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in Inland Waterway Logistics

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LOGISTIKUM Steyr
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viadonau

READER – STRENGHTENING OF DANUBE NAVIGATION

Extract of relevant passages from the „Manual of Danube Navigation", via donau (2012).

Transport policy framework

In addition to the goal of ensuring a high level of accessibility, **European and national transport policies** are increasingly striving to create preconditions for sustainable and energy-efficient transport. Inland navigation can contribute substantially to this due to the fact that it is environmentally friendly, safe and offers spare capacity.

In order to strengthen the share of inland navigation in an integrated transport system, the European Union has published an **Action Programme for the Promotion of Inland Waterway Transport** – "**NAIADES**" (European Commission 2006). In the Danube region, the Strategy for the Danube Region of the European Union will provide an important framework for development activities until 2020 (European Commission 2010b).

On a national scale, transport policy targets have been defined in specific **action programmes** for inland navigation or in **national transport master plans**, which refer to the above-mentioned political programmes at a European level.

One of the most important goals for the coming years will be to utilise the national and European programmes and strategies in order to enhance and modernise navigation on the Danube.

Strengths and weaknesses of Danube navigation

The **strengths** of Danube navigation lie mainly with its ability to convey large quantities of goods per vessel unit, its low transport costs and its environmental friendliness. Furthermore, it is available around the clock, with no prohibition on driving at weekends or during the night. In addition, it has a high level of safety and low infrastructure costs.

The **weaknesses** of this mode of transport are its dependence on current fairway conditions and the associated variable load factor of the vessels, its low transportation speed and network density which means that pre- and end-haulage by road or rail are often necessary.

The main **opportunities** for Danube navigation are the enormous amount of spare capacities that the waterway has to offer, international development initiatives such as the Strategy for the Danube Region, the internalisation of external costs on a European scale, cooperation activities with road and rail, as well as the application of modern and harmonised River Information Services (RIS).

The key **threats** to Danube navigation are its variable weighting on the political agenda, and consequently in the budget debates of the various Danube countries, as well as the need for modernisation of many Danube ports and parts of the Danube fleet.

STRENGTHS	WEAKNESSES
• low transport costs • ability to convey large quantities of goods per unit • environmental friendliness • safety • availability around the clock • low infrastructure costs	• dependence on variable fairway conditions • low transport velocity • low network connectivity, often requiring pre- and end-haulage
OPPORTUNITIES	**THREATS**
• spare capacity of the waterway • rising demand for environmentally friendly transport modes • modern and harmonised cross-border information services (RIS) • cooperation activities with road and rail • international development initiatives (e.g. NAIADES, Strategy for the Danube Region)	• inadequate maintenance of the waterway in some Danube riparian countries • high requirement for modernisation of ports and fleet

Source: via donau

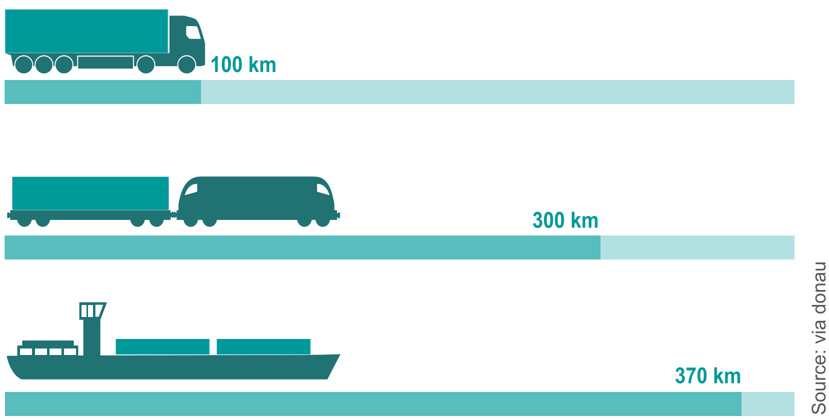
SWOT analysis of Danube navigation

Danube navigation compared to other modes of transport

In comparison to other modes of transport, several factors demonstrate the advantages of inland navigation. For example, it features the lowest specific energy consumption and the lowest external costs of any land transport mode. Furthermore, it has the ability to transport large quantities of goods per unit (bulk freight capacity) and requires comparably low investment in maintaining and expanding its infrastructure.

Specific energy use

With regard to **specific energy use**, inland navigation can be described as the most effective and most environmentally friendly mode of transport. An inland vessel is able to transport one ton of cargo almost four times further than a truck using the same consumption of energy.



Transport distances for one ton of cargo requiring the same amount of energy

External costs

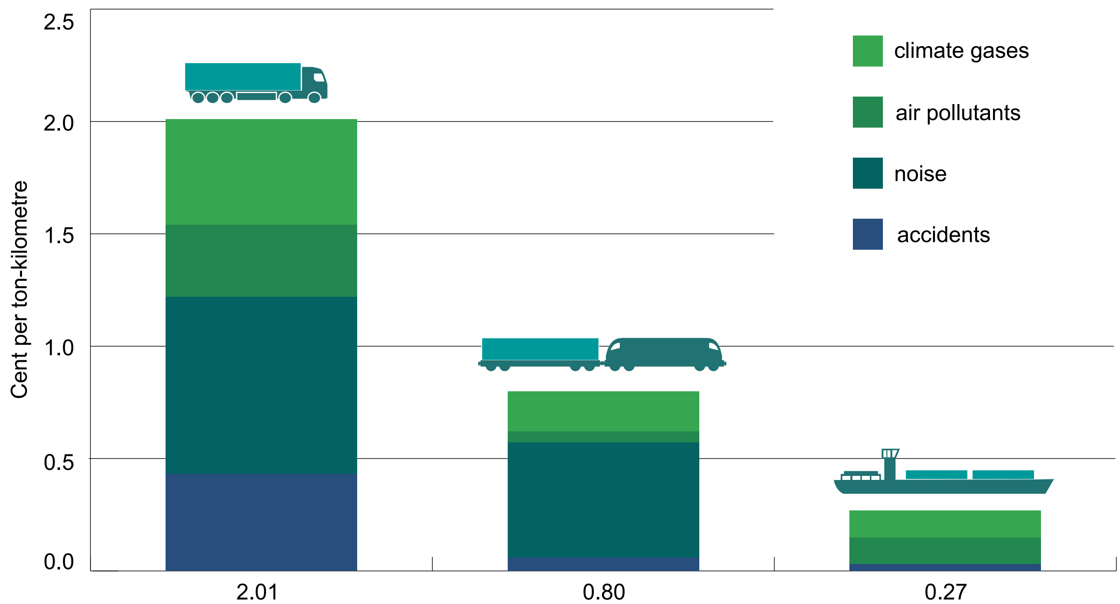
External costs for inland navigation, i.e. costs deriving from climate gases, air pollutants, accidents and noise, are the lowest when compared to other transport modes. CO_2 emissions are, in comparison to other modes of transport, especially low and this enables inland navigation to contribute to the achievement of climate goals set by the European Union.

Bulk freight capacity

Compared with other land transport modes, Danube navigation offers significantly higher **transport capacity per transport unit**. A single convoy with four pushed lighters can move 7,000 tons of goods, which corresponds to a load of 175 railway wagons each containing 40 net tons or 280 trucks each containing 25 net tons. Raising the amount of goods transported on the Danube will consequently result in a reduction of traffic jams, noise, pollution and accidents on roads and relieve strain on the railway system.

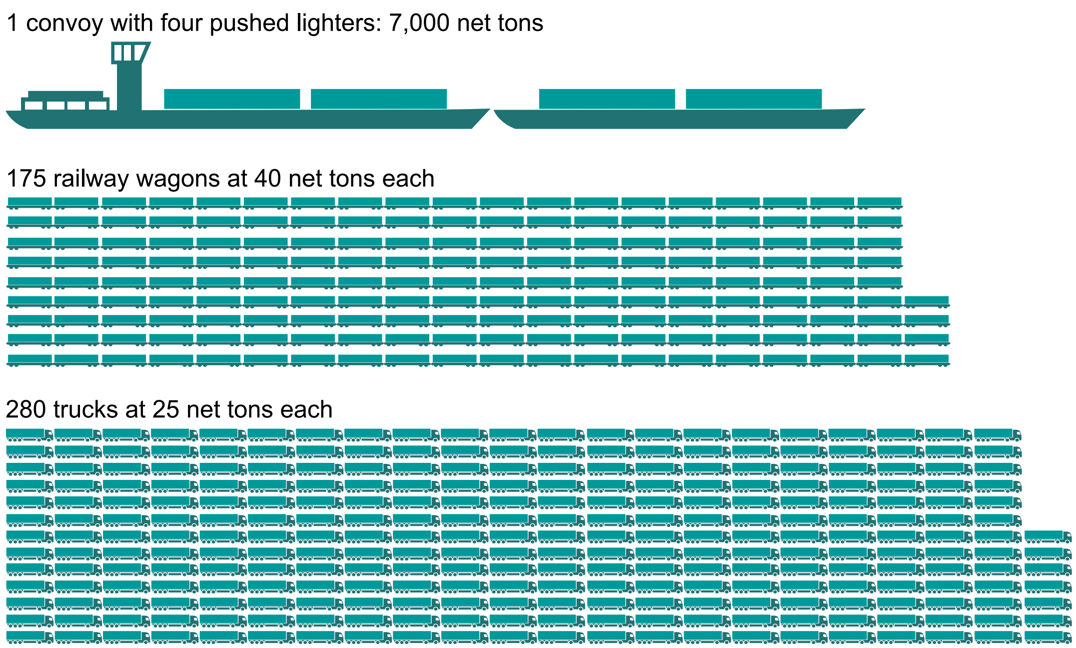
Infrastructure costs

Infrastructure costs consist of **costs for constructing and maintaining transport routes**. In the case of inland navigation, natural infrastructure is usually available, resulting in comparably low infrastructure costs. Detailed comparisons of aspects regarding inland transport modes are available for Germany: infrastructure costs per ton-kilometre are roughly four times higher



The sum of external costs for inland vessels is by far the lowest (average values for selected transports of bulk goods)

Source: PLANCO Consulting & Bundesanstalt für Gewässerkunde 2007



Inland vessels beat road and rail in terms of transport capacity

Source: via donau

Comparison of infrastructure costs (example of German inland transport modes)

Source: PLANCO Consulting & Bundesanstalt für Gewässerkunde 2007

for road or rail than for waterways (PLANCO Consulting & Bundesanstalt für Gewässerkunde 2007).

Improving the complete infrastructure of the 2,415 km long Danube waterway would require an investment of 1.2 billion EUR according to current cost estimations for infrastructure projects in the Danube riparian states. This corresponds roughly with the cost of constructing 50 km of road or rail infrastructure. The costs for current railway tunnel projects in Europe amount to between10 and 20 billion EUR.

In addition, the EU is striving to better integrate private stakeholders into the financing of projects. The most important financing opportunities are represented in the **European funding database for inland waterway transport**.

European funding database for inland waterway transport: www.naiades.info/funding

Transport policy framework at European level

Overall targets and strategies

The EU strategy **Europe 2020**, which was adopted in 2010, describes the essential overriding (transport) policy targets and strategies of the European Union for the year 2020. Accordingly, the strategy also provides the policy framework for the further development of inland navigation (European Commission 2010a). In a rapidly changing world, the EU is aiming for growth which is:

- **smart** (through more effective investments in education, research and innovation),
- **sustainable** (thanks to a decisive move towards a low-carbon economy and competitive industry) and
- **inclusive** (with a strong emphasis on job creation and poverty reduction).

