

Sustained use of water.
Water is one of our most important resources in life. The protection of water is a major ecological objective for the BMW Group. To achieve this objective we must use water carefully in a sustainable system throughout all divisions of the company and in all our activities. Recycling and circulation systems based on natural models help us to meet these demands.





**"Everything comes from water! And everything is kept alive by water!"
Johann Wolfgang von Goethe, Faust II, 1833.**

Water forms the very basis of our life, it is indispensable and irreplaceable. In the year 2001, each inhabitant of Germany consumed an average of approximately 126 litres of water a day, including three litres of water for human consumption, 49 litres for taking baths or showers, 17 for washing laundry, and 44 for flushing sanitary installations. So it is quite natural for us to literally "turn on the tap". Today, however, 1.2 billion people all over the world – that is one out of every five human beings – have no access to clear drinking water in adequate supply.

Water – a valuable resource.

Water is indispensable not only in our private lives, but also in the industry. It is used in one way or another in most business processes, whether as a raw material or as an operating or transport medium, for cooling or washing.

In the year 2001, the BMW Group consumed well over 3.5 million cubic metres of water the world over, which is a lot. Relating this figure to the number of BMW associates, we yet find that in the last 10 years the BMW Group has reduced the average consumption of water per capita by approximately 25 per cent, while for comparison private consumption per capita is down by only about 13 per cent.

The BMW Group is fully aware of its responsibility for resources and the environment. Indeed, this is clearly borne out by a Board Resolution taken in February 2000:

"Sustainability is becoming the fundamental principle of economic and social prosperity and is crucial to the interaction of the market and democracy. The BMW Group will continue its process of sustained development as a fundamental principle of our corporate strategy."

Since 1994 the BMW Group has been establishing binding Directives for Environmental Care. Proceeding from these Directives, the Group compiled guidelines in the year 2001 for a careful, sustainable use of water which is one of the world's most important resources. Specifically, these guidelines state that

- intervention in the natural cycle of water must be kept to a minimum
- consumption of water must never exceed the natural supply of unused water
- infusion of substances into the environment must not exceed the level and capacities of natural degradability.

Drinking water – the purest water in every respect.

Drinking water is a very valuable but finite natural resource. The BMW Group's Water Guidelines therefore state that drinking water should be used only if absolutely necessary and that water must be re-used as many times as possible. The required purity of water depends on each specific form of use and application and thus drinking water is not needed in all cases.



Water used for commercial purposes, for cooling or spraying, for example, need not have the same quality as drinking water. The BMW Group therefore consistently seeks to use ground or surface water – suitably processed – for operating purposes wherever possible, instead of deploying drinking water supplied by communal networks or valuable water from deep wells.

Today BMW's plants in Munich, Dingolfing and Landshut obtain up to 40 per cent of their water from ground water near the surface, using surface wells to provide this supply. In Munich, the Group does not use any valuable deep-well water at all, ground water from low strata thus being preserved in full as drinking water for the City of Munich and its inhabitants.

Preventive care of ground water.

The BMW Group is committed not only to safeguard the use of water, but also to the protection of underground water reservoirs.

All kinds of construction projects are constantly changing the countryside and often intervene in underground bodies of water. Building foundations extend deep into the ground and therefore may disturb the flow of ground water or, if the worst comes to the worst, even interrupt the flow of ground water in full. Computer simulations showing in advance what could happen underground are therefore of indispensable value.

In cooperation with the Gerling Consulting Group (initially working with the Munich Plant, then also with BMW's Plant in Berlin and, only recently, with the BMW Research and Innovation Centre in Munich-Milbertshofen), the BMW Group has developed an innovative ground water model. Using geological and hydrological data, this program allows specific forecasts on the effects of planned construction and building projects.

Yet this is still not all: Studies conducted with the ground water model reveal the best locations for drilling water wells and indicate where precipitation may move down into the ground. At the same time the model can simulate the effects an accident would have on the ground water, since accidents can never – even with the most conscientious safety measures and precautions – be ruled out. If – after an accident – harmful substances reach and penetrate the ground water, the computer is able to determine very quickly – within an hour at most – how fast and where the substances will spread underground, thus allowing appropriate countermeasures wherever necessary.

