



BAW

Federal Waterways Engineering
and Research Institute

Competence
for Waterways



Dear reader,

The BAW's work as a scientific consultancy and federal research institute for waterways engineering and specialised shipbuilding covers a broad range of topics and challenging tasks. These include, among other things, future-proof solutions for managing an ageing infrastructure. However, concepts to meet the growing ecological challenges in waterways construction, operation and maintenance will also be needed in the future. We study the impacts of climate change and are introducing digital technologies in waterways engineering. We also support the development of low-emission propulsion technologies for shipping, or automation in inland navigation.

As a waterways engineering competence centre advising the federal government, the BAW applies state-of-the-art scientific methods and technologies. Research and development, many years of experience and interdisciplinary project work are the foundation on which our consulting services are based. Driving innovation in waterways engineering, the BAW has a formidable reputation in the national and international scientific community.

The BAW offers fascinating work, cooperation across disciplines, cutting-edge technological equipment, and an inspiring professional environment and also excellent employment conditions.

I wish you an interesting read.

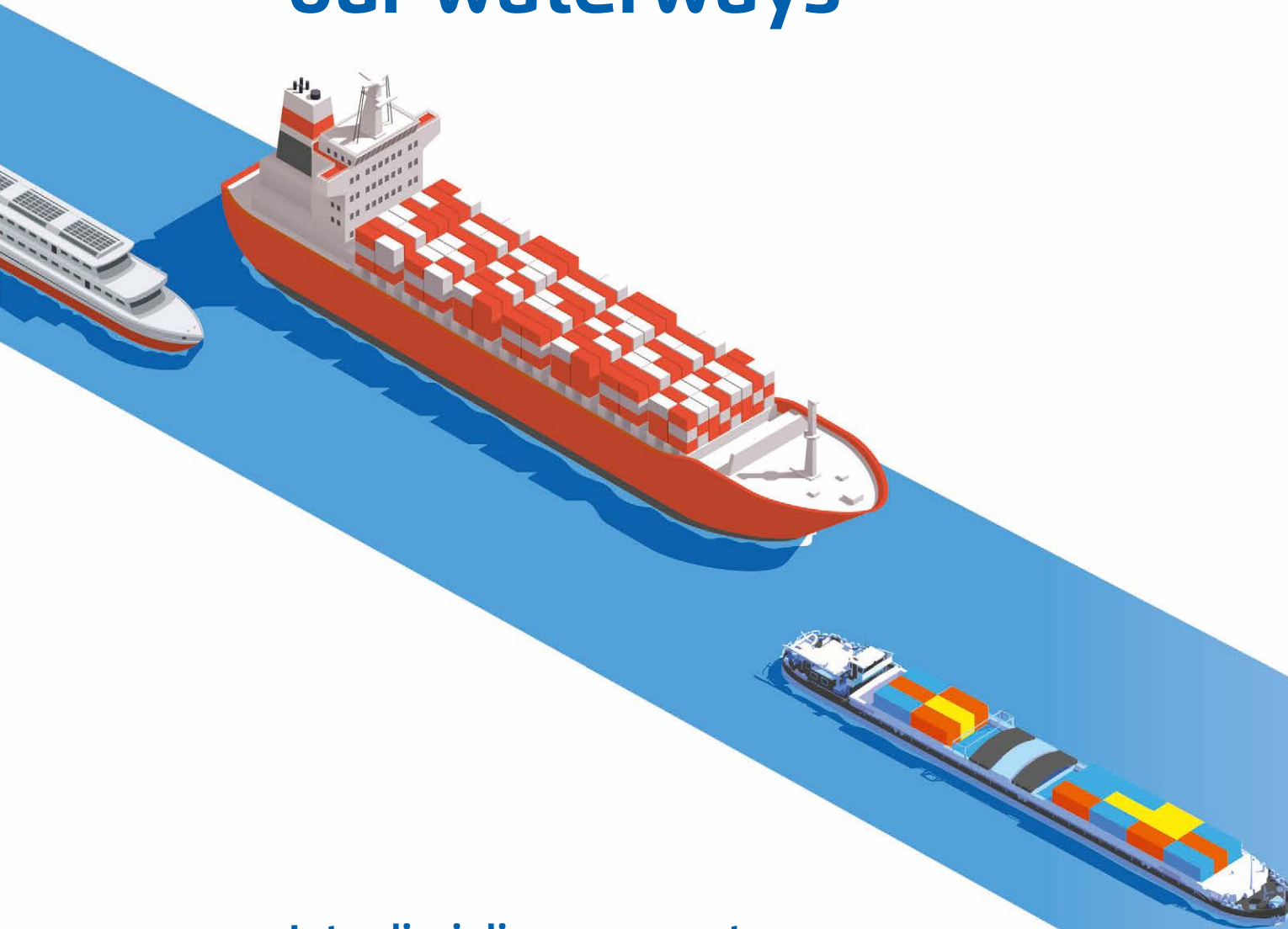
Prof. Dr.-Ing. Christoph Heinzlmann
Director Federal Waterways Engineering and Research Institute