Further information on the Europe 2020 strategy is available on the website of the European Commission: ec.europa.eu/europe2020

The process will be steered on the basis of five policy targets, which will enable the measurement of its implementation. The fields of **climate change and energy** together with **research and development** are of particular relevance to inland navigation. In the field of climate change and energy, targets have been set to cut greenhouse gas emissions in the range of 20 to 30% in comparison to 1990, to raise the share of renewable energy to 20% and to boost energy efficiency by 20%. For research and development in Europe, 3% of the gross domestic product of the EU will be made available.

The European Commission's 2011 **White Paper on Transport** titled "Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system" (European Commission 2011) sets ambitious targets for reducing oil dependency and CO_2 emissions. The latter should be reduced by 60% by 2050 in comparison to 1990.

The White Paper recognises inland navigation as an energy-efficient transport mode and encourages the raising of its share in the modal split. The following **goals of the White Paper** are specifically relevant for inland navigation:

- 30% of road freight over 300 kilometres should shift to other transport modes such as waterway transport by 2030, and more than 50% by 2050. This shall be facilitated by efficient and green multimodal transport corridors. The Danube is part of such a corridor within the scope of the EU's trans-European transport network (TEN-T), i.e. core network corridor

No. 10 “Strasbourg – Danube”.

- A fully functional and EU-wide multimodal TEN-T core network shall exist by 2030, with an extended network of high quality and high capacity by 2050 with a corresponding set of information services. Special relevance is given to the European ports in their function as interfaces between the transport modes.
- Equivalent management systems for land and waterway transport (River Information Services – RIS) shall be deployed.
- The principles of “user pays” and “polluter pays” shall be fully applied in the transport sector and a higher level of engagement by the private sector should be encouraged. This shall contribute to the elimination of distortion, generate revenue and ensure financing for future transport investment.

Source: via donau/Johannes Scherzer

Further information on the 2011 White Paper on Transport is available on the website of the European Commission: ec.europa.eu/transport/strategies/2011_white_paper_en.htm

Website of the NAIADES Action Programme: www.naiades.info

The targets of the White Paper shall be achieved by means of a **roadmap of 40 project activities** over the next decade. For Danube navigation, relevant project activities include the creation of a multimodal core network, the establishment of a suitable framework for inland navigation and the development of multimodal freight transport backed by telematics systems (“e-freight”).

Targets and strategies related to inland navigation

The **Action Programme for the promotion of inland waterway transport “NAIADES”** created by the European Commission defines the inland navigation policy of the European Union (European Commission 2006). The programme was first published in 2006 and combines legislative, coordinative and other supportive measures. It provides guidelines for a joint approach to strengthen inland waterway transport to the member states as well as the European Union itself.

Until 2020, the **NAIADES II Action Programme** will advance the strategic development in the five areas of infrastructure, markets, fleet, jobs and skills as well as River Information Services. It is designed to augment the capacity utilisation of inland waterways along with the sustainability of inland navigation in Europe.

PLATINA (Platform for the Implementation of NAIADES) has been installed as a platform for the coordinated implementation of the strategies and measures of the NAIADES Action Programme. The initiative was started by numerous partners from several European countries and has, to date, produced essential milestones, such as improved access to financing for innovations, the development of education standards, the definition of strategic research needs, the bundling and dissemination of innovative concepts and good practices as well as guidelines for the sustainable planning of waterway infrastructure development projects.

Website of the NAIADES implementation platform PLATINA: www.naiades.info/platina

The NAIADES Action Programme, together with the successful operation of the PLATINA implementation platform, has positively influenced the perception of inland navigation not only at a European and national political level but also in the European navigation sector. Crucial preconditions for promoting this sustainable transport mode have been developed and will serve as a basis for work in the coming years.

Transport policy framework in the Danube region

Strategy for the Danube Region

The **Strategy of the European Union for the Danube Region** (EUSDR) has been in force since 2011 (European Commission 2010b). The EUSDR is a macro-regional strategy comprising of 14 Danube countries, among them EU member states, candidate countries and third countries. Additionally, a large number of stakeholders are involved in the process of the strategy's implementation.

Danube countries participating in the Strategy for the Danube Region are: Germany, Austria, the Czech Republic, Slovakia, Slovenia, Hungary, Romania, Bulgaria, Croatia, Serbia, Montenegro, Bosnia and Herzegovina, Ukraine and Moldova.

The strategy is intended to be implemented until 2020 on the basis of an action plan which rests on four pillars: Connecting the Danube Region, Protecting the Environment in the Danube Region, Building Prosperity in the Danube Region and Strengthening the Danube Region. For each pillar, distinct targets and actions have been specified by the EU and the Danube countries.

The four pillars are further divided into eleven priority areas. Austria and Romania are jointly coordinating Priority Area 1a – **To improve mobility and multimodality: Inland waterways**.

Web platform of Priority Area 1a – To improve mobility and multimodality: Inland waterways: www.danube-navigation.eu

Further information on the ICPDR, including the text of the Danube River Protection Convention: www.icpdr.org

Information on the EU's Water Framework Directive: ec.europa.eu/environment/water/water-framework

The targets for Priority Area 1a for inland waterways of the Strategy for the Danube Region are defined as follows:

- Increase the cargo transport on the river by 20% by 2020 compared to 2010.
- Solve obstacles to navigability, taking into account the specific characteristics of each section of the Danube and its navigable tributaries and establish effective waterway infrastructure management by 2015.
- Develop efficient multimodal terminals at river ports along the Danube and its navigable tributaries to connect inland waterways with rail and road transport by 2020.
- Implement harmonised River Information Services (RIS) on the Danube and its navigable tributaries and ensure the international exchange of RIS data preferably by 2015.
- Solve the shortage of qualified personnel and harmonise education standards in inland navigation in the Danube region by 2020, taking duly into account the social dimension of the respective measures.

Based on periodic evaluation, target achievement will be measured and roadmaps for implementing specific measures will be adapted accordingly.

Source: via donau/Robert Tögel

Win-win for navigation and ecology by integrative waterway infrastructure projects on the Danube

Belgrade Convention

The **Convention Regarding the Regime of Navigation on the Danube** was signed by all Danube riparian states ("Belgrade Convention" of 1948). Its main targets are to safeguard the freedom of navigation on the Danube for all states as well as to oblige the Danube states to maintain their sections of the Danube waterway to a navigable condition.

The implementation of the Belgrade Convention, together with adherence to its provisions, is supervised by the **Danube Commission** which is based in Budapest. The Commission is made up of the signatory states of the Belgrade Convention.

Danube River Protection Convention

The International Commission for the Protection of the Danube River (ICPDR) was founded in 1998 and is located in Vienna. The dedicated aim of the "Danube River Protection Commission" is the implementation of the **Convention on Cooperation for the Protection and Sustainable Use of the Danube River** ("Danube River Protection Convention") as well as that of the Water Framework Directive (WFD) of the European Union in the Danube region. The signatories of this convention – along with members of the commission – are 14 Danube states and the European Union. The Danube River Protection

The signatory states of the Belgrade Convention are Bulgaria, Germany, Croatia, Moldova, Austria, Romania, Russia, Serbia, Slovakia, Ukraine and Hungary.

Detailed information about the Danube Commission including the text of the Belgrade Convention:
www.danubecommission.org

Web platform of the Strategy for the Danube Region:
www.danube-region.eu

Source: INTERACT

Area of application of the Danube Strategy

Convention is of relevance to inland navigation, because river engineering measures have an effect on the hydromorphological situation and/or the natural composition of ecological communities. In addition to the effects on hydromorphology, navigation may also have further effects on riverine landscapes, e.g. from pollution or wash from waves.

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Further information on the Sava River Basin Commission including the text of the Framework Agreement on the Sava River Basin:
www.savacommission.org

Framework Agreement on the Sava River Basin

The Sava river is one of the most important navigable tributaries of the Danube. The International Sava River Basin Commission (ISRBC) was founded in 2005 in order to implement the **Framework Agreement on the Sava River Basin** (FASRB), which was signed by the four Sava riparian states Serbia, Bosnia and Herzegovina, Croatia and Slovenia in 2002. The commission pursues the following goals:

- establishment of an international regime of navigation on the Sava river and its navigable tributaries
- establishment of sustainable waterway management, including the integrated management of surface and ground water resources
- implementation of measures to prevent or limit hazards such as floods, ice, droughts and accidents involving substances hazardous to water

Transport policy framework in Austria

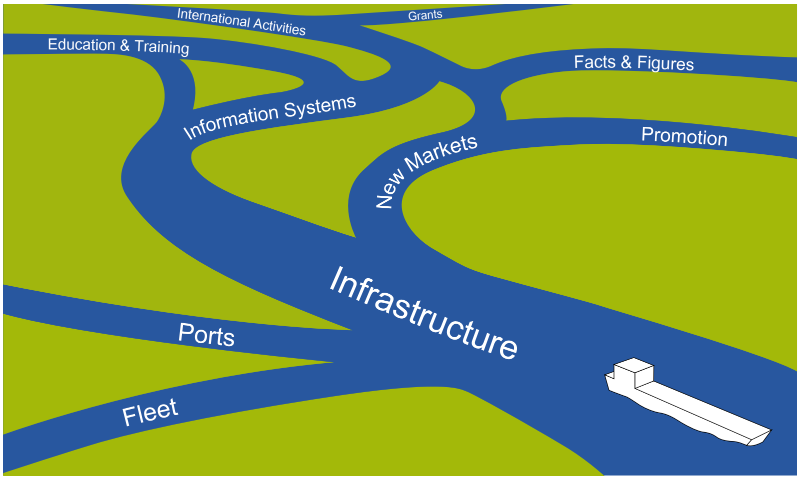
National Action Plan for Danube Navigation

In Austria, transport master planning is defined by the "National Investment Programme for Federal Transport Infrastructure 2011–2016" and is based on a prognosis for the transport modes of road, rail, waterway and air until 2025.

The detailed basis for Austria's policy on inland navigation is the **National Action Plan for Danube Navigation** – NAP (Federal Ministry for Transport, Innovation and Technology 2006). The Action Plan has been included in Austria's governmental programme since 2007 and is jointly implemented by via donau – Österreichische Wasserstraßen-Gesellschaft mbH and the Federal Ministry for Transport, Innovation and Technology.

On the basis of European guidelines, the NAP aims to strengthen inland navigation in Austria through various measures. These measures focus on the following areas as depicted in the illustration below, and are described in detail in the various chapters of this manual.

Numerous core measures of the National Action Plan have already been



Source: via donau

Interdependency of measures according to the Austrian National Action Plan on Danube Navigation

implemented while the strategy as a whole is constantly being further developed.

National funding schemes

In order to promote the development of inland navigation, **funding schemes for specific issues** have also been launched at a national level in Austria in addition to the strategic and legal framework. The current Austrian funding programmes are also featured in the **European funding database for inland waterway transport**.

Legal framework for inland navigation in Austria

The legal provisions for inland navigation in Austria are defined by European regulations and their conversion into national law on the one hand, along with specific national legal provisions on the other.

