Water for Berlin

clear water – clear information
A city wants to be taken care of
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Water for Berlin
Modern technology, sustainable management and responsibility towards Berlin and its people. That is what public service means for us.

Water is our element. We extract groundwater from the soil, which is then aerated and filtered in the waterworks. The Berlin drinking water is ready. Without any added chemicals. Berlin’s drinking water is an all natural product. That is also why it is so hard and rich in minerals, just as nature would have it.

Used water is wastewater. We look after that too. It is collected in the sewers and pumped to the sewage treatment plants, where it is purified according to the latest standards.

Berliner Wasserbetriebe is the largest water supply and wastewater disposal company in Germany. We supply drinking water to 3.5 million Berlin citizens and nearly 100,000 inhabitants in the surrounding region. In addition to this, we take care of the environmentally sound disposal and treatment of wastewater in Berlin and for 500,000 people in the surrounding region.

Our modern facilities ensure an ample supply of high-quality water that fulfils and remains well within the standards of the German Drinking Water Ordinance.

On a daily basis, our waterworks supply around 600,000 cubic metres (m³) of drinking water to the population, industry and trade. A peak output of more than 1 million m³ is possible.

Our sewage treatment plants process approximately 660,000 m³ of wastewater each day. The plants are equipped with the latest process technology for biological nutrient removal.

And we are also a service provider for Berlin in other areas. With our waterworks we treat and regulate groundwater on behalf of the State of Berlin wherever this is possible. We provide treatment services for the Tegeler Lake and refill the Grunewald lakes. We conduct research on new technologies, are an important employer, vocational trainer and investor in Berlin.
Tap water –
a source of refreshment

The quality of Berlin’s drinking water is outstanding and originates from a regional cycle. We look after this cycle: with natural water treatment, groundwater enrichment and thorough purification of the wastewater, which flows back into the cycle after use. All of this works well. Berlin’s drinking water not only meets all of the requirements of the German Drinking Water Ordinance, but it also undercuts the defined limits. Even Stiftung Warentest recommends drinking tap water rather than bottled water.

Drinking water is the best monitored foodstuff in Germany. It must have properties which enable its lifelong use in unlimited quantities without any health hazard. In order to be called drinking water and to be considered a foodstuff, it must adhere to the German Drinking Water Ordinance, a very strict health act.

In the summer of 2003, the organisers of a nationwide drinking water test stated: “Never, for as long as valid test results have been available, have the Germans had as clean water as they do today.”

Strictly monitored

The legal drinking water quality requirements are higher than those for mineral water. This undergoes constant quality checks. Samples are taken and tested on a regular basis, directly with the consumers, at 104 extraction points all over the city. Furthermore, the drinking water’s chemical composition is checked on a daily basis in the waterworks. For the timely detection of contaminants in the drinking water, the raw water from wells is also monitored on a regular basis. This is how the waterworks ensure that they can identify contaminants in the groundwater within their local area in good time.

High in calcium and magnesium, yet low in chlorides and sulphates, Berlin’s drinking water is an excellent thirst quencher. It also tastes good when carbonated. The corresponding appliances are commercially available.

Low in nitrates, Berlin’s drinking water can safely be used for the preparation of baby food. At 1.1 to 3.9 mg per litre, Berlin’s water is well below the 50 milligrams (mg) per litre stipulated by the Drinking Water Ordinance.

Unleaded

Since 1 December 2013, the Drinking Water Ordinance has required that a litre of drinking water can contain a maximum of 0.01 mg of lead. Berlin’s drinking water already meets the standard at less than 0.005 mg of lead.

No lead pipes exist in the drinking water network of Berliner Wasserbetriebe. However, on the final metres towards your tap - for example, in non-renovated or partially renovated buildings, the water can possibly flow through old lead pipes. This is particularly dangerous for babies and toddlers. The owner is responsible for the building installation.

Anyone who wants to can have a water sample analysed in one of our accredited laboratories. For households in which pregnant women or babies aged up to twelve months live, we cover the costs of the lead analysis. For this, please present your pregnancy record book or your child’s birth certificate.

Clearly chlorine-free

Drinking water coming from groundwater reserves is considered free of germs and therefore does not need to be chlorinated. Only after pipe bursts and other repairs to the pipe network do these areas require brief chlorination. Berlin’s drinking water also does not contain any other additives, such as fluoride for the prevention of caries.
A question of use

The drinking water supplied by the waterworks does not need to be softened or otherwise processed as a foodstuff. However, hard water has several disadvantages. For example, it increases the use of soap and detergents and forms lime scale, particularly in hot water appliances. At temperatures above 60° C the lime scale separates and settles. This results in a rise in energy consumption and water lines in the appliances become blocked.

Modern and economical

Water must not be wasted. This applies everywhere. But in Berlin, appeals to save water or advertising for additional use of rainwater are neither ecologically or economically necessary. In contrast to other regions, the capital has a large reservoir of groundwater; it is practically built on water. In addition to this, falling consumption means rising costs for ensuring water quality on the way to the customer and for maintaining the sewer network. These costs make up a considerable part of the prices for water and wastewater. But no one needs to fear that water will be wasted because of this. The technological development in households and businesses already rules this out.

Hard and rich in minerals

Water is a very good natural solvent. As it travels through various layers of soil, it absorbs many natural substances and minerals, including calcium and magnesium, which influence the hardness of the water. The amount of these substances varies depending on the geological conditions underground. In general: the higher the mineral content, the harder the water. Calcium and magnesium are therefore also referred to as hardeners.

Knowing the drinking water hardness is important for the correct use of soap and detergents. Detergents work best in soft water. The softer the water, the smaller amount of detergent is required. The detergent industry is legally required to clearly specify dosing recommendations for the hardness ranges soft, medium and hard on its packaging.

