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Possible Futures of the Parisian Sanitation System and How to Adapt the City's Heritage to the Effects of Climate Change

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Abstract
Climate change will profoundly affect urban water management through its effects on the water cycle but also in terms of the changes required for climate mitigation. In this context, Eurydice, an association of urban hydrologists, has sought to imagine various futures of urban water management. In this article, we explore potential changes that could reshape the Parisian landscape, including the management of heavy rainfall and severe drought, very low flows in the Seine, and the phasing out of individual cars in the city, which may open new opportunities for the reuse of parking structures. Our aim in the article is to broaden perspectives on urban water management.

Policy Recommendations

- Set up a City of Paris working group by 2026 to carry out a preliminary study of the possible consequences of climate change for historical heritage, as well as for technical heritage, which is often neglected.
- Provide training from 2026 onward on the effects of climate change for institutions in charge of heritage management in Paris.

KEYWORDS

climate change
urban water
sewage
stormwater management
sanitation

WATER ICONS



< Fig. 1 A freight barge on the Seine in Paris (Source: Jean-Pierre Tabuchi, 2014).

Introduction

Eurydice, an association of urban hydrologists founded in 1988, has launched a foresight exercise to imagine possible futures of urban water management in about fifty years. Climate change is of course at the heart of these reflections, because of its many effects on natural, urban, agricultural, economic and other types of environments. Acting on these effects requires both drastic mitigation and adaptation measures. Despite the warnings issued by scientists, we have been slow to take necessary measures. The impacts of the measures to be taken, if they are taken, will be powerful and they will affect all societies (as will the effects of climate change, if we do nothing). Therefore, conducting this prospective exercise is eminently risky and it will most likely be contradicted by the facts. However, it allows us to see current points of weakness, both societal and technical, in order to remedy them today.

In carrying out this exercise, we have imagined three different scenarios based on the scenarios drawn up by the French Environment and Energy Management Agency (ADEME) for France to achieve carbon neutrality by 2050. The three contexts allow us to project ourselves into the future. The first is characterized by a controlled and accepted sobriety and assumes that climate change mitigation objectives have gained widespread acceptance by political leaders and members of the population. It means that society has been able to organize itself to reduce its final energy consumption by 40 per cent, with all that this implies in terms of changes in travel habits and becoming more careful about its consumption of raw materials. The second context is characterized by an unwanted and uncontrolled sobriety. Society has squandered its chances of adopting a successful climate change mitigation and adaptation policy. This has led to shortages of energy and raw materials. Society operates in a "degraded mode" or permanent crisis. The third context is shaped by technological innovation. Technology makes it possible to repair the damage caused to the environment by human activity.

Regarding the climate, given the global situation observed in 2025, we consider the IPCC's SSP3 scenario to be plausible. It involves an increase in the global average temperature of more than 3°C.

The result of this exercise is that the world of tomorrow will be very different from the one we know today. It will be a very unstable world where all our statistical references will be turned upside down.

The Case of Paris: A Significant Legacy

The city of Paris and the greater Paris metropolitan area have inherited an important and historic "water heritage" involving its water supply and wastewater treatment. The city's most significant water heritage dates mainly to the nineteenth century and includes its canals and aqueducts, its dual water distribution network (drinking and raw water) and a sewer system that is unique in the world because it is fully visitable (in its Parisian section) and was made famous by Victor Hugo's 1862 novel *Les Misérables*.

The twentieth century brought a system of 800 million m^3 reservoirs upstream of the agglomeration, which is a formidable tool for adapting to climatic extremes including droughts and flooding of the Seine. Wastewater treatment infrastructure has also undergone considera-

ble development, enabling the Seine, where it flows through the capital, to attain the good physico-chemical status of the Water Framework Directive.[1] This recovery of river water quality provides sufficient conditions, in dry weather, for swimming, as displayed during the Paris 2024 Olympic and Paralympic Games.

Finally, it is worth emphasizing the importance of clean water flowing along the banks of the Seine in Paris, which are listed as a UNESCO World Heritage Site.

The Consequences of Climate Change

Based on scientific studies of the effects of climate change, we have identified three major changes that will take place in the functioning of the water cycle in the Seine basin by 2100. As for total annual precipitation, it should remain close to current levels, but with a different distribution throughout the year. Winters will most likely be wetter, with increased frequency of flooding likely. In summer, the rains will be less frequent but more violent, thus challenging the ability of wastewater systems to manage storm events, particularly in the Parisian combined sewer system. Managing the impact of these rains on Seine River pollution (and therefore swimming) will also be much more complex.