Waterways Act (Federal Gazette I 177/2004)

The Waterways Act defines the tasks and the organisation for the management of Austria's federal waterways for which via donau – Österreichische Wasserstraßen-Gesellschaft mbH is responsible. via donau is a federal agency owned by the Austrian Federal Ministry for Transport, Innovation and Technology. The strategic planning, steering and supervision of the federal waterways lies with the Federal Ministry itself.

According to the law, all measures involving bodies of water have to be undertaken in a way that is as environmentally friendly as possible. Waterways have to be planned, built and maintained in a way that enables

@ Detailed information on the National Action Plan for Danube Navigation: www.bmvit.gv.at/verkehr/schifffahrt/binnen/aut/nap.html

@ European funding database for inland waterway transport: www.naiades.info/funding

@ Further information on the legal framework for inland navigation in Austria can be found on the website of the Federal Ministry for Transport, Innovation and Technology: www.bmvit.gv.at/verkehr/schifffahrt/binnen/

all users to use them without danger in accordance with the legal navigation regulations.

Navigation Act (Federal Gazette I 62/1997)

The Navigation Act regulates navigation on Austrian waters and contains provisions with regard to waterways, shipping facilities, laws regulating shipping trade licenses, ship's certificates, ship operation and navigation schools.

System elements of waterway infrastructure

The size of inland vessels or convoys suitable for specific inland waterways depends mainly on the current **infrastructure parameters of the waterway** concerned. Determinants of waterway infrastructure for navigation are:

- Fairway (depth and width, curve radius)
- Lock chambers (available length and width of lock chambers, depth at pointing sill)
- Bridges and overhead lines (clearance height and available passage width under bridges and overhead lines)

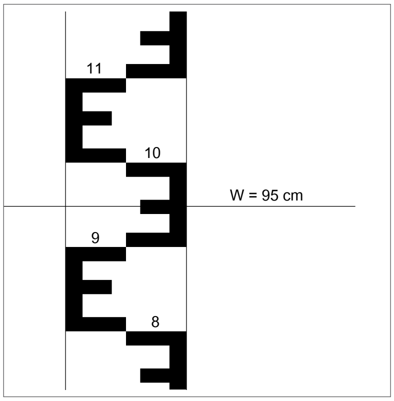
In context with these determinants there are **further framework conditions** which may influence navigation on a certain waterway section:

- Waterway police regulations (e.g. maximum permissible dimensions of vessel units, limitations on the formation of convoys)
- Traffic regulations (e.g. one-way traffic only, maximum permissible speed on canals or in danger areas)

- Navigation restrictions and suspensions due to adverse weather conditions (floods, ice formation), maintenance and construction works at locks, accidents, events etc.

Water levels and gauges of reference

A **water gauge** measures the gauge height which corresponds to the height of water at a certain point in the reference profile of a body of water, i.e. the **water level**. In general, gauge heights are measured several times a day. Nowadays, they are also published on the Internet by the national hydrographic services.



Source: via donau/Andi Bruckner

Gauge staff at a gauging site; sample water level at gauge: 95 cm

It has to be kept in mind that the water level measured at a water gauge does not allow for any conclusions about the actual water depth of a river to be made and hence about current fairway depths. This is due to the fact that the **gauge zero**, i.e. the lower end of a gauge staff or altitude of a gauge, does not correspond with the location of the riverbed. The gauge zero can lie above or below the medium riverbed level of a river section. In rivers, the flow of the current and the riverbed change fairly often and hence the gauge zero of a water gauge cannot be constantly realigned.

When assessing the currently available water depths within the fairway, boatmasters refer to **gauges of reference**, which are relevant for certain sections of inland waterways. The water levels at the water gauge of reference are decisive for the draught loaded of vessels, for the passage heights under bridges and overhead lines as well as for restrictions on or suspension of navigation in periods of floods.

Reference water levels

The mean sea level measured at a gauging site of the nearest ocean coast serves as the reference for determining the absolute or geographic level of a gauge zero on the earth's surface, the so-called **absolute zero point**. Hence, the water gauges along the river Danube have different reference points: the North Sea (Germany), the Adriatic Sea (Austria, Croatia, Serbia), the Baltic Sea (Slovakia, Hungary) and the Black Sea (Bulgaria, Rumania, Moldova, Ukraine).

As the water level at a gauge changes continually, **reference water levels** or **characteristic water levels** have been defined in order to gain reference values, e.g. on the maintained depth of the fairway. Characteristic water levels are **statistical reference values for average water levels** which have been registered at a certain gauge over a longer period of time. The most important reference water levels for inland waterway transport are:

- **Low navigable water level** (LNWL)
- **Highest navigable water level** (HNWL)

If the highest navigable water level (HNWL) is reached or exceeded by over a certain degree, the authority responsible for the waterway section concerned may impose a temporary suspension of navigation for reasons of traffic safety.

Low navigable water level (LNWL) = the water level reached or exceeded at a Danube water gauge on an average of 94% of days in a year (i.e. on 343 days) over a reference period of several decades (excluding periods with ice).

Highest navigable water level (HNWL) = the water level reached or exceeded at a Danube water gauge on an average of 1% of days in a year (i.e. on 3.65 days) over a reference period of several decades (excluding periods with ice).

Fairway and fairway depths

The **fairway** or fairway channel is the area of a body of inland water for which certain fairway depths and fairway widths are maintained for navigation purposes. The width and the course of the fairway are marked by internationally standardised **fairway signs** such as buoys or marks on river banks.

For rivers, the determination of the cross section of the fairway, i.e. its depth and width, is based on a "minimal" cross section. This minimal cross section is

Source: via donau/Andi Bruckner

Red buoy with cylindrical topmark for marking the right-hand fairway limit inferred from the “most shallow” and “most narrow” stretches of a certain river section at low water levels. For the Danube, the **fairway depth** determined for a “minimal” cross section refers to low navigable water level (LNWL). The **current fairway depth** can be calculated with the following formula:

Current water level at gauge of reference
+ Minimum fairway depth at LNWL
– LNWL value for gauge of reference
Current minimum fairway depth

In order to provide navigation with sufficient fairway depths on natural waterways during periods of low water levels and enable cost-effective transport on a river even during such adverse water levels, **river engineering measures** may be taken. Generally, this includes the construction of **groynes** which maintain the river’s water yield within the fairway at low water levels. Groynes are structures which are normally made up of coarse boulders which are dumped into a certain area of the riverbed at a right angle or with a certain inclination. River engineering structures which are constructed parallel to a river’s flow are called **training walls** and have the purpose of influencing the flow direction of a body of water and stabilising its cross section.

The authorities and organisations responsible for maintaining a waterway aim to keep fairways at a constant minimum depth, e.g. by conservational dredging measures in the fairway. These so-called **minimum fairway depths** of a fairway are geared to low navigable water level (LNWL) as a statistical reference value for the water level.

Source: via donau

Declining groyne, i.e. adjusted to the river’s flow direction, for river regulation at low water levels

As there are **no guaranteed minimum fairway depths** at LNWL on the Danube (with the exception of the Bavarian section of the Danube in Germany), boatmasters and shipping operators have to plan their journeys according to the fairway depths which are currently available at the most shallow stretches of the waterway (= fords) or according to the admissible maximum draught loaded (= draught of a vessel when stationary) as foreseen by waterway police regulations.

The Romanian section of the Danube between Brăila and Sulina is also termed **maritime Danube** as this section is also navigable by river-sea vessels and sea-going vessels. 170 kilometres long, this river section is maintained by the Romanian River Administration of the Lower Danube for vessels with a maximum draught of 7.32 metres. Beyond this, the **Kilia/Bystroe arm**, which is not subject to the Belgrade Convention and which falls under the Ukrainian waterway administration, is navigable by river-sea vessels and sea-going vessels. The Ukraine intends to develop this waterway for sea-going vessels with a miximum draught of 7.2 metres (currently, this value amounts to 5.85 metres).

For more information on the interdependency of available fairway depths and the cost-effectiveness of Danube navigation cf. the section “Business management and legal aspects” in the chapter “The market for Danube navigation”.

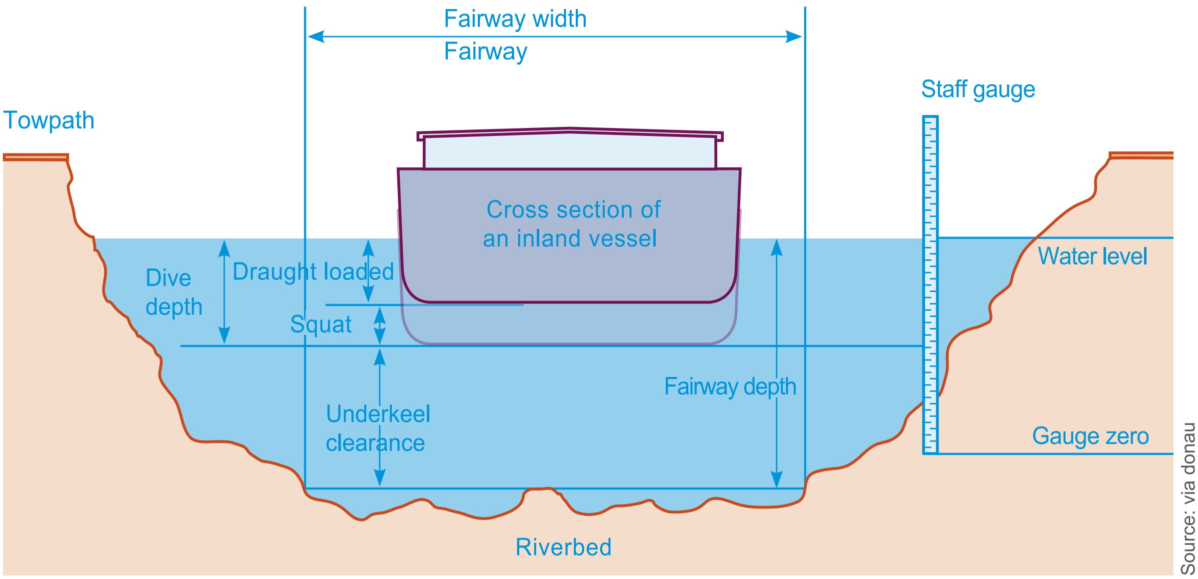
Draught loaded, squat and underkeel clearance

Water depths available in the fairway determine how many tons of goods may be carried on an inland cargo vessel. The more cargo loaded on board of a vessel, the higher is its **draught loaded**, i.e. the **draught** of a ship when stationary and when carrying a certain load. The draughts loaded which may be realised by navigation companies have a decisive influence on the cost-effectiveness of inland waterway transport.

In calculating the potential draught loaded of a vessel on the basis of current fairway depths, the **dynamic squat** as well as an appropriate safety clearance to the riverbed, the so-called **underkeel clearance**, have to be considered in order to prevent groundings of cargo vessels in motion. The **immersion depth** of a ship equals the sum of its draught loaded (loaded vessel in stasis; velocity v = 0) and its squat (loaded vessel in motion; velocity v > 0).

Immersion depth = draught loaded ($V_{vessel} = 0$) + squat ($V_{vessel} > 0$)

Squat refers to the level to which a ship sinks while it is in motion compared to its stationary condition on waterways with a limited cross section (i.e. rivers and canals). A loaded vessel has a squat within a range of about 20 to 40 centimetres. As the squat of a vessel is continually changing according to the different cross sections of a river and the different velocities of a vessel, the boatmaster should not calculate the safety clearance between the riverbed and the bottom of the vessel too tightly when determining the draught loaded of his vessel.