Berlin has hard water. With its hardness of 15.5° to 25.2°dH (degrees German hardness), it is in the hard range. The hardness of water is measured according to the international unit millimole per litre (mmol/l). One degree of hardness (°dH) equates to 0.179 mmol/l, i.e. 10 mg/l CaO (calcium oxide). The hardness range “hard” corresponds to more than 2.5 mmol/l total hardness (14° dH).
Tips for dealing with hard water

- **Tea**
  Tea fans appreciate soft water. But with a little trick, even hard water quickly becomes soft: simply allow it to bubble up two to three times in an open kettle. This causes the lime scale to deposit at the bottom of the kettle. Then, let the water cool slightly, boil it again and then pour it over the tea.

- **Coffee maker**
  If the coffee maker is calcified, a lime scale remover can help. The same effect can be achieved with white vinegar or citric acid. The lime scale will loosen after short treatment.

- **Shower**
  Lime scale stains in the shower can be easily removed with commercially available specialist products.

- **Washing machine**
  The detergent industry’s dosage recommendations for individual hardness ranges are listed on each detergent package. In order to avoid unnecessarily contaminating the wastewater, you should only use the amount of detergent recommended.

- **Dishwasher**
  A special salt for dishwashers softens the water. This must be refilled on a regular basis.

- **Steam iron**
  Steam irons can be filled with boiled water. The use of distilled water is not necessary.

- **Pre-set your boiler**
  Lime scale deposits are formed at water temperatures above 60°C. In most cases, lower temperatures suffice in private households. We therefore recommend that you set your hot water boiler so that this temperature is not exceeded. This saves energy and prevents lime scale deposits. We do not recommend the common practice of boiling water and then adding cold water to reach the required temperature.

The analysis values of Berlin drinking water are available in a table on the Internet at [www.bwb.de/qualitaet](http://www.bwb.de/qualitaet), with the most important values also retrievable by postal code.

### Here is an extract from the analysis results:

| Nitrate NO₃⁻ | 3,12 | 50 |
| Calcium Ca²⁺ | 111  |
| Magnesium Mg²⁺ | 10,6 |
| Sodium Na⁺ | 37  | 200 |
| Sulphate SO₄²⁻ | 118 | 250 |
| Chloride Cl⁻ | 54  | 250 |

* all Berlin waterworks 2013
We at Berliner Wasserbetriebe extract groundwater from deep layers which formed during the Ice Age 10,000 years ago. This formation is also called the Berlin-Warsaw Glacial Valley. The underground consists of sand and gravel up to a depth of 170 m with embedded boulder clay and clay seams. These many water-bearing layers contain freshwater. Beneath these layers there is a contiguous layer of clay, around 100 m thick. It separates the “freshwater stratum” from the deeper underlying “saltwater stratum”.

An extraordinary quantity of good quality groundwater is in vast abundance in Berlin. In order to safeguard this natural treasure, water protection areas have been specified in the immediate vicinity of water extraction points. Depending on the proximity to the wells, any type of activity which could present a danger to the groundwater reserves is either completely prohibited or permitted only in special cases.

The water protection areas are comprised of three protection zones: a far zone (Zone III), a near zone (Zone II), and a containment area (Zone I).

The boundaries of the protection zones are determined by “isochrones”. These are lines which are calculated from the time it takes the water to flow to the well. Isochrones are determined by the groundwater’s flow direction and velocity. How fast and in which direction the water flows is calculated on the basis of the soil composition and its permeability.

**Formation of new groundwater**

Drinking water is extracted from groundwater. This is constantly renewed by means of bank filtration of stormwater and surface water from rivers and lakes. Furthermore, groundwater can also be artificially replenished with treated surface water. Stormwater and surface water slowly and evenly pass down through layers of sand and gravel into the groundwater. Many pollutants can already be filtered out in the upper soil layers by these means alone. This way, the water is cleaned naturally. The thicker the soil layer which covers the underlying groundwater reservoir, and the more clay and silt it contains, the lower the risk of groundwater contamination. However, groundwater contamination can still pose a great risk to our drinking water supply. Therefore, water protection is an extraordinary quantity of good quality groundwater is in vast abundance in Berlin. In order to safeguard this natural treasure, water protection areas have been specified in the immediate vicinity of water extraction points. Depending on the proximity to the wells, any type of activity which could present a danger to the groundwater reserves is either completely prohibited or permitted only in special cases.

Berlin's drinking water is extracted from around 650 groundwater wells, which are all situated in water protection areas. By the way: altogether, Berlin’s water protection areas are as large as 31,000 football pitches.

**Berlin’s treasures lie at a depth of up to 170 metres**
zones with restricted access have been specified for such catchment areas. There is no severe groundwater contamination in the catchment area of the wells used for Berlin's drinking water supply. But there are no guarantees that the wells of the waterworks will remain safe. For example, industrial contamination was discovered in the water inflow of the Johannisthal waterworks, which is no longer in operation. This made it necessary to carry out renovation measures for the rehabilitation of the aquifer, which are not yet completed.

**Prohibitions within Zone III**

In the latest Berlin Protection Zone Regulations, Zone III is subdivided into Zone III A (500-1,000 day isochrone) and III B (10-30 year isochrone). This area must be protected against non-degradable or minimally-degradable chemical and radioactive substances.

Zone III includes an area extending approximately 2.5 km around the wells, depending on geological properties in the area.

Within this perimeter, anything which could contaminate the reserves or impair the taste of the groundwater is strictly prohibited. This includes discharging wastewater, cooling water and condensation or even rainwater (except stormwater run-off from roofs) into the ground.

Housing complexes and industrial and commercial facilities are not permitted to be built unless they are connected to the local public sewer network. Parking, washing or repairing motor vehicles (including oil change) on unpaved soil is not permitted.