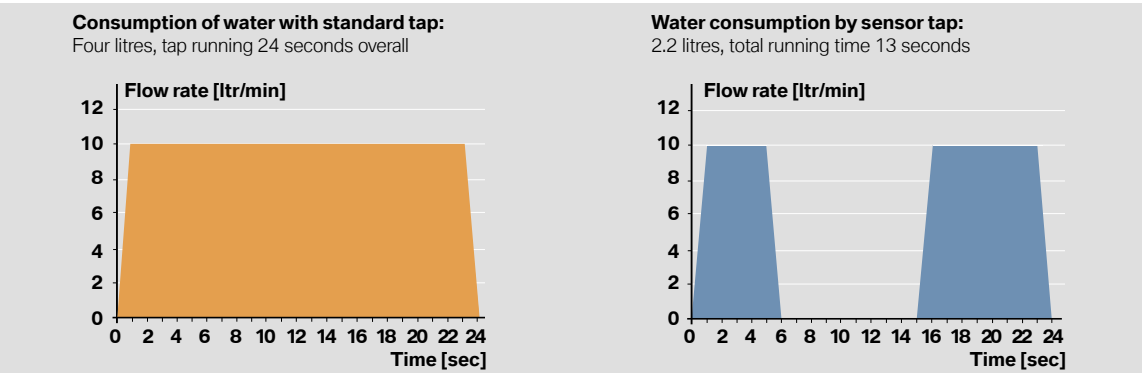


Computer simulation also can reveal the best and most effective location for a cleaning well, preventing the spread of harmful substances to the greatest possible extent by pumping them out of the ground water. This makes it possible to avoid negative repercussions, limit damage to a minimum, and organise optimum remedies more quickly and effectively. Without having ever suffered such damage, the BMW Group is fully committed to a so far-reaching policy of protecting the ground water.

Only one-third of all waste water comes from production.

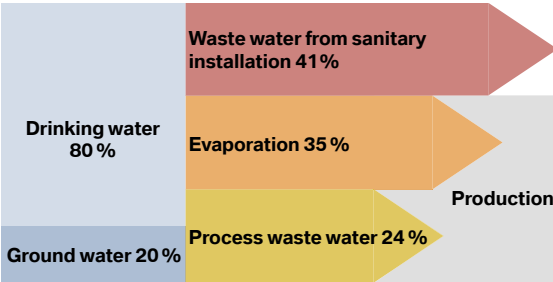
It is perhaps surprising to note that only about one-third of all the BMW Group’s waste water comes from production. The other two-thirds are used in sanitary installations, where, contrary to the balance of water already largely optimised in car production, there is still a great potential for savings. Additional to an active information policy as well as using water-saving supply and feed systems, the BMW Group also seeks to reduce the water consumption at this point by touch-free water control systems.

Sensor-controlled wash basin taps reduce average water consumption when washing your hands by up to 45 per cent.



Recycling processes to reduce evaporation and water consumption.

The No.1 principle in the use of water is, quite simply, to save as much as possible. This requires not only the right spirit on part of all consumers, but also the most advanced technological processes. In automotive production water is needed above all to cool machines, to moisten the air in air conditioning systems and for production purposes.



Most of the total amount of 3.5 million cubic metres of water consumed by the BMW Group worldwide in 2001 was used up by evaporation and sanitary purposes. Apart from successfully applied water-saving production processes, many new options for saving water are being checked and introduced step-by-step in this area, too, accounting for three-quarters of total consumption.

The share of water evaporating in this process was approximately 35 per cent in the year 2001. In order to reduce this, the BMW Group pursues the policy of replacing conventional open cooling cycles by closed cycles already state-of-the-art in new construction projects.