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Working for our waterways



Interdisciplinary competence enables future-proof solutions

Climate change, increasing ship sizes, modernisation and extension projects: waterways engineering in Germany faces exciting challenges. Our seaports are transshipment hubs in a global transportation system and growth drivers for the German economy. Rivers and floodplains offer huge potential for nature protection and biodiversity. And then there are the new digitalisation and automation technologies, which make inland navigation even more efficient. Our task is to ensure that waterways are fit for the needs of the future: by developing sustainable infrastructure and mobility, conducting practice-related research and taking on board a wide range of stakeholders.

Areas of responsibility at a glance



Consultancy and expert opinions

The BAW is a provider of science services in the field of waterways engineering and special shipbuilding. We offer comprehensive consultancy, reflecting the latest developments in science and technology to our clients; especially the Federal Ministry of Transport and Digital Infrastructure and the Federal Waterways and Shipping Administration. In addition to hydraulic engineering, our focus is on the maintenance of existing structures and the development of infrastructure by extension and new construction measures to meet future demand. In this context, environmental and climate-relevant parameters play an increasingly important role.

Research and development

Our services are founded on extensive research and development work. We are currently involved in around 100 research projects on infrastructure, mobility and ecological issues, often in close cooperation with other research institutions. Topics range from sediment management issues, repairs of existing structures and restoration of ecological connectivity at barrages through to the creation of near-natural habitats by means of technical-biological bank protection.



Standardisation

We are involved in national and international activities to develop and improve specific standards for the construction, operation and maintenance of waterways. In cooperation with German and international experts working in a large number of standardisation committees and associations, we develop new standards for technical applications and methods, which ensure the safety, efficiency, and profitability of waterways engineering.

Transfer of knowledge

We prioritise transparency and participation. This is why we organize conferences and training on the implementation of technological innovations. By holding lectures at universities and other higher education institutions, we support the education of junior engineers in the domain of waterways engineering. Comprehensive digital offerings at no charge provide accessible specialist information to businesses, administrative and scientific institutions, and society as a whole, e.g. in the Hydraulic Engineering Information Centre (*Infozentrum Wasserbau, IZW*).



“Model- and data-driven analyses are the basis of sustainable estuary management.”

Frank Kösters,
Head of the Section of Estuary Systems,
Hydraulic Engineering in Coastal Areas



HYDRAULIC ENGINEERING IN COASTAL AREAS

Long-term simulations for a better understanding of systems

For centuries, estuaries have been preferred regions for settlements and trade. International seaports such as Hamburg or Bremerhaven developed in the estuarine areas of the River Weser and the River Elbe. Today, modern hydraulic engineering in coastal areas faces complex challenges. What is the impact of sea level rise on ship navigation and the Wadden Sea? How can we provide the best possible near-natural bank protection? What are the important factors for construction and development works on maritime waterways? The BAW's experts apply state-of-the-art methods to collect data on hydrodynamics, sediment transport and morphodynamics. Planning is based on computer-aided long-term simulations covering one to several decades. The increasing precision of the analyses ensures that ecological requirements are reconciled with economic considerations.

