# Design Standards for Construction, Restoration and Maintenance of Inland Waterways

This policy statement by the Inland Waterways Association (IWA) covers the design standards for construction, restoration and maintenance of inland waterways. It recognises the diversity of the waterways and the importance of their heritage.

It is concerned with all waterways used by freight and other commercial craft (of all types and local variations), as well as waterways used primarily for amenity purposes. However, the waterways are a dynamic living system that is continually changing. The needs of modern users are different from those of the past and opportunities continue to arise to enhance the system to meet modern needs. IWA recognises the importance of waterways to the nation and supports the diverse user base.

This policy statement applies to maintenance, repair and enhancement of all existing waterways, whether currently navigable or derelict, as well as to construction of new waterways.

## 1. General

The Association:

- encourages the increased use of the waterways by all types and sizes of craft within the relevant craft gauge;
- seeks to maintain the cultural and environmental heritage and character of individual waterways;
- supports moves towards the integration of existing broad waterways into a national broad network through enhancement of selected existing waterways and construction of new broad waterways;
- considers that each proposed waterway development should be assessed on its merits.

## 2. Retention and recovery of gauge

2.1 The Association will oppose all attempts to reduce the craft gauge of a waterway (i.e. the maximum size of vessels able to use it).

2.2 The Association will press navigation authorities to maintain each waterway in a satisfactory condition safely to accommodate vessels of its craft gauge and to permit access by such vessels and to ensure that the navigation channel is not blocked by craft so as to prevent through navigation by vessels of its craft gauge.

2.3 The Association will press for the restoration of dimensions suitable for the passage of vessels of the constructed gauge where subsequent works or deterioration (such as subsidence or structural movement) have created pinch points.

2.4 The Association considers that the opportunity should be taken to make minor improvements to achieve the appropriate constructed gauge where structures of heritage value are repaired or restored.

2.5 On standing mast routes, the Association will press for retention or restoration of headroom adequate for the tallest masts of vessels typically able to use the waterway. Where there are existing crossings (e.g. by overhead cables or high-level bridges) that provide acceptable clearance, the Association will object to any proposals for new crossings that would reduce clearance along the waterway or its approaches from the sea.

2.6 Where either temporary or permanent works are planned which will affect a waterway (e.g. road, rail, or utilities crossings; bridge reconstruction; riparian development) the Association will press for retention of dimensions suitable for the passage of vessels of craft gauge. Where such works are planned to cross the route of a proposed new waterway or of an existing waterway proposed for restoration or enlargement, the Association will press for the provision of adequate clearance for vessels of the intended craft gauge so that no new pinch points are created.

2.7 As we have seen examples of new or reconstructed bridge crossings that are of sufficient height and width but still impede the passage of large craft due to poor channel configuration, we recommend the use of Swept Path Analysis (see Appendix) where a waterway route is to be amended or restored or works affecting a waterway route are planned.

## 3. Minimum gauge of new, reconstructed and repaired works

The Association has the following views on gauge.

3.1 Any works intended to extend or enhance the waterway network should take into account:

- the constructed gauge of the waterway(s) concerned;
- the dimensions of adjoining waterways, whether existing or planned;
- national and regional strategies for waterway gauges;
- the desirability of constructing them to accommodate craft of either narrow or broad standard craft gauges.

3.2 Works to accommodate craft of dimensions less than the relevant standard craft gauge would comply with Policy 3.1 if the route involved repair (as opposed to rebuilding) of a substantial number of structures (e.g. locks) where these were originally built for craft of less than the relevant standard craft gauge.

3.3.1 For each new narrow or broad waterway, the craft gauge should not be smaller in any dimension than the respective standard craft gauge and the swept path of a craft of standard gauge should be capable of being accommodated.