**Prohibitions within Zone II**

Zone II corresponds to the 50-day isochrone and includes a diameter of at least 100 m around the wells. It serves to protect the groundwater hygienically, particularly from pathogens, i.e. disease-causing contamination (e.g. bacteria, viruses, parasites, etc.). Pathogenic substances are almost completely biologically degraded after a flow duration of 50 days. Apart from the restrictions in Zone III, all other activities which entail the continuous presence of people and animals or removal or destruction of the upper soil layer are deemed high risk, and therefore, strictly prohibited. These include the construction and renovation of buildings, excavations (pits, trenches, etc.) and the transport and storage of liquids hazardous to water as well as the transport of rubble and waste. Parking, washing or repairing motor vehicles on unpaved soil is also not allowed.

Furthermore, it is prohibited to keep animals for commercial purposes, use natural fertilisers, weed killers, biocides and pesticides, as well as to erect camping and car parking facilities or docking facilities for boats.

**Prohibitions within Zone I**

The containment area, Zone I, is a 10 m wide strip on both sides of a row of wells. Stringent safety regulations apply here.

Any activity involving the upper layer of soil in the immediate vicinity of groundwater extraction facilities, above all any activity that would lead to a risk of contamination, is strictly prohibited. This does not include servicing work on wells or the regeneration of wells by Berliner Wasserbetriebe.

The regulations for the Berlin water protection zones have been issued by the Senate Department for Urban Development. They are published in the law and regulatory gazettes for Berlin. Anyone deliberately or negligently in violation of these prohibitions is thus guilty of infringement of the regulations and will be subjected to large fines.

Due to extensive recreation areas and dense settlement, groundwater protection is a particular problem for Berlin. Many industrial sites are located next to bodies of water or in the immediate vicinity of waterworks. Most of the water protection areas along the rivers Havel, Spree and Dahme are also highly frequented recreation sites for local people. There are tens of thousands of people who swim and windsurf here. We trust people to behave responsibly.
Each of Berlin’s residents uses an average of 110 litres of water per day. Each day, an average of 520,000 m$^3$ of drinking water is made available to households, industry and trade. A maximum of 1 million cubic metres is possible. Groundwater is pumped from over 650 wells between 30 m and 170 m deep to the waterworks, where it is further processed and stored in clean water tanks. Depending on demand, water is then pumped from the tanks into our extensive pipe network, which has a length of 7,900 kilometres. The waterworks and intermediate pumping stations are connected via a closely knit network of transport pipes. This is why the drinking water in the network almost always comes from several waterworks simultaneously.

**Supply on demand**

Supply bottlenecks are prevented by the waterworks working together. Even if one of the waterworks fails, this will not lead to a local collapse in the water supply. From the three large waterworks, Tegel, Friedrichshagen and Beelitzhof, two smaller waterworks and the pumping stations in the supply network are also monitored and controlled. Remote control is possible for all plants through a centralised system. Berlin’s geographically lowest district is Wannsee in the southwest at 32 m above sea level (the so-called Normal Null (NN) or Amsterdam level); Buch in the northeast is the highest district at 64 m above NN. Due to these differences in altitude, the pipe network is divided into a northern and southern high city zone and a low city zone in the area of the glacial valley.

Today, there are 7,900 km of drinking water mains beneath Berlin’s roads. Most of these, around 6,400 km, are water mains with a diameter of 5 to 30 cm. The remaining 1,500 kilometres of mains have a diameter of up to 1.40 m; 52 % of these are made from grey cast iron, 26 % from ductile cast-iron pipes, 12 % from reinforced concrete, 9 % from steel and a small...
Deep wells
Approximately 650 wells are in operation for nine waterworks. They are between 30 m and 170 m deep. They are mainly vertical wells, which supply between 40 m³ and 400 m³ of raw water per hour. Two horizontal filter wells can supply up to 1,600 m³ of raw water per well.

Aeration system
Raw water does not contain any free oxygen. Therefore, it is sprayed through nozzles in the aeration chambers or passed over weir overfalls so that it can absorb the oxygen in the air and replenish itself.

Reaction tanks
Raw water contains dissolved iron and manganese. These elements chemically react with oxygen in the water and form flakes, which then settle to the bottom. So that this process can take place without disturbance, the water flows through the reaction tanks in 15 to 60 minutes.

Rapid filter system
The remaining iron flakes and manganese are removed from the water in the rapid filter system. This takes place in filter tanks that have a two-metre-thick sand filter. If the sand gets clogged, it is flushed clean with air and water.

Clean water tank
Raw water has now become clean water. It is stored in the clean water tank. Relatively consistent quantities of water are extracted from the wells. However, drinking water consumption fluctuates depending on the time of day and day of the week. The clean water tank is therefore not only a storage facility but also serves as a balancing tank.

Pumping station
The pumping station contains clean water pumps which pump drinking water through the pipes to the consumer. These pumps are driven by electric or diesel motors. This guarantees a steady supply of water, even in the event of a blackout.

Building connection
From the waterworks, the drinking water makes its way to the customer through intermediate pumping stations and a network of water mains transport lines which has a length of approximately 7,900 km. There are more than 270,000 building connections in the city, from which the water is distributed to the individual homes via the building installation.

