Navigation Committee

05 September 2024
Agenda item number 10

Future proofing Broads Authority public moorings

Report by Head of Construction, Maintenance & Ecology

Purpose

To provide an interim review on selected aspects of the Authority's strategy for public mooring provision. This report updates members on mooring design and specifications; increasing resilience for continued safe and practical moorings in the face of climate change; and managing the risks and costs of adopted approaches.

Broads Plan context

A2 - Work towards making all Broads Authority operations carbon neutral by 2030 and carbon zero by 2040.

C2 - Maintain existing navigation water space and develop appropriate opportunities to extend access for various types of craft

- Develop understanding of long-term trends in water levels and impacts on navigation, and refresh mean water level data using standardised methodology

E1 - Improve the integrated network of access routes and points (with easier access for people with mobility and sensory needs), linked to visitor facilities

- Maintain and where possible enhance BA 24-hour free mooring network, informed by boat census and strategic priority sites data

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1. Introduction

1.1. This report seeks to set the Broads Authority's provision of public moorings in the context of future challenges from climate change. Of critical importance in this challenge are the design and maintenance regimes needed to ensure the Authority provides functional and safe locations to moor vessels. This report progresses planned objectives in the Authority's Integrated Access Strategy (IAS), chiefly objective "M4 Feasibility study of different mooring design options and consultation".

1.2. The following principles embedded in the IAS are applicable to the question of future resilience of public mooring provision:

- 4.3 Financial cost effectiveness – to ensure that the cost and value for money of all projects is evaluated at the outset and the financial viability considers a broad range of benefits, such as to public health and the local economy.
- 4.7 Access for All - Ensure provision of safe access with adoption of the least restrictive options following the design principles of coherent; safe; comfortable; and attractive: to encourage and enable people of all ages and abilities to experience the Broads' countryside and waterways.
- 4.8 Innovative design - All access infrastructure to be consistent with local planning policies whilst delivering user benefits and value for money.
- 4.9 Asset liabilities - When considering acquiring new assets, the Broads Authority should consider the cumulative implications of taking on new liabilities, in particular the potential cost of replacing physical assets, maintenance costs over duration of tenure, etc.
- 4.10 Climate change resilience - Project design should consider the potential impacts of climate change, such as changes in weather patterns and water levels, to support long-term resilience and adaptation.

1.3. This report focusses on operational decisions around fundamental mooring designs; details of quay heading and vertical piling arrangements and specifications; and surfacing types on the landward side of the moorings. Additional reporting on the following mooring related IAS objectives and the budgeting to achieve them shall be completed by the end March 2025:

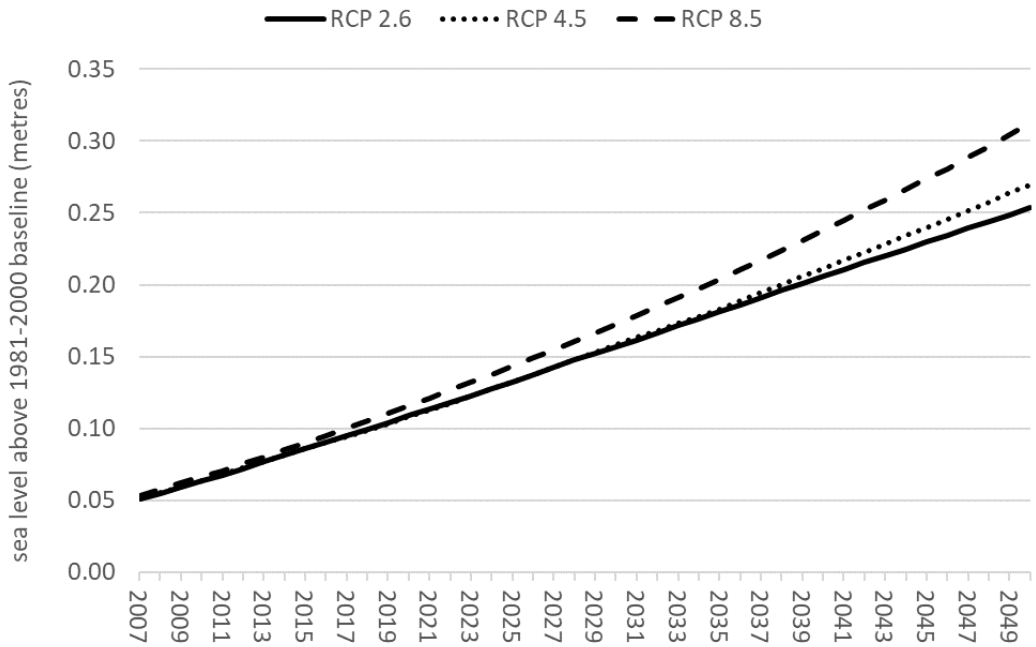
- M3 Identify locations for new short-stay moorings in gaps identified by gap analysis
- M4 Review de-masting provision in the Broads and develop a prioritisation methodology to guide future investment in new provision