3.3.2 For each narrow or broad waterway which is under restoration or currently navigable:

- each repaired structure should on completion be no smaller in any dimension (including swept path) than is required to pass vessels of the constructed gauge of the waterway;
- where structures are being built new or completely rebuilt, a relevant craft gauge should be adopted as part of any agreed strategy for that waterway;
- where no such strategy exists, consideration should be given to each structure built new or rebuilt being able to accommodate vessels of the respective standard craft gauge.
- individual waterways unlikely ever to be connected to the main, or the relevant subsidiary, network should be assessed on an individual basis.

## 4. Studies

The Association considers that any study of a project involving construction of a new waterway, enhancement of a waterway or restoration of a derelict waterway should consider:

- feasibility;
- degree of likely use;
- craft gauge;
- users and riparian owners;
- economic impacts;
- social and community benefits;
- sustainability;
- costs;
- water resources;
- environmental impacts;
- heritage value and character;
- planning and other permissions;
- health & safety;
- long-term economic management.

NOTE: These issues are not listed in order of priority.

## 5. Support

The Association will normally:

- support any proposed waterway development that appears to provide, in relation to its expected costs, major benefits to navigation users without substantial disbenefits to other interests;
- advocate that benefits to the wider community, economic and environmental impacts should be taken into account as appropriate;

- not oppose a waterway project that appears to have low benefits in relation to costs or substantial adverse environmental impacts. However, it will not invest significant effort on such a project unless a realistic case for support has been provided.

## 6. Freight

The Association considers that:

- each new or improved commercial waterway should be constructed to accommodate modern freight and other commercial vessels; an indication of typical sizes of modern freight vessels on larger European waterways is given in the Appendix;
- achievement of sufficient headroom to allow passage by container carrying vessels with ISO containers stacked at least two-high should be prioritised where potential for such traffic can be identified;
- where there is potential for access from the sea, capacity should reflect current and predicted developments in river/sea shipping;
- for freight waterways intended solely for use by inland vessels, the size of waterway required to accommodate projected and potential future traffic should be assessed;
- in all cases the craft gauge should be selected to maximise the likely economic and environmental benefits.

## 7 Facilities

The Association considers that ideally every waterway should have:

- facilities for all forms of waterway recreational use;
- a continuous towing path alongside the waterway, not excepting road and other crossings;
- visitor moorings alongside the towing path or off-line at suitable locations;
- off-line permanent moorings;
- a suitable profile throughout (both above and below water level) for the passage of vessels of craft gauge;
- adequate landings where craft need to wait (e.g. at locks, moveable bridges);
- winding holes/swinging areas/turning places at regular intervals;
- on freight waterways, suitably located separate landings for freight and leisure vessels at lock approaches and elsewhere as necessary;
- on freight waterways, allocated waterside sites for freight terminals.

## 8. Environmental considerations

In certain circumstances there may be environmental constraints affecting achievement or maintenance of the waterway's capacity to accommodate vessels of constructed gauge. In these cases the Association prefers environmentally acceptable ways of accommodating vessels of constructed gauge rather than accepting a restriction to vessels of a smaller gauge. The Association takes a similar approach to constraints affecting the throughput of

the waterway, which might otherwise lead to restrictions on the number or frequency of vessels navigating it.

## 9. Heritage Considerations

Wherever practicable, heritage structures should be restored with similar materials and building methods as originally constructed, as long as it can meet the current needs for the use of the structure. Lock gates and lock gear should also be restored using designs that were contemporary with the waterway's construction or were known to have been used at some time during the life of the waterway. However, the heritage value and appropriateness of restoring to the original design should be assessed on a case by case basis.

## 10. Water Control

10.1 Overflows take the form of by-washes conducting water supply around locks and side weirs allowing the discharge of excess water to protect navigation works from flooding. Each should be adequate to accommodate reasonably anticipated maximum flows.

10.2 On river navigations, flood locks, flood gates or similar devices are typically needed at the head of each side cut to protect the navigation from flooding.

10.3 The need and adequacy of side weirs should be determined before a pound is first filled on restoration or, if already in water, before being acquired from a third party.