CONSTRUCTION MATERIALS
AND STRUCTURAL ENGINEERING

Hydraulic structures for generations

Solid structures such as locks and weirs are designed for a service life of at least 100 years with a minimum of repairs. In some cases, the loads to which they are exposed in this time by far exceed the loads acting on normal structures: for example due to approaching ships, bed-load transport, or frost and chloride attack. These are challenging requirements with a significant influence on the design and the selection of the concrete used. Only those types of concrete that combine high resistance characteristics with low heat development in the hardening phase are suitable for hydraulic engineering purposes. We provide consultancy in the building phase of such solid structures, and the results are included in recommendations, codes and guidelines for planners, construction material manufacturers and the parties responsible for the construction work.

**“The durability of our
hydraulic structures is the
benchmark for our work.”**

Andreas Westendarp,
Head of the Section of Construction Materials,
Department of Structural Engineering



Geotechnical Engineering

“As geotechnical engineers we assess the interaction between water, ground and structure to assure the stability and resistance of navigation locks, weirs, embankments and banks.”

Dr.-Ing. Jan Kayser,
Head of the Department of
Geotechnical Engineering

The planning of hydraulic structures requires comprehensive geotechnical expertise. The many years of professional experience accumulated in our department combined with excellent testing equipment are in demand whenever complex geotechnical issues arise in connection with the maintenance and development of waterways.

We advise the German Federal Waterways and Shipping Administration (WSV) on construction measures carried out on inland waterways and in coastal areas. We also investigate ground and groundwater conditions, produce recommendations for foundations, support the WSV in river bank and bottom protection measures and provide consultancy regarding soil dynamics. Construction work in existing

building stock, in particular, requires specific method expertise: For instance, it is important to understand the complex interaction taking place between a structure, the water and the ground when deep excavation sites are adjacent to locks or weirs in operation.

Climate change, environmental protection and (Germany's) 'energy turnaround' all present us with new challenges regarding expertise and methods. Projects, such as offshore wind turbines with foundations up to 50 m below the water surface or the renaturation of banks and river landscapes, involve breaking new technological ground. It is especially in such projects that research and practice are closely intertwined, laying the foundation for new standards and guidelines.

Structural Engineering

Hydraulic structures like the Niederfinow ship lift, which was commissioned in 1934, or the more than 100-year-old Eder Dam are still admired. But can the existing infrastructure meet current requirements for safety and economic efficiency considering the increasing loads on this structure? Is there any material fatigue in the structure or is the efficiency of corrosion protection impaired? These are some of the issues investigated by the BAW's Structural Engineering department with the aid of expert opinions, analyses and research results.

We provide consultancy to the WSV on construction-, statics- and material-specific tasks, both with respect to existing facilities and the planning of new hydraulic structures. In doing so, we have to consider a large variety of aspects and parameters. This is why we work across

sections when dealing with hydraulic engineering topics or reliability analyses, bringing together the knowledge and competence of our experts.

When thorough investigations and evaluations of existing structures are needed or concepts for repair measures have to be developed, the BAW relies on in-depth examination of structures, state-of-the-art methods and up-to-date codes and regulations. In this way we can ensure the continuing reliability of hydraulic structures. The planning, construction and operation of the structures are increasingly supported by digital technologies. Overall, our experience, our analyses, our internally-developed methods and our networking activities in the waterways engineering and scientific communities are the foundation of our excellent reputation.

“Hydraulic structures stand for longevity and robustness. Maintaining existing facilities and building new future-proof structures require safety and sustainability concepts – that's what we are working for.”

Claus Kunz,
Head of the Department of
Structural Engineering



Hydraulic Engineering in Inland Areas

Increasing the attractiveness of waterways as a mode of transport and enhancing their capacity as a response to growing ecological and water management requirements: the tasks the BAW faces with regard to the inland waterway network are challenging.