Fairway parameters (schematic presentation)

Underkeel clearance =
fairway depth
– (draught loaded + squat)

This safety clearance is termed **underkeel clearance** and is defined as the distance between the bottom of a vessel in motion and the highest point of the riverbed. Underkeel clearance should not be less than 20 centimetres for a riverbed made of gravel or 30 centimetres for a rocky bed in order to prevent damage to the ship's propeller and/or its bottom.

River power plants and lock facilities

Barrages, i.e. facilities which impound a river with the aim of regulating its water levels, are often created in the form of **river power plants**, which convert the power of the flowing water into electrical energy. In this process they make use of the incline created by impounding the water between the water upstream and downstream of the power plant (headwater and tailwater).

A river power plant usually comprises of one or several **powerhouses**, the **weir** and the **lock** with one or more lock chambers. Locks enable inland vessels to negotiate the differences in height between the impounded river upstream of a power plant and the flowing river downstream of a power plant.

The most common type of lock on European rivers and canals is the **chamber lock** whereby the headwater and the tailwater are connected via a lock chamber which can be sealed off at both ends. When the lock gates are closed, the water level in the lock chamber is either raised to the headwater level (admission of water from the reservoir) or lowered to the tailwater level (release of water into the section downstream of the power plant). No pumps are required for the admission and release of the water.

Depending on the direction in which a vessel passes through a lock, the terms used are **upstream locking** (from tailwater to headwater) or **downstream locking** (from headwater to tailwater). Once a vessel which needs to pass through a lock has been announced via radio, the locking is carried out by the **lock manager**. A locking operation takes approximately 40 minutes, about half of which is required to navigate the vessel into and out of a lock chamber.

Source: via donau

Lock facilities of the river power plant Vienna-Freudenau (river-km 1,921.05)

The fairway depth in a lock chamber is determined by the **depth at the pointing sill** – the distance between the surface of the water and the pointing sill, i.e. the threshold of a lock gate which forms a watertight seal with the gate to avoid drainage of the lock chamber.

Special protective devices protect the lock gates from damage caused by vessels.

Stop logs serve to seal off lock chambers from headwater and tailwater in order to drain lock chambers mainly for reasons of **lock overhaul**, i.e. for maintenance work or for the replacement of lock components.

There are a total of **18 river power plants** on the Danube, with 16 of these power plants located on the Upper Danube due to the high gradient of the river between Kelheim and Gönyű. 14 of the 18 lock facilities on the Danube feature **two lock chambers**, thus enabling the simultaneous locking of vessels sailing upstream and downstream.

The lock facilities downstream of Regensburg all feature a minimum **utilisable length** of 226 metres and a **width** of 24 metres which enables locking of convoys made up of at least two pushed lighters which are coupled in parallel.

No.	Lock/power plant	Country	River-km	Lock chambers Length (m)	Width (m)	Number
1	Bad Abbach	DE	2,397.17	190.00	12.00	1
2	Regensburg	DE	2,379.68	190.00	12.00	1
3	Geisling	DE	2,354.29	230.00	24.00	1
4	Straubing	DE	2,327.72	230.00	24.00	1
5	Kachlet	DE	2,230.60	226.50	24.00	2
6	Jochenstein	DE/AT	2,203.20	227.00	24.00	2
7	Aschach	AT	2,162.80	230.00	24.00	2
8	Ottensheim-Wilhering	AT	2,147.04	230.00	24.00	2
9	Abwinden-Asten	AT	2,119.75	230.00	24.00	2
10	Wallsee-Mitterkirchen	AT	2,095.74	230.00	24.00	2
11	Ybbs-Persenbeug	AT	2,060.29	230.00	24.00	2
12	Melk	AT	2,038.10	230.00	24.00	2
13	Altenwörth	AT	1,980.53	230.00	24.00	2
14	Greifenstein	AT	1,949.37	230.00	24.00	2
15	Freudenau	AT	1,921.20	275.00	24.00	2
16	Gabčíkovo	SK	1,819.42	275.00	34.00	2
17	Đerdap / Porțile de Fier I	RS/RO	942.90	310.00*	34.00	2
18	Đerdap / Porțile de Fier II	RS/RO	863.70 862.85	310.00	34.00	2

* The lock Đerdap / Porțile de Fier I consists of two consentive lock chambers wich require two-stage lockage

Source: via donau

Lock facilities along the Danube

Local RIS lock management

Locks constitute bottlenecks for inland navigation as the bundling of vessel traffic and the time-intensive process of locking delay the journey. Waiting times can be expected by vessels particularly before locking, as currently no long-term advance notification of a vessel's arrival at a lock is possible. Due to the short radio range, boatmasters can only register for the locking process when they are already in the proximity of the lock facility. Therefore, vessels arriving at the lock will be handled according to the principle of "first come, first served" (the only exceptions are liner service, which are given priority in some countries).

The main purpose of a lock management system for inland navigation is to optimise traffic flows by making locking procedures more efficient and projectable. **River Information Services (RIS)** support lock operators in their daily tasks.

RIS lock management in Austria

The RIS systems designed to support lock management at the Austrian Danube locks consist of two main components:

- the tactical traffic image from the DoRIS system and
- the electronic lock management system (LMS)

There is also a connection to the hull database (vessel registration platform).

For the planning of lockings and the identification of the optimum time for a locking procedure, the **use of AIS (Automatic Identification System)** facilitates the determining of the position of all vessels included in the system. According to this, locking cycles can be better planned, unnecessary waiting times can be avoided and empty lockings can be reduced.

An **electronic lock management system** has been introduced at the Austrian Danube locks. With the help of this system, the legally mandatory recording of locking procedures and other workflows has been largely automated.

Before admission to European inland waterways, inland vessels have to undergo a technical inspection. The results of which are recorded in a central vessel database.

Bridges

Bridges can span a waterway, a port entrance or a river power plant and hence a lock facility. On free-flowing, i.e. unimpounded river sections, water

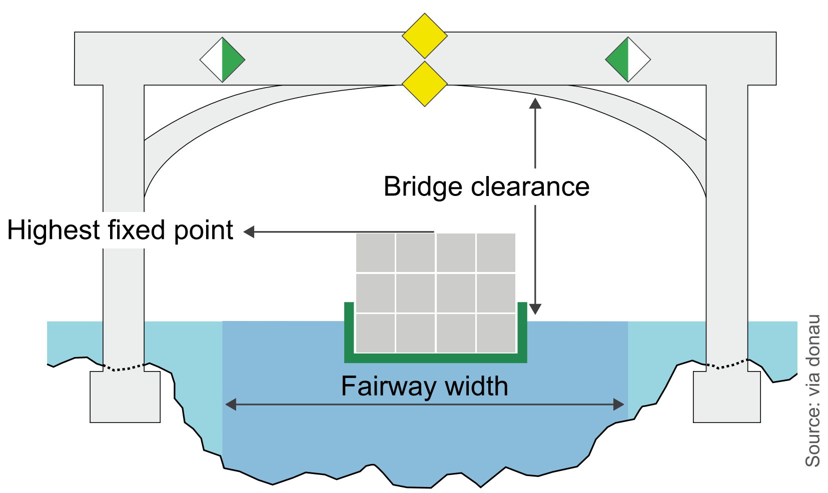
Source: via donau/Andi Bruckner

Lock management at the lock Freudenau in Vienna

levels can be subject to considerable fluctuations which influences the potential passage under bridges at high water levels.

Depending on the distances between the individual bridge pillars there will be one or more – in most cases two – **openings for passage** of vessels. If a bridge has two openings for passage which are dedicated for navigation purposes, one is generally used for upstream traffic and the other for downstream traffic.

Whether a vessel can pass under a bridge depends on the **bridge clearance** above the water level and on the **highest fixed point of the vessel**. The air draught of a vessel is the vertical distance between the waterline and the highest fixed point of a vessel once movable parts such as masts, radar devices or the steering house have been removed or lowered. The air draught of a vessel can be reduced by **ballasting** the vessel. For this purpose, ballast water is pumped into the ballast tanks or solid ballast is loaded.



Air draught of a vessel and vertical bridge clearance as determining parameters for passages under bridges

In addition to the height of bridge openings and a vessel's air draught, the **bridge profile** is another factor which determines whether a vessel is able to pass under a bridge.

For sloped or arch-shaped bridges, not only a vertical but also a sufficiently dimensioned **horizontal safety clearance** must be ensured. As the figures indicating the height and width of an opening for passage below a bridge always refer to the entire width of the fairway, the clearance below the crest of arch-shaped bridges, i.e. below the centre of the bridge, is higher than at the limits of the fairway.

On free-flowing sections of rivers, **vertical bridge clearance** is indicated in relation to the **highest navigable water level** (HNWL), whereby the indicated passage height corresponds to the distance in metres between the lowest point of the lower edge of the bridge over the entire fairway width and the highest navigable water level. The **width of the fairway** below a bridge is indicated in relation to **low navigable water level** (LNWL). In river sections regulated by dams, the **maximum impounded water level** serves as the reference value both for the vertical and the horizontal bridge clearance. The reference level on artificial canals is the upper operational water level.

Between **Kelheim and Sulina**, a total of **130 bridges** span the international Danube waterway. Of these 130 Danube bridges, 21 are bridges over locks and weirs. By far the highest density of bridges, namely 89, can be found on the **Upper Danube**: 41 bridges span the German section of the Danube, 42 the Austrian and six the Slovakian sections of the Danube. On the **Central Danube** there are a total of 34 bridges; on the **Lower Danube** there are only seven.

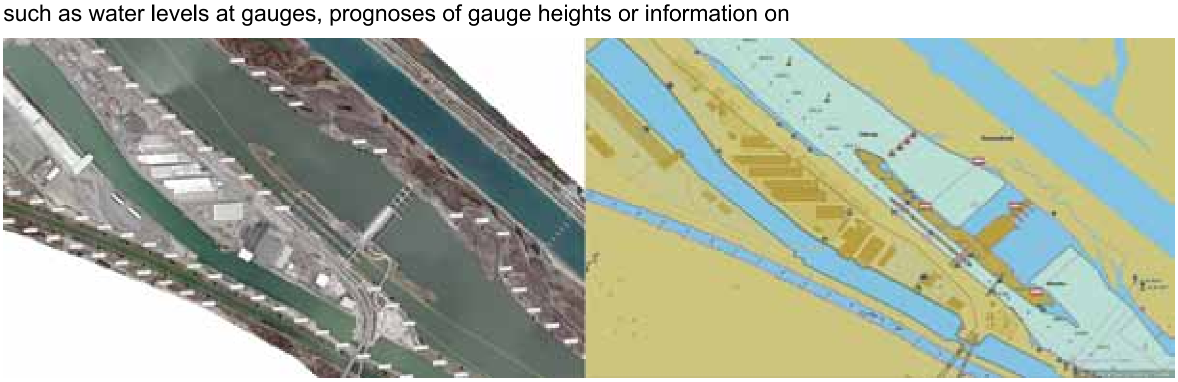
List of Danube bridges with information on their position, main use, passage parameters and reference water gauges: www.donauschifffahrt.info/en/facts_figures

Fairway Information Services

So-called **Fairway Information Services** (FIS) provide current information on the navigability of waterways and therefore support boatmasters, fleet operators and other waterway users in the planning, monitoring and execution of inland waterway transport. The most common way to publish fairway-related information is either through **electronic navigational charts** (Inland ENCs) or online via **Notices to Skippers** (NtS).