Keeping an eye on the pressure
In Berlin, there are around 273,000 building connections to the supply mains. In addition, there are approx. 68,000 hydrants and more than 96,000 shut-off valves. Pressure and flow rates are constantly monitored at numerous points along the network. The average pressure lies between 4.5 and 5.5 bar. This pressure ensures that even the top floor of a five-storey building can be easily supplied with fresh water. High buildings or buildings situated on higher ground have their own booster stations to support this process. Berlin no longer operates water towers.

remainder are made of plastic. Building connections are mainly made of steel or plastic. The few, old lead pipes still remaining are being replaced by Berliner Wasserbetriebe. The average age of a water main in Berlin is 52 years; the oldest pipes are around 120 years old. When new mains and supply pipes are laid today, ductile cast iron pipes are used for pipes up to a size of 30 cm; steel pipes are the material of choice for larger cross-sections. These are lined with cement mortar to prevent corrosion. Plastic pipes are used for building connections.
On the way to the customer

We at Berliner Wasserbetriebe have divided our supply area into five water districts. Each district has a service network operating centre, whose staff are responsible for the servicing and maintenance of the mains and pipes. Each year they carry out around 5,300 repair jobs, of which 2,000 jobs alone are due to pipe bursts in supply and building connection pipes. This alone requires around 21,000 road excavations per year. In order to avoid damage, the Berliner Wasserbetriebe employees annually check more than 68,000 fittings in the pipe network with regard to their accessibility and renew numerous signs. In addition to this, around 2 km of pipes are cleaned annually and lined with cement mortar in order to improve their flow rate. In order to service the network, the water mains are also checked systematically for leaks every four years. As a result of this, Berlin has a very low rate of water losses. They amount to less than four percent.

Metering – an exact science

A building connection pipe connects the water main in the road to the shut-off valve behind the water meter. Everything behind the meter flowing into the house is then the obligation of the customer. Building connection pipes up to the meter area are serviced and maintained by Berliner Wasserbetriebe.

At the end of each connection pipe, there is a water meter that keeps track of the level of water consumption in the respective property. The water meters are the property of Berliner Wasserbetriebe. They are checked and calibrated every five years. This is the responsibility of our state-approved testing facility for cold water measuring instruments. Around 46,000 water meters are replaced each year in Berlin. By the way: a water meter can also be used to discover leaks in building pipes. If all water taps and tapping points in the building have been shut off, the small cog wheel on the water meter should stand still. If it doesn’t, then there is a leakage at some point in the system and a plumber should be notified.

Most people in Berlin, namely those who live in a block of flats, never see their water meters. Water consumption in Berlin is normally charged as part of the rent, depending on the size of the flat. We at Berliner Wasserbetriebe charge the water consumption by property with the respective property owner.

Road cross-section in a combined system

There is almost as much traffic beneath the road as on top: the lines of all utilities are buried here. The wastewater sewers are usually the deepest. In the main collector, the wastewater from several sewers flows to the wastewater pumping station and then to the sewage treatment plant. The combined water sewer transports wastewater from households and rainwater from the street gullies. For drinking water, there is a large supply pipe in the middle of the road and a smaller one beneath the pavement, from which the buildings are supplied.
Brief explanations

Water mains ...
... are pipes through which water is transported over greater distances. Mainly located under streets, they are between 40 cm and 1.40 m in diameter in Berlin. Those that are presently laid are made of steel with a reinforced concrete lining.

Supply pipes ...
... branch off of the water mains, are mostly located under pavements and have a diameter of up to 30 cm. They are now made of ductile (malleable) cast iron with a reinforced concrete lining.

Building connection pipes ...
... are the pipes that branch off of the supply pipe and connect to the water meter installation on the property. They are now made of plastic.
We help nature along: plants clean river and lake water, which then percolates into the groundwater

There is an ample supply of groundwater in Berlin and the surrounding areas due to favourable geological, hydrogeological and climatic conditions. Never-theless, even with its abundant water resources, we cannot draw unlimited amounts of drinking water from this region without certain considerations. Our groundwater reserves need to be managed in an environmentally sound and feasible manner. Quantity and quality vary somewhat from catchment area to catchment area, so individual waterworks must come up with different solutions for the management of groundwater resources for each respective area. They must take into careful consideration any deficit in the amount of water available and also pay close attention to any potential hazards due to industrial and natural contamination.

Soil acts as a filter

Sufficient amounts of groundwater do not always form naturally. Therefore, in order to extract the required quantities, we at Berliner Wasserbetriebe replenish groundwater with treated surface water. This is achieved by impounding water into shallow earth basins or into natural ponds and ditches. As the soil in Berlin is mostly made of sand, water can percolate easily through it and flow down to the groundwater reservoir. The upper layers of soil act like a giant filter. The natural cleaning power of the soil improves the quality of the water physically, chemically and biologically so that it is comparable to that of natural groundwater. On the way to the wells, percolated water also reaches the same temperature as groundwater. Apart from the Kuhlake in the Spandau Forest, all the water bodies of the Grunewald lake area (Schlachtensee, Krumme Lanke, Grunewaldsee, Hundekehlesee and Waldsee) act as natural soakaways. Earth basins have been built near the Tegel and Spandau waterworks. In and around the Stolpe waterworks, surface water from the Rivel Havel is filtrated on the Havel meadows.

Phosphorous out – everything is clear

Surface water can be pre-treated before it is used for filtration purposes. In two treatment plants for surface water, the substances that can be filtered out, as well as the phosphates and nitrates, are reduced using the flocculation-sedimentation-filtration principle. To this end, flocculating agents are added to the water and then filtered. The Beelitzhof surface water treatment...
The Berlin supply region has an area of 892 km² and a population of 3.5 million. It extends 45 km at its widest point from east to west, and 38 km from north to south. The River Spree flows through the city’s districts from east to west, forming a 7 km wide valley, bounded by high areas in the north and south. It then flows into the valley of the River Havel near Spandau. These valleys are part of the so-called Berlin-Warsaw Glacial Valley formed by the water masses which melted after the Ice Age. They are filled with sand and gravel at a depth of 30 to 50 metres. These gravel layers contain the groundwater resources which serve as the basis for Berlin’s drinking water supply.
An underground world of its own

Drinking water turns into wastewater. It flows through the building connection sewers in freefall to the collector sewer pipes in the roads and through ever larger sewers to the pumping stations, which then pump it to the local sewage treatment plants. The Berlin wastewater sewers are 9,600 km long. This is equivalent to the distance between Berlin and Peking.