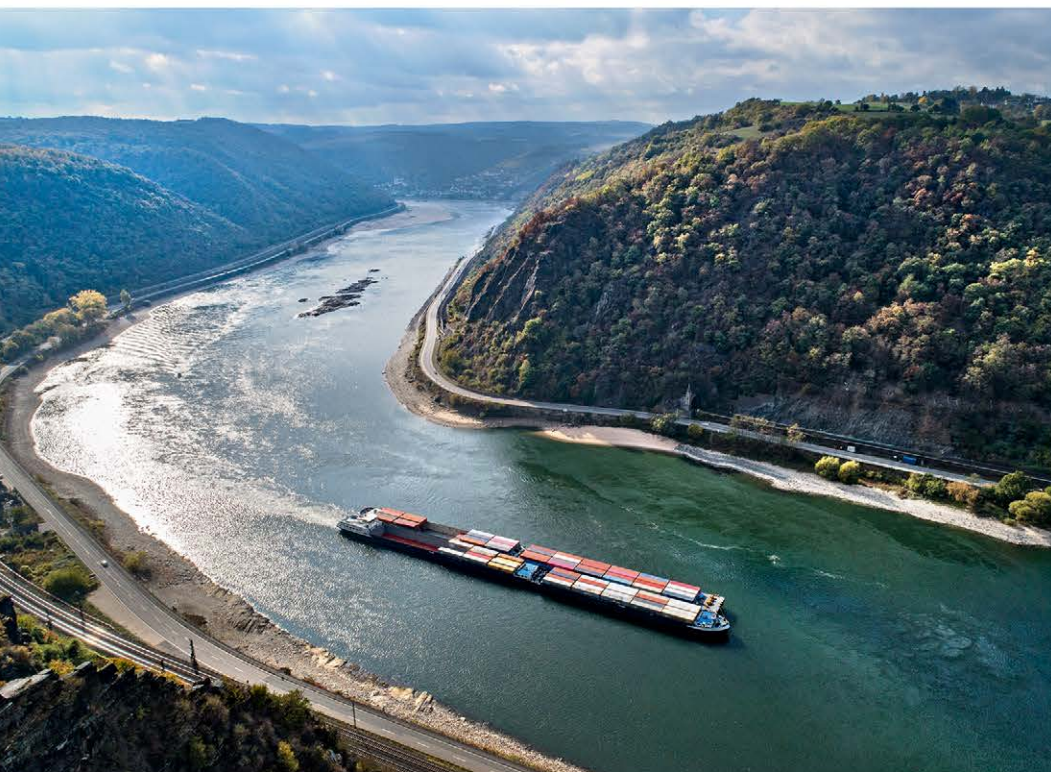
Our investigations and research results provide important decision-making input when it comes to developing our waterways to manage increasing usage demand and climate-related change. In this context, a comprehensive understanding of the system is needed, as is reflected in our focal topics. These cover a broad range of subjects, from the hydraulics of waterways engineering structures to assistance systems for efficient ship handling; from river control structures such as groynes to optimised water-

ways maintenance strategies, e.g. by means of sediment management.

In addition to field measurements, the BAW uses especially hydraulic, morphological and ship dynamics simulations based on numerical and physical methods. For instance, our laboratories in Karlsruhe house the model of a 4.4 km-long section of the River Rhine in the reach between Bingen and St. Goar at a scale of 1:60. The BAW uses this model to examine how sediment deposition in the fairway can be reduced in order to maintain shipping operations, including in increasingly frequent low water conditions. Another experimental design is used to improve upstream fishways and thus ensure ecological connectivity in Germany's federal waterways.

"Modern waterways engineering needs to provide holistic solutions in line with the numerous functions federal waterways are expected to fulfil."

Prof. Dr.-Ing. Andreas Schmidt,
Head of the Department of
Hydraulic Engineering in Inland Areas



Hydraulic Engineering in Coastal Areas



More than 90 percent of the goods traded worldwide are transported by sea. In view of Germany's increasing volume of foreign trade, high-capacity infrastructure in seaports and on the waterways to ports is crucial for the German economy. At the same time, maritime waterways in tidal rivers and coastal waters, with their brackish and shallow water zones and tidal flats, are ecosystems that require special protection. Balancing these conflicting goals can be difficult for the responsible decision-makers.

Climate change and sea level rise are both major challenges for the Department of Hydraulic Engineering in Coastal Areas. Which adaptations will be required to maintain the safe-

ty and ease of navigation, and accessibility of seaports in the future? How can the potential effects of planned measures on the environment be analysed before these measures are even implemented?

We approach these complex issues and other questions in close cooperation with all the relevant stakeholders representing the interests of environmental protection, the fishing industry and also the recreational and tourism sector. Using data from field investigations, laboratory analyses, model tests and simulation models, we deliver recommendations for long-term investment decisions which reconcile economic and ecological needs to achieve future-proof solutions.

