# Annex 2: Examples of possible measures

List of navigation needs, respective measures, their general effect and specific pressures on ecology. Ecological measures to achieve and ensure the environmental objective/sustainability are included (to be extended).

This list is not exhaustive.

| Navigation Needs | Navigation Measures | General Effects | Pressures/Effects on Ecology | Ecological Needs | Environmental Measures |
|---|---|---|---|---|---|
| Minimum water depth (navigation fairway) | Transformation of the navigation fairway towards outer bank and deep water sections, low water regulation, dredging and refilling of material | Increase of water level at low flows | River channelization due to low water regulation, reduction of morphodynamics | Minimization of river engineering measures | River restoration (esp. river banks and floodplains) |
| Minimization of lateral flow velocity | Improvements of the flow field at confluences with tributaries and reconnected side channels by river engineering | Low cross sectional flow velocities | Reduced morphodynamics of confluences, less cross sectional flow velocity | No restriction to river bank and side channel dynamics | Side channel reconnection and restoration of tributary confluences |
| No sudden changes in flow field, flow velocity | Limitation of flow velocity changes (gradual changes) from reaches with e.g. new low water regulation towards not modified downstream and upstream sections | Low spatial variability of boundary conditions for navigation | Modified flow field compared to more natural conditions | Development of flow field and flow velocities towards Leitbild conditions (visions) | Development of river engineering measures to improve flow field variability |

| Navigation Needs | Navigation Measures | General Effects | Pressures/Effects on Ecology | Ecological Needs | Environmental Measures |
|---|---|---|---|---|---|
| Predictable position and geometry of navigation channel | Minimization of sudden sedimentation by use of groins, dredging and refilling | Less interruption / disturbance for navigation | Modified sediment transport and river morphology, habitat alteration | Variable water depths, flow widths, grain sizes, low lateral river bed gradients | Restoration measures leading to high variances of water depth, channel widths, grain sizes, moderate lateral gradients |
| No extreme trend towards river bed aggradation / degradation of the main channel | E.g. Construction of groins (aggradation), dredging and refilling of material, / river bed widening, granulometric bed improvement (degradation) | Dynamic river bed stability | Also a need for ecology as the pressure is not resulting from the driver navigation | No extreme trend towards river bed aggradation / degradation of the main channel | E.g. Construction of groins (aggradation), dredging and refilling of material, / river bed widening, granulometric bed improvement (degradation) |
| | | | | Channel morphodynamics | Preservation or improvement of river morphology: no river bed pavement, keeping of morphodynamics, specific groins forms to improve morphodynamics, avoiding of groin fields |

| Navigation Needs | Navigation Measures | General Effects | Pressures/Effects on Ecology | Ecological Needs | Environmental Measures |
|---|---|---|---|---|---|
| | | | | River bank morpho-dynamics | Initiation of more nature-like river banks: river bank restoration, removal of bank protection, side erosion, declinant groins to enhance side erosion |
| | | | | Lateral connectivity | Floodplain / wetland / sidearm reconnection, more water in the floodplain/alluvial area, improvement of habitats |
| **General needs** | **General measures** | | | | |
| Keeping of flood levels | Improvement of retention areas, river bed widening, no increase of flood risk | | , | | |