# APPENDIX

## A1. Definitions

For the purposes of this document, the following definitions will apply.

- Broad waterway - a navigation constructed to accept craft with a maximum beam between 2.15m (7'1") and 4.35m (14'3").
- Constructed channel profile - the cross section to which the channel was originally constructed or subsequently intentionally enlarged.
- Craft gauge - the maximum length, beam, draught, and air draught of craft which it is currently intended should be able to pass through the channel and structures (e.g. locks, bridges) of the waterway.
- Constructed gauge - the craft gauge of a waterway as originally constructed or as reconstructed subsequently with the intention of changing the craft gauge.
- Fairway - that part of the channel in which craft passing along the waterway normally travel.
- Commercial waterway - a navigation principally available for the passage of freight-carrying vessels.
- Narrow waterway - a navigation constructed to accept craft with a maximum beam of 2.15 m (7'1") or less, not including canals designed for passage by tub boats only. (In addition, the Herefordshire & Gloucestershire Canal and the South Wales canals are considered to be narrow waterways.)
- Pinch point - a structure or part of a structure, which has been constructed or reconstructed, or has deteriorated, to dimensions which do not allow the passage of vessels of constructed gauge.
- Standing mast route – a waterway available to passage of vessels with tall masts without the need to lower masts (meaning that all low-level bridges must open to provide unlimited headroom across the width of at least craft gauge beam).
- Waterway - an inland navigation, or length of an inland navigation, having a constant constructed gauge or a constant historic craft gauge, where the craft gauge is not defined by construction.
- Wide waterway - a navigation accepting craft with a maximum beam greater than 4.35m (14'3").

## A2. Standard craft gauge

The constructed gauge varies among waterways and this policy statement seeks to ensure the protection of this gauge as a minimum in each case. Subject to paragraph 3.2, for structures being built new or rebuilt (but not for structures being reconstructed for conservation purposes or being repaired), the standard craft gauges for most narrow and broad waterways in England are:

- Length: 22 m (72'2");
- Beam: 2.15 m (7'1") for narrow waterways , 4.35 m (14'3") for broad waterways;
- Draught: 1.3 m (4'3") for narrow waterways, 1.5 m (5.0") for broad waterways;

- Air draught: 2.2 m (7'3") for narrow waterways; 2.7 m (8'10") for broad waterways.

For modern freight waterways, an internationally agreed classification system is in place (CEMT, 1992). Most principal waterways in western Europe accommodate or are subject to proposals for enlargement to accommodate, vessels of the following craft gauges:

- **Class IV (for barges):** length 80-85m (262'6"-278'). Beam 9.5m (31'), draught 2.5m (8'), air draught 4.95m (16') or 6.7m (22'), cargo capacity 1000-15000 tonnes;
- **Class Va (for barges and river-sea ships**): length 95-110m (311'4"-361'), beam 11.4m (37'6"), draught 2.5m-4.5m (8'-15'), air draught 5.25m (17'), 7.0m (23') or 9.1m (30')**, cargo capacity 1500-3000 tonnes;
- **Class Vb (also for pushed convoys – now the target minimum standard for international routes in Europe):** length 172-185m (564'-607'), beam 11.4m (37'6"), draught 2,5-4.5m (8'-15'), air draught 5.25m (17'), 7.0m (23') or 9.1m (30')**, cargo capacity 3200-6000 tonnes.

** - for two, three or four layers of containers respectively.

## A3. Minimum Channel Dimensions

Width and depth - In slack water lengths (e.g. canals and some canalised sections of river navigations), the minimum dimensions of the channel required to accommodate craft of gauge beam B and gauge draught D at normal water level are as follows.