"Our focus lies on reconciling economic, ecological and societal needs when planning a future-proof traffic infrastructure in coastal areas."

Holger Rahlf,
Head of the Department of
Hydraulic Engineering in Coastal Area

SHIP TECHNOLOGY

Meeting the highest requirements – specialised shipbuilding involves several federal institutions

Modern specialised vessels fulfil a multitude of functions in maritime emergency preparedness and rescue operations, marine and fisheries research, marine environmental monitoring, maritime surveying, wreck search or testing of new radar and navigation equipment. The requirements for planning and building new, sustainable research vessels or workboats are therefore very high. The BAW's Department of Ship Technology is a competence centre for the building of specialised civilian ships and provides consultancy to various federal institutions on all issues relating to technical concepts and ship design. The BAW takes over the operational management during building: from the initial concept, planning and contract award procedures through to construction and final handover to the operator. With innovative solutions for challenging tasks.



"Before a specialized ship designed by us is put to sea for the first time, we accompany the whole process, from the initial concept and construction through to sea trial and its launch."

Benno Lenkeit,
Head of the Section of Ship Technology

“How can the safety and efficiency of navigation locks be increased even more? Practical scientific investigations help us to find answers to such complex questions.”

Dr.-Ing. Lydia Schulze,
Scientist, Section of Hydraulic Structures

THE BAW AS A FEDERAL RESEARCH INSTITUTE

Finding answers to today's and tomorrow's questions

We need future-proof strategies to ensure that our waterway transport system can meet tougher requirements. For the BAW as a federal research institute it is therefore crucial, in addition to working on current topics, to focus on forward-looking research. In our work we combine a practical, problem-oriented approach with standards of quality. For example, new, scientifically corroborated criteria for the hydraulic design of locks provide the foundation for standardised evaluations and hydraulic engineering solutions – from the planning of simplified filling systems to the adaptation of operational schedules and prevention of critical system states.

Shared knowledge lays the foundation for progress

Whether in the field of infrastructure, mobility or ecology: Using increasingly precise calculation and simulation models, study methods and analyses, we establish the basis for competent guidance and recommendations. The data thus generated are an invaluable asset, both for our future work and for external scientists, planners and hydraulic engineers. An important part of our digitalisation strategy therefore lies in user- and service-centred data management. The overall aim: quality-assured, specialised data provided for free use and in a structured and platform-independent form. As part of our open access and open data strategies we ensure the accessibility of specialist publications and data worldwide and at no charge, as, for example, in the world's first discipline-specific repository for hydraulic engineering (HENRY), which the BAW has been operating since 2017.

“From platform-independent access to data to an international specialist exchange: digitalisation offers tremendous potential in waterways engineering.”

Ellen Diermayer,
Section of Data Management
and Systems Technology

Working together to make the future predictable

Actively shaping infrastructure planning: everyday work for our staff. In a variety of consulting and research projects, and as sought-after experts in science and politics. At our locations in Karlsruhe and Hamburg, experts from a variety of disciplines are working together on interdisciplinary topics and practical issues, supported by cutting-edge equipment and infrastructure.

Perfectly networked

To meet personnel requirements, the BAW has for a long time been cooperating closely with universities and other higher education institutions in Germany and abroad. We provide custom-tailored programmes for junior scientists, with BAW experts supporting them in their work on papers and theses. PhD students are offered challenging research projects in hydraulic, geotechnical and structural engineering disciplines.

“We set great store by continuous training and active networking with other scientists. Our Hydraulic Engineering Information Centre provides the necessary digital knowledge and research tools.”

