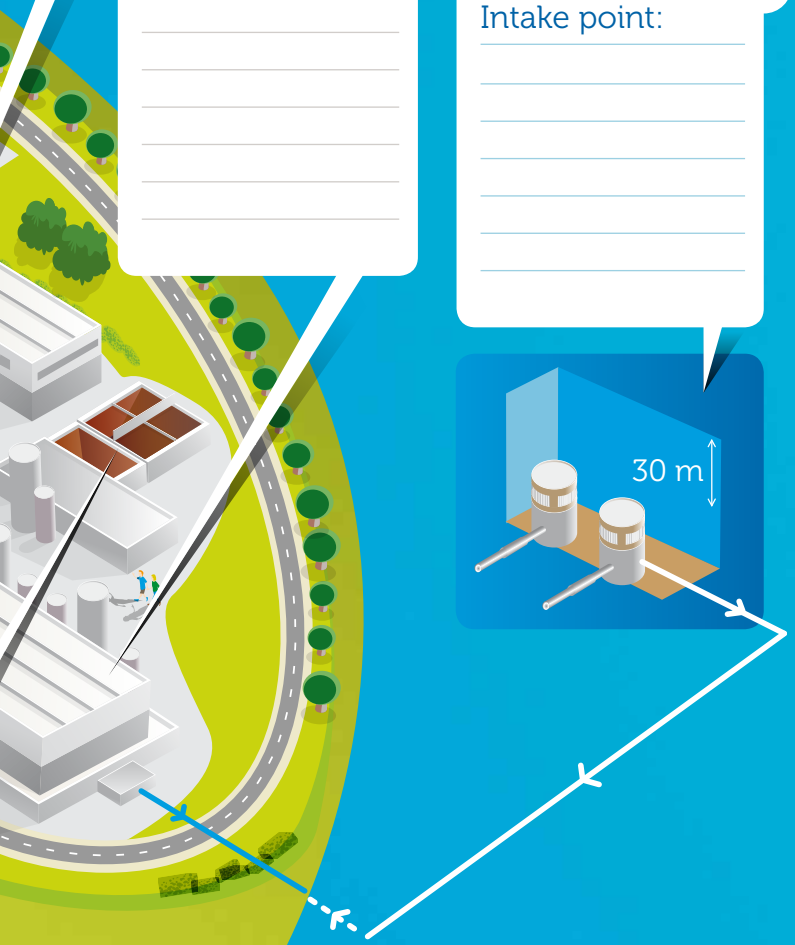
It takes 5.5 hours to potabilise a drop of seawater from the time it is at the bottom of the sea to when it is available for consumption.

What water is used for in Catalonia:
- 50% agriculture
- 32% industry
- 18% urban uses

3 Open filtration:
Filtration by gravity through a layer of sand and pumice stone

2 Flotation:

1 Intake point:




Treatment stages:
- Pre-treatment
- Reverse osmosis
- Post-treatment

## Technical specifications

Design output volume: 200,000,000 l/day

Supply: 1,000,000 inhabitant equivalents

Surface area: 5.5 ha

Type of water treatment: reverse osmosis

Owner: ATLL

Construction: 2009

Investment: 230 million euros, 75% of which was provided by the European Union Cohesion Fund

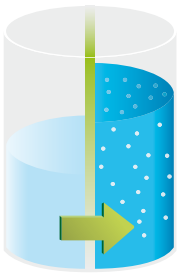
Employment: 29 direct jobs

Benefits: guarantees the supply of good quality water –it accounts for 20% of the consumption of the regional supply network- and enables water to be kept in reservoirs and rivers.

## *Osmosis and reverse osmosis

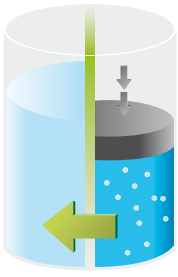
### Osmosis in living beings

Water from the dissolution with the lower concentration passes through a semi-permeable membrane to the one with the higher concentration so they can become equal. For example, cells are hydrated by osmosis because the inside of the cell normally has a higher concentration of molecules than the liquid on the outside.



### Reverse osmosis

In the desalination process, the water must pass through the membrane in the opposite direction to that of osmosis, ie from the liquid with the higher concentration to the one with the lower concentration. For this to happen, pressure must be applied to the more highly concentrated solution.