Berlin underground

Berlin is divided into honeycomb-like drainage areas, whose boundaries are not identical with those of the Berlin residential districts, but rather, follow the courses of rivers and canals. They also follow varying levels of terrain. Sewers always lead to the lowest point of a drainage area. There is a pumping station situated there, which then pumps the wastewater on to the sewage treatment plants.

The Berlin wastewater sewers are a total of approximately 9,600 km long. This includes 4,330 km of wastewater sewers, 3,300 km of stormwater sewers and 1,920 km of combined water sewers. Around three-quarters of the city area of Berlin are set up as one separate sewer network system and one quarter as a combined sewer network system.

The combined system

In the combined system, wastewater and stormwater are transported together through one type of sewer. This system has definite advantages, especially in the inner city, where there is very little space under the roads, next to the subway and other lines. However, for the measurement of the sewers, the share of stormwater is very important, because, in the event of rain, many times the amount of waste water must be drained away as compared to the amount of water drained during dry weather. In order to keep the size of the combined water sewers economical and relieve the network system and treatment plant of excess incoming stormwater, there are storage and stormwater overflow facilities situated at fixed points along the sewer network as well as in the proximity of local pumping stations. During a storm, nearly a quarter of a million cubic metres of water can be held back in the sewers of the combined system. By 2020, a total of 306,000 m³ of storage space is intended to be available. This prevents dirty water from the sewer network from overflowing into the bodies of water. During heavy rainfall, local wastewater treatment plants are not in a position to handle all the incoming water at once. In these rare cases, they would be overloaded and the delicate biological treatment process would be permanently disrupted. To prevent this, the maximum capacity of the pumping stations is limited to the maximum treatment capacity of the respective sewage treatment plant. If the level of stormwater exceeds the storage volume of the combined water sewer, the stormwater and wastewater which is not held back by the
pumping station then passes untreated through the stormwater overflows into the combined sewers and is subsequently discharged into bodies of water. However, this is the exception, not the rule.

**The separate system**

In the separate system, wastewater and stormwater are collected in two separate sewer systems. Wastewater from households and businesses flows from wastewater sewers to pumping stations, which then pump it on to wastewater treatment plants. The advantage here is that the amount of wastewater going through the system is fairly uniform and the occasional large quantities of stormwater due to bad weather conditions do not have to be transported to the treatment plant through the sewers and pressure mains. For this purpose, special stormwater sewers collect and discharge rainfall and other precipitation to nearby rivers, sewers, streams or lakes. In areas with permeable soil, stormwater percolates where it falls.

For roads with heavy traffic, stormwater sewers have been installed to ensure run-off and to take away any pollutants that may occur as a result. Around 62% of the sewer network is made from vitreous clay pipes. Road sewers range from 20 cm in diameter up to 2.80 m for main collector sewer pipes and up to a size of 4.20 m wide by 3.20 m high for masonry sewers. The smallest building connection sewer is 15 cm in diameter.

**Material information**

The following materials are used for the sewer network:

- vitreous clay pipe for wastewater and combined water sewers
- concrete pipe for stormwater sewers
- reinforced concrete pipe for all types of sewers
- concrete or masonry for all types of sewers, if a special section is required due to local circumstances

**Sewer pipe with egg profile:** Narrow at the bottom, so that even a small amount of water flows quickly
Green intensive cleaning

A special form of these treatment plants are retention ground filters. These filters clean dirty stormwater from heavily traveled roads and industrial surfaces by filtering and retaining removable dirt from the water using a substrate and reed plants. So far, Berliner Wasserbetriebe has built four retention ground filters at the Baggersee Lake in Biesdorf, in Adlershof, in Blankenburg and at Halensee Lake.

Open hatches during heavy rainfall

There are more than 160 emergency outlets and stormwater overflows in Berlin. They are located on the rivers Spree, Havel, Panke, and on the Land-wehr Canal, the Teltow Canal, and the Neukölln and Berlin-Spandau shipping canals. There are also several stormwater retention tanks at strategically important points. They catch the combined water during short and heavy storms in order to overflowing into local bodies of water. When the rain subsides and the pumping stations and wastewater treatment plants are again running at normal capacity, the excess contents of the tanks can be pumped away and treated further. During long, sustained heavy rainstorms, it is possible to treat stormwater in the tanks directly.

The stormwater collected in the sewers first flows into a tank, in which the dirt that has also flowed in settles. In the actual filter, the loosened dirt, such as phosphorous and nitrogen and heavy metals are bonded to the substrate and in the plants. The reed plants ensure that the filter does not become blocked. After passing through the filter, the water is then freed from 80% of the filterable substances - among other things, heavy metals adhere to them - and 70% of the phosphorus compounds. Together with extensive renovation work in the sewers, these plants have the purpose of achieving a good ecological balance in the Spree-Havel river system by 2015. Sewers transport raw water to any one of 152 pumping stations within the area of the city.

With pressure to the sewage treatment plant

From there, the raw water is pumped through a total length of 1,160 km of pressure mains to the sewage treatment plants. Main pumping stations transport the wastewater through these pressure mains to the sewage treatment plants. They serve to coordinate the operation of all the other connecting, overflow and stormwater pumping stations, which are monitored and remotely controlled from here. In the near future, all of Berlin’s pumping stations will be monitored and controlled from a single control room.
Getting to the bottom of the matter

Drainage sewers must be cleared of grit and sludge so that wastewater and stormwater can flow through freely. We use state-of-the-art technology for this purpose, as most sewers are so small that they cannot be accessed.

Smaller sewers can be cleaned using simple water cleaning or high-pressure cleaning. A special cleaning apparatus is used, which is pulled through the sewer with the help of a cable winch. Sludge, sand and other deposits are then transported to the next manhole where they are suctioned up.

Pumps on the special vehicles, used for pressure cleaning, can generate water pressure of up to 150 bar with their pumps. This pressure is 30 times higher than the pressure in the water pipeline network. The pressure loosens deposits, swirls them up and flushes them to the next manhole, where they are suctioned up.