However, the natural summer flow of the Seine will be reduced by 20 to 40 per cent. The Seine Grands Lacs reservoirs will be able to alleviate the reduced flow, but with a higher probability of failure compared to the present time (Dorchies et al. 2012). A recent study by Météo France (Soubeyroux et al. 2025) shows that in France at +4°C, the number of hot nights (night-time temperature over 20°C) would increase from 8 to 43. The number of heatwave days could be multiplied by 7. The fight against urban heat could therefore become a vital issue. On a purely physical level, we must therefore prepare for a world of tomorrow that is very different from today. Policies to adapt to climate change will become a necessity, provided that the financial means and natural resources are sufficient.

Possible Changes

As a consequence and as a response to climate change, there are many possible societal changes. If we remain in a context of voluntarily reduced fossil fuel emissions and resource consumption, it is very likely that investment capacity will trend downward because the objective of sobriety can only be achieved in a world that is reducing its economic activity. The role of the automobile in the mobility of tomorrow should be very different and significantly reduced. The role of river transport could be much greater. Eating habits could change quite radically, with animal protein consumption halved, for example, and local food production increased. Finally, it is reasonable to think that tourism could be very different from what we know today, and probably much reduced.

In terms of water management, due to extreme instability of the weather, we can expect a periods of water scarcity. We can expect the development of rainwater harvesting and its use, including domestic use, along with the development of alternative sanitation methods such as those that allow the use of urine as a fertilizer, as well as higher stakes in the manage-

1. https://www.eau-seine-normandie.fr/documents-strategiques/Etat-des-lieux-2025.



^ Fig. 2 Two examples of white roofs for albedo reduction (Source: Jean-Pierre Tabuchi, 2025).

ment of extreme rainfall events, an increase in the temperature of the wastewater and therefore significant odour problems, difficulties in maintaining the quality of the Seine in good condition and suitable for bathing, very low flows of the Seine in some summers.

Two proposals for adaptation

To illustrate the possible impacts of these changes on the urban fabric and sanitation, we propose two actions in response to urban runoff and heat waves. The first involves transforming underground parking lots into rainwater storage reservoirs. Indeed, a virtual disappearance of the private car is plausible, at least in Paris. Paris has 140,000 underground parking places. This potentially offers a storage capacity of 4 million m^3, representing an enormous potential to be investigated for the collection and reuse of rainwater.

Conclusion

Based on our reflections on what urban water management may face in about fifty years' time, we note that we can expect any possible future situation to be very different from what we know today. When reflecting on the future of historical heritage, this observation leads us to ask:

- what the consequences might be of a plausible scarcity of financial resources, while recognizing that adaptation to climate change should become an absolute investment priority;
- how to manage potential conflicts between adaptation measures and the protection of historical heritage (including the banks of the Seine and the rooftops of Paris);
- what place tourism might have in the future, and what revenues it might provide to finance heritage preservation.

As for reconnecting the city to its river, this would seem to be an essential step in the context of adapting to climate change, given the Riverbanks amenities. Will it be possible to maintain a swimmable Seine? It is legitimate to ask the question.

Acknowledgment

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Jean-Pierre Tabuchi is now retired. He worked at Seine Normandy Water Agency for 25 years, where he managed stormwater policy and provided financial support to public water companies in the Paris region. In 2009, he became a project manager in the Territorial Strategy Department at the SIAAP, focusing on future-oriented projects. His work involved the evolution of water management in Greater Paris, energy and sludge management, alternative sanitation, climate change and smart systems. He has also provided technical assistance in integrated water resources management in China and Cuba.

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Jean-Claude Deutsch is a retired professor and researcher at the École des Ponts-ParisTech, who spent his entire career in the field of urban water management in Paris, serving successively as head of a pollution control unit, project manager for water pollution at the Ministry of Equipment, lecturer and researcher at ENPC, laboratory director and then director of the Doctoral School, also at ENPC. His collaborative works include *Manual on Stormwater Drainage* (December 1989), *Technical Guide to Ponds* (February 1994), *Water in the City: General Assessment* (April 1995), *Encyclopedia of Urban Hydrology and Sanitation* (May 1997) and *Water in the City, General Assessment: Is Our Friend Waging War on Us?* (February 2015).

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