# El Prat de Llobregat WWTP and WRS

## Technical specifications

Design treatment capacity:
- 420,000,000 l/day without nutrient elimination
- 320,000,000 l/day with nutrient elimination

Design regeneration capacity: 3,500 l/second

Inhabitant equivalents: 2,000,000

Surface area: 36 ha

Type of water treatment: biological, with elimination of nutrients and regeneration

Type of sludge treatment: anaerobic digestion with cogeneration and dessication

Owner: Barcelona Metropolitan Area (except reverse osmosis and injection into the aquifer)

Managing company: Empresa Metropolitana de Sanejament, SA (EMSSA)

Construction: 2002

Subsequent remodellings: addition of tertiary treatment (2006) and advanced regeneration (2009)

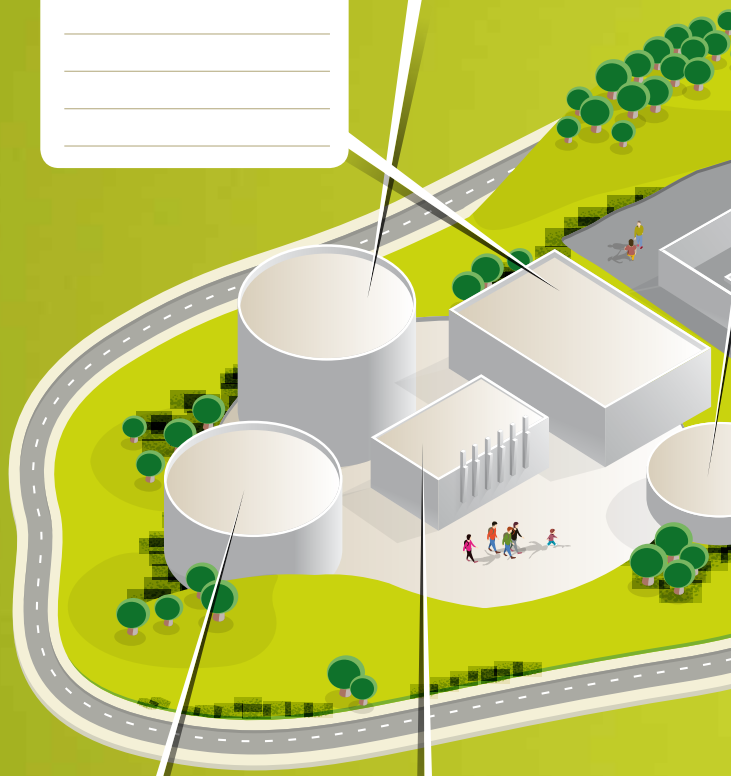
Running and treatment costs: 7.28 million euros (2010)

Employment: 72 direct and 424 indirect jobs

Benefits: recovery of the Prat de Llobregat littoral and the south Barcelona beaches, reduction of the risk of eutrophication of the river Llobregat and the littoral, re-use of water, energy generation and use of sludge for agriculture.

The Catalan Water Agency aims to achieve the target of re-using 31% of the water treated in this plant by 2015.

El Prat Water Regeneration Station can increase water resources in the Barcelona Metropolitan Area by 50 million litres a day.