In most of the sewer cleaning vehicles, the pressure cleaning is combined with sludge suction equipment. Water sucked up with the sludge is simultaneously filtered and used again to flush the system.

Sewers at a height of 1.20 m are accessed for cleaning. Some of the deposits have to be shovelled away because they cannot be removed by scrapers. Sewer operations employees also work underground to manually clean special structures such as stormwater tanks and coarse filtering equipment in the stormwater sewer network. Siphons (i.e. sewer underpasses below other installations, such as the underground railway) are cleaned by pressure cleaning.

Filming the remotest corner: camera robot
Cleaning and inspection

Wastewater sewers can collapse or leak when penetrated by tree roots. Wastewater then leaches into the soil and can contaminate groundwater. Conversely, percolating groundwater that seeps into the pipes can increase the overall load at local sewage treatment plants. Due to Berlin’s high level of groundwater, this is a common occurrence. Repair of the sewer network effectively serves to protect the environment. Therefore, wastewater sewers need to be inspected on a continual basis. Most accessible sewers can be physically inspected by employees of the sewer operations service centres. The non-accessible sewers are inspected using mobile sewer cameras. Even building connection sewers, which are only 15 cm in diameter, can easily be examined this way.

Evaluate and rehabilitate

The sewer CCTV vehicles are equipped with a self-propelled, watertight camera, as well as a monitor, video recorder and a computer with a printer. The videos are evaluated and listed in Berliner Wasserbetriebe’s sewer register. This allows us to document the exact status and condition of the sewers, also for future inspections and for planning rehabilitation works. Building connection sewers are inspected using portable versions of the CCTV equipment from the building shaft or by so-called “satellite systems” from the main sewer.
Strict requirements for trade and industry

Our laboratories at the Berliner Wasserbetriebe continually check the effluents of the sewage treatment plants in order to be able to make any adjustments to the treatment processes at any given time based on the quality of the effluent. The sewage treatment plant is managed on the basis of the measurement values obtained from constant sampling.

Any effluents coming from industry and trade customers are tested by the Berliner Wasserbetriebe’s Discharge Monitoring department. Around 20,000 companies are registered with our organisation and 1,200 of these are monitored routinely.

It is strictly prohibited by law to discharge substances that are hazardous to water into sewers. In addition to this regulation for industrial and trade customers, the Indirect Discharge Ordinance clearly states that contamination is to be identified at the point where it first occurs.

These legal requirements are there to safeguard those who have to work in the sewers, pumping stations and other drainage facilities. In addition to this, the drainage facilities must not be damaged and the biological processes must not be disturbed during wastewater treatment. For example, cyanide, chlorinated hydrocarbons, heavy metals or acids could potentially cause major damage.

The basis for the investigations of the individual stages of wastewater treatment are, for example, a permit from the water authority and quality-based ordinances, the compliance with which is ensured through unannounced spot-checks by the state water authority.

Everything clear? Help to protect the environment

True to the motto “out of sight, out of mind” many Berlin residents dispose of items through the sewer system, which can already become a problem right in front of their door in the form of a blockage or offensive odour.

Berlin’s drinking water and wastewater disposal is based on a natural cycle, so toxic or environmentally harmful substances must not enter the wastewater. Even state-of-the-art sewage treatment plants are not able to remove some substances. If they enter into the groundwater, they could endanger the drinking water supply.

Therefore, the following do not belong in the drain or toilet:

- solid waste, such as textiles, hygiene items, cigarette butts, razor blades or cat litter
- leftover food, oils and fats
- lacquers, paints, solvents and all other chemicals and drugs

And you can do even more to relieve the sewer system and thereby protect the environment:

- Do not discharge stormwater or drainage water into the wastewater sewer system to avoid the sewer network backing up.
- Do not sweep any dirt or rubbish from the pavements and cycle paths into the gullies.

You can find out exactly what can be discharged into the sewer system in our General Terms and Conditions for Drainage in Berlin (ABE) at www.bwb.de.

You can also receive advice from our Discharge Monitoring department at tel. 030.86444876

Inspection in the sewer: Only 5% of Berlin sewers are higher than 1.10 m and are therefore accessible.
Wastewater consists of used water from households, businesses and industry, on the one hand, and stormwater, i.e. rain, on the other hand. Domestic sewage includes water from sanitary installations, kitchen water with vegetable and food residues, as well as cleaning, washing and bathwater. Stormwater contains dirt from roofs, courtyards, gardens, roads and public spaces.

Wastewater can contain solid matter and soluble substances. Solid matter floats in water or sinks to the bottom. Soluble substances can only be biologically or chemically separated from water. There are also semi-soluble substances called colloids. Colloids cause the water to be turbid. All of these substances are made up of organic and mineral compounds.

In our 6 wastewater treatment plants in Berlin, 95% of all solid and biodegradable substances can be removed. The following parameters are used in assessing the degree of wastewater pollution: biochemical oxygen demand (BOD), chemical oxygen demand (COD) as well as the level of certain nutrients, such as phosphorus and ammonium. BOD is the quantity of oxygen which is consumed by microorganisms through the degradation of organic substances within five days at 20°C.

COD is the estimated consumption of potassium chromate, which is produced during the chemical oxidation of organic water compounds. It is given as the oxygen equivalent in milligrams per litre. To ensure the best treatment performance, the respective concentrations are checked regularly at the outlets of the sewage treatment plants. In Berlin’s sewage treatment plants, the majority are well within the specified limits.
We can manage that

Nutrients

Phosphorus and nitrogen compounds are important nutrients for plants, also for aquatic plants. The nutrients in bodies of water accumulate over time due to their presence in raw water and in other sewage washed out from areas used for agricultural purposes. This itself promotes rapid algae growth and is a self-perpetuating cycle. Dying algae settle on the bottom of the lake or river where they are consumed by micro-organisms. This in turn releases phosphates and nitrogen. These further accumulate in the body of water and consume oxygen.