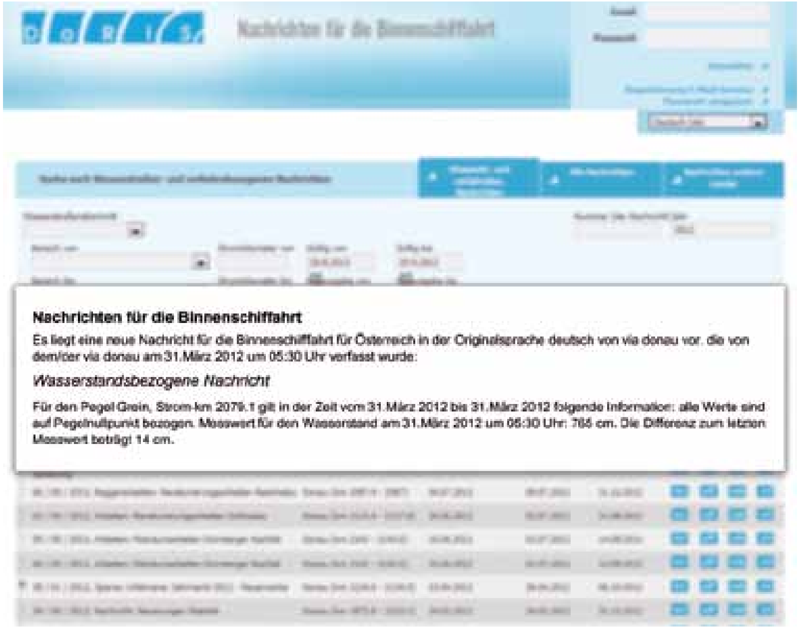
More information on Electronic Navigational Charts and Notices to Skippers can be found in the chapter “River Information Services”.

Static data such as bridge parameters, the dimensions and position of the fairway or results of riverbed surveying activities are included in Electronic Navigational Charts which are updated on a regular basis. Dynamic data such as water levels at gauges, prognoses of gauge heights or information on



Source: via donau

From the areal photograph to the electronic navigational chart



Source: via donau

Online display of a Notice to Skippers

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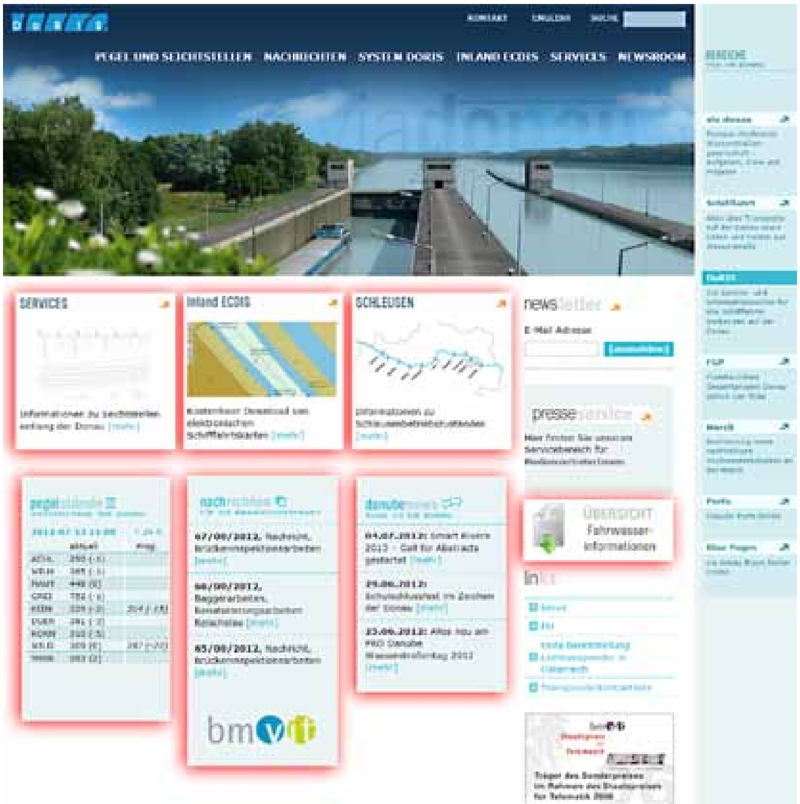
Current fairway information for the Austrian section of the Danube are available at the DoRIS website: www.doris.bmvit.gv.at

navigation restrictions and suspensions are provided via Notices to Skippers or can be directly accessed on the Internet.

Fairway Information Services in Austria

In Austria, a variety of fairway information services is available online and free of charge on the DoRIS website (DoRIS = Donau River Information Services). These include:

- Water levels and shallow sections: information on current water levels and prognoses of gauge heights at nine gauge stations and on fairway depths at relevant shallow sections of the two free-flowing sections of the Danube in Austria; these services can also be retrieved via SMS or Inland AIS (Automatic Identification System)
- Notices to Skippers: include waterway and traffic related messages as well as ice messages and reports
- Current operational status of the nine Austrian Danube locks
- Closures due to flood or ice formation
- The “One Page Info” informs about current water levels, shallow sections, lock status and Notices to Skippers in PDF format which is issued on a daily basis.
- Electronic navigational charts are available for download for the entire section of the Austrian Danube; with the help of a waterline



Source: via donau

Online services available at the DoRIS website

level model for the free-flowing sections of the Danube east of Vienna and in the Wachau valley fairway depths can be displayed in relation to the latest results of riverbed surveying.

Fairway maintenance

The necessary works for the maintenance of the fairway on natural waterways depend on the general characteristics of the respective river: In free-flowing sections the flow velocity of the river is higher than in impounded sections, in artificial canals or in sections flowing through lakes.

In free-flowing sections of rivers the **transport of sediments** (e.g. gravel or sand) is an important dynamic process, especially in periods with higher water levels and the corresponding higher flow velocities of the river. Along with the respective discharge of the river, this transportation of sediment leads to **continuous change in the morphology of the riverbed**, either in the form of sedimentation or erosion.

In **shallow areas** of the river this continuous change of the riverbed can lead to restrictions for navigation with regard to the minimum fairway parameters (depth and width) to be provided by waterway administrations, i.e. reduced depths and widths of the fairway.

Legal and political framework

The overriding aim with regard to the maintenance and optimisation of waterway infrastructure by the Danube riparian states is the **establishment and year-round provision of internationally harmonised fairway parameters**.

The recommended minimum fairway parameters for European waterways of international importance – including the Danube – are listed in the **European Agreement on Main Inland Waterways of International Importance** (AGN) (United Nations Economic Commission for Europe 2010). With regard to the fairway depths to be provided by waterway administrations, the AGN makes the following provisions: On waterways with fluctuating water levels the value of **2.5 metres minimum draught loaded of vessels** should be reached or exceeded on 240 days on average per year. However, for upstream sections of natural rivers characterised by frequently fluctuating water levels due to weather conditions (e.g. on the Upper Danube), it is recommended to refer to a period of at least 300 days on average per year.

Based on the **Convention Regarding the Regime of Navigation on the Danube**, which was signed in Belgrade on 18th August 1948 ("Belgrade Convention"), the Danube Commission recommended the following fairway parameters for the Danube waterway: **2.5 m minimum fairway depth** (1988) repectively **2.5 m minimum draught loaded of vessels** (2013) below low navigation water level (LNWL) (i.e. on 343 days on average per year) on free-flowing sections and a **minimum fairway width of between 100 and 180 metres**, dependent on the specific characteristics of the river section concerned (Commission du Danube 1988 resp. Danube Commission 2011).

Further information on the Danube Strategy and on the EU's trans-European transport network can be found in the chapter "Targets and Strategies" of this manual.

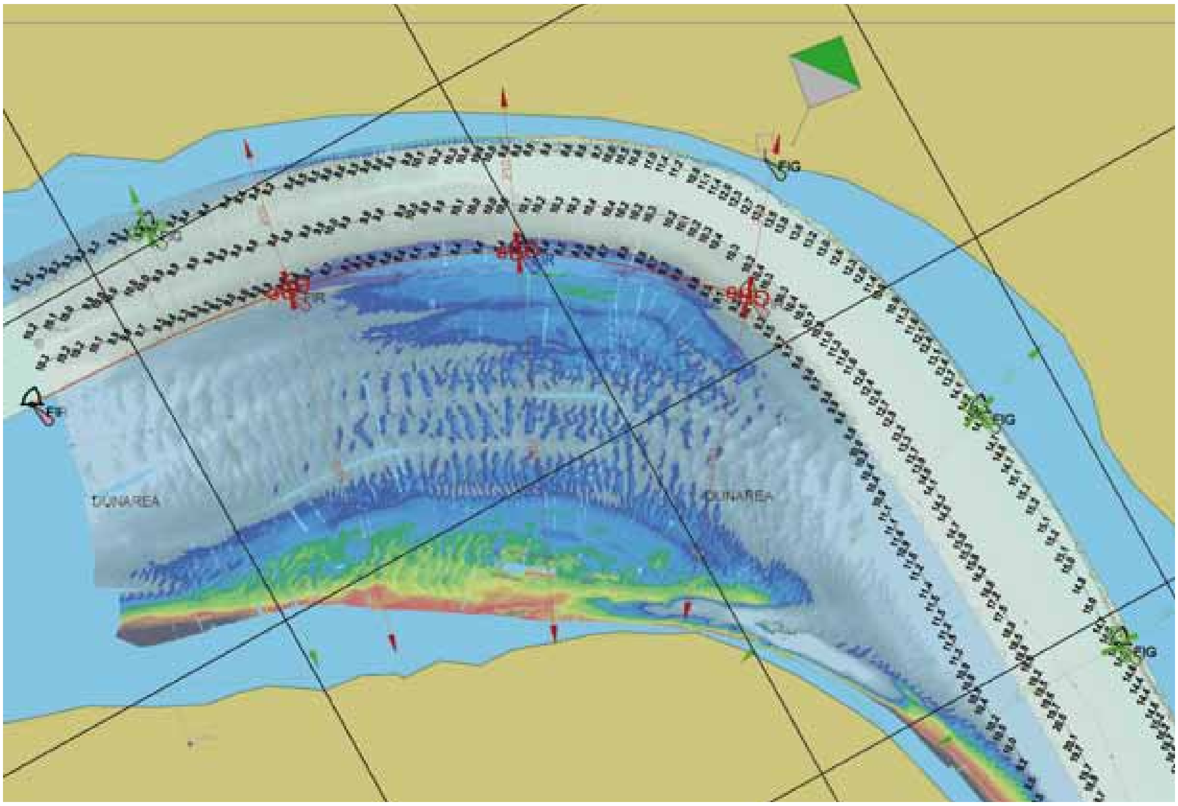
On 7th June 2012, the transport ministers of the Danube riparian states met for the first time at the European Union's Council of Transport Ministers in Luxemburg to agree on a **Declaration on effective waterway infrastructure maintenance on the Danube and its navigable tributaries**. The Declaration came about as a reaction to the Danube's low discharge in autumn 2011 which exposed the shortfalls of some countries in maintaining the infrastructure of the waterway. The riparian states are committed to maintaining adequate fairway parameters for good navigational status according to the provisions of the "Belgrade Convention" and – for those countries who have ratified it – the AGN. The Danube's ministers of transport will now meet once a year to follow up on the conclusions of this meeting and coordinate their actions to implement the targets of the declaration within the framework of the governance structure of the Strategy of the European Union for the Danube Region (EUSDR) and the European Coordinator of the trans-European transport network (TEN-T) responsible for inland waterways. The declaration was signed by all riparian states with the exception of Hungary; Serbia and Ukraine have submitted letters of intent (Status: December 2012)

Fairway maintenance cycle

In the case that the minimum fairway parameters are not achieved, the responsible waterway administration is obliged to take suitable measures in order to re-establish them. This is generally accomplished by **dredging shallow areas** (fords) within the fairway. Dredging is an excavation operation with the purpose of removing bottom sediments (sand and gravel) and disposing of them at a different location in the river in due consideration of ecological aspects.