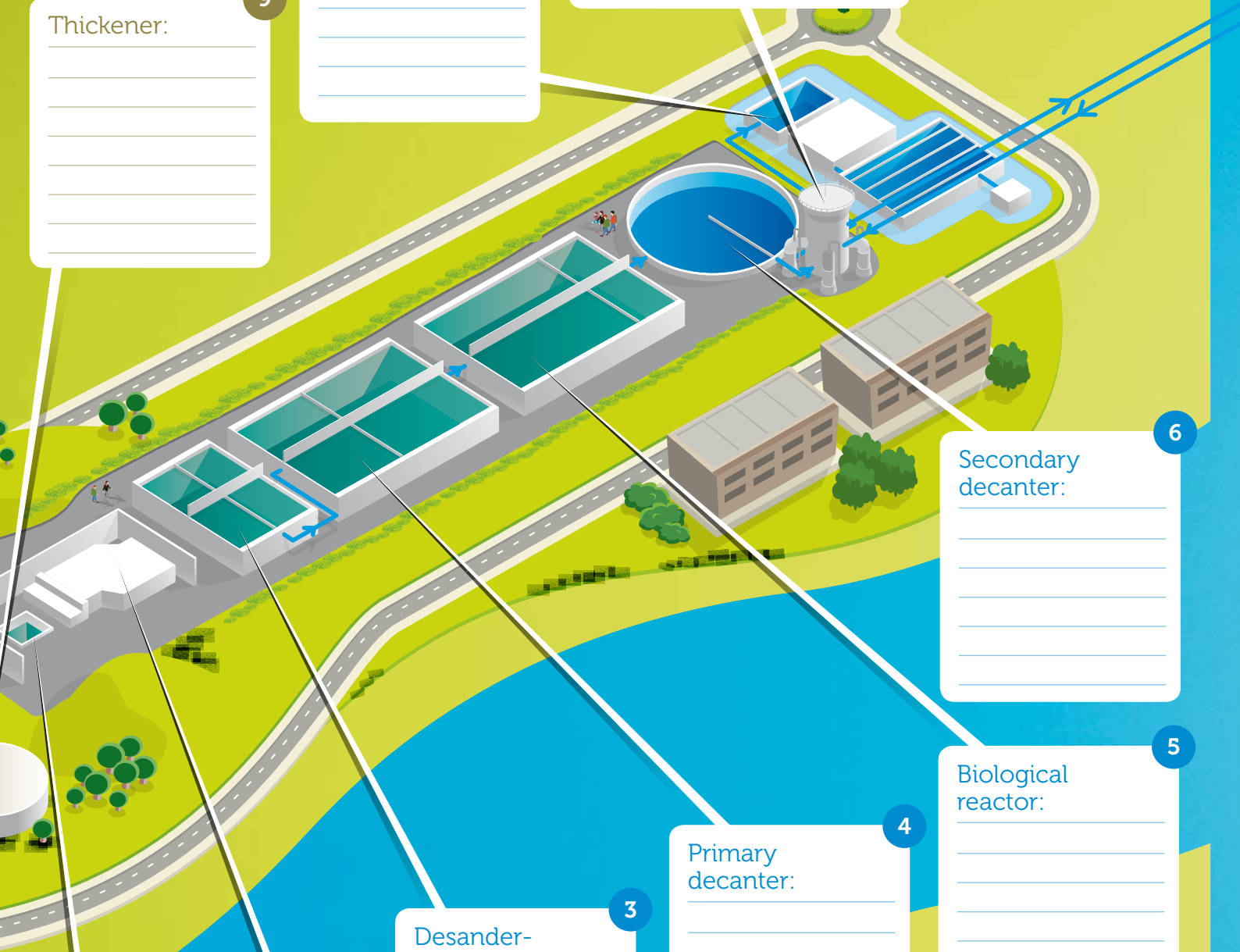


10 Digester:

11 Dehydrator & dessicator:

12 Cogeneration plant:

13 Gasometer:



**8 Regeneration:**

**7 Return to the environment:**
the treated water from the Llobregat basin is sent into the sea through the undersea outlet

**9 Thickener:**

**6 Secondary decanter:**

**5 Biological reactor:**

**4 Primary decanter:**

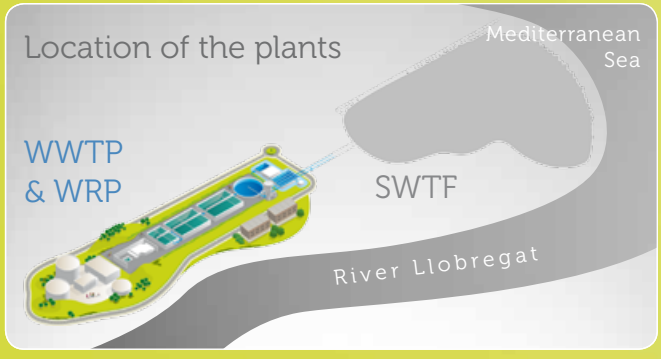
**3 Desander-degreaser:**

**1 Pre-screening:**

**2 Screening:**

Treatments:
- Water treatment
- Sludge treatment

Location of the plants



# Best practices in water use

In the economically more developed countries, 94% of the population has access to piped drinking water as opposed to just 16% in regions such as Sub-Saharan Africa.