2. Water level changes in the Broads

2.1. Based on UK climate change projections (UKCP18) UK Climate Projections (UKCP) - Met Office, making some allowances for climate change in the Authority's forward asset management planning, enables development of projects and strategies that can adapt to a future climate change scenarios. With this adaptive approach we are seeking to develop solutions that are more effective in the long-term and for a range of climate change scenarios.

2.2. UKCP18 provide projections of relative mean sea level rise around the whole UK coast. As an example of the challenges to come, Figure 1 shows the increase in sea level at Great Yarmouth for three climate change scenarios. RCP stands for Representative Concentration Pathways (RCP). These are climate change scenarios which project future greenhouse gas concentrations. These pathways (or trajectories) describe future greenhouse gas concentrations (not emissions) and have been formally adopted by the Intergovernmental Panel on Climate Change (IPCC). These scenarios are adopted in Defra guidance of climate change resilience and are used by the Environment Agency for all flood risk management decision making, see Flood risk assessments: climate change allowances. RCP 2.6 is the low emission pathway; RCP 4.5 is medium-low and RCP 8.5 is high.

Figure 1. UK climate change predictions for sea level rise by 2050 for Great Yarmouth. (data extracted from UKCP18 databases August 2024, based on the 50th percentile which represents the central estimate (median) amongst the individual model projections)



2.3. Given that we are now in 2024, the predicted sea level rise at Great Yarmouth through to 2050, using this government endorsed approach, is in the range 12.6 to 17.5 cm. This rise does not consider the predicted changes in rainfall which will also increase water

levels in the Broads. Further modelling of the combined impacts of sea level, river flow and rainfall intensity and its impacts in the Broads will be carried out by of the Broadland Futures Initiative (BFI). BFI will use the climate change predictions to guide the Broadland hydrological model which underpins all the discussions and decisions to be had about water management over the timescale of that initiative.

2.4. For Broads Authority public moorings (and any other physical asset sensitive to water level in the Broads) any long-term structural modifications clearly need to build in resilience to climate change and water level increases. The materials lifespan of moorings constructed to "standard" vertical steel piling designs should last somewhere between 30-50 years. The impact of a predicted water level increase over the next 25 years of between 12.6 – 17.5 cm from rising sea level alone. This starts to focus design and location decisions about how the Authority builds in resilience and continues to offer safe public moorings. This has been highlighted by the prolonged and exceptionally high water levels, particularly across the norther rivers in the Broads over the autumn/winter of 2023/24.

3. Mooring design

3.1. The Broads Authority manages public moorings with a range of vertical piling designs and a handful of pontoon moorings. The user experience is largely driven by what lies above the waterline and the provision of mooring furniture available for them to fix lines to. The engineering considerations required to achieve an effective mooring in a tidal system, often with unstable peat soils, is not without its challenges. Also added to this is the complex inherited history of the various designs and materials that make up the suite of existing older moorings in the Broads.