The fewer nutrients there are in a river or lake, the clearer its water is. Each person produces around three grams of phosphorus, in the form of phosphates, and twelve grams of nitrogen per day that end up in wastewater. In Berlin the phosphate concentration level – converted into phosphorus – is not allowed to exceed the limit of 0.5 mg/l per litre in the effluent of the sewage treatment plants. In Berlin’s wastewater treatment plants, the annual average limit lies between 0.3 and 0.7 mg per litre. This means that 97% of the phosphates in wastewater can be removed.

Heavy metals

Heavy metals get into the wastewater from industry, as well as from households. The heavy metal content in Berlin’s wastewater is low. Chromium, nickel and cadmium are only found in minute quantities. The most frequently occurring heavy metal in Berlin’s wastewater is zinc. Its concentration lies between 0.2 and 0.5 milligrams per litre and one third of it stems from industry. The remainder stems from zinc coated building installation pipes or roof gutters.
From the sewer to the Spree river

Six wastewater treatment plants clean sewage from Berlin and the surrounding regions

In such densely populated regions as Berlin, particularly high requirements are set for cleaning wastewater. During dry weather conditions, Berliner Wasserbetriebe’s six wastewater treatment plants clean approximately 650,000 cubic metres of wastewater per day. Treated wastewater flows into the River Spree and the River Havel directly or via the Erpe, the Panke, the Nordgraben or the Teltow Canal. These bodies of water are slow moving and have a low volume.

The wastewater that is pumped by the pumping stations through pressure mains to the wastewater treatment plants initially passes through the mechanical treatment stage.

Course contaminants such as paper, textiles, wood and plastic are removed in the screening plants. Automatic rakes remove any waste stuck on the screen. Then it is collected, dewatered in containers, and disposed of in an ecologically sound manner.

The wastewater then flows through the grit chamber. It consists of long channels in which coarse mineral solids such as sand, gravel and stones settle on the floor at a flow velocity of around 30 cm per second. These solid materials are pushed by scrapers into hoppers and pumped into grit washing tanks. There, the grit is freed of organic substances, dewatered and later disposed of.

In the primary settlement tanks, the flow velocity of the wastewater is reduced to around 1.5 cm per second so that lighter, undissolved substances can settle out to the floor of the tank. The buoyant particles collect on the water’s surface. The sludge is pushed by scrapers into sludge hoppers. The sludge is stored temporarily and then pumped to the sludge treatment plant. Floating matter, which moves on the water’s surface and mainly consists of grease, is removed by scrapers.

The mechanically pre-treated wastewater then flows into the aeration tanks of the biological treatment stage. In this
Bacteria and microorganisms: Our important sewage treatment plant employees can only be seen under the microscope.

In the treatment stage, dissolved organic substances, as well as phosphorus and nitrogen compounds, are degraded. The degradation is carried out by bacteria and other microorganisms which form the aerated sludge. The first part of the aeration tanks is kept free of oxygen. This stimulates bacteria to consume phosphorus compounds in the wastewater in the subsequent oxygen-rich zone of the aeration tanks. The nitrogen compounds are reduced by other bacteria, which are also exposed to changing oxygen concentrations.

In addition to biological phosphorus removal, simultaneous chemical precipitation can be used if needed. In this case, the precipitant iron (I) sulphate or iron (II) chloride is added to the aeration tanks in a dissolved form. Iron (III) phosphate is produced, which then mixes with the biological sludge.

The wastewater then flows through the final clarification tanks. Here the activated sludge has several hours to settle out. Afterwards, it is pushed into hoppers and then mostly pumped back into the aeration tanks in order to maintain a constant level of micro-organisms for biological treatment. Finally, any excess sludge is passed on to the sludge treatment plant for further processing.

The treated wastewater - we call it clear water - is transported into a body of water so that it returns to the natural water cycle.
Sustainable for the city

Sustainability is at the centre of our corporate strategy. With our activities and projects, we observe ecological, social and economic aspects. Furthermore, with each of our decisions, we consider which consequences these have for future generations.

Stiftung Warentest has confirmed: Our water is first class. We ensure that it stays that way. Nearly every drop of water that we need in households or businesses flows back to nature. We preserve our natural resources so that future generations in Berlin can also have water of the best quality.

The water cycle is part of an environment that is constantly changing. We react to the influence of social and climatic changes, such as the pollution of wastewater with contaminants or the quantity of the inflowing water due to rain. Through advances in science and technology, we can react to more and more unwanted substances in an increasingly finer concentration in our water.

We ensure that pipeline networks and sewer networks are intact and that we have efficient pumping stations and sewage treatment plants, in which we can purify our wastewater. We analyse our groundwater on a regular basis in order to identify hazards to water quality at an early stage and take countermeasures in an emergency.

We have established an in-house Research department. In cooperation with universities and scientific institutions, it develops solutions for exactly those questions for which the answers are particularly urgent for us and our customers.

Water is an energy-intensive business that generates CO₂ emissions. Through the use of energy that is constantly becoming more efficient and through self-produced renewable energies, we make a measurable contribution to the success of the turnaround in energy policy. Energy is also an important cost factor. By using these in an increasingly efficient manner, we can also stabilise our operating costs.

We also do not lose sight of our present customers. They profit from our products and service improving further, managing increasingly efficiently, so that water remains an affordable commodity for everyone and so that we protect the environment, the climate and natural resources of Berlin and the region.
Apart from cleaning wastewater, wastewater treatment plants also treat sludge resulting from wastewater treatment so that it can be used or disposed of in an environmentally friendly manner. Sludge treatment in Berliner Wasserbetriebe’s six wastewater treatment plants is currently carried out using two fundamentally different processes.

In our wastewater treatment plant in Ruhleben, sludge consists of up to 95% water and is dewatered in centrifuges. The dewatered sludge is now called sludge cake. The water contained in the sludge cake, still around 75%, evaporates on fluidised bed furnaces and the remaining solid material is incinerated thereafter. Depending on the amount of water left in the sludge, heating oil may have to be used in order to reach the specified combustion temperature of at least 850°C needed to prevent the formation of noxious odours caused by flue gas.

**Energy and fertiliser**

The flue gases are cooled in heat recovery boilers, cleared of dust using electric filters and then cleaned in a flue gas purification plant.

The harmful substances are removed so that their proportions in the flue gas are significantly below the admissible values at the chimney exit. The heat contained in the smoke is used to generate steam and electric power in the sewage treatment plant.

Leftover ashes are used as landfill for mines that have been shut down. More than one third of all sewage sludge produced thermally is recycled in this way.

In the sewage treatment plants at Stahnsdorf, Wassmannsdorf, Münchehofe, Wansdorf and Schönerlinde, sludge is treated in digesting tanks or digesting chambers. At a temperature of about 33°C, the whole process takes around 20 to 30 days. The organic substance is converted into biogas, which is then used to generate heat or electric power. Then, this “digested” and dewatered sludge is used to generate energy in power plants and cement works, as well as in the Ruhleben sewage treatment plant through co-incineration.

And we also extract magnesium ammonium phosphate from the sewage sludge, a high-quality mineral long-term fertiliser, which is commercially available under the name of “Berliner Pflanze”. Its use contributes to the preservation of the limited natural phosphorus resources.
Always there for you

In an emergency, we always have a solution

You can reach our emergency service around the clock in case of an emergency (e.g. burst pipes, disruption of the drinking water supply, backup).

0800.292 75 87

The toll-free telephone helpline all around water

Do you have any questions? You can find out more about our products and services here. We are happy to answer any of your questions, ranging from wastewater disposal to meter changes. Our Customer Service is there for you Mondays to Fridays from 7:00 a.m. - 8:00 p.m.

Information and advice about the building connection

Do you need a new connection to the public drinking water pipeline and wastewater sewer network. For a personal advisory discussion, you can contact our local customer advisors. You can find the building connection service team near you here: www.bwb.de/beratung

Our customer centre in the heart of Berlin:

Neue Jüdenstraße 1, D-10179 Berlin-Mitte, opening hours: Monday to Thursday from 8:00 a.m. - 5:00 p.m., Friday from 8:00 a.m. to 3:00 p.m., Klosterstraße subway station.

Guided tours through waterworks and sewage treatment plants

We offer pupils from year 4 free guided tours through waterworks, sewage treatment plants and pumping stations. You can find further information on the Internet at: www.bwb.de/fuehrungen, e-mail: fuehrungen@bwb.de, for reservations call telephone number: +49 (0)30 8644-6393.

www.klassewasser.de – The website for children, pupils and teachers

The exciting world of water can be discovered by children, young people, pupils and teachers on this multi-award-winning website. It offers everything that pupils need to know and that teachers need for structuring their lessons.

Advanced training for teachers

We offer state-certified teachers advanced training and further education courses in cooperation with Beuth Hochschule für Technik Berlin. These advanced training courses are primarily aimed at teachers in the subjects of mathematics, information technology, natural sciences and engineering.

Museum in the Friedrichshagen waterworks

For an insight into the 150-year history of water supply and wastewater treatment in Berlin, we recommend you visit the museum in the Friedrichshagen waterworks: Müggelseedamm 307, D-12587 Berlin, www.museum-im-wasserwerk.de

www.bwb.de, service@bwb.de
A company with tradition

1852
Conclusion of a contract between the state government of Prussia and the English company Fox and Frampton to supply the city of Berlin with drinking water.

1856
The first waterworks of the Berlin Waterworks Company went into operation at the Stralauer Tor.

1873
The Berlin Waterworks Company is purchased by the city of Berlin. Formation of a municipal construction commission for Berlin's sewers, headed by James Hobrecht.

1878
Founding of Charlottenburger Wasserwerke AG that supplied Berlin's southern suburbs. Formal handover of the drainage facilities built so far to an operations director.

1937
Full ownership of Berliner Städtische Wasserwerke, public waterworks, is assumed by the city.

1945
Merger of Berliner Städtische Wasserwerke with Charlottenburger Wasser- und Industriewerke AG to form Berliner Wasserwerke, fully owned by the municipal government.

1949
The City of Berlin is divided. The water supply and municipal drainage facilities are split in half.

1951
Berliner Stadtentwässerung and Berliner Wasserwerke in East Berlin merge to form Groß-Berliner Wasser- und Entwässerungswerke.

1964
Founding of VEB Wasserversorgung und Abwasserbehandlung Berlin in East Berlin.

1967
The public utility Berliner Stadtentwässerung is changed to a municipal company owned by the Berlin city government and renamed Berliner Entwässerungswerke in West Berlin.

1988
Merger of Berliner Wasserwerke and Berliner Entwässerungswerke to form Berliner Wasser-Betriebe in West Berlin.

1990
Wasserversorgung und Abwasserbehandlung Berlin is converted to a municipal company.

1992
Merger of Berliner Wasser-Betriebe and Wasserversorgung und Abwasserbehandlung Berlin to form today's Berliner Wasserbetriebe.

1994
Berliner Wasserbetriebe becomes a municipal company.

1999
Part-privatisation. The city government of Berlin now holds 50.1% of the shares, RWE and Veolia together hold 49.9% of the shares in Berliner Wasserbetriebe.

2011
Successful referendum to disclose the part-privatisation contracts triggers the re-municipalisation process.

2013
The City of Berlin buys back shares from RWE and Veolia. Berliner Wasserbetriebe is completely back in the municipal family.

Charlottenburg intermediate pumping station in the 19th century