Dredging works require initial planning on the basis of the results gained from regular **riverbed surveying** and a concluding monitoring (control of success) of the works, which have to be carried out by the responsible waterway administration.

As these **tasks** of maintaining the fairway are **recurrent and interdepend-**

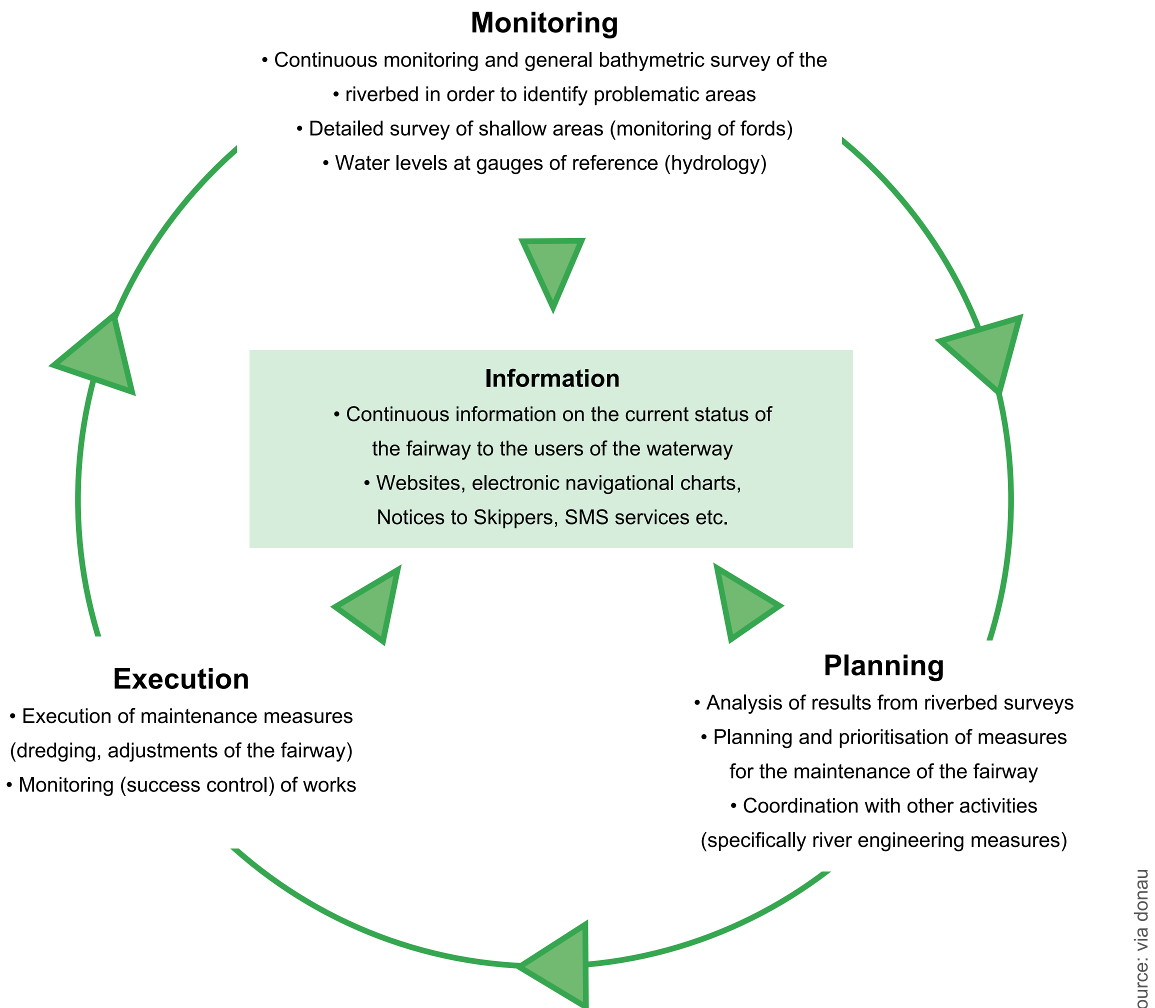


Source: Administraţia Fluvială a Dunării de Jos

Riverbed survey of the maritime Danube stretch in Romania at Tulcea

ent, they can be described as a “fairway maintenance cycle”. Among the most important tasks of this cycle are:

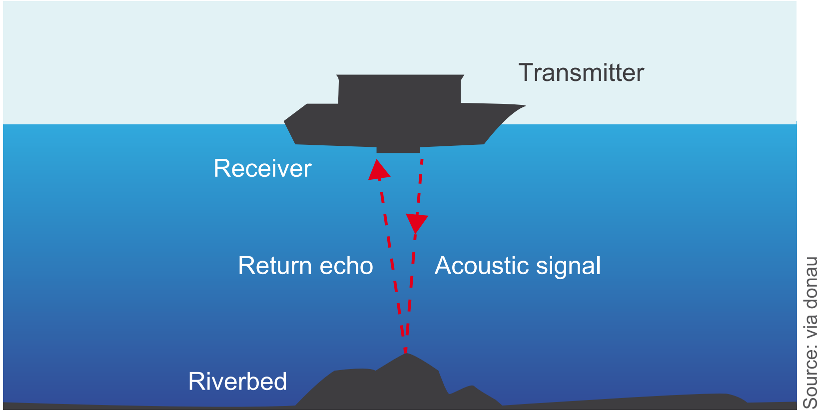
- Regular bathymetric surveys of the riverbed in order to identify problematic areas in the fairway (reduced depth and widths)
- Planning and prioritisation of necessary interventions (dredging measures, realignment of the fairway, traffic management) based on the analysis of up-to-date riverbed surveys
- Execution of maintenance works (mainly dredging measures, including success control)
- Provision of continuous and target group-specific information on the current state of the fairway to the users of the waterway



Fairway maintenance cycle

Surveying of the riverbed

The continuous bathymetric surveying of the riverbed is one of the basic tasks of a waterway administration in order to carry out fairway maintenance measures. Bathymetric survey is conducted on so-called **survey vessels** which are equipped with specific **survey equipment**.



Schematic mode of operation of an echo sounder

The basic device for bathymetric surveying of the riverbed is an **echo sounder** which uses sonar technology for the measurement of underwater physical and biological components. Sound pulses are directed from the water's surface vertically down to measure the distance to the riverbed by means of sound waves. The transmit-receive cycle is rapidly repeated at a rate of milliseconds. The continuous recording of water depths below the vessel yields high-resolution depth measurements along the survey track. The distance is measured by multiplying half the time from the signal's outgoing pulse to its return by the speed of sound in the water, which is approximately 1.5 km/sec.

The two main bathymetric systems for riverbed surveying which are based on the technology of echo sounding are the single-beam and the multi-beam methods.

Single-beam bathymetric systems are generally configured with a transducer mounted to the hull or the side of a survey vessel. A sonar transducer turns an electrical signal into sound (transmitter) and converts sonar pulses back into electrical signals (receiver). Survey vessels using the single-beam technology can only measure water depths below their own survey track, i.e. directly beneath the vessel, thus creating cross or length profiles for the water depths of a river. Accordingly, areas in between the recorded profiles are not surveyed, but in order to display survey results on a map, water depths for these areas are calculated on the basis of a mathematical interpolation

Source: via donau/Andi Bruckner

Multi-beam riverbed survey on the free-flowing section of the Danube east of Vienna by via donau – Österreichische Wasserstraßen-Gesellschaft mbH

method. Consequently, single-beam technology cannot ensure a full coverage of the current morphology of the riverbed. Waterway administrations generally use the single-beam technology to gain a quick overview on the general morphology of shallow river stretches.

In order to obtain full coverage of a riverbed, **multi-beam bathymetric systems** are used. The multi-beam sonar system has a single transducer, or a pair of transducers, which continually transmits numerous sonar beams in a swathe or fan-shaped signal pattern to the riverbed. This makes multi-beam systems ideal for the rapid mapping of large areas. In addition, and in contrast to single-beam technology, multi-beam bathymetry yields 100% coverage of the morphology of a riverbed, i.e. there are no data gaps between cross or length profiles produced by single-beam bathymetry. Unfortunately, multi-beam surveys are more time-consuming and also more complex than single-beam surveys. Waterway administrations use the multi-beam technology as a basis for the planning and monitoring of dredging works as well as for other complex tasks such as searching for sunken objects or research activities.

Maintenance dredging works

On the basis of the results of a bathymetric survey of the riverbed, **shallow areas within the fairway** which need to be dredged can be identified. Waterway administrations either carry out dredging works themselves or assign specialised dredging companies to the task.

The essential questions in this respect are: How much material (measured in m^3) needs to be dredged at which location? At which location shall the dredged material be deposited in the river? The latter question has both an economic aspect (distance between dredging site and disposal area) as well as an ecologic aspect (where is the best place to dispose of the dredged material in terms of environmental impact?).

In general, the **selection of the dredging equipment** to be used for a specific measure is based on the characteristics of the dredging task. On the river Danube, the following dredging equipment is principally used.

On the Upper Danube from Germany to Hungary, where the riverbed generally consists of coarse material (gravel or rocky material), the dredging equipment usually used is **backhoe dredgers in combination with hopper barges**. A backhoe dredger consists of a hydraulic crane which is mounted on a spud pontoon. The crane excavates the material and loads it onto a hopper barge for transportation. Hopper barges have a bottom equipped with doors which can be opened to deposit the dredged material at the disposal site. These non-motorised vessels are moved by pushers and need minimum water depths of approximately two metres. Backhoe dredgers can dredge a wide range of different materials (from silt to soft rock), but their output level is limited. This dredger type is very convenient for accurate dredging such as the removal of local shallow areas.