3.2. Despite this inherent variability, where the Authority seeks to fully reconsider its mooring provision at a particular location, opportunities to build in climate change resilience are available. Most commonly when the vertical piling (steel or in some cases timber) is being completely replaced, this allows opportunity to increase the design level of the top of the piling and the effective level of the quay heading.

3.3. To demonstrate how variable the quay heading level is above the water level at different sites, Table 1 shows the effective mooring "freeboard" at the 24 hour moorings prioritised for full piling replacement. This approach attempts to set a standard condition for determining freeboard. As mean high water level (calculated as the average of all high water peaks between 1993 and 2019 at that location) has a unique gradient along each river valley, the freeboard values have taken into account the local MHW value for that mooring. The methodology for the calculation of mean high water level is presented in section 4.1.2 of the Authority's Waterways Management Strategy.

3.4. What has not been defined before in standard details for Broads Authority public moorings is the minimum effective freeboard that is safe and convenient for boat users. This is usually greater than the typically low freeboard preferred by canoe and

paddleboard users. As an example, if we take 30 cm as a workable freeboard measurement above MHW and add resilience of these sites to water level rise, adopting the upper range of 17.5 cm increase. then any mooring being repiled should aim for a minimum final capping level at least 47.5 cm above MHW for that location.

Table 1. Mooring freeboard and future level increases at 24 hour moorings due for repiling.

Mooring	Average height of current capping above MHW level (cm)	Increase in piling level (cm) required to retain 30 cm freeboard by 2050
Deep Dyke	30.0	17.5
White Slea	46.6	0.9
Deep Go Dyke	45.2	2.3
Catfield Staithe	38.8	8.7
Dilham Staithe	50.1	none
Hoveton Viaduct	46.1	1.4
Wroxham Castle Staithe	37.3	10.2
Somerleyton	30.2	17.3
Herringfleet	24.1	23.4
Worlingham	64.7	none

3.5. Table 1 shows that most existing moorings would need some increase in height to retain resilience through until 2050. Using the example of 30 cm freeboard, where moorings require raising to meet this resilience target, the height increase varies between 0.9 to 23.4 cm. Further work is required to gain this data for all the Authority's moorings and to better understand the full picture.

3.6. For all refurbishment and repiling work that is not strictly on a like for like basis, prior discussion with the Environment Agency is required to determine whether a Flood Risk Activity Permit (FRAP) is required. Similar conversations with the Authority's planning team will also be required.

4. Alternatives to hard-edged, vertical piled moorings

4.1. Where physical space in the waterbody allows, floating pontoon moorings offer consistent freeboard at all states of tide. This option works well in marinas and open water where there is sufficient width for finger pontoons, or alongside existing river edges where ramps can be used for pedestrian access and allow alongside mooring of vessels. A benefit of this approach is that the land footprint is minimal, requiring only the area for the ramp landing and any fixings. Depending on the river location and tidal

range, pontoons do not have to rely on a hard piled edge for their entire length, so offer savings in terms of materials and maintenance costs.

4.2. Where boaters do not need to gain access to land, such as at demasting or temporary lay-by moorings near bridges, floating pontoons offer an ideal solution. Usually, they are in line with the channel, so the process of coming alongside and then casting off is safe and simple. The positional fixing is via steel piles, that allow the pontoon to rise and fall with the tide. The Authority manages six pontoons which are for temporary lay-by usage. Two 24 hour moorings also have pontoons

4.3. In areas of low tidal rise and fall, horizontal boards set on vertical piles, can be used for alongside mooring. This is a common method in inland waterways where water levels are maintained at a set level. Locations with this design in the Broads are mainly limited to third party layby moorings near bridges. If used for alongside mooring, the benefits are that landward engineering is not required which reduces costs, but pedestrian access to land is not provided.