**Bearing in mind that each number always represents the same letter, work out what the text in the grid says with the aid of the words you get by completing the following exercise.**

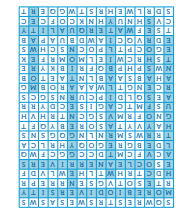
| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13 | 4 | 8 | 2 | 11 | | 6 | 3 | | 4 | | 14 | 9 | 9 | 1 |
| | 8 | 15 | 4 | 8 | | 12 | 16 | 3 | 8 | | 17 | 2 | | 16 |
| 3 | 2 | 1 | | 11 | 2 | 3 | 10 | 2 | 18 | 8 | 19 | 16 | 5 | 5 |
| 20 | | 3 | 9 | | 4 | 3 | | 8 | 9 | | 14 | 16 | 4 | 11 |
| 4 | 7 | 8 | 2 | 2 | | 8 | 15 | 2 | | 10 | 9 | 10 | 16 | 5 |
| 4 | 8 | 6 | 9 | 7 | ' | 3 | | 17 | 4 | 3 | 6 | 18 | | 18 |
| 9 | 7 | 3 | 16 | 12 | 10 | 8 | 6 | 9 | 7 | | 4 | 7 | 1 | |
| 10 | 11 | 2 | 3 | 2 | 11 | 21 | 2 | | 8 | 15 | 2 | | 4 | 22 |
| 16 | 4 | 8 | 6 | 18 | | 2 | 18 | 9 | 3 | 20 | 3 | 8 | 2 | 12 |
| 3 | | ( | 11 | 6 | 21 | 2 | 11 | 3 | , | | 3 | 2 | 4 | , |
| | 3 | 16 | 17 | 3 | 9 | 6 | 5 | , | | 2 | 8 | 18 | .). | |
| 18 | 9 | 7 | 8 | 11 | 6 | 17 | 16 | 8 | 2 | | 20 | 9 | 16 | 11 |
| | 1 | 11 | 9 | 10 | | 9 | 19 | | 13 | 4 | 8 | 2 | 11 | |
| 8 | 9 | | 8 | 15 | 2 | | 13 | 9 | 11 | 5 | 1 | : | | 3 |
| 4 | 21 | 2 | | 6 | 8 | | 4 | 7 | 1 | | 1 | 9 | 7 | ' |
| 8 | | 12 | 4 | 23 | 2 | | 6 | 8 | | 1 | 6 | 11 | 8 | 20! |

## Which water treatment plants have you visited?

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 4 | 8 | 6 | 9 | 7 | | 10 | 5 |
| 4 | 7 | 8 | | | | | | | | | | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | 11 | 2 | 4 | 8 | 12 | 2 | 7 | 8 | | 10 | 5 | 4 | 7 | 8 |

Text of the grid: Water is a good that must be used respectfully so as to guarantee the population's basic consumption and preserve the aquatic ecosystems (rivers, sea, subsoil, etc.). Contribute your drop of water to the world: save it and don't make it dirty! Water treatment plants: Desalination/ Treatment Plant



In the course of time, the state of the aquatic systems has varied. The appearance of water treatment plants, especially wastewater treatment plants, has brought about a major improvement in the quality of rivers and beaches. The first wastewater treatment plant in Catalonia was built in 1983. There are now 390 of them in operation and by 2014 there are expected to be 1,544. All this, together with the technological advances and greater awareness among the public should make it possible to face the future guaranteeing conservation of the environment and access to drinking water.

**Think about the past, present and future of water and discover the benefits that the water treatment plants have brought to the environment in the wordsearch puzzle.**