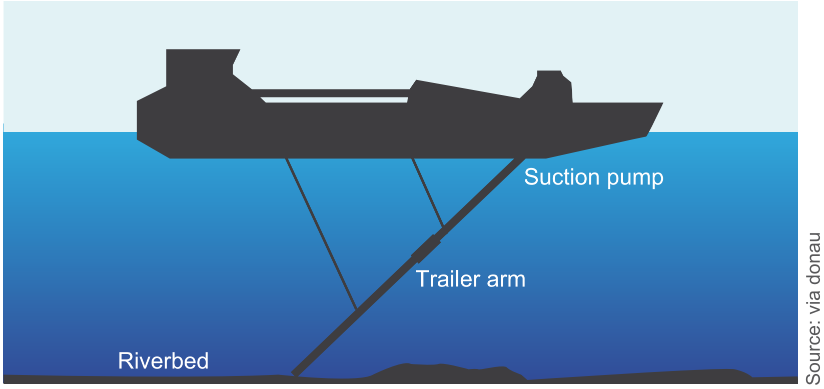
Source: via donau

Dredging works with backhoe dredger in combination with hopper barges on the free-flowing section of the Wachau valley on the Austrian Danube; the excavated material is used to create new gravel islands in the river

Trailing suction hopper dredgers are well suited to dredging soft soil (silt or sand) but require sufficient water depths, i.e. a minimum of five metres. This dredging equipment is especially suitable for the Lower Danube on the Bulgarian and Romanian stretches of the river, where the riverbed consists mainly of silt or sand. Trailing suction hopper dredgers are vessels which are equipped with a suction pipe which acts like a huge "vacuum cleaner" on the riverbed. The excavated material is pumped on board and stored in the hopper (a hold on board the ship). Once the vessel is fully loaded, it navigates to the disposal area where the bottom doors of the hopper are opened and the excavated material falls onto the riverbed. This type of dredger does not need anchors and is also very convenient for carrying out maintenance dredging works, provided that a disposal site can be found in the river at a reasonable distance.

Improvement and extension of waterways

Apart from the maintenance of the fairway of inland waterways for the purpose of meeting the recommended fairway parameters, infrastructure work on waterways may also include the improvement or extension of the existing inland waterway network. The **improvement** of a waterway pertains to the upgrade of its UNECE waterway class or to the removal of so-called "infrastructural bottlenecks". The **extension** of the network can be the construction of new



Scheme of a trailing suction hopper dredger

waterways which in some cases, according to the AGN, may be described as "missing links".

The maintenance, improvement and extension of inland waterways should always be accomplished by taking the following two main aspects of inland waterway infrastructure development into account:

- **Economics of inland navigation**, i.e. the connection between the existing waterway infrastructure and the efficiency of transport

- **Ecological effects of infrastructure works**, i.e. balancing environmental needs and the objectives of inland navigation (integrated planning).

Legal and political framework

The legal/political framework for the improvement and the extension of the inland waterway infrastructure network is set at the following different levels by the corresponding institutions as well as by strategic projects and documents:

- **Pan-European**: United Nations Economic Commission for Europe (UNECE) international resolutions and agreements (AGN; Resolution No. 49 on the most important bottlenecks and missing links in the E waterway network)
- **European**: European Union (primarily the Directorates-General for Mobility and Transport, Regional Policy, Environment) Danube waterway as part of Corridor 10 in the framework of the trans-European transport network; Priority Area 1a (To improve mobility and multimodality: Inland waterways) of the Strategy of the European Union for the Danube region; Water Framework Directive, Natura 2000 network etc.
- **Regional** (Danube region): Danube Commission, International Commission for the Protection of the Danube River, International Sava River Basin Commission Belgrade Convention, Recommendations on the minimum requirements of fairway parameters as well as the improvement of the Danube by hydro-engineering and other measures, plan for the principal works called for in the interests of navigation; Danube River Basin Management Plan, Joint Statement (cf. below under "environmentally sustainable Danube navigation"); Framework Agreement on the Sava River Basin and accompanying strategy for its implementation

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UNECE Working Party on Inland Water Transport:
www.unece.org/trans/main/sc3/sc3.html

Trans-European transport network:
ec.europa.eu/transport/infrastructure

Infrastructure bottlenecks in the Danube river basin waterway network according to UNECE Resolution No. 49

Priority Area on inland waterways of the Danube Region Strategy: www.danube-navigation.eu

Danube Commission: www.danubecommission.org

International Sava River Basin Commission: www.savacommission.org

More information on the topic at the website of the Danube Protection Commission: www.icpdr.org/main/issues/navigation

- **National**: national transport strategy and development plans of the ten Danube riparian states, as the maintenance and improvement of the infrastructure of inland waterways is a national competence of the countries concerned

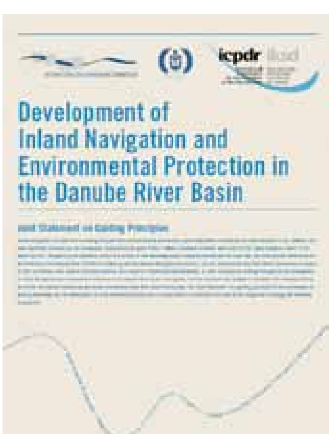
Environmentally sustainable Danube navigation

Large river systems such as the Danube are highly complex, multi-dimensional, dynamic ecosystems and thus require comprehensive observation and management within their catchment area.

Such a holistic approach is also required by the **Water Framework Directive** (WFD) of the European Union (🗎 European Commission 2000). For international river basin district entities such as the Danube the WFD requires the coordination of international river basin management plans which also involve non-EU member states wherever possible. In the Danube river basin district, the **International Commission for the Protection of the Danube River** (ICPDR) is the platform for the coordination of the implementation of the WFD on the basin-wide scale between the Danube countries.

In 2008, the ICPDR, the Danube Commission and the International Sava River Basin Commission (ISRBC) endorsed a **Joint Statement on Guiding Principles for the Development of Inland Navigation and Environmental Protection in the Danube River Basin** (🗎 International Commission for the Protection of the Danube River 2008). The statement provides guiding principles and criteria for the planning and implementation of waterway projects that bring together the sometimes conflicting interests of navigation and the environment. It opts for an **interdisciplinary planning approach** and the establishment of a "common language" across all disciplines involved in the process.

International Commission for the Protection of the Danube River: www.icpdr.org



In order to facilitate and ensure the application of the Joint Statement, a **Manual on Good Practices in Sustainable Waterway Planning** has been developed by the ICPDR and relevant stakeholders in the Danube region within the framework of the EU project PLATINA in 2010 (🗎 Platform for the Implementation of NAIADES 2010). The basic philosophy is to integrate environmental objectives into the project design, thus preventing legal environmental barriers and significantly reducing the amount of potential compensation measures.

The Manual proposes the following **essential features for integrated planning**:

- Identification of integrated project objectives incorporating inland navigation aims, environmental needs and the objectives of other uses of the

Source: via donau/Andi Bruckner

Win-win for ecology and commerce: renaturation and innovative regulation of low water levels on the free-flowing section of the Danube east of Vienna

river reach such as nature protection, flood management and fisheries
- Integration of relevant stakeholders in the initial scoping phase of a project
- Implementation of an integrated planning process to translate inland navigation and environmental objectives into concrete project measures thereby creating win-win results
- Conduct of comprehensive environmental monitoring prior, during and after project works, thereby enabling an adaptive implementation of the project when necessary

Integrative waterway planning in Austria

via donau – Österreichische Wasserstraßen-Gesellschaft mbH, a subsidiary of the Austrian Federal Ministry for Transport, Innovation and Technology, has gained the required experience and competency regarding the improvement of ecological conditions for navigable rivers as a result of numerous projects accomplished over the past years.

Seen against this background, the **Bad Deutsch-Altenburg pilot project** is a unique milestone. This EU co-funded project has been designed to test river engineering measures on a project stretch of approximately three kilometres which are scheduled to be implemented along the entire 48 km long section of the Danube between the Freudenau power station

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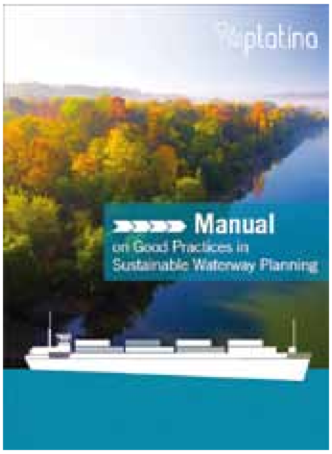
PLATINA project website, on which the Good Practices Manual is available under "Downloads" in electronic form: www.naiades.info/platina



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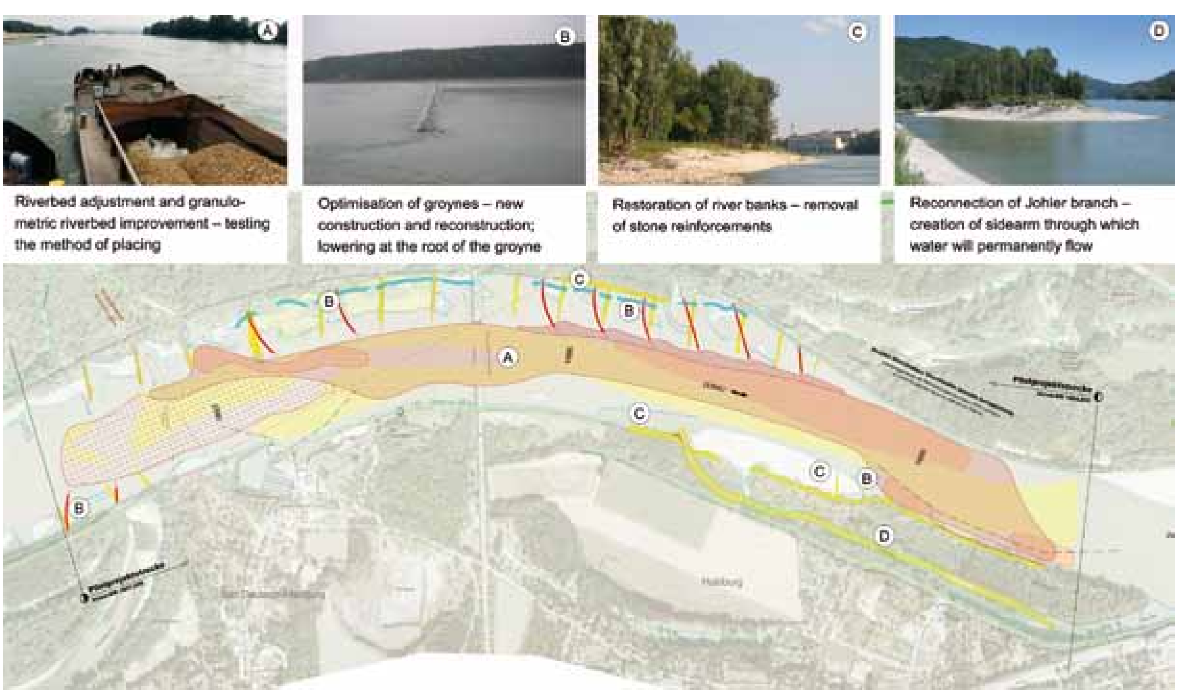
Project website:
www.lebendige-wasserstrasse.at

and the Slovakian border at a later date. Measures are aimed at eliminating the progressive degradation of the Danube's riverbed on this stretch of the river and improving navigation conditions as well as the ecological situation in the Danube Floodplain National Park in a sustainable way. Giving due consideration to flood control, these improvements will be achieved solely by using hydraulic engineering measures, thus preserving the free-flowing section of the Danube in this area:

- **Restoration of river banks**: The removal of stone reinforcements on a stretch approximately 1.2 kilometres long will allow the Danube to form natural banks once again.
- **Lowering of bank structures**: This measure will make it easier for Danube water to flow into the Stopfenreuth floodplain at higher water levels.
- **Reconnection of sidearms**: In this section of the Danube, the 1.3 kilometres long Johler branch will become the first sidearm through which water will flow throughout nearly the whole year.
- **Optimisation of low-water regulation**: In total, 19 groynes will be completely removed, four will be lowered and ten new ones will be built, including the testing of declining and crescent-shaped structures.