Peter Weinmann,
Head of the Department
of Central Services

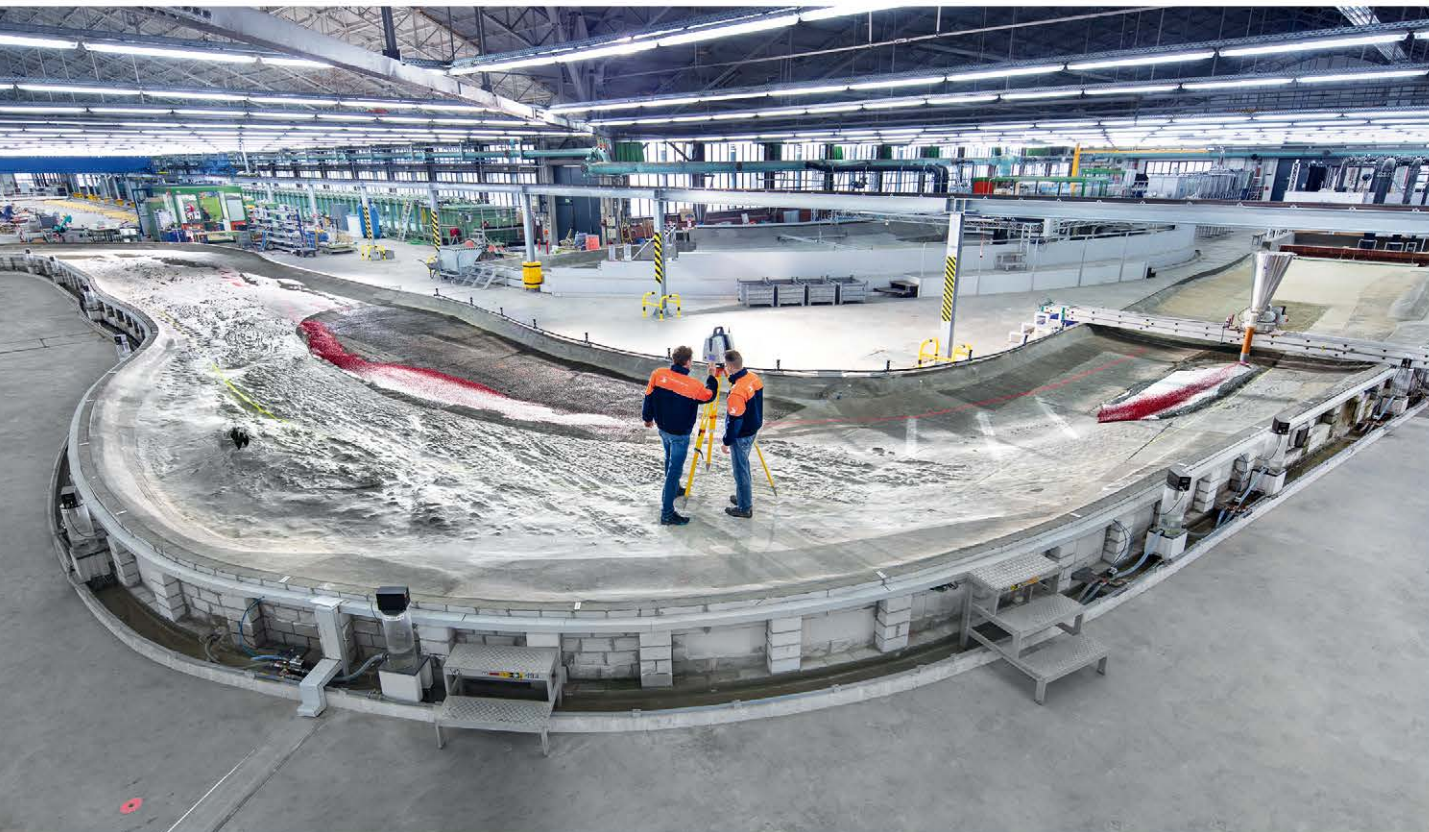


Family-friendly organised

At the BAW, opportunities for personal development and career-building not only mean working in excellent teams, with state-of-the-art equipment and in diverse projects. It is also important to us to promote our employees' work-life balance, e.g. by offering flexible working time models and attractive fringe benefits, such as our health management scheme, which offers our staff in Karlsruhe and Hamburg a multifaceted prevention programme. Moreover, working parents at our Karlsruhe location can use the on-site nursery “Water Fleas” with a total of 25 places for children within the age range of six months to six years.

“Flexible working hours and a creative work environment: we aim to offer an open company culture as the basis of excellent cooperation.”

Katja Perras,
Deputy Head of the Department
of Central Services



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