- Depth of fairway: D + 20% or 0.3 m, whichever is greater.
- Width of fairway: 2.1 x B or 6 m, whichever is greater.
- Depth at landings, wharves, and moorings: D + 0.2 m.
- Depth at other banks: At 1.0 m from every bank or, where there is a bank-side vegetation fringe, at the waterside of that fringe, no less than 0.6 m. Where protection is installed on the towpath bank, the depth at this bank shall be the depth the protection was designed to make possible. The depth at the non-towpath bank shall be deep enough to achieve the required fairway dimensions.
- At bridges and other narrows: The minimum straight navigable width should be 3 m (narrow waterways), 5.5 m (broad waterways).

These dimensions will need to be increased in river sections and other sections with significant flow, to allow for the effects of current and changing water levels.

Cross-section - In lengths where the channel is not restricted by structures or other local features, the ratio of the water cross section to the wetted cross section of a craft of craft gauge should be no less than 3.5:1, as an absolute minimum for short lengths, but 6:1 or greater is preferred, to reduce erosion and adverse effects on fringes of vegetation.

Channel lining: - Where new channel lining is installed, the depths and channel cross-section it creates should comply with the above requirements for craft gauge beam and draught.

Tidal and river navigations - On tidal navigations and sections of river navigations not covered in A2 above, including those which may have no constructed gauge, channel maintenance specifications should be derived for each waterway, in consultation with users, so as to facilitate safe and efficient navigation.

Bends - In all cases, fairway width on bends should be increased as necessary to ensure that two vessels of craft gauge can pass safely.

Headroom -

- On narrow waterways 2.8 m (9'2") headroom is preferred although 2.5 m (8'2") would comply with this policy.
- On broad waterways 3.0 m (9'10") headroom is desirable.

The required headroom should be provided over a width of at least craft gauge beam. For safety reasons the Association considers that there should be at least 0.3 m clearance above the craft air draught.

Towpath headroom - a minimum headroom over the towpath of 2.2 m is desirable under bridges.

Freeboard - minimum channel freeboard at highest design water level should be 0.3 m.

## A4 Dredging

The Association has the following views.

Profile - Whenever dredging is undertaken, it should recover the full constructed channel profile subject to local engineering constraints. Where it is not possible to confirm the dimensions of this profile, it should be estimated as a channel with the dimensions required above to accommodate vessels of constructed gauge or that defined by the original channel lining (e.g. puddled clay), whichever is smaller. Where the channel dimensions have been reduced by subsequent lining (e.g. with concrete or geotextile), dredging should be undertaken to the profile established by that lining in the lined length only.

Triggers - Dredging should be required as soon as the depth in any part of the fairway has degraded to less than the constructed gauge draught at normal water level. Dredging should be required at landings, wharves, and moorings as soon as the depth there has reduced to less than the constructed gauge draught.

Tidal waters - On each tidal navigation, a dredging plan should be agreed in consultation with users.

## A5. Swept Path Analysis

Swept Path Analysis is analysis of the way a vehicle moves, considering the movements of different parts of a vehicle in order to establish the envelope swept out by the structure of the vehicle and the amount of manoeuvring space required. The technique is commonly used in road design, where standard software for tracking vehicles is available. It may also be beneficial in designing waterway routes, for instance for diversions to accommodate new infrastructure or in the alignment of bridges in restoration projects.

In adapting the software for use for boats on inland waterways, the 'vehicle' that best simulates the behaviour of a narrowboat or a barge will have two axles. The forward axle is located at the centre of rotation of the boat and is fixed (forward pointing, non-steerable). The rear axle is located at the stern and is steerable. Analysis shows that the location of the centre of rotation of the boat is 35% of the overall length of the boat from the bow. For a land-based vehicle the steering is affected by the minimum turning radius and the lock-to-lock time. However, in the case of a boat these variables are not so important as the speed can be reduced.

It should be noted that Swept Path Analysis only applies to a boat with parallel, straight sides. In addition, the method should not be relied upon exclusively. A full navigational risk assessment should be carried out to take account of currents and any other relevant factors.

### *Version History*

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