Source: via donau

Integrative river engineering measures planned for the Bad Deutsch-Altenburg pilot project east of Vienna

- **Granulometric riverbed improvement**: Coarse gravel will be used to cover lower riverbed zones which are particularly exposed to the river's current while fords will remain untouched by this measure.

Thanks to **integrated planning**, this project will allow both the environment and navigation to profit from these measures. An Interdisciplinary Steering Group consisting of experts from the fields of hydraulic engineering, inland navigation, regional economy and ecology is accompanying the process. Project planning is based on common design principles which were agreed upon by the Interdisciplinary Steering Group. Their realisation will provide the possibility of gaining new experience from the river. For this reason, a targeted observation of developments in the project's implementation as well as continuative scientific research on the ecosystem are essential elements of the project. Furthermore, affected and interested groups of people – among them commercial enterprises and environmental organisations – are involved in a stakeholder forum, providing them with the possibility to effectively contribute to the pilot project.

In designing the **timeline and the manner of implementation of construction works**, periods that are ecologically sensitive for animal and plant life have been and are being taken into consideration. A special ecological supervisory body will ensure the project's low-impact realisation.

Waterway management in Austria

With a river stretch of 350.50 kilometres, Austria's share of the entire Rhine-Main-Danube waterway is about 10%. In addition to the Danube, the following water bodies are also dedicated waterways in Austria: Danube Canal in Vienna (17.1 km) and short sections of the Danube tributaries Traun (1.8 km), Enns (2.7 km) and March (6.0 km).

via donau – Österreichische Wasserstraßen-Gesellschaft mbH is responsible for maintaining the Austrian section of the Danube waterway and its navigable tributaries and canals. The company was established in 2005 by the Austrian Federal Ministry for Transport, Innovation and Technology (bmvit) for the purpose of maintaining and developing the Danube waterway. The legal basis for all activities and services supplied by the company is provided by the **Waterways Act** (Federal Law Gazette I 177/2004). Tasks include the establishment and provision of fairway parameters (waterway maintenance in accordance with the international

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Website of via donau:
www.via-donau.org

provisions in force), the implementation of ecological hydraulic engineering and renaturation projects, the maintenance and restoration of river banks as well as the continuous provision of hydrographical and hydrological data. Regarding traffic management, via donau operates an in-

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formation and management system for navigation named DoRIS (Donau River Information Services) and is responsible for the management of the nine Austrian Danube locks. The headquarter of via donau is located in Vienna; in order to carry out its tasks, the company also owns five branch offices along the Danube and March rivers.

@ Website of bmvit:
www.bmvit.gv.at

The strategic planning, control and monitoring of the administration of federal waterways rests with the **Federal Ministry for Transport, Innovation and Technology** (bmvit). As a subordinate entity of the Supreme Navigation Authority (OSB) in the Ministry, navigation surveillance is carried out by nautically trained administration police who are responsible for ensuring the consistent administration of navigation on the Austrian section of the international Danube waterway within the framework of the “Belgrade Convention”. Among the tasks of the navigation surveillance, which has six field offices along the Danube in Austria, are navigation control, including marking of the fairway, the supervision of adherence to all administrative regulations pertaining to navigation, the issuing of directives to the users of the waterway and assistance after accidents.

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River Information Services

What are River Information Services?

The growing demand for high-quality, cost and time-saving transport services, as well as the provision of electronic information, has become an important success factor for logistics companies. In order to better equip inland waterway transport with the necessary tools for these needs, tailor-made **information and management services** – so-called River Information Services (RIS) – have been developed in Europe to assist both freight and passenger shipping on the waterway.

River Information Services increase traffic safety and improve the efficiency, reliability and scheduling of transport. The available RIS data form a base of information for the support of traffic and transport related tasks.

Source: via donau

Inland AIS base station

The European Union RIS Directive

The harmonisation of river information services is EU wide and regulated by the **Directive on harmonised river information services (RIS) on inland waterways in the Community** which has been effective since 20th October 2005 (European Commission 2005).

This so-called "RIS Directive" contains mandatory technical provisions for navigational equipment and electronic data interchange along with minimum requirements for RIS implementation. The aim is to prevent the development of a conglomerate of dissimilar RIS applications and incompatible technologies within the EU. The Directive regulates:

- Mandatory **technical standards** for RIS implementation regarding
  - Tracking and tracing of inland vessels (Inland AIS)
  - Electronic navigational charts (Inland ENCs)
  - Notices to Skippers (NtS)
  - Electronic reporting systems for voyage and cargo data (ERI – Electronic Reporting)
- Standardisation of **vessel equipment**
- Standardisation of **RIS data exchange**

RIS technologies

RIS technologies such as **Inland AIS, Inland ECDIS, NtS** and **ERI** are specified in the RIS Directive. These technologies are the basis for a variety of services, including fairway information services, traffic information, traffic management, information for transport logistics, port and terminal management, voyage planning and statistics.

This chapter provides a general overview of RIS technologies. Detailed information on the individual technologies are included in the other chapters of this manual.

Inland AIS

In inland navigation, the **vessel tracking and tracing system** Inland AIS (Inland Automatic Identification System) is used for the automatic identification and tracking and tracing of vessels. AIS was originally introduced by the International Maritime Organization (IMO) to support maritime navigation. In order to meet the requirements of inland navigation, it was extended to the Inland AIS standard which enables the transmission of additional information.

Source: via donau/Andi Bruckner

AIS transponder on board an inland vessel

In Austria, Slovakia and Hungary, an AIS transponder requirement for vessels with a length exceeding 20 metres is effective. Serbia and Croatia already have a nationwide AIS infrastructure and in the future a requirement to carry an AIS transponder on board is planned. Bulgaria and Rumania are still working on the construction of the AIS infrastructure (status as of December 2012).

The most important AIS element on board an inland waterway vessel is the so-called **Inland AIS transponder**, which enables the exchange of information relevant to the positioning and identification of vessels and also facilitates the exchange of data between vessels equipped with transponders. Each vessel equipped with an Inland AIS transponder sends static (e.g. ship number, call sign, name), dynamic (e.g. position, speed, course) and voyage-related (e.g. draught loaded, destination, estimated time of arrival) data. All vessels equipped with transponders, as well as Inland AIS base stations on the shore, can see the transmitting vessel which is within reach on the display of the transponder or on a computer with Inland ECDIS software. Hereby, boatmasters are provided with an accurate overview of live traffic within the surrounding area of their vessel.

River Information Services supported by Inland AIS include:

- Automated vessel tracking and tracing
- Tactical traffic imaging
- Real-time traffic information
- Calculation of estimated time of arrival
- Tracking of accidents
- Lock management

Inland ENCs and Inland ECDIS

Inland ENCs are electronic navigational charts which can be displayed with the aid of a special software (Inland ECDIS). The basic contents of **electronic inland navigational charts** (Inland ENCs) include:

- Limits of the fairway
- Traffic control data such as buoys, zones where traffic is prohibited, lighting and traffic signs
- Structures and obstacles such as bridges, locks and weirs
- Shorelines and river engineering structures (groynes and training walls)
- Orientation guidance such as waterway axis, kilometre and hectometre markers

Inland ENCs are fundamentally different from paper charts. The electronic storage of geographical data in the form of vector data enables the correct representation of all details and ensures a reliable and clear presentation of information. Inland ENCs are produced, updated and published either by commercial providers or by waterway administrations.

The advantages of Inland ENCs as opposed to conventional paper charts are:

- Detailed and well-arranged presentation of charts in all resolutions and all sizes of the chart sections


Source: via donau

Electronic navigational chart in support of navigation

- Simple and fast updating procedures
- Presentation in various levels of detail due to layer technology
- Access to information on all objects at the click of a mouse

River Information Services supported by Inland ENCs and Inland ECDIS include:

- Tactical traffic image
- Monitoring of vessel traffic
- Fairway information services

Notices to Skippers (NtS)

Notices to Skippers support traffic safety on inland waterways. In a similar way to traffic reports for road transport, NtS are published by the competent authorities and contain information regarding the usability of transport infrastructure (e.g. fairway or locks).

Among the fundamental functions of NtS are:

- **Fairway and traffic related messages** with information about waterway sections or objects (e.g. locks, bridges) such as suspension of navigation, reduced passage heights, widths or depth
- **Water level related information** with information about water levels, lowest fairway depths according to riverbed surveying, vertical clearance under bridges and overhead cables, discharge, flow regime or water level forecasts
- **Ice messages** containing information about obstructions and suspension of navigation caused by ice

Source: via donau

Notices to Skippers on websites from different European countries

In the past, Notices to Skippers were distributed via VHF radio or in written form via a black board or by fax in the relevant national language. Because of this, a RIS standard for Notices to Skippers in inland navigation, which allows for automatic translation of the most important safety information in the local language, has been introduced (European Commission 2007, Central Commission for the Navigation of the Rhine 2009).

River Information Services supported by NtS include:

- Fairway information services
- Voyage planning tools

Electronic Reporting (ERI) of dangerous goods

Shipping companies are required to report data on the transport of dangerous goods to different authorities, depending on the national or international legislation in force. This results in the same data having to be reported again and again, sometimes in different languages and by means of different forms. When using **Electronic Reporting**, shipping companies only need to provide information about the cargo or the upcoming voyage once.

An Electronic Reporting software is a computer application available via an Internet browser which was developed to support users by simplifying the pro-


Source: via donau

Reporting of dangerous goods on the Austrian Danube section

cess of generating reports detailing the voyage, the vessel and the cargo. The modification and deletion of voyage and cargo data, together with the import and export of this data, is also facilitated by this application.

Cargo codes enable an unambiguous identification of the load and an accurate translation into other languages. This is an especially important innovation for the handling of dangerous goods. Thanks to electronic reporting, errors and mistakes can be easily avoided. Furthermore, the provision of electronic cargo information enables better planning of the loading and unloading, and paperwork is also reduced because customary message reports no longer need to be sent by fax or letter.

River Information Services supported by Electronic Reporting include:

- Strategic traffic information
- Lock and bridge management
- Avoidance of accidents
- Transport management
- Border control and customs services

River Information Services in Austria

Danube River Information Services (DoRIS) is a modern information and management system for inland navigation on the Danube in Austria which is operated by via donau. In 2006, Austria was the first European country to implement the development and operation of such a comprehensive information system. On 1st July 2008 an Inland AIS transponder requirement for the Austrian Danube section was introduced.

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Information on the current state of the waterway can be retrieved from the DoRIS website: www.doris.bmvit.gv.at

DoRIS has two main functions:

- Representation – so-called tracking and tracing – of vessels on an electronic chart, as well as
- Fairway information on water levels and forecasts, shallow sections and Notices to Skippers.

In addition, DoRIS enables the restricted access to historical data following navigation accidents which can then be used to better reconstruct the accident, if necessary also at court.

Apart from information for boatmasters and authorities, the system also offers value added services for commercial users, such as port or berth operators. Within this area of service, users have the ability to use vessel data for their own data processing purposes, provided that the use of these data is authorised by the company which owns the vessel.

The further development of DoRIS in Austria is supported by the "National Action Plan for Danube Navigation" and also within the framework of several European initiatives.

The following illustration shows the variety of services and technical facilities offered by DoRIS (e.g. electronic lock management system, DoRIS website, electronic reporting of dangerous goods). More information on these topics can be found in the other chapters of this manual.

River Information Services on the Austrian Danube

Source: via donau