4.4. Pile moorings are not common in the Broads. Around Breydon Bridge there are some single piles with vertical mooring “handles” for mooring lines (jug-eared handles), as well as the same type of handles installed on the dolphins in that area. Pile moorings benefit from being relatively simple and cost effective to install and can cope with high tidal rise and fall. The number of vessels that can moor at pile moorings is limited, as well as not being that easy to moor against under certain wind directions. Options for this type of mooring in more remote areas of the wider tidal rivers has the potential to add to the diversity of mooring types, capacity and diversity of overnight experiences and fill gaps in provision where harder engineering would be very difficult or costly.

5. Mooring surfacing

5.1. An element in the fundamental design of moorings is the surfacing on the landward side of the timber capping of traditional quay heading. This is the zone where the mooring posts are positioned, and where people alight from their vessels when mooring up. As such, the surfacing is critical for safe use of the site in all weather conditions.

5.2. Of the 63 mooring locations (includes split sites that have different surfacing) that the Authority manages for public use, Table 2 gives the number of locations and total area of each surfacing type (assuming a standard 1.2 m width of path behind the quay heading)

5.3. Over the winter 2023/24, which has seen exceptionally high river levels, the moorings with wood chip surfacing have suffered particularly badly. Where water over-topped the moorings, the wood chip has floated away and left unacceptable surface conditions. The additional material and staff time cost of replacing this each time there is a high water event can be avoided by replacement with compacted crushed aggregate.

Table 2. Number and area of different surfacing types behind Authority moorings

Surfacing type	Number of mooring locations	Total area of surfacing type (m^3)
Compacted crushed aggregate (Type I granite)	35	4,310
Grass	16	1,930
Wood chip	7	500
Gravel	3	260
Asphalt	2	180

5.4. The few sites with gravel surfacing are under review. One site near an urban centre suffers from repeat theft of the gravel, so is planned to be replaced with compacted crushed aggregate. Another site has trialled a hard plastic mesh with gravel within the mesh grid, as used in car parks and other areas exposed to heavy usage. The surfacing has held up well, but the main issue, other than the greater cost per square metre compared to other surfaces, is in terms of maintenance. If any work or repairs are needed to this quay heading or the mooring posts, the complexity and time to complete the task is increased, as larger areas of mesh and gravel need to be removed to access the area to be maintained. This means simple repairs often carried out by the ranger team at other sites, requires the maintenance team with additional equipment and materials to complete the task at this trial location, increasing staff time and materials costs.

6. Financial implications

6.1. To best understand the financial implications of both the long-term maintenance of the existing mooring assets, as well as the strategic ambitions to increase provision in certain instances, the outcomes of a report to be completed of the Integrated Access Strategy due for completion by the end of March 2025 will reveal more. The scope of this report will be the asset replacement cost (re-piling on a like for like basis, plus climate change resilience), as well as the interim refurbishment of the timber quay heading that typically has a shorter life span. This report offers the opportunity to reset the forward budget requirements to maintain the existing mooring stock, as well as understand the Authority's capacity to expand provision as per the strategic ambitions.

6.2. Where different means of providing moorings of public use in the Broads offer cost efficiencies, identify opportunities where and how this can be done will be highlighted.

7. Risk implications

7.1. Safety considerations for users are foremost in all thoughts and decisions regarding publicly accessible moorings owned or managed by the Broads Authority. Once these minimum safety standards are met, subsequent decision making can then cover wider

and longer-term strategic aims, such as the distribution and capacity of moorings across the navigable system, planning for the Authority's long-term maintenance liabilities, working towards achieving Net Zero by 2050 and increasing resilience to the predicted impacts of climate change.

8. Conclusion

8.1. Views are sought from the Navigation Committee on the issues raised. Questions for consideration are:

1. What are thoughts on the suggested approach to setting a safe and practical mooring freeboard height above mean high water levels?
2. What are the thoughts on mooring design options other than the traditional vertical piling with timber quay heading?
3. What are thoughts on replacement of all wood chip mooring surfacing with compacted crushed aggregate given the cost, maintenance and future resilience benefits?

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Background papers: Integrated Access Strategy (IAS) 2023; Waterways Management Strategy

Broads Plan strategic objectives: A2; C2; E1