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S | Q | W | R | E | S | T | R | S | W | E | S | A | S | W | S |
| M | O | R | E | B | I | O | D | I | V | E | R | S | I | T | Y |
| R | T | E | S | O | T | V | G | S | E | N | R | R | E | P | R |
| H | D | C | T | R | H | W | T | L | H | E | W | L | V | D | F |
| E | S | O | C | L | E | A | N | E | R | R | I | V | E | R | S |
| A | C | V | F | C | M | T | D | C | C | G | G | C | F | W | Q |
| L | D | E | B | G | R | E | G | O | Q | Y | H | R | L | C | A |
| T | R | R | W | S | M | R | N | L | N | G | Q | G | S | N | S |
| H | A | Y | V | Y | T | A | S | O | R | E | B | Y | Q | F | T |
| G | N | O | F | R | M | V | S | G | C | N | T | R | H | V | H |
| U | S | F | M | T | C | A | G | I | S | E | C | D | Y | R | R |
| A | E | S | Q | L | D | I | P | C | U | R | N | S | G | C | S |
| R | C | E | N | G | T | L | W | A | A | A | R | O | B | M | G |
| A | H | A | B | S | A | A | B | L | N | T | A | E | T | O | B |
| N | W | S | P | H | P | B | Q | F | R | I | B | K | Y | R | E |
| T | S | H | R | C | W | I | E | L | M | O | M | R | F | E | K |
| E | G | O | C | P | T | L | P | O | C | N | S | C | H | W | S |
| E | D | R | V | Q | C | I | A | W | D | B | U | A | P | A | B |
| T | S | E | F | W | A | T | E | R | Q | U | A | L | I | T | Y |
| C | V | S | H | N | U | Y | H | N | K | C | O | F | C | E | C |
| S | D | R | L | W | E | H | R | S | T | W | G | Q | E | R | T |

In 2010 the metropolitan wastewater treatment plants treated 288mh3 of wastewater, enough to fill 115,000 Olympic-size swimming pools.

Check whether you have understood what you have seen today and think about how you use water (there may be more than one correct answer to some of the questions).

**1 Where does the water entering the desalination plant come from?**

A The river
B The sea
C The river and the sea
D The sewers

**2 Where does the water entering a potable water treatment plant come from?**

A The river
B The sea
C The river and the sea
D The sewers

**3 Where does the water entering a wastewater treatment plant come from?**

A The river
B The sea
C The river and the sea
D The sewers

**4 What is desalinated water used for?**

A To replenish the aquifer
B For human consumption
C For human consumption and to replenish the aquifer
D For human consumption and to maintain the ecological flow of the river Llobregat

**5 What is done with the purified water?**

A One part is sent into the sea and the other is regenerated
B One part is sent into the sea and the other is used to replenish the aquifer
C One part is returned to the river to maintain the ecological flow and the other is regenerated
D All of it is regenerated

**6 What is the regenerated water used for?**

A To replenish the aquifer
B For human consumption
C To replenish the aquifer, maintain the ecological flow of the river Llobregat, water farms and gardens, clean streets and for industrial purposes
D To return it to the environment in a better state

**7 When I wash myself:**

A I always have a shower
B I always have a bath
C I usually have a shower and occasionally have a bath
D I have a shower just once a week to save water

**8 When I go to the toilet:**

A I only flush the toilet when necessary
B When I flush the toilet I take advantage of this to get rid of used cotton buds
C When all I have done is a wee, I press the button for the smaller discharge
D I've put a bottle full of water in the cistern to reduce the volume of water discharged

**9 What do you do with used cooking oil?**

A I don't pour it down the sink; I pour it down the toilet
B I pour it down the sink and let the hot water run on it to make it go down better
C I keep re-using it until there is none left
D I take it to a waste collection and storage depot

**10 To water plants:**

A I use the water from cooking vegetables or boiling eggs
B I always water them at midday, because that is the hottest part of the day
C I have native plants because they are better adapted to the climate here and don't need to be watered so often
D I use the water from mopping the floor, provide I haven't put any detergent in it

**Answers:** 1B, 2A, 3D, 4B, 5A, 6C, 7A, 8A, C and D, 9D, 10A, C and D


**Sources:**
Agència Catalana de l'Aigua
(Catalan Water Agency)
World Health Organisation
Generalitat de Catalunya
Metropolitan Environmental Data 2010
Aigües Ter Llobregat
Àrea Metropolitana de Barcelona
(Barcelona Metropolitan Area)

Generalitat de Catalunya
**Departament de Territori i Sostenibilitat**

ATLL AIGÜES TER LLOBREGAT

AMB Àrea Metropolitana de Barcelona

co2 mission neutral Certified
The design of this publication has taken into account environmental criteria (offset emissions through e)mission).