A specific example: So-called wet cooling towers are used frequently both in industry and in power stations for cooling components, with water “raining” in from above and evaporating in part in the process. The low temperatures generated in evaporation reduce the temperature of the remaining coolant, but at the same time evaporation wastes a lot of water. In closed-cycle cooling, by contrast, water flows through a system of pipes and is cooled exclusively by contact with the outer air. With such dry coolers not being able to operate efficiently enough in hot weather, for example in the middle of summer, water is sprayed in under such conditions – but only in that case – to use the low temperatures generated by the evaporation process.

Recycling systems in water spray tests reduce water consumption by up to 80 per cent.



A cooling system of this kind is referred to as a hybrid cooler and offers a good compromise able to save cooling water whenever appropriate for ecological and economic purposes.

Multiple use also reduces the consumption of water.

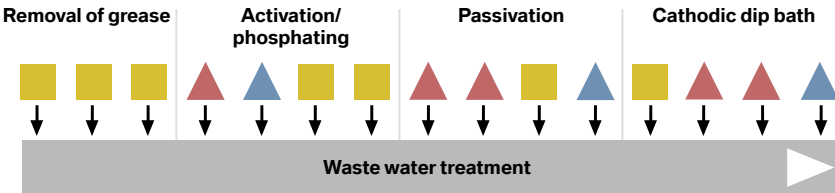
It is no coincidence that at BMW production accounts for only one-third of all waste water. This goes back to the fact that water required in automobile production is used several times over wherever possible, the average amount of waste water per car thus dropping significantly within the BMW Group in recent years: While in 1996 the average volume per car was – an already very low – 1.3 cubic metres, this figure was further reduced to just 1.0 cubic metres in the year 2001. In the years to come, water consumption is to drop to a significantly lower level, especially since some of the Group’s plants have already cut consumption to less than one cubic metre per car, many small and big improvements adding up to provide this success.

Specific examples of the multiple use of water in recycling systems.

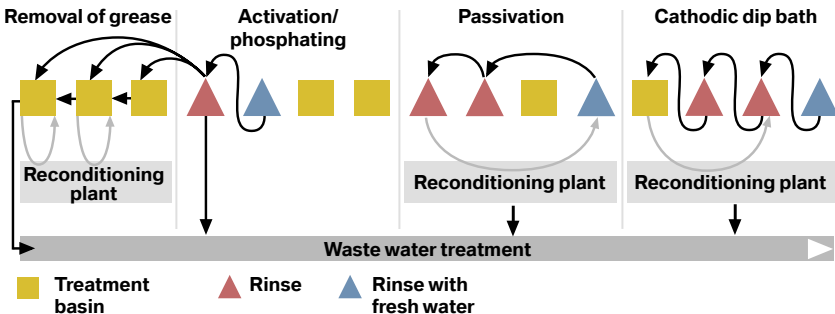
The No.1 strategy in reducing water consumption is to recycle the water required, using it several times over. This means that contaminated water has to be cleaned sufficiently for repeated use.

Process-based reconditioning of waste water will save up to 70 per cent of the water used in future.

Flow process in the past : low efficiency (more than 10 litres/m² body-in-white)



Flow process today/in the future : high efficiency (approx 3–5 litres/m² body-in-white)



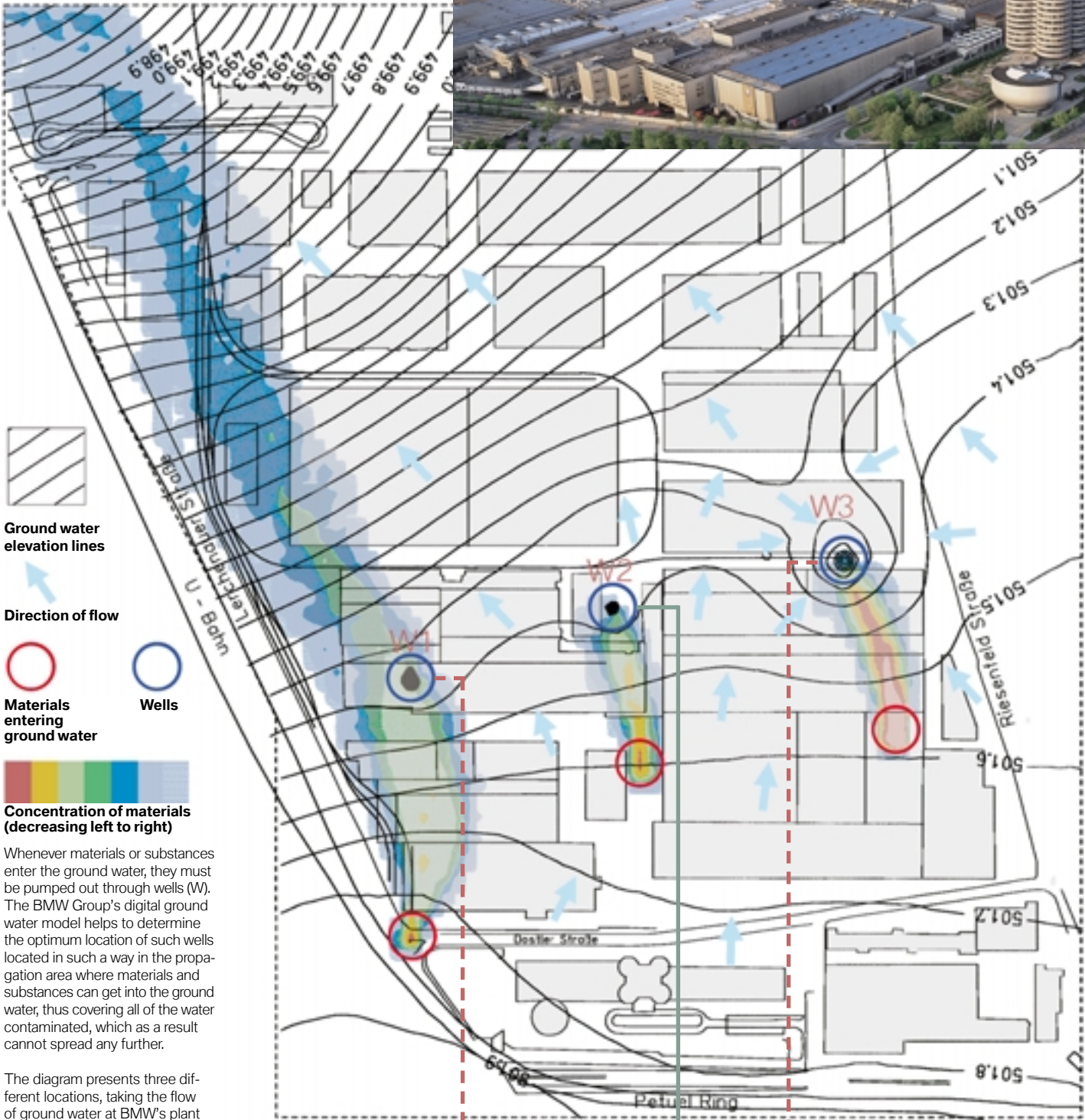
- Three examples show what this principle means in practice:
- About 80 per cent of the water used by the BMW Group for washing new cars are reconditioned and recycled.
 - At the BMW plant in Munich the rinse water used for cleaning filters in the cooling circuit runs through a separate line filter and then goes back into the cooling circuit. With a total 15,000 rinsing processes a year, the individual effect of one cubic metre of water per rinsing operation adds up to two per cent of the plant’s total consumption of water.
 - The passenger, luggage and engine compartment of a car must be absolutely watertight. To achieve this goal, cars are sprayed with water from all sides in a kind of “shower” prior to their completion. One single test of this kind requires several hundred litres of water. The South African plant is only one example of the BMW Group’s success to reduce water consumption by half between 1997 and 2000 due to the introduction of a water recycling system and other appropriate measures in order to test the watertightness of the body.

Multiple use of water in the paintshop, too.
To ensure that the various layers of paint protecting a car from corrosion stick firmly to the body, the body-shell has to be treated and cleaned several times. The water consumed in this process represents the largest share of the total amount of water used in production, indeed. While a number of years ago more than ten litres of water were required for this purpose for each square metre of the body, only about six litres per square metre are required today. Seeking to reduce this figure even further, the BMW Group by now has reached a level of only 4.5 litres at the Regensburg Plant and a further reduction to approximately three litres being the target for the future.

So-called cascade systems are of particular significance in this context, ensuring the intelligent re-use of contaminated process water in a cycle running in the opposite direction of the workpiece as such. The cascade system can be applied whenever a process requires the use of basins with chemicals of different concentration. This is the case, for instance, when a body-in-white is pre-treated at the paintshop. A further point is that waste water going through the cascades is partly reconditioned and used again. In fact, this system is currently being optimised, know-how gained in the process being applied subsequently throughout BMW’s worldwide plant network. So this is an excellent example of how the transfer of knowledge within the company ensures a consistent process of improvement. Ultrafiltration facilities also are very effective in reducing the water consumption and have therefore been in use at BMW plants for years – for example at the Munich plant, where such facilities have dramatically reduced the water consumption in cathodic dip bath treatment of the bodyshell from eight down to just two cubic metres. One single ultrafiltration system of this kind saves approximately 23,000 cubic metres of water a year.

Practical application of the ground water model.

Simulation of materials and substances entering the ground water and their removal.



- **Inadequate supply** (W1)
- **Optimum supply** (W2)
- **Excessive supply** (W3)

Powder-based clear paint technology does not require any water and thus there is no waste water.



Water-saving treatment methods in the paintshop.

No matter how precisely the spray robots in the paintshop are directed at the car, there is always a small amount of unavoidable overspray. A water curtain serves to hold back this excessive paint subsequently collected in a basin. New treatment technologies developed over several decades now extend the intervals required for emptying these basins to a whole year (while formerly they had to be emptied each month). This alone saves about 6,000 cubic metres of water a year in just one plant.

Applying paint without water and solvents.

In 1997 BMW became world pioneer by trying out a revolutionary technology in Dingolfing. A new treatment of the topmost layer of paint received international attention in a large-scale test: powder application of the paintwork. As soon as the colourless paint powder leaves the spraygun, it is electrostatically charged by an electrode. Due to this the powder particles stick to the earthed body and form a compound with the coloured water-based paint. Today this procedure is used as a standard procedure in serial production.

Powder-based paint offers significant advantages in protecting the environment. First, it does not require any solvents. Instead, the powder is filtered in particles as fine as dust and then aerated in order to build up a consistent cloud of paint. Furthermore, powder-based paint does not require any water to retain overspray, any excess material being held back within the paintshop and mixed with fresh powder. Powder-based paint application is therefore virtually free of waste and organic solvents and saves water in the process. At BMW's new Leipzig plant the topcoat paint will be applied exclusively through this procedure.

What really counts is the bottom line.

It takes many small steps to add up to a significant total reduction of water consumed. In order to save such valuable resources, each associate must be sensitised to this issue. Precisely this is why each BMW Group plant has not only an Environmental Protection Manager, but also a Water Protection Specialist.

Consistent monitoring of the Group's ambitious objectives as well as careful compilation of operating data are crucial to success in this area. Such processes also pave the way for planning new facilities, taking environmental requirements into account from the



start and making the job easier for planners, communities, suppliers and, finally, operators.

What really counts, however, is the overall result, the bottom line, when it comes to saving water. So wherever water preservation strategies are still too expensive, the BMW Group is working consistently on alternatives.

The vision of the BMW Group for the fuel of the future again shows that water opens up the door to a new world: This is the Group's CleanEnergy philosophy using hydrogen recovered from water with the help of renewable energy to provide the driving power of the future. Another vision is therefore coming true in this context – the vision of driving into a mobile future with engines running on hydrogen